OCS EIS/EA
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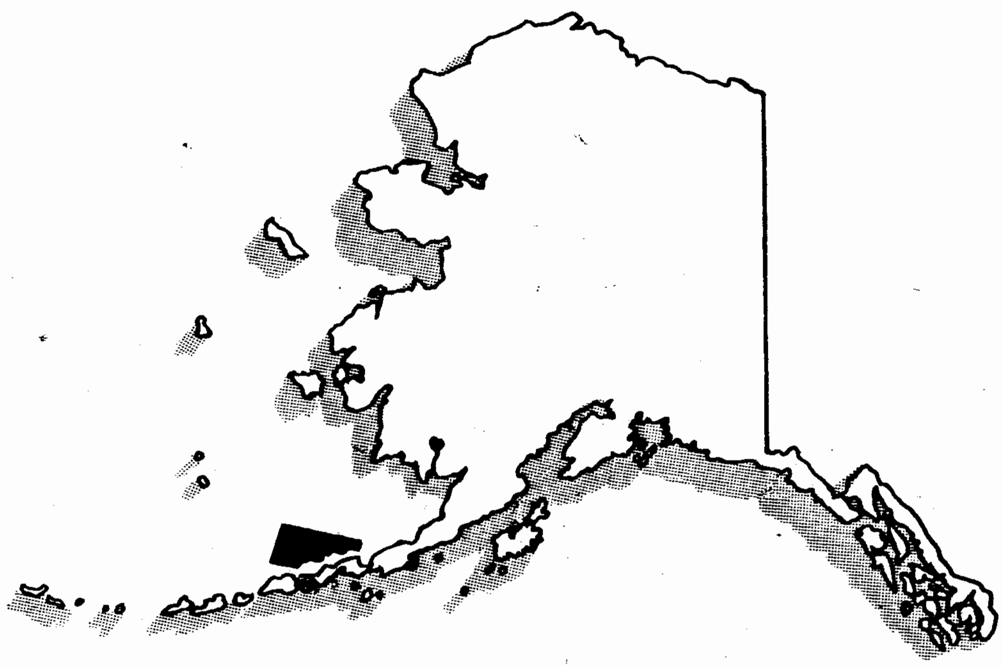
Final Environmental Impact Statement
NORTH ALEUTIAN BASIN SALE 92
Volume 1



U.S. Department of the Interior
Minerals Management Service
Alaska Outer Continental Shelf Region

This Environmental Impact Statement (EIS) is not intended, nor should it be used, as a local planning document by potentially affected communities. The facility locations and transportation scenarios described in this EIS represent assumptions that were made as a basis for identifying characteristic activities and any resulting environmental effects. These assumptions do not represent a Minerals Management Service recommendation, preference, or endorsement of any facility, site, or development plan. Local control of events may be exercised through planning, zoning, land ownership, and applicable state and local laws and regulations.

United States
Department of the Interior

Final
Environmental Impact Statement

Volume 1

September 1985

Proposed
North Aleutian Basin
Lease Sale
(Sale 92)

Prepared by
Minerals Management Service
Alaska OCS Region

ADDENDUM

The draft environmental impact statement (EIS) for Outer Continental Shelf (OCS) Lease Sale 92 assumed that the range of oil and gas resources included a low estimate at one extreme (95 percent probability) of discovering 83 million barrels (MMbbls) of oil and .56 trillion cubic feet (TCF) of gas and, at the other extreme (5 percent probability), a high estimate of discovering 759 MMbbls of oil and 5.25 TCF of gas. This range of estimates included a conditional mean estimate between the two extremes of 364 MMbbls of oil and 2.62 TCF of gas resources. This mean estimate was assumed to apply to both the proposed action (Alternative I) and the Alaska Peninsula Deferral (Alternative IV), for purposes of environmental analysis. Geologic information and analysis, however, indicated a lower marginal probability of occurrence of the mean level of resources for the smaller area, Alternative IV.

A number of comments on the draft EIS addressed the assumption that the resource estimates for Alternatives I and IV were assumed to be equal. In response to these concerns, the hydrocarbon potential of the sale area was reviewed. A separate estimate of oil and gas resources for Alternative IV has been prepared to improve the comparison of possible environmental effects between the two alternatives; and the resource estimate for Alternative I has been updated, in light of an earlier 83 percent reduction in the size of the area being considered for leasing. As a result of new data and new analysis that have become available, the conditional mean resource estimates, which fall within the broader range of high-to-low estimates, are as follows:

	Conditional Resources					
	Alternative I			Alternative IV		
	Low	Mean	High	Low	Mean	High
Draft EIS						
Oil (MMBbls)	83	364	759	83	364	759
Gas (TCF)	.56	2.62	5.25	.56	2.62	5.25
Revised Estimate						
Oil (MMBbls)	63	279	615	62	254	562
Gas (TCF)	.45	2.10	4.38	.39	1.76	3.74
Marginal Probability		.20			.14	

The exploration and development scenarios for Alternatives I and IV were reviewed carefully. The reduction of approximately 23 percent in the conditional mean estimates would have little, if any, effect on the action scenario to develop the resources in either case. Only one oil-production platform and one gas-production platform would result for either alternative, using either the original or the revised estimated amounts of resources. There also would be no tangible difference between support facilities and transportation requirements to develop either assumed level of resources. The two Alternative IV scenarios (for pipeline transportation and for offshore loading of tankers) would differ from the Alternative I scenarios only by the number of production wells -- four fewer wells for oil and three fewer wells for gas. The analysis contained in the final EIS proceeds on the basis of these action scenarios, which are virtually the same for both alternatives. The other principal change that could result would be a reduction in oil spill contact probabilities, due to the 23 percent reduction in the conditional mean level of resource estimates.

As a result of the limited consequences of using the lower conditional mean estimates, it would not be necessary to modify the extensive analytical work already completed in the final EIS. Instead, in order to provide a useful basis for comparing the environmental risks of Alternatives I and IV, a revised conditional mean estimate for Alternative IV was developed, for purposes of environmental analysis in the final EIS. That estimate for Alternative IV is proportionate to the estimate assumed for Alternative I in the final EIS. In summary, the estimates that have been used in the final EIS for comparative analysis are as follows:

	Conditional Resources					
	Alternative I			Alternative IV		
	Low	Mean	High	Low	Mean	High
Final EIS						
Oil (MMBbls)	83	364	759	82	331	694
Gas (TCF)	.56	2.62	5.25	.48	2.20	4.49
Marginal Probability		.20			.14	

Both the original and the revised estimates are being published in the final EIS to provide for public review. An environmental assessment of these estimates also will be prepared and published for public review before the decision on the final notice of sale. A further EIS, based on the latest available resource estimates, will be prepared for development and production in the North Aleutian Basin. These procedures comply with legal requirements for preparation of an OCS lease sale EIS, as interpreted in California v. Watt, 683 F.2d 1253 (9th Cir. 1982).

FINAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Outer Continental Shelf
Oil and Gas Lease Sale
North Aleutian Basin
(Sale 92)

Summary Sheet

( ) Draft (x) Final

U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region, P.O. Box 101159, Anchorage, Alaska 99510.

1. Type of Action: Proposed Oil and Gas Lease Sale, North Aleutian Basin (Sale 92).

(x) Administrative ( ) Legislative

2. Description of the Action: The leasing proposal consists of a total of 2.27 million hectares (approximately 5.6 million acres) of outer continental shelf (OCS) lands. The conditional-mean-resource estimates for undiscovered recoverable oil and gas resources in the proposed lease sale area are 364 MMbbls of oil and 2.62 TCF of gas. The 990 blocks included are located in the southeastern Bering Sea in waters that are from 18 to about 185 kilometers (11 to 114 miles) offshore of the Alaska Peninsula. The area lies in waters between 30 and about 100 meters deep. The lease sale is tentatively scheduled to be held in early 1986.

3. Environmental Effects: All blocks offered pose some degree of pollution risk to the environment if leased, and explored and developed. The risk is related to adverse effects on the environment and on other resource uses that may result from accidental or chronic oil spills. Socioeconomic effects from onshore development could have state, regional, and/or local implications.

Several alternatives and mitigating measures that would reduce the type, occurrence, and extent of adverse effects associated with this proposal may be applied. Other measures, which are beyond the authority of this agency to apply, also have been identified. In spite of mitigating measures, some effects are considered unavoidable. For instance, if oil were discovered and produced, oil spills would be statistically probable and there would be some disturbance to fisheries, wildlife values, and commercial fishing.

4. Alternatives to the Proposed Action:

   a. No Sale (Alternative II).

   b. Delay the Sale (Alternative III).

   c. Modify the proposed lease sale area by deferring the leasing of 137 blocks that are within 40 kilometers of the northern coast of the Alaska Peninsula (Alternative IV).

5. Technical and Reference Papers: This document incorporates by reference the Summary of Fisheries Information - North Aleutian Basin, and a series of technical reference papers and EIS's prepared by the Alaska OCS Region (see Bibliography). Copies of those papers have been placed in a number of libraries throughout Alaska, and single copies are available from the Alaska OCS Region Library.

6. Public Hearings: Public hearings on the Sale 92 draft EIS were held in Dillingham on February 19, Naknek on February 20, and Anchorage on February 26, 1985. A public hearing scheduled for Sand Point on February 21, 1985, was cancelled because of bad weather. The public also was invited to submit comments on the subsistence-use analysis required under Section 810 of the Alaska National Interest Lands Conservation Act. Oral and written comments were obtained and responded to in this final EIS.

7. Contacts: For further information regarding this final EIS, contact:

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Final Environmental Impact Statement
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Summary of Environmental Impact Statement for the Proposed North Aleutian Basin (Sale 92)

This environmental impact statement (EIS) examines (1) a proposal for oil and gas leasing in the North Aleutian Basin, (2) three alternatives to the proposal, (3) the major issues identified through the scoping process and through staff analysis, and (4) the potential mitigating measures associated with the proposal.

The proposal (Alternative I) consists of 990 blocks (approximately 2.27 million hectares) in the North Aleutian Basin that range from 18 to about 185 kilometers offshore of the Alaska Peninsula at water depths ranging from 30 to about 100 meters. Alternative II (No Sale) would cancel the proposed lease sale, scheduled for early 1986. Alternative III (Delay the Sale) would delay the proposed lease sale for a period of 5 years. Alternative IV (Alaska Peninsula Deferral) would defer leasing on 137 blocks identified in the proposal that are within 40 kilometers of the Alaska Peninsula at water depths ranging from 40 to 100 meters. After a thorough review, the Secretary of the Interior will decide which options or combination of options should take place.

The potential effects of this leasing proposal are based, in part, on the assumption that the conditional-mean-resource estimates of 364 MMbbls of oil and 2.62 TCF of gas would be discovered and produced in the proposed lease area. The marginal probability of hydrocarbons being present in the sale area is 20 percent. For the projected amount of oil, 1 oil spill of 1,000 barrels or greater is anticipated over the 26-year life of the proposal. Given that commercial hydrocarbons are present in the proposal area, there is a no-higher-than-10-percent chance that 1 or more spills of 1,000 barrels or greater would occur and contact land (Port Moller area) within 30 days. The probability of the estimated number of spills of 100,000 barrels or greater occurring and contacting land (Port Moller area) within 30 days over the expected production life of the lease area is no higher than 1 percent. The expected number of 100,000-barrel-or-greater oil spills is 0.03. The risks from oil spills would be mitigated by the extent to which weathering and decay of oil occurred at sea, and by any oil-spill countermeasures that would be attempted.

The environmental analysis in this EIS focuses on exploration and development and production activities associated with the development of oil and gas resources. The analysis of Alternative I is based on two separate hydrocarbon-transportation-scenario options: (1) pipelines and (2) offshore loading. In the pipeline-transportation scenario, oil production from one offshore platform would be transported by pipeline to a landfall in the Port Moller area and across the Port Moller/Balboa Bay transpeninsula transportation corridor to a transshipment terminal at Balboa Bay. Oil would be transported from the terminal to markets by 80,000-DWT (dead-weight-tonnage) tankers. Gas produced from one offshore platform would be transported by pipeline to a liquid natural gas (LNG) plant at Balboa Bay on the southern coast of the Alaska Peninsula. Gas would then be transported directly to a Pacific Rim LNG terminal by LNG tankers of the 125,000-cubic-meter class.

In the offshore-loading scenario, oil resources from one platform would be offshore loaded onto 80,000-DWT tankers and transported through Unimak Pass directly to markets. Gas resources would be transported by pipeline to an LNG plant at Balboa Bay. Tankers of the 125,000-cubic-meter class would transport the LNG to a Pacific Rim terminal.

Table S-1 summarizes the possible effects that could occur, as a result of the leasing proposal (Alternative I) and the alternatives to the proposal, on those resources identified as major concerns during the scoping process (see Table S-2 for the definitions used in assessing effects). The analyses supporting the conclusions in Table S-1 assume that all current laws, regulations, and OCS operating orders are part of the leasing proposal. If the potential mitigating measures described in Section II.C.1.b. of this EIS were adopted, some of the effects described in Section IV would be reduced (the effectiveness of the potential mitigating measures is discussed in Sec. II.C.1.d. of this EIS).

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Table S-1
Summary of Effects for
Alternatives I, III, and IV, and Cumulative Effects[1/]

Resource Category	Alternative I (Proposal): Pipeline-Transportation Scenario	Alternative I (Proposal): Offshore-Loading-Transportation Scenario	Cumulative Effects	Alternative III (Delay the Sale)	Alternative IV (Alaska Peninsula Deferral)
BIOLOGICAL RESOURCES					
Fisheries Resources					
a. Salmonids	MINOR (MODERATE)[2/]	MINOR (MODERATE)[2/]	MINOR	MINOR	MINOR (MODERATE)[2/]
b. Forage Fish:					
Herring	MINOR (MAJOR)[3/]	MINOR (MAJOR)[3/]	MINOR	MINOR	MINOR (MAJOR)[3/]
Other Species	MINOR (MODERATE)[3/]	MINOR (MODERATE)[3/]	MINOR	MINOR	MINOR (MODERATE)[3/]
c. Groundfish	MINOR (MODERATE)[4/]	MINOR (MODERATE)[4/]	MINOR	MINOR	MINOR (MODERATE)[4/]
d. Red King Crab	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR
e. Other Invertebrates	MINOR (MODERATE)[5/]	MINOR (MODERATE)[5/]	MINOR	MINOR	MINOR (MODERATE)[5/]
Marine and Coastal Birds	MODERATE (MAJOR)[6/]	MODERATE (MAJOR)[6/]	MODERATE (MAJOR)[6/]	MODERATE	MINOR (MAJOR)[6/]
Pinnipeds and Sea Otters					
a. Fur Seals	MODERATE	MODERATE	MODERATE (MAJOR)[7/]	MODERATE	MODERATE
b. Other Pinnipeds	MINOR	MINOR	MINOR	MINOR	MINOR
c. Sea Otters	MODERATE	MODERATE	MODERATE (MAJOR)[7/]	MODERATE	MINOR
Endangered Cetaceans					
a. Gray Whale	MINOR	MINOR	MODERATE	MINOR	MINOR
b. Right Whale	MINOR	MINOR	MINOR	MINOR	MINOR
c. Bowhead Whale	NEGLIGIBLE	NEGLIGIBLE	MINOR	NEGLIGIBLE	NEGLIGIBLE
d. Fin Whale	MINOR	MINOR	MINOR	MINOR	MINOR
e. Sei Whale	NEGLIGIBLE	MINOR	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
f. Blue Whale	NEGLIGIBLE	MINOR	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
g. Humpback Whale	MINOR	MINOR	MINOR	MINOR	MINOR
h. Sperm Whale	NEGLIGIBLE	MINOR	MINOR	NEGLIGIBLE	NEGLIGIBLE
Endangered Birds	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
Nonendangered Cetaceans	MINOR	MINOR	MODERATE	MINOR	NEGLIGIBLE

Table S-1 (continued)
Summary of Effects for
Alternatives I, III, and IV, and Cumulative Effects[1/]

Resource Category	Alternative I (Proposal): Pipeline-Transportation Scenario	Alternative I (Proposal): Offshore-Loading-Transportation Scenario	Cumulative Effects	Alternative III (Delay the Sale)	Alternative IV (Alaska Peninsula Deferral)
SOCIAL AND ECONOMIC SYSTEMS					
Commercial Fishing Industry					
a. Salmon	MINOR	MINOR	MINOR	MINOR	MINOR
b. Herring	MINOR	MINOR	MODERATE	MINOR	MINOR
c. Groundfish	MINOR	MINOR	MINOR	MINOR	MINOR
d. Other Invertebrates	MINOR	MINOR	MINOR	MINOR	MINOR
e. Red King Crab	MAJOR	MAJOR	MAJOR	MAJOR	MAJOR
Local Economy	MINOR	MINOR	MAJOR	MINOR	MINOR
Community Infrastructure					
a. Unalaska	NEGLIGIBLE	NEGLIGIBLE	MAJOR	NEGLIGIBLE	NEGLIGIBLE
b. Cold Bay	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE (MODERATE)[8/]	NEGLIGIBLE	NEGLIGIBLE
Subsistence-Use Patterns	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
Sociocultural Systems					
a. Sand Point	MINOR	MINOR	MINOR	MINOR	MINOR
b. Unalaska	NEGLIGIBLE	NEGLIGIBLE	MODERATE	NEGLIGIBLE	NEGLIGIBLE
c. Cold Bay	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
d. Bristol Bay Region and Lower Alaska Peninsula Subregion	NEGLIGIBLE	NEGLIGIBLE	MINOR	NEGLIGIBLE	NEGLIGIBLE
OTHER ISSUES					
Water Quality	MINOR	MINOR	MINOR	MINOR	MINOR
Air Quality	MINOR	MINOR	MINOR	MINOR	MINOR
Cultural Resources	MINOR	MINOR	MINOR	MINOR	MINOR
Transportation Systems	MAJOR[9/]	MAJOR[9/]	MINOR	MAJOR	MAJOR
Land-Use Plans and Coastal Management					
a. Land-Use Plans	MINOR (MAJOR)[10/]	MINOR (MAJOR)[10/]	MODERATE	MINOR	MINOR
b. Coastal Management	MODERATE	MODERATE	MODERATE	MODERATE	MINOR
Terrestrial Mammals	MINOR	MINOR	MODERATE	MINOR	MINOR

Table S-1 (continued)
Summary of Effects for
Alternatives I, III, and IV and Cumulative Effects[1/]

Source: USDOI, MMS, 1985.

1/ Alternative II (No Sale) - Effects associated with Alternative I (proposal) would not occur as a result of this alternative. However, effects associated with other federal oil and gas lease sales and with the growth of the regional domestic commercial fishing industry would continue.

2/ Only a major oil spill (100,000 barrels) which contacted and exposed nearshore areas to lethal concentrations of hydrocarbons when vulnerable lifestages were concentrated in those areas could result in a MODERATE effect.

3/ If a major oil spill (100,000 barrels) occurred and contacted nearshore areas in the Port Moller area while spawning adult herring, roe, larvae, and juveniles were present, a MAJOR effect could result. If a major oil spill occurred and contacted nearshore areas inhabited by the susceptable lifestages of capelin, Pacific sand lance, boreal smelt, or eulachon, a MODERATE effect could result.

4/ Only a major oil spill (100,000 barrels) which contacted nearshore areas being used by concentrations of vulnerable lifestages of groundfish (i.e., larvae, juveniles) could result in a MODERATE effect.

5/ If a major oil spill (100,000 barrels) contacted a nearshore area inhabited by concentrations of breeding adults, planktonic larvae, juveniles or other vulnerable lifestages of invertebrates, MODERATE effects could result.

6/ If an oil spill entered the area surrounding a major seabird-nesting colony in the Shumagin Islands in summer, or heavily used waterfowl-staging area (Izembek and Nelson Lagoons) in spring and fall, MAJOR effects could result.

7/ MAJOR cumulative effects on sea otters or northern fur seals are possible if several thousand sea otters were killed, probably as a result of more than 1 spill, or if several fur seal rookeries were contaminated heavily during the pupping season. These events are very unlikely.

8/ Population trends projected for Cold Bay would have a NEGLIGIBLE effect on Cold Bay's infrastructure except for the water-supply and sewage-treatment systems, which would experience MODERATE effects.

9/ MAJOR effects on the transportation systems at Cold Bay, Balboa Bay, and along the pipeline corridor are expected, while the effects on Unalaska would be MODERATE. Effects on Unimak Pass vessel traffic would be MINOR.

10/ The effects on Unalaska and Cold Bay as a result of industrial and residential land-use demands would be MINOR. The development of an oil pipeline between Port Moller and Balboa Bay on the Alaska Peninsula would conform with the preferred transportation corridors identified in the Bristol Bay Regional Management Plan. However, pipeline and terminal development would have a MAJOR effect on the area's wilderness values.

Table S-2
Definitions Assumed in Effects Assessment

MAJOR ISSUES	MAJOR	MODERATE	MINOR	NEGLIGIBLE
Biological Resources (Fish, Marine Birds, Fur Seals, Other Pinnipeds and Sea Otters)	A regional population or species declines in abundance and/or distribution beyond which natural recruitment does not return it to its former level within several generations.	A portion of a regional population changes in abundance and/or distribution over more than one generation but is unlikely to affect the regional population.	A specific group of individuals of a population is affected in a localized area and over a short time period (one generation).	No measurable short-term or long-term changes in numbers or distribution of individuals occur in a population.
Endangered and Threatened Species, and Nonendangered Cetaceans	The regional population is likely to decline in abundance and/or distribution such that recovery is expected to take longer than several breeding cycles.	A portion of a regional population is likely to decline in abundance and/or distribution so that recovery is expected within several breeding cycles and the viability of the regional population is unlikely to be affected.	A specific group of individuals in a localized area is likely to change in abundance and/or distribution such that recovery occurs within one breeding cycle, and the viability of the regional population is unlikely to be affected.	No detectable short-term or long-term changes in a local or regional population are likely to occur.
Commercial Fishing Industry	Major disruptions to industry operations occur. Conflicts are frequent and significantly affect the fishing industry. Economic loss to the commercial fishing industry exceeds 10 percent.	Minor conflicts are frequent or significant conflicts occur occasionally. Economic loss to the industry is between 3 and 10 percent.	Minor conflicts may develop. The economic loss to the commercial fishing industry is between 1 and 3 percent.	Economic loss to the industry is less than 1 percent.
Economy	Economic effects occur which will require major changes in governmental policies, planning, or budgeting, or which have the potential to create major problems or to cause important changes in the economic well-being of residents of the area.	Economic effects occur which definitely require modification of governmental policies, planning or budgeting, or which may create problems such as an increased rate of price inflation or housing shortages, or which may significantly affect the economic well-being of residents of the area.	Economic effects occur which require marginal changes in governmental policies, planning or budgeting, or which may marginally affect the economic well-being of residents of the area.	Economic effects occur which are not large enough to have any measurable effect on governmental policies, planning, or budgeting, or any measurable effect on the economic well-being of residents of the area.
Community Infrastructure	The capacity of the existing service or facility is exceeded by demands. Demands on the service as a result of OCS population increases and/or industrial expansion account for over 20 percent of the total demand on any individual service.	The capacity of the existing service or facility is exceeded by user demands. Demands on the service as a result of OCS population increases and/or industrial expansion account for between 10 and 20 percent of the total demand on any individual service.	The capacity of the existing service or facility is exceeded by user demands. Demands on the service as a result of OCS population increases and/or industrial expansion account for up to 10 percent of the total demand on any individual service.	User demands are within the capacity of the existing service.

Table S-2 Continued

	MAJOR	MODERATE	MINOR	NEGLIGIBLE
Subsistence-Use Patterns	One or more important subsistence resources become unavailable locally for a period of time exceeding 1 year.	One or more subsistence resources become locally unavailable for a period of time not exceeding 1 year.	Subsistence resources are affected for a period of less than 1 year, but not to the extent of relative non-availability.	Subsistence resources are affected only to the extent of a loss of a small number of individual fish or wildlife resources, with no apparent effects on subsistence harvests.
Sociocultural Systems	Long-term (5 years or more), chronic disruption of local sociocultural systems occurs, with a tendency toward the displacement of existing institutions.	Long-term (5 years or more), chronic disruption of local sociocultural systems occurs without a tendency toward the disruption of existing institutions.	Short-term disruption of local sociocultural systems occurs without a tendency toward the displacement of existing institutions.	Periodic disruption of local sociocultural systems occurs without apparent effects.
OTHER ISSUES				
Water Quality	There is long-term measurable degradation throughout the planning area.	There is short-term measurable degradation throughout the planning area.	There is long-term local degradation.	There is short-term local degradation.
Air Quality	Applicable standards are exceeded throughout the planning area on a long-term basis or environmental degradation is measurable throughout the planning area.	Effects are short-term but exceed applicable standards.	Effects are local but long-term and exceed standards of local secondary effects.	Effects are short-term, local, and result in no measurable secondary effects.
Cultural Resources	Many cultural resources are expected to be present and disturbed.	Some cultural resources are expected to be present and disturbed.	Few cultural resources are expected to be present and disturbed.	No cultural resources are likely to be present or affected.
Transportation Systems	Total traffic for any system increases by more than 25 percent or the traffic of any system increases beyond that system's traffic capacity, causing delay and potential conflicts between contending users; or there is large-scale construction of new facilities and/or extensive upgrading or repair of existing facilities.	Total traffic for any system increases by 16 to 25 percent; the traffic for any system reaches but does not exceed the system's traffic capacity; or facilities are constructed and existing facilities are upgraded or repaired.	Total traffic for any system increases by 6 to 25 percent; the carrying capacity of any system is not reached; or existing facilities are repaired or upgraded.	Total traffic for any system increases by less than 5 percent; or there are minor repairs or upgrading of existing facilities.

Table S-2 Continued

	MAJOR	MODERATE	MINOR	NEGLIGIBLE
Land-Use Plans and Coastal Management	High incompatibility occurs between an OCS-facility and other uses (e.g., support base in wilderness area). Siting of a facility results in noise, traffic, or nuisance effects. A small amount of land exists for expansion.	Facility siting may result in changes to existing land-use plans and cause a lesser degree of effects.	Effects are mitigated by land-use plans, CZM plans, or federal, state, and local regulations. A large amount of suitable land is available for new developments.	No measurable change occurs.

I.

PURPOSE FOR ACTION

I. PURPOSE FOR ACTION

The Department of the Interior is required by law to manage the exploration and development of oil and gas resources on the outer continental shelf (OCS). To help meet the energy needs of the nation, these resources must be developed as expeditiously, and yet as carefully, as possible. While overseeing this development, the federal government must, among other things, balance orderly resource development with protection of the human, marine, and coastal environments; ensure that the public receives a fair return for these resources; and preserve and maintain free-enterprise competition.

In compliance with the Outer Continental Shelf Lands Act, as amended (43 U.S.C. 1331 et seq.), the Secretary of the Interior submits a proposed 5-year leasing program to the Congress, the Attorney General, and the governors of affected states. The Secretary periodically reviews, revises as necessary, and maintains the oil and gas leasing program. Goals of the leasing program include (1) the orderly development of OCS oil and gas resources in an environmentally acceptable manner; (2) the maintenance of an adequate supply of OCS production to help meet the nation's energy needs; and (3) the reduction of dependency on foreign oil. The purpose of this proposed lease sale is to contribute to that program.

Current U.S. energy demands are met primarily by domestic and foreign fossil fuel. Since the 1973 Arab oil embargo, it has become increasingly apparent that our nation must become less dependent on foreign imports, lessen our vulnerability to supply economics and supply interruptions, and prepare for the time when oil production approaches its capacity limitation. In 1978, Congress and the President mandated the Department of the Interior to engage in "expedited exploration and development of" the OCS in order to "assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade." The Secretary has stated that "we honor that mandate, and until there is other direction, it will be our foremost guideline in all OCS activity."

The OCS leasing program does not represent a decision to lease in a particular area. Instead, it is representative only of the Department's intent to consider leasing in certain areas, and to proceed with the offering of such areas only if it is determined that leasing and development would be technically feasible and environmentally and economically acceptable.

As a part of the overall offshore leasing program, the Department of the Interior has scheduled the North Aleutian Basin (Sale 92) for early 1986.

A. Leasing Process

The Outer Continental Shelf Lands Act (OCSLA) of 1953, as amended, charges the Secretary of the Interior with administering mineral exploration and development on the U.S. OCS and with conserving its natural resources. The Secretary has delegated authority to carry out offshore leasing and resource management functions to the Minerals Management Service (MMS). The OCS leasing program is implemented by 30 CFR Part 256 (formerly 43 CFR Part 3300, as amended, see the Federal Register at 47 FR 47006, October 22, 1982). Lease supervision and regulation of offshore operations is implemented by 30 CFR Part 250. The following steps summarize the leasing process for the proposed lease sale.

1. Leasing Schedule: The Outer Continental Shelf Lands Act, as amended, requires that the Secretary prepare and maintain a 5-year OCS oil and gas leasing program and that he review the program annually to ensure that it meets the nation's energy needs. The current 5-Year OCS Oil and Gas Lease Sale Schedule, announced by the Department of the Interior on July 21, 1982, consisted of 41 proposed lease sales for the period August 1982 through June 1987, including 16 sales offshore of Alaska. A new 5-year program is currently being prepared pursuant to Section 18 of the Act (43 U.S.C. 1344). The proposed North Aleutian Basin (Sale 92) has been scheduled for early 1986.

2. Request for Resource Reports: Resource reports for a specific lease area are requested from various federal and state agencies approximately 2 years before the scheduled month of the lease sale. These reports provide valuable geological, biological, oceanographic, navigational, recreational, environmental, archeological, and socioeconomic information on a proposed lease area. Resource reports for the North Aleutian Basin were requested in August 1982 and were received by the MMS Alaska OCS Region through April 1983.

3. Call for Information: A Call for Information is made on an entire planning area and is published in the Federal Register. The North Aleutian Basin Planning Area covers approximately 13.1 million hectares (32.5 million acres) containing 5,947 blocks. The North Aleutian Basin is generally located in the eastern Bering Sea northwest of the Alaska Peninsula and is bounded on the north by 59°N latitude and on the north, south, and east by the 3-geographical-mile line. It is bounded on the west by 165°W longitude from 59°N latitude to the 3-geographical-mile line at approximately 54°40'N latitude.

The Call invites the oil industry, governmental agencies, environmental groups, and the general public to comment on areas of interest or special concern in the proposed lease sale area. The Call for the proposed lease sale in the North Aleutian Basin was published in the Federal Register on April 29, 1983 (48 FR 29620), and requested comments on the areas of interest and on the initial lease terms within 30 days of publication. The comments submitted provided information on lease terms and block size, and identified significant environmental concerns.

Fourteen companies responded to the Call by submitting comments and indicating interest in areas for leasing. Respondents showed interest in the entire Call area. Comments also were received from agencies of the State of Alaska; the Fish and Wildlife Service (FWS); the National Marine Fisheries Service (NMFS); the Bristol Bay Coastal Resource Service Area (CRSA); the Aleutians East CRSA; the Bristol Bay Native Association; the Natural Resources Defense Council, Inc. (NRDC); and a regional-level, nonprofit Native organization, Nunam Kitlutsisti.

4. Area Identification: Based on information from the resource reports; responses to the Call for Information; recommendations from the MMS, FWS, and NMFS; comments from the Governor of Alaska regarding technological and socioeconomic information; and the Department of the Interior's own environmental, technological, and socioeconomic information, the Secretary selects an area for further environmental analysis and study.

In August 1983, the Department of the Interior announced the selection of the entire North Aleutian Basin Planning Area for environmental analysis and study in the EIS (13.1 million hectares or 32.5 million acres). However, as a result of the Secretary's consultation with the Governor of Alaska (March 1984), the area to be studied was reduced to approximately 2.27 million hectares (5.6 million acres) consisting of 990 blocks (Graphic 1). The reduced area, which lies generally in the southwest portion of the North Aleutian Basin Planning Area, represents approximately 17 percent of the area originally selected for analysis in this EIS.

5. Scoping: The Council on Environmental Quality (CEQ) defines scoping as "an early and open process for determining the scope of issues to be addressed in an environmental impact statement (EIS) and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). It is a means for early identification of important issues that deserve study in an EIS. The intent of scoping is to avoid overlooking important issues that should be analyzed and to deemphasize less important issues. The MMS has maintained contact with representatives from various federal and state agencies, the oil and gas industry, environmental groups, local communities, and the general public to help identify critical issues, special concerns, and possible alternatives to the proposed North Aleutian Basin lease sale. Scoping letters issued by the MMS requested comments by November 4, 1983. Finally, the MMS ensured that this information, and the information collected and the concerns identified during the scoping process for the St. George Basin (Sale 70) and the cancelled North Aleutian Shelf (Sale 75), also was fully considered in this proposal. For detailed information on the scoping process, see Section I.E.

6. Preparation of Draft Environmental Impact Statement (DEIS): As required by Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969, an EIS is prepared prior to the conduct of any major federal activity that significantly affects the quality of the human, marine, and coastal environments. Offshore leasing is considered a major federal activity for which an EIS should be prepared. Issues and alternatives raised during the scoping process are analyzed in the EIS for consideration by the Secretary. For this EIS, the MMS also used information gathered in March 1982 during a synthesis meeting held for the cancelled North Aleutian Shelf (Sale 75). Appendix K provides information about and a list of MMS-sponsored studies.

The DEIS describes the potentially affected marine and onshore environment; presents an analysis of potential adverse effects on this environment and the area's inhabitants; describes potential mitigating measures to reduce the adverse effects of offshore leasing and development, and possible alternatives to the proposal; and presents a record of consultation and coordination with others during DEIS preparation. As part of the EIS process, the MMS prepared an evaluation of potential adverse effects on subsistence uses under Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) (see Sec. IV.K.).

The DEIS was filed with the Environmental Protection Agency (EPA) on January 14, 1985, and its availability was announced in the Federal Register (FR Vol. 50, No. 12, January 17, 1985, p. 2629). Any interested party may request a copy of the DEIS by contacting the MMS office listed in the Federal Register.

7. Endangered Species Consultation: Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the MMS consults with the Fish and Wildlife Service and the National Marine Fisheries Service, as appropriate, to determine whether a species that is listed (or proposed to be listed) as endangered or threatened may be jeopardized by the proposed action.

Both formal and informal consultations were conducted on the potential effects of OCS leasing and exploration activities on endangered species. In accordance with Section 7(a) of the Endangered Species Act of 1973, as amended, formal consultations for the proposed North Aleutian Basin (Sale 92) were initiated with the NMFS and the FWS on September 28, 1983. A biological opinion was received from the FWS on November 4, 1983. On March 21, 1984, the NMFS submitted its biological opinion on the proposed area (see Appendix H).

8. Public Hearings: Public hearings are held after release of the DEIS, and specific dates and locations for public hearings are announced in the Federal Register. Public hearings on the Sale 92 DEIS were held in Dillingham on February 19, Naknek on February 20, and Anchorage on February 26, 1985. A public hearing was scheduled for Sand Point on February 21, 1985; however, this hearing was cancelled due to bad weather. Oral and written comments are obtained and responded to in a final environmental impact statement (FEIS), which is made available to the public. The public was invited to submit comments on the subsistence-use analysis under Section 810 of the ANILCA.

9. Preparation of Final Environmental Impact Statement (FEIS): Oral and written comments on the adequacy of the DEIS are obtained and responded to in the FEIS, which is then made available to the public and filed with the EPA. The availability of the FEIS is announced in the Federal Register.

10. Secretarial Issue Document (SID): The SID, which is prepared in addition to the FEIS, includes a discussion of significant factors connected with the Department's proposed lease sale. The SID provides relevant environmental, economic, social, and technological information to the Secretary to assist him in reaching a decision on whether to conduct a lease sale and, if so, what terms and conditions should be applied to the sale and leases.

11. Proposed Notice of Sale: At least 90 days before the proposed sale, a Proposed Notice of Sale is published in the Federal Register. A copy of this notice is furnished to the Governor of Alaska pursuant to Section 19 of the OCSLA so that he and any affected local governments may comment on the size, timing, and location of the sale. Comments must reach the Secretary within 60 days after publication of the Proposed Notice of Sale.

12. Decision and Final Notice of Sale: The entire prelease process culminates in a final decision by the Secretary on whether to hold a lease sale and, if so, its size and its terms and conditions. The Final Notice of Sale must be published in the Federal Register at least 30 days prior to the sale date. It may differ from the Proposed Notice subject to the Secretary's final terms, i.e., size of lease sale, bidding systems, and stipulations.

13. Lease Sale: The North Aleutian Basin (Sale 92) is scheduled to be held in early 1986. Sealed bids for individual blocks (those listed in the Notice of Sale) are opened and publicly announced at the time and place of the sale. The MMS assesses the adequacy of the bids, and the Department of Justice and the Federal Trade Commission review them for compliance with antitrust laws. If bids are determined to be acceptable, leases may be awarded to the highest qualified bidders. However, the Secretary reserves the right to withdraw any blocks from consideration prior to written acceptance of a bid and the right to accept or reject bids generally within 90 days of the lease sale.

14. Lease Operations: After leases are awarded, the MMS Field Operations Office (FO) is responsible for supervising and regulating operations conducted on the lease area. Prior to any exploration activities on a lease, except preliminary activities, a lessee must submit an exploration plan, an environmental report--including an Oil-Spill-Contingency Plan and an Application for Permit to Drill (APD)--to the MMS for approval. The Office of Ocean and Coastal Resource Management, FWS, NMFS, National Park Service, Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Coast Guard, the State of Alaska, and the public are provided an opportunity to comment on the exploration plan. The exploration plan must be approved or disapproved within 30 days, subject to the State of Alaska's concurrence with the lessee's federal consistency determination under Section 307(c)(3)(B) of the Coastal Zone Management Act of 1972, as amended. The APD also is approved after the state has concurred with the lessee's federal consistency determination.

B. Leasing History

There has not been a federal offshore lease sale in the North Aleutian Basin. The first oil and gas lease sale scheduled for this area appeared in a proposed leasing schedule dated November 1974 as Sale 51, Outer Bristol Basin, October 1977. The sale date was revised to December 1977 on the June 1975 proposed leasing schedule. At the request of the Governor of Alaska, the sale was deleted from the January 1977 proposed OCS leasing schedule. This area appeared again on a June 1979 proposed leasing schedule sent to Congress as proposed Sale 75 (North Aleutian Shelf).

Based on the 1980 Final 5-Year Oil and Gas Lease Sale Schedule, a Call for Nominations and Comments was issued in the Federal Register on May 21, 1980, for the proposed North Aleutian Shelf (Sale 75). The sale originally was scheduled for October 1983, but the accelerated proposed 1981 schedule advanced the sale date to April 1983. As the prelease process continued, an area was selected for further study; scoping meetings were held; and data were gathered for preparation of an EIS. However, when the final 1982 5-Year OCS Oil and Gas Lease Sale Schedule was approved on July 21, 1982, the Secretary of the Interior had decided to delete Sale 75 from the schedule, and the EIS was not completed.

One Deep Stratigraphic Test well was drilled in the planning area. This well was spudded by ARCO on September 8, 1982, and completed on January 14, 1983 (see Fig. I-1.)

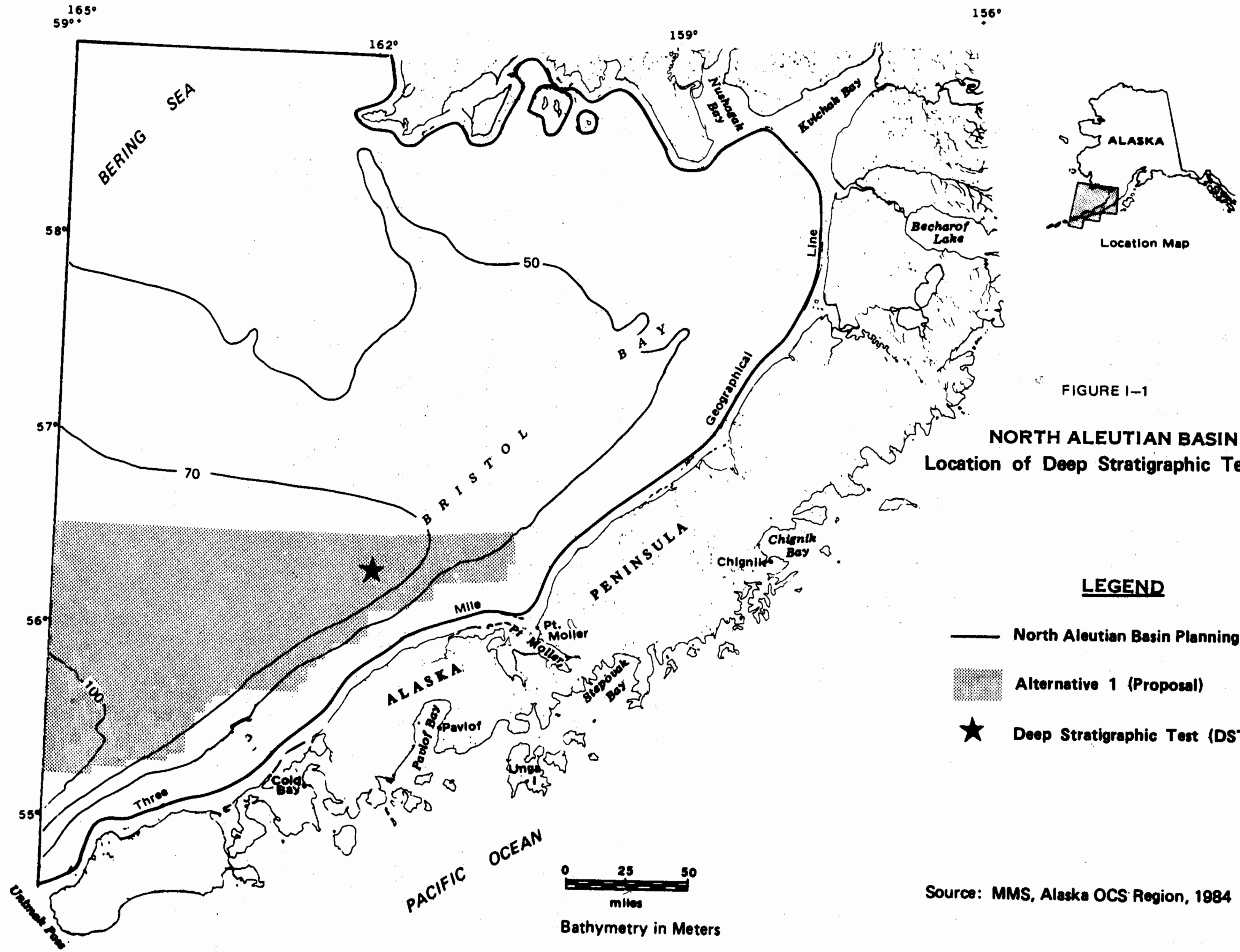


FIGURE I–1

NORTH ALEUTIAN BASIN
Location of Deep Stratigraphic Test Well

LEGEND

- North Aleutian Basin Planning Area
- Alternative 1 (Proposal)
- ★ Deep Stratigraphic Test (DST) Well

Source: MMS, Alaska OCS Region, 1984

On March 26, 1968, the State of Alaska held a competitive offshore lease sale in state waters in Bristol Bay. The sale area consisted of 346,623 offshore acres, including tracts in the Port Moller and Port Heiden areas. As a result of this sale, 164,961 acres were leased for hydrocarbon development. The 147 leases issued have expired. One exploratory well was drilled on one of the leased tracts in the Port Heiden area. This well was spudded on June 19, 1972, and completed on September 14, 1972.

Onshore, the federal and state governments and the Bristol Bay Native Corporation have leased lands for hydrocarbon development. During the late 1950's and early 1960's, federal noncompetitive leases and federal development contracts were issued, resulting in nine exploratory wells being drilled onshore along the northern coastal-lowland area of the Alaska Peninsula between Egegik and Moffet Point. Although the wells were effectively dry holes, a number of oil and gas shows were encountered in basal-sandstone beds of the Bear Lake, Stepovak, and Tolstoi Formations.

The State of Alaska held a competitive oil and gas lease sale on the Alaska Peninsula in September 1984. The Sale 41 (Bristol Bay Uplands) area consisted of approximately 1.44 million onshore acres south of the Kvichak River and north of Port Heiden on the Alaska Peninsula. As a result of the sale, 279,938.96 acres were leased for exploration and possible hydrocarbon development.

The next State of Alaska onshore lease sale on the Alaska Peninsula (Sale 56, between Liesko Cape and Port Heiden) is scheduled for September 1988.

C. Litigation History

The State of Alaska filed suit against the Department of the Interior on August 4, 1980 (Alaska v. Andrus, Civ. No. 80-1997, D.C. Cir.), contesting the June 16, 1980, decision by Secretary Andrus that approved and adopted a 5-year oil and gas lease sale schedule, particularly those sales proposed for the St. George Basin and the North Aleutian Shelf. The state petitioned for deletion of these sales from the leasing schedule and, in its complaint, alleged that the Department of the Interior did not comply with Section 18 of the Outer Continental Shelf Lands Act (OCSLA) (Sec. 18 sets forth procedures for the preparation, maintenance, and periodic revision of the OCS leasing program). This suit was combined with others in California, et al., v. Watt, (Civ. Nos. 80-1894, 80-1897, 80-1935, and 80-1991, filed August 1980, D.C. Cir.).

The merits of the case were argued on March 4, 1981, before the U.S. Court of Appeals for the District of Columbia; and a decision and judgment were entered on October 6, 1981. The court order did not vacate the OCS leasing schedule but remanded the leasing program back to the Secretary of the Interior for reconsideration, in accordance with the OCSLA. The court retained jurisdiction over the case until the Secretary revised and reapproved the program.

Subsequent to the announcement of the new 5-Year Oil and Gas Lease Sale Schedule, the States of California and Alaska, the North Slope Borough, several environmental groups, and a local Coastal Resource Service Area Board filed Petitions for Review on July 22, 1982, with the U.S. Court of Appeals, District of Columbia, requesting that the original suit on the 5-year schedule (California v. Watt, 688 F. 2d 1290 (D.C. Cir. 1981)) against the 1980 schedule, be reopened and reviewed. Several issues regarding the Secretary's compliance with the court's opinion issued on October 6, 1981, and objections to the size, timing, and location of the new lease sales on the schedule, were raised in the petitions.

The State of Alaska specifically objected to sales scheduled in the North Aleutian Basin, St. George Basin, Norton Sound, Barrow Arch, and Diapir Field (the pack-ice zone in the Beaufort Sea). Alaska claimed that the lease sales in these areas would adversely affect state air and water quality; endanger major commercial, subsistence, and sport fisheries; adversely affect marine mammal and bird populations of the regions; threaten the economy, social structure, and lifestyles of persons residing in coastal areas adjacent to these lease sales; result in incompatible land and water uses; and impair the ability of the state and its political subdivisions to manage and protect renewable resources in these regions. Alaska also was opposed to certain streamlining procedures in the OCS oil and gas program and claimed that these procedures would disrupt the state's ability to plan and prepare for the adverse effects of the scheduled lease sales.

The U.S. Court of Appeals hearing on the combined suit was held in Washington, D.C., on February 25, 1983. Reargument of the case was heard on May 23, 1983. On July 5, 1983, the Court of Appeals issued its opinion (in support of its June 9, 1983, court order) approving Secretary of the Interior Watt's 1982 5-Year OCS Oil and Gas Lease Sale Schedule, California v. Watt, 712 F.2d 584 (D.C. Cir. 1983).

D. Legal Mandates, Authorities, and Federal Regulatory Responsibilities

Bureau of Land Management (BLM)-Alaska OCS Technical Paper No. 4, "Legal Mandates and Federal Regulatory Responsibilities," describes legal mandates and authorities for OCS leasing, outlines federal regulatory responsibilities, and discusses authorities of other federal agencies affecting OCS activities. This paper explains the Secretary's authorities on the OCS and further contains the following:

- A summary of the OCS Lands Act, as amended; including a detailed discussion of the requirements for federal/state coordination; the establishment of compensatory funds; and the environmental studies program.

- A discussion of the Secretary's ongoing authority to control lease activities, including his authority to suspend operations and cancel a lease for environmental reasons.

- The functions of the National OCS Advisory Board and the Regional Technical Working Group (RTWG) of the Board. The RTWG serves a primarily advisory function on technical matters of the OCS program.

- OCS Orders, prepared by the MMS, for the Arctic and Gulf of Alaska areas.

NOTE: Alaska OCS Order Numbers 1 through 5, 7, 8, and 12, covering all of the Alaska OCS Region, were published in the Federal Register on October 22, 1982, at 47 FR 47180, and supersede the Arctic and Gulf of Alaska Orders referenced in this technical paper. Technical Paper No. 4 is scheduled to be revised.

Alaska OCS Region Reference Paper No. 83-1, "Federal and State Coastal Managment Programs," incorporated herein by reference, describes the coastal-management legislation and programs of the federal government and the State of Alaska. This paper highlights sections particularly pertinent to offshore oil and gas development and briefly describes some of the effects of the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National Interest Lands Conservation Act (ANILCA) on coastal management.

E. Results of the Scoping Process

1. Issues: The scoping process for the North Aleutian Basin (Sale 92) consisted of the Request for Resource Reports in August 1982; the Call for Information in April 1983; and a letter in October 1983 requesting further information and identification of concerns from various federal and state agencies, oil and gas industry personnel, environmental groups, and local communities. All information gathered during scoping for the cancelled North Aleutian Shelf (Sale 75) also was included.

The MMS has consulted with the State of Alaska and fishing-interest groups to:

- Provide the state and fishing-interest groups the opportunity to identify major concerns and issues that should be addressed in the EIS for the North Aleutian Basin (Sale 92) and in other MMS decision documents.

- Identify potential information needs.

On August 16, 1984, representatives of the MMS, State of Alaska, United Fishermen of Alaska, and Bering Sea Fisherman's Association met at the MMS (Alaska OCS Region) office in Anchorage, Alaska, to identify issues and concerns to be addressed in the EIS. Other meetings resulting from this special coordination effort are listed in Section VI.

The following issues were identified during the scoping process. Issues raised at the August 16, 1984, meeting are indicated with an asterisk (*).

Issue	Specific Concern	Location in EIS
BIOLOGICAL RESOURCES		
Fisheries Resources:	Effects of oil spills on fish, especially herring, salmon, and groundfish and invertebrates.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	*Effects of an oil spill on outmigrating juvenile salmon and herring in all regions of Bristol Bay.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	Effects of oil dispersants on fisheries resources.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)

Issue	Specific Concern	Location in EIS
Fisheries Resources (continued):	Effects of an oil spill on the lifestages of fish species in the North Aleutian Basin area (detailed coverage).	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	*Effects of geophysical operations on fisheries resources.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	*Effects of a potential oil spill on herring in the Togiak area.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	Effects analysis of the various crab species, considering depressed state of crab populations in the Bering Sea.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	*Effects of chronic oil spills on fisheries resources.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	*Effects of oil spills on nearshore fisheries, particularly spawning habitat and nearshore migrations.	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
Marine and Coastal Birds:	*Effects of oil spills and other disturbances on marine and coastal birds, particularly black brant, emperor goose, Steller's eider, and cackling and white-fronted geese.	Secs. IV.B.1.a.(2) and IV.B.2.a.(2)
	*Effects of industry-induced air traffic on bird populations in the Izembek Lagoon area.	Secs. IV.B.1.a.(2) and IV.B.2.a.(2)
Pinnipeds and Sea Otters:	Effects of oil spills and other disturbances on marine mammals, particularly sea otter, sea lion, harbor seal, and walrus.	Secs. IV.B.1.a.(3) and IV.B.2.a.(3)
Endangered and Threatened Species:	Effects of seismic activity, oil spills, vessel traffic, and other disturbances on endangered cetaceans (gray, blue, fin, sei, sperm, humpback, bowhead, and right whales).	Secs. IV.B.1.a.(4) and IV.B.2.a.(4)

Issue	Specific Concern	Location in EIS
General:	*Effects of drilling muds, cuttings, and production waters on biological resources.	Sec. IV.B.1.a.
	*Effects analysis from an ecosystem-wide perspective on biological resources (Example: If capelin were affected, what implications would this have on species that feed on capelin).	Secs. IV.B.1.a.(1) and IV.B.2.a.(1)
	*Effects of an oil spill, resulting from tankering out of Balboa Bay on the southern side of the Alaska Peninsula, on biological resources.	Sec. IV.B.1.a.
SOCIAL AND ECONOMIC SYSTEMS		
Commercial Fishing Industry:	*Effects of potential economic losses on the fishing industry due to the public's reluctance to purchase oil-tainted fish products, particularly salmon.	Secs. IV.B.1.b.(1) and IV.B.2.b.(1)
	Effects of OCS development (oil spills and pipeline development) on kelp beds and the roe-on-kelp fishery.	Secs. IV.B.1.b.(1) and IV.B.2.b.(1)
	*Effects of seismic operations on commercial fishing activities.	Sec. IV.B.1.b.(1)
	*Effects of materials lost (debris), during platform and pipeline placement, on commercial fishing operations.	Sec. IV.B.1.b.(1)
	Effects of potential competition between the fishing and oil industries for space and facilities in ports.	Secs. IV.B.1.b.(1) and IV.B.2.b.(1)

Issue	Specific Concern	Location in EIS
Commercial Fishing Industry (continued):	*Effects of vessel traffic and the seasonality of construction activities on commercial fishing gear (pots and nets).	Secs. IV.B.1.b.(1) and IV.B.2.b.(1)
	Effects of oil fouling on fishing gear, especially nets.	Secs. IV.B.1.b.(1) and IV.B.2.b.(1)
	*Effects of the potential change in structure of the fish-harvesting sector as a result of increased population in the region.	Secs. IV.B.1.b.(1) and IV.B.2.b.(1)
Local Economy:	Effects on prices of food, hardware, and fuel.	Sec. IV.B.1.b.(2)
	Effects on local employment.	Secs. IV.B.1.b.(2) and IV.B.2.b.(2)
Community Infrastructure:	*Effects of oil and gas development on existing community facilities and services in the cities of Unalaska and Cold Bay, particularly on the water-supply system.	Secs. IV.B.1.b.(3) and IV.B.2.b.(3)
Subsistence-Use Patterns:	Effects of OCS activities on subsistence resources and village subsistence livelihood.	Secs. IV.B.1.b.(4) and IV.B.2.b.(4)
	*Effects of potential regional population increase due to OCS-related petroleum development, and of a potential corresponding increase in competition for subsistence resources.	Secs. IV.B.1.b.(4) and IV.B.2.b.(4)
	*Effects on the Yukon/Kuskokwim-area villages if fisheries resources, which migrate through the proposed lease sale area and are used in this region, are affected by an oil spill.	Secs. IV.B.1.b.(4) and IV.B.2.b.(4)

Issue	Specific Concern	Location in EIS
Sociocultural Systems:	Effects on the cultural, political, and social activities of local residents.	Secs. IV.B.1.b.(4) and IV.B.2.b.(4)
OTHER ISSUES		
Transportation:	Effects on air and marine transportation.	Sec. IV.F.4.
Terrestrial Mammals:	*Effects on major game species as a result of increased population and hunting pressure on the Alaska Peninsula.	Sec. IV.F.6.
General:		
Cumulative Effects:	Cumulative effects and interactions between this sale and other petroleum-province developments.	Sec. IV.B.
	*Long-term cumulative effects of multiple spills and chronic discharges.	Sec. IV.B.
Constraints on Development:	Effects of winter-weather conditions and geohazards on the safety of conducting offshore operations.	Secs. III.A.2. and IV.A.5.
Oil Spills:	Effects of the lack of cleanup technology for an oil spill on or under the ice.	Sec. IV.A.4.
	*Effects of oil-spill transport, particularly the movement of oil through the water column.	Sec. IV.A.3.d.
	*Effects of mitigating measures on oil-spill-contingency plans and oil-spill-cleanup technology.	Sec. IV.A.4.

Issue	Specific Concern	Location in EIS
Oil Spills (continued):	*Effects of oil-spill-response and cleanup capabilities in an open-water environment.	Sec. IV.A.4.

2. Issues Not Analyzed in the EIS: The following concerns raised during the scoping process are not analyzed in the EIS.

a. Effect of Gravel Extraction on Anadromous-Fish Streams: It is not anticipated that gravel would be extracted from anadromous-fish streams for oil-and-gas-industry construction projects. Under AS 16, State of Alaska, Department of Fish and Game, approval is required if a mining site is located within an anadromous stream or could block fish passage. Gravel mining for construction projects associated with development activities also would have to be consistent with the State of Alaska and the Aleutians East Coastal Resource Service Area (CRSA) coastal-management programs.

b. Effect of Explosive Seismic-Energy Sources on Fisheries Resources: In prior seismic-survey efforts in the North Aleutian Basin, explosives were not used as seismic-energy sources. High-resolution surveys used either a sparker or j-boomer as a sound source, while deep-seismic surveys used an array of airguns. In addition, sleeve exploders and waterguns were listed on some North Aleutian Basin permits. Based on the anticipated seismic activity and past history of seismic surveys in the basin (Appendix F), the use of explosive seismic-energy sources is not anticipated. Industry may request the use of explosive-energy sources under special conditions; however, their use would be evaluated on a case-by-case basis in subsequent environmental assessments. Permit applications for seismic activities to be conducted in state waters also would have to be consistent with the State of Alaska and the Aleutians East CRSA Coastal Zone Management Programs.

3. Alternatives Recommended during the Scoping Process:

a. The State of Alaska has requested that the North Aleutian Basin (Sale 92) be cancelled or deferred until:

- "Experience in other Alaskan OCS lease areas demonstrates the capability to operate in the North Aleutian Basin."
- "The effects of oil and gas exploration and development in the North Aleutian Basin on birds, fish, crustaceans, marine mammals and their critical habitats can be predicted and quantified with greater certainty."
- "Additional information is obtained on the biological resources of the area, particularly the distribution of their larval stages, which are most likely to be impacted by spilled oil."

° "Coastal management planning has progressed to the extent that the sociocultural and economic effects that may occur as a result of oil and gas development activities can be addressed by local citizens."

Alternative II would cancel the proposed lease sale. Alternative III would delay the proposed lease sale for a period of 5 years.

b. The Bristol Bay CRSA Board requested a deferral encompassing the entire planning area east of a line drawn from Cape Peirce to Cape Seniavin on the Alaska Peninsula.

As a result of consultations with the Governor of Alaska, the Secretary of the Interior reduced the area to be studied to about 2.27 million hectares. The areas requested to be deferred by the Bristol Bay CRSA Board are not now included in the areas considered for leasing in the proposal.

c. A number of organizations requested deferral of leasing on blocks adjacent to the northern coast of the Alaska Peninsula, to provide protection for the abundant biological resources in this area. The FWS requested a deferral on all blocks within 12 nautical miles (13.8 miles or 18 kilometers) of the Alaska Peninsula. The FWS also requested that no leasing should occur in water depths less than 70 meters to afford protection to sea otters in the southern Bristol Bay area. The National Marine Fisheries Service requested that no leasing occur within an 80-kilometer (50-mile) radius of Unimak Pass and within 40 kilometers (25 miles) of the northern coast of the Alaska Peninsula (Appendix H). The Bristol Bay CRSA Board requested a 40-kilometer (25-mile) deferral along the shoreline; and the Aleutians East CRSA Board requested a 48-kilometer (30-mile) deferral. The Natural Resources Defense Council, Inc., requested special protection for Unimak Pass and the lagoons along the Alaska Peninsula.

Alternative IV (Alaska Peninsula Deferral) defers leasing on all blocks within 40 kilometers (25 miles) of the northern coast of the Alaska Peninsula and within 80 kilometers (50 miles) of Unimak Pass. Water depths in the area that would be offered for leasing range from 40 to 100 meters. The majority of the area has water depths greater than 70 meters.

4. <u>Mitigating Measures Recommended during the Scoping Process</u>: The following mitigating measures were recommended during the scoping process and are considered in the EIS:

a. A program to inform industry personnel about the environmental and cultural sensitivities of the lease sale area. This measure was developed as the Orientation Program, discussed in Section II.C.1.b.

b. A measure to ensure that offshore structures are placed away from geological hazards. This was believed to duplicate Alaska OCS Region Order No. 2 (Drilling Operations). Order No. 2 (Sec. 2.1.1, Fitness of Drilling Units) indicates that all fixed and mobile drilling units shall be capable of withstanding the oceanographic, meteorologic, and ice conditions for the proposed area of operation. In addition, lessees are required to submit a shallow-geologic-hazards report and to conduct such shallow-geologic-hazards surveys as required by the Regional Supervisor, Field Operations (RSFO) (Sec. 2.1.3, Well Site Surveys).

c. A measure to provide navigational aids, especially in Unimak Pass, was proposed. This measure was developed as the Information to Lessees (ITL) on Fairway Designations, discussed in Section II.C.1.b.(2).

Other mitigating measures that were previously used or recommended for other lease areas were considered during internal scoping meetings and staff analysis. Those measures identified as current and appropriate are included in Section II.C.1.b.

II.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section describes the proposed action and the alternatives to the proposal for the North Aleutian Basin (Sale 92). It also discusses the resource estimates, transportation scenarios, and potential mitigating measures that shape the environmental analysis contained in this document. In addition, this section contains a summary and comparative analysis of the proposal and the alternatives.

A. Resource Estimates

The hypothetical development and transportation scenarios discussed in this section are based on the conditional-mean estimate for undiscovered recoverable resources of 364 million barrels (MMbbls) of oil and 2.62 trillion cubic feet (TCF) of gas. The marginal probability for hydrocarbons is estimated to be 0.20, which indicates that there is only a 20-percent chance of recoverable hydrocarbons being present in the lease sale area. Table II-1 compares the resource levels that were used to analyze the proposal and each of the alternatives. The transportation scenarios and the environmental analysis are based on these unrisked resource estimates.

Table II-1
Resource Comparison of the Proposal and Alternatives
(Conditional-Unrisked)

Resource	Minimum Case	Mean Case (Alternative I)	Maximum Case	Alaska Peninsula Deferral (Alternative IV)
Oil (MMbbls)	83	364	759	331
Gas (TCF)	---	2.62	5.25	2.20

Source: USDOI, MMS, Revised Exploration and Development Report, 1984b.

Resource estimates are developed from an analysis of geophysical and geologic information on subsurface and adjacent surface formations which is used in engineering and economic calculations to determine minimum commercial field sizes.

The analyses in this EIS are based on estimates of the oil and gas resources in the area being offered for lease, and on corresponding infrastructure scenarios developed by the MMS prior to the lease sale. There is much uncertainty about the quantities of oil and gas resources that may be present; indeed, in some areas it is probable that the entire area has no hydrocarbons. Because the potential environmental effects resulting from a lease sale in a barren area are minimal, the effects analysis is based on conditional resource estimates, i.e., the estimate of quantities of oil and gas resources that may be found and developed, given that there are economically recoverable accumulations of hydrocarbons present. Because of the uncertainties surrounding the potential volumes of hydrocarbons present in prospects and which prospects and/or combinations of prospects may contain hydrocarbons, the conditional-resource estimates are developed using probabilistic techniques and reported as probability distributions rather than as point estimates. Resource estimates corresponding to three positions on the conditional-probability distribution--the 5th percentile, the mean, and the 95th percentile--are reported.

Monte Carlo or range-of-values simulation techniques are used to develop a conditional-probability distribution for the area as a whole. This technique explicitly recognizes the probabilistic nature of the variables affecting the resource assessment, and calculates a large number of possible outcomes, based on random samples from the input probability distribution. Providing a single number for the resource estimates for an area is misleading, since it provides no insight as to the relative uncertainty involved. The Monte Carlo technique provides a range of resource estimates for the area, with the probability of each value occurring being a direct consequence of the uncertainty in the geological and engineering data (i.e., areal extent and thickness of the hydrocarbon pay zone, recovery factors, and which prospects and/or combination of prospects will contain hydrocarbons). Specific oil and gas amounts corresponding to the mean value and the 5th-percentile value of the distribution for barrel equivalent of total resources are reported for use in the EIS. Also reported is the probability that no economically recoverable resources exist in the area under consideration.

The resource estimates are based on secondary-production methods. Differing assumptions regarding both economic and engineering factors affect the estimate of recoverable resources. Assumed economic factors include exploration and development costs, operating expenses, price and market value for oil and natural gas, taxes, depreciation, and royalty and production rates. The engineering factors included in the assumptions are reservoir thickness and area, properties of the oil-bearing rocks, feasibility and effectiveness of pressure maintenance through secondary recovery, well spacing, deviation in depth, climate, surficial geology, and other environmental factors affecting the design and technology of surface drilling, and development and production operations.

B. Transportation Scenarios

There are many transportation scenarios that could be selected to develop the environmental analysis for the proposal and the alternatives. The strategies discussed in the following two development scenarios for the North Aleutian Basin were developed based on the following considerations: (1) the geographic locations of existing infrastructure; (2) the locations of potential support-facility sites; (3) the state-of-the-art technology; (4) the potential development of technology; and (5) the economics of developing the resource. The transportation scenarios selected for analysis do not represent an MMS recommendation, preference, or endorsement of facility sites or development schemes.

1. Pipeline-Transportation Scenario: This scenario is based on the use of pipelines to transport oil and gas from offshore production platforms to a major onshore storage and loading transshipment terminal at Balboa Bay on

the southern coast of the Alaska Peninsula. Tankers in the 80,000-DWT class would transport oil from the transshipment terminal to market every 5 to 7 days. Gas would be transported by pipeline to an LNG plant at Balboa Bay; it would then be transported to a Pacific Rim LNG terminal by LNG tankers of the 125,000-cubic-meter class every 10 to 12 days.

During the exploration and development phases, marine and primary air support would be based in Unalaska and Cold Bay, respectively. The pipeline-transportation scenario is used for the proposal (Alternative I), the maximum-resource case (Appendix A), and Alternative IV (Alaska Peninsula Deferral). A description of activities and infrastructure for the proposal and the maximum-resource case can be found in Section IV.A.1. and Appendix A, respectively.

2. Offshore-Loading-Transportation Scenario: This scenario is based on the transfer of oil from production platforms to 80,000-DWT tankers, which would transport the product to market. The offshore-loading scenario is used as a transportation option in the proposal and the minimum-resource case. Gas resources are not included in the minimum-resource case. A description of activities and infrastructure for the minimum-resource case can be found in Appendix B.

C. Description of the Proposal and Alternatives

1. Alternative I - Proposal: The proposed action would offer for lease 2.27 million hectares (990 blocks), which equates to 17 percent of the North Aleutian Basin Planning Area (Fig. II-1). The blocks are located in waters that range from 18 to about 185 kilometers offshore of the Alaska Peninsula. Water depths range from 30 to about 100 meters. The conditional-mean estimate for undiscovered recoverable resources is 364 MMbbls of oil and 2.62 TCF of gas.

The analysis of expected effects (described in detail in Sec. IV) is based on hypothetical scenarios formulated to provide a set of reasonable prelease assumptions and estimates on the amount, locations, and timing of OCS exploration, and development and production operations and facilities (both offshore and onshore). The transportation scenarios used in analyzing the proposed action, a pipeline from Port Moller to Balboa Bay and offshore loading, are described in detail in Section IV.A.1. A summary of major assumptions for these scenarios follows:

Pipeline-Transportation Scenario:

- The drilling of 10 exploration and delineation wells would occur during the period 1986 to 1991.

- The installation of one oil and one gas production platform and the drilling of 32 development/production wells would occur during the period 1990 to 1993.

- Oil and gas production would begin in 1993 and 1994, respectively, and reach a peak annual production in 1994 to 1999 for oil (31 MMbbls) and in 1995 to 2012 for gas (.126 TCF).

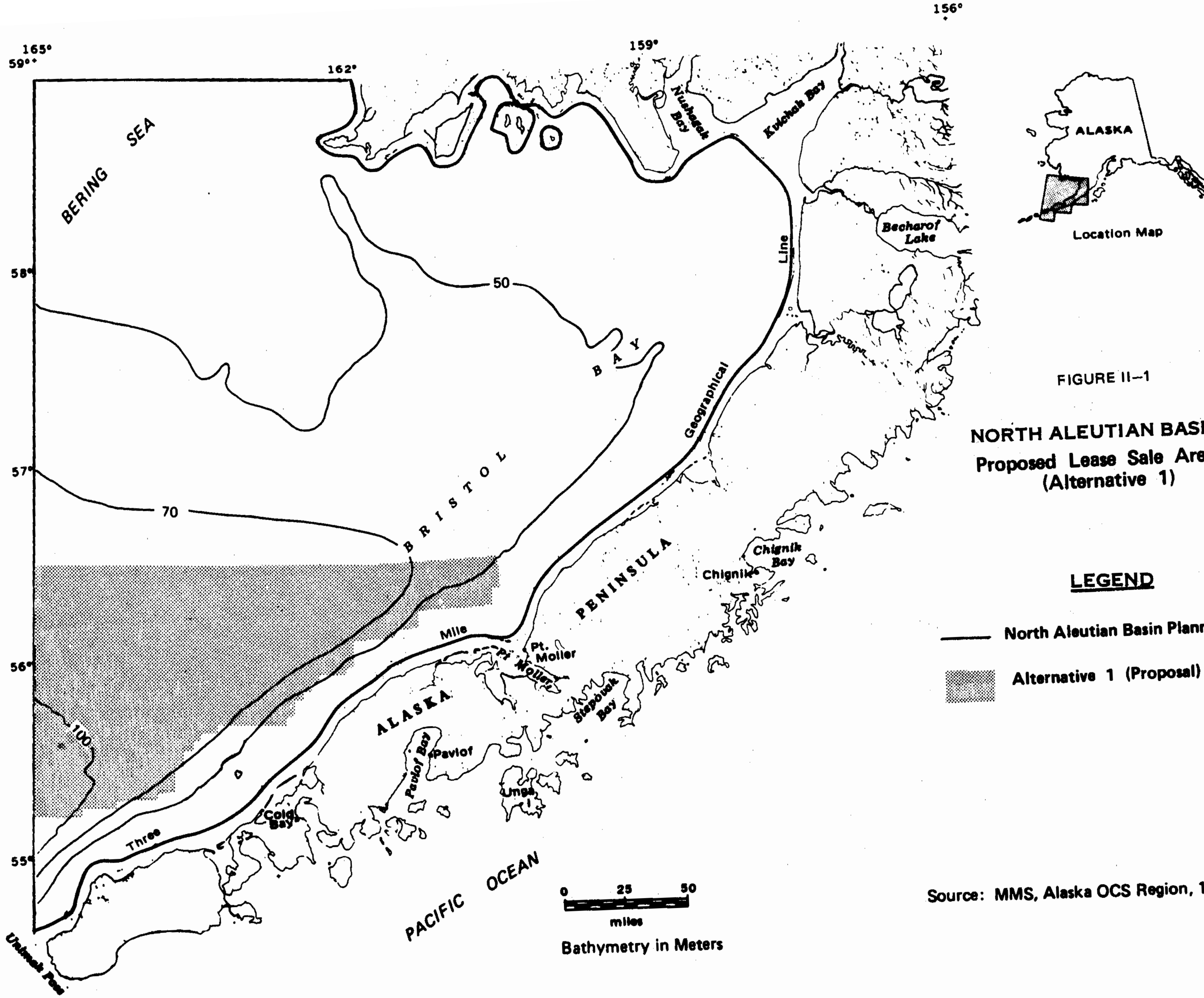


FIGURE II–1

NORTH ALEUTIAN BASIN
Proposed Lease Sale Area
(Alternative 1)

LEGEND

North Aleutian Basin Planning Area

Alternative 1 (Proposal)

Source: MMS, Alaska OCS Region, 1984

- ° Oil production from one offshore platform would be transported by pipeline to shore and across the Port Moller/Balboa Bay transpeninsula transportation corridor to a transshipment terminal at Balboa Bay. The Bristol Bay Area Plan (State of Alaska, Department of Natural Resources, 1984); Alaska Peninsula National Wildlife Refuge Draft Comprehensive Conservation Plan (USDOI, FWS, 1984); and the Bristol Bay Regional Management Plan (BBRMP, 1985) identified this route as a preferred transportation corridor and recommended that it be developed for industrial and private use (Fig. II-2).

- ° Gas production from one offshore platform would be transported by pipeline to shore and across the Port Moller/Balboa Bay transportation corridor to an LNG plant at Balboa Bay.

- ° Oil would be transported from the Balboa Bay transshipment terminal to markets by 80,000-DWT tankers. Gas would be transported directly by LNG tankers of the 125,000-cubic-meter class to a hypothetical Pacific Rim LNG terminal.

- ° Marine support for offshore operations would be based in Unalaska, and Cold Bay would serve as the primary air-support site.

Offshore-Loading-Transportation Scenario:

- ° The drilling of 10 exploration and delineation wells would occur during the period 1986 to 1991.

- ° The installation of one oil and one gas production platform and the drilling of 32 development/production wells would occur during the period 1990 to 1993.

- ° Oil and gas production would begin in 1993 and 1994, respectively, and reach a peak annual production in 1994 to 1999 for oil (31 MMbbls) and in 1995 to 2012 for gas (.126 TCF).

- ° Oil production from one platform would be offshore loaded on 80,000-DWT tankers and transported through Unimak Pass to markets.

- ° Gas production from one offshore platform would be transported to shore by pipeline and across the Port Moller/Balboa Bay transportation corridor to an LNG plant at Balboa Bay.

- ° Gas would be transported directly by LNG tankers of the 125,000-cubic-meter class to a hypothetical Pacific Rim LNG terminal.

- ° Marine support for offshore operations would be based in Unalaska, and Cold Bay would serve as the primary air-support site.

a. Mitigating Measures That Are Part of the Proposed Action: Standard mitigating measures that are in place include those mandated by the OCS Lands Act (OCSLA), as amended, such as the Offshore Oil Spill Pollution Fund and the Fishermen's Contingency Fund, oil-spill-contingency plans, OCS Orders, and Notices to Lessees and Operators. OCS Orders describe in detail the requirements and specifications for oil and gas operations. Permit

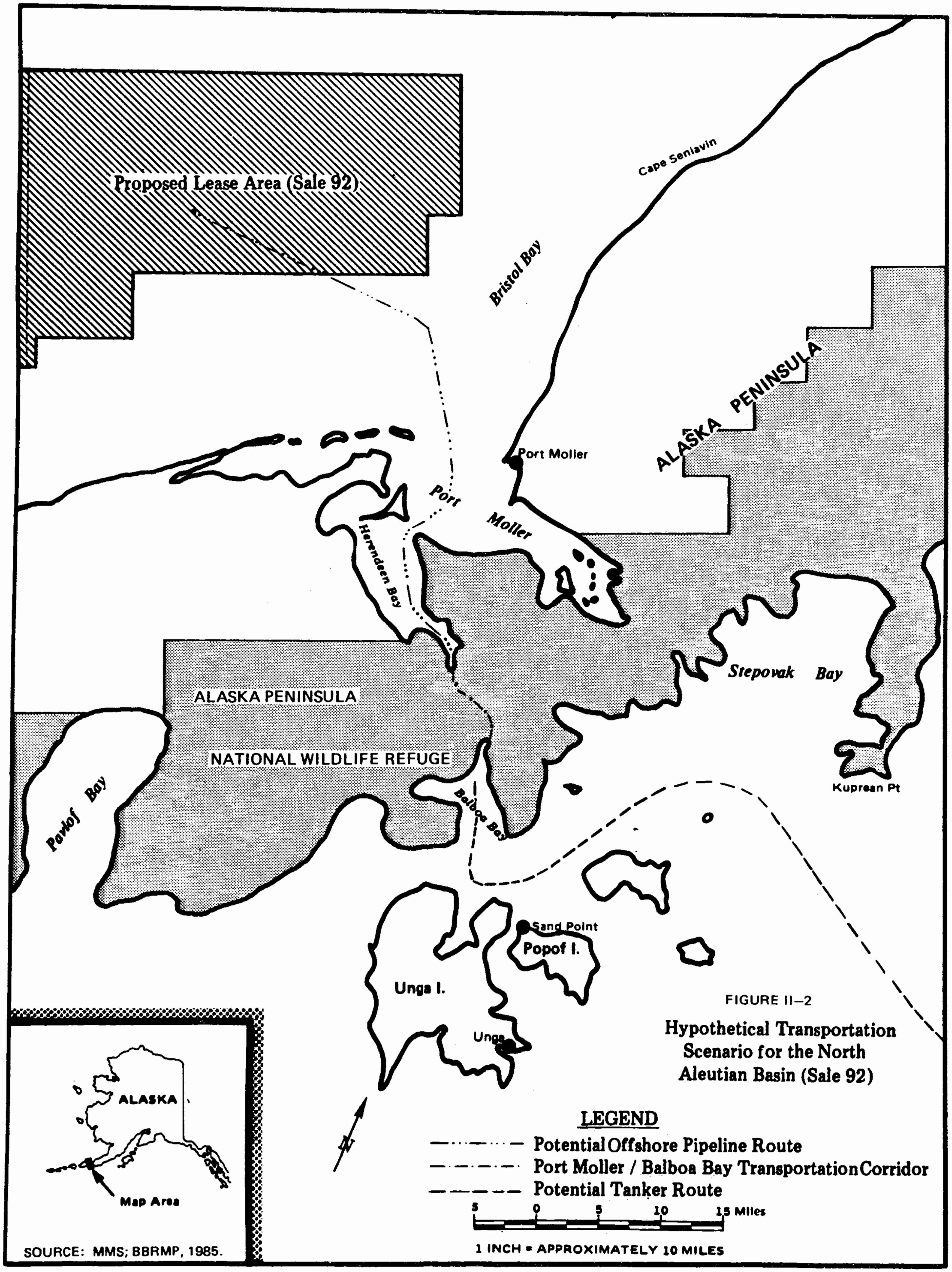


FIGURE II–2

Hypothetical Transportation Scenario for the North Aleutian Basin (Sale 92) requirements, engineering criteria, and testing procedures; and information requirements also are outlined. These requirements are developed and administered by the MMS.

Federal regulation (30 CFR 250.34) requires a lessee to conduct shallow-hazards and other geological and geophysical surveys that are necessary for the evaluation of activities to be carried out under a proposed exploration or development and production plan. Data collection by the lessee on a lease will be analyzed by the Regional Supervisor, Field Operations (RSFO), to ensure that drilling, development, and production activities can be conducted in an acceptable manner with minimum acceptable risk or damage to human, marine, and coastal environments. Based on the review and analysis of the data received and other available data and information, the RSFO either approves or requires modification of an exploration or development and production plan or application for permit to drill, or recommends that the Director, MMS, temporarily prohibit or suspend the conduct of exploration or development and production activities, according to provisions of the OCSLA and appropriate regulations. Existing regulations authorize the RSFO to take whatever steps are necessary to assure safe offshore operations, whether shallow hazards are delineated before or after the lease sale.

The general procedures to be followed by the lessee in conducting site-specific geologic-hazards surveys are set forth in various Notices to Lessees and Operators (NTL's) issued by the Regional Offices of the MMS. The NTL's and applicable lease stipulations impose minimum requirements and do not restrict the authority of the RSFO to impose additional requirements on the lessee when necessary.

b. Potential Mitigating Measures: The following measures (potential stipulations and Information to Lessees [ITL's]) are proposed to reduce or eliminate potential effects identified in Section IV. There has not been a Secretarial decision on these mitigating measures; they are noted here as prospective measures that could further mitigate the potential effects of this lease sale. The Secretary has imposed similar measures in previous federal oil and gas lease sales; use of these measures is likely to continue unless more effective mitigating measures are identified or developed. If any of these measures is adopted, it will appear in the Notice of Sale. It should be noted that analysis in this EIS does not assume that the following mitigating measures are in place. These measures are, however, evaluated in Section II.C.1.d. (Effectiveness of Potential Mitigating Measures).

(1) Proposed Stipulations: The following stipulations are proposed for the North Aleutian Basin (Sale 92):

Stipulation No. 1, Protection of Cultural Resources
Stipulation No. 2, Orientation Program
Stipulation No. 3, Protection of Biological Resources
Stipulation No. 4, Wellhead and Pipeline Requirements
Stipulation No. 5, Transportation of Hydrocarbons

Stipulation No. 1, Protection of Cultural Resources

(1) "Cultural resource" means any site, structure, or object of historic or prehistoric archeological significance. "Operations"

means any drilling or construction or placement of any structure for exploration, development, or production of the lease.

(2) If the Regional Supervisor, Field Operations (RSFO), believes a cultural resource may exist in the lease area, the RSFO will notify the lessee in writing. The lessee shall then comply with subparagraphs (a) through (c).

(a) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RSFO, to determine the potential existence of any cultural resource that may be affected by operations. The report, prepared by an archeologist and a geophysicist, shall be based on an assessment of data from remote-sensing surveys and other pertinent cultural and environmental information. The lessee shall submit this report to the RSFO for review.

(b) If the evidence suggests that a cultural resource may be present, the lessee shall either:

(i) Locate the site of any operation so as not to adversely affect the area where the cultural resource may be; or

(ii) Establish to the satisfaction of the RSFO that a cultural resource does not exist or will not be adversely affected by operations. This shall be done by further archeological investigation, conducted by an archeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RSFO. A report on the investigation shall be submitted to the RSFO for review.

(c) If the RSFO determines that a cultural resource is likely to be present in the lease area and may be adversely affected by operations, he will notify the lessee immediately. The lessee shall take no action that may adversely affect the cultural resource until the RSFO has told the lessee how to protect it.

(3) If the lessee discovers any cultural resource while conducting operations in the lease area, the lessee shall report the discovery immediately to the RSFO. The lessee shall make every reasonable effort to preserve the cultural resource until the RSFO has told the lessee how to protect it.

<u>Purpose of Stipulation No. 1</u>: This measure would reduce the possibility of damage to or destruction of cultural resources through early identification of the resource.

A cultural resource baseline study (Dixon et al., 1976) covers the lease sale area. This study and others serve as a basis for the archeological analysis developed by the MMS for the entire lease sale area. This MMS report (Appendix J) analyzes the potential for the survivability and detectability of prehistoric cultural resources in the lease sale area and indicates a low probability for the detectability or survivability of any cultural resources in this lease sale area.

The findings of the report in no way eliminate the lessee's responsibility to notify the RSFO if any cultural resources are found during exploration, or to protect these resources. Such notification would allow protection of the cultural resources through the Cultural Resources Stipulation.

Stipulation No. 2, Orientation Program

The lessee shall include in any exploration or development and production plans submitted under 30 CFR 250.34 a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the Regional Supervisor, Field Operations (RSFO). The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns which relate to the sale and adjacent area. The program shall be formulated by qualified instructors experienced in each pertinent field of study and shall employ effective methods to ensure that personnel are informed of archeological, geological, and biological resources and habitat including endangered species, fisheries, bird colonies, and marine mammals, and to ensure that personnel understand the importance of avoidance and nonharassment of wildlife resources, and legal authorities and penalties pertinent to the harassment of wildlife. The program shall also be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating, and shall include information concerning avoidance of conflicts with commercial fishing operations and with commercial fishing gear. The program also shall include presentations and information about all pertinent lease sale stipulations and Information to Lessees provisions and about stipulations applied to subsequent exploration plans, and development and production plans.

The program shall be attended at least once a year by all personnel involved in on-site exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

Purpose of Stipulation No. 2: This measure would provide a positive mitigating effect, by making the workers aware of the special environmental, social, and cultural values of the regional residents and the environment. The orientation program would help to promote an understanding of and appreciation for local community values, customs, and lifestyles of Alaskans.

It also would provide necessary information to personnel that could reduce behavioral disturbance to wildlife and reduce conflict between the commercial fishing industry and the oil and gas industry.

Stipulation No. 3, Protection of Biological Resources

If biological populations or habitats which may require additional protection are identified by the Regional Supervisor, Field

Operations (RSFO), on any lease, the RSFO may require the lessee to conduct biological surveys to determine the extent and composition of biological populations or habitats. The RSFO shall give written notification to the lessee of his decision to require such surveys.

Based on any surveys which the RSFO may require of the lessee, or on other information available to the RSFO on special biological resources, the RSFO may require the lessee to: (1) relocate the site of operations; (2) establish to the satisfaction of the RSFO, on the basis of a site-specific survey, either that such operation will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist; (3) operate during those periods of time, as established by the RSFO, that do not adversely affect the biological resources; and/or (4) modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such findings to the RSFO and make every reasonable effort to preserve and protect the biological resource from damage until the RSFO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RSFO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RSFO provides written directions to the lessee with regard to permissible actions.

Purpose of Stipulation No. 3: Important biological populations and habitats, in addition to those identified in the ITL's on Areas of Special Biological Sensitivity, may exist in the proposed lease sale area. Such populations and habitats may require additional protection because of their sensitivity and/or vulnerability to lease operations. If critical biological resources are identified, measures could be designed to reduce possible adverse effects from oil and gas activity. These measures could include shifts in operational sites and modifications in drilling procedures.

This potential stipulation also could provide data for the environmental report required in exploration and development plans, which must be reviewed and approved according to 30 CFR 250.34.

Stipulation No. 4, Wellhead and Pipeline Requirements

Subsea wellheads and temporary abandonments, or suspended operations that leave protrusions above the seafloor, are potential hazards to fisheries trawling gear. They shall be constructed or protected if feasible and as appropriate and in such a manner as to allow commercial fisheries trawling gear to pass over the structures without snagging or otherwise damaging the structures or the fishing gear. The lessee shall submit latitude and longitude coordinates of these structures and their water depths to the Regional Supervisor, Field Operations (RSFO). The lessee shall also forward this information to the U.S. Coast Guard in accordance with Alaska OCS Order No.1, Part 4. To determine the coordinates of such structures, the lessee shall use navigation systems with accuracy of at least ±50 feet at 200 miles.

All pipelines, unless buried, including gathering lines, shall have a smooth-surface design. If an irregular pipe surface is unavoidable because of the need for valves, anodes, or other structures, it shall be protected in such a manner as to allow trawling gear to pass over the object without snagging or otherwise damaging the structure or the fishing gear.

Purpose of Stipulation No. 4: The intent of this measure is to mitigate the potential damage that could result from commercial fisheries trawling equipment becoming entangled with seafloor structures of oil and gas operations.

To reduce the risk of damage to the trawling gear or the seafloor structures, this measure:

- Recognizes that subsea wellheads and pipelines may pose hazards to fisheries trawling gear;

- States that pipelines should be constructed to avoid damage to trawling gear or seafloor structures;

- Cautions that--in some cases--pipelines may have to be buried; and

- Recognizes the importance of the oil and gas industry reporting accurate information about the location and dimension of subsea wellheads and pipelines to the RSFO. This information would be published by the U.S. Coast Guard and other agencies that regulate marine traffic so that commercial fishermen with certain types of trawl gear, which might not successfully pass over the subsea structures, could avoid them.

Stipulation No. 5, Transportation of Hydrocarbons

Pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts. The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to any recommendation of the Regional Technical Working Group, or other similar advisory groups with participation of Federal, State, and local governments and industry.

All pipelines, including both flow lines and gathering lines for oil and gas, shall be designed and constructed to provide for adequate protection from water currents, storms and ice scouring, permafrost, subfreezing conditions, and other hazards as determined on a case-by-case basis. Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the Regional Supervisor, Field Operations.

Purpose of Stipulation No. 5: This stipulation is intended to ensure that the decision on which method to use in transporting hydrocarbons weighs the social and environmental costs as well as the economic feasibility of pipelines over alternative methods of transportation.

(2) Information to Lessees: The mitigating measures considered as ITL's provide the lease operators with notice of special concerns in or near the lease area. These measures either advise or inform the lessees of existing legal requirements; in most cases, ITL's carry no specific enforcement authority by the Department of the Interior (USDOI). USDOI's authority extends to operations actually conducted on the leasehold. However, these measures frequently advise operators of other laws and regulations that are binding. Regardless of USDOI's enforcement authority, these measures provide a positive mitigation by creating greater awareness of these special concerns on the part of the operator.

The following ITL's are proposed for the North Aleutian Basin (Sale 92):

Information on Coastal Zone Management and Bristol Bay Area Plan
Information on Areas of Special Biological Sensitivity
Information on Bering Sea Biological Task Force
Information on Bird and Marine Mammal Protection
Information on Endangered Whales (Noise Disturbance)
Information on Endangered Whales (Oil Spills)
Information on the Aleutian Canada Goose
Information on Fairway Designations
Information on Potential Gear Conflict with Commercial Fishing Industry
Information on Oil-Spill-Contingency Plans

Information on Coastal Zone Management and Bristol Bay Area Plan

Lessees are advised that the Alaska Coastal Management Program (ACMP) contains policies and standards which are relevant to exploration, development, and production activities associated with leases resulting from this lease sale. In addition, approved local CMP's which are part of the ACMP may contain more specific policies related to energy-facility siting; areas with particular geologic hazards, subsistence uses, habitats, and transportation uses; and areas which have historic or prehistoric resources. Lessees are advised that the draft Aleutians East Coastal Resource Service Area (CRSA) Coastal Management Plan delineates archeological and historical sites.

Coastal districts with approved CMP's may have policies applicable to ACMP consistency reviews of postlease activities. Coastal districts near the lease area engaged in policy development or implementation include: the Yukon/Kuskokwim CRSA, the Bristol Bay CRSA, the Aleutians East CRSA, the Bristol Bay Borough, and the Cities of Bethel, Akutan, and St. Paul. Early consultation and coordination with the State and coastal districts involved in coastal management review is encouraged.

The Minerals Management Service (MMS) anticipates that the State will review exploration plans, development and production plans, and pipeline right-of-way applications for consistency with the ACMP pursuant to Section 307(c)(3)(B) of the Coastal Zone Management Act. As specified in Section 307(c)(3)(B), the State may disagree with the lessee's certification of consistency for the lessee's plans for exploration, development, and production, or pipeline right-of-way applications, and recommend additional measures be taken by the lessee, as a condition of certification, that will ensure that the transportation, storage, and loading of produced oil is consistent with applicable mandatory enforceable policies listed in the ACMP.

The State of Alaska has advised the MMS that it will review the lessee's consistency certification accompanying oil-spill-contingency plans specifically for consistency with the State's CMP. The State may not concur with the lessee's plans for exploration, development, and production under Section 307(c)(3) of the Coastal Zone Management Act unless they are adequate to ensure consistency with applicable policies in the State's program. The State has advised that its review will consider the use of best available and safest technologies for operating in the North Aleutian environment. Also considered in this are the lessee's contingency plans in the event of an oil-well blowout (including relief-well plans), and the lessee's ability to initiate timely oil-spill-recovery operations, as required by Federal or State regulations to protect areas of special biological sensitivity.

Lessees are also advised that the State of Alaska adopted a land-use-management plan in September 1984. That plan, the Bristol Bay Area Plan, contains policies adopted by the State that indicate priorities for different land uses in portions of the Alaska Peninsula and the rest of the Bristol Bay region. Policies include pipeline transportation across State tidelands and the Alaska Peninsula.

Purpose of This Measure: This ITL focuses directly on the coastal management policies most pertinent for review with respect to offshore oil and gas activities and onshore facilities associated with resource development. It also refers to a regional land-use plan adopted by the State for the Bristol Bay area.

The ITL indicates that state coastal management policies may be expanded during local program development subject to approval by the state and the Secretary of Commerce, and that more detailed policies are possible. Privately owned land within national wildlife refuges also may be regulated through the CMP, as long as the regulations are consistent with the refuge management plans. The above ITL would help to ensure that coastal-zone-management laws and regulations are met. The intent of the ITL is to suggest the siting of major energy facilities in areas conforming with the state's coastal policy program. The ITL also notifies lessees of the state's land-use plans for the Bristol Bay area, as a guide to future planning for development and transportation of oil and gas resources.

Information on Areas of Special Biological Sensitivity

Lessees are advised that certain areas are especially valuable for their concentrations of marine birds, marine mammals, and/or fish. Lessees are advised that seasonal concentrations of fishes, including major salmon streams, and birds and/or marine mammals in the Izembek and Togiak National Wildlife Refuges, Izembek State Game Refuge, Walrus Islands and Cape Newenham State Game Sanctuaries, State Critical Habitat Areas (Egegik, Pilot Point, Cinder River, Port Heiden, and Port Moller), Port Moller/Herendeen Bay/Bear River area, Nelson Lagoon, Bechevin Bay, Unimak Pass, Amak Island, Sea Lion Rocks, and the Shumagin Islands, are identified as areas of special biological sensitivity. Other areas of special biological sensitivity include Moffett Lagoon, Big Lagoon, Hook Bay, St. Catherine Cove, and Swanson Lagoon. These areas are among areas of special biological sensitivity to be considered in the oil-spill-contingency-plan section of Alaska OCS Order No. 7 and environmental report requirements of 30 CFR 250.34-3. Lessees are advised that subject to approval by the State and the Secretary of Commerce, areas of special biological sensitivity also may be defined by local coastal management programs. Areas of special biological sensitivity may also be identified by local and regional organizations, planning offices, village councils, and regional nonprofit corporations.

Due to the sensitivity and vulnerability of these areas to spilled oil, special attention will be given to deployment plans and time requirements on the review of oil-spill-contingency plans. Such protection should not include dispersant usage unless such usage has been approved in advance.

Purpose of This Measure: The areas mentioned above are among some of those identified by federal and state agencies and private-interest groups as important to the continued well-being of fish, bird, and mammal populations that use North Aleutian Basin marine habitats.

Regionally important seabird populations nest and/or migrate in this area, and important concentrations of several fish species, fur seals, sea otters, sea lions, and endangered whales also are found here.

Recognition of such regionally important wildlife-concentration areas in oil-spill-contingency plans could significantly reduce oil-spill risks to these populations if such awareness resulted in implementation of special precautions in their vicinity.

Information on Bering Sea Biological Task Force

In the enforcement of the Protection of Biological Resources stipulation, the Regional Supervisor, Field Operations (RSFO), will receive recommendations from a Bering Sea Biological Task Force (BTF) composed of designated representatives of the MMS, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Environmental Protection Agency. (Before making recommendations to the RSFO, the Bering Sea BTF should consult with representatives of the State of Alaska and local communities that can contribute to biological evaluations.) The RSFO will consult with the Bering Sea BTF on the conduct of biological surveys by lessees, and the appropriate course of action after surveys have been conducted.

Purpose of This Measure: The BTF's for the Beaufort Sea, Diapir Field, and Bering Sea have proven helpful in providing recommendations concerning biological resources to the Regional Supervisor. These recommendations should provide for better decisionmaking concerning biological resources and an increased protection from possible adverse effects.

Information on Bird and Marine Mammal Protection

Lessees are advised that during the conduct of all activities related to leases issued as a result of this lease sale, the lessee and its agents, contractors, and subcontractors will be subject to, among others, the provisions of the Marine Mammal Protection Act of 1972, as amended; the Endangered Species Act of 1973, as amended; and International Treaties.

Lessees and their contractors should be aware that disturbance of wildlife could be determined to constitute harm or harassment and thereby be in violation of existing laws. With respect to endangered species, disturbance could be determined to constitute a "taking" and be in violation of the Endangered Species Act. Under the Endangered Species Act, the term "take" has been defined to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Violations under these acts and treaties should be reported to the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (FWS), as appropriate.

Of particular concern is disturbance at major wildlife-concentration areas including bird colonies, marine mammal haulout and breeding areas, and wildlife refuges and parks. Maps locating major wildlife-concentration areas in the vicinity of the lease area are available from the Regional Supervisor, Field Operations (RSFO). Lessees are also encouraged to confer with the FWS and the NMFS in planning transportation routes between support bases and leaseholdings.

Behavioral disturbance of most birds and mammals found in or near the lease area would be unlikely if aircraft and vessels maintained at least a 1-mile horizontal distance from known or observed wildlife-concentration areas, such as bird colonies and marine mammal haulout and breeding areas. Therefore, unless more restrictive distance or routing requirements have been specified by the RSFO, or other resource agencies, it is recommended that aircraft and vessels operated by lessees or their contractors maintain at least a 1-mile horizontal distance from known or observed wildlife concentrations.

For the protection of endangered whales and marine mammals throughout the lease area, operators of fixed-wing aircraft or helicopters should maintain a 1,500-foot altitude when in transit between support bases and exploration sites; and lessees and their contractors are encouraged to reduce, minimize, or reroute trips to and from the leasehold by aircraft, tugs, barges, supply ships, hovercraft, or other self-propelled surface vessels when endangered whales are likely to be in the area. Information on general locations of endangered whales is available from the RSFO.

The distance and altitude herein recommended to avoid disturbance to wildlife is advisory and does not preclude other agency rules or regulations. Human safety will take precedence at all times over these provisions.

Purpose of This Measure: Conformance by lessees with the recommendations described above would help to ensure that behavioral disturbance of wildlife, particularly at known concentration areas, would be reduced. The North Aleutian Basin is an important habitat for endangered and nonendangered marine mammals and marine birds and waterfowl. Of particular concern are: (1) Unimak Pass (marine birds, waterfowl, fur seals, cetaceans); (2) gray whale spring and fall migratory routes and concentration areas; (3) other endangered whale species (right, blue, humpback, sperm, fin, sei) throughout the lease sale area during the summer and during the spring and fall migratory periods; (4) Amak Island sea lion rookery; (5) walrus haulouts on Round Island and Cape Seniavin; (6) seabird colonies in the Aleutian Islands and Bristol Bay areas; (7) waterfowl-staging areas in Izembek and Nelson Lagoons and Capes Newenham and Peirce; and (8) areas identified in ITL's on Areas of Special Biological Sensitivity. Compliance with this measure could substantially reduce disturbance and possible injury or mortality of marine birds, seals, sea lions, sea otters, and cetaceans from industrial activities. Block-specific requirements may be made by the RSFO, as appropriate. Appropriate authorities may issue more specific regulations under existing legislation that could further reduce behavioral disturbance to wildlife.

Information on Endangered Whales (Noise Disturbance)

Lessees are advised that the Regional Supervisor, Field Operations (RSFO), has the authority and intends to limit or suspend any noise-producing operations, including geophysical surveys, on a lease whenever endangered whales are near enough to be subject to noise disturbance from offshore oil and gas activities which would be likely to result in a "take" situation. Under the Endangered Species Act, the term "take" has been defined to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." A Notice to Lessees has been issued to specify performance standards before any preliminary activities may be conducted on a lease.

Purpose of This Measure: This measure should effectively reduce the risk (low probability) of endangered whales interacting with preliminary activities in the North Aleutian Basin. Conformance by lessees with the recommendations described above would help to ensure that behavioral disturbance of endangered whales would be reduced, thereby reducing the likelihood of disrupting endangered whale summer or traditional feeding areas, migration routes, or otherwise interfering with socialization. It also informs lessees that a complete shutdown of preliminary activities may be required when endangered whales are observed. Without the measure, there would be a greater chance of a potentially harmful interaction between endangered whales and the offshore oil and gas activities in the lease area.

Information on Endangered Whales (Oil Spills)

Lessees are advised that the Regional Supervisor, Field Operations (RSFO) has the authority and may limit or suspend oil and gas drilling activities on any lease whenever endangered (especially gray or right) whales are present and near enough to be subject to probable oil-spill risks. Exploratory drilling, testing, and other downhole activities below a predetermined threshold depth, with the exception of testing through casing, may be prohibited whenever these whales are in the vicinity of the drilling operation. Such prohibition would continue until it is determined that the whales are outside of the zone of probable influence or are no longer subject to likely risk of oil spills, unless the RSFO determines that continued operations are necessary to prevent a loss of well control or to ensure human safety.

Purpose of This Measure: This measure should effectively reduce the risk of endangered whales interacting with preliminary oil and gas activities in the North Aleutian Basin. Conformance by lessees with the recommendations described above would help to ensure that disturbance and displacement of endangered whales would be reduced, thereby reducing the likelihood of disrupting endangered whale summer or traditional feeding areas, migration routes, or otherwise interfering with socialization. It also informs lessees that a complete shutdown of preliminary activities may be required when endangered whales are observed. Without the measure, there would be a greater chance of a potentially harmful interaction between endangered whales and the offshore oil and gas activities in the lease area.

Information on the Aleutian Canada Goose

Lessees are advised that the Aleutian Canada goose (*Branta canadensis leucopareia*) is listed as an endangered species by the U.S. Department of the Interior (16 U.S.C. 1531 et seq.). A potential for conflict may exist in this region between the onshore-support facilities of OCS exploration or development and production activities, and the Aleutian Canada goose. Such conflicts can be avoided if onshore-support facilities are not located near Chagulak or Kiliktagik Islands, and aerial-support flight paths maintain a 1,500-foot altitude and vessel traffic a 1-mile distance from Aleutian Canada goose populations.

Lessees are advised that the U.S. Fish and Wildlife Service (FWS) will review all exploration or development and production plans submitted by the lessee to the Minerals Management Service (MMS). The FWS may apply certain restrictions to further protect the Aleutian Canada goose habitats as a result of this review. Lessees and affected operators should establish regular communication with the MMS and the FWS. Human safety will take precedence at all times.

Purpose of This Measure: If this ITL is adopted, it would be unlikely that the Aleutian Canada goose would be significantly affected by disturbance due to oil and gas activities. This ITL may reduce risks to the endangered geese and eliminate certain localized adverse effects on individual geese or small population segments.

Information on Fairway Designations

Blocks offered for lease may fall in or adjacent to areas that may be included in fairways, precautionary zones, or traffic-separation schemes, which may be established, among other reasons, for the purpose of protecting maritime commerce. Lessees are advised that the United States may designate necessary fairways through leased areas pursuant to the Ports and Waterways Safety Act of 1972, as amended (33 U.S.C. 1221 et seq.).

Purpose of This Measure: U.S. Coast Guard designation of fairways aids in the protection of maritime commerce through the avoidance of vessel-routing conflicts and collisions. The Coast Guard has studied vessel-traffic levels through Unimak Pass and has determined that a traffic-separation scheme is not necessary at this time. This ITL advises the potential bidders and lessees that fairways may be established in the future which affect operations on the leases issued as a result of Sale 92.

Information on Potential Gear Conflict with Commercial Fishing Industry

To reduce potential fishing gear conflicts, the lessees should keep commercial fishermen in the area advised of plans for seismic surveys, drilling-rig transport, or other vessel traffic, and discuss mutually satisfactory ways to avoid fishing-gear conflicts. Additionally, designations of open-ocean-storage areas for crab pots are subject to change. Vessels transiting these areas should operate in such a manner as to prevent loss of these stored crab pots. Locations of storage areas can be provided by the Alaska Department of Fish and Game and the North Pacific Fishery Council. The Minerals Management Service encourages the lessees to use the Oil/Fisheries Group of Alaska to reduce potential conflicts between the oil and commercial fishing industries.

Purpose of This Measure: Communication and cooperation between these two industries operating in the same ocean space should reduce the potential for conflict. Loss of fixed commercial fishing gear, particularly crab pots, has been cited repeatedly as a concern by the fishermen of Kodiak and Homer, the Kodiak OCS Advisory Council, and the Kodiak Island Borough. This ITL recognizes the potential for similar problems in the North Aleutian Basin and recommends measures to reduce conflict.

Information on Oil-Spill-Contingency Plans

> Lessees are notified that oil-spill-contingency plans are required under Alaska OCS Order No. 7, pursuant to the authority prescribed in 30 CFR 250.11, 250.34 and 250.43, prior to approval of exploration plans and development and production plans. Furthermore, lessees are required under 30 CFR 250.34-2 to include in development and production plans, descriptions of all vessels, pipelines, and other facilities, and descriptions of all environmental safeguards. Prior to approval of development and production plans, the Regional Supervisor, Field Operations (RSFO), will review these items to determine whether those oil-transportation facilities described, which are regulated by the Minerals Management Service, can safely transport oil under expected conditions in the leased area.

Purpose of This Measure: The ITL informs lessees of the Alaska OCS Order No. 7 requirement that oil-spill-contingency plans are required.

c. Effectiveness of Potential Mitigating Measures: The following are analyses of the effects of the potential proposed mitigating measures on the resources (biological, social and economic, and others) discussed in Section IV. This discussion provides an indication of how the effects discussed for the proposed action would be mitigated if these measures were adopted. In some cases, a reduction in the level of effects was concluded and is indicated.

(1) Biological Resources:

(a) Fisheries Resources: The potential stipulation on the Protection of Biological Resources provides a mechanism for identifying and protecting sensitive populations and habitats that may be located on leased blocks. This measure would provide protection for some benthic species or prey species and would thereby provide benefits for some fisheries resources. The Orientation Program stipulation could reduce the adverse effects of development on fisheries resources by informing workers of: (1) the hazards their activities could pose; and (2) what measures could be taken to avoid potentially adverse effects. The ITL on Areas of Special Biological Sensitivity stresses that areas of particular biological importance should be given special consideration in formulating oil-spill-contingency plans. This measure could reduce overall oil-spill effects by increasing protection in vulnerable areas.

(b) Marine and Coastal Birds: The stipulation on Protection of Biological Resources provides a mechanism for identifying and protecting sensitive populations and habitats that may be located on leased blocks. This measure could provide protection for certain prey species and thereby provide indirect benefits for some birds. This measure could provide primarily local benefits to some marine and coastal birds, with the potential for reducing indirect effects to minor levels. The involvement of the Bering Sea BTF in the implementation of this stipulation would help to ensure that current, comprehensive biological information is available to the MMS and that the concerns of other appropriate agencies are considered.

If aircraft and vessels maintained the recommended 1,500-foot and 1-mile distances, respectively, from known bird-concentration areas or from concentrations of marine and coastal birds, the ITL on Bird and Marine Mammal Protection could reduce disturbance of marine and coastal birds from minor to negligible levels, in most instances.

The ITL on Areas of Special Biological Sensitivity stresses that listed areas of particular biological importance should be given special consideration in formulating oil-spill-contingency plans. Given effective oil-spill-containment and cleanup techniques, this measure potentially could reduce overall oil-spill effects from major to moderate and moderate to minor by increasing protection in vulnerable areas, especially where the probability of oil-spill contact is comparatively high.

The Orientation Program could impart some general benefit to marine and coastal birds by informing workers of the hazards their activities could pose to birds, and by identifying measures that may be taken to avoid most potentially adverse effects.

In conclusion, the above mitigating measures potentially reduce noise and disturbance effects on marine and coastal birds from minor to negligible. The potential effects from oil spills could be reduced to minor in most of the lease area, and to moderate on the northern and southern coasts of the Alaska Peninsula.

(c) Pinnipeds and Sea Otters: Among the suggested mitigating measures, the Orientation Program and the ITL on Bird and Marine Mammal Protection should help to minimize air and boat disturbance of marine mammals by informing the lessees of this concern. Although compliance with air- and boat-traffic restrictions near haulout areas and marine mammal concentrations is strictly voluntary, public awareness and compliance with the Marine Mammal Protection Act and FWS regulations through use of the ITL's could effectively eliminate most of this type of disturbance.

The stipulation on Protection of Biological Resources provides a mechanism for identifying and protecting sensitive or unique biological populations and habitats. The measure protects primarily benthic habitats and associated fauna that could be important to some marine mammal species. This measure also may provide local benefits to marine mammals.

The ITL on Areas of Special Biological Sensitivity identifies important marine mammal habitat areas that would be considered in oil-spill-contingency plans. This measure potentially reduces oil-spill effects on marine mammals in the Izembek Lagoon, Nelson Lagoon, Walrus Islands, and Cape Newenham areas. However, the effectiveness of oil-spill cleanup and the protection of sensitive areas are completely dependent on favorable weather conditions. The ITL on Areas of Special Biological Sensitivity would provide little protection for sea otters, which are widely distributed in nearshore waters along the coasts of the Alaska Peninsula and Unimak Island.

Fairway designations could reduce oil-spill risks to marine mammals in the Unimak Pass area by potentially reducing the chance of tanker collisions with other vessels in this increasingly busy traffic corridor. The ITL on the

Bering Sea BTF informs the lessees of the existence of this governmental interagency group that addresses specific resource problems associated with oil and gas activities in Bering Sea lease areas. This measure would aid in identifying environmental problems concerning marine mammals and would help implement specific environmental protection measures.

In conclusion, the above mitigating measures potentially reduce noise and disturbance effects on marine mammals from minor to negligible. Potential oil-spill effects may be reduced somewhat by the above mitigating measures. However, moderate effects on sea otters are still likely.

(d) Endangered and Threatened Species: The ITL on Bird and Marine Mammal Protection may reduce risks to endangered cetaceans. It also may eliminate certain localized effects on individual cetaceans and birds or small population segments. In general, however, such a reduction of risk would contribute only a minor overall benefit to local cetacean and bird populations. This conclusion is derived because the factors most likely to have significant long-term effects, if any (i.e., overall increment in aircraft- and vessel-introduced noise), would not necessarily be modified by the proposed ITL on Bird and Marine Mammal Protection.

The ITL's on Endangered Whales would effectively reduce the risk (due to the issued NTL's) of endangered whales interacting with offshore oil and gas activities in the North Aleutian Basin area. Conformance by lessees would help to ensure that behavioral disturbances and displacement of endangered whales would be reduced, thereby reducing the likelihood of disrupting or terminating endangered whale use of summer feeding areas, traditional feeding areas, and migration routes, or otherwise interfering with socialization.

Without this measure, there would be a greater chance of potentially harmful endangered whale interaction with offshore oil and gas activities in the lease area.

The ITL on Areas of Special Biological Sensitivity may reduce risks to endangered whales during their summer feeding period. Although certain localized effects on individual cetaceans or small population segments may be eliminated by this measure, the reduction of risk most likely would contribute only a minor overall benefit to the whale population. This conclusion is based upon findings similar to those expressed for the ITL on Bird and Marine Mammal Protection. The factors most likely to have significant effects (geophysical, aircraft, and vessel noise) would not necessarily be modified by this measure.

(e) Nonendangered Cetaceans: The ITL on Bird and Marine Mammal Protection may reduce risks to nonendangered cetaceans. It also may eliminate certain localized effects on individual cetaceans or small population segments; but, in general, such a reduction of risk would contribute only a minor overall benefit to local cetacean populations. This conclusion is derived because the factors most likely to have significant long-term effects, if any (i.e., overall increment in aircraft- and vessel-introduced noise), would not necessarily be modified by the proposed ITL on Bird and Marine Mammal Protection.

The ITL on Areas of Special Biological Sensitivity may reduce risks to nonendangered cetaceans during their summer feeding period in the vicinity of the Alaska Peninsula. Although certain localized effects on individual cetaceans or population segments may be eliminated by this measure, the reduction of risk would most likely contribute only a minor overall benefit to the cetacean population. This conclusion is based upon findings similar to those expressed for the ITL on Bird and Marine Mammal Protection. The factors most likely to have significant effects (geophysical, aircraft, and vessel noise) would not necessarily be modified by this measure.

(2) Social and Economic Systems: The potential mitigating measures would not mitigate the proposal's effect on the local economy or community infrastructure.

(a) Commercial Fishing Industry: Implementation of the Orientation Program stipulation and the ITL on Potential Gear Conflict with the Commercial Fishing Industry would assist in preventing potential gear conflicts. Educating supply-vessel operators and seismic-survey-vessel operators on the various gear types, fishing areas, and fishing seasons would be the first step toward reducing or eliminating potential gear conflicts, such as loss of fixed gear (crab pots and longlines). Greater awareness of these factors and of the potential for conflict could lead to better planning and coordination of oil-industry-vessel operations in order to prevent conflicts.

Implementation of the Wellhead and Pipeline Requirements stipulation would reduce only slightly the already low risk of damage to trawl gear by requiring lessees to design pipelines and subsea wellheads and abandonments to allow trawl gear to pass over, and to provide exact locations of such subsea facilities so that fishermen could navigate to avoid them. Even with this stipulation in place, the magnitude of effects would remain negligible.

(b) Subsistence and Sociocultural Systems: The Orientation Program would provide a positive mitigating effect, in that it would make the workers aware of the special environmental, social, and cultural values of the regional residents and the environment. The Orientation Program would help to promote an understanding and appreciation of local community values, customs, and subsistence lifestyles of Alaskans. It also would provide necessary information to personnel that could reduce behavioral disturbance to wildlife and reduce conflict between the commercial fishing industry and the oil and gas industry.

A Biological Task Force (ITL on Bering Sea BTF) could serve as a means for local participation when such is considered appropriate by the task force members (i.e., review of Orientation Program materials).

(3) Other Issues: The potential mitigating measures would not mitigate the proposal's effects on water quality, air quality, and terrestrial mammals.

(a) Cultural Resources: The adoption of the potential mitigating measure on the Protection of Cultural Resources could reduce effects on cultural resources from minor to negligible. This would occur if cultural resources were detected when examining the hazards-survey results before placement of a platform. The mitigating measure would require the placement of the platform or pipeline in another location for protection of the resource.

(b) Transportation Systems: The ITL on Fairway Designations notifies lessees that fairways may be designated through leased blocks. Designation of fairways would aid in the protection of maritime commerce through the avoidance of vessel-routing conflicts and collisions, particularly in the Unimak Pass area. The U.S. Coast Guard is studying vessel-traffic levels through Unimak Pass to determine if a vessel-traffic-separation scheme is necessary.

(c) Land Use: The ITL's concerning Coastal Zone Management and the Bristol Bay Area Plan, and Areas of Biological Sensitivity, may be useful in guiding development in areas where land-use effects may be reduced. The Orientation Program also may provide a minor reduction in risk by educating personnel about local land uses and preferences.

(d) Coastal Management: The ITL's concerning Coastal Zone Management (the Alaska CMP) and Areas of Biological Sensitivity could help to alleviate potential conflicts with CMP policies by guiding development in areas where effects can be minimized. Several additional stipulations and ITL's relate to issues addressed in the coastal-management policies. These benefits generally complement the objectives of the CMP.

2. Alternative II - No Sale: This alternative equates to cancellation of the proposed lease sale scheduled for early 1986 in the current 5-Year OCS Oil and Gas Lease Sale Schedule. The opportunity to lease and eventually produce the estimated 364 MMbbls of oil and 2.62 TCF of gas projected to be in the proposed lease sale area would be foregone, under the current 5-Year OCS Oil and Gas Lease Sale Schedule.

3. Alternative III - Delay the Sale: This alternative would delay the proposed lease sale for a period of 5 years. All development activity would be expected to occur as described for the proposal (Alternative I).

4. Alternative IV - Alaska Peninsula Deferral: The total area offered with this alternative would be 1.96 million hectares (853 blocks). This alternative would defer leasing on 312,397 hectares (137 blocks) in the area identified for the proposal (Fig. II-3) which are within 40 kilometers of the Alaska Peninsula. Water depths range from 40 to 100 meters; the majority of the area has water depths greater than 70 meters. A list of blocks within the deferral area is available at the MMS Office of Leasing and Environment. The protection of biological resources along the northern coast of the Alaska Peninsula was a major concern in the development of this alternative. Areas of special concern include the Izembek State Game Refuge, the Port Moller Critical Habitat Area, and the Izembek and Alaska Maritime National Wildlife Refuges.

The conditional- (unrisked) mean-resource estimates used for Alternative IV are 331 MMbbls of oil and 2.20 TCF of gas (Table II-1). The marginal probability for hydrocarbons is estimated to be 0.14 for Alternative IV. This assumes that at least one of the prospects in the North Aleutian Basin has an economically recoverable accumulation of hydrocarbons. Resource estimates are conditional based on economically recoverable resources being present in at least one of the prospects; however, it is not necessary or probable that all or any specific number of prospects contain accumulations of hydrocarbons.

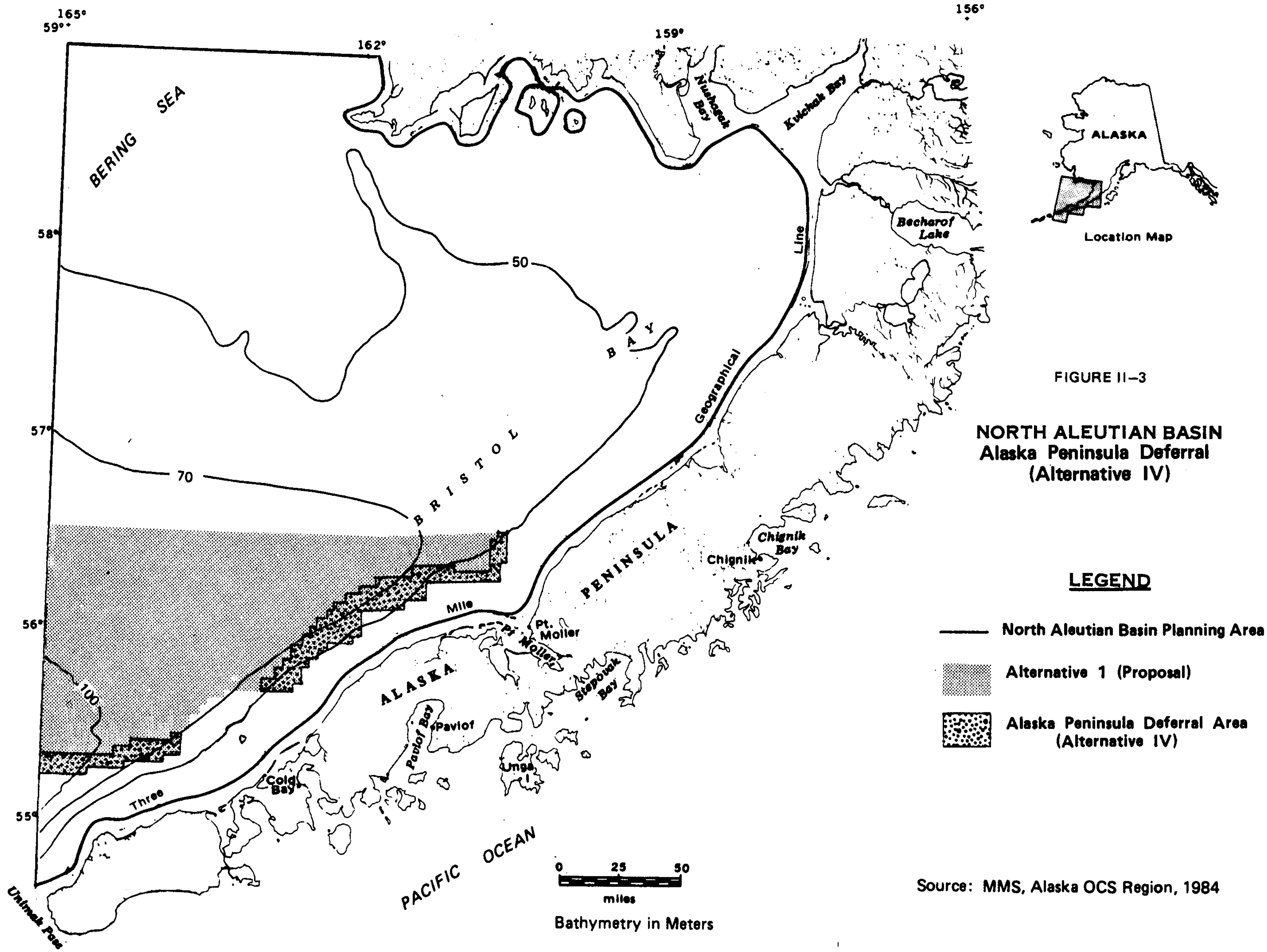


FIGURE II–3

NORTH ALEUTIAN BASIN
Alaska Peninsula Deferral
(Alternative IV)

D. Summary and Comparative Analysis of the Alternatives and Possible Effects: Alternative II (No Sale) would remove the total area proposed for leasing from further consideration. Therefore, effects identified to occur as a result of the proposal would not occur. This alternative could perpetuate the need for imported oil and add to the need for developing alternative-energy resources.

Alternative III (Delay the Sale) would delay the proposed lease sale for 5 years. Effects analyzed for this alternative could be the same as for Alternative I (the proposal), but they would be delayed 5 years. Delay of the sale for 5 years would permit the City of Akutan, which is located in proximity to Unalaska, to complete its CMP. Akutan would not experience direct effects from the lease sale, but rather might be affected if the fishing industry needed additional moorage. The delay also would provide additional time to complete ongoing MMS studies and other research. Section IV.D. contains a list of studies pertaining to the North Aleutian Basin, proposed for the 1986 and 1987 Alaska Regional Environmental Studies and the Social and Economic Studies Programs.

Table II-2 summarizes the effects of the proposal, the pipeline-transportation scenario (Alternative I), and the Alaska Peninsula Deferral (Alternative IV) regarding major topics of concern. Table II-2 does not include a summary of the effects of the offshore-loading-transportation scenario for Alternative I; the effects of this transportation scenario are generally the same as those identified for the pipeline-transportation scenario. The summaries are presented in tabular form to allow a comparison of the effects of each alternative by resource discipline. Terms identifying the levels of effects (i.e., negligible, minor, moderate, and major) are defined in Table S-2.

Table II-2
Summary and Comparative Analysis of Potential Effects for Alternatives I and IV for the North Aleutian Basin (Sale 92)

Alternative I (Proposal)	Alternative IV (Alaska Peninsula Deferral)
Description of the Alternatives	
The area offered in this Alternative would be 990 blocks (2.27 million hectares). The conditional-mean-resource estimate for the area is 364 MMbbls of oil and 2.62 TCF of gas.	The area offered in this Alternative would be 853 blocks (1.96 million hectares). The conditional-resource estimate for the area is 331 MMbbls of oil and 2.20 TCF of gas.
Unalaska and Cold Bay would serve as marine- and air-support sites, respectively.	Unalaska and Cold Bay would serve as marine- and air-support sites, respectively.
Oil production would be transferred from one production platform to a transshipment terminal at Balboa Bay via a pipeline across the Port Moller/Balboa Bay transpeninsula corridor. Gas production from one platform would be transported via a pipeline to an LNG plant at Balboa Bay.	Oil production would be transferred from one production platform to a transshipment terminal at Balboa Bay via a pipeline across the Port Moller/Balboa Bay transpeninsula corridor. Gas production from one platform would be transported via a pipeline to an LNG plant at Balboa Bay.
BIOLOGICAL RESOURCES	
Fisheries Resources	
The combined effects of seismic activity and discharges of drilling fluids, cuttings, and formation waters on adult salmon would be minor. Only a major oil spill that contacted and exposed nearshore areas to lethal concentrations of hydrocarbons when vulnerable salmon lifestages were concentrated in those areas is expected to produce a moderate effect on a regional population. The Port Moller area, which has major runs of sockeye, chinook, coho, and chum salmon, has the highest probability of oil-spill contact. Given salmons' extensive distributions and numbers in the lease sale area and Bristol Bay, effects are not expected to result in a change in the regional population. Overall effects would be MINOR. The combined effects of seismic activity and drilling and production discharges on herring would be minor. An offshore spill would have a minor effect on pelagic adults traversing the lease sale area during spawning migrations. If an oil spill occurred and contacted nearshore habitats in the Port Moller or Port Heiden areas while spawning adult herring, roe, larvae, and juveniles were present, a major effect could result. If an oil spill occurred and contacted nearshore habitats while susceptible lifestages were present, a moderate effect could result for other forage-fish species. Given the extensive distribution of herring in the Bristol Bay area and south of the Alaska Peninsula, localized effects would be MINOR and would not result in a change in the regional population.	Localized groups of fishery resources may experience limited reductions of effects of seismic activity and drilling and production discharges. The overall effects of seismic activity, drilling and production discharges, and oil spills on localized groups of fishery resources are not expected to exceed MINOR for salmon, forage fish, groundfish, and other invertebrates and MAJOR for red king crab (the same as for the proposal).

Table II-2
Summary and Comparative Analysis of Potential
Effects for Alternatives I and IV
for the North Aleutian Basin (Sale 92)
(Continued)

Alternative I (Proposal)	Alternative IV (Alaska Peninsula Deferral)
The combined effect of seismic activity and drilling and production discharges on groundfish would be minor. Only a major oil spill that contacted and exposed nearshore areas to lethal concentrations of hydrocarbons would be expected to produce a moderate effect on one or more regional populations of groundfish. In such an event, reduced stocks of pollock, halibut, and yellowfin sole could be particularly vulnerable to moderate effects. Given the extensive distributions of groundfish, localized effects would not result in a change in regional populations. Overall effects would be MINOR.	
The combined effects of seismic activity and drilling and production discharges on red king crab would be minor. An offshore or nearshore oil spill would have a major effect on the depressed regional red king crab population. Overall effects would be MAJOR.	
The combined effects of seismic activity and drilling and production discharges on other invertebrates would be minor. Only a major oil spill that contacted and exposed nearshore areas to lethal concentrations of hydrocarbons when vulnerable lifestages were concentrated in those areas is expected to produce a moderate effect on other invertebrates. Given the extensive distributions of invertebrates, localized effects would not result in a change in regional populations. Overall effects would be MINOR.	
<u>Marine and Coastal Birds</u>	
Throughout most of the lease area or associated potentially affected areas, the effect of this lease sale on regional populations of marine and coastal birds is expected to be MODERATE. However, if a spill entered the areas surrounding a major seabird-nesting colony in the Shumagin Islands in summer, or heavily used waterfowl staging area (Izembek and Nelson Lagoons) in spring or fall, MAJOR effects could occur. Effects in northern Bristol Bay would be NEGLIGIBLE, and in pelagic areas MINOR effects could result. Disturbance effects are likely to be MINOR throughout most of the region, but in Izembek and Nelson Lagoons the potential for MODERATE disturbance effects exists in spring and fall.	Removal of potential spill sites farther offshore under this alternative would decrease the probability of oil contact with birds in coastal habitats. Major effects still could occur if oil entered lagoons in spring or fall, and moderate effects could occur in inshore areas in summer; but the likelihood of such an occurrence is reduced under this alternative. Overall effects of the lease sale would be MODERATE in lagoons and MINOR in inshore areas. Elsewhere, there would be no change from the proposal. In sum, the adverse effects under this alternative are expected to be MINOR.
<u>Pinnipeds and Sea Otters</u>	
Sea otters would be the species at greatest risk as a result of the proposal. Sea otters would be likely to suffer direct mortality from oil-spill contact and be adversely affected by a local reduction in available food sources. If an oil spill contacted the nearshore area along the Alaska Peninsula, particularly Port Moller, several hundred sea otters could be killed. Considering the low reproductive rate and slow dispersal to available habitats, this loss would have a MODERATE	Oil spills and noise and disturbance effects on marine mammals as a result of this alternative are likely to be minor. Oil-spill risks to sea otter concentrations along the northern coast of the Alaska Peninsula could be significantly reduced, particularly in the Port Moller area. The oil-spill effects on sea otters and pinnipeds, other than fur seals, would be MINOR; effects on fur seals could be MODERATE (the same as for the proposal).

Table II-2
Summary and Comparative Analysis of Potential
Effects for Alternatives I and IV
for the North Aleutian Basin (Sale 92)
(Continued)

Alternative I (Proposal)	Alternative IV (Alaska Peninsula Deferral)
effect on the northern peninsula regional sea otter population. Few pinnipeds other than fur seals are likely to be seriously affected. As a result, the effects on other pinnipeds are likely to be MINOR. However, MODERATE effects on fur seals could occur if several thousand seals were contaminated from a possible oil spill associated with the assumed tanker traffic from Balboa Bay on the southern side of the Alaska Peninsula.	
Noise and disturbances resulting from the proposal would most likely affect harbor seals inhabiting breeding and haulout areas in the Izembek Lagoon, Nelson Lagoon, Bechevin Bay, Port Moller, and Port Heiden areas, while sea lions and walrus may be disturbed at breeding sites on Amak Island. Due to the transitory and brief nature of disturbances, the effects would likely be MINOR. Overall effects on sea otters and fur seals would be MODERATE, and effects on other pinnipeds would be MINOR.	Noise and disturbance resulting from this alternative would most likely affect harbor seals inhabiting breeding areas along the northern coast of the Alaska Peninsula, while sea lions and walrus also may be disturbed at breeding and haulout sites. However, the effects on marine mammals are likely to be MINOR (the same as for the proposal).
<u>Endangered and Threatened Species</u>	
Events and actions associated with the proposal that may affect endangered cetaceans include oil spills, noise, and disturbances from geophysical seismic surveys, aircraft and vessel traffic, and mobile drilling units. These actions may result in "flight" behavior, deflection of migratory routes, temporary loss of baleen-filtering efficiency, loss or deterioration of habitat and indirect temporary change of prey species. These effects would most likely be temporary in nature and could be more extensive during migratory and summer feeding periods. Effects on bowhead, blue, sei, and sperm whales would be NEGLIGIBLE, because these species infrequently enter the proposed lease sale area. Effects on gray, fin, right, and humpback whales would be MINOR.	This alternative would result in some reductions of oil-spill risks and noise disturbance on endangered species and their habitats. Effects resulting from this alternative are expected to be NEGLIGIBLE for bowhead, sei, sperm and blue whales and MINOR for the gray, right, fin and humpback whales. Risks to these whales would not be strongly reduced by implementation of this alternative because not all spill points providing the highest probability of contact would be deleted.
Effects on endangered birds (short-tailed albatross and peregrine falcon) are expected to be NEGLIGIBLE.	Due to their low use of this area, potential effects on endangered and threatened birds would be the same as for the proposal--NEGLIGIBLE.
<u>Nonendangered Cetaceans</u>	
The effect of the proposal on nonendangered cetaceans is expected to be MINOR. Due to broad distributions, seasonal use, and the low probability of oil spills, it is unlikely that oil spills would contact high population levels of cetaceans. If an interaction occurred, it is unlikely that cetaceans frequenting the area would be significantly adversely affected. Noise and disturbances associated with the proposal may affect cetaceans; however, the short-term responses are not expected to preclude successful migration or disrupt use of species feeding areas.	This alternative would result in a reduction of oil-spill risks and noise disturbance on nonendangered cetaceans using this area. Effects of this alternative are expected to be reduced from minor, under the proposal, to NEGLIGIBLE.

Table II-2
Summary and Comparative Analysis of Potential
Effects for Alternatives I and IV
for the North Aleutian Basin (Sale 92)
(Continued)

Alternative I (Proposal)	Alternative IV (Alaska Peninsula Deferral)
SOCIAL AND ECONOMIC SYSTEMS	
Commercial Fishing Industry	
Loss of harvest through foreclosure of fishing areas by offshore facilities (platforms and pipelines) would be NEGLIGIBLE because the maximum projected space/catch loss does not exceed 2 percent for any of the fisheries. Crab-pot loss due to vessel traffic is expected to be NEGLIGIBLE. Damage to drift-net, purse-seine, longline, and trawl gear is expected to be NEGLIGIBLE. Unless a major oil spill hit a concentrated fishing area, which is unlikely, the effects on the commercial salmon, herring, and groundfish fisheries would be MINOR. Effects on the red king crab fishery would be MAJOR.	The Alaska Peninsula deferral would reduce the likelihood of oil spills contacting salmon and herring fisheries. The deferral would not appreciably reduce other effects on the fisheries. Overall effects on fisheries would remain the same as for the proposal. The effects on the commercial salmon, herring, and groundfish fishery would be MINOR. Effects on the red king crab fishery would be MAJOR.
Local Economy	
Effects on the local economy are expected to be MINOR. The projected increase in employment opportunities would not decrease joblessness in the affected community. However, because petroleum-industry jobs generally pay well, it is possible that average incomes would be increased as a result of the lease sale.	The local economic effects would be approximately the same as for the proposal, MINOR. Because the level of exploration and development and production activity is generally the same for this alternative as for the proposal, the associated employment and other economic effects would be the same.
Community Infrastructure	
Population increases resulting from the operation of a marine-support base in Unalaska would have a NEGLIGIBLE effect on all services and facilities. OCS-generated service demands would account for 5 percent or less of the total demand on any service or facility over the life of the project. OCS air-support operations in Cold Bay would have a NEGLIGIBLE effect on all community services. Demands from OCS activities would be offset by decreased usage resulting from population declines attributed to a contraction of traditional FAA, military, and communication functions. The water- and sewage-treatment systems would require upgrading to meet minimal standards; however, this would be required even in the absence of OCS activities.	The effects on the community infrastructure of Unalaska and Cold Bay would generally be the same as for the proposal.
Subsistence-Use Patterns	
Effects from the proposal on subsistence-use patterns in Unalaska, Cold Bay, and the Bristol Bay region as a whole would be NEGLIGIBLE. The proposal would contribute only marginally to changes in subsistence-use patterns among the population of Unalaska, compared to the increased competition for scarce subsistence resources produced by the extensive growth of the groundfish-processing industry. Subsistence-use patterns in Cold Bay are not expected to undergo material change from those brought about by the normal growth of the community because of the relative abundance of local resources, combined with the limited subsistence practices carried out in the community.	This alternative encompasses the same development scenario as the proposal, thus producing comparable levels of population growth and development activity. Because of this, effects on subsistence-use patterns at Unalaska and Cold Bay and in the Bristol Bay region generally would be the same as for the proposal--NEGLIGIBLE. Placement of lease blocks farther offshore of the Alaska Peninsula (by deferring certain nearshore blocks) offers the potential for reducing the risk to nearshore subsistence resources and habitats. The deferral of the nearshore blocks deletes a considerable amount of oil-spill risk to shoreline areas.

Table II-2
Summary and Comparative Analysis of Potential Effects for Alternatives I and IV for the North Aleutian Basin (Sale 92)
(Continued)

Alternative I (Proposal)	Alternative IV (Alaska Peninsula Deferral)
Within the Bristol Bay region and the lower Alaska Peninsula subregion, subsistence-use patterns are much less likely to be directly affected by the lease sale (from population pressure or oil-spill risk) than indirectly affected should an oil-spill event cause a major reduction or closure of the Bristol Bay or Alaska Peninsula commercial salmon fisheries for fear of producing a tainted product for market. Thus, effects on subsistence-use patterns in the Bristol Bay region would be less the result of effects on subsistence resources for everyone than the result of the effects on the means to acquire them or satisfy other economic requirements for those commercial fishermen, families, or villages that are more marginal to the salmon fishery than the norm, because of technological and/or cultural reasons.	
Sociocultural Systems	
In Unalaska, Cold Bay, and the Bristol Bay region as a whole, effects on sociocultural systems would be NEGLIGIBLE. MINOR effects on sociocultural systems are possible in Sand Point. Effects of the lease sale on the sociocultural systems of Unalaska are expected to be minimal compared to the effects of growth conditions expected to be created by groundfish-oriented industrial development. In Cold Bay, the character of the population associated with lease-sale activities would be compatible with sociocultural systems of the community. The population growth would be marginal and easily absorbed into the community with minimal disruption. In the Bristol Bay region as a whole, indirect effects of oil-spill incidents felt by the marginal commercial/subsistence fishermen are anticipated to create temporary disruption to the kinship structure, values and orientations toward fishing as a livelihood, and possibly cause some outmigration. Siting a terminal in Balboa Bay could intensify changes in the social organization of Sand Point due to fisheries-induced population growth, creating a more diversified and stratified community as well as a decrease in the ability among the population to depend on the kinship structure for a support network. The current trend towards displacement of cultural values and orientations also is expected to continue as the population grows and more employment opportunities become available.	Levels of population growth and industrial activity under Alternative IV are comparable with the proposal and would result in similar effects. Removal of lease sale blocks farther offshore of the Alaska Peninsula would make no substantial reduction in potential effects on subsistence-use patterns and therefore would do little to reduce social, cultural or political effects generated by reduced effects on subsistence resources. The removal of blocks, however, should reduce the fear of potential effects on sociocultural systems generally embraced by residents of the Bristol Bay region. Political effects on regional community associations, such as the Bristol Bay Native Association, the Aleutian-Pribilof Islands Association, and the several coastal resource service areas, may be reduced.
OTHER ISSUES	
Water Quality	
Anchoring of exploration and production drilling rigs and entrenchment of pipelines would increase turbidity only temporarily over a limited area. Platform discharges of drilling fluids during exploration and production would temporarily contaminate less than 1 square kilometer. Production, but not exploratory, discharge would continue	The level of oil industry activity would generally be comparable with that discussed for the proposal. Therefore, water-quality effects would be the same as for the proposal, MINOR, except that drilling discharges would not occur in the deferred blocks, and oil-spill risks to the deferred area would be reduced.

Table II-2
Summary and Comparative Analysis of Potential
Effects for Alternatives I and IV
for the North Aleutian Basin (Sale 92)
(Continued)

Alternative I (Proposal)	Alternative IV (Alaska Peninsula Deferral)
intermittently over several years. The projected oil spill of 1,000 barrels or greater could significantly, but temporarily, increase water-column hydrocarbon concentrations over several hundred kilometers. Water-quality effects would be characterized as MINOR.	
Air Quality	
Effects on air quality from activities in the proposal are expected to be MINOR. In all likelihood, emissions from offshore operations, even during peak production, would be well below air-quality-analysis exemption levels. Operation of a terminal at Balboa Bay would require emission-control technology to meet federal ambient-air-quality and Class II Prevention of Significant Deterioration Standards.	The level of oil industry activities would be similar to that discussed for the proposal. Therefore, the effects on air quality would be the same as discussed for the proposal--MINOR.
Cultural Resources	
Within the proposed lease sale area, it is improbable that cultural sites would be discovered, since recent bathymetric information indicates that the sale area was not emergent and could not have been inhabited by man.	The level of oil industry activities would be similar to that discussed for the proposal. Therefore, the effects on cultural resources would be the same as for the proposal--MINOR.
Onshore cultural resources could be indirectly affected by oil spills, should cleanup efforts involve the use of heavy equipment over areas containing archeological sites or other cultural resources. Areas of cultural significance adjacent to the proposed sale area have a less-than-10-percent probability of being contacted by an oil spill. Also, population increases associated with oil-development activities could result in the disturbance of cultural sites. The aggregate effect of all factors on the area's cultural resources would be MINOR.	
Transportation Systems	
Given the current undeveloped state of the Balboa Bay area's transportation structure, the effects of activities associated with the proposal would be MAJOR.	The level of oil industry activity would be similar to that discussed for the proposal. Therefore, the effects on transportation systems would be the same.
Due to low traffic volumes generated by the proposal, supply traffic through Unimak Pass would be considered a minor portion of the overall Unimak Pass traffic. During the development phase, six to seven barges per year would be expected to transport goods through Unimak Pass.	
Total aircraft operations during peak development could range between 650 and 700 operations per month, a sevenfold increase over current activity. Activity of this nature would have a major effect on existing facilities because they are currently inadequate to handle this level of activity.	
Effects on Unalaska are anticipated to be MODERATE.	

Table II-2
Summary and Comparative Analysis of Potential
Effects for Alternatives I and IV
for the North Aleutian Basin (Sale 92)
(Continued)

Alternative I (Proposal)	Alternative IV (Alaska Peninsula Deferral)
<u>Land Use</u>	
The effects on land use in Unalaska and Cold Bay as a result of industrial and residential demands would be MINOR. Because only two production platforms are envisioned, existing support facilities in Unalaska and Cold Bay could be utilized with minimum modifications. Development of an oil pipeline between Port Moller and Balboa Bay, on the Alaska Peninsula, would conform with the preferred transportation corridor identified in the Bristol Bay Regional Management Plan; however, pipeline development would have a MAJOR effect on the area's wilderness values.	Effects on land uses in Unalaska and Cold Bay, and along the proposed pipeline route would be substantially the same as for the proposal because the level of industrial activity and population growth would remain the same.
<u>Coastal Management</u>	
The potential exists for conflict with several habitat and facility-siting policies. Habitat policies usually are most affected by potential oil spills. Potential conflicts with facility-siting policies also result from possible oil spills, but the loss of wilderness and the filling of wetlands also are sources of potential conflict. Potential MODERATE conflicts with coastal management are possible.	Deferral of blocks within 40 kilometers of the Alaska Peninsula lessens conflicts with the policies for lagoon and estuarine habitats. Effects associated with the construction and operation of the pipeline and transshipment terminal would not change with this alternative. Potential conflicts with coastal management policies are reduced to MINOR.
<u>Terrestrial Mammals</u>	
Neither brown bear nor caribou are likely to be substantially affected by offshore OCS activities, although any spilled oil reaching beaches could affect animals foraging there. Disturbance, habitat degradation, and elevated mortality are the principal types of adverse effects of onshore activities that could cause terrestrial mammal populations to decline in abundance and distribution. Interruption of movements between critical seasonal-use areas, and disturbance while animals are occupying such areas, are the most likely causes of adverse effects. However, because of the distribution of brown bear and caribou, and seasonal-use areas and projected development, effects are likely to be quite localized and of MINOR importance.	The transportation scenario for Alternative IV revolves around the onshore support activities and the transpeninsula-pipeline corridor, which are the same as those identified for the proposal. Because of this, the effects of this alternative on terrestrial mammal populations would be the same as for the proposal--MINOR.

III.

DESCRIPTION OF THE AFFECTED ENVIRONMENT

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. Physical Considerations

The use of "continental shelf," "slope," and similar references in this document is strictly for description of physiographic provinces and for analytical purposes. Such references have no legal significance under domestic or international law.

1. Environmental Geology:

a. Physiography: Onshore areas along the Aleutian Chain and the Alaska Peninsula are characterized by rugged volcanic peaks with intermittent areas of rolling topography. Numerous indented bays and small islands are located along the coastline. Many of the islands have wave-cut platforms up to 183 meters above the present sea level.

Offshore, the seafloor within the proposed lease area is extremely flat and shallow. Water depths are generally less than 100 meters.

b. Geologic Setting: Three major structural features have been identified within this proposed lease sale area. Two are the sediment-filled Amak and Bristol Bay Basins; the third is a basement ridge that extends offshore from the Black Hills region of the Alaska Peninsula (Fig. III-1).

The Bristol Bay Basin is a structural depression that underlies much of the northern side of the Alaska Peninsula and extends offshore in a southwestward direction. The basin's sedimentary section is composed mostly of Cenozoic sediments that are more than 6,000 meters thick. The offshore area of this feature is approximately 21,750 square kilometers. Eighty (80) percent of it lies offshore in water depths less than 60 meters (Marlow et al., 1980).

The Amak Basin, located just north of Unimak Island, is a gentle coastal sag beneath the flat southern shelf. This elongated sediment-filled trough has a westward-trend parallel to the Black Hills ridge. The main center of deposition is circular in shape and filled with more than 4 kilometers of sediment. The sediments within the basin are flat-lying or with a very gentle dip. Folding and high-angle faulting have offset the strata along the flanks of the Black Hills ridge.

The Black Hills ridge is an offshore extension of the Black Hills structural high near the western end of the Alaska Peninsula. The ridge extends at least as far west as 166°W longitude. Near 167°W longitude, the Black Hills and the Pribilof ridges appear to connect in the form of a basement saddle (Marlow et al., 1982). Onshore exposures and dredge samples along the continental margin indicate that the Black Hills structural high is composed of arkosic to lithic sandstones of late Jurassic age. The northern flank is downfaulted, forming the southern edge of the Bristol Bay Basin.

A more detailed description of the regional geologic setting discussed above can be found in Marlow et al. (1979); Dames and Moore (1980); Marlow et al. (1980); and Marlow and Cooper (1984).

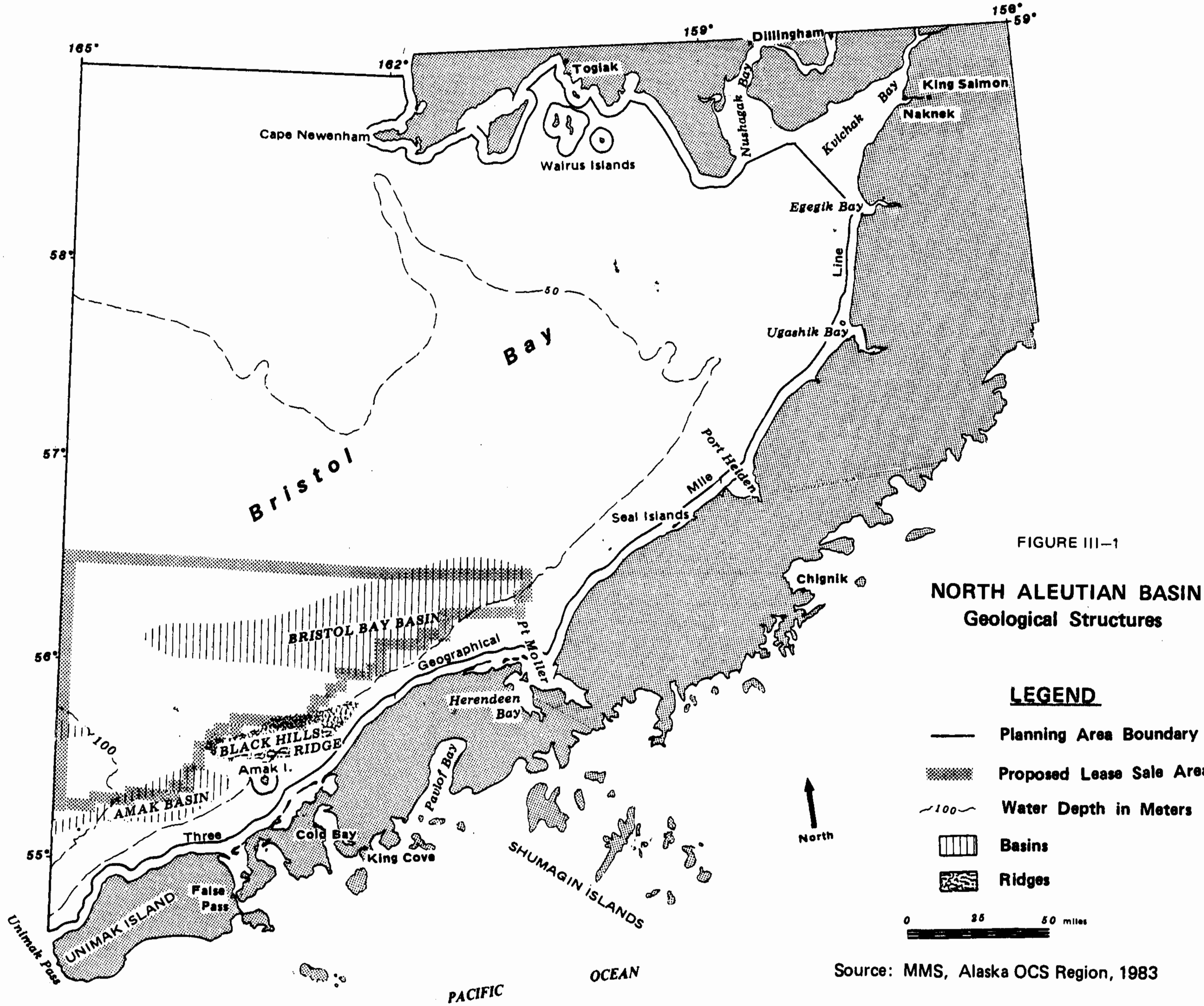


FIGURE III–1

NORTH ALEUTIAN BASIN
Geological Structures

Source: MMS, Alaska OCS Region, 1983

c. Earthquakes and Related Hazards: The eastern Aleutian Islands and the Alaska Peninsula are located in one of the world's most active seismic zones. The Aleutian trench, which borders this area to the south, is the site of the subduction zone between the Pacific and North American plates. Most of the energy accumulated as a result of this convergence is released during great earthquakes (Kelleher, 1970; Sykes, 1971; Pulpan and Kienle, 1980). Earthquakes with magnitudes between 7 and 8 (Richter scale) have been recorded along the Alaska Peninsula; several between magnitudes 6 and 7 have been recorded within the proposed lease area.

A more detailed discussion of the earthquake hazards to onshore and offshore oil development is contained in the St. George Basin (Sale 70) FEIS, which is incorporated herein by reference. Other references include Meyer (1976); Davies and Jacob (1980); House et al. (1980); and Davies (1981).

Shallow Faulting: In the southwestern portion of the lease area, Hoose et al. (1984) mapped an eastward extension of the St. George graben system. This feature, called the North Amak fault zone, is indicated by a 30-kilometer-wide, east-west-trending zone consisting of numerous parallel and subparallel normal-surface and subsurface faults. Many can be traced for up to 16 kilometers.

Hoose et al. (1984) indicate that all surface faults are growth faults. Any indication of the faults' presence on the seafloor surface is characterized by sags rather than by abrupt scarps. This is attributed to the unconsolidated nature of the Holocene sediment and the vigorous seafloor erosion taking place on the shelf.

Subsurface faults terminate at depths ranging between 30 and 290 meters below the seafloor surface; some can be classified as growth faults.

All shallow faults mapped within this area have an offset greater than 5 meters. Because of recent seismicity and seafloor expression, certain faults should be considered active. Between 1957 and 1978, most of the 38 shallow-focus earthquakes (up to 5.7 magnitude) detected in the St. George Basin/North Aleutian Shelf region occurred within the North Amak fault zone.

In early 1984, the Minerals Management Service released an MMS map series (84-004) on the North Aleutian Shelf (for more detailed information and location of the faults discussed in this section, refer to that series). The map showing acoustic anomalies and faults is by Hoose and Ashenfelter (1984); scale is 1:250,000.

Tsunamis and Seiches: Because of the high probability of major earthquakes occurring in this region, there is a strong possibility that such events could generate regional tsunamis offshore or seiches along the steep, indented coastlines of the Alaska Peninsula and the Aleutian Islands. A complete description of these hazards can be found in the St. George Basin (Sale 70) FEIS (USDOI, MMS, 1982, pp. III-4 and III-5).

Volcanoes: The southern boundary of this proposed lease area is one of the most active volcanic areas in the world. Coats (1950) listed 25 active volcanoes on the Aleutian Islands and 11 on the Alaska Peninsula. Aleutian volcanoes can be highly explosive; their lavas have a high silica content and high viscosities. Several, such as Mt. Makushin on Unalaska Island and the Okmok Caldera on Umnak Island, erupted explosively during the Holocene epoch.

A more detailed description of the volcanic activity summarized above can be found in the St. George Basin (Sale 70) FEIS; Marlow et al. (1979); Cooper et al. (1982); and Marlow et al. (1982).

d. Sediments: The shelf-surface sediments in this lease area consist mostly of coarse-grain sand near the shoreline to finer-grain sand in areas of greater water depth. Grain-size sorting can be described as moderately poorly sorted to extremely poorly sorted for most of the proposed lease area (Sharma, 1979).

The primary sources for today's surface sediments are thought to be the runoff from major rivers draining into the southeastern Bering Sea and shoreline erosion. Some portion of the shelf sediment is relict material deposited during lower stands of sea level (Sharma, 1979).

A description of the Holocene sediments for the southern portion of the proposed lease area and an isopach map can be found in a Geological Survey open-file report (Hoose et al., 1984).

Bedforms: Hoose et al. (1984) identified four types of current-generated bedforms in the nearshore portion south of 56°30'N latitude. These features are scour depressions, small ripple marks, mega-ripples, and sediment waves.

The scour depressions appear as flat-floored troughs recessed up to 2 meters below the seafloor and bounded by steep walls. Coarse-lag deposits cover the bottoms. These features usually occur in small zones (three or more depressions) or in extensive scour zones that cover up to 600 square kilometers. The individual width of each scour ranges between 5 and 300 meters, and they tend to run parallel to each other.

Small ripple marks can be found in the coarse sediment on the floors of the scour depressions. These features have straight crests and wavelengths of approximately 1 meter.

Mega-ripples, with wavelengths ranging from 9 to 25 meters, occur on the seafloor outside of the scour depressions. The dominant trend of these ripples is approximately at right angles to the scour-depression trend.

Sediment waves have been identified in only one location in the southern portion of the lease area. They are rather large features, with a height from crest to trough of up to 3.7 meters.

A detailed description of the features described in this section and maps showing their locations can be found in Hoose et al. (1984).

Gas-Charged Sediments: Acoustic anomalies, which may represent gas-charged sediment, have been identified in all parts of the proposed lease area south of 56°30'N latitude. Most of the anomalies occur within 7 to 25 meters of the seafloor; however, several occur as deep as 60 meters. The largest anomalies occur near the 56°30'N latitude. These anomalies are centered over depressions in the pre-Holocene surface that are related to low sea-level stillstands at the end of the Pleistocene. Several acoustic anomalies have been identified near faults. However, it is not clear to Hoose et al. (1984) whether these anomalies are caused by biogenic gas or by thermogenic gas that migrated upward along the faults.

2. Meteorological Conditions: Climatically, the southeastern Bering Sea is classified as polar-oceanic (Overland, 1981). The Bering Sea is alternately affected by arctic and continental air masses during the winter and maritime air masses during the summer. An important factor in the climatology of the Bering Sea is the frequency and seasonal change in position and tracks of storm centers across the Bering Sea and the northern Gulf of Alaska. Overland and Pease (1981) identified two primary storm tracks. In winter, storms generally move along the Aleutian Islands and into the northern Gulf of Alaska. During summer, the primary track is along the Aleutians, curving northward into the northern Bering Sea. The seasonal change in mean position of the Aleutian low-pressure system usually results in three to four storms per month occurring over the southeastern Bering Sea in summer and increasing to four or five storms per month in winter. Winter storms generally are more intense (Overland, 1981).

Average annual precipitation in the North Aleutian Basin varies from 50 to 100 centimeters. During the winter months, 25 to 35 percent of the total observations report precipitation, with 60 to 80 percent of these reporting snow. Fifteen (15) to 20 percent of the summer observations report precipitation. Temperatures in the planning area range from -2°C in February and March to approximately 10°C in August. Observed windspeeds and directions vary seasonally from winter to summer, as is the case in the St. George Basin. Mean winter (generally October-April) windspeeds in the planning area range from 16 to 20 knots from the southeast to northeast, with the highest mean speeds occurring in November through February. Mean speeds fall slightly during summer to the 10- to 16-knot range, and directions vary from the southeast to west. Windspeeds greater than 34 knots occur in less than 10 percent of all observations from the area and are more frequent (less than 5%) in summer than in winter. Table III-1 gives the annual average weather for selected reporting stations bracketing the North Aleutian Basin Planning Area. The occurrence of fog and reduced visibility is reported in less than 10 percent of the October-to-March observations. This percentage increases to 20 to 30 percent in July and August. The frequency of occurrence of fog, smoke and haze, and blowing snow for selected stations in the North Aleutian Shelf area is shown in Table III-2.

3. Physical Oceanography: The oceanographic composition of the eastern Bering Sea has been studied by many investigators. The vertical and circulation structures of the eastern Bering Sea shelf vary across the shelf but can be used to divide the shelf into three regions (Kinder and Schumacher, 1981a). These regions, or domains, closely correspond to shelf depths of less than 50 meters (coastal, or inner-shelf, domain); depths between 50 and 100 meters (middle-shelf domain); and depths between 100 meters and the shelf break (outer-shelf domain). Seaward of the shelf break, there is a fourth domain, noted as the oceanic domain. Each domain is separated from the next by a frontal region. The inner front, separating the coastal and middle domains, is approximately 10 kilometers wide and generally follows the 50-

Table III-1
Annual Average Weather for Stations Bracketing
the North Aleutian Basin Area

	Cape Newenham	Port Moller	Driftwood Bay
Mean Temperature			
Min (°C)	-1.7	-2.9	-0.7
Max (°C)	2.8	5.5	6.3
Precipitation (centimeters)			
Total (Rain and Snow)	95	110	52
Snowfall	205	234	178
Prevailing Surface Winds (knots)			
Direction and Mean Speed	N 9.8	S 8.7	NW 8.3
Fastest Direction and Speed	E 60	S 55	WSW 55

Source: Wise and Searby, 1977.

Table III-2
Weather Frequency for Stations in the
North Aleutian Basin Area

	Cape Newenham	Port Moller	Driftwood Bay
Precipitation			
(Total Percent of Time)	27.2	22.0	16.9
Rain	14.9	11.8	8.9
Freezing Rain	0.2	0.2	0.1
Snow/Sleet	12.8	10.0	7.9
Poor Visibility			
(Total Percent of Time)	28.6	24.4	26.8
Fog	26.1	24.4	26.8
Smoke/Haze	--	0.1	0.4
Blowing Snow	4.0	2.9	4.0

Source: Wise and Searby, 1977.

meter isobath. The middle front, separating the middle shelf from the outer shelf, and the shelf-break front, between the outer shelf and the oceanic domain, are much broader than the inner front and not as well defined (Fig. III-2).

In the coastal domain, the water depth is less than the thickness of the tidally mixed bottom layer; the water column is usually homogenous. Stratification does occur near the coast at times of direct influence of freshwater discharge (Schumacher et al., 1983; Schumacher and Moen, 1983). The middle shelf has water depths that generally equal the sum of the thickness of the tidally mixed bottom layer and the wind-mixed surface layer. This results in a two-layered system. Water depths on the outer shelf exceed the sum of the thicknesses of the tidally and wind-mixed layers. The water column between the wind-mixed and the tidally mixed layers is weakly stratified and often shows finestructure on scales of 1 to 10 meters.

The long-term mean circulation in the eastern Bering Sea is quite weak. Kinder and Schumacher (1981b) and Schumacher and Kinder (1983) analyzed numerous current records from the eastern Bering Sea and defined three current regimes that closely coincide with the three hydrographic domains previously discussed. A characterization of the circulation pattern is shown in Figure III-3. Water flow along the peninsula is substantially greater than summer flow. With the exception of a weak, intermittent northeast flow along the northern side of the Alaska Peninsula, little cross-shelf flow is evident.

The wind provides the major source of energy for driving currents in the inner-shelf regime and 92 percent in the middle-shelf regime (Schumacher and Kinder, 1983). Wind and other weather phenomena supply 94 percent of the flow energy. In the middle- and coastal-current regimes, meteorologically forced currents are often observed.

Tides are the major source of energy for currents and mixing over the shelf as a whole (Kinder and Schumacher, 1981b). Sixty (60) to 90 percent of the kinetic energy is tidal and, although mean currents generally are weak, instantaneous tidal currents of 10 to 30 centimeters/second are not uncommon and produce tidal excursions of 5 to 7 kilometers. Eighty (80) percent of the tidal energy is semidiurnal, and 20 percent is diurnal. The tidal ellipses formed are oriented generally across-shelf and show a clockwise rotation. Near the northern side of the Alaska Peninsula, in the North Aleutian Basin, however, the ellipses are flattened and the motion is nearly rectilinear, parallel to the local isobaths.

The North Aleutian Basin Planning Area is much shallower than the St. George Basin Planning Area and is comprised almost entirely of inner- and middle-shelf waters. Water depths range from 30 to 180 meters. Mean currents are weak and generally cyclonic in nature. There is a slight northeastward flow of 2 to 5 centimeters/second along the northern side of the Alaska Peninsula. Flow along the northern part of the planning area is west to northwest at 1 to 3 centimeters/second, whereas currents in the central portion of the planning area are weak (less than 1 cm/sec, with indeterminant directions).

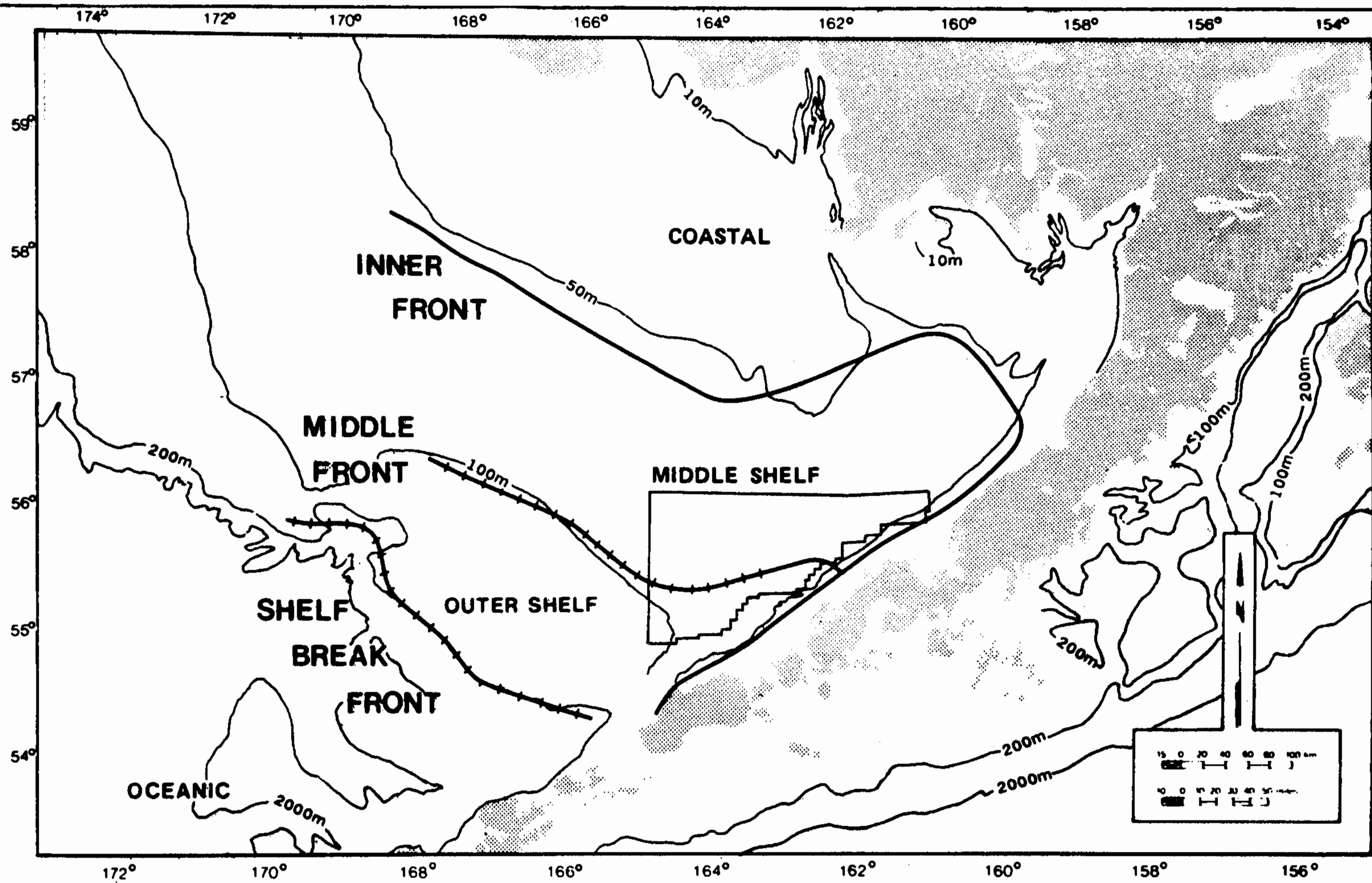


FIGURE III–2

APPROXIMATE BOUNDARIES SEPARATING THE THREE SHELF (coastal, middle, outer) AND THE OCEANIC HYDROGRAPHIC REGIONS. THE BOUNDARIES ARE THREE FRONTS: INNER, MIDDLE, AND SHELF BREAK. THESE FRONTS ROUGHLY COINCIDE WITH THE 50 m ISOBATH, THE 100 m ISOBATH, AND THE 200 m ISOBATH (shelf break). REDRAWN FROM KINDER AND SCHUMACHER (1981 a).

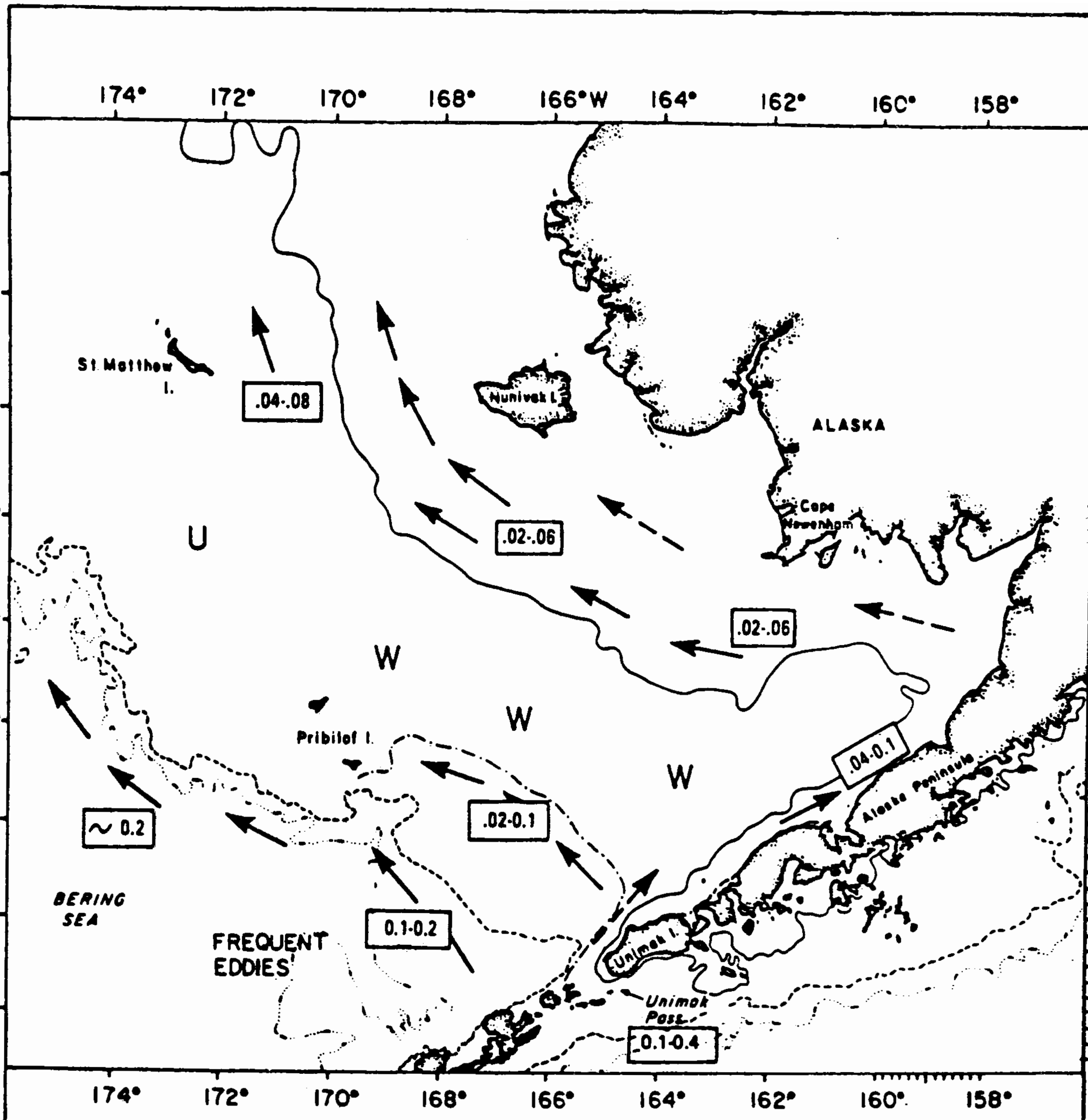


FIGURE III–3

Estimated Mean Circulation

LEGEND

Direction of Current

Uncertain or Intermittent

U Unknown

W Weak (< 0.02 Knots)

0.2-0.4 Approximate Speed in Knots

North Aleutian Basin Planning Area

Bathymetry

50 meters

100 meters

200 meters

2000 meters

NOTE: Dashed arrows in the northern coastal region express uncertainty.

Arrow along Alaska Peninsula expresses intermittency.

Source: Redrawn from Kinder and Schumacher (1981 b) and Schumacher (1981 a).

The distribution of sea ice in the Bering Sea is subject to great seasonal variation. The Bering Sea is ice-free in summer. Ice begins to form along south-facing shorelines during the early fall and can be found in the northern sections of Bristol Bay in October and November. The advance of the ice edge occurs in a series of steps: (1) the waters of south-facing shorelines freeze, and the ice is advected to the south under the influence of prevailing northerly winds; (2) the advection of ice to the south leaves a band of open water along the shore which then freezes, repeating the cycle; and (3) the ice edge continues to the south until it reaches its maximum extent sometime in late March or April, when it begins a rapid retreat.

Overland and Pease (1981) and Niebauer (1981) attributed the extent of ice cover to upper air steerage of fall and winter storm tracks in the Bering Sea which, in turn affect surface-water temperatures. During heavy ice years, there are fewer storms and colder water in the Bering Sea. Those that occur concentrate over portions of the eastern shelf; that is, over the St. George and North Aleutian Basins. The upper air steerage and variation in surface-water temperature are results of multiyear climatic fluctuations in the North Pacific, such that heavy ice years or light ice years often occur at least in pairs.

The position of the southernmost ice edge is set by a balance of wave action, wind stress, melting, and southern advection of new ice (McNutt, 1981; Overland and Pease, 1981). Exposure to sea and swell causes ice near the open water to undergo extensive rafting and ridging, creating floes approximately 10 to 20 meters in diameter and 2 to 5 meters thick (Martin and Bauer, 1981). Farther into the pack, where the effects of sea and swell are greatly diminished, floes are subjected to little or no rafting; consequently, their lateral dimensions are greater but their thicknesses are reduced (0.2 to 0.6 meters). The more heavily rafted floes form bands of ice that move downwind faster and at higher windspeeds than the main pack.

The northern part of the North Aleutian Basin Planning Area is an active area of sea-ice formation. Ice begins to form along the shorelines in late October and November. As the winter progresses, the ice edge advances farther south from the mainland coastlines and to the west from the Alaska Peninsula. During a heavy ice year, the ice edge may advance as far south as Unimak Island and follow the shelf break to the northwest. In more average years, the approximate southern limit of the ice edge is in the vicinity of Port Moller. Ice coverage in Bristol Bay generally is on the order of 60 to 70 percent. In an extremely heavy ice year, ice coverage increases to 80 to 90 percent.

B. Biological Resources:

The major ecosystem components (fish, bird, mammals and endangered species) described in this section do not exist apart from the total ecosystem upon which they depend. In order to demonstrate the complex ecosystem relationship in the Bering Sea region, a generalized food-web diagram is presented (Fig. III-4).

1. Fisheries Resources:

The fisheries resources of the North Aleutian Basin lease sale area are diverse and extensive. More than 300 species of fish inhabit the Bering Sea. Benthic species, most of which are found on the continental shelf and slope at depths of less than 300 meters, account for over 50 percent of the marine fish. There are approximately 40 species of pelagic and bathypelagic fishes (including most of the anadromous species). In addition, the eastern Bering Sea shelf supports more than 251 pelagic and 472 benthic species of invertebrates. Commercially valuable species occurring in or near the North Aleutian Basin lease sale area include the five species of Pacific salmon, Pacific cod, yellowfin sole, walleye pollock, Pacific halibut, Pacific herring, rock sole, flathead sole, Alaska plaice, red king crab, and tanner crab.

The North Aleutian Basin lease sale area is used by different lifestages of a variety of fish and invertebrate species. Many species of adult fish, crabs, and other invertebrates inhabit the area. The area also is an important reproductive site for spawning, incubation of eggs, and larval development of many species. In addition, it is an important nursery area for juveniles of many species. Finally, the area is used during adult spawning migrations and juvenile outmigrations of a majority of the salmon stocks of the Bering Sea.

Species included in this discussion are important in terms of abundance, commercial interest, or trophic value. Information is most abundant, however, for the species of commercial importance, as reflected in the species discussions that follow.

Salmonids: All five species of Pacific salmon are present in the North Aleutian Basin lease sale area: chinook (king), sockeye (red), coho (silver), pink (humpback), and chum (dog). Their feeding migrations in the North Pacific and the Bering Sea are extensive, and salmon migrate long distances to their spawning streams. Salmon runs fluctuate greatly from year to year. An estimated 88 percent of all salmon entering streams bordering the Bering Sea traverse North Aleutian Shelf waters on their spawning migrations (Thorsteinson, 1984).

The life history of the Pacific salmon occurring within the North Aleutian Basin lease area has been separated into three phases for consideration (Thorsteinson, 1984): (1) seaward migration of juveniles through the area; (2) temporary residence of immatures in and adjacent to the area; (3) and return spawning migrations of adults through the area. Adult salmon migrating through the North Aleutian Basin area are a complex mixture of stocks of five species returning to streams on the northern side of Unimak Island or the Alaska Peninsula, in Bristol Bay, or farther north along the Bering Sea coast (Thorsteinson, 1984). Adult salmon are present in the area from May through October, and a number of immatures are present in the area year-round.

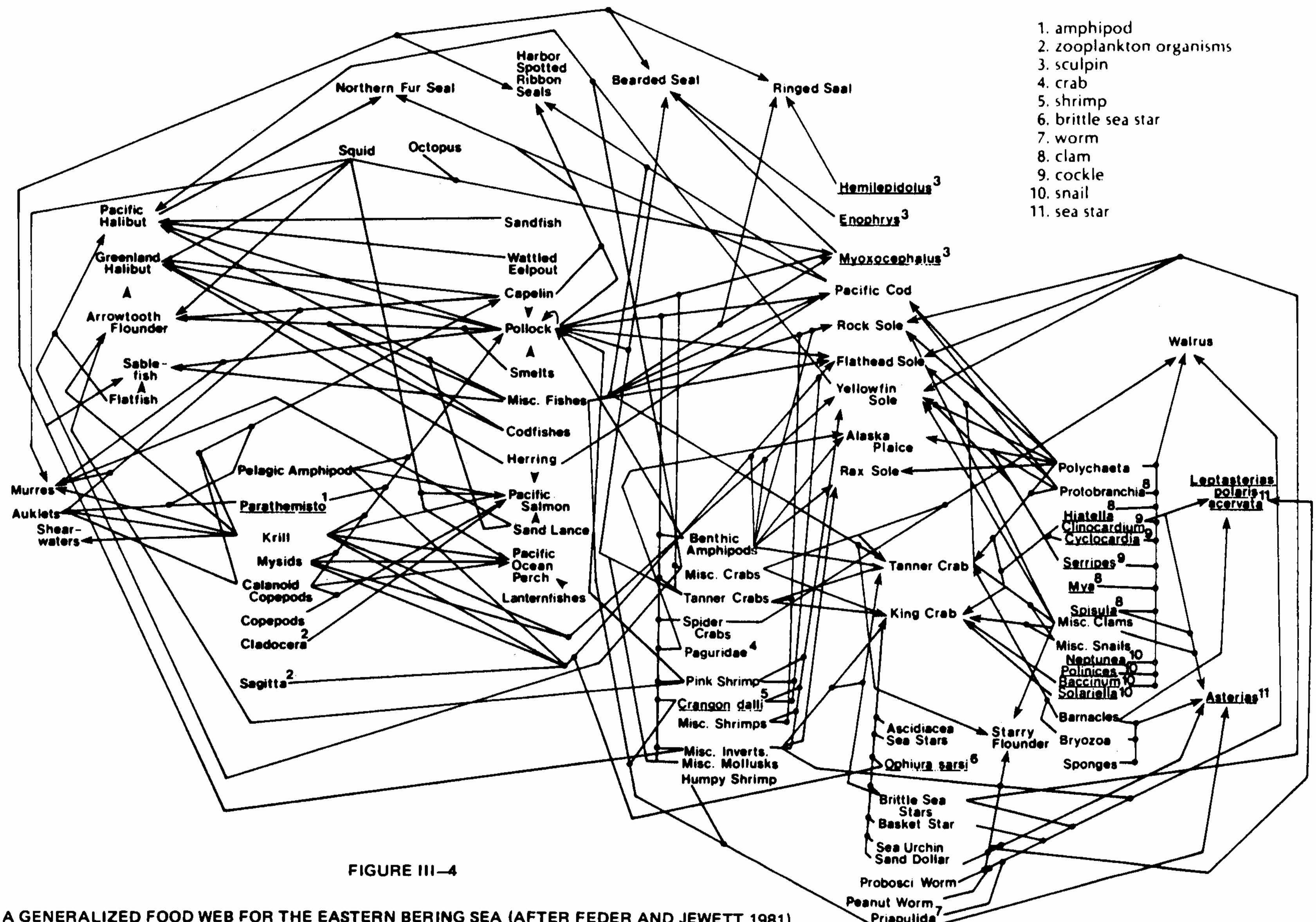


FIGURE III–4

A GENERALIZED FOOD WEB FOR THE EASTERN BERING SEA (AFTER FEDER AND JEWETT 1981)

In general, the life histories of the five species in this area are similar. Adults migrate from the open ocean through the North Aleutian Basin lease sale area on their return to natal streams for spawning. Chinook are the first to enter the area, followed in order by sockeye, chum, pink, and coho (Thorsteinson, 1984). Migration rates from the shelf edge to the Kvichak River in Bristol Bay were estimated by Straty (1981) as ranging from 45 to 60 kilometers per day. Along the southeastern Bering Sea coast, salmon migrate in a band that extends to 162 kilometers offshore, with a center of abundance 50 to 100 kilometers from shore (Straty, 1981). During this migration, the prespawning adults pass through the lease area or through areas adjacent to it. Once they reach their spawning grounds, salmon deposit their eggs in the gravel beds of streams, rivers, or lakes (depending on the species and its origin). Alevins hatch in the winter and remain in the gravel substrate until they have absorbed their yolk sacs in the spring. They emerge from the gravel as fry, some of which stay in fresh water for a period ranging from a few weeks to 1 or more years, while others migrate immediately to the sea.

Juvenile salmon are present in the nearshore waters of the North Aleutian Basin Planning Area from May through September annually (Straty, 1974). Outmigration of Juvenile salmon is species- and stock-specific and varies with annual differences in environmental conditions (i.e., ice breakup on lakes and streams, over-winter stream-water temperatures).

Only sockeye salmon have been studied sufficiently to describe their seaward migration in some detail; however, general information on outmigration of all five species is known. After entering the Bering Sea, juvenile salmon remain in nearshore waters for varying lengths of time and grow rapidly during the initial few months of seaward migration (Hartt et al., 1967; Straty, 1974; Barton, 1979a). Observations from other ocean waters off Alaska indicate that coastal movement during the first few months of seaward migration is typical behavior for Pacific salmon throughout their range (Straty, 1981). Juveniles move along the coastline of the southeastern side of Bristol Bay and the northern side of the Alaska Peninsula. The migratory route apparently is determined by salinity gradients and water temperatures (Favorite et al., 1977; Straty and Jaenicke, 1980). Speed of migration is determined in large part by water temperatures and consequent growth and energy rates (Straty and Jaenicke, 1980). With increased growth in these nearshore areas from early summer to late fall, the fish move offshore to more pelagic regions (Straty, 1974; Barton, 1979). This offshore migration is species-specific and variable according to annual differences in time of entry into the Bering Sea. Information on shelf distribution of juvenile salmon after leaving coastal waters is only fragmentary (Straty, 1981).

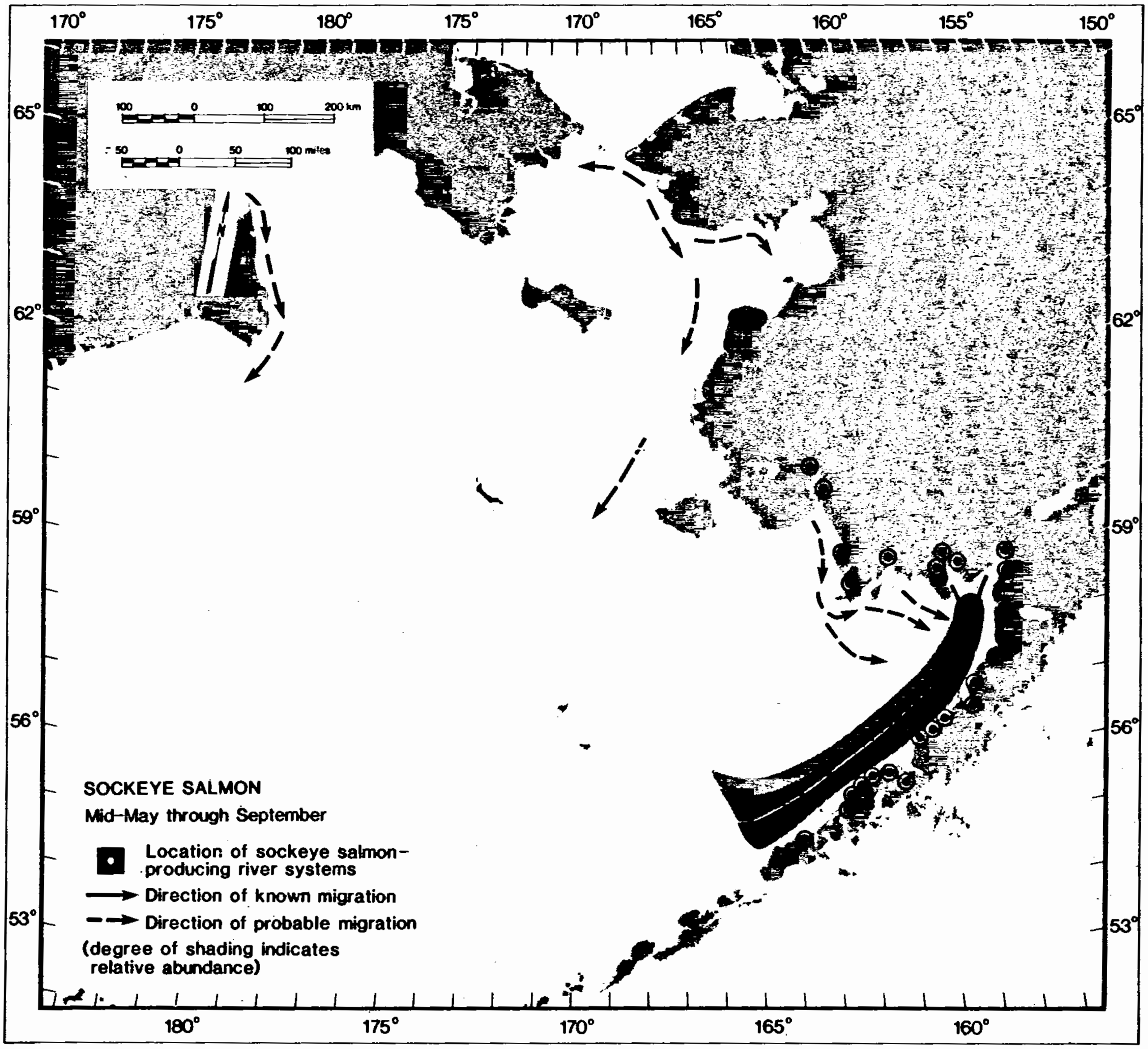
Offshore, adults are epipelagic, usually found in the upper 10 to 30 meters of water. Adults spend 1 to 4 years at sea (depending on the species), return to their natal streams to spawn, and subsequently die. Maturing salmon are most abundant in the southeastern Bering Sea shelf region from mid-May to early September and are concentrated in the upper 5 meters of water (Hokkaido University, 1965, 1968).

Streams adjacent to the 20-kilometer overland portion of the Port Moller/ Balboa Bay transportation corridor include Portage Valley, Johnson, Bishop, and Foster Creeks and two unnamed creeks. Salmon have not been reported in Portage Valley Creek. Pink and chum salmon use Johnson Creek. Pink salmon are present in Bishop Creek and the two other unnamed streams. Foster Creek provides about 3 miles of pink and chum salmon habitat (Resource Analysts, 1984; BBRMP, 1985).

Sockeye Salmon (Oncorhynchus nerka): This species is the most important commercial salmon of the Bering Sea. Sockeye spawning runs are widespread throughout Bristol Bay and along the northern side of the Alaska Peninsula (Fig. III-5). Bristol Bay produces more sockeye than any other area in the world. Major Bristol Bay runs are in the Kvichak, Naknek, and Nushagak Rivers. Bristol Bay sockeye runs peak every 5 years. Restraints on the fishery in 1974 and 1975 resulted in stronger runs in 1980, 1981, and 1983. On the northern side of the Alaska Peninsula, nearly every drainage supports a run of sockeye. Major runs occur in the area from the Bear River to north of Port Moller, and in the Nelson, Sandy, and Ilnik Rivers. On the southern side of the Peninsula, there are numerous, but small, runs including those on Shumagin Island and in the Stepovak and Chignik Rivers.

Sockeye use areas in and adjacent to the lease area during their spawning migrations and seaward migrations as juveniles. Mature sockeye have been captured in many places throughout the Bering Sea during their spawning migrations. In May and early June, stocks from the northern portions of the Bering Sea and stocks from the Gulf of Alaska which have migrated through the Aleutian passes begin to move into Bristol Bay. These prespawning adults concentrate in two bands offshore (one north and one south of the Pribilof Islands), and traverse Bristol Bay as they migrate to rivers around Bristol Bay, along the northern side of the Alaska Peninsula and in Kuskokwim Bay. Spawning runs occur from July to September (Musienko, 1970; Barton, 1979; Morrow, 1980), with sockeye most abundant on the southeastern Bering Sea shelf between mid-June and late July as they migrate to their natal streams (Thorsteinson, 1984). Following spawning, fry emerge in the spring, generally between April and June (Morrow, 1980). A few sockeye populations have individuals that migrate immediately to the sea, but most sockeye spend 1 to 2 years in fresh water before migrating to the ocean (Lewbel, 1983).

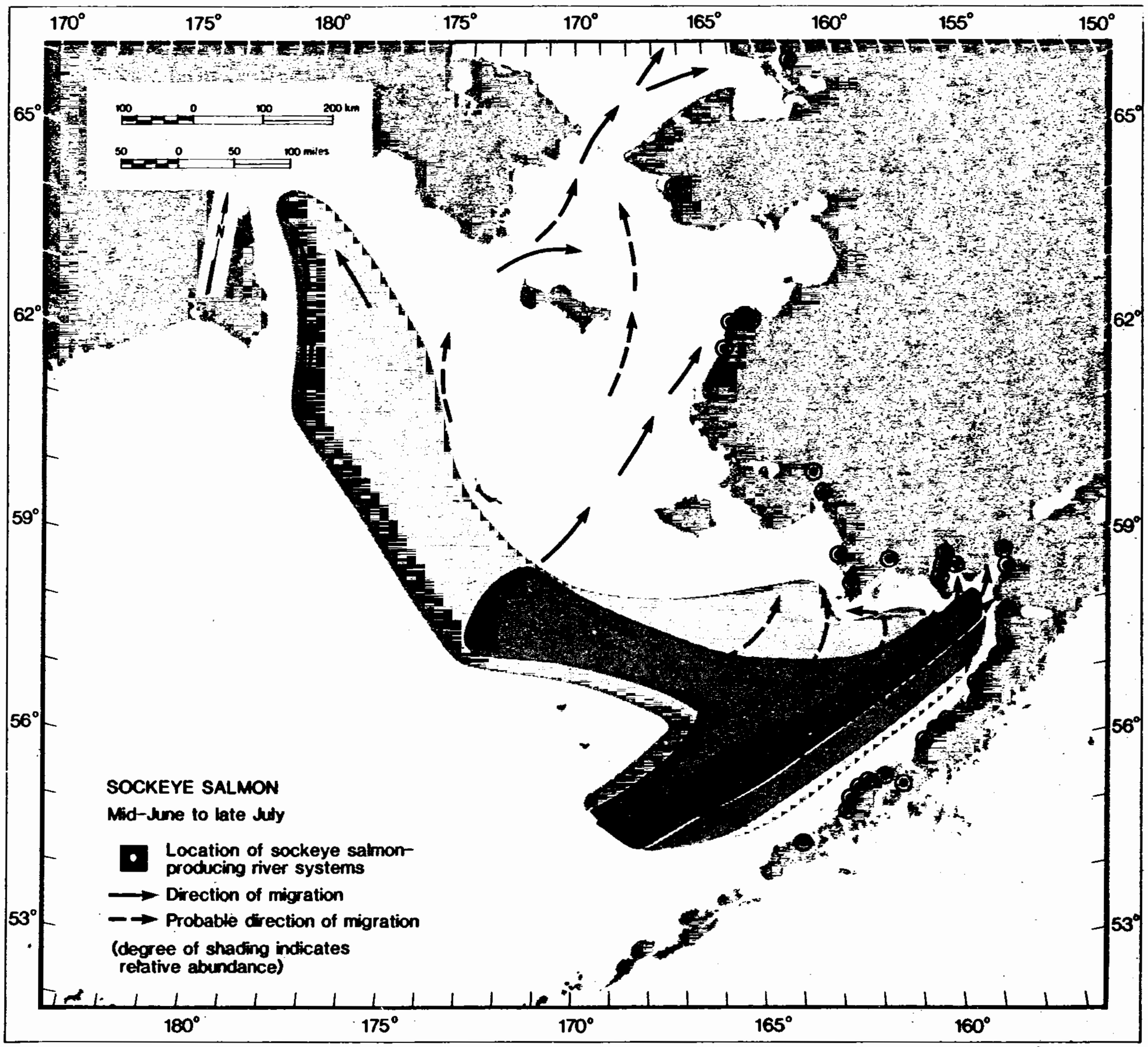
Juveniles are abundant in the North Aleutian Basin Planning area from mid-May through at least September (Thorsteinson, 1984). Juveniles originating in rivers along Bristol Bay and along the northern side of the Alaska Peninsula enter the Bering Sea at different times during late spring and early summer, depending on environmental conditions. Young sockeye leave Bristol Bay from mid-May to August, with a peak around June. Juveniles leave the northern side of the Alaska Peninsula during the same period, but peak later. Young sockeye entering the sea are segregated during the first weeks of seaward migration by age, class, and origin, so they are distributed throughout most of the migration-route area from late May through late July. From late May to early August, the greatest biomass of juveniles occurs along the coast of Bristol Bay to north- east of Port Heiden (Straty, 1974). Food is less abundant in inner Bristol Bay than farther seaward, so juveniles move rapidly to the Port Heiden area, which has a more abundant food supply (Thorsteinson, 1984). After early August, the majority of the sockeye occur west (seaward) of Port Heiden. The young move westward along the northern shore of the Alaska Peninsula (Fig. III-6), and eventually turn north or move south through the Aleutian passes.



Source: Thorsteinson, L.K. (ed.), 1984 (from Straty, 1981).

FIGURE III–5

DISTRIBUTION OF SOCKEYE SALMON DURING SEAWARD MIGRATION, MID-MAY THROUGH SEPTEMBER.



Source: Thorsteinson, L.K. (ed.), 1984 (from Straty, 1981).

FIGURE III-6

DISTRIBUTION OF SOCKEYE SALMON DURING SPAWNING MIGRATION.

From late May to late September, the juveniles travel in a belt between the coast and 48 kilometers offshore, avoiding the colder offshore waters (Thorsteinson, 1984). These seaward-migrating juveniles are most abundant in the upper 2 meters of the water column during the day and in the uppermost meter at night (Straty, 1974). Sockeye usually spend 1 to 3 years in the sea before returning to their natal streams to spawn.

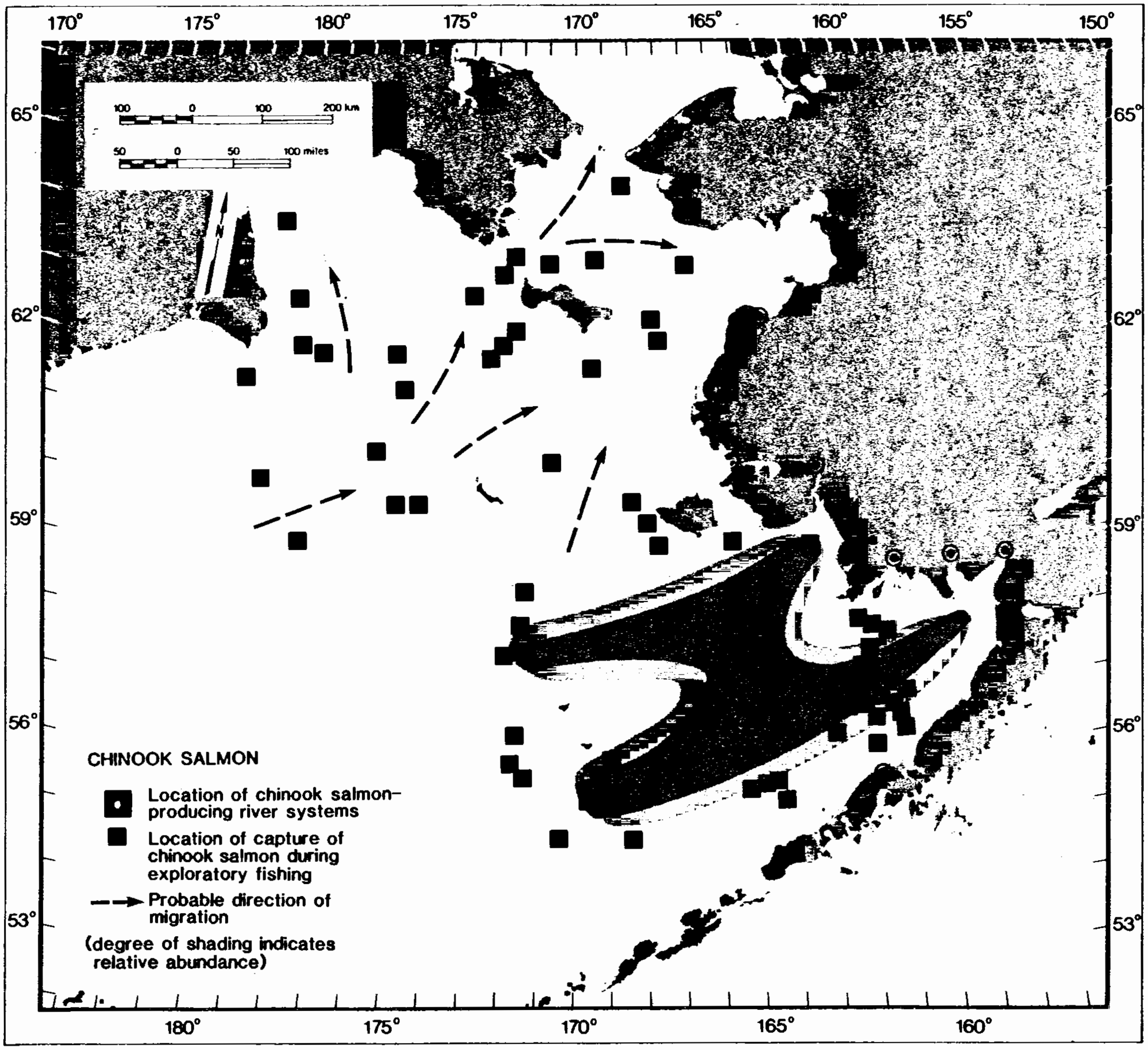
Juveniles feed on euphausiids, copepods, cladocerans, and sand lance. Adults prey on copepods, euphausiids, amphipods, and small fish (Hart, 1973; Nishiyama, 1977; Morrow, 1980).

Chinook Salmon (Oncorhynchus tschawytscha): Chinook are widely distributed throughout the Bering Sea, but are relatively low in abundance. This salmon species comprises approximately 2.2 percent of the commercial catch for the Bering Sea (Straty, 1981). Bristol Bay supports approximately 40 percent of the total annual chinook production (Straty, 1981).

Chinook salmon enter the Bering Sea through Unimak Pass and migrate some distance offshore through the Bering Sea toward their natal streams along the Alaska Peninsula and Bristol Bay (Fig. III-7). This species is more abundant farther offshore of the northern side of the Alaska Peninsula than sockeye (Thorsteinson, 1984). The Nushagak River supports the largest run of chinook into Bristol Bay, but the Togiak, Alagnak, Naknek, and Mulchatna River systems all support major runs. Bristol Bay-area populations have increased in recent years; runs in 1981 and 1982 were particularly high. Streams and rivers on the northern side of the Alaska Peninsula also support significant numbers of spawning salmon, particularly the Sapsuk River system (Nelson Lagoon), the Meshik River system (Port Heiden), and the Cinder River. On the southern side of the Alaska Peninsula, chinook are found concentrated in the Chignik River system.

Chinook spawning migrations into Bristol Bay occur from mid-June to July. Eggs hatch in 7 to 12 weeks, and alevins generally emerge in 2 to 3 weeks. Chinook fry live in fresh water for 1 to 2 years before migrating to the sea. Juveniles are most abundant along the southeastern coast of the Bering Sea; few have been caught in Bristol Bay, perhaps because sampling has not been conducted during periods of assumed peak abundance (late April-May) or because, for some unexplained reason, they have been missed by fishing gear (Thorsteinson, 1984). After migrating to the sea, smolts remain in coastal waters during their initial months (Straty, 1981). They are most abundant across the North Aleutian Basin Planning Area from April 21 to June 1 (Thorsteinson, 1984). Juveniles move out of coastal waters, migrating seaward during May and early June, earlier than the offshore migration of other salmon species (Thorsteinson, 1984). Immatures spend 1 to 6 years in the ocean before returning to spawn. Thorsteinson (1984) reported that 2 percent of the immatures had spent 1 year at sea; 77 percent had spent 2 years; 19 percent had spent 3 years; and 2 percent had spent 4 to 6 years. Maturing chinook have been captured throughout the Bering Sea during their spawning migrations, but the route of this migration has not been established in detail. Straty (1981) hypothesized that chinook follow the same migration route as other salmon species in responding to the same environmental clues.

Scott and Crossman (1973) reported that 97 percent of the chinook diet consists of herring, sand lance, capelin, and smelt. Although chinook are highly



Source: Thorsteinson, L.K. (ed.), 1984 (from Straty, 1981).

FIGURE III–7

DISTRIBUTION OF CHINOOK SALMON DURING SPAWNING MIGRATION, EARLY JUNE TO MID-JULY.

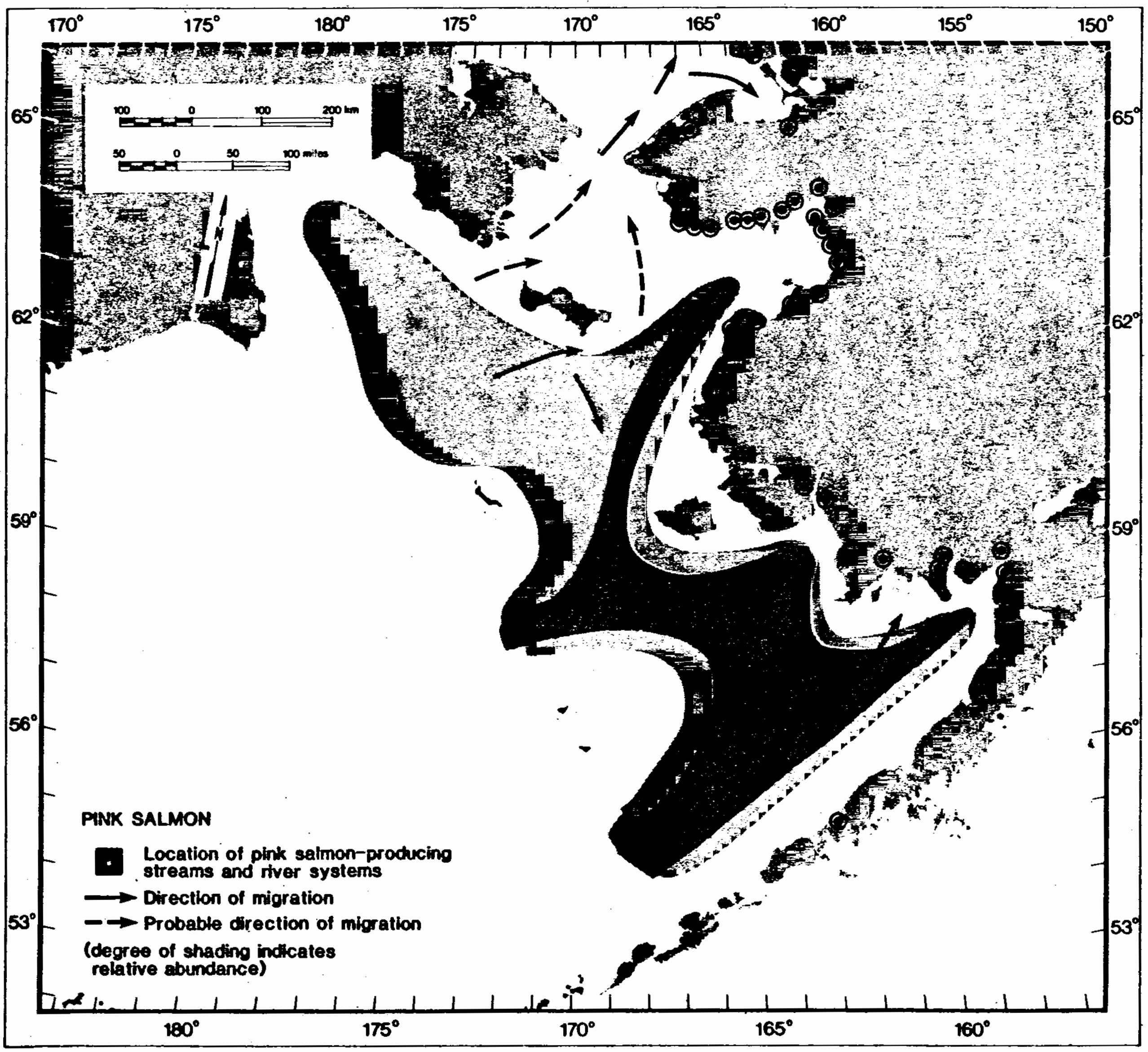
piscivorous, they also consume some squid, amphipods, euphausiids, and crustaceans.

Pink Salmon (Oncorhynchus gorbuscha): Of the three commercially important salmon species in the Bering Sea, pink salmon is the least abundant. Within the Bering Sea, 92 percent of the pink salmon production is from Bristol Bay (Lewbel, 1983), where the primary system is the Nuyakuk River, a tributary to the Nushagak River. On the northern side of the Alaska Peninsula, pink salmon are not abundant, but they occur in limited numbers in several systems in Bechevin Bay. On the southern side of the Alaska Peninsula, pink salmon is the major species, including streams on Deer Island. Populations of pink salmon have increased greatly in this area during the past 20 years. Streams in the Chignik district support pink runs that declined due to severe winters in 1970 and 1971, but the runs have approached historical levels since 1978.

Pink salmon have been captured throughout offshore areas of the Bering Sea during their spawning migrations (Fig. III-8). The heaviest concentrations are in two bands north and south of the Pribilof Islands. The band south of the Pribilofs, which migrates through Bristol Bay, heads primarily for rivers entering Bristol and Kuskokwim Bays and a few streams along the northern side of the Alaska Peninsula. Spawning runs occur from July to October. Pink salmon rarely migrate more than 160 kilometers upstream, and some spawn in intertidal areas (Lewbel, 1983). The young hatch from December to February and remain in the gravel as yolk-sac larvae until spring.

After emerging, fry immediately migrate seaward, where they form large schools in estuaries and remain nearshore for their first summer. Juveniles captured in Bristol Bay after late June are primarily in coastal areas of inner Bristol Bay east of 159°W longitude, where they increase in abundance from late June through mid-August (Thorsteinson, 1984). Pink salmon do not reach the outer coastal areas of inner Bristol Bay until late August and September, and they are not abundant in the North Aleutian Basin Planning Area until sometime in September or October (Thorsteinson, 1984). Once in the sea, fry remain on the continental shelf in areas with estuarine salinities (Straty, 1981). Adult pink salmon are widely distributed during their ocean period. With few exceptions, they return to spawn after 2 years. Prey of adult pink salmon are believed to be similar to that of other salmon species, including euphausiids, squid, amphipods, and small fish.

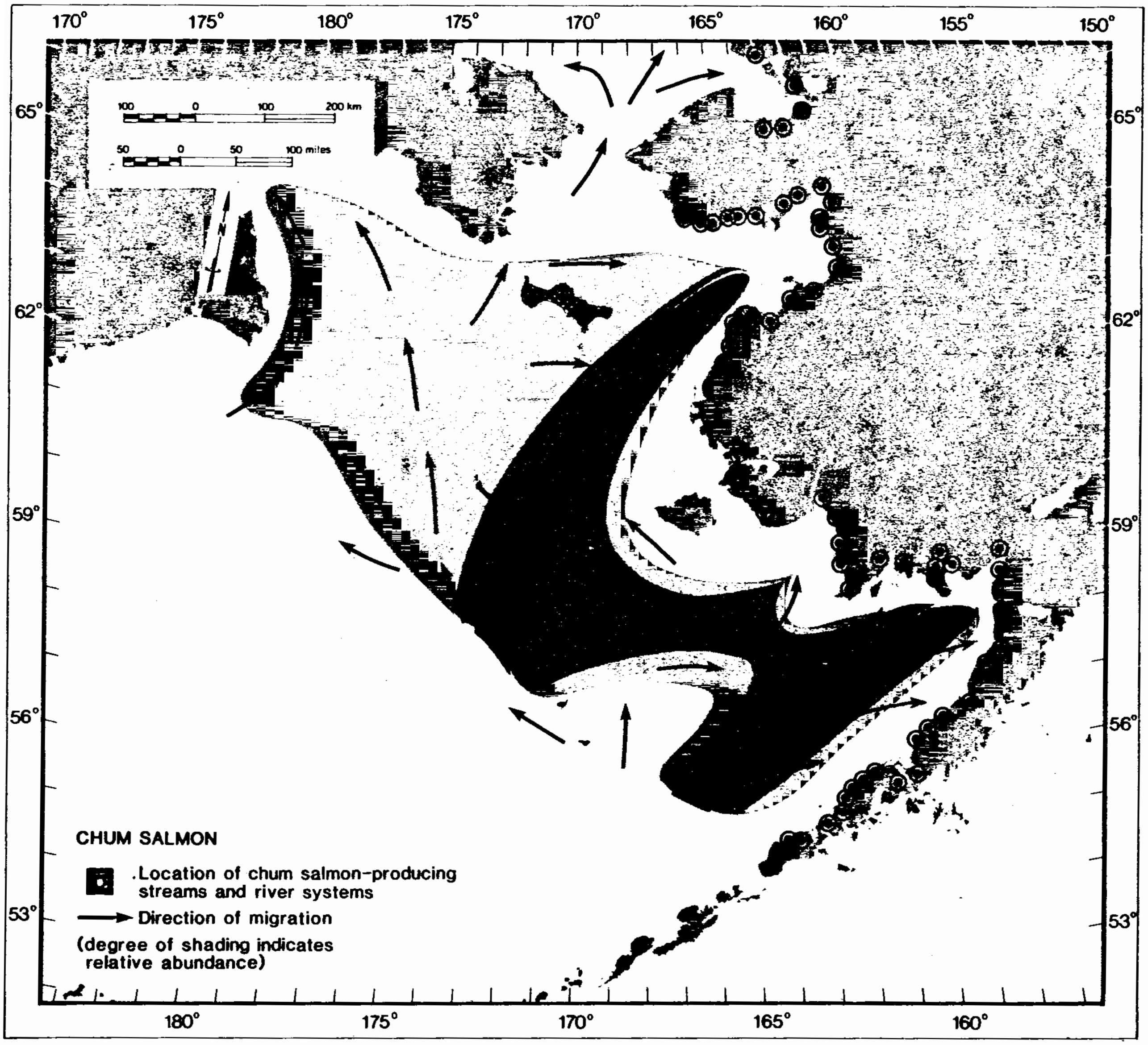
Chum Salmon (Oncorhynchus keta): Chum salmon are widely distributed throughout the Bering Sea. During their spawning migrations, chum are more extensively distributed throughout the Bering Sea than are sockeye (Fig. III-9) (Thorsteinson, 1984). In Bristol Bay, chum salmon are produced largely in the Nushagak, Togiak, and Naknek-Kvichak River systems. Bristol Bay chum populations are stable. On the northern side of the Alaska Peninsula, major systems used by this species include: Izembek-Moffet Bay, Bechevin Bay, the Sapsuk River (Nelson Lagoon), Herendeen-Moller Bay, and Frank's Lagoon. Populations in these areas fluctuate in size. On the southern side of the Alaska Peninsula, chum salmon inhabit every bay east of False Pass, with major runs at Stepovak, Canoe, Balboa, Volcano, and Belkofski Bays. In the Chignik area, chum use the same streams as pink salmon.



Source: Thorsteinson, L.K. (ed.), 1984 (from Straty, 1981).

FIGURE III-8

DISTRIBUTION OF PINK SALMON DURING SPAWNING MIGRATION, MID-JUNE TO MID-AUGUST.



Source: Thorsteinson, L.K. (ed.), 1984 (from Straty, 1981).

FIGURE III-9

DISTRIBUTION OF CHUM SALMON DURING SPAWNING MIGRATION, MID-JUNE TO EARLY AUGUST.

Chum salmon use areas in and adjacent to the lease area for their spawning migrations and their seaward migrations as juveniles. During their spawning migrations, chum concentrate in two bands north and south of the Pribilofs. The southern band traverses Bristol Bay and includes fish returning to rivers in Bristol and Kuskokwim Bays and on the northern side of the Alaska Peninsula. While migrating through outer Bristol Bay, these salmon begin to segregate according to the location of their spawning streams. By mid-June and late July, they are most abundant on the southeastern Bering Sea shelf, with largest numbers found in estuaries and at the mouths of streams. Most populations of chum salmon are fall spawners (August-November) (Lewbel, 1983). Chum salmon sometimes spawn in intertidal areas.

Following emergence, fry migrate to the sea. Small numbers of young have been captured in the coastal waters of Bristol Bay as early as mid-June, but they generally are not abundant until after mid-July (Thorsteinson, 1984). Once they reach the sea, juveniles remain in nearshore areas for several months before migrating offshore in the early fall. Young fish follow estuarine salinities as they feed and migrate along the continental shelf (Straty, 1981). Juveniles have been found to remain abundant along the southwest coast of Bristol Bay (seaward of 159°W longitude) through August and until at least mid-September (USDOC, NOAA, NMFS, 1966-72). Chum generally spend 3 to 4 years at sea before returning to fresh water to spawn. Adults feed on euphausiids, amphipods, squid, and planktonic crab larvae (Hart, 1973).

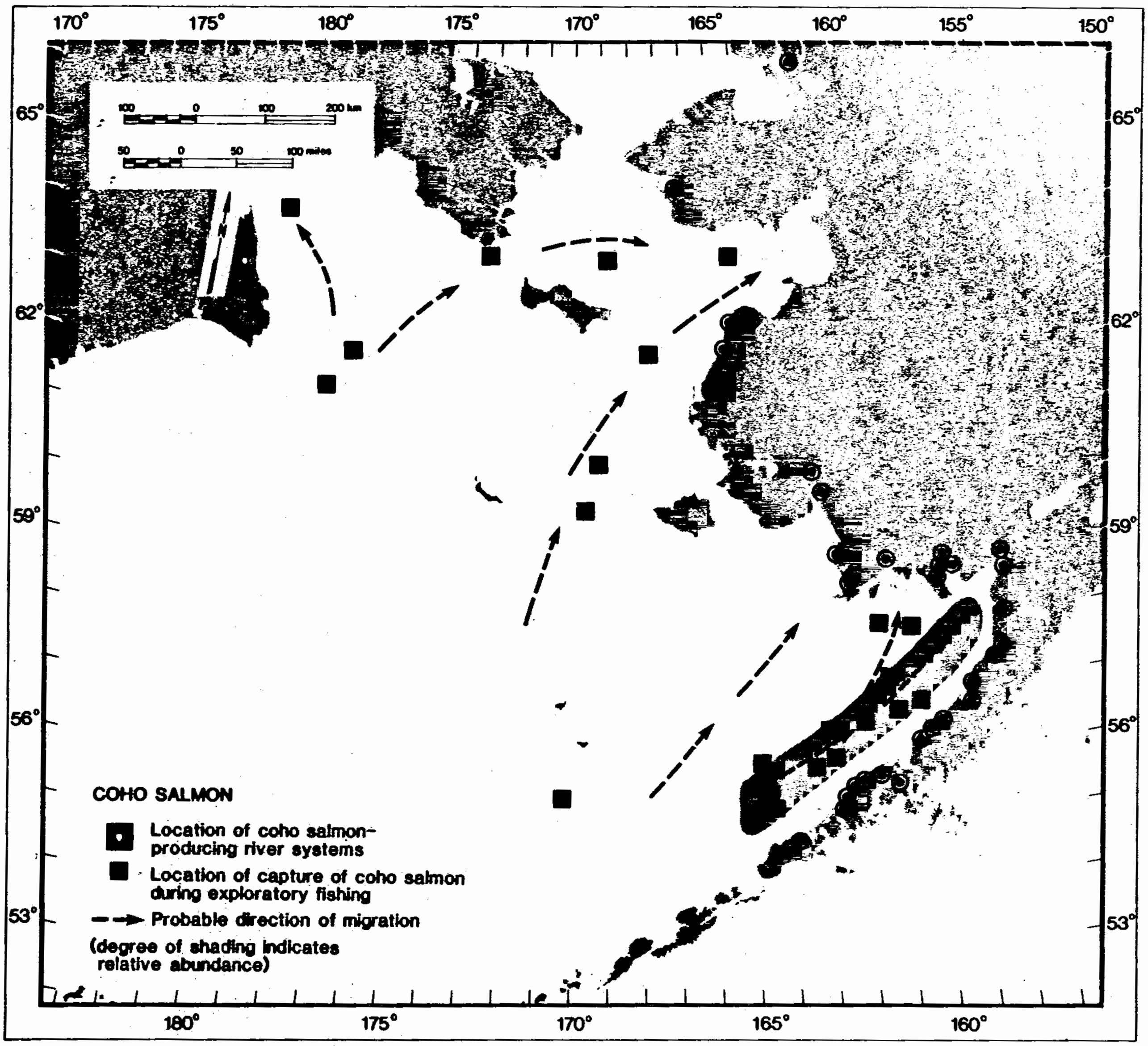
Coho Salmon (Oncorhynchus kisutch): Coho is the least abundant salmon species in the Bering Sea (Fig. III-10). The most abundant populations of maturing coho in the Bering Sea (in decreasing order) are in Kuskokwim Bay, Bristol Bay, and along the northern side of the Alaska Peninsula (Straty, 1981). Coho are found in streams throughout Bristol Bay, but are harvested primarily in the Nushagak and Togiak Rivers. On the northern side of the Alaska Peninsula, coho are harvested at Nelson and Swanson Lagoons, and at the Ilnik River, Port Heiden, and the Cinder River. On the southern side of the Alaska Peninsula, the Chignik River produces most of the coho.

Mature coho salmon enter the Bering Sea shelf areas in mid- to late July on their spawning migrations and begin to congregate at river mouths in late summer. Spawning runs are generally from September to October. Fry emerge from the gravel from March to July, depending on water temperatures (Hart, 1973; Scott and Crossman, 1973). Juveniles remain in fresh water for 1 to 3 years before entering the ocean.

Coho is the salmon species whose juveniles enter Bristol Bay latest each year on their seaward migrations. Although they have been captured along the southeast coast of Bristol Bay as early as mid-June, coho are not abundant until late June or early July (USDOC, NOAA, NMFS, 1962-66); they remain abundant throughout July and August. Smolt remain nearshore and near-surface for several months, feeding before moving farther offshore.

Juveniles feed on small fish and planktonic crustaceans. Adults feed on squid, euphausiids, and small fish. Herring and sand lance may make up to 80 percent of the adult coho diet (Morrow, 1973; Scott and Crossman, 1973).

Pacific Herring (Clupea harengus pallasi): This pelagic species is abundant and widespread in the Bering Sea, where it is important both commercially and



Source: Thorsteinson, L.K. (ed.), 1984 (from Straty, 1981).

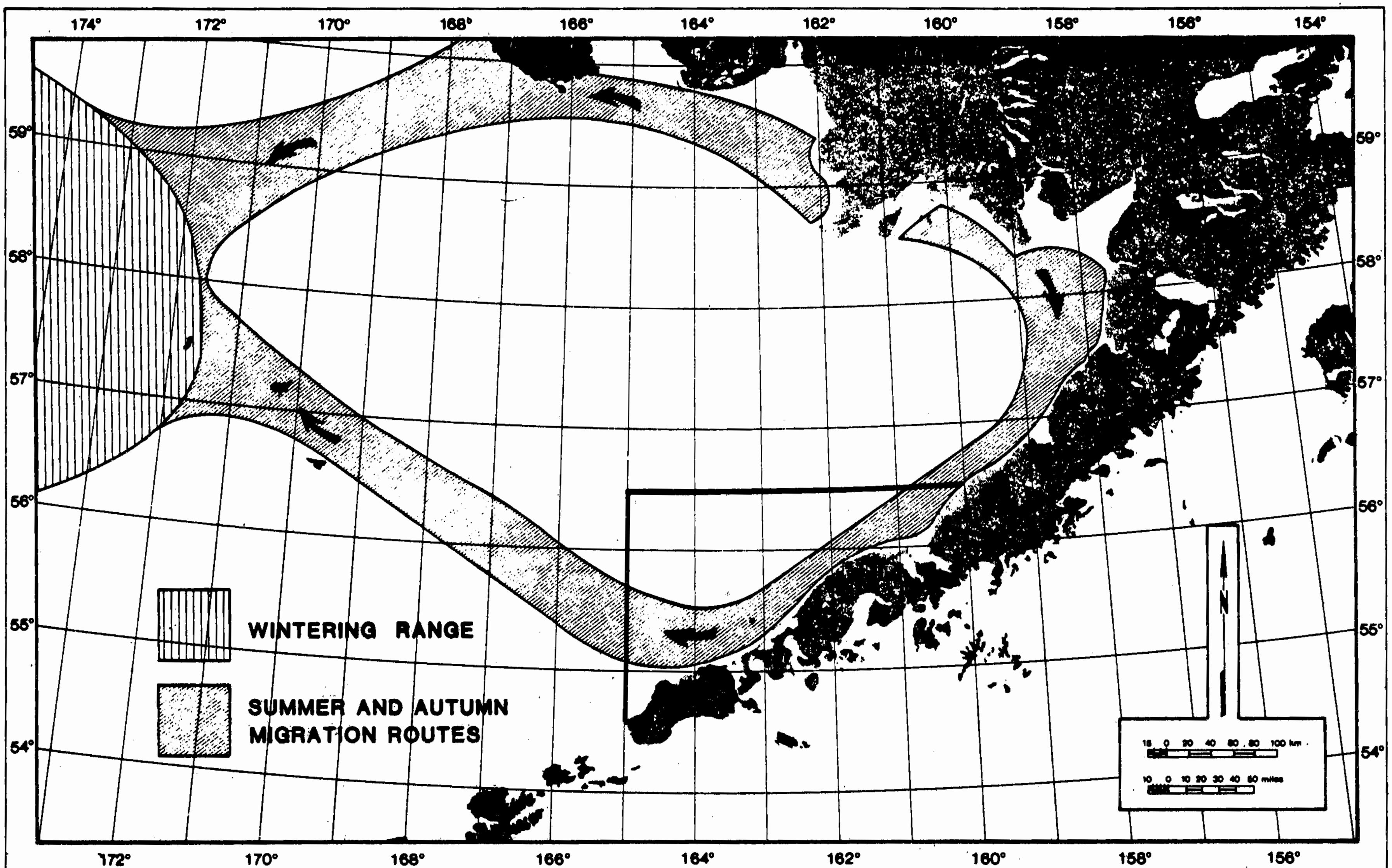
FIGURE III–10

DISTRIBUTION OF COHO SALMON DURING SPAWNING MIGRATION, EARLY SEPTEMBER.

as a forage fish. Herring migrate along the Alaska Peninsula or traverse the lease area as they move between their offshore overwintering grounds and shallow, coastal areas where they spawn (Fig. III-11). The nearshore areas used for spawning, along the northern side of the Alaska Peninsula (i.e., Port Moller), are adjacent to the lease area.

Herring have a seasonal distribution in the Bering Sea. This species overwinters in offshore waters near the edge of the continental shelf. Identified overwintering grounds include an area between St. Matthew Island and the Pribilofs (Warner and Shafford, 1981; Wespestad and Barton, 1981), and the Navarin Basin (Morris, 1981; Wespestad and Barton, 1981). In the spring, adults migrate from their overwintering grounds, through or along the lease area, to nearshore spawning areas. This major wintering ground of eastern Bering Sea herring is northwest of the Pribilofs, between approximately 57° and 59°N latitude, and encompasses an area of 1,600 to 3,000 square kilometers (Shaboneev, 1965) which shifts in relation to the severity of the winter. In mild winters, herring concentrate farther north and west, and in severe winters, further south and east. Dense schools are found during the day a few meters off the bottom at depths of 105 to 137 meters, at water temperatures of 2° to 3.5°C (Dudnik and Usoltsev, 1964). Very few are found in more shallow areas on the continental shelf, where lower temperatures prevail. Distinct diurnal, vertical migrations occur in early winter; however, as the season progresses, diurnal movements diminish and herring remain on-bottom during the day and slightly off-bottom at night (Shaboneev, 1965). Only a small number of herring are believed to remain offshore in the summer; most inhabit coastal waters. Herring are believed to remain in coastal waters in the summer because of heavy phytoplankton blooms (1-3 g/m^3) in nearshore waters and poor feeding conditions on the outer shelf (Rumyantsev and Darda, 1970). In late summer, herring migrate along the coast and concentrations begin reappearing in offshore waters in the areas of Nunivak and Unimak Islands in August (Rumyantsev and Darda, 1970). Migrations to the winter grounds continue through September, with the herring progressively moving to deeper water and concentrating in the 2°- to 4°C-temperature stratum (Wespestad and Barton, 1981). Mature fish arrive at the wintering grounds before the immature fish arrive (Rumyantsev and Darda, 1970), with concentration in wintering grounds beginning in October (Wespestad and Barton, 1981).

Pacific herring spawn in two types of habitats along the northern side of the Alaska Peninsula: (1) rocky headlands and (2) intertidal or shallow subtidal bays and lagoons (Barton, 1978; Hameedi, 1982). The preferred spawning substrate is vegetation, usually rockweed kelp (*Fucus*) or eelgrass (*Zostera*) (Barton, 1979b; Morris, 1981; Warner and Shafford, 1981). During dense spawning, other substrates may be used, including bare rock, *Laminaria* species pilings, and submerged tree branches (Reid, 1972; Hart, 1973). South of Norton Sound, most spawning occurs on *Fucus* in the intertidal zone (Wespestad and Barton, 1981). In the southeastern Bering Sea, herring spawning has been documented only along the northern shore of Unimak Island, in Herendeen Bay, and in Port Heiden (Jackson and Warner, 1976; Warner and Shafford, 1981). There has been speculation of herring spawning in Bechevin Bay because of its eelgrass beds; however, this has not been confirmed. Based on Soviet research, similarities in age composition, and the distribution of Japanese trawl catches during spawning migrations, it is believed that most of the herring that overwinter near the Pribilof Islands spawn in Bristol Bay or in



Source: Thorsteinson, L.K. (ed.), 1984.

FIGURE III-11

BERING SEA HERRING SUMMER AND FALL MIGRATION ROUTES IN RELATION TO PROPOSED NORTH ALEUTIAN BASIN LEASE AREA.

the areas between the Yukon and Kuskokwim Rivers (Wespestad, 1978; Barton, 1979). The relative abundance of spawning herring along the northern side of the Alaska Peninsula (Port Moller and Port Heiden) is low compared to other areas (i.e., Togiak, Cape Newenham) (Wespestad and Barton, 1981). In the eastern Bering Sea, herring biomass was estimated to be 2.16 million metric tons, based on a Soviet hydroacoustic survey of the wintering grounds in 1963 (Shaboneev, 1965). Spawning time varies with latitude, beginning earlier in the south (i.e., late May at Port Moller) (Rumyantsev and Darda, 1970; Barton, 1979). Some herring spawn for the first time at age 2, but the majority do not spawn until ages 3 (50% mature) and 4 (78% mature) (Wespestad and Barton, 1981). By age 5, 95 percent of the population has matured (Rumyantsev and Darda, 1970). Sexual maturity of eastern Bering Sea herring coincides with recruitment into the fishery, primarily at ages 3 and 4 (Wespestad and Barton, 1981).

Following spawning, adults move offshore to feed in deeper waters. Eggs hatch in 10 to 23 days (Musienko, 1970; Hart, 1973) depending on water temperature. Hatching success is usually low due to failure of fertilization, dessication during low tides, uprooting of substrate, or predation. A hatching rate of 50 percent is considered high, but hatching success may be as low as 1 percent (Morris et al., 1983). Larvae are pelagic drifters during their 6- to 8-week planktonic stage. Concentrations of larval herring occur in nearshore areas. Larvae generally remain within the vicinity of their hatching locations (Checkley, 1983a). Abundance of larvae decreases exponentially in relation to distance offshore, which indicates that their movement offshore is controlled by diffusion rather than by advection or directed swimming (Checkley, 1982). The distribution and abundance of herring larvae are related to the presence of abundant prey (copepod, nauplii, and microzooplankton) (Checkley, 1983b). In ichthyoplankton surveys, herring larvae have been collected in shallow waters in Bristol Bay and Norton Sound, and are scarce in offshore areas (outside the intertidal areas, where spawning occurs) (Waldron, 1981). Larval mortality is also high and has been attributed to larvae being caught in offshore currents and presumably perishing (Morrow, 1980).

After larval metamorphosis, free-swimming juvenile herring inhabit kelp beds for protection during their first summer. By fall, they form dense schools and start to move offshore (Taylor, 1964). The movements of juveniles in the Bering Sea from the time they leave the coast following their first summer until they are recruited into the adult population are not documented specifically, but their general seasonal movements are known. Juveniles feed in coastal waters in the summer, and move to deeper waters in the winter (Rumyantsev and Darda, 1970). Significant numbers of age-1 herring have been observed in June in nearshore waters of Hagemeister Strait in northern Bristol Bay (Barton, 1979b). In October, after migrating along the Alaska Peninsula, immature herring are found from St. Matthew Island almost to the shelf break (Wespestad and Barton, 1981, modified by Rumyantsev and Darda, 1970), and they overwinter in this area to the northwest of the Pribilof Islands (Hameedi, 1982).

Herring fry feed on immobile prey, such as diatoms. Adult herring feed on copepods, amphipods, euphausiids, and fish fry (Hart, 1973; Barton, 1979; Morrow, 1980).

Capelin (Mallotus villosus): This forage fish is distributed throughout the Bering Sea, including most coastal areas, and extending offshore to the continental shelf break (Lewbel, 1983). Capelin are found in large bathypelagic schools, often long distances from shore, during much of the year (Macy et al., 1978). Nearshore waters of the North Aleutian Basin Planning Area are traversed by large schools of capelin that have been encountered during the herring fishery in April and May. Capelin are believed to be the most abundant forage species in the spring and summer (Thorsteinson, 1984).

Mature adults migrate toward the shore in the spring and spawn from May through July (Musienko, 1970; Warner and Shafford, 1981). Capelin usually begin to spawn at 2 years of age. Specific spawning locations used by capelin along the northern shore of the Alaska Peninsula are not well-defined. Capelin are believed to use the area between Moffet Point and Port Heiden (Jackson and Warner, 1976) and north to Cape Menshikof (Barton, 1977b). They may spawn over a broader area from Urilia Bay into Bristol Bay. Areas around Port Moller (Herendeen Bay) and Port Heiden have been observed being used for spawning (Hale, 1983). It is also known that capelin use sand or gravel beaches for spawning at night during high tides and that eggs can be found at or below the high-tide mark (Warner and Shafford, 1979). In some years, capelin reproduce en masse along open beaches to the extent that windows of trapped capelin may be observed for miles. Capelin have very specific grain-size requirements (0.5- to 1.5-mm diameter pebbles) for spawning substrate (Warner and Shafford, 1981). The types of substrates preferred by capelin are very prominent along the northern shore of the Alaska Peninsula (Michel et al., 1982). In addition, offshore spawning has been reported to depths of 280 meters, but usually occurs in water less than 75 meters deep (Hale, 1983).

The cohesive eggs form small masses that adhere to the gravel substrate (Musienko, 1970). Depending on temperature, eggs hatch in 1 to 4 weeks (Musienko, 1970; Macy et al., 1978; Warner and Shafford, 1981). Distribution of capelin larvae in the Bristol Bay area is only generally known. Since capelin spawn on beaches from Moffet Point to Point Heiden, the larval distribution is assumed to include the coastal nearshore waters adjacent to the beaches between these points. Larvae, hatched from eggs deposited on beaches, drift in the nearshore zone during the summer months, until winter temperatures force them into deeper waters (Warner and Shafford, 1979). There also are indications, however, that larval distributions are more widespread than just in coastal waters. Capelin larvae have been caught in ichthyoplankton surveys in the Bering Sea, generally south of 60°N latitude, almost exclusively over the continental shelf and extending into the easternmost part of Bristol Bay (Waldron, 1981).

Capelin prey primarily on small crustaceans, including euphausiids, amphipods, decapod larvae, and copepods, and on small fish (Hart, 1973; Macy et al., 1978; Vesin et al., 1981).

Pacific Sand Lance (Ammodytes hexaptera): In the Bering Sea, sand lance are present in much of Bristol Bay, along the Aleutian Chain, south of St. Lawrence Island, and along the coast near the Yukon and Kuskokwim deltas (Waldron, 1981). Their distribution and abundance appear to be related to temperature (Lewbel, 1983), with sand lance showing an affinity for warmer waters.

In the Bering Sea, it is believed that sand lance spawn in the winter in areas with sandy substrates (Lewbel, 1983). The demersal, adhesive eggs usually hatch within a month, depending on the temperature (Macy et al., 1978). Yolk-sac larvae bury themselves in the sandy substrate until their yolks have been absorbed. Once they emerge, the larvae are pelagic. Sand lance larvae have been captured near the Pribilofs from July to September (Musienko, 1963). Sand lance distribution and abundance along the Alaska Peninsula is described in Houghton (1984). Of the fish captured in a 1984 sampling, sand lance was the dominant species, comprising 62.6 percent of all fish captured, which indicates that sand lance is one of the most important species of forage fish in the southeastern Bering Sea. From late June to mid-August, densities appeared greater in the inshore waters. They were widely, but irregularly, distributed throughout the study areas. Concentrations were found in and outside Port Moller during late June to mid-July and in Izembek Lagoon from mid-August to mid-September. After mid-July, there was a progressive, significant decline in catches and a shift from the inshore waters into midbay by midsummer. By late summer, there was a strong offshore movement.

Sand lance larvae feed on phytoplankton (Macy et al., 1978). Adults prey on crustaceans, barnacle larvae, copepods, and chaetognaths (Clemens and Wilby, 1949; Hart, 1973; Macy et al., 1978). Sand lance are important as forage fish for numerous other species including halibut, coho, and chinook salmon.

Rainbow Smelt (Osmerus mordax): This smelt is distributed along the entire coastline of the Bering Sea. They generally occur in the continental shelf area to depths of 120 meters (Macy et al., 1978). Rainbow smelt are a schooling pelagic fish.

Rainbow smelt migrate upstream to spawn in the spring. The eggs are adhesive and attach to the substrate. Eggs incubate for 19 to 29 days (McKenzie, 1964), depending on temperature. Larvae drift downstream to lakes or estuaries after hatching.

Larval smelt feed on copepods, amphipods, cladocerans, and aquatic insects (Scott and Crossman, 1973). As they grow, smelt feed on mysids and amphipods, and as adults they become piscivorous, feeding on cod and other small marine and anadromous fish (Macy et al., 1978).

Eulachon (Thaleichthys pacificus): The Bering Sea distribution of this smelt includes both coastal and oceanic areas. They inhabit waters around the Aleutian Chain and the Pribilof Islands and in most of Bristol Bay (Hart, 1973; Scott and Crossman, 1973; Carl et al., 1977). These anadromous fish are especially abundant in the Meshik-Port Heiden area from mid-April through July (Thorsteinson, 1984).

Eulachon are present in the lease area and adjacent nearshore areas. These anadromous fish spend most of the year in marine or estuarine waters before returning to spawn from March to May in deep rivers with coarse-sand or gravel substrates (Scott and Crossman, 1973). Most eulachon die after spawning, but a few survive and return the following year to spawn again (Barraclough, 1964). The demersal, adhesive eggs hatch in 3 to 6 weeks, depending on the temperature. Because the larvae are weak swimmers, many are carried out to estuarine areas (Hart, 1973), but some remain in backwater areas. Spawning occurs after 2 or 3 years of growth (Warner and Shafford, 1981).

Young eulachon feed on larval and adult copepods, mysids, ostracods, and cladocerans (Hart, 1973). Adults feed on euphausiids (Barraclough, 1964; Hart, 1973) and small fish (McPhail and Lindsey, 1970).

Walleye Pollock (Theragra chalcogramma): This species is the most abundant demersal fish on the continental shelf in the Bering Sea and is estimated to comprise approximately 55 percent of the total biomass of all demersal fish in the Bering Sea (Morris, 1981). Large schools of pollock occur on the outer continental shelf and upper slope, from the surface to 500 meters in depth. Pollock populations declined in the early 1970's because of overharvesting by foreign fisheries, but slowly increased to a standing stock biomass of approximately 7.5 million tons by 1979 (Thorsteinson, 1984). The Bering Sea stock is currently stable, although smaller than prior to its decline. Pollock also are found along the southern side of the Alaska Peninsula. All lifestages of this species inhabit the waters of the North Aleutian Basin lease area: juveniles, eggs, larvae, and adults.

Pollock undergo seasonal and diurnal migrations associated with spawning and feeding in the eastern Bering Sea. Pollock distribution appears to be related to water temperature (Morris, 1981). Overwintering occurs along the outer shelf and upper slope at depths of 150 to 300 meters, where bottom temperatures are warmer (Morris, 1981). As water temperatures rise in the spring, pollock move to more shallow waters (90 to 140 m), where they spawn. From March through July, spawning occurs along the outer shelf, with major concentrations of spawning fish between the Pribilof Islands and Unimak Island (Lewbel, 1983). Pollock also move vertically in the water column. Adults aggregate near the bottom during the day and rise to near-surface waters in the evening to feed.

Spawning occurs from February through July from off the shelf edge into approximately 90-meter water depths along the outer shelf. The eggs are pelagic and abundant in surface waters until they hatch in 2 to 3 weeks, depending on the water temperature (Lewbel, 1983). The larvae also are pelagic and remain in surface waters until they are 35 to 50 millimeters long, when they begin a demersal existence (Pereyra et al., 1976; Morris, 1981). Larvae are most abundant between Unimak Pass and the Pribilof Islands along the continental slope (Waldron, 1981). In the summer, they show a more widespread distribution from the Aleutian Islands to 60°30'N latitude, and from well up on the continental shelf in Bristol Bay across the central basin to 177°E longitude (Waldron, 1981). Larvae may take 2 or 3 months to develop into juveniles, depending on water temperature. Juvenile pollock are found in near-surface waters. Groundfish-trawl surveys have found 2- to 4-month-old pollock over a large area of the northwestern outer shelf, with highest concentrations of 0-age juveniles directly west of the Pribilof Islands (Smith, 1981). Following spawning along the southeastern outer continental shelf, the northwest drift apparently carries larvae and metamorphosing juveniles to the vicinity of the Pribilofs (Smith, 1981). The North Aleutian Basin lease area and adjacent nearshore areas also are important as a nursery area for pollock (USDOC, NOAA, NMFS, 1980). By 1 year of age, pollock are distributed broadly over the entire central and outer continental shelf, completely overlapping the adult range, but also extending inshore beyond the adult range (Smith, 1981). By 2 years of age, pollock are more restricted to deep water (Smith, 1981). As they mature at age 3 to 4, juveniles join the adult demersal population on the outer continental shelf.

Larval pollock feed on copepod eggs and nauplii after their yolk reserves have been exhausted (Cooney et al., 1980). Juvenile pollock prey on larger copepods, euphausiids, and amphipods. Adults feed on copepods, euphausiids, and fish (a majority of which are juvenile pollock) (Morris, 1981).

Pacific Cod (Gadus macrocephalus): In the Bering Sea, schools of this demersal species are most abundant on the continental shelf and upper slope. Pacific cod are similar to pollock in distribution, but occur in more shallow waters, commonly at depths of 80 to 260 meters (Pereyra et al., 1976). The greatest concentrations of adult cod are at depths of less than 100 meters (Morris et al., 1983). As a result of an extremely strong year-class in 1977 (and possibly 1978), the biomass of Pacific cod has increased significantly in recent years, with a recent estimate of 0.81-0.86 million tons (Thorsteinson, 1984).

The shallow waters of the North Aleutian Basin Planning Area were not thought to be of great importance to Pacific cod until recent Outer Continental Shelf Environmental Assessment Program (OCSEAP) research catches (Thorsteinson, 1984). Adult cod are abundant along the northern side of the Alaska Peninsula throughout the area from Cape Seniavin to Cape Sarichef (Thorsteinson, 1984). Areas near Sanak Island (west of the Shumagin Islands) and deeper portions of the bays on the southern side of the Alaska Peninsula support Pacific cod during the winter and spring, as indicated by trawl catches (Thorsteinson, 1984). Pacific cod migrate seasonally between the continental slope and shelf in the Bering Sea. Cod overwinter and spawn in deeper waters in the canyons across the shelf and along the shelf edge and upper slope at depths of 100 to 400 meters, and move to more shallow waters (30-75 m) in the summer.

Life-history information on the Pacific cod is limited. These cod spawn from January to May, but the exact timing and areas of spawning are not known (Morris, 1981). The demersal eggs hatch within 10 to 20 days and the pelagic larvae are found at water depths from 25 to 150 meters, with concentrations at 75 to 100 meters (Lewbel, 1983). Larvae have been caught in ichthyoplankton surveys in the Aleutian Islands and on the continental shelf south of Nunivak Island (Waldron, 1981). Some larvae have been caught in nearshore waters (less than 50 m deep) in northern Bristol Bay, and others within the 50- to 100-meter contours (Waldron, 1981). Coastal areas with rocky bottoms are used by juveniles before they move offshore into deeper waters. The North Aleutian Shelf area is important as a nursery area for Pacific cod (USDOC, NMFS, 1980).

Pacific cod feed on benthic and planktonic organisms. They also prey on fish such as herring and sand eels, and on invertebrates including polychaetes, clams, snails, and shrimp (Morris et al., 1983; Thorsteinson, 1984). Cod are a major predator on juvenile crabs.

Rockfish: Of the 11 known species of rockfish in the Bering Sea (Quast and Hall, 1972), only the Pacific Ocean perch is abundant and used commercially. Rockfish species are primarily demersal, but are distributed from the surface to depths of up to 2,800 meters (Hart, 1973). Because little is known about Bering Sea distributions of other rockfish species, only the Pacific Ocean perch will be discussed. Other rockfish are believed to have similar life histories.

Pacific Ocean Perch (Sebastes alutus): This rockfish is present in the Bering Sea in offshore waters at depths of 0 to 600 meters (Hart, 1973) and is commonly found in and along canyons and depressions on the upper continental slope (Pereyra et al., 1976). Two main stocks have been identified in the Bering Sea: an Aleutian stock (probably the most abundant), and a stock along the continental slope in the eastern Bering Sea with large concentrations from the Pribilofs to Unimak Island. Pacific Ocean perch also are known to be present along the southern side of the Alaska Peninsula.

Pacific Ocean perch mate during the fall and winter (October-February), and their live young are released in the following spring (March-June). The larvae are believed to be planktonic for approximately 1 year (Morris, 1981), after which the young become demersal at depths of 125 to 150 meters. Rocky areas and pinnacles are used as nursery areas for juveniles (Carlson and Straty, 1981). As the juveniles mature, they move into deeper waters.

Juvenile Pacific Ocean perch prey primarily on copepods. Adults feed on copepods, euphausiids, fish, and squid (Pereyra et al., 1976; Morris, 1981).

Atka Mackerel (Pleurogrammus monopterygius): Large schools of this fish inhabit the upper water layers of the outer continental shelf; and they are found throughout the Bering Sea to its northern boundary, the Bering Strait (Andriyashev, 1954). Atka mackerel also are found south of the Alaska Peninsula, particularly near the Shumagin Islands.

Atka mackerel are pelagic during much of the year, but they migrate annually to moderately shallow waters where they become demersal during spawning (Morris et al., 1983). While spawning, they are distributed in dense aggregations near the bottom. Larvae are found north of the Alaska Peninsula from Port Moller southwest to Umnak Island, including the lease area (Lewbel, 1983).

Spawning occurs from June through September (Musienko, 1970; Morris, 1981). Atka mackerel generally deposit their eggs on rocky substrates at 10 to 17 meters (Gorbunova, 1962), but also may deposit them on kelp (Andriyashev, 1954). The adhesive eggs hatch in 40 to 45 days (Musienko, 1970). The larvae are planktonic and are dispersed at distances of 320 to 800 kilometers from shore. The life history of young mackerel is not known.

Larvae feed on plankton soon after hatching (Gorbunova, 1962). Adults consume a variety of prey including plankton, microcrustaceans, euphausiids, and small fish (Andriyashev, 1954; Gorbunova, 1962; Rutenberg, 1962).

Sablefish (Anoplopoma fimbria): In the Bering Sea, the sablefish (or black cod) is most abundant on the continental slope (100-600 m), where approximately 13 percent of the total species biomass is found (Pereyra et al., 1976). Although present in the Bering Sea, the greatest abundance of sablefish is in the Gulf of Alaska (Morris et al., 1983). This species occupies a wide range of depths from 0 to 1,200 meters (Pereyra et al., 1976). Sablefish also inhabit areas south of the Alaska Peninsula.

Sablefish undergo extensive migrations in the North Pacific (Morris, 1981), and more localized cross-shelf migrations (Pereyra et al., 1976). These fish also undergo diurnal, vertical movements from more shallow waters during the day to waters near the bottom at night (Morris, 1981).

Sablefish spawn during the winter at depths of 250 to 750 meters (Morris et al., 1983). Their pelagic eggs are buoyant and develop near the surface (Pereyra et al., 1976; Morris, 1981). Larvae also are planktonic and are common in surface waters of the shelf and in shallow bays and inlets during the late spring and early summer (Morris et al., 1983). One-year-old juveniles are found in shallow coastal waters (Morris, 1981). These shallow areas in and adjacent to the North Aleutian Basin lease area are important as a nursery area for sablefish (USDOC, NMFS, 1980). Gradually, the juveniles move into deeper waters and assume a demersal existence.

Sablefish are omnivorous and feed on both pelagic and benthic prey, depending on the season, location, and age of fish (Pereyra et al., 1976). Sablefish prey include squid, capelin, pollock, sand lance, herring, euphausiids, polychaetes, and crustaceans (Morris, 1981; Morris et al., 1983).

<u>Yellowfin Sole (Limanda aspera)</u>: This flatfish is found in continental shelf waters at depths of 5 to 360 meters in the North Pacific Ocean, the Bering Sea, and the Chukchi Sea. Its largest population is found in the eastern Bering Sea (Pereyra et al., 1976).

Yellowfin sole have complex seasonal movements in the eastern Bering Sea. During winter (September-March), adults are concentrated in dense schools on the outer shelf and upper slope at depths of 100 to 360 meters, with largest trawl catches at depths of 100 to 200 meters (Fadeev, 1970; Salverson and Alton, 1976; Bakkala, 1981). One of the primary winter concentrations of adult yellowfin sole is located north of Unimak Island. Smaller concentrations are found in Bristol Bay (Bakkala, 1981). Winter concentrations generally do not feed until April, although exceptions have been reported (Fadeev, 1970). In the spring, yellowfin sole move inshore to more shallow waters (100 m) along the Alaska Peninsula, where feeding intensity remains low (Skalkin, 1963; Smith et al., 1978). In April and May, the fish migrate northward into outer Bristol Bay where, at depths of 40 to 100 meters, spawning and intensive feeding occur (Bakkala, 1981). It is believed that the water temperature and the extent of winter ice cover in the Bering Sea affect the rate of these summer migrations and the summer distributional patterns (Bakkala, 1981). With the advent of winter, adult yellowfin sole migrate back to deeper waters, probably in response to the advance of pack ice that covers portions of the Bering Sea in winter (Bakkala et al., 1983). In warmer years, the fish may remain in more shallow, central-shelf areas throughout winter (Bakkala et al., 1983). Young yellowfin sole (less than 8 years old) are found year-round in the inner-shelf region, including Bristol Bay (Fadeev, 1970). Large numbers of juvenile yellowfin sole have been found along the southern shore of Bristol Bay and on the northern side of the Alaska Peninsula and Unimak Island (Morris, 1981) during International Halibut Commission surveys. During the winter, adult yellowfin sole also move up vertically in the water column (Fadeev, 1965).

Yellowfin sole populations have been depleted significantly due to intense fishing pressure by foreign trawlers and have only recently begun to improve. Populations were significantly reduced by 1963 (Lewbel, 1983), when fishing efforts switched to pollock. The estimated biomass of exploitable yellowfin sole in the eastern Bering Sea ranges from 1.3 to 2.0 million metric tons (Alverson et al., 1964; Wakabayashi, 1975, cited in Bakkala, 1981). By 1963, the exploitable population was reduced by approximately 60 percent (NPFMC, 1983). In the mid-1960's, the population showed signs of recovery but again declined in 1970 (Bakkala, 1981). The yellowfin sole population has recovered since 1970 (INPFC, 1982; NPFMC, 1983), and its current biomass is estimated to be 50 to 85 percent of its former level (North Pacific Fishery Management Council, 1983b).

Yellowfin sole spawning begins in early July and continues into September in the Bering Sea (Musienko, 1970), in waters up to 75 meters deep (Thorsteinson, 1984). Spawning is concentrated southeast and northwest of Nunivak Island (Bakkala, 1981; Thorsteinson, 1984), but also has been observed in Bristol Bay (Fadeev, 1965; Bakkala, 1981). Females release millions of pelagic eggs that hatch in approximately 4 days (Thorsteinson, 1984); 3 days later yolk sacs are absorbed (Bakkala, 1981). The pelagic larvae are found in nearshore areas of the continental shelf at depths of less than 50 meters (Thorsteinson, 1984). After 4 or 5 months as pelagic larvae, they metamorphose into juvenile sole that settle to the bottom along the inner shelf (Morris, 1981), including Bristol Bay, which they occupy year-round (Fadeev, 1970). The North Aleutian Basin Planning Area is an important nursery area for yellowfin sole (Thorsteinson, 1984). Large numbers of juvenile yellowfin sole have been found along the southern shore of Bristol Bay and on the northern side of the Alaska Peninsula and Unimak Island during International Halibut Commission surveys (Morris, 1981). After spending their first few years in nearshore waters, the juveniles gradually disperse to deeper offshore waters (Thorsteinson, 1984).

The diet of the yellowfin sole in the Bering Sea varies with both depth and location (Skalkin, 1963). In the southeastern Bering Sea, major prey species include small amphipods, mysids, and euphausiids, and bivalve mollusks and some fish species. Sole are generally benthic feeders, but they may feed on nonbenthic organisms when benthic prey are scarce. Fadeev (1965) suggested that yellowfin growth in the Bering Sea is limited by food abundance. Concentrations of plankton in rearing areas are probably important for yellowfin larvae (Cooney et al., 1979).

Pacific Halibut (Hippoglossus stenolepis): Halibut is a flatfish species that is widespread on the shelf and slope to depths of up to 700 meters in the Bering Sea (Pereyra et al., 1976; Morris, 1981). Although more numerous in the Gulf of Alaska, halibut also are distributed throughout the eastern Bering Sea, from the Alaska Peninsula to as far north as Norton Sound and St. Lawrence Island. The entire North Aleutian Shelf is contained within the area identified by the International Pacific Halibut Commission as a halibut nursery area. Substantial numbers of juvenile halibut are found distributed along the southern shore of the southeastern Bering Sea from Unimak Island into Bristol Bay (Thorsteinson, 1984). Halibut also inhabit areas south of the Alaska Peninsula, particularly near the Shumagin Islands.

During the winter months, ice covers much of the Bering Sea and water temperatures near the bottom drop to 0°C or lower, which forces the halibut to concentrate in the deeper, warmer waters along the continental edge. During this time, the major portion of the halibut population of the eastern Bering Sea occupies outer continental shelf and slope areas from Unimak Island to west of the Pribilof Islands (Webber and Alton, 1976). With the retreat of the ice and rising water temperatures in April and May, halibut migrate eastward along the northern side of the Alaska Peninsula into the more shallow (30-140 m) spring feeding areas of the inner shelf (Morris, 1981). Throughout the summer and fall, halibut are found scattered over the shelf in shallow waters. With declining bottom-water temperatures in the late fall, halibut migrate back to the deeper waters of the continental slope (250 to 550 m) where they overwinter and spawn (Morris, 1981).

Spawning occurs from October to March (Novikov, 1964; Lewbel, 1983) along the continental shelf at depths from 228 to 456 meters (Bell, 1981) between Unimak Island and the Pribilofs (Best, 1981). Females release up to 2 million pelagic eggs (Lewbel, 1983), which hatch after approximately 15 days (Webber and Alton, 1976), depending on water temperature (Forrester and Alderice, 1973). Larvae are planktonic for 6 to 7 months prior to metamorphosis (Webber and Alton, 1976; Morris et al., 1983). Larvae have been caught over the continental slope and in deeper water, and a few have been caught on the edge of the continental shelf, distributed in a narrow band extending from the vicinity of Unimak Pass to northwest of the Pribilofs (Waldron, 1981). Later larval developmental stages tend to rise in the water column, where they are moved by winds into more shallow shelf waters (Gusey, 1978).

Juveniles settle to the bottom in shallow, nearshore nursery areas (Best, 1981). Juveniles also undergo seasonal movements related to water temperatures as described by Best (1981). During winter months, ice cover and cold water temperatures force them to concentrate in deeper waters (330 to 370 m) between Unimak Pass and the Pribilof Islands. As the ice retreats and the water warms in the spring, juveniles disperse over the shallow flats, which provide suitable habitat for a nursery for young halibut. In April, halibut have been found concentrated near the northern entrance of Unimak Pass at depths of 80 and 104 meters. As warming continues, juveniles move eastward along the northern side of the Alaska Peninsula and are found throughout Bristol Bay in June. Large numbers of juveniles have been caught in the eastern Bering Sea from Unimak Island to Bristol Bay (Thorsteinson, 1984).

In the 1960's, halibut stocks in the eastern Bering Sea supported an intensive fishery, which resulted in a reduction in the population. Both the high level of exploitation and the large incidental catches of immatures by foreign trawlers contributed to this decline in abundance. The stock has increased slightly since the reduction in incidental catch (McCaughran, personal communication, March 25, 1985). Halibut biomass was estimated at 10,100 metric tons during the NMFS 1975 summer survey in the Bristol Bay region.

Halibut are omnivorous and consume a variety of prey, which vary with age and area. Halibut of up to 30 centimeters feed primarily on crustaceans, such as shrimp and small crabs (Novikov, 1964; Morris et al., 1983). Adult fish consume a wide variety of crustaceans and fish including flatfishes, smelt, capelin, pollock, sand lance, and particularly yellowfin sole (Novikov, 1964). Halibut prey heavily on yellowfin sole, and the summer distribution of halibut in the Bering Sea is believed to be determined largely by the movements of yellowfin sole (Novikov, 1964).

Greenland Turbot (Reinhardtius hippoglossoides): This flatfish is widely distributed over the continental shelf and slope of the eastern Bering Sea with a depth range of 70 to 760 meters (Pereyra et al., 1976). Greenland turbot are concentrated in an area bordering on the lease area located between Unimak Island and the Pribilofs, and in an area west of St. Matthew Island (Morris, 1981). The biomass of this species in the Bristol Bay area (where it is not as abundant) was estimated at 4,000 metric tons (USDOC, NMFS, 1980). Turbot also inhabit areas south of the Alaska Peninsula.

This species has complex seasonal movements that are not well understood. Greenland turbot generally are found at more shallow depths in the summer than in the winter (Morris, 1981).

Spawning occurs from October to December on the continental shelf and slope at water depths greater than 100 meters (Lewbel, 1983). The eggs are bathypelagic, developing in deep water. The larvae are pelagic, rising to more shallow waters (30-130 m). When they reach a length of approximately 80 millimeters, the larvae become demersal (Pereyra et al., 1976). Generally, juveniles are found in shelf waters at depths of less than 200 meters, and adults inhabit slope waters at depths of 200 meters or greater. They feed on a variety of pelagic and demersal fish and crustaceans (Lewbel, 1983).

Rock Sole (Lepidopsetta bilineata): This species is most abundant in the southeastern portion of the Bering Sea, where it inhabits shelf areas to depths of 300 meters (Pereyra et al., 1976). All lifestages of the rock sole are present in the North Aleutian Basin lease area. The rock sole biomass in Bristol Bay was estimated at 67,200 metric tons by the NMFS survey in 1975. This species is also present south of the Alaska Peninsula.

Seasonal movements of this species are not well understood, but they are believed to be similar to those of other flounders. Adults are believed to inhabit more shallow waters during the spring, summer, and fall.

Rock sole spawn from March to June at depths near 100 meters (Lewbel, 1983). Their eggs are demersal and adhesive (Lewbel, 1983). Larvae are pelagic and are believed to spend their first year near the spawning areas or in slightly more shallow waters. The North Aleutian Basin lease area and adjacent nearshore areas are important as nursery areas for this species (USDOC, NMFS, 1980).

Adult rock sole prey on benthic invertebrates, including mollusks, polychaetes, and crustaceans (Lewbel, 1983). They occasionally feed on other fish.

Alaska Plaice (Pleuronectes quadrituberculatus): Alaska plaice are found in the waters of the continental shelf in the Gulf of Alaska, Bering Sea, and Chukchi Sea. All lifestages of this flatfish are present throughout the North Aleutian Basin lease area. The eastern Bering Sea population of plaice appears to be restricted to shelf areas south of St. Matthew Island (Lewbel, 1983). The total biomass of this species was estimated at approximately 20,000 metric tons (USDOC, NMFS, 1980).

Alaska plaice make seasonal migrations from deeper shelf waters (130 m) to more shallow waters (30 m) during the summer and fall. During the winter and spring, they inhabit the deeper waters.

Plaice spawn during the spring (late April to mid-June) at depths of 75 to 150 meters. The eggs are pelagic and widely distributed in the water column for up to 2 months prior to hatching. Larvae also are pelagic, but occur near the surface (Lewbel, 1983). Plaice prey upon benthic polychaetes, mollusks, and crustaceans (Lewbel, 1983).

Flathead Sole (Hippoglossoides elassodon): This flatfish is most abundant in the eastern Bering Sea. It is found in the North Aleutian Basin lease area in all lifestages. The total biomass of flathead sole in Bristol Bay was estimated at 8,300 metric tons from the NMFS 1975 survey. It inhabits shelf and slope waters ranging from the surface to 550 meters (Lewbel, 1983). Flathead sole also are present south of the Alaska Peninsula.

Seasonal distributions of flathead sole change as the fish migrate from deeper waters inhabited in the winter to more shallow waters, where they spend the spring and summer. Adult fish overwinter on the outer shelf and upper slope at depths of 70 to 400 meters, and then migrate eastward to more shallow shelf waters of 20 to 180 meters (Pereyra et al., 1976). During the summer, flathead sole are widely distributed over the outer shelf from Unimak Island northwest to the central Bering Sea. These fish rise to the surface at night.

Flathead sole spawn from February to May within the shelf boundaries of the Bering Sea at depths of 50 to 150 meters (Lewbel, 1983). The eggs are pelagic and become widely distributed at depths ranging from 30 to 500 meters (Pereyra et al., 1976). The larvae are pelagic and float near the surface until they metamorphose and descend to the bottom. The area north of the Alaska Peninsula is an important nursery area (USDOC, NMFS, 1980).

Adults prey on benthic crustaceans and echinoderms in deeper waters (Lewbel, 1983). In shallow waters, adults feed on planktonic crustaceans and chaetognaths (Lewbel, 1983).

Arrowtooth Flounder (Atheresthes stomias): Atheresthes stomias is the more common of the two arrowtooth flounder species in the eastern Bering Sea. This species is abundant on the continental slope in the southeastern, central, and northwestern Bering Sea at depths of 200 to 500 meters (Pereyra et al., 1976; Morris, 1981). During winter, arrowtooth flounder occupy deeper waters (300-500 m), and they migrate to more shallow waters (200-400 m) in the summer. These migrations are believed to be associated with changes in water temperature (Pereyra et al., 1976).

Arrowtooth flounder spawn from December to February. They release up to 500,000 eggs, which are bathypelagic (Pereyra et al., 1976). Larvae occupy shallow, nearshore shelf waters for several months prior to settling to the bottom (Morris, 1981). Juvenile fish gradually migrate to deeper waters. Their prey include crustaceans (euphausiids, shrimps, and crabs) and fish (pollock and other flatfish) (Lewbel, 1983).

Invertebrates: The eastern Bering Sea shelf supports an abundant and diverse invertebrate fauna, which in turn supports the extensive fish resources of the area (Cooney, 1981). Pelagic invertebrates in the eastern Bering Sea include at least 251 species, and 472 benthic species have been identified (Stoker, 1981).

Pelagic Invertebrates: All organisms not closely associated with the seafloor are considered pelagic invertebrates. The microscopic forms that cannot swim effectively from one area to another and thus drift with the currents are generally called zooplankton. Invertebrates that are large enough to swim from one place to another despite the currents are called nekton. The Bering Sea zooplankton includes cladocerans, cumaceans, ostracods, and 11 species of copepods (Cooney, 1981). Copepods are dominant in terms of both biomass and productivity. Bering Sea nektonic invertebrates include amphipods, euphausiids, pelagic mollusks and polychaetes, chaetognaths, mysids, isopods, and decapods (Lewbel, 1983). Of these, amphipods and euphausiids are the most important food items.

Benthic Invertebrates: Most of the knowledge of the benthic invertebrate fauna is of shallow-burrowing macroinfauna and epifauna.

Macroinfauna: On the eastern Bering Sea shelf, the macroinfauna includes 143 species of polychaete annelid worms, 76 species of gastropods, 76 species of amphipods, and 54 species of bivalves (Stoker, 1981).

Bivalve Mollusks: Although bivalves are widely distributed on the shelf, they are concentrated in the midshelf region of the Bering Sea (Lewbel, 1983). Some species are found in the nearshore surf zones. The Pacific razor clam (*Siliqua patula*) is found on sand beaches of the Alaska Peninsula, including Izembek Bay and Bechevin Bay (Nickerson, 1975). Other clams inhabiting the Alaska Peninsula include the surf clam (*Spisula polynyma*), distributed between Port Moller and Ugashik Bay; the Great Alaskan Tellin (*Tellina lutea*); two species of cockle (*Serripes groenlandicus* and *S. laperousii*); and other less frequently taken species. The surf clam biomass has been estimated at 286,184 metric tons and the Great Alaskan Tellin biomass has been estimated at 82,000 metric tons (Hughes et al., 1977).

Clams generally spawn in the summer during periods of warmer water temperatures. The eggs and/or larvae may be planktonic before metamorphosing into sedentary juvenile stages.

Epifauna: The eastern Bering Sea shelf supports at least 211 epifaunal invertebrate species (Jewett and Feder, 1981), of which mollusks are the most diverse (76 species), followed by arthropods (52 species), and echinoderms (28 species). More than 80 percent of the epibenthic biomass is comprised of echinoderms, particularly the sea star (Lewbel, 1983). Four commercially important crab species are dominant epifauna in the southeastern Bering Sea.

Red King Crab (*Paralithodes camtschatica*): King crab are the most prominent members of the epifaunal community of the southeastern Bering Sea (Lewbel, 1983). They inhabit the continental shelf at depths up to 400 meters. Red king crab are concentrated immediately north of the Alaska Peninsula and around Bristol Bay. Their average density has been estimated at $67/km^2$, with a high density of $54,600/km^2$ at Port Moller (Lewbel, 1983). (Blue king crab [*P. platypus*] are found in a band from the Pribilof Islands up through the Bering Strait.)

Historically, the abundance of the red king crab population in the southeastern Bering Sea has been cyclic on 7- to 14-year intervals influenced primarily by environmental conditions (Thorsteinson, 1984). Cycles of abundance suggest that year-class failure or success may be based on survival of critical lifestages (i.e., larvae and young juveniles) in nearshore areas (Armstrong et al., 1983). Instantaneous mortality rates of juvenile and sublegal, sexually mature crab are estimated to be low, approximately 10 percent per year, until entering the fishery (Balsinger, 1976; Reeves and Marasco, 1980). Consequently, the size of a future fisheries cohort is determined predominantly by reproductive success and survival of larvae and young of the year (0+ crab) in nursery areas.

Larval survival is influenced strongly by water temperature (Kurata, 1960, 1961; McMurray et al., 1983), and also by food supply and predation (Armstrong et al., 1983). Lethal temperatures are those greater than 15°C or lower than 0.5° to 1.8°C (Kurata, 1960) and survival of zoeae is greater between 5° to 10°C (McMurray et al., 1984). In addition, the number and location of spawning females may significantly influence larval survival and location of megalopae relative to optimal substrates at metamorphosis (Armstrong et al., 1983).

Although the magnitude of initial larval hatch and numbers surviving to metamorphosis may be important determinants of year-class strength, the geographic location of survivors at metamorphosis may be more important if refuge habitat is scarce and/or patchy. If optimal bottom type does not occur uniformly along the North Aleutian Shelf into Bristol Bay, location of spawning female populations and the interplay of oceanographic factors and influences (i.e., currents and direction, windspeed and direction) during development time could be the major determinants of placement and survival rates of larvae over optimal bottom types at metamorphosis (Armstrong et al., 1983).

Any source of mortality that substantially reduces numbers of large males could threaten the breeding potential of the red king crab population. Insemination of larger females by smaller males results in reduced clutch size. A male-female weight ratio of 1:7 is required for 100-percent copulation (Reeves and Marasco, 1980); below this weight, smaller males have less success breeding mature females. This may have been the case in the 1982 NMFS observations, which found an unusually large number of barren female crabs (i.e., which had not extruded eggs) in a year of very low male abundance. It is not clear whether or not there is a relationship between spawners and eventual recruits for this species (Reeves and Marasco, 1980).

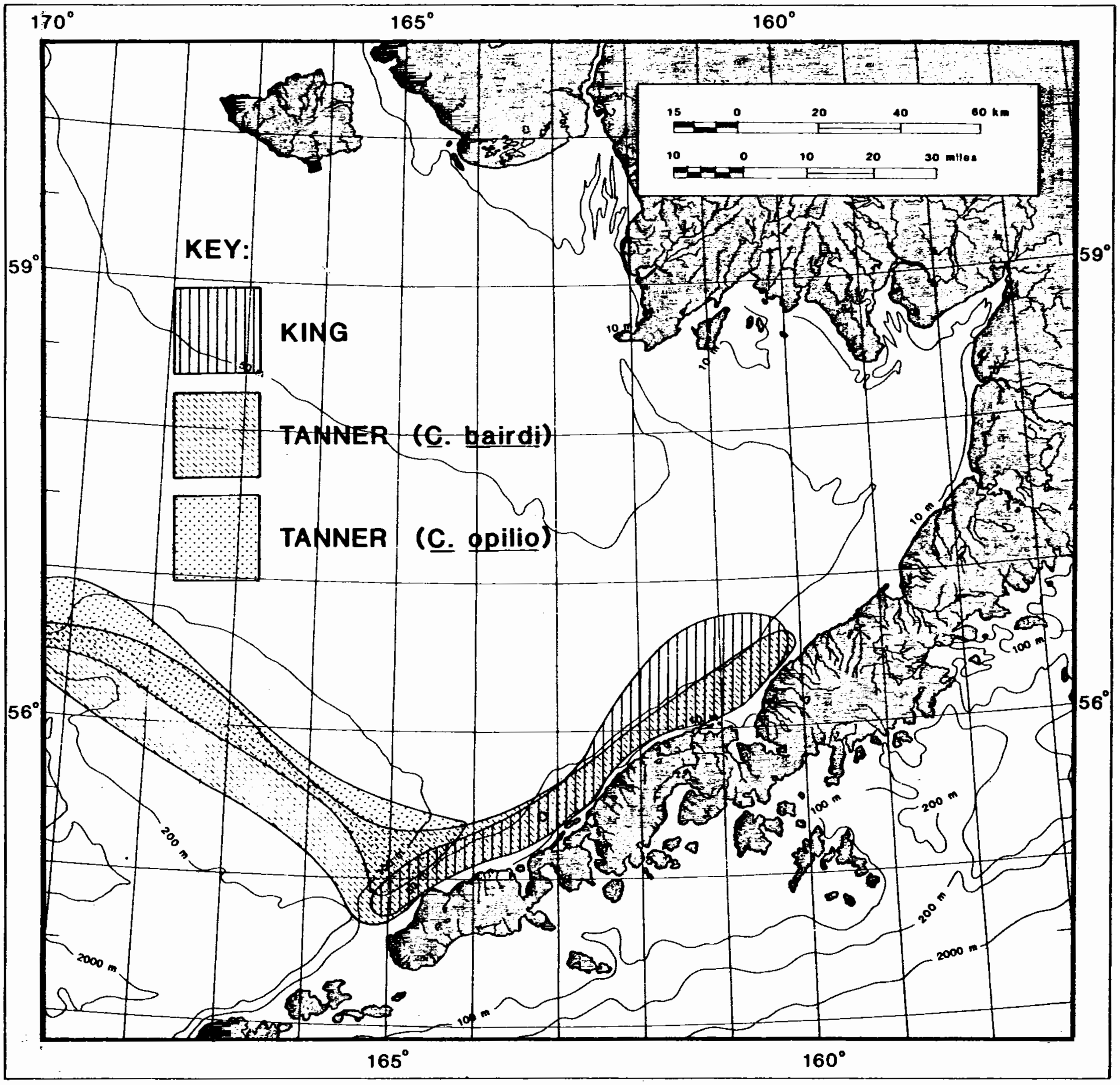
The abundance of male red king crabs in the southeastern Bering Sea has been decreasing since 1981. As summarized in Reeves (1985), this precipitous decline in this stock appears to result from the occurrence of weak year-classes recruiting to the fishery and increased mortality among adult, and especially sublegal, crabs of these weaker year-classes (Reeves, 1985). The occurence of weak year-classes is related to conditions that affect survival during the immature lifestages. Increased mortality of adult crabs appears to be related to a number of factors, including predation by halibut, Pacific cod, and yellowfin sole; competition; fishery effects (handling mortality); disease; and temperature; all of which showed some correlation. No single factor showed a dominant correlation, however, when factors were grouped (i.e., halibut and yellowfin sole predation, catchers/processors, and temperature), correlations increased. Apparently, many factors are influencing the decline of this population.

The life cycle of the red king crab is characterized by a spring spawning migration and a summer-fall feeding migration. Beginning in January, females move from deep, offshore waters into more shallow, coastal waters (70 m or less) north of the Alaska Peninsula. Males are more abundant in the deeper waters farther offshore to the north and west of the North Aleutian Basin lease area in the winter, and they migrate into the more shallow waters in or near the lease area a month later than the females to mate. Pereyra et al. (1976) indentified spawning areas near Amak Island and in the Black Hills-Port Moller areas. Reviews of studies have indicated that spawning occurs in nearshore waters between Unimak Island and Cape Seniavin (Armstrong et al., 1983; McMurray et al., 1984). After mating, the males and the ovigerous females feed in coastal areas before returning to deeper waters in the late summer or fall. Eggs are carried by the females for approximatley 11 months before hatching after the females have returned to nearshore waters. Hatching generally occurs from April 1-20, although the timing can vary up to a month (Weber, 1967; Haynes, 1974).

Red king crab larvae are present in the nearshore areas from April to August. Important larval release areas are the Port Moller area and off the Black Hills area of the Alaska Peninsula (Lewbell, 1983). Larvae develop at depths of 40 to 70 meters (Armstrong et al., 1981). They are found only in the southern part of the St. George Basin and in a nearshore band that extends from Unimak Pass northeast into Bristol Bay along the 50-meter isobath (Fig. III-12). The highest known densities of red king crab larvae occur from western Unimak Island to Port Moller, but the extent and abundance of larvae from Cape Seniavin into Bristol Bay remain unknown (McMurray et al., 1984).

The larvae are planktonic and tend to drift northeastward with the prevailing water currents along the Alaska Peninsula toward Bristol Bay, and may be carried quite some distance before reaching the benthic stage (Haynes, 1974; Hebard, 1979). Data on development time and current speeds (Kinder and Schumacher, 1981b) suggest that larvae could be transported more than 200 kilometers during the time from hatch to metamorphosis. By August, inshore areas contain very low densities of larvae. Relatively heavy pelagic larval distributions have been found from the Black Hills area to Port Heiden, with largest concentrations (2,000/100 m^2 found 200 km offshore between Cape Seniavin and Port Heiden) (Armstrong et al., 1983), which correlates with high concentrations of phytoplankton. Red king crab larvae also exhibit a diel vertical migration, which probably is influenced by tidal action. The larvae pass through several molts and finally settle to the bottom as juveniles.

The juveniles migrate into shallow waters. Starting at age 3, juveniles form dense pods (thousands to hundreds of thousands of individuals) that inhabit the intertidal and shallow subtidal zones. Smaller juvenile crabs (to 60 mm carapace length) have not been caught by nets in the NMFS survey area, and are consequently presumed to be concentrated in nearshore areas. Larger juveniles (to 110 mm) are found on the coastal, middle, and outer shelf around the 50-100-meter isobaths (Kinder and Schumacher, 1981a). Age-3 to -5 juveniles appear to form pods in the Port Moller area at water depths of 40 to 60 meters. The nearshore area along the northern side of the Alaska Peninsula also



Source: Thorsteinson, L.K. (ed.), 1984 (from Armstrong et al., 1981).

FIGURE III–12

DISTRIBUTION OF LARVAL KING AND TANNER CRABS IN THE SOUTHEASTERN BERING SEA, MARCH THROUGH MID-AUGUST.

has the extensive gravel and rocky substrates requisite for survival of the early benthic lifestages of this species (Sharma, 1979). This substrate also supports the invertebrate fauna that are food for juvenile red king crab (Armstrong et al., 1983). It is hypothesized that postlarval survival is related to settlement onto this refuge habitat that is thought to consist of gravel or larger-sized rocky substrates inhabited by several attached epifaunal invertebrates, which are food for juvenile crab and the vegetation that provides protective cover for these juveniles. King crab mature sexually at 5 or 6 years of age, at which time podding behavior ceases and they join the seasonal feeding and breeding migrations. Planktonic larval crabs feed on phyto- and zooplankton. Juveniles feed on diatoms, protozoa, algae, echinoderms, small mollusks, and other benthic species. Adult king crab are omnivorous and feed on small benthic invertebrates, including bivalves, gastropods, polychaetes, brittle stars, and tanner crab. They also feed on small fish and dead organisms. Age-3 to -5 juveniles appear to form pods in the Port Moller area at water depths of 40 to 60 meters. Waters to the east of Port Moller are very important to red king crab.

Tanner Crabs (*Chionoecetes opilio* and *C. bairdi*): Two species of commercial importance are distributed widely throughout the southeastern Bering Sea. These species generally occur at depths of 40 to 100 meters and greater (Lewbel, 1983). *Chionoecetes opilio* is common throughout the southeastern Bering Sea. Trawl samples from the area revealed an average density of 11,115/km^2, with a high of 269,500/km^2 for a sample taken 300 kilometers north of Unimak Pass (Jewett and Feder, 1981). *Chionoecetes bairdi* is concentrated in two areas: around the Pribilof Islands and immediately north of the Alaska Peninsula (Jewett and Feder, 1981). In the southeastern Bering Sea, this species was common only at depths below 100 meters. Densities averaged 844/km^2, with a high of 32,788/km^2 near Unimak Island. Tanner crab populations are cyclic. The stocks have been depressed, but are currently stable and recovering slowly. Both species are believed to have distributions and abundances inversely related to the densities of king crabs (Gusey, 1978).

Tanner crab make seasonal movements related to spawning. They move into more shallow waters (less than 100 m) in the spring and summer for spawning. During the fall and winter, they inhabit deeper waters.

Tanner crabs breed in shallow shelf waters from January to May. Eggs are carried by females on their abdomens for approximately 11 months. Hatching is temperature-dependent. *Chionoecetes bairdi* eggs have a prehatching mortality of approximately 20 percent (Thorsteinson, 1982). The larvae are pelagic and concentrated in nearshore areas in the upper 60 meters of water (Thorsteinson, 1984) for approximately 3 months, depending on the availability of food and on water temperatures (Fig. III-12). Juveniles are bottom dwellers. The area north of the Alaska Peninsula is a nursery area for tanner crab. There is a higher abundance of *C. bairdi* larvae and juveniles in the North Aleutian Basin Planning Area, although larvae of both species are present from April through October (Thorsteinson, 1984).

Tanner crab larvae feed on phyto- and zooplankton. As demersal juveniles, they feed on benthic diatoms, hydroids, and detritus. Adults consume dead mollusks and crustaceans and prey on shrimp, polychaetes, clams, hermit crabs, and brittle stars.

Dungeness Crab (Cancer magister): The shallow, nearshore waters north and south of the Alaska Peninsula are the northern limit of this species. They inhabit bays, estuaries, and open-ocean, nearshore areas from the intertidal zone to depths of 90 meters. There is a seasonal movement to more shallow waters associated with breeding.

Dungeness crab mate from July to September. The females carry the eggs for 7 to 10 months before the eggs hatch in April and May. The larvae are planktonic for 3 to 4 months before molting to juveniles. Juveniles generally are associated with stands of eelgrass or, in the absence of eelgrass, with masses of detached algae that are believed to provide them protection from predation.

Korean Hair Crab (Erimacrus isenbeckii): The Korean hair crab occurs in water depths of 10 to 360 meters. The largest concentrations of this species are found in the shallow waters along the northern shore of the Alaska Peninsula and around the Pribilof Islands. Hair crabs hatch in the spring, and the larval stage lasts approximately 5 months (Armstrong et al., 1983).

Pandalid Shrimp (Pandulus spp.): Two commercially important species of shrimp are common throughout the Bering Sea--pink shrimp (P. borealis) and humpy shrimp (P. goniurus). They are most abundant along the central outer shelf and slope of the Bering Sea. The pink shrimp inhabits depths of 85 to 110 meters in zones of deep, warm waters and is found concentrated near Nome and northwest of St. Paul Island (Lewbel, 1983). The humpy shrimp is found at similar depths, but in cooler waters, with a concentration between the Pribilof Islands and Bristol Bay.

Shrimp spawn in September and October. Eggs are carried on females during the winter and hatch the following spring. The larvae spend 2 to 3 months in the nearshore plankton, feeding and molting before they metamorphose to juveniles and assume the semidemersal habit of adults. Juveniles inhabit waters less than 40 meters deep in the winter and deeper waters in the summer (University of Alaska, AEIDC, 1974).

Shrimp larvae feed on diatoms and plankton. Adults feed on benthic organisms, including polychaetes, and small crustaceans. Shrimp make diurnal feeding migrations, rising in the water column at night to feed (Thorsteinson, 1984).

Mysids: Although 20 species of mysid shrimp have been identified in the Bering Sea (Cooney, 1981), little is known of their distribution and abundance. Mysids are important prey for many fish species. Taxonomic disagreements and sampling problems (with seasonal migrations) have precluded much understanding of the distribution and abundance of these species.

Echinoderms: These species account for more epibenthic biomass than any other taxon in the eastern Bering Sea shelf (Jewett and Feder, 1981). The sea star (Asterias amurensis) makes up 84.4 percent of the biomass in the shallow waters (0-40 m) of the southeastern Bering Sea. Little is known of the life history of these species. The larvae are known to be pelagic.

Large Gastropods: These are concentrated along the outer shelf at depths from 40 to 100 meters. Neptunea heros and N. ventricosa are the dominant species. From May to October, they produce eggs that hatch after about 3 months. Neptuniids prey on polychaetes, bivalves, barnacles, crustaceans, and fish (MacIntosh and Somerton, 1981).

Intertidal Invertebrates: The intertidal fauna have not been sampled extensively in this area, particularly in the fall when biomass would be greatest (Lewbel, 1983). The intertidal eelgrass fauna at Izembek Lagoon and Port Moller was found to have more than 31 species of polychaetes, many oligochaetes, amphipods, and two bivalves (O'Clair et al., 1981). Densities of these species were sometimes very high (more than $100/cm^2$).

Seagrasses: Seagrass ecosystems perform a number of important functions in the coastal environment, as summarized in McRoy and Williams (1977):

> The high rate of primary production of seagrasses and other associated producers such as benthic algae and epiflora furnish energy for grazer and complex detrital foodwebs...The production of Izembek eelgrass beds also exports 180,462 mt of particulate and dissolved carbon annually (Barsdate et al., 1974) to the Bering Sea. Additional functions of seagrass ecosystems are providing substrate and shelter for organisms (O'Gower and Wacasey, 1967), consolidating sediments by the root and rhizome system and subsequent protection of the bottom from storm damage (Ginsberg and Lowenstam, 1958), increasing organic material locally through the baffling effect of seagrass leaves (Wood et al., 1969), and regenerating nutrients (McRoy and Barsdate, 1970).

Eelgrass: *Zostera marina* is the dominant marine macrophyte along the northern side of the Alaska Peninsula (Kinnetics Labs, Inc., 1984), concentrated in the bays and lagoons of the region (McRoy, 1970). The average biomass of eelgrass in Izembek Lagoon is 1 kg dry/m^2 (McRoy and McWilliams, 1977), and eelgrass is estimated to cover approximately 68 percent of the total area (Kinnetics Labs, Inc., 1984). Annual eelgrass production in Izembek Lagoon is estimated to be approximately 500,000 metric tons dry (Barsdate et al., 1974). Most of the bays and lagoons on the northern side of the Alaska Peninsula contain eelgrass (Kinnetics Labs, Inc., 1984), but biomass and productivity have not been estimated for these areas.

2. Marine and Coastal Birds:

Introduction: Coastal areas adjacent to the North Aleutian Basin Planning Area and the southern side of the Alaska Peninsula support outstanding concentrations of marine and coastal birds, including several of Alaska's most important seabird nesting and waterfowl/shorebird staging areas.

At least 85 species of seabirds, waterfowl, and shorebirds (Table III-3)--many representing major segments of their world, North American, or regional populations--breed, migrate, or overwinter in Bristol Bay/Alaska Peninsula/eastern Aleutian coastal habitats adjacent to areas potentially affected by oil industry activities in the North Aleutian Basin (Gill et al., 1981; Hunt et al., 1981b; King and Dau, 1981). Of particular importance are several species of waterfowl and the Alcidae; centers of abundance for a majority of the latter are located in the southeastern Bering Sea region.

Habitats: Since topography along the northern side of the Alaska Peninsula adjoining the lease area is generally low and rolling, with beaches, bays,

Table III-3

Numbers of Species Represented in the North Aleutian Basin Regional Avifauna

Species Group	Number	Percent
Loons/Grebes	6	7.1
Tubenoses	6	7.1
Cormorants	3	3.5
Waterfowl	24	28.2
Raptors	1	1.2
Cranes	1	1.2
Shorebirds	22	25.9
Jaegers/Gulls/Terns	11	12.9
Alcids	11	12.9
TOTAL	85	100.0

Sources: Gabrielson and Lincoln, 1959; Bellrose, 1976; Gill et al., 1981.

lagoons, and marshes providing the most common habitats, waterfowl and shorebirds dominate the avifauna. Elsewhere in the region, cliffs and turf habitat for burrowing species attracts substantial numbers of colonial seabirds to northwestern Bristol Bay, the eastern Aleutians, and the southern side of the Alaska Peninsula.

In the pelagic environment of the southeastern Bering Sea, three oceanographic fronts occur where oceanographic and nutrient conditions and the biological communities they support change over relatively short distances--approximately at the 200-meter, 100-meter, and 50-meter depth contours. These fronts enclose two zones (outer shelf and middle shelf) over the continental shelf, which differ substantially in their biological communities and productivity (Iverson et al., 1979; Coachman et al., 1980; Hunt et al., 1981a; Kinder et al., 1982). Most (90.9%) of the lease area lies within the middle-shelf zone, where foraging conditions less favorable than in the outer-shelf zone (7.2%) contribute to generally lower pelagic-bird density. The remainder of this lease area (1.9%) and coastal waters south to Unimak Pass lie in the coastal zone, within the 50-meter depth contour.

Although densities in heavily used portions of the southeastern Bering Sea may be similar, patterns of use and species involved differ (Eppley et al., 1982). The primary pattern in the North Aleutian Basin is one of seasonal use by nonresident and generally nonbreeding birds. Except in northwestern Bristol Bay, where large colonies are located, the contribution of breeding birds to density north of the peninsula is relatively slight. High densities are associated with concentrations of colonies in the Krenitzen (eastern Aleutian) Islands and south of the Alaska Peninsula.

In winter, approximately one-half of the Bristol Bay region becomes unavailable to birds due to ice cover, which typically extends north of the lease area to the vicinity of Ugashik Bay/Port Heiden (Graphic 2). Overwintering birds, especially alcids and seaducks, tend to concentrate along the variable ice front, where foraging conditions may be improved by concentration of forage species attracted to favorable nutrient conditions and algal blooms in the ice-edge habitat. This diverse community typically is present from December through April.

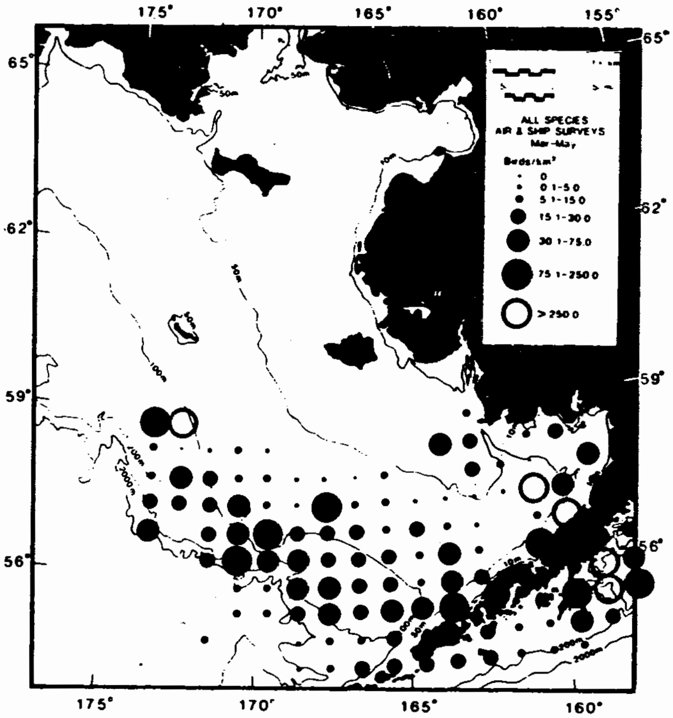
Pelagic Distribution: Pelagic distribution of birds in the southeastern Bering Sea varies considerably between species and seasons. Thus, differences between species tend to obscure regional patterns of distribution and abundance when information for all species is combined. Typically, a variable pattern of distribution is evident with scattered, highly mobile units (frequently single individuals) coalescing into larger assemblages for short periods, and then dispersing (Hunt et al., 1981c). This results in a "patchy" pattern of high and low densities, determined to a great extent by the distribution of prey concentrations and proximity to nesting areas. An area of generally lower density is evident between the 50- and 100-meter isobaths (Fig. III-13; Graphic 2).

Most species in this region attain their greatest abundance either along the shelf break or over the continental shelf (Table III-4). Northern fulmar, fork-tailed storm petrel, and red-legged kittiwake are concentrated near the shelf break (distribution of fulmar, and of other species, may be strongly influenced by the presence of fish-processing ships that discard large amounts

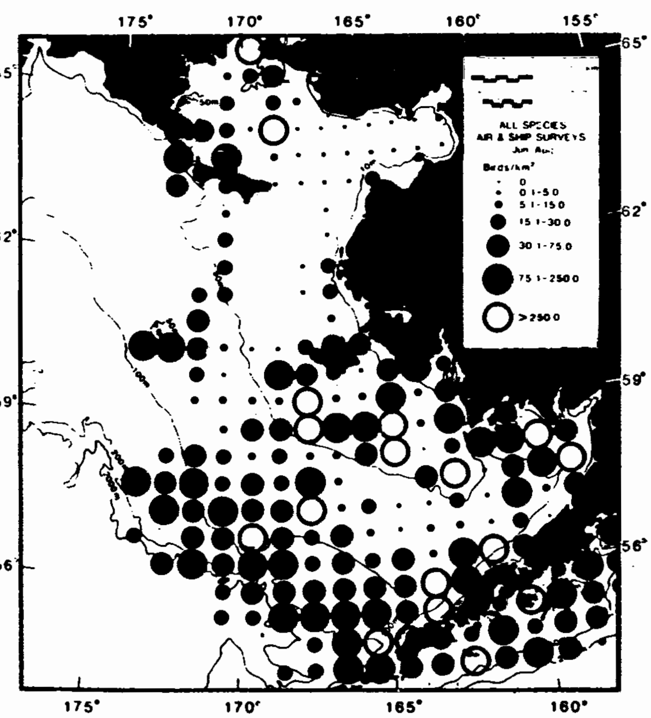
FIGURE III–13

PELAGIC DISTRIBUTION OF MARINE BIRDS IN THE SOUTHEASTERN BERING SEA IN (A) SPRING, (B) SUMMER, AND (C) FALL.

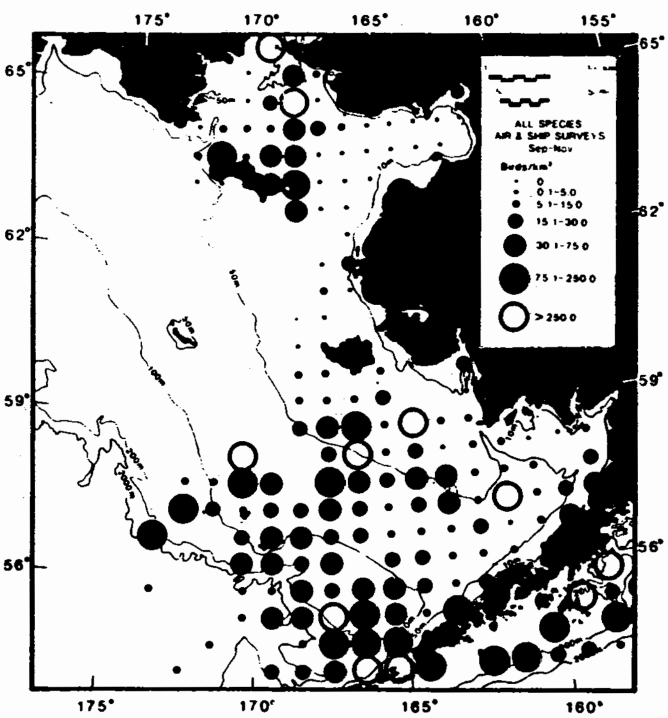
SOURCE: Hunt et al., 1981 C



(A) Spring **Pelagic distribution of all species—air and ship surveys: March-May.**



(B) Summer **Pelagic distribution of all species—air and ship surveys: June-August.**



(C) Fall **Pelagic distribution of all species—air and ship surveys: September-November.**

Table III-4

Density Indices (Birds/km^2) for Seasons and Habitats in the Eastern Bering Sea 1/

Species/ Species group	Winter 2/ CS	Winter 2/ SB	Winter 2/ OC	Spring CS	Spring SB	Spring OC	Summer CS	Summer SB	Summer OC	Fall CS	Fall SB	Fall OC
Fulmar	1	3	2	3	11	2	3	16	3	12	35 3/	9
Shearwaters	0	0	0	3	3	+	81 3/	13	3	35	104 3/	2
Storm-petrels	0	3	1	1	2	2	2	7	2	1	6	3
Larus gulls	+ 4/	1	+	1	2	1	1	1	+	1	2	+
Kittiwakes	+	+	1	1	2	1	2	2	1	3	5	1
Alcids	16	2	2	34	20	5	15	17	2	9	3	2
Murres 5/	14	0	0	19	2	1	9	1	+	4	1	+
Tufted puffins 5/	0	0	0	1	1	1	1	2	1	2	1	+
Total birds 6/	31	9	7	56	41	12	109 3/	58	11	65	157 3/	16
Total birds minus shearwaters and fulmars	30	6	5	50	27	10	25	29	5	18	18	4

Source: Hunt et al., 1981c.

1/ Data are derived from combined ship and air surveys. Habitats include continental shelf (CS), shelf-break (SB), and oceanic (OC) waters.

2/ Based on a single aerial survey and no shipboard surveys.

3/ These densities are highly biased from sighting of large flocks.

4/ All densities have been rounded to nearest whole number. A "+" indicates fewer than 0.5 birds/km^2.

5/ Included in alcids.

6/ Includes waterfowl, shorebirds and others not listed in the table.

of waste). Murres typically occur over the continental shelf with marked concentration near colonies during the breeding season; likewise, distribution of horned puffin, parakeet auklet, crested auklet, and least auklet is closely tied to food resources near their colonies in summer (Hunt et al., 1981c). Tufted puffin and black-legged kittiwake are distributed rather evenly over the southeastern Bering Sea. Nonbreeding southern-hemisphere shearwaters, the most abundant species in late spring, summer, and fall, stay mainly within the coastal zone.

In winter (December-March), pelagic-bird densities are low compared to other seasons (Table III-4). Beginning in the fall and continuing throughout the winter months, colony-nesting species, as well as seaducks, disperse widely over the southern Bering Sea from the ice front south to the Aleutian Islands and east to the Kodiak Archipelago (Gill et al., 1978; Gould et al., 1982). Highest densities occur over the continental shelf. Most species tend to concentrate in areas of high food availability, such as where tide rips are substantial or where currents converge or diverge (Pingree et al., 1974). The ice front, which typically extends from the vicinity of Port Heiden/Ugashik Bay northwestward past the Pribilof Islands, also is a region of prey abundance and concentration in winter and spring. Availability of open-water habitat in the ice front varies with the degree of wind-generated compression or dispersion of the ice. According to Divoky (1979, 1981), bird densities in and adjacent to the ice front in winter and early spring average 11 birds/km^2 in open water south of the shelf, 99 birds/km^2 in open water over the shelf (i.e., within the lease area), and 561 birds/ km^2 in the front. Murres are the most abundant species in the front, averaging 200 birds/km^2, with densities as high as 10,000/km^2 observed and 1,000/km^2 not uncommon. One flock of 25,000 was encountered (Divoky, 1981).

For many species, numbers peak in spring (Table III-4) prior to breakup of the pack ice, when overwintering individuals and migrants are concentrated south of the ice front. As breakup proceeds in spring, these birds move over a broad front northward along recently opened waterways to their breeding areas. Highest mean spring density (67.3 birds/km^2) occurs over the shelf (Table III-5); alcids, particularly murres, comprise much (65.8%) of this density (Tables III-4 and III-6). Since large numbers of shearwaters (9-20 million) do not arrive until late May or early June, they represent only a small percentage (8.8%) of birds present until summer (Tables III-4 and III-7). Spring densities (estimated from both ship and aerial surveys; Table III-7) average 56, 41, and 12 birds/km^2 in shelf, shelf-break, and oceanic habitats, respectively (Hunt et al., 1981c, 1981d).

Highest pelagic-bird densities over the Bering Sea shelf occur in summer and fall (late May-October). Average densities exceeding 75 to 250+ birds/km^2 are frequent over the shelf in summer (Fig. III-13); mean density over the shelf exceeds 200 birds/km^2 (Table III-5). Fulmars, storm petrels, and some alcids are abundant foragers near the shelf break (Table III-4), while shearwaters dominate the avifauna within the 50-meter isobath. Shearwaters frequently occur in flocks containing hundreds of thousands of individuals, and flocks of over 1 million have been observed (USDOI, FWS, unpublished; Guzman, 1981), far outnumbering local seabird populations. According to Hunt et al. (1980), peak densities near the Pribilof Islands vary from 431 birds/km^2 toward the shelf break to 530/km^2 over the shelf. Such densities suggest that at least 600,000 birds could be present in this area at any given moment.

Table III-5

Marine and Coastal Bird Mean Densities
(Birds/km^2 ±90% Confidence Interval)
in the Eastern Bering Sea 1/

Season	Habitat: Bay and Shelf	Shelf Break	Oceanic
Winter	2/	2/	2/
Spring	67.3 ± 14.7	54.2 ± 16.8	13.5 ± 6.9
Summer	211.6 ± 151.8	67.7 ± 17.6	13.9 ± 2.7
Fall	81.4 ± 29.2	241.0 ± 175.1	14.8 ± 2.2

Source: Gould et al., 1982.

1/ Estimated from shipboard surveys.

2/ No surveys.

Table III-6

Percent of Alcids in Total Bird Density
in Eastern Bering Sea Habitats

Season	Habitat: Bay and Shelf	Shelf Break	Oceanic
Winter	1/	1/	1/
Spring	65.8	43.5	42.2
Summer	7.9	35.9	20.1
Fall	16.5	1.5	12.8

Source: Adapted from Gould et al., 1982.

1/ No surveys.

Table III-7

Percent of Shearwaters in Total Bird Density in Eastern Bering Sea Habitats

	Habitat		
Season	Bay and Shelf	Shelf Break	Oceanic
Winter	1/	1/	1/
Spring	8.8	10.9	1.5
Summer	84.0	15.7	20.9
Fall	68.7	80.2	14.2

Source: Adapted from Gould et al., 1982; USDOI, MMS, 1985.

1/ No surveys.

Table III-8

Numbers of Seabirds Breeding in Areas Potentially Affected by the North Aleutian Basin Lease Sale

Area	Numbers of Seabirds (Millions)	Percent
Bristol Bay	1.9	42.2
Krenitzen Islands	0.5	11.1
Alaska Peninsula (south)	1.2	26.7
Shumagin Islands	0.9	20.0
Total	4.5	100.0

Source: USDOI, MMS, 1985.

Seabird Colonies: The breeding seabird population of this region is estimated to be at least 4.5 million (Table III-8), about 20 percent of the total known Alaskan population (Sowls et al., 1978; USDOI, FWS, unpublished data). Within the North Aleutian Basin Planning Area, seabirds are found in greatest concentration at Cape Peirce, where about 858,000 birds are present during the breeding season. This population estimate may be revised downward when analyses of data obtained in 1984 studies are completed. Cape Newenham, Hagemeister Island, and the Walrus Islands support an additional 986,000 birds. These four areas contain 97.1 percent of the seabirds nesting in the North Aleutian Basin area (Table III-9) and account for most of the nearshore bird densities of 76 to 466 birds/km^2 (mean density=86/km^2) reported by Arneson (1980) in northwestern Bristol Bay. Kittiwakes and the larger, fish-eating alcid species (murres, tufted puffin) are the most abundant in these colonies. Smaller, plankton-eating species (auklets) apparently do not find sufficient favorable foraging and/or nesting habitat conditions to breed in large numbers in this area (USDOI, MMS, Navarin Basin FEIS, 1983e). A colony containing 1,000 Aleutian terns is located in Port Moller. Waterfowl also contribute substantially to spring densities. In summer, density in the Walrus Islands area is estimated to be 139 birds/km^2, with alcids the most numerous group.

Other substantial seabird concentrations exist along the southern side of the Alaska Peninsula (Graphic 2, Table III-10), particularly in the Shumagin Islands (Bailey, 1978; Sowls et al., 1978; Bailey and Faust, 1980, 1981). Colonies in this area total approximately 1.1 million birds. An additional 1.0 million birds nest in colonies peripheral to this region.

Breeding Phenology: The approximate breeding-season schedule for the Pribilof Islands, representative of the southeastern Bering Sea region, is shown in Figure III-14. In general, marine birds arrive in the vicinity of nesting colonies in April and lay eggs in May and June, although there may be considerable variation among species, areas, and years. Hatching takes place in June, July, and August. The young of most species fledge from late August into October (Hunt et al., 1980, 1981b), making the initial portion of their dispersal to overwintering grounds on the water.

Alaska Peninsula: Major proportions of several waterfowl populations depend for part of their annual cycle upon comparatively restricted areas along the northern side of the Alaska Peninsula (Graphic 2); those highly dependent on this area are given in Table III-11. Heaviest use occurs during spring and fall migratory periods when birds stop over to build up fat reserves for the remainder of their migration (Fig. III-15). Izembek and Nelson Lagoons are the most important areas for geese, dabbling ducks, Steller's eider, and several species of shorebirds (Gill and Handel, 1981; Thorsteinson, 1984). Other important areas include Egegik Bay, Ugashik Bay, Pilot Point, Cinder River, Port Heiden, Seal Islands Lagoon, and Port Moller. Nearby coastal waters are important for scoters, king eider, oldsquaw, and harlequin duck (Gill et al., 1978a,b).

The populations of four goose species that nest on the Yukon/Kuskokwim Delta (emperor, brant, white-fronted and cackling Canada geese) have declined dramatically in recent decades (King and Conant, 1983; Conant and Hodges, 1984). It appears that natural and human predation on breeding and wintering grounds and destruction of winter habitat, together with a complex interaction

Table III-9

Estimated Populations of Seabird Colonies in the North Aleutian Basin Area

Area	Population Estimate	Percent of Total Population in North Aleutian Basin
Cape Peirce	857,987	45.2
Walrus Islands	567,601	29.9
Cape Newenham	387,619	20.4
Hagemeister Island	31,098	1.6
Amak Island	14,166	0.7
Other	40,679	2.1
Total	1,899,150	99.9

Sources: Petersen and Sigman, 1977; Sowls et al., 1978.

Table III-10

Estimated Populations of Major Seabird Colony Areas on the Southern Side of the Alaska Peninsula

Area	Population Estimate 1/	Percent
Amagat Island	451,140	24.1
Unga Island	103,156	5.5
Deer Island - Sandman Reefs	354,464	19.0
Shumagin Islands	896,024	47.9
Mitrofania Island area	65,312	3.5
Total	1,870,099	100.0

Source: Sowls et al., 1978.

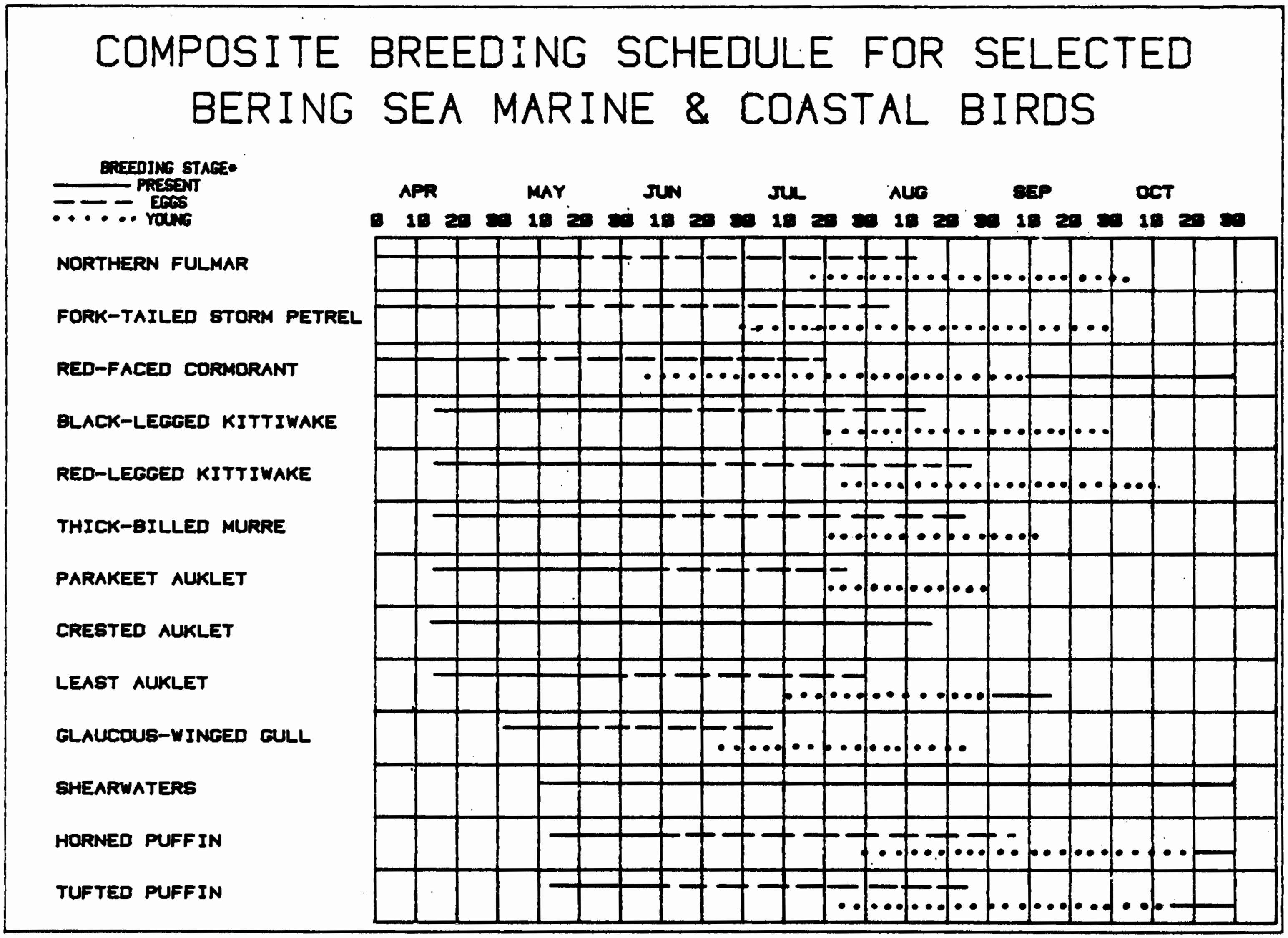
1/ Numbers for some colonies may increase substantially when nocturnal species are accurately censused.

Table III-11
Waterfowl Species with Major Segments of Their Population Dependent on Areas within and Adjacent to the North Aleutian Basin

Species	Population (1,000's)	% Pacific Regional Population	Period of Use	Important Use Areas
Emperor Goose	79	100	Spring-Fall	Ugashik Bay-Izembek Lagoon
Brant	120-150	100	Spring-Fall	Izembek Lagoon
Taverner's Canada Goose	80	75	Fall	Izembek Lagoon Area
Cackling Canada Goose	27	100	Spring-Fall	Pilot Point (Ugashik Bay)
White-Fronted Goose	80	30	Fall	Pilot Point
Steller's Eider	200	100	July-Fall	Izembek-Nelson Lagoons
King Eider	375-650	75	Winter	Nearshore, Offshore Areas

Sources: Bellrose, 1976; King and Dau, 1981; Hameedi, ed., 1982; USDOI, FWS, Unpublished.

FIGURE III-14



Sources: Hunt et al., 1980; Strauch & Hunt, 1982.

*/breeding stage dates represent 3-5 year averages; most records were obtained in the Pribilof Islands

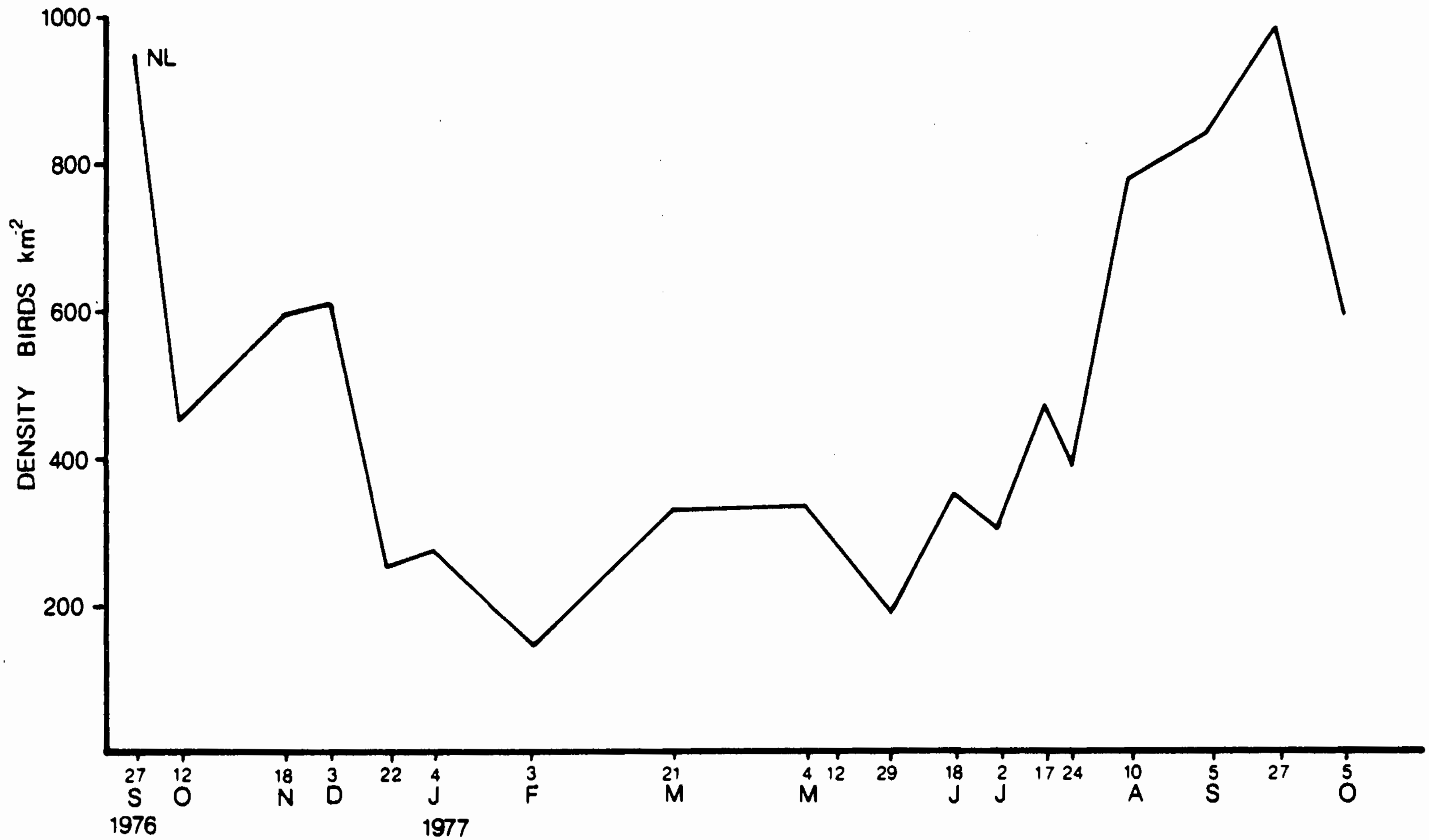


FIGURE III– 15

DENSITIES OF WATER BIRDS RECORDED DURING AERIAL SURVEYS OF LITTORAL AREAS AND NEARSHORE WATERS OF NELSON LAGOON (SEPTEMBER 1976 - OCTOBER 1977)

SOURCE: Gill et al., 1981.

of environmental variables, are potential factors contributing to this trend. Taverner's Canada goose appears not to be experiencing such a substantial decline.

Since 1981, brant, cackling Canada, and emperor goose-nesting success on the delta has declined approximately 45, 15, and 15 percent (±5%), respectively (Garett and Wege, 1984), and observations in the spring of 1983 suggest, for example, an overall decline of 21 percent in the emperor goose population since 1982 (USDOI, FWS, unpublished). If the current population decline continues unchanged, these populations are expected to reach extremely low levels by 1994 (King and Conant, 1983).

In April and May, Arneson (1980) recorded 200,000 birds along the northern shore of the Alaska Peninsula, including about 31,000 emperor geese, 55,000 brant, 15,500 dabbling ducks, 23,000 Steller's eider, and 44,000 gulls. Mean density was 141 birds/km^2. Densities were highest in Nelson Lagoon (849 birds/km^2) and Applegate Cove in Izembek Lagoon (358 birds/km^2). Most abundant species in Nelson Lagoon were emperor geese (388/km^2), seaducks (233/km^2, 88% Steller's eider), and gulls (208/km^2). In Applegate Cove, brant were the most abundant species (319/km^2). Brant remain at Izembek until about mid-May and emperor geese remain until late May before moving north to breed (Bellrose, 1976; Gill et al., 1978a).

Relatively few geese breed in the Bristol Bay/eastern Aleutian region (40,000 white-fronted geese), but an estimated 378,000 and 148,000 ducks breed in the two areas, respectively, and the annual fall flight is estimated to exceed 860,000 individuals (ADF&G, 1976).

Most nesting takes place in the northeastern portion of Bristol Bay. Pintail, scaup, harlequin duck, scoter, and oldsquaw are most abundant in Bristol Bay, while harlequin duck and common eider dominate waterfowl counts in the Aleutians. In addition, an estimated 10,600 tundra swans nest in the Bristol Bay area north of Port Heiden (ADF&G, 1976).

In fall, over 1 million birds were recorded along the northern side of the Alaska Peninsula (Arneson, 1980), including 144,000 Canada geese, 150,000 brant, 106,000 emperor geese, 54,500 dabbling ducks, 85,000 Steller's eider, 51,000 scoters, 96,000 shorebirds, and 31,000 glaucous-winged gulls. Up to 100,000 snow geese use the Egegik, Ugashik, and Cinder River estuaries for fall staging; and most of the cackling Canada goose population stages in Ugashik Bay prior to fall migration. Mean density was 453 birds/km^2, and highest densities were recorded in Izembek Lagoon (1,044/km^2), Nelson Lagoon (746/km^2), and Port Moller (618/km^2). In Izembek Lagoon, geese (brant, Canada, emperor) were the most abundant birds (932/km^2); in Nelson Lagoon, emperor geese (168/km^2) and seaducks (420/km^2) predominated. Steller's eiders undergo their postbreeding molt in the lagoon before proceeding to their wintering grounds. Observers in the fall have recorded as many as 105,000 waterfowl in Nelson Lagoon, together with 100,000 or more shorebirds (Gill et al., 1978b).

In winter, substantial numbers of waterfowl overwinter along both sides of the Alaska Peninsula. On winter surveys, Arneson (1980) recorded about 34,000 birds including 2,000 emperor geese, 4,000 Steller's eider, and 4,500 glaucous-winged gulls. Mean density was 53 birds/km^2; highest density (197 birds/km^2) occurred between Port Heiden and Seal Islands, with relatively high densities between Egegik and Ugashik Bays, in Nelson Lagoon, and in Bechevin Bay. Farther offshore, large numbers of oldsquaw and common and king eiders also overwinter (Divoky, 1981; USDOI, FWS, Petersen, personal communication, 1984). When lower temperatures cause increased ice cover and reduced foraging opportunities, many waterfowl move to bays and other protected habitats on the southern side of the Alaska Peninsula. Arneson (1980) found highest densities near Mitrofania Island (138 birds/km^2), in the Shumagin Islands (124/km^2), and in Cold Bay (99/km^2). Mean density was 67 birds/km^2; alcids comprised 44 percent, geese and shorebirds 5 percent each.

Critical Habitat Areas: In the North Aleutian Basin, important seabird nesting habitat and associated foraging areas exist at Capes Peirce and Newenham and in the Walrus Islands in northwestern Bristol Bay. Summer foraging habitat at and within the 50-meter isobath also is important for vast numbers of nonbreeding shearwaters. South of the Alaska Peninsula, the Shumagin Islands contain many important seabird colonies. During spring and fall migration periods, bays and lagoons on the northern side of the peninsula, especially Izembek and Nelson Lagoons, provide critical waterfowl staging habitat. Unimak Pass is an important migration route between the North Pacific and the Bering Sea. Bays and other protected waters on both sides of the Alaska Peninsula are important overwintering areas for waterfowl as well as seabirds.

3. Pinnipeds and Sea Otters: Five noncetacean species of marine mammals commonly occur in the proposed North Aleutian Basin lease sale area and are likely to have some interaction with proposed OCS oil and gas industrial activities. These species are the sea otter, Steller sea lion, harbor seal, Pacific walrus, and northern fur seal. Other pinniped species that are uncommon in the lease area but that seasonally occur in small numbers include spotted, ringed, bearded, and ribbon seals. Due to the relative numerical insignificance of the latter species in the lease area, they are not discussed further.

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972. By Congressional intent in the Act, it was declared that marine mammals "be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and that the primary objective of their management should be to maintain the health and stability of the marine ecosystem." General habitat areas of marine mammals are shown on Graphic 3.

The following account briefly describes the biology and life histories of common noncetacean marine mammals relevant to the potential adverse effects of oil and gas activities in the lease area.

Sea Otter: Since protected by international treaty in 1911, sea otters have reoccupied much of their former range (California/Bering Sea/Japan), including several areas in the North Aleutian Basin lease sale area. Significant concentrations of sea otters are found along the northern coast of Unimak Island and the Alaska Peninsula to Port Moller, and along the southern coast of the Alaska Peninsula from Unimak Island to Balboa Bay, including the Shumagin Islands (Graphic 3).

Surveys made between 1957 and 1976 indicate that, by 1970, sea otters had expanded their range north of Port Heiden; but severe winter conditions in 1971, 1972, and 1974--when ice advanced south to Unimak Island--resulted in the deaths of hundreds, if not thousands, of individuals and forced a retreat to the south from which the population has not yet recovered. Some otters are still found as far north as Ugashik Bay (Schneider, personal communication, 1982).

Schneider (1976) conservatively estimated the Port Moller/Unimak Island population at 17,173 otters for an overall density of 3.9 individuals/km^2, with 6.5 individuals/km^2 in high-density areas (Graphic 3). There may be as many as 20,000 otters (Cimberg et al., 1984). Pods of 100 animals are not uncommon in this area, and pods containing over 1,000 were sighted near Amak Island and other areas up to 50 kilometers offshore (Schneider, 1981). The otter's preferred habitat includes kelp beds and offshore reefs and rock shores exposed to the open ocean (Lensink, 1962).

Sea otters may migrate through False Pass to and from the southern side of the Alaska Peninsula during the spring and fall, reflecting the reported changes in their abundance and distribution in the lease sale area (Cimberg et al., 1984).

Otters may breed at any time of year, but this activity reaches a peak in September through November; pupping peaks from April through June. Productivity is quite low; females normally produce one pup every 2 years from age 4. Molt is prolonged over the entire year, rather than occurring seasonally as in other marine mammals.

To maintain their high metabolic rate, sea otters consume 20 to 25 percent of their weight in food each day (8-15 pounds). Their food consists primarily of benthic invertebrates and bottomfish in some habitat areas. Food availability is the primary factor limiting sea otter-population growth in specific locales (Schneider, 1976).

Steller Sea Lion: In Alaska, Steller sea lions occur over the continental shelf in the Gulf of Alaska, the Aleutian Islands, and the Bering Sea.

Current estimates place the total population between 24,000 and 290,000 individuals (Loughlin et al., 1984), with about 200,000 inhabiting Alaskan waters (Braham et al., 1980). Approximately 40 percent (100,000-130,000) of the total population resides in the Bering Sea and Aleutian Islands (McAlister, 1981). An estimated 5,000 occur in Bristol Bay with about 2,500 in the lease area (Frost et al., 1982). Sea lions generally use well-defined breeding and haulout areas throughout their range. Sixty-two regularly used breeding rookeries and haulout sites have been identified and censused in the area covered by Graphic 3 (ADF&G, 1973; Braham et al., 1977a; Calkins and Pitcher, 1977, 1978, 1979; Braham et al., 1980). Apparently, many of these haulout areas are subject to change in use patterns, since areas previously identified as haulout sites are now considered only as stopover areas (Calkins and Pitcher, 1977).

Comparison of site-specific population estimates from the eastern Aleutians and Alaska Peninsula made between 1957 and 1977 indicate that a sea lion population decline of approximately 50 percent occurred (Braham et al., 1980).

The cause of this decline is unknown, however; this decline may reflect a shift in the population or in seasonal movements, as well as possible effects from human activities (Loughlin et al., 1984).

Sixteen rookeries have been identified in the eastern Aleutian Islands, on the Alaska Peninsula, and on Amak Island (Graphic 3). Many of the rookeries are used as haulout areas throughout the rest of the year, and nonbreeding individuals may occupy nearby haulout areas during the breeding season. The greatest numbers of sea lions are present between May and early July during the breeding season (Braham, personal communication, 1985).

In early May, mature males begin arriving at the rookeries and establish territories, preceding the arrival of pregnant females (Pitcher and Calkins, 1981). Nursing is protracted in sea lions, typically lasting from 8 to 11 months; females often are observed nursing both a pup and a yearling.

Females mate on the rookery 1 to 2 weeks after giving birth, or elsewhere if not parturient (Braham et al., 1977b). Territorial behavior of males declines in early July, and by mid-July most breeding activity has ceased. The molting period lasts from the end of the breeding period until October.

Sea lions usually forage in water less than 180 meters (590 ft) deep and within 24 kilometers (15 mi) of shore; however, they were observed as far offshore as 85 nautical miles (Kenyon and Rice, 1961). Fish generally comprise over 95 percent of their diet, with pollock and capelin the most common species taken (Pitcher, 1981).

Harbor Seal: Harbor seals are common residents of coastal areas (Graphic 3) throughout the eastern Aleutian Islands, the Alaska Peninsula, and inner Bristol Bay and Shumagin Islands (Everitt and Braham, 1979, 1980). Their total population in the southeastern Bering Sea is conservatively estimated to be 30,000 to 35,000 (Everitt and Braham, 1980). About 20 percent of these inhabit the eastern Aleutians; most of the remaining 80 percent occupy a few major haulout areas along the northern side of the Alaska Peninsula (Braham et al., 1977b). Three major haulout-breeding areas occur adjacent to the proposed sale area (Graphic 3): Port Moller (about 6,100 individuals), Izembek/Moffet Lagoon (4,500), and the Isanotski Islands in Bechevin Bay (400). Estimates for the numerous lesser haulout areas are given in Everitt and Braham (1979). At 16 such areas in the eastern Aleutians, concentrations of 100 to 500 individuals were observed at various times of the year.

Movements of harbor seals are poorly understood; they appear to be a relatively sedentary species with strong fidelity to traditional haulout sites. In heavy ice years, when the bays freeze over and shorefast ice is extensive, seals are prevented from hauling out in the usual winter areas. Apparently, some individuals disperse to the pack ice in winter, especially in severe winters when it extends farther into the southern Bering Sea (Braham et al., 1977b).

Although primarily coastal inhabitants, they have been observed up to 100 kilometers (62 mi) offshore (Fiscus et al., 1976) and upstream in coastal rivers.

Although no data are available for the Bering Sea, pupping is reported from mid-May to late June on Tugidak Island southwest of Kodiak Island (Pitcher and Calkins, 1977). Pups are able to enter the water soon after birth, and weaning occurs 3 to 5 weeks later (Bishop, 1967; Johnson, 1977). Mating occurs from late June to late July, within 2 weeks after females have ceased nursing their pups (Pitcher and Calkins, 1977, 1979).

Physical condition, as indicated by blubber thickness, is highest from November to mid-May. Seals are thinner during the summer months. This is probably associated with the energic demands of lactation, breeding, and molting (Pitcher and Calkins, 1979). Lowest energic levels occur during the peak molting period, mid-July to mid-September.

Harbor seals are opportunistic feeders, and thus their diet varies according to season and location. In the Gulf of Alaska, Pitcher and Calkins (1979) found that fish (especially pollock and capelin) comprised 73.8 percent, cephalopods 22.2 percent, and decapod crustaceans 4.1 percent of the occurrences of prey items.

Walrus: Recent census figures indicate that the Pacific population may be as high as 250,000 to 300,000 animals (Krogman et al., 1979; Lourie, 1982). The Pacific walrus ranges primarily from the Chukchi Sea (summer) to the northern and southeastern portions of the Bering Sea, including the North Aleutian Basin. Following southward migration, usually beginning in November and continuing into January, walrus are widely distributed in the seasonal pack ice overlying shallow water in the Bering Sea (Graphic 3). During winter months (December-March), numbers are especially high near St. Lawrence Island, St. Matthew Island, and within the planning area near Nunivak Island, Kuskokwim Bay, and northern Bristol Bay where leads and polynyas in the pack ice are numerous (Burns et al., 1981).

As the seasonal pack ice melts and recedes northward in spring, usually beginning in April, a majority of walrus--particularly females and young--move north with it, leaving behind a portion of the male population in Bristol Bay and in several other areas. By far the greatest number haul out on Round Island and on several other islands in Walrus Islands State Game Sanctuary in northern Bristol Bay. In recent summers, as many as 12,000 to 15,000 bulls have been counted at Round Island. Other spring- and summer-observed haulout areas adjacent to the lease area include Capes Newenham, Constantine, and Seniavin; Hagemeister and Amak Islands; and the Islands of Port Moller, Ugashik Bay, and the Cinder River area (Graphic 3).

In years of substantial ice cover, the April population of Bristol Bay has been estimated at 35,000 individuals (Kenyon, 1972). In May 1980, 5,000 to 7,000 walrus were observed south of Round Island, amounting to an estimated Bristol Bay population of 63,800 individuals (Fay and Lowry, 1981). Walrus are relatively abundant in the planning area from March to June. Numbers decline, or animals are more widespread, from July to December. From January to March, numbers are low, probably because males migrate to the west, where females congregate for the breeding season (Fay, 1981).

Recent observations indicate that the Pacific walrus population is at or approaching carrying capacity of the habitat and, as a result, may be under considerable stress. Signs of population stress, such as higher mortality rates, less body fat, and greater incidence of disease, have been noted recently. Results of a recent study (Fay and Lowry, 1981) suggest that walrus could have consumed 17 to 33 percent of the total harvestable surf clam biomass in a local Bristol Bay clam fishery zone, or two to four times the estimated annual sustained yield. Pressure of this magnitude by walruses on their food supply could severely deplete food resources and could result in a serious decline in habitat carrying capacity, especially within the winter/spring range--possibly resulting in a shift of the population to less favorable habitats. The walrus population also may be influenced by competition for food from other benthic feeders, such as bearded seals.

Mating takes place in the heavier ice habitat west of Bristol Bay, from January to March, prior to spring migration. Calving occurs between March and early June on the ice. Though able to swim at birth, calves require constant attention, especially to maintain body temperature, and are accompanied by the females for 18 to 24 months. Since only 32 to 43 percent of females breed in a given year (Gol'tsev, 1968; Kelly, 1980), and both gestation and nursing periods are protracted, productivity is low in this species. Molting of the sparse body hair occurs over a period of 2 weeks between April and August. Fasting may occur during this period.

Walrus feed, primarily on mollusks, at depths up to 80 meters. Over 60 genera of benthic invertebrates have been found in stomach analyses (Fay, 1982); however, from 60 to 90 percent of the biomass usually is from bivalve mollusks.

Northern Fur Seal: This species is the most abundant pinniped occurring in the southeastern Bering Sea. The Pribilof Island population is estimated at 871,000 seals and has declined by about 5 to 8 percent per year in recent years (North Pacific Fur Seal Commission, 1984). This population is about 72 percent of the world population. Fur seals forage offshore in outer Bristol Bay, including western portions of the North Aleutian Basin Planning Area. However, their primary feeding habitat during the breeding and pupping season is in the St. George Basin, along the shelf break and south to Unimak Pass adjacent to the lease area (Graphic 3). Fur seals occur seasonally in the Bering Sea from late April through November, although some individuals may overwinter in the southern Bering.

Major important habitats for fur seals in Alaska are located in the St. George Basin Planning Area and include the rookeries and haulout areas of the Pribilof Islands; the continental shelf, and slope areas near the Pribilof Islands extending southeastward to the Unimak Pass/Unalaska Island area (where particularly females forage during the breeding season); and their migration corridors through the Gulf of Alaska (Graphic 3).

Fur seals tend to congregate in areas where nutrient upwelling results in an abundant food supply, such as over the shelf break and outer continental shelf. They feed mainly at night and in early morning on various schooling fishes that ascend to the upper water layers. In the Bering Sea, from June to November, important prey species include walleye pollock, squid, and capelin.

4. Endangered and Threatened Species: The Endangered Species Act of 1973 defines an endangered species as any species that is in danger of extinction throughout all or a significant portion of its range. The Act

defines a threatened species as one that is likely to become endangered within the foreseeable future. The following paragraphs list the endangered and threatened species that may occur within or near the North Aleutian Basin Lease sale area. The U.S. Fish and Wildlife Service has reclassified the Arctic peregrine falcon as threatened, as published in the Federal Register, Vol. 49, No. 55, 1984. There are no listed endangered plants in areas immediately adjacent to the lease sale area.

a. Endangered Cetaceans: There are at least 18 cetacean species that may occur in or adjacent to the North Aleutian Basin lease sale area. Eight of these species are listed as endangered in the Federal Register (Vol. 48, No. 145) and include the bowhead whale (*Balaena mysticetus*), right whale (*Balaena glacialis*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*), gray whale (*Eschrichtius robustus*), and sperm whale (*Physeter catodon*). These species also are protected under the Marine Mammal Protection Act of 1972, the Whale Conservation and Protection Study Act of 1976, and the International Convention for the Regulation of Whaling of 1946. See Graphic 4 for general distributions and Alaska ranges of these endangered cetaceans.

Bowhead Whale: The most recent bowhead whale population estimate, derived from counts at Point Barrow, is approximately 4,000 individuals (Dronenburg et al., 1983). Bowheads frequent the ice front of the central and southwestern Bering Sea in winter and migrate to their summer feeding areas in the Beaufort Sea in spring. During average ice years, they spend the winter in the first-year ice and polynyas from St. Lawrence Island south to St. Matthew Island (Brueggeman, 1982). During heavy ice years, when the sea ice extends to its maximum southern limit or unusual ice or storm conditions persist, the whales are forced to move farther southeast than normal. Bowheads have been sighted infrequently in the lease area (Braham et al., 1977). Most whales leave their wintering areas by early May, depending on the timing of the breakup. Generally, whales follow the opening lead system, but they are often found migrating in the heavier ice. They generally concentrate their feeding in the summer and fall migration periods. Bowheads are planktonic feeders; engulfed fish can escape between the baleen plates that do not meet in front of the bowhead mouth (Berg, 1977). They occasionally feed on benthic invertebrates.

Right Whale: Right whales were once abundant along all major land masses in the temperate latitudes of both hemispheres. Because of over-exploitation by whalers during the early portion of this century, the population is near extinction and probably numbers only a few hundred animals in the North Pacific (Berzin and Yablakov, 1978). In the Pacific Ocean, they occur from Alaska south to Oregon and California and from the Gulf of Anadyr and the Sea of Okhotsk to the Yellow and China Seas (Tomilin, 1955). The largest historical concentration of these whales occurred in the Gulf of Alaska, particularly near Kodiak Island (Townsend, 1935). Right whales feed on planktonic crustaceans. In 1963, TINRO vessels observed about 200 right whales at 51°N latitude, 145°W longitude (Berzin and Doroshenko, 1982). St. Lawrence Island has been described as the extreme northern limit of the species range (USDOD, NARL, 1980). Right whales in the Bering Sea are most likely to be found in an area bounded by St. Matthew Island, Nunivak Island, and Atka Island from June through August. A right whale was sighted adjacent to the lease sale area at

58°32'N, 167°32'W (Berzin and Rovnin, 1966). Two right whales were recently observed at 60°48'N, 175°18'W within the Navarin Basin lease sale area (Brueggeman, 1982).

Sperm Whale: Sperm whales are the most abundant large cetacean in the North Pacific and the only toothed whale listed as endangered. The population is estimated at approximately 740,000 individuals (Rice, 1978), with approximately 15,000 in the Bering Sea during the summer months (Morris, 1981). This species is distributed in the North Pacific from the equator north to Cape Navarin. Large numbers of whales have been observed in the region from Kodiak Island westward along the Aleutian Chain to the Commander Islands. Mature males migrate to more northern latitudes, while females and young whales seldom migrate north of a 10°C isotherm (approximately 50°N latitude). The whales found in the Bering Sea generally enter through Unimak Pass and migrate along the shelf break from the Pribilof Islands westward to the vicinity of Cape Navarin. Sperm whales were captured in the region centered at 56°N, 170°W just south of the Pribilof Islands (Nasu, 1963). Fiscus et al. (1976) describe the sperm whale as primarily an oceanic (shelf-slope and off-the-continental-shelf) inhabitant, but some individuals have been sighted in the lease sale area. If they venture into the shallower waters of the lease sale area, sperm whales are likely to be in the area between March and September.

Blue Whale: Blue whales are the largest of the rorquals, a family of baleen whales characterized by their pleated or corrugated throats. In the early 1900's, their population probably numbered over 200,000. Today, there are only about 12,000 blue whales left in the entire world; 1,500 occur in the North Pacific (Rice, 1978). During the summer, the North Pacific whales range from the immediate offshore waters of central California and the northeastern coast of Honshu, Japan, north to the Gulf of Alaska and the Aleutian Chain. There are three general regions of high summer usage: (1) a narrow strip along the oceanic side of the Aleutian Chain from 170°E to 175°W longitude; (2) from 170°W to 160°W longitude; and (3) from Kodiak Island southeast across the northern portion of the Gulf of Alaska and along the coast approximately to Vancouver Island (Berzin and Rovnin, 1966). They rarely enter the Bering Sea, but Arsen'ev (1961) observed seven blue whales south of the Pribilof Islands. Whaling records indicate a peak occurrence of blue whales near the Aleutian Islands in June and July; the fall migration begins in September (Rice, 1974).

Fin Whale: Fin whales range from the North Pacific Ocean to the Bering and Chukchi Seas and migrate into the Siberian waters of the Chukchi Sea from at least early summer through October (Nasu, 1960). The North Pacific population has been estimated at between 17,000 and 21,000 individuals, and it is estimated that approximately 5,000 enter the Bering Sea during the summer (Morris, 1981). Fin whales generally winter off Baja California, although a few whales overwinter in the Gulf of Alaska and near the Commander Islands (Berzin and Rovnin, 1966). There appear to be several migration routes: (1) along the coast of the Alexander Archipelago; (2) across the Gulf of Alaska to the Albatross/Portlock Banks and south of the Aleutian Chain to the Commander Islands; and (3) through Unimak Pass to the Bristol Bay area and northward into the Chukchi Sea. Starting as early as April, fin whales may be present in the lease sale area for 6 to 8 months. Although the fall migration begins in September, some fin whales may remain in the Aleutians and the Gulf of Alaska until November; some possibly overwinter in the Aleutians. Concentrations of fin whales were recorded during summer along the shelf break northwest of the Pribilof Islands and east of St. George Island (University of Alaska, AEIDC, 1978). Berzin and Rovnin (1966) reported numerous fin whales in the area south of the Pribilof Islands. The whales also were reported in relatively dense numbers along the continental slope northwest of Unimak Pass (Nemoto, 1963). A feeding-concentration area used by lactating females and juveniles is located north of Unimak Pass (Morris, 1981). Fin whales feed by engulfing large swarms or schools of euphausiids, anchovies, capelin, herring, and squid.

Sei Whale: Sei whales occur in the Pacific, Atlantic, and Antarctic Oceans. They are more commonly found in the Gulf of Alaska and southeast of the Aleutian Chain area during the summer months (May and June) and migrate to the southern latitudes during winter. Migration periods and routes are similar to those of the fin whale. Although the main summer population is found south of the Aleutian Chain, some sei whales migrate into the Bering Sea. Braham et al. (1977) reported one sighting in the Fox Islands and one sighting east of the Pribilof Islands. Fetal growth curves indicate that breeding occurs from October to March. The North Pacific population is estimated at between 8,600 and 9,000 individuals. The principal food source is copepods (Calanus sp.), which the sei whale catches by skimming the water surface. Other food sources include euphausiids, herring, sand lance, and pollock. The population currently is suffering from a unique disease that causes progressive shedding of the baleen plates and their replacement by an abnormal papilloma-like growth (Morris, 1981).

Humpback Whale: Humpback whales are one of the most familiar of the large cetaceans. In the North Pacific, the humpback whales are distributed from the equator north to 70°N latitude in the Chukchi Sea, and the summer range extends from the coast of Vancouver Island northward to the southern portion of the Chukchi Sea. The whales migrate from wintering grounds off California and Mexico along the coast to the Gulf of Alaska (early April), the eastern Aleutian Islands (late June), and northward to the Bering and Chukchi Seas (July-September). Scattered accumulations of humpbacks were observed to the east of the Pribilof Islands and north of Unalaska Island (Nasu, 1963). Concentrations of whales also were observed in Bristol Bay and in the Cape Newenham region (Berzin and Rovnin, 1966). The whales are found in the lease area from May through November; the autumn migration begins in September. Photo-identification of humpbacks indicates that migratory routes exist between Hawaii and southeastern Alaska and between Mexico and southeastern Alaska. Soviet and Japanese tagging and whaling records indicate that humpbacks heading for the St. George Basin migrate between Japan and the southeastern Bering Sea (Hameedi, 1981). Humpbacks feed on euphausiids and sometimes small fish, obtaining most of their food resources during the summer feeding period (Wolman, 1978). The population is severely depeleted and numbers between 850 and 1,400 in the North Pacific (Morris, 1981).

Gray Whale: Gray whales are now endemic to the North Pacific and adjacent waters of the Arctic Ocean. The current eastern North Pacific stock is estimated at about 17,000 individuals, 80 percent of which enter the Bering Sea from April to December (Rugh, 1984). The Korean stock is nearly extinct (Brownell, 1977).

Gray whales begin their northbound migration from their calving grounds in Baja California around March. Some whales start earlier; Braham (1984) reported sighting gray whales in Unimak Pass on March 22, 1980. Many whales were sighted in Bristol Bay in April; however, most sightings along the northern side of the Alaska Peninsula and Bristol Bay were in June (Braham, 1984). Gray whales enter the Bering Sea through Unimak Pass from March through June on the northbound migration to summer feeding grounds in the Chirikov Basin and the Chukchi Sea. The migration route generally follows within 3 kilometers of shore along the northern shore of the Alaska Peninsula and around Bristol Bay.

After entering the southeastern Bering Sea in spring and early summer, gray whales follow the west coast of Unimak Island and continue the coastal migration through the North Aleutian Basin lease sale area (within 1-2 km of shore), until the whales near Egegik Bay. There the whales begin to head west 5 to 8 kilometers offshore across northern Bristol Bay. Smaller numbers of whales are present throughout summer in nearshore waters and estuaries along the northern side of the Alaska Peninsula. Gray whales also have been observed feeding inside several lagoons and estuaries along the northern shore of the Alaska Peninsula. Gray whale feeding behavior has been observed in Izembek Lagoon, Port Moller, and Port Heiden, and between Bechevin Bay and Nelson Lagoon (Zimmerman and Merrell, 1976; ADF&G, 1983; Gill and Hall, 1983). Gill and Hall's (1983) data suggest that, once the whales move into nearshore and estuarine waters along the northern shore of the Alaska Peninsula, many begin feeding. Invertebrate samples taken near a feeding whale in Nelson Lagoon were identified as the sand shrimp Crangon alaskensis, which is very abundant during the summer in Alaska Peninsula lagoons. Copulation, nursing, and other social behaviors also were observed in Nelson Lagoon (Thorsteinson, 1983). Gray whale use of Nelson Lagoon has varied annually, but as many as 30 whales were observed using the lagoon at one time during the summer.

Some whales migrate directly northwest from Unimak Pass to the area around the Pribilof Islands, where several dozen are seen annually (Braham and Dahlheim, 1981). A portion of these whales proceeds to more northern feeding grounds, while others summer around the Pribilof Islands (observed from April-July). Several gray whales were observed in English Bay, St. Paul Island, during June 1976 (Zimmerman and Merrell, 1976). From July to November, large concentrations of gray whales are found off the northeastern side of St. Lawrence Island, where one of their major feeding grounds is located (Chirikov Basin). Recent evidence (Norris, 1980) suggests that subsidiary summer populations of gray whales do not migrate to the northernmost ranges but feed at scattered subarctic locations. Nerini (1984) indicates that some feeding probably occurs in winter and during their fall migration, as well as during their spring migration through Alaskan waters (Braham, 1984). Whales migrating northward have exhibited feeding behavior along the outer coast of Baranof Island, at Cape St. Elias, and along the southeastern coast of Kodiak Island (Braham et al., 1982). Gray whales, unlike other baleen whales, are predominantly benthic feeders. The preferred prey is amphipods, although polychaetes, mollusks, and small fish occasionally are taken.

The southbound migration from the summer feeding areas generally begins in mid-October (Johnson et al., 1981). Moore and Ljungblad (1984) recorded gray whales in the northern waters of the Bering Sea until at least November. Two gray whales were sighted on December 14, 1982, near Gambell on St. Lawrence Island (Braham, 1984). The whales return to Baja California to calve between December and January, generally following the same route as the northbound migration, but somewhat farther offshore. Whales migrating through the St. George Basin pass in a broad front across the shelf from Nunivak Island to Unimak Pass. Gray whales can be found in the lease area on their migrations between March and June (spring migration) and October to December (fall migration). A portion of the population feeds in the area during the summer months.

b. Endangered and Threatened Birds: Of the four avian species listed as endangered in Alaska, only the American peregrine falcon (*Falco peregrinus anatum*) and the short-tailed albatross (*Diomedia albatross*) are likely to be encountered in the lease sale area. The Aleutian Canada goose (*Branta canadensia leucopareia*) and the Eskimo curlew (*Numerius borealis*) have not been sighted in the lease sale area for many years. The range of the Eskimo curlew included St. Matthew and St. Paul Islands; therefore, the species would have had to pass through the lease area to reach St. Paul Island. The proposed lease sale area is outside the range of the threatened Arctic peregrine falcon (*F. p. tundrius*).

Short-Tailed Albatross: The short-tailed albatross was once abundant and widespread in the North Pacific, particularly in Alaskan waters. Activities of feather hunters on the nesting islands reduced the species to near extinction. Since its rediscovery as a breeding species on Torishima (in the early 1950's), the short-tailed albatross has staged a slow comeback and now numbers approximately 250 individuals. Elliot (1898) noted that these birds were once abundant near the Pribilof Islands, where they fed on the wastes from whaling fleets. A few were sighted recently near the western Aleutian Islands and in the Bering Sea. There also is a record of a sighting near Sanka Island in 1980 (Hasegawa and DeGange, 1982).

American Peregrine Falcon: There are three subspecies of peregrine falcons: the American peregrine falcon is listed as endangered, the Arctic peregrine falcon is listed as threatened, and the nonendangered subspecies, Peale's peregrine falcon, nests on the coastal cliffs throughout the Bristol Bay region. The American peregrine falcon occurs throughout interior Alaska, and highest densities occur along portions of the Yukon, Tanana, and Porcupine Rivers. The documented nesting areas closest to the lease sale area are in the Kuskokwim and Nushagak River systems. In these areas, four pairs produced seven young in 1981 (USDOI, FWS, 1982). There is little evidence to indicate that the Bristol Bay region ever supported substantial numbers of the endangered American peregrine falcon (USDOI, FWS, 1982).

5. Nonendangered Cetaceans: There are at least 10 nonendangered cetacean species that may occur in or adjacent to the lease sale area. The marine mammal species discussed are protected under the Marine Mammal Protection Act of 1972 and the International Convention for the Regulation of Whaling of 1946. The more commonly observed species include the minke whale (*Balaenoptera acutorostrata*), killer whale (*Orcinus orca*), beluga whale (*Delphinapterus leucas*), Dall's porpoise (*Phocoenoides dalli*), and harbor porpoise (*Phocena phocena*). Other species that are either infrequent visitors or less frequently observed include the short-finned pilot whale (*Globicephala macrorhynchus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*),

Bering Sea beaked whale (Mesoplodon stejnegeri), goosebeak whale (Ziphius cavirostris), and the giant bottlenose whale (Berardius bairdii). Several of the more common species are year-round residents in the lease area (Fig. III-16).

Minke Whale: Minke whales are one of the smaller baleen whales, which inhabit all oceans of the world except equatorial regions. The species occurs broadly over the North Pacific and into the southeastern Chukchi Sea during the summer months and migrates to southern latitudes (approximately 25°N latitude) during the winter. The North Pacific population is categorized as abundant, and sightings of this species have occurred in the pack ice in April. Minke whales apparently occur in the Bering Sea on a year-round basis, with concentrations near the Aleutian Islands and the Pribilof Islands during summer (Braham and Dahlheim, 1981). Over 95 percent of all minke whale sightings in the NMFS data base were within the 200-meter isobath, and most were in shallow coastal waters (Morris et al., 1983). Minke whales feed locally on abundant fish, euphausiids, and copepods. Euphausiids are the preferred prey in the North Pacific, followed by schooling fish and copepods. From March through December, minke whales are seen feeding most frequently in the lagoons and coastal waters along the northern shore of the Alaska Peninsula (i.e., Port Moller and Nelson Lagoon).

Killer Whale: Killer whales were observed in all major oceans and seas of the world and appear to increase in abundance shoreward and toward the poles of both hemispheres (Mitchell, 1975). In the Pacific Ocean, they are more closely associated with subarctic waters than with polar or tropical waters. It is hypothesized that killer whales are year-round residents, but they are most frequently observed between April and October (Braham and Dahlheim, 1982). Killer whales were sighted throughout Bristol Bay, although they are more commonly observed nearshore. Several observations also were made far offshore and in waters up to 2,000 meters deep. The whales commonly feed on sea lions and harbor seals, which are abundant in shallow waters. Killer whales also are abundant just south of the Pribilof Islands along the continental shelf and slope, where several marine mammal species concentrate during the summer. Killer whales appear to be opportunistic feeders, eating mostly fish (such as salmon) and switching to marine mammals when fish are less abundant. The distribution and movements of killer whales are, in part, related to the availability of prey, especially fish and marine mammals. The North Pacific killer whale population is regarded as abundant.

Beluga Whale: Beluga whales are circumpolar in arctic and subarctic waters, numbering at least 30,000 in the North American arctic (Sergeant and Bradie, 1975). Belugas are abundant in Alaskan waters, especially above 60°N latitude; at least two stocks are generally recognized, one in the Cook Inlet/Gulf of Alaska region and the larger population(s) in the Bering, Chuckchi, and Beaufort Seas. The Alaskan population is at least 9,000 and perhaps as high as 16,000 individuals. The summer-resident population of Bristol Bay is estimated at between 1,000 and 5,000 individuals (Sergeant and Brodie, 1975). Belugas occur in Bristol Bay year-round and are found in association with the seasonal pack ice in winter and early spring. Belugas feed from midwater to the bottom, primarily on fish (such as salmon, smelt, flounder, and sole), and usually in shallow waters of the continental shelf and at the mouths of major rivers. Gurevich (1980) reported belugas (50 to over 500 whales) moving twice a day during May and June up and down the Kvichak River, foraging for red salmon and smelt. Beluga concentrations also were reported north of Port

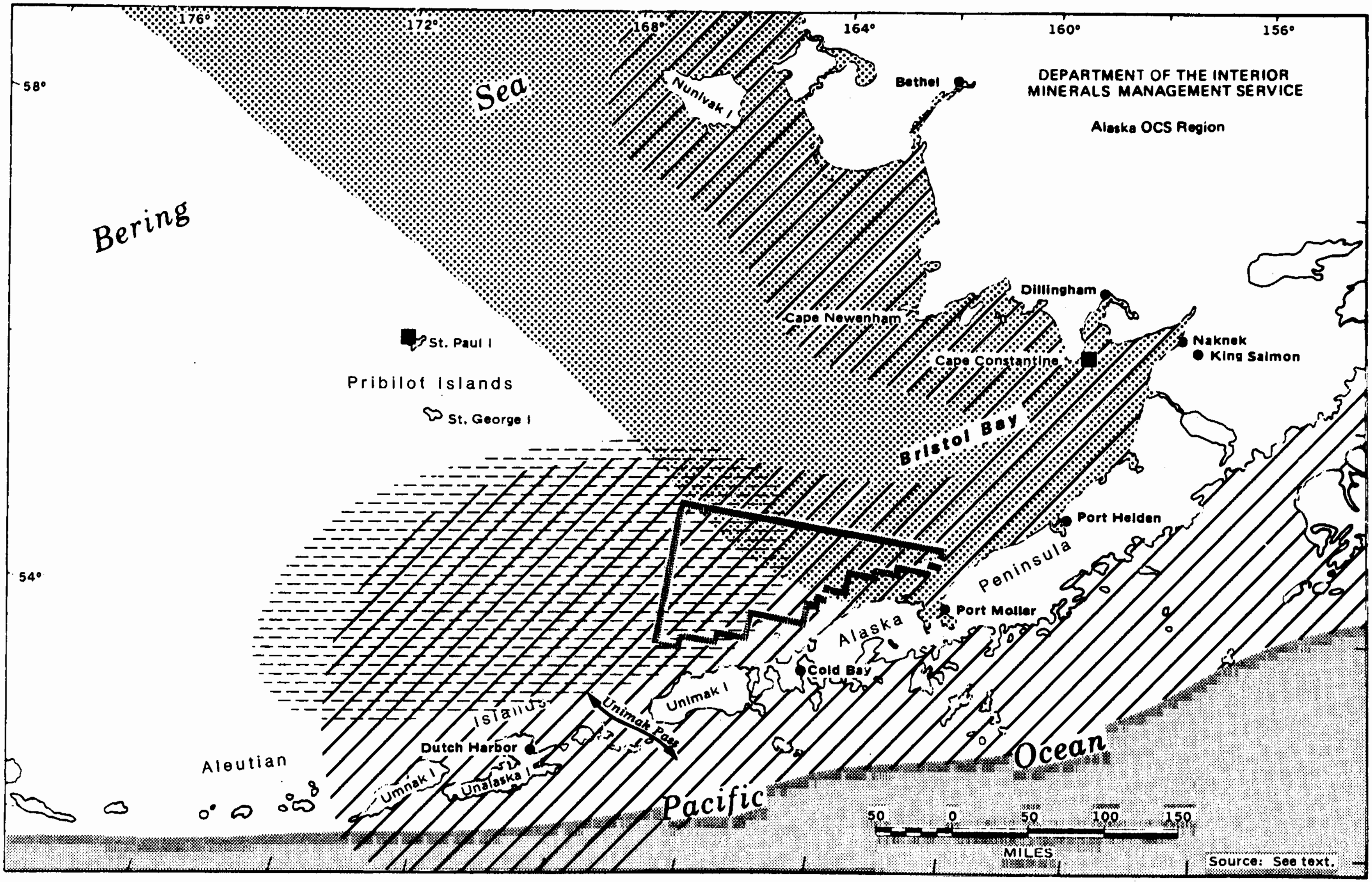


FIGURE III-16

AREAS OF MOST PROBABLE OCCURRENCE OF NON-ENDANGERED CETACEANS

LEASE SALE 92 BOUNDARY

BELUKHA WHALE (YEAR-ROUND)

SUMMER CONCENTRATION OF NON-ENDANGERED CETACEANS

PACIFIC WHITE-SIDED DOLPHIN AND GOOSEBEAK WHALE (SUMMER)

HARBOR PORPOISE (SUMMER AND FALL)

BERING SEA BEAKED WHALE STRANDINGS (PROBABLY PRESENT IN SUMMER, SOUTHEAST OF PRIBILOFS)

MAJOR MIGRATION ROUTE BETWEEN GULF OF ALASKA AND BERING SEA

NOTE: DISTRIBUTION OF MINKE, KILLER AND GIANT BOTTLENOSE WHALES, AND DALL'S PORPOISE EXTENDS TO NEARLY ALL MARINE WATERS IN THIS FIGURE

Heiden (300 individuals) along the coast during summer (Gurevich, 1980). Although belugas were observed near the Pribilof Islands, they are generally characterized as a nearshore and estuarine species that feeds and calves in those areas during the summer months. Belugas generally breed during the spring and early summer months and have a gestation period of 15 months.

Dall's Porpoise: Dall's porpoise are sighted year-round throughout the lease sale area. They occur in shallow waters but have been most frequently sighted in waters over 100 meters deep. Concentrations occur from June through August along the shelf break from Unimak Pass to the Pribilof Islands. This species ranges from Baja California, along the western coast of North America, and across the North Pacific Ocean to the coastal waters of Japan. The northern limit of the species is generally Cape Navarin (62°N latitude) in the Bering Sea, although they have been observed as far north as 66°N latitude (Morris et al., 1983). Migratory movements are not well understood, but available information suggests local migrations along the coast and seasonal onshore/-offshore movements through the lease area. The estimated size of the North Pacific population (not including California-to-Washington coastal waters) of Dall's porpoise is 840,000 to 1,300,000 animals, with a Gulf of Alaska population between 130,000 and 250,000 individuals (Bouchet, 1981). Dall's porpoise usually travel in small schools of two to twenty animals and feed predominantly on capelin, hake, and herring. Morejohn (1979) reported that Dall's porpoise breed and calve year-round in the northeastern Pacific waters from southern California to Alaska. Killer whales are natural predators of Dall's porpoise.

Harbor Porpoise: The harbor porpoise is a boreal temperate-zone species ranging along the North Pacific coast from Point Barrow, Alaska, to central California, and occasionally as far south as Mexico. Harbor porpoise are usually sighted singly or in pairs. Although the harbor porpoise may be present in the lease area year-round, most sightings occur in the summer months. Neave and Wright (1969) report that harbor porpoise move north in late May and south in early October. Harbor porpoise generally are seen in coastal environments such as harbors, bays, and the mouths of rivers. They feed primarily on small schooling gadoid and clupeoid fish (i.e., cod, herring, and mackerel). The principal mating season is reported to be from June to possibly as late as October, with peak calving occurring in May and July. Gestation probably lasts approximately 11 months. Their life span is relatively short, perhaps not exceeding 15 years (Leatherwood and Reeves, 1983).

Short-Finned Pilot Whale: Pilot whales are considered rare in Alaskan waters, and they have been reported only on a few occasions (Reilly, 1978). Whales present in the lease area are rare; they normally range no farther north than California. They travel in groups of up to several hundred animals, frequently in association with other cetaceans. Although information on seasonal movements is limited, populations may shift northward in the summer and south in the winter in response to changes in water temperatures. Pilot whales were sighted only inside the 50-meter isobath (three times). They are long-lived and apparently have a relatively long reproductive life; the oldest pregnant female found was 35 years old (Kasuya, 1977). Squid is the preferred food of the short-finned pilot whale.

Pacific White-Sided Dolphin: Pacific white-sided dolphins were observed in the lease area, primarily in waters 100 to 200 meters deep. The species range is from Baja California to the Aleutian Islands, as well as off the coast of Japan. Most abundant in the summer months, this species concentrates in areas of high fish abundance, such as along the shelf break. Pacific white-sided dolphins are opportunistic feeders that eat a variety of fish and squid. Presumably, the dolphins shift their distribution farther north during the summer season and also may move offshore (Morris et al., 1983). They are frequently observed in groups exceeding 100 individuals; groups of between 500 and 2,000 individuals have been sighted.

Bering Sea Beaked Whale: This species is endemic to the subarctic and cold temperate North Pacific Ocean, ranging from northern Japan, along the Aleutian and Pribilof Islands, through the Gulf of Alaska to northern California. Bering Sea beaked whales have not been observed in the lease area, but 2 sightings were reported in adjacent areas (Fig. III-16). During a summer survey in 1979 (along the central Aleutian Islands) 52 individual whales were observed in 7 pods ranging from 5 to 15 animals per group. The whales were observed in waters off the continental slope ranging in depth from 730 to 1,560 meters (Loughlin et al., 1982).

Goosebeak Whale: This species is found in all oceans of the world, except for arctic and antarctic waters (Moore, 1963). It may be the most abundant beaked whale in the eastern North Pacific. There was only one sighting in the southern Bristol Bay/Bering Sea area (Braham et al., 1977). Sightings of goosebeak whales in the Gulf of Alaska occurred in water depths of greater than 1,200 meters. It appears that they inhabit the deeper waters of the Pacific (Morris et al., 1983). Goosebeak whales feed on deep-sea fish and squid (Kenyon, 1961).

Giant Bottlenose Whale: This species is endemic to the North Pacific and ranges from St. Matthew Island, through the Gulf of Alaska, to southern California (Rice, 1974). Whaling records from Japan indicate a greater density of giant bottlenose whales in waters beyond 1,000 meters deep, and it is assumed that they are similarly distributed in Alaskan waters. These whales feed predominantly on squid and demersal fish (Rice, 1978). Studies in Japan indicate that mating activity peaks during October and November, and peak calving occurs from March to April (Kasuya, 1977).

C. Social and Economic Systems

1. Commercial Fishing Industry: The fisheries of the North Aleutian Basin are among the most productive in the world. Major fisheries associated with the basin include those for salmon, king and tanner crab, herring, and groundfish. Historically, the salmon fishery has dominated in the region. It takes place in the inshore waters of Bristol Bay and along the Alaska Peninsula, where salmon destined for Bristol Bay also migrate. In contrast, the king and tanner crab fisheries are concentrated offshore, in the outer, southern portions of the North Aleutian Basin north of Unimak Island. Foreign groundfish fisheries, primarily for pollock, are located in the outer portion of the North Aleutian Basin, mostly between 163°W and 165°W longitude, while joint-venture groundfish operations for yellowfin sole and cod occur from 163°W longitude east to the shores of the Alaska Peninsula and Bristol Bay. The area has been closed to halibut fishing by regulation since 1971. Two herring fisheries operate in the basin: one in the Togiak area and the other, smaller one, in two areas of the Alaska Peninsula (north of the Shumagin Islands and near Port Moller). The salmon fishery takes place in the summer, peaking from late June through July. King crab is taken primarily in the fall, in September and October, whereas tanner crab is taken in the spring, mainly from March through May. The season for herring also is in the spring, from late April through June. Groundfish fisheries take place throughout the year.

The commercial fisheries of the North Aleutian Basin annually bring fishermen hundreds of millions of dollars. The estimated average annual ex-vessel value of North Aleutian Basin fisheries between 1977 and 1982 was $200 million, over half of which was from salmon. The salmon fishery also is the economic mainstay of the area's communities, since almost half of the commercial-salmon-permit holders are local residents and salmon is a primary source of income and employment. Subsistence-caught salmon also is the traditional food and dietary staple of the area.

Crab fishermen are almost all from outside Alaska, primarily from Seattle; but crab processing also contributes to the local economy through some employment of local residents. The groundfish fisheries traditionally have been the exclusive domain of foreign countries; but American fishermen are increasing participation through joint-venture arrangements with foreign processors. These American fishermen also are predominantly from outside Alaska.

In addition to the monetary value of regional fisheries resources that are processed for consumption, there also is an economic value derived from the sport fisheries. Due to the remoteness of the area in the vicinity of the lease sale, sport fishing is primarily a recreational activity of the local inhabitants; however, there is some economic benefit from sport fishing--hunting guides provide fishing opportunties when their clients engage in recreational hunting. In the Aleutians East CRSA in 1982, about 22,000 salmon; 1,600 rainbow trout; 13,000 Dolly Varden/Arctic char; 15,000 smelt; and 800 halibut were taken in the sport fisheries (Resource Analysts, 1984).

The fisheries of the North Aleutian Basin are therefore economically important--both absolutely, in terms of the total economic benefits they provide at the local, state, national, and international levels, and relatively, in terms of their primary role in the local economy.

a. <u>Harvest Methods</u>: Harvest technology for fisheries of the North Aleutian Basin consists of five primary gear types. These include gillnets (both drift nets and set nets), purse seines, pot gear, longlines, and trawls.

Gillnets are used primarily in the salmon and herring fisheries. These consist of small-thread meshing floated like a curtain by a cork line and held toward the bottom by a leaded line. Salmon are caught by swimming into the meshes. Drift gillnets are attached to a vessel and are periodically pulled aboard, where the fish are removed from a segment of the net at a time. Drift-net gear has been fished effectively day and night. Set-net gear, on the other hand, is anchored to the beach with the net extended perpendicular to the shore and anchored offshore by use of a skiff. Set gillnets are often left exposed on the beach at low tide, enabling the fishermen to remove the catch. When operated in deeper waters, catches usually have been "picked" by the use of work skiffs 12 to 18 feet long (Natural Resource Consultants, 1984).

Purse seines are used to capture schooling salmon and herring. The principle is to set the net across the path of a moving school of fish, encircle them, and draw closed the bottom of the net to prevent escape. One end of the net is secured to a small skiff, which is released when the net is set. The seine boat circles around the school; it then returns to the skiff, receives the net end from the skiff, and commences to haul in the net.

The greatest usage of purse seines in the salmon fishery traditionally has occurred in the western portion of the northern Alaska Peninsula and the southern peninsula, particularly in the False Pass region. The use of purse seines in the Bristol Bay salmon fishery is prohibited by regulation; however, purse seines are used in the herring roe fisheries of northern Bristol Bay. The vessels and procedures are similar to salmon fishing, except that aircraft are used to locate herring schools and guide the vessel in setting the net.

Pot gear is used in the king, tanner, and Dungeness crab fisheries. Large rectangular traps (pots), approximately 7 feet by 7 feet by 3 feet deep, are used for king crab, with smaller pots being used in the other crab fisheries. A perforated container filled with bait is hung inside the pot, and approximately 50 to 125 fathoms of line are attached to the pot. Two floats are attached to the line for identification and recovery. The pot is then launched from the vessel and usually is left on the bottom for 1 to 3 days. In recovery, the line is retrieved with a grapple, brought on board, and passed onto a hydraulic winch that brings the pot up to the vessel's side, where it is secured to a crane and brought on board. Typically, each vessel carries 60 to 70 pots and may fish up to 200 pots at a time. In the Bering Sea, some of the larger boats may carry upwards of 100 pots and may fish as many as 1,000 pots at a time. Crab vessels have large tanks that recirculate sea water, in which the crabs are kept alive until they are delivered to a processor.

Longline gear is used by the Japanese for sablefish and Pacific cod. This gear consists of a heavy groundline to which branch lines with hooks (gangions) about 3 feet long are attached. Many units (skates) of gear can be joined, and a set may be laid out over several miles. The hooks are baited, usually with herring or squid, and the line is "shot" out of the stern of the vessel. The ends of the line are anchored on bottom-hauling lines that continue to the surface and are attached to flags and floats. After setting, the vessel returns to the starting end and hauling begins. The line is brought in over the side of the vessel and the fish are removed by a gaff man standing at the rail.

Trawl types include otter trawls towed by a single vessel using "otter boards" or "doors" to spread and hold open the net mouth. This method is generally used by U.S. vessels for groundfish, where two nets may be used. The Japanese groundfish fishery uses small vessels in mothership operations. Pair trawls are towed by two vessels, and efficiency is increased through the combined horsepower of both vessels. Trawls may be fished on the bottom or in mid-water. On-bottom trawling is used to target on flatfish, and midwater trawling is used for schooling species, such as pollock.

b. Salmon Fishery: The annual salmon runs which surge around the end of the Alaska Peninsula and into Bristol Bay are the largest and most lucrative in the world. Bristol Bay salmon provide 30 percent of the entire world's salmon harvest. Salmon has been the economic mainstay of the region and continues to be so today, chiefly because of the commercial fisheries.

The Bristol Bay fishery is the larger of the two salmon fisheries--it is the largest salmon fishery in the world (Fig. III-17). From 1978 through 1982, the Bristol Bay commercial catch averaged over 135 million pounds per year. The Alaska Peninsula catch (the smaller fishery) averaged 57 million pounds per year. In addition, the two fisheries provide the local people with a minimum of 1.1 million pounds per year in subsistence harvests. Between 1979 and 1981, this subsistence-caught salmon, the region's dietary mainstay, amounted to at least 650 pounds per year for each of the 1,700 households in the region.

All five species of salmon are harvested in the Bristol Bay/Alaska Peninsula region: sockeye, king, pink, chum, and coho. Sockeye salmon provide the bulk of the catch, except on the southern side of the Alaska Peninsula, where pink salmon predominate in the commercial harvest (Appendix L, Figs. L-1 through L-5, Tables L-1 and L-2).

The sockeye salmon run is extremely cyclic. Since sockeye salmon account for between 80 and 90 percent of the Bristol Bay salmon catch and earnings, the size of the sockeye run largely determines the economic success or failure of the Bristol Bay salmon season. The Alaska Peninsula fishery also rises and falls in cycles similar to those of Bristol Bay (Fig. III-17), but these cycles are less pronounced. In the Alaska Peninsula, sockeye and pink salmon each make up about 35 percent of the total catch, followed by chum salmon at 25 percent of the total (Fig. III-17) (Appendix L, Fig. L-1).

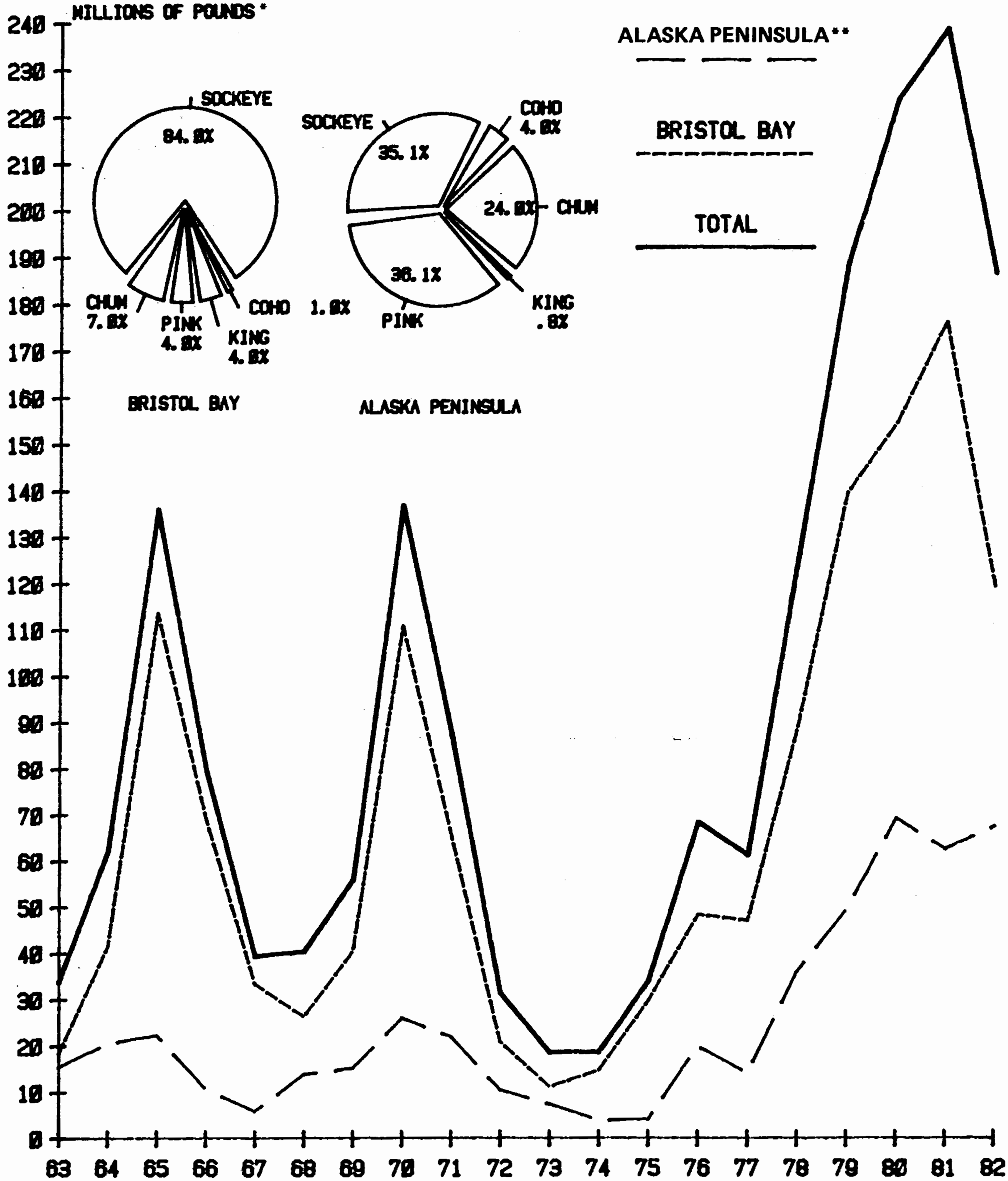
Since 1979, both the Bristol Bay and Alaska Peninsula commercial catches have been much higher than historical averages (Fig. III-17). The Alaska Peninsula catch peaked at an all-time high of 69 million pounds in 1980. In 1981, the Bristol Bay catch was the highest in history at 176 million pounds.

(1) Commercial Catch:

Bristol Bay: The Bristol Bay salmon catch comes from five different river drainages: the Naknek/Kvichak, Egegik, Ugashik, Nushagak, and Togiak Rivers. Each one of these is a separate fishing district (Figs. III-18 and III-19).

FIGURE III-17

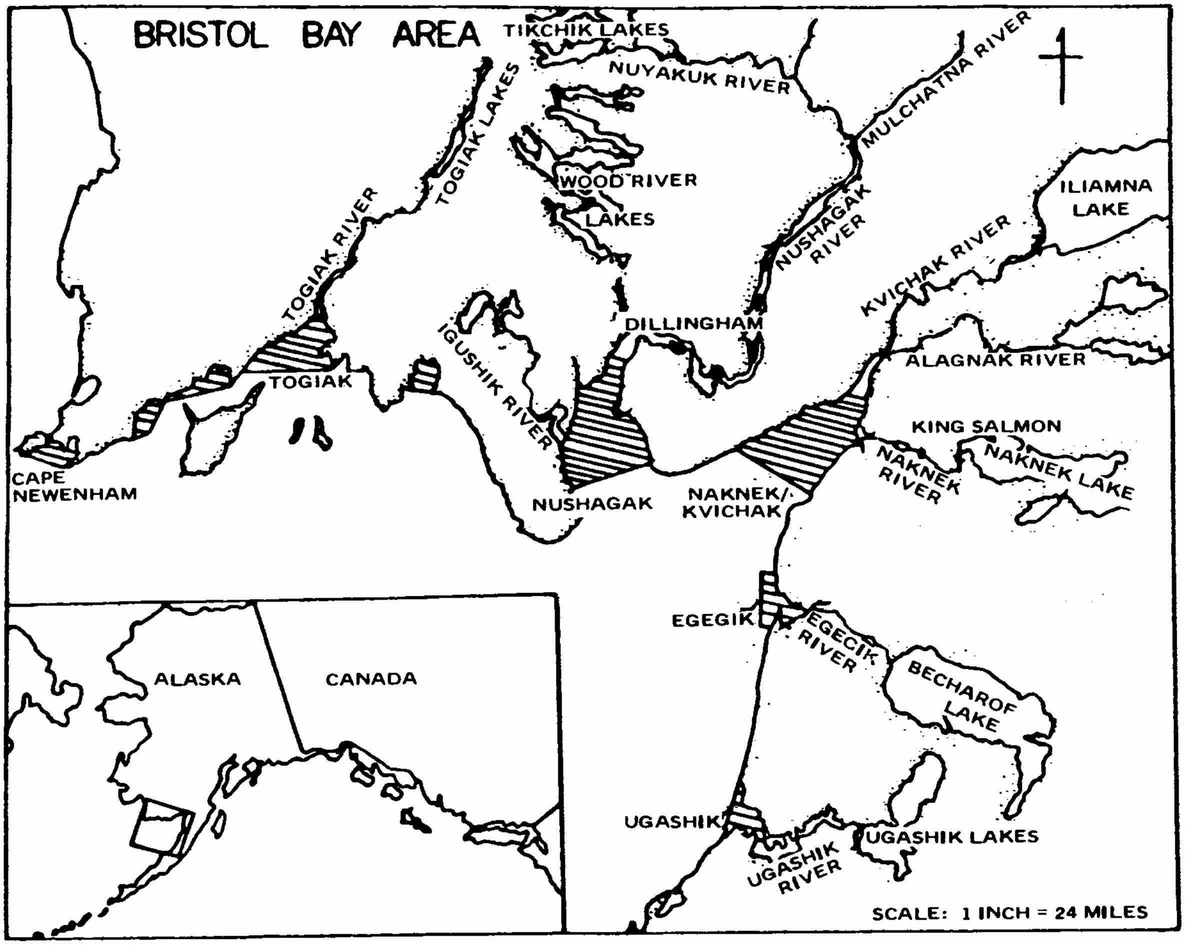
NORTH ALEUTIAN BASIN SALMON CATCH IN MILLIONS OF POUNDS 1963 - 1982



*POUNDS ARE ESTIMATED BASED ON AVG WEIGHTS, BY DISTRICT, FOR EACH SPECIES.

**SINCE SALMON WAS USUALLY NOT SOLD BY THE POUND IN THE 60'S, AVG WEIGHTS FOR THE ALASKA PENINSULA WERE NOT KEPT. AN AVG OF THE AVERAGE WEIGHTS 1973-82 WAS USED TO COMPUTE 1963-1972 FIGURES.

SOURCES: ADF&G COMM, FISH DIVISION, 1982 & 83.



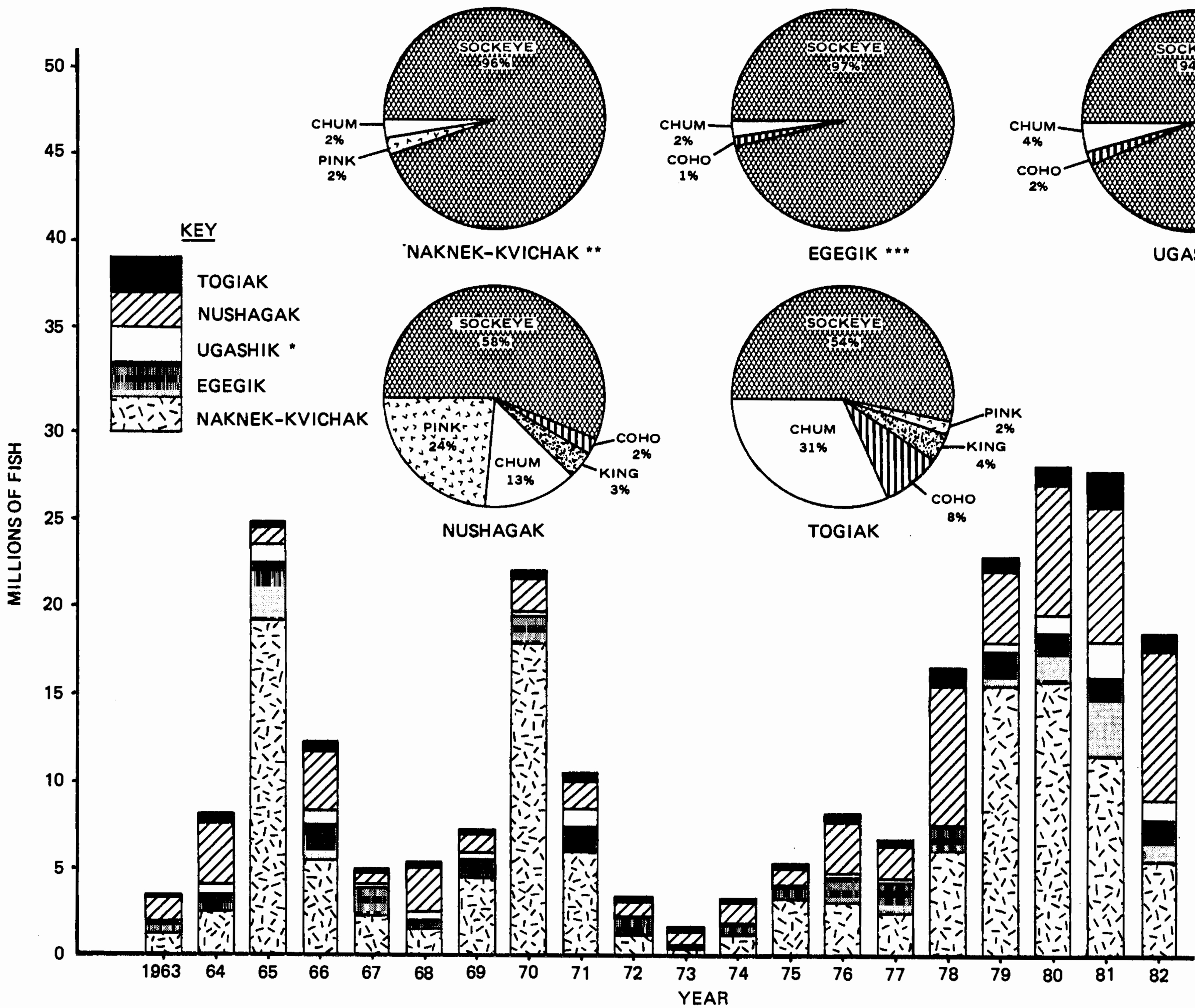
Source: ADF & G, 1984.

FIGURE III–18

FISHING DISTRICTS IN BRISTOL BAY, ALASKA

FIGURE III–19

BRISTOL BAY SALMON CATCH BY DISTRICT IN MILLIONS OF FISH (1963-1982)



* From 1972 through 1975 and again in 1978, catches from the Ugashik District were too small to show up on this graph. Similarly,

** King and coho salmon represented less than 1% of total catch (1963-1982)

*** King and pink salmon represented less than 1% of total catch (1963-1982).

Source: MMS, 1984.

The Naknek/Kvichak River system is the biggest producer; over the past 20 years, over half of the total Bristol Bay catch has come from this drainage. It is the drainage most famous for the highly cyclic red salmon run, so this drainage also accounts for most of the variation in the yearly Bristol Bay catch (Fig. III-19). In poor years, other drainages are more stable and relatively more important to total catch figures.

The catch from the Nushagak drainage has increased since the mid-1970's, both absolutely and relative to the total. The peak-catch years for the Nushagak drainage have occurred in the last 5 years, whereas the Naknek/Kvichak peak-catch year was 1970.

The Togiak district catch has remained a very small part of Bristol Bay's total but has increased in recent years (Fig. III-19). It tends to remain relatively stable in the face of area-wide variations.

Salmon species composition varies by district, or drainage. While over half of the fish caught in every Bristol Bay drainage are sockeyes, sockeyes represent over 90 percent of the fish caught in the Naknek/Kvichak, Egegik, and Ugashik River systems. In the Nushagak and Togiak drainages, other species are more numerous. Pink salmon may account for over half of the fish caught in the Nushagak River during even years; most of the pink salmon caught in Bristol Bay come from the Nushagak River (85%). Chum salmon have accounted for almost one-third of the Togiak district catch since 1962 and for 13 percent of the Nushagak catch (Fig. III-19). Over half of Bristol Bay's chum salmon also come from the Nushagak River.

Although king salmon represent a very small portion of the catch in every Bristol Bay drainage (Fig. III-19), they are most numerous in the Nushagak and Togiak drainages. Since 1963, over 70 percent of Bristol Bay's king salmon have come from the Nushagak drainage, and another 17 percent have come from the Togiak drainage (ADF&G, 1982).

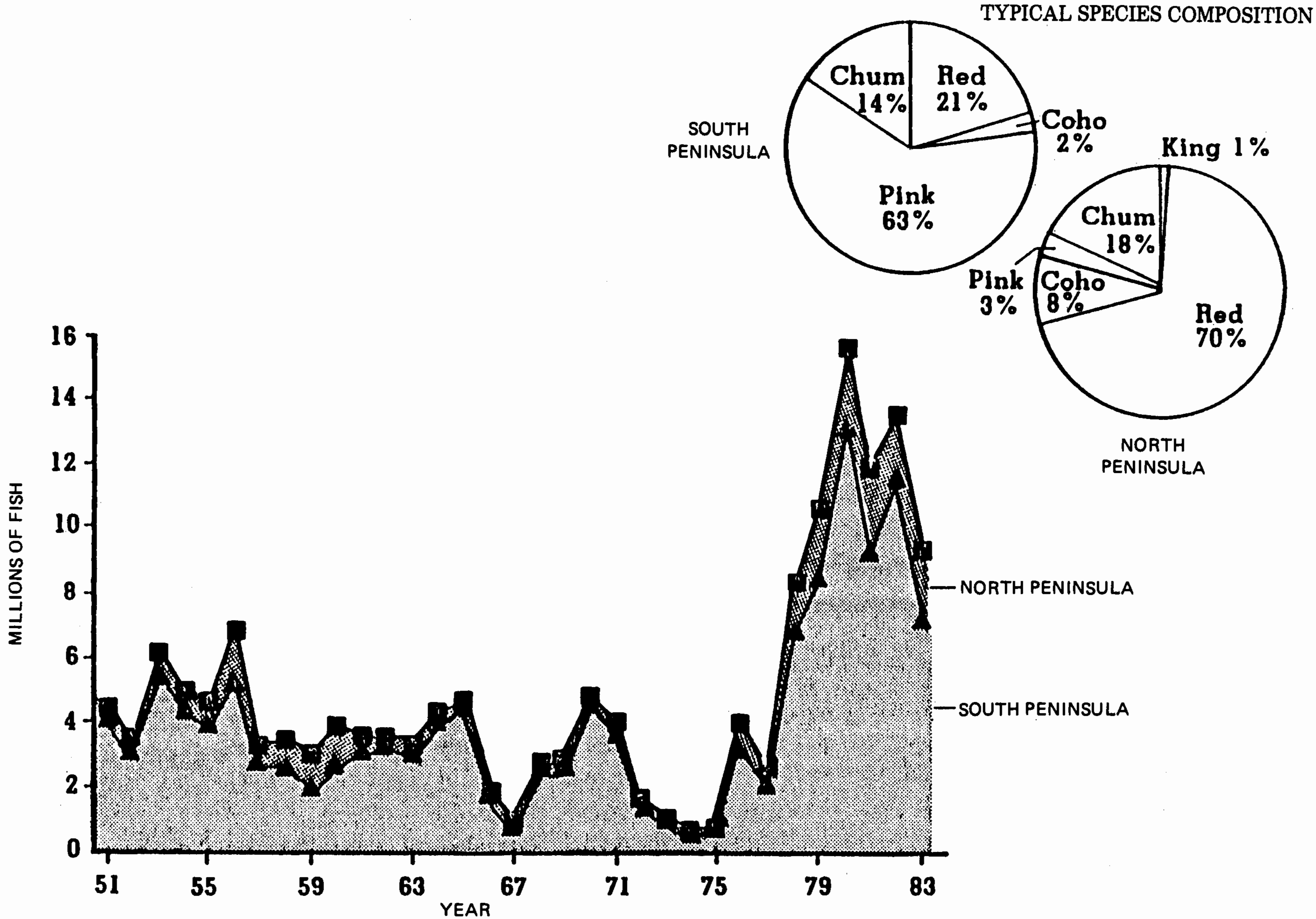
Alaska Peninsula: The Alaska Peninsula Salmon Management Area encompasses the North Peninsula and South Peninsula fishing districts. More fish are harvested on the southern side of the peninsula than on the northern (Fig. III-20), and the species composition of the catches of these two areas is quite different. In South Peninsula waters, pink salmon account for the largest proportion of the catch (63%), with sockeyes and chums comprising the majority of the remainder of the harvest. Only very limited numbers of cohoes and kings are taken. Balboa Bay on the southern coast of the Alaska Peninsula has an annual commercial pink and chum salmon purse-seine fishery from June 1 through July 10. Along the northern side of the peninsula, 70 percent of the salmon taken are sockeyes, with chums, cohoes, and small numbers of kings accounting for the rest of the catch (Fig. III-20) (Aleutians East CRSA, 1983).

(2) Ex-Vessel Value: The ex-vessel value (dollars paid to the fishermen) of the Bristol Bay and Alaska Peninsula salmon fisheries increased rapidly during the late 1970's. This was brought about both by increased salmon catches since 1975 and by increased salmon prices. In 1975, the Bristol Bay catch was worth about $12 million to the fishermen; by 1982, its worth had risen to $81 million. Similarly, the Alaska Peninsula catch was worth only about $1.7 million to the fishermen in 1975, but by 1982 was twenty

FIGURE III–20

TOTAL ALASKA PENINSULA COMMERCIAL SALMON CATCH

1951-1983



Source: Aleutians East Coastal Resource Service Area, 1983.

times as high at nearly $36.7 million. The highest value ever brought to the Bristol Bay fishermen was in 1979, when they received over $138 million for their catch. In 1981, Alaska Peninsula fishermen received an all-time high of $41 million for their catch (Fig. III-21; Appendix L, Fig. L-2). Once the fish is processed, the values at the wholesale and retail levels increase substantially.

The relative contribution of each salmon species to the fishery total value varies from year to year, but the sockeye harvest consistently contributes the greatest proportion of the value. In Bristol Bay, sockeye salmon have made up 88 percent of the fishery's total value since 1963. During the peak-harvest years of 1979 and 1981, sockeye salmon made up 93 and 92 percent of the total Bristol Bay fishery value, respectively. In the Alaska Peninsula fishery, sockeye salmon constituted 52 percent of the value in 1982, even though it accounted for just one-third of the total pounds caught (Appendix L, Fig. L-6 through L-10).

While salmon prices vary widely according to season, area, and contractual arrangement, sockeye and king salmon generally bring the highest prices to the fishermen. Chum and pink salmon bring lower prices--about half as much per pound as sockeyes and kings. A king salmon is worth more than any other species, due not only to its high price per pound, but to the fact that it weighs three times as much as a red salmon (kings weigh about 15-20 lbs on average; reds about 6 lbs). Conversely, a pink salmon is worth the least of any species; it weighs only about 3 pounds and brings only about half as much per pound as a red or a king. The prices fishermen received for each species in 1982 are illustrated in Table III-12.

(3) Subsistence Value: It is profitable for a fisherman residing in the local area (Table III-13) to take a certain amount of salmon for his own food needs. Salmon is the culturally preferred food, and it is uneconomic to sell fish for $.70 per pound when it would cost over $3.00 per pound to buy it in a can from a local store. The high cost of other imported food in the region, together with the difficulty of getting fresh produce in many of the more remote communities and the superior taste and nutritional quality of the locally caught salmon, further increase its economic value to the fishing households.

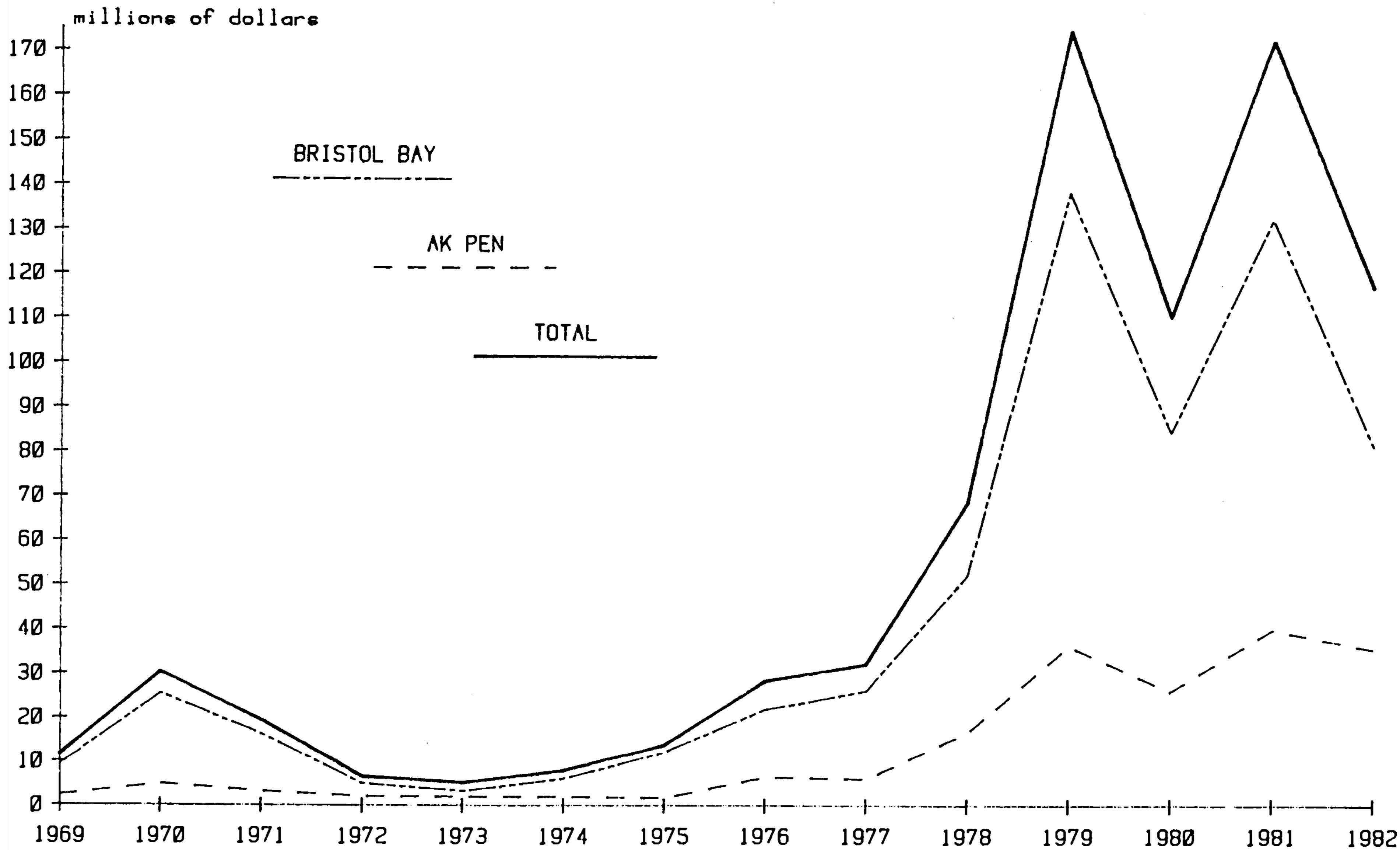
Unlike commercial catches and ex-vessel salmon prices, which fluctuate greatly from year to year (1.3 million pounds per year [Table III-14]), subsistence catches have been remarkably stable over the years. People take enough salmon to meet their food needs, whether it is a good or a bad year in the commercial fishery; therefore, the economic value of subsistence-caught salmon is a relative constant from year to year, rising only in direct relation to population increases and the cost of food.

(4) Employment, Income, and the Role of Salmon in the Local Economy: More than 6,000 fishermen in Bristol Bay and another 1,000 in the Alaska Peninsula area share in the value of the salmon fishery each year. They participate either as permit holders or as crew members.

There are 2,635 limited-entry permits in the Bristol Bay fishery--1,720 are drift net and 915 are set-net permits. Each permit holder also has between one and four crew members working on the permit.

FIGURE III-21

NORTH ALEUTIAN BASIN SALMON
EX-VESSEL VALUE IN MILLIONS OF DOLLARS
1969-1982



SOURCES: ADF&G COMM, FISH DIV, 1982; LANGDON, 1983

Table III-12
Ex-Vessel Value of Salmon Harvest in Bristol Bay and the Alaska Peninsula
1982

Species	Bristol Bay (Per Pound)	Alaska Peninsula (Per Pound)
Sockeye	$ .56 - canned .70 - fresh/frozen	$ .86 - .89
King	.75 - canned 1.17 - 1.30 fresh/frozen	1.07 - 1.17
Chum	.32	.44 - .46
Pink	.18 - .30	.13 - .15
Coho	.70	.71 - .74

Sources: ADF&G, 1982; CFEC, 1983.

Table III-13
Population and Fishery
Affiliation of Communities
in the Bristol Bay and Alaska
Peninsula Regions (1980)

Subregions/Communities	Fishery	Fishing District[1/]	1980 Population
Togiak	Bristol Bay	Togiak	
Togiak			470
Twin Hills			70
Manakotak			294
Total Population Togiak Region			834
Nushagak River	Bristol Bay	Nushagak	
Aleknagik			154
Dillingham			1,563
Clarks Point			79
Ekuk			7
Portage Creek			48
Ekwok			77
New Stuyakok			331
Koliganek			117
Total Population Nushagak River Region			2,376
Iliamna Lake	Bristol Bay	Naknek-Kvichak	
Nondalton			173
Newhalen			87
Iliamna			94
Pedro Bay			33
Kakhonak			83
Igiugig			33
Levelock			79
Total Population Iliamna Lake Region			582
Upper Alaska Peninsula	Bristol Bay		
Naknek		Naknek-Kvichak	318
King Salmon		Naknek-Kvichak	170
South Naknek		Naknek-Kvichak	145
Egegik		Egegik	75
Pilot Point		Ugashik	66
Ugashik		Ugashik	13
Port Heiden	Alaska Peninsula	North Peninsula	92
Total Population Upper Alaska Peninsula Region			879
Lower Alaska Peninsula	Alaska Peninsula		
Sand Point		North and South	625
King Cove		Peninsula	460
False Pass			70
Nelson Lagoon		North Peninsula	59
Total Population Lower Alaska Peninsula Region			1,214
Total Population of Bristol Bay and Alaska Peninsula Regions			5,885

Sources: U.S. Bureau of the Census, 1980; ADF&G Commercial Fisheries Division, 1982.

1/ Fishermen do not always fish in the district where their community is located.

Table III-14
Estimated Yearly Subsistence Salmon Harvest
by Subregion[1/]
1979-1981

Subsistence Salmon Species Harvested
(pounds)

Subregion	Sockeye	King	Chum	Pink	Coho	Total
Togiak	65,104	30,003	20,658	2,178	35,706	153,649
Nushagak Bay and River	310,313	174,073	73,884	10,690	34,479	603,439
Iliamna Lake	276,155	10,460	1,622	1,787	1,523	291,547
Upper Alaska Peninsula	128,961	4,882	760	834	713	136,150
Lower Alaska Peninsula	407	64,020	53,971	9,428	3,259	131,085
Total Pounds	780,940	283,438	150,895	24,917	75,680	1,315,870

Source: Economic, Subsistence, and Sociocultural Projections in the Bristol Bay Region, University of Alaska, ISER, 1983.

1/ Subsistence harvests for Quinhagak, Goodnews Bay, and the Chignik villages are included with these estimates. Their subsistence fishing does not occur in the Bristol Bay or Alaska Peninsula fisheries management areas. Without these villages, it is estimated that the total regional subsistence harvest is 1.1 rather than 1.3 million pounds.

All estimates are minimums and very approximate. Pounds are determined by using the average round weight for each species for 1979-81, and by multiplying by 75 percent to get the dressed weight. To the extent that people use the head, roe, or other parts of the fish normally discarded, subsistence-fish consumption is higher than shown here.

These fishermen come from many different places, which helps determine where the income from the fishery goes and is spent. The Bristol Bay salmon fishery is the only large-scale fishery in the North Aleutian Basin in which a sizable portion of the earnings go to local residents. In addition, over half the fishery's earnings go to residents of Alaska. Figures on residency of permit holders show that, as of 1981, 41 percent of the Bristol Bay permit holders resided in Bristol Bay. Urban Alaska was the residence of another 16 percent, while 6 percent were from other parts of rural Alaska. The remaining 37 percent came from outside the state (Table III-15) (Langdon, 1983).

Although Bristol Bay residents account for sizable portions of permit holders and crews, the majority of permits are held by people who officially reside outside the region. Furthermore, a disproportionate share of the ex-vessel income goes to permit holders from outside the region (Table III-16). Even though Bristol Bay residents hold nearly one-half the permits, they earn less than one-third of their total income from the fishery (Impact Assessment, Inc., 1984).

One reason for this is that most of the drift-net permits, which are generally more lucrative than set-net permits, are held by people residing outside of Bristol Bay. Bristol Bay residents own only 35 percent of the drift-net permits. More than four out of five permits owned by people residing outside of Alaska are drift-gillnet permits, while only half of the Bristol Bay permits are drift-gillnet. Income from a drift-gillnet permit usually exceeds that of a set-net permit by three or four to one. For example, in 1980, average gross earnings by drift-gillnet-permit holders in Bristol Bay were $28,000, while earnings from set nets were only $8,400.

Another reason for the difference in earnings between local fishermen and nonlocal fishermen is the differing quality of equipment used. Nonlocals tend to have newer and larger boats, more modern navigational equipment, and superior gear. Their boat hulls are usually made of aluminum and fiberglass, whereas many local residents' boats are still made of wood. Thus, Bristol Bay residents with drift-gillnet permits earn less than non-Bristol Bay residents with drift-gillnet permits. The same is true of set-net fishermen. Moreover, Alaskan residents living outside of Bristol Bay earn less than non-Alaskan fishermen. The figures in Table III-17, available for 1979 only, illustrate these differences.

It is important to note that 1979 may not be a representative year, since 1979 was the most lucrative year for the fishermen in the history of the fishery.

In the Alaska Peninsula Fisheries Management Area, the limited-entry permit and earnings situation is quite different from Bristol Bay. Here, a total of 383 permits are issued (Table III-18). Two-thirds of them, 263 permits, belong to residents of the Alaska Peninsula communities. Here also, in contrast to Bristol Bay, the local residents own as large a share of the most lucrative purse-seine permits as they own of the least lucrative set-net permits.

Like the Bristol Bay fishery, most of the nonlocal fishermen in the Alaska Peninsula fishery are from outside Alaska.

Table III-15

Ownership of Bristol Bay
Salmon Permits by Residence Category

	Drift Gillnet	Set Gillnet	Total
Bristol Bay Residents	594	493	1,087
Percent	35	54	41
Other Rural Alaskans	111	38	149
Percent	6	4	6
Urban Alaskans	256	179	435
Percent	15	20	16
Nonresidents	759	205	964
Percent	44	22	37
Total Permits	1,720	915	2,635
Percent	100	100	100

Sources: CFEC, 1983; Langdon, 1980.

Table III-16
Ex-Vessel Income from Salmon Fishing Industry in Bristol Bay - 1975 to 1982

Year	Income to Bristol Bay Residents 1/	Income to Other Fishermen	Total Income to All Fishermen (Ex-Vessel Value)	Percent Bristol Bay 1/
1975	$ 3,042,858	$ 8,984,142	$ 12,027,000	25.3
1976	7,770,533	14,177,467	21,948,010	35.4
1977	8,691,902	17,453,098	26,145,000	33.2
1978	20,312,276	31,960,724	52,273,000	38.9
1979	34,266,905	104,138,095 1/	138,405,000	24.8
1980	22,312,643	61,989,357	84,302,000	26.5
1981	37,607,716	94,883,284	132,491,000	28.4
1982	21,794,299	59,555,701	81,350,000	26.8

Source: Langdon, 1981.

1/ Pilot Point, Egegik, Ugashik, and Port Heiden on the Alaska Peninsula are not included with Bristol Bay, but are included with "Income to Other Fishermen."

Table III-17
Average Gross Earnings from Bristol Bay Salmon Fishery
by Gear Type and Residence
1979

Gear Type	All Fishermen	Bristol Bay Fishermen	Other Alaskan Fishermen	Out of State Fishermen
Drift gillnet	$71,696	$52,147	$72,643	$81,002
Set gillnet	$16,493	$14,724	$17,010	$19,484

Source: Langdon, 1981, as cited in Impact Assessment, Inc., 1984.

Table III-18
Ownership of Alaska Peninsula
Salmon Permits by Residence Category

Permit Holders	Purse Seine	Drift Gillnet	Set Gillnet	Total Permits (and Percent of All Permits)
Residents	93	85	85	263
(Percent of permits)	80	54	77	69
Other Rural Alaskans	0	2	3	5
(Percent of permits)	-	1	3	1
Urban Alaskans	5	12	8	25
(Percent of permits)	4	8	7	7
Nonresidents	19	57	14	90
(Percent of permits)	16	37	13	23
Total Permits	117	156	110	383
Total Percent	100	100	100	100

Sources: Langdon, 1980; CFEC, 1983.

The residents of the Alaska Peninsula usually earn the bulk of the ex-vessel income produced by the Alaska Peninsula salmon fishery (Table III-19). However, nonlocal fishermen still have higher average earnings.

Data on local-resident ex-vessel income are not available after 1979. For the years before 1979, it appears that the local-resident share of ex-vessel income was declining.

The largest share of the ex-vessel income in the Alaska Peninsula fishery usually goes to the purse-seine fishermen, followed by the drift gillnetters (Table III-20). The set netters earn only about 10 percent of the fishery. No discernible trends in earnings by gear type have occurred over the past 5 years.

In the Alaska Peninsula, many fishermen own more than one type of permit. The average number of permits held by each local fisherman is 1.73, or almost 2 permits per fisherman. Thus, even though different types of permits bring different earnings, Alaska Peninsula fishermen share in the earnings more equally than Bristol Bay fishermen do.

Although the salmon fishery is but one of the several commercial fisheries in the North Aleutian Basin, it is the prevailing traditional activity and the driving force of the modern commercial economy. The following discussion applies to Bristol Bay only, as similar figures are not available for the Alaska Peninsula. Between 1970 and 1980, fishing, almost entirely for salmon, accounted for 65 percent of the total annual personal income in Bristol Bay (resident and nonresident). Seasonal salmon fishing is even more important at the village level, where year-round employment is virtually absent. Most villagers either fish or work in fishing-related industries. Their entire year's needs for food, fuel, and supplies must often be met from income earned during the short 3- to 6-week summer salmon-fishing season. For the Bristol Bay region as a whole, commercial fishing is the largest single source of employment, representing almost one-half of the total employment in 1980. However, because more than half of Bristol Bay's total personal income is tied to nonresidents, there is a high degree of income leakage out of Bristol Bay in the commercial fishing sector. When only residents are considered, 31 percent of their personal income comes from commercial fishing. The rest comes from the government and support sectors (54%) and from transfer payments (15%). As might be expected, transfer payments were lower in the late 1970's than in the early 1970's, when residents' commercial fishery earnings were higher (Fig. III-22). In addition, employment in the government sector tends to vary inversely with employment in the fishing sector. During a good fishing year, government employment drops and vice versa. Also, nonresidents tend to participate more in the economy when fishing is good than when it is not. Thus, in 1973, when earnings in the fishery were lowest, resident income comprised 74 percent of the total income. In contrast to this, resident income was only 39 percent of the total income in 1979, the year of the highest earnings.

Even though the salmon fishery is the economic mainstay of Bristol Bay, the area's economy is considered underdeveloped in that so much of the fishery's earnings of residents and nonresidents alike is spent outside the region. In 1980, less than one-fourth of personal earnings in Bristol Bay was spent in Bristol Bay. Nonresident earnings--virtually all from salmon fishing--

Table III-19
Ex-Vessel Income from Salmon Fishing Industry
Alaska Peninsula
1975-1982

Year	Income to Alaska Peninsula Residents	Income to Other Fishermen	Total Ex-Vessel Value	Income to Local Residents (Percent of Total Ex-Vessel Value)
1975	$ 1,076,303	$ 581,888	$ 1,658,191	65
1976	4,063,957	2,357,658	6,421,615	63
1977	3,690,773	2,264,840	5,958,613	62
1978	10,059,507	6,472,686	16,532,193	61
1979	17,401,023	18,847,503	36,248,526	48
1980	1/	1/	26,127,260	1/
1981	1/	1/	40,092,464	1/
1982	1/	1/	35,649,325	1/

1/ Not available.

Sources: Earl R. Combs, Inc., 1982; Langdon, 1983.

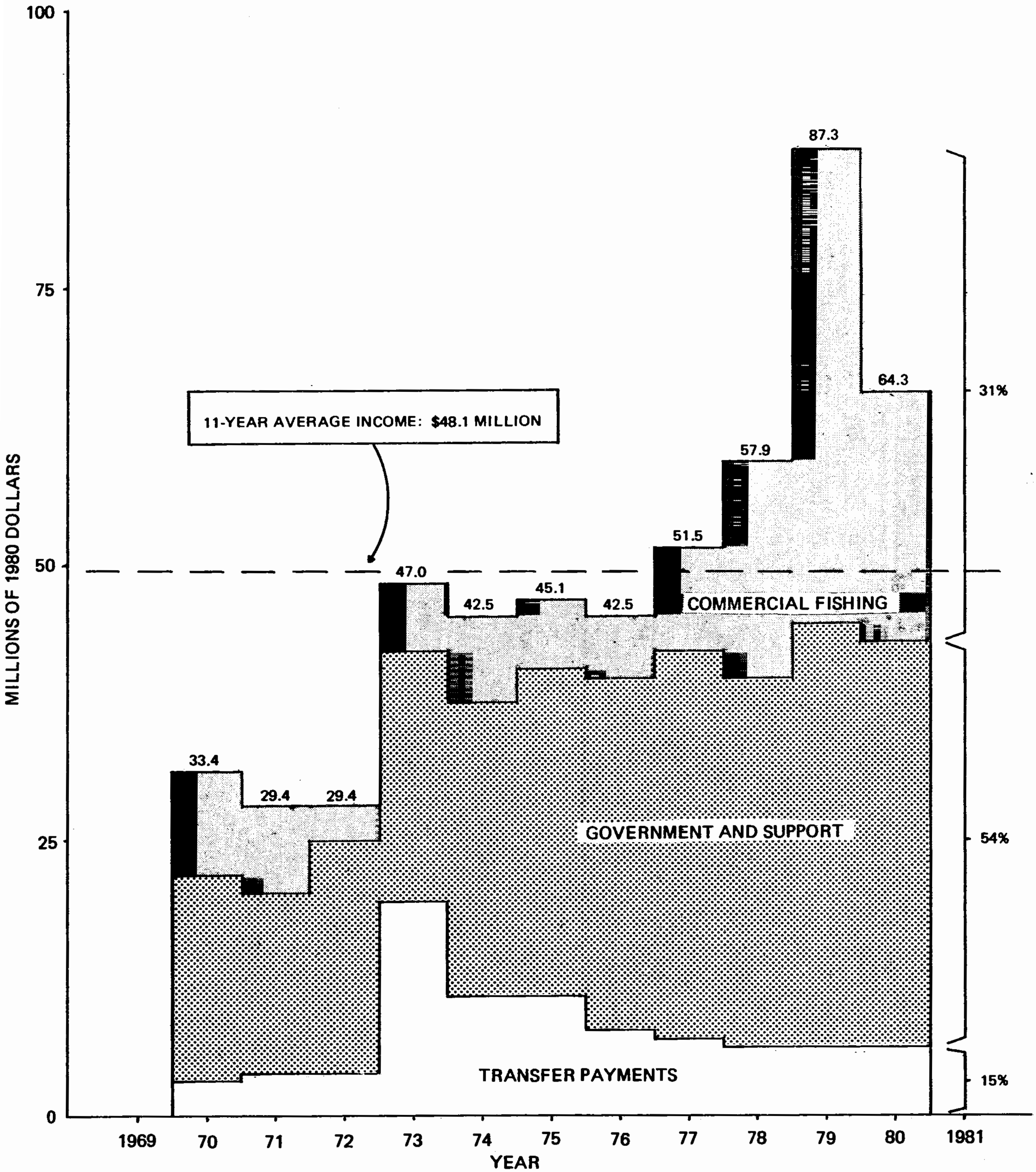
Table III-20
Percent of Earnings by Gear Type in the
Alaska Peninsula Salmon Fishery
1978-1982

Year	Purse Seine	Drift Gillnet	Set Gillnet
1978	59.5	33.2	7.3
1979	51.9	37.4	10.7
1980	70.6	21.4	8.0
1981	54.6	32.8	12.6
1982	51.3	38.9	9.8

Source: Langdon, 1983.

FIGURE III– 22

RESIDENT-ADJUSTED REAL PERSONAL INCOME IN BRISTOL BAY, 1970-1980



Source: George Rogers, 1982; Bureau of Economic Analysis, Personal Income by Major Sources, 1970-1980 (as cited by Nebesky, 1984).

accounted for over half of the income in Bristol Bay and they spent almost all of it outside Bristol Bay. Because spending in the local economy is a small share of total spending, and because spending that occurs locally is primarily for imported goods rather than for locally produced goods, the economic multiplier in Bristol Bay is low--about 1.2.

However, between 1970 and 1980, the proportion of total personal income that was spent inside Bristol Bay increased. Resident participation in the local economy also increased. While real income of nonresidents fell, real income of local residents more than doubled (Nebesky, 1984). These trends indicate that a decline in the fishery might affect local income and spending more than has been the case in the past.

It is questionable whether these trends toward retention of more of the Bristol Bay fishery's ex-vessel value in the local economy will continue. Two other trends are occurring in the opposite direction and indicate that more of the income from the fishery may be leaving the local economy: one is the increasing number of permits being purchased by people from outside Bristol Bay; the other is the increasing number of crew members being hired from outside the region.

Since the initial issuance of limited-entry permits in 1975, the number held by local residents has gradually declined. Local drift-net ownership has declined by 7 percent and set-net ownership by 14 percent. Meanwhile, drift-net-permit ownership by urban Alaskans has increased by 16 percent and set-net ownership by 10 percent. Among fishermen from outside the state, drift-net permits have increased by 4 percent and set-net permits by 40 percent.

This trend toward outside permit purchase does not indicate a decline in interest in or dependence on the fishery by local residents. Rather, it has to do with the increasing costs of participating in the fishery as competition increases among the limited number of permit holders for larger shares of the earnings. As the value of the permits increases, new purchasers must increase their catch of fish enough to be able to cover the increased costs of the permit. Therefore, newer, larger boats are required; these in turn require higher boat payments. In order to successfully compete with these new permit holders, local fishermen also must upgrade their boats and equipment. This increases their capital requirements to participate in the fishery, and the fishermen have to go further into debt. This is occurring at a time when canneries, which traditionally had flexible loan programs, are making fewer loans due to higher interest rates; and fishermen are becoming increasingly tied to strict yearly loan payments under conventional-financing arrangements. Meanwhile, the value of their permits is going up, and it becomes more tempting to sell (Langdon, 1983a; Nebesky, 1984).

The increasing costs of participation in the fishery put more emphasis on the need to make a profit, which means increasing productivity by catching as much fish as possible. Some pressure to catch more fish is also exerted by the canneries, which like to deal with fishermen who catch large volumes. These forces are in conflict with the traditional cultural values, which stress sharing and the domestic mode of production, and in which maximum profit is not the primary goal. In the domestic mode of production, kinspeople are hired as crew members. Kinspeople have traditionally earned high crew shares, i.e., a crew share of 25 to 30 percent or more. But, as costs increase and as profit becomes more important in order to cover payments on newer and larger boats that are now necessary in order to successfully compete, some permit holders are beginning to hire crew members who will work for only 10 or even 5 percent of the crew share. This means that people must be hired from outside the region, since a permit holder would be too ashamed to ask one of his/her kinspeople to work for such a low amount of money. Thus, in the future, increased numbers of permits and crew earnings in the fishery may go to people from outside Bristol Bay.

To summarize, the value of Bristol Bay salmon exists not only in absolute dollar terms but because of its overriding importance in the livelihood of the people of Bristol Bay. Even though the majority of salmon earnings go outside the Bristol Bay region, salmon is much more significant to the Bristol Bay economy than to any economy outside the region. The increasing costs of participating in the fishery--including the increasing need to go into debt, and the consequent importance of making a profit--conflict with traditional cultural values based on sharing and hiring kinspeople as crew members. The uncertainty of future salmon markets and run size could cause local fishermen to face hardship, given the need to hold onto the limited entry permit as the source of village livelihood (Langdon, 1983a; Nebesky, 1984).

(5) Salmon Processing: Salmon in the Bristol Bay and Alaska Peninsula areas are processed both by the traditional major canneries and by an increasing number of fresh and fresh-frozen processors and cash buyers who operate floating-freezer facilities or small-scale, onshore operations.

In 1982, a total of 72 processors/buyers reported operations in Bristol Bay. All of the bay's available canning lines operated in 12 land-based canneries. In addition, 60 companies operated in fresh-export, brine-export, and the frozen- and cured-salmon marketing areas (ADF&G, 1982).

On the Alaska Peninsula, the only operating cannery is at King Cove. Two other canneries operate outstations in the area. Three large-scale and one small-scale freezer facilities operate out of Alaska Peninsula communities, and several more floating processors and small-scale cash buyers purchase fish in the area.

The value of the salmon caught in the North Aleutian Basin area increases substantially after it is processed. Processing also provides jobs for hundreds of people each year and thus provides indirect economic spinoffs to other segments of the economy. Table III-21 shows the wholesale value of Bristol Bay salmon compared with the value to the fishermen (ex-vessel value) in millions of dollars. These figures show that the value of the Bristol Bay fishery often doubles or triples at the wholesale level; and it increases again at the retail level.

A similar situation exists for the Alaska Peninsula salmon fishery. While wholesale figures are not available for all salmon processed in the region, the following information (Table III-22) from three of the Alaska Peninsula processors covers 70 to 80 percent of the fish poundage processed and 60 to 70 percent of the ex-vessel value (information was not available for the fourth major processor or from the increasing number of cash buyers and floating processors [Table III-22]). These figures show that the fishery's value almost

Table III-21
Comparison of Wholesale and Ex-Vessel Value of Bristol Bay Salmon Harvest
1970-1982

Year	Ex-Vessel Value in $ Millions	Wholesale Value in $ Millions	Percent Value-Added
1970	$ 25.5	$ 50.1	96.5
1971	16.1	36.7	128
1972	4.8	14.4	200
1973	3.1	9.7	213
1974	6.0	14.0	133
1975	12.0	35.2	193
1976	21.9	53.9	146
1977	26.1	50.0	92
1978	52.3	85.5	63
1979	138.4	162.4	17
1980	84.3	291.8	246
1981	132.5	not available	—
1982	81.4	not available	—

Sources: Ex-vessel Value: ADF&G. 1982. Bristol Bay Annual Management Report. Values from the Commercial Fisheries Entry Commission would be slightly higher.

Wholesale Value: Rogers, George. 1982. Preliminary Assessment Pertaining to the Bristol Bay Salmon Fisheries Economic Development. Dillingham: Co-Man Services.

Table III-22
Comparison of Wholesale and Ex-Vessel Value of
Alaska Peninsula Salmon Harvest
1979-1980

Year	Ex-Vessel Value in $ Millions	Wholesale Value in $ Millions	Percent Value-Added
1979 (38.8 million lbs)	26.0	46.0	77
1980 (47.9 million lbs)	23.6	68.5	190

Source: Earl R. Combs, Inc., 1982.

Table III-23
Comparison of Canned Salmon vs. Fresh/Frozen Production - Bristol Bay
1978-1982

Year	Canned Salmon Pack 1/	Fresh and Frozen Salmon Production 2/
1978	801,792 cases	20.6 million pounds
1979	727,693 cases	69.5 million pounds
1980	687,605 cases	64.5 million pounds
1981	855,929 cases	83.5 million pounds
1982	246,640 cases	93.2 million pounds

Source: Bristol Bay Annual Management Report, ADF&G, 1982.

1/ 48 1-pound cans per case.
2/ Measured in million pounds.

doubled at the wholesale level in 1979, and almost tripled in 1980. In actuality, the increase probably was greater than this because the information that was not available includes mostly fresh-frozen processors, whose product has a higher value added than canned salmon.

Traditionally, canned salmon has dominated the market in both Bristol Bay and the Alaska Peninsula. However, in the past few years, the amount of higher-quality, higher-priced fresh and frozen salmon marketed to the world has increased substantially. From about 1977 on, the salmon runs began to increase in size, and a structural gap emerged as a result of both abundance of product and new technologies. Quick- or flash-freezing allowed increasing competition to move in, in the form of small operators who could make a handsome profit by shipping directly to remote U.S. locations, Europe, or Japan. This increasing competition among processors increased the prices paid to the fishermen.

The proportion of salmon that left Bristol Bay in cans declined from 63 percent of the total harvest in 1978 to 17 percent in 1982, while the proportion of frozen salmon that left the region increased from 12 to 60 percent. At the same time, the percentage of fresh salmon exported increased from 9 to 20 percent. This reflects a radical change in the nature of the commercial economy in a very short time period.

Until 1982, canned-salmon production remained fairly stable, while the total fresh and frozen product continued to increase. However, the disastrous losses caused by the 1981 botulism scare accelerated the shift away from canned salmon. Total production figures in Table III-23 for the 5-year period 1978-1982 illustrate this.

In addition to the increasing competition from the small-scale, fresh/frozen buyers and the botulism scare, the solidarity of the traditional processors has been weakened by the increasing power of Japanese investors. Many of the major processors have been forced to seek new financing in order to survive and are currently under partial or total control of Japanese capital.

Long-term future trends in processing are toward further increases in fresh and fresh-frozen markets, which should be a factor in keeping both ex-vessel and wholesale prices at relatively high levels. Small, independent processing operations and local buyers and transshippers will form an increasingly large part of the economic base of the fishing industry, in both the Bristol Bay and the Alaska Peninsula fisheries (Impact Assessment, Inc., 1984).

c. Herring Fishery: Commercial herring fishing occurs in the Togiak district of Bristol Bay and, to a much lesser extent, on both the northern and southern sides of the Alaska Peninsula. Compared with the commercial salmon fisheries, the value of the herring fisheries is very small. However, these rapidly growing fisheries bring several million dollars per year to the fishermen who participate.

(1) Togiak District Herring: In the Togiak district, small-scale efforts for both sac-roe and roe-on-kelp date back to the late 1960's. However, commercial fishing for herring did not become significant until passage of the Fisheries Conservation and Management Act (FCMA) in 1977, which extended the jurisdiction over fisheries out to 200 miles and effectively excluded the Japanese from harvesting herring.

Except for 1981, the total Togiak herring catch has increased every year since 1976. In 1982, it was its highest ever for American fishermen, at over 43 million pounds, which brought the fishermen $6.3 million. This was lower than the high of $7 million earned in 1979 for slightly over half as much herring (22.7 million lbs) (Table III-24).

Per pound, herring is not nearly as valuable to the fishermen as salmon. In 1982, Bristol Bay fishermen received $88 million for 119 million pounds of salmon, whereas they received $6.3 million--only one-fourteenth as much money--for one-third as much herring (43 million lbs).

The Togiak herring fishery is actually three fisheries in one: purse-seine sac-roe, gillnet sac-roe, and roe-on-kelp. The purse-seine sac-roe fishery is the most lucrative, accounting for two-thirds of the total value of the fishery in 1982. Most of its participants are large-scale fishermen from outside of the region. The gillnet sac-roe fishery, which accounts for most of the rest of the total herring value, is mostly Bristol Bay-resident fishermen. The roe-on-kelp fishery made up only 3 percent of the total herring value in 1982, but it brings the highest per-pound value to the fisherman and requires a minimal amount of investment and risk. A majority of those participating in this fishery live in the Togiak district of Bristol Bay. Roe-on-kelp also is an important subsistence resource harvested for consumption and for giving to others (ADF&G, 1982; Langdon, 1983a).

A huge difference in average gross earnings exists in the three herring fisheries. Since 1977, the average purse-seine fisherman, who usually lives outside the region, has grossed an average of $30,000 per year fishing sac-roe. On the other hand, the average gillnet fisherman, who is usually from Bristol Bay, has brought in a fraction of that at $5,500 per year. The roe-on-kelp fisherman, most often from Togiak, has brought in a mere $660 per year.

The number of fishermen participating in each of the herring fisheries since 1977 has not shown any particular trends. The purse-seine sac-roe fishery has averaged 94 fishermen per year; the gillnet sac-roe fishery has averaged almost double that at 184 fishermen; and the roe-on-kelp fishery is highest at an average of 246 fishermen per year (Langdon, 1983).

(2) Alaska Peninsula Herring: The Alaska Peninsula fishery is a new and developing fishery with very small catches compared to Togiak. The South Peninsula has winter food-bait and summer sac-roe fisheries, and the North Peninsula has a sac-roe fishery.

In 1982, the first year of the South Peninsula's food-bait fishery, all 1.1 million pounds of food-bait herring were taken from Stepovak Bay due north of the Shumagin Islands. All of the harvest was made by one vessel, with the help of four different tenders. About one-third of the catch was frozen for crab bait and brought $240 per short ton (about $.12/lb); the rest was frozen and packaged as food herring and brought fishermen $160 per ton (about $.08/lb). The total ex-vessel value of the food-bait herring was $107,000.

The South Peninsula's sac-roe fishery has been occurring since 1979. The peak year was 1981, when 1.5 million pounds were taken. Catch by bay varies greatly by year; since 1980, Canoe Bay has been the highest producer, followed

Table III-24
Catch and Value of the Togiak District Commercial
Herring Fishery, 1976-1982

	Purse-Seine Sac-Roe		Gillnet Sac-Roe		Roe-on-Kelp			
Year	Catch[1/]	Value[2/]	Catch	Value	Catch	Value	Total Catch	Total Value
1976	0	$ 0	0	$ 0	295,780	$127,000	295,780	$ 127,000
1977	4,972,275	398,000	615,195	49,000	275,774	116,000	5,863,244	563,000
1978	14,261,940	2,424,000	1,239,210	211,000	329,858	120,000	15,831,008	2,755,000
1979	13,382,145	4,045,000	8,921,430	2,696,000	414,727	249,000	22,718,302	6,990,000
1980	32,920,650	2,692,000	6,271,020	513,000	189,662	95,000	39,381,332	3,300,000
1981	20,561,625	3,272,000	4,513,635	718,000	378,207	250,000	25,453,467	4,240,000
1982	29,754,270	4,261,000	13,366,710	1,914,000	234,924	176,000	43,355,904	6,351,000

Source: Annual Management Report, ADF&G, Commercial Fisheries Division, 1982.

1/ Measured in pounds.

2/ Measured in dollars.

by Stepovak, Pavlof, Beaver, and Coal Bays. Some sac-roe herring also is taken from the Cold Bay and Volcano Bay sections and from Balboa and Belkofski Bays. In 1982, a herring sac-roe fishery occurred in Balboa Bay, but the harvest was small when compared with other herring fisheries.

In 1982, South Peninsula fishermen received almost as much for 350,000 pounds of herring roe as they did for over 1 million pounds of food-bait herring (Table III-25). The herring roe brought $550 per ton or $.28 per pound, for a total ex-vessel value of $97,000. Six vessels participated in the South Peninsula harvest and averaged $16,000 per boat.

The North Peninsula sac-roe herring fishery is centered around the Port Moller/Herendeen Bay area. Although unknown numbers of herring have been present in previous years, 1982 was the first year of a commercial sac-roe herring harvest. Of the 1 million pounds harvested, over half came from Herendeen Bay, and the rest came from Port Moller and the adjacent Bering Sea coast. The average price paid was $500 per ton ($.25/lb), slightly lower than on the southern side of the Peninsula. Three purse-seine vessels participated, and the total value to the fishermen was approximately $252,000 (Table III-25) (ADF&G, 1982).

d. Capelin Fishery: The potential exists for a commercial capelin fishery to develop in the Bristol Bay region. In 1984, 1,178 short tons of capelin were caught in Togiak Bay during the herring sac-roe fishery. The capelin were processed for sac-roe, yielding 489 short tons of this product valued at $97,800. This was the only commercial capelin fishery conducted in Alaska in 1984. Capelin may be taken for subsistence purposes in some areas of Southwestern Alaska.

e. Crab Fishery:

(1) Tanner Crab: Prior to the mid-1970's, tanner crab was harvested primarily by the foreign long-range fishing fleet in the Bering Sea. Since 1973, the domestic Bering Sea tanner crab fishery (including C. bairdi and C. opilio) has developed rapidly. Currently, foreign vessels are prohibited from harvesting tanner crab. Table III-26 and Figure III-23 show the U.S. tanner crab harvest in the Bering Sea in recent years.

The Bering Sea tanner crab fishery includes the tanner crab taken in the North Aleutian Basin. Table III-27 and Figure III-23 show the harvest in the North Aleutian Basin since 1977-1978. Since 1977-1978, about half of the Bering Sea tanner crab has come from the North Aleutian Basin. Of this, roughly 70 percent has been taken within the boundaries of the lease sale area.

In 1982 and 1983, the Bering Sea harvest declined from the late-1970's levels due to a series of weak year-classes. The portion caught in the North Aleutian Basin also declined. In 1977-1978, the North Aleutian Basin furnished over one half of the Bering Sea catch, while by 1982-1983 it furnished only 15 percent. Since 1981, the biggest part of the Bering Sea tanner crab catch has come from the St. George Basin (USDOI, MMS, St. George Basin [Sale 89] FEIS, 1985).

The tanner crab harvest in the North Aleutian Basin has declined sharply since landings peaked at 54 million pounds in 1979-1980. In 1982-83, the catch was less than 5 million pounds (Table III-27, Fig. III-23).

Table III-25
Catch and Value of the Alaska Peninsula
Herring Fishery
(1979-1982)

	South Peninsula				North Peninsula		Total	
	Winter Food Bait		Summer Sac Roe		Summer Sac Roe			
Year	Catch[1/]	Value[2/]	Catch	Value	Catch	Value	Catch	Value
1979	-	-	20,000	-	-	-	20,000	-
1980	-	-	906,000	-	-	-	906,000	-
1981	-	-	1,574,000	-	-	-	1,574,000	-
1982	1,130,000	$104,000	352,000	$97,000	1,028,000	$252,000	2,510,000	$453,000

Source: Finfish Annual Report, Alaska Peninsula-Aleutian Islands Areas, ADF&G, Commercial Fisheries Division, 1982.

1/ Measured in pounds.

2/ Measured in dollars.

Table III-26
Tanner Crab Harvest in Bering Sea Management Area[1/]
1968-1984

Year	Quantity (1,000 Pounds)		Number of Vessels	Ex-Vessel Value ($1,000)
1968-69	1,009		not available	not available
1969-70	1,015		not available	not available
1970-71	166		not available	not available
1971-72	108		not available	not available
1972-73	232		not available	not available
1973-74	5,044		not available	not available
1974-75	7,284		28	$ 1,457
1975-76	22,341		68	$ 4,245
1976-77	51,455		83	$15,437
1977-78	66,431	*C. bairdi*	281	$25,244
	1,716	*C. opilio*	15	515
	67,944			$25,759
1978-79	42,547	*C. bairdi*	144	$22,124
	31,428	*C. opilio*	102	$ 9,428
	73,975			$31,552
1979-80	36,558	*C. bairdi*	286	$19,010
	39,573	*C. opilio*	134	$ 8,310
	76,131			$27,320
1980-81	29,732	*C. bairdi*	165	$17,245
	52,750	*C. opilio*	153	$13,715
	82,482			$30,960
1981-82	11,009	*C. bairdi*	125	$13,981
	29,351	*C. opilio*	122	$21,426
	40,360			$35,407
1982-83	5,274	*C. bairdi*	108	$ 6,329
	26,128	*C. opilio*	109	$11,496
	31,402			$17,825
1983-84	not available			

Source: Westward Region Shellfish Report, Dutch Harbor. ADF&G, 1984.

1/ In the St. George Basin, *C. bairdi* tanner crab also come from the East Aleutian (Dutch Harbor) Shellfish Management Area.

Table III-27
Tanner Crab Catch and Ex-Vessel Value in
the North Aleutian Basin Planning Area
1977-78 to 1982-83

Tanner Crab Species

Year	C. bairdi Catch 1/	C. bairdi Ex-Vessel Value 2/	C. opilio Catch	C. opilio Ex-Vessel Value	Total Catch	Total Ex-Vessel Value
1977-78	44,606	$16,950	514	$ 154	45,120	$17,104
1978-79	36,765	$19,118	13,098	$3,929	49,863	$23,047
1979-80	33,075	$17,199	20,891	$4,387	53,966	$21,586
1980-81	24,635	$14,288	4,386	$1,140	29,021	$15,428
1981-82	6,932	$10,259	4,089	$2,985	11,021	$13,244
1982-83	3,905	$ 4,686	760	$ 327	4,665	$ 5,013
6 Year Average	24,986	$13,750	7,290	$2,154	32,276	$15,904

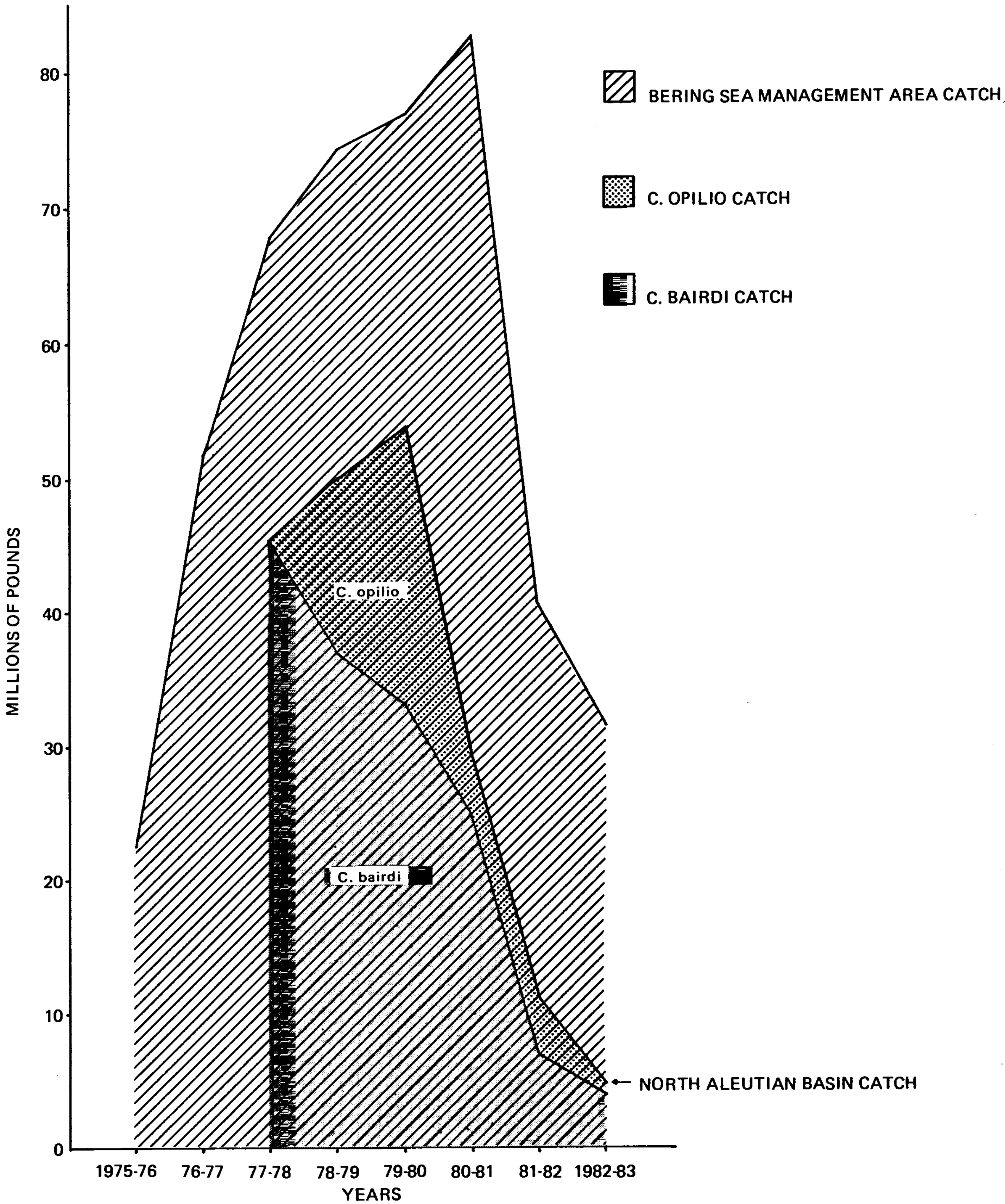
Source: Westward Region Shellfish Report, Dutch Harbor, ADF&G, Commercial Fisheries Division, 1984.

1/ In pounds, times 1,000.

2/ In dollars, times 1,000.

FIGURE III–23

TANNER CRAB CATCH IN THE BERING SEA MANAGEMENT AREA AND IN THE NORTH ALEUTIAN BASIN, 1975-76 to 1982-83



Source: State of Alaska, Dept. of Fish and Game, 1984.

For the Bering Sea as a whole, the species composition of the tanner crab taken has reversed itself since the late 1970's. In 1977-1978 and before, almost all of the tanner crab taken was C. bairdi; but now, almost all of the catch is C. opilio. However, C. bairdi continues to dominate in the North Aleutian Basin portion of the Bering Sea. In fact, the North Aleutian Basin now accounts for practically all of the C. bairdi taken in the Bering Sea.

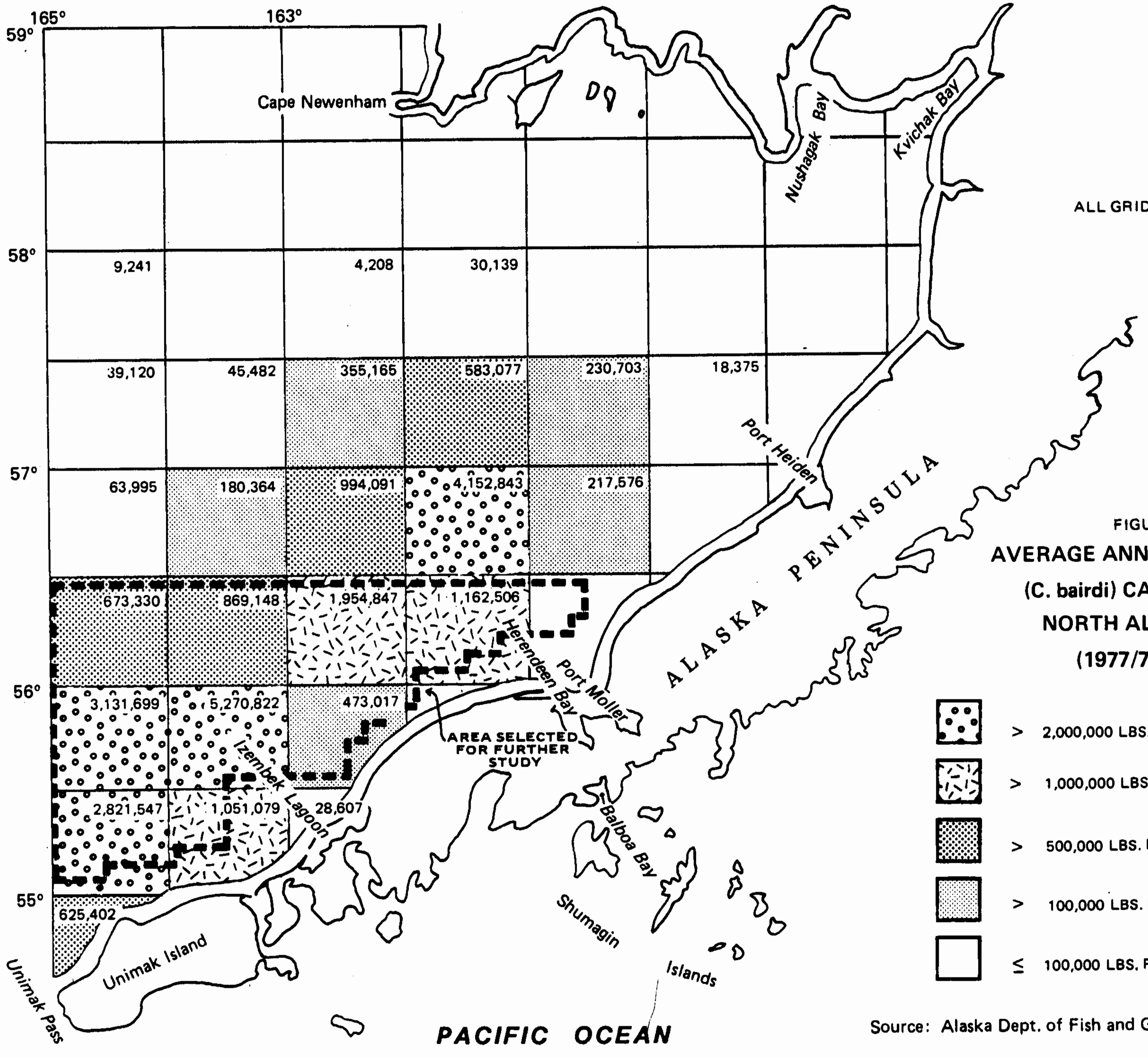
C. bairdi is the more valuable of the two tanner crab species; it weighs about twice as much as C. opilio and brings about twice the price per pound. Therefore, even though the North Aleutian Basin contributed only 15 percent of the Bering Sea tanner crab catch in 1982-1983, it contributed almost one-third of the Bering Sea ex-vessel value due to the high value of the C. bairdi.

Most of the tanner crab taken from the North Aleutian Basin comes from off the coast of the Alaska Peninsula, west and southwest of Port Moller, which is also the area of the lease sale. Roughly 60 percent of the C. bairdi and 85 percent of the C. opilio comes from within the lease sale area (Figs. III-24 and III-25).

The North Aleutian Basin planning area can be divided into about 50 latitudinal-longitudinal grids; this is how shellfish- and groundfish-catch figures are recorded. As shown in Figures III-24 and III-25, there is great variation in the catch according to the grid. Of the seven grids with C. bairdi catches averaging over 1 million pounds, six are wholly or partly within the sale area. The C. opilio catch is even more concentrated, with the two grids with catches over 1 million pounds both in the southwest portion of the sale area, north of Unimak Pass. Eight of the C. opilio grids have catches averaging over 100,000 pounds, and seven of these grids are within the lease sale area.

(2) King Crab: Alaska's most productive region for king crab is the southeastern Bering Sea, which overlaps the North Aleutian Basin Planning Area. This king crab fishery traditionally has depended on red king crab, which is the only king crab species taken within the North Aleutian Basin. Table III-28 and Figure III-26 show the red, blue, and brown king crab harvests in the Bering Sea Management Area in recent years. By far the largest catches of red king crab in the Bering Sea region have come from the Alaska Department of Fish and Game's Bristol Bay Registration Area T, which is bounded primarily by the region comprising the North Aleutian Basin and St. George Basin lease sale areas (Fig. III-27). The origin of catches during the 1977-1982 base period was 68.6 percent from the North Aleutian Basin, 29.6 percent from the St. George Basin, and 1.7 percent from the Norton Basin. The importance of the North Aleutian and St. George Basin lease sale areas is shown by the fact that, together, they accounted for 98 percent of the red king crab harvest, with over two-thirds of the total coming from the North Aleutian Basin lease sale area alone (Natural Resource Consultants, 1984). Table III-29 and Figure III-28 show the red king crab catch in the North Aleutian Basin for recent years.

In 1983-1984, the Bristol Bay red king crab season was closed due to the very poor condition of the resource. Most likely reasons for the depleted stocks seem to be: increased fishing intensity and greater handling mortality; increased predation, especially by cod; and the possible effects of disease or other factors which have lowered spawning viability (Natural Resource Consultants, 1984).



ALL GRIDS 24,986,383 LBS.

FIGURE III–24

AVERAGE ANNUAL TANNER CRAB (C. bairdi) CATCH IN POUNDS NORTH ALEUTIAN BASIN (1977/78 to 1982/83)

(dots)	> 2,000,000 LBS. PER YEAR
(dashes)	> 1,000,000 LBS. PER YEAR
(dense stipple)	> 500,000 LBS. PER YEAR
(light stipple)	> 100,000 LBS. PER YEAR
(blank)	≤ 100,000 LBS. PER YEAR

Source: Alaska Dept. of Fish and Game; 1983 and 1984.

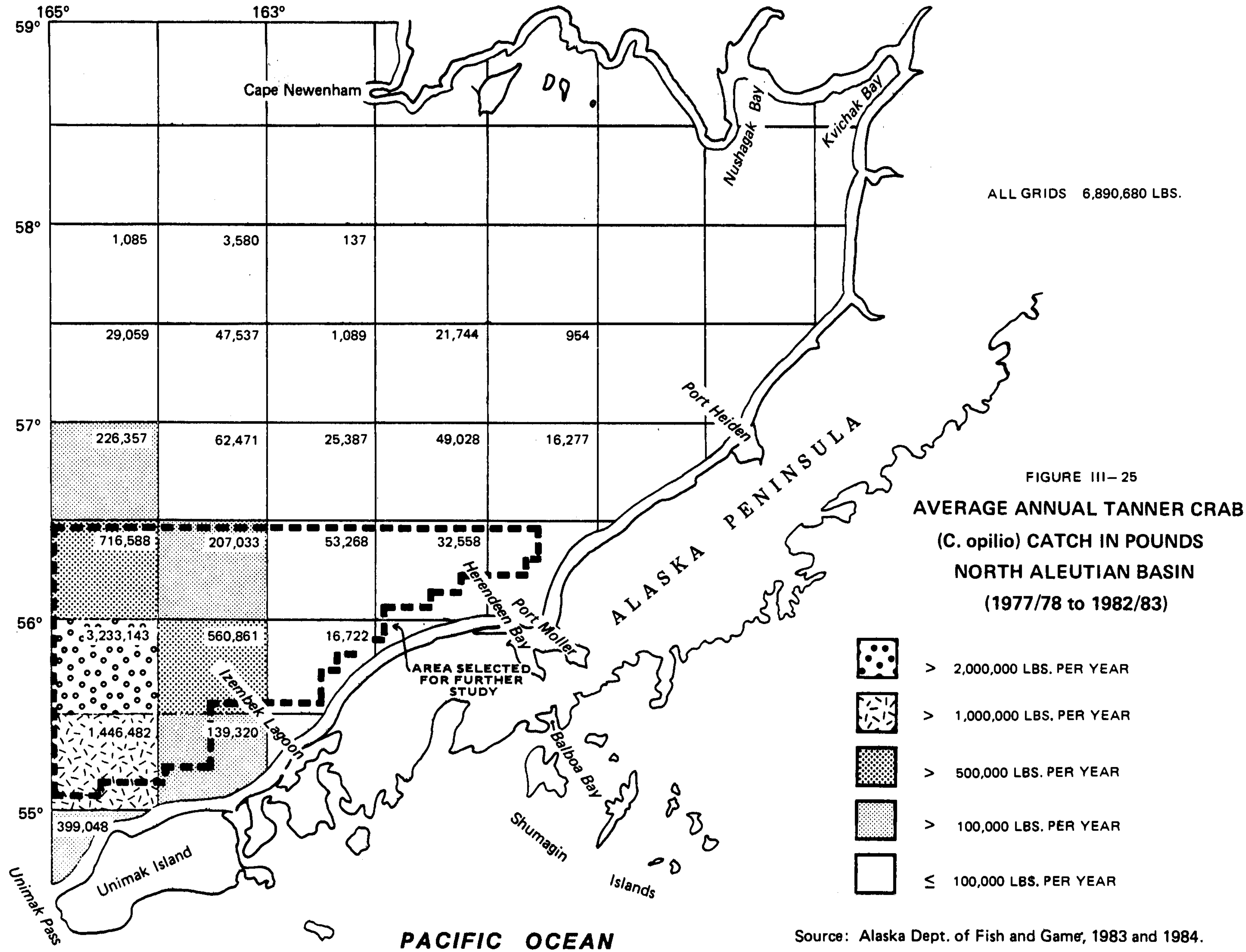


FIGURE III–25

AVERAGE ANNUAL TANNER CRAB (C. opilio) CATCH IN POUNDS NORTH ALEUTIAN BASIN (1977/78 to 1982/83)

Table III-28
King Crab Harvest in Bering Sea Management Area[1/]
1969-1984

Year	Bristol Bay District (Area T) Quantity[2/][4/]	Number of Vessels	Ex-Vessel Value[3/]	Pribilof District (Area Q) Quantity	Number of Vessels	Ex-Vessel Value	Northern District (Area Q) Quantity	Number of Vessels	Ex-Vessel Value
1968-69	8,687	59	not available						
1969-70	10,403	65	not available						
1970-71	8,559	51	not available						
1971-72	12,945	52	not available						
1972-73	21,745	64	not available						
1973-74	28,190	67	$23,680	1,277 blue	8	$ 1,073			
1974-75	41,946	108	$15,939	7,107 blue	70	$ 2,701			
1975-76	51,326	102	$19,504	2,434 blue	20	$ 925			
1976-77	63,920	141	$37,074	6,611 blue	47	$ 3,834			
1977-78	69,968	130	$77,664	6,457 blue	34	$ 7,167	1,202 blue	10	$ 1,202
							543 red	8	$ 543
							1,745		$ 1,745
1978-79	87,618	162	$107,770	6,396 blue	58	$ 7,867	1,984 blue	22	$ 1,885
							2,008 red	43	$ 1,908
							3,992		$ 3,793
1979-80	107,828	236	$108,300	5,995 blue	46	$ 6,055	211 blue	18	$ 148
							3,024 red	34	$ 2,117
							3,235		$ 2,265
1980-81	129,948	236	$116,953	10,970 blue	110	$ 9,873	220 blue	2	$ 165
				921 red	15	$ 829	354 red	4	$ 266
				11,891		$10,702	574		$ 431
1981-82	33,591	177	$50,387	9,081 blue	99	$13,622	4,628 blue	31	$ 4,165
				1,274 red	65	$ 1,911	64 red	5	$ 58
				8 brown	2	$ 16	4,692		$ 4,223
				10,363		$15,549			
1982-83	3,001	90	$ 9,153	4,405 blue	122	$13,435	8,845 blue	96	$17,690
				469 red	93	$ 1,430	4 red	1	$ 8
				70 brown	10	$ 231	194 brown	22	$ 388
				4,944		$15,096	9,043		$18,086
1983-84	CLOSED			2,193 blue	126	$ 6,579	9,507 blue	177	$28,521
				46 red	53	$ 138	7 red	3	$ 18
				656 brown	45	$ 1,640	(in progress)		
				2,895		$ 8,357	9,514		$28,539

Source: ADF&G, 1984

1/ In the St. George Basin, king crab also come from the Eastern Aleutian (Dutch Harbor) Shellfish Management Area.

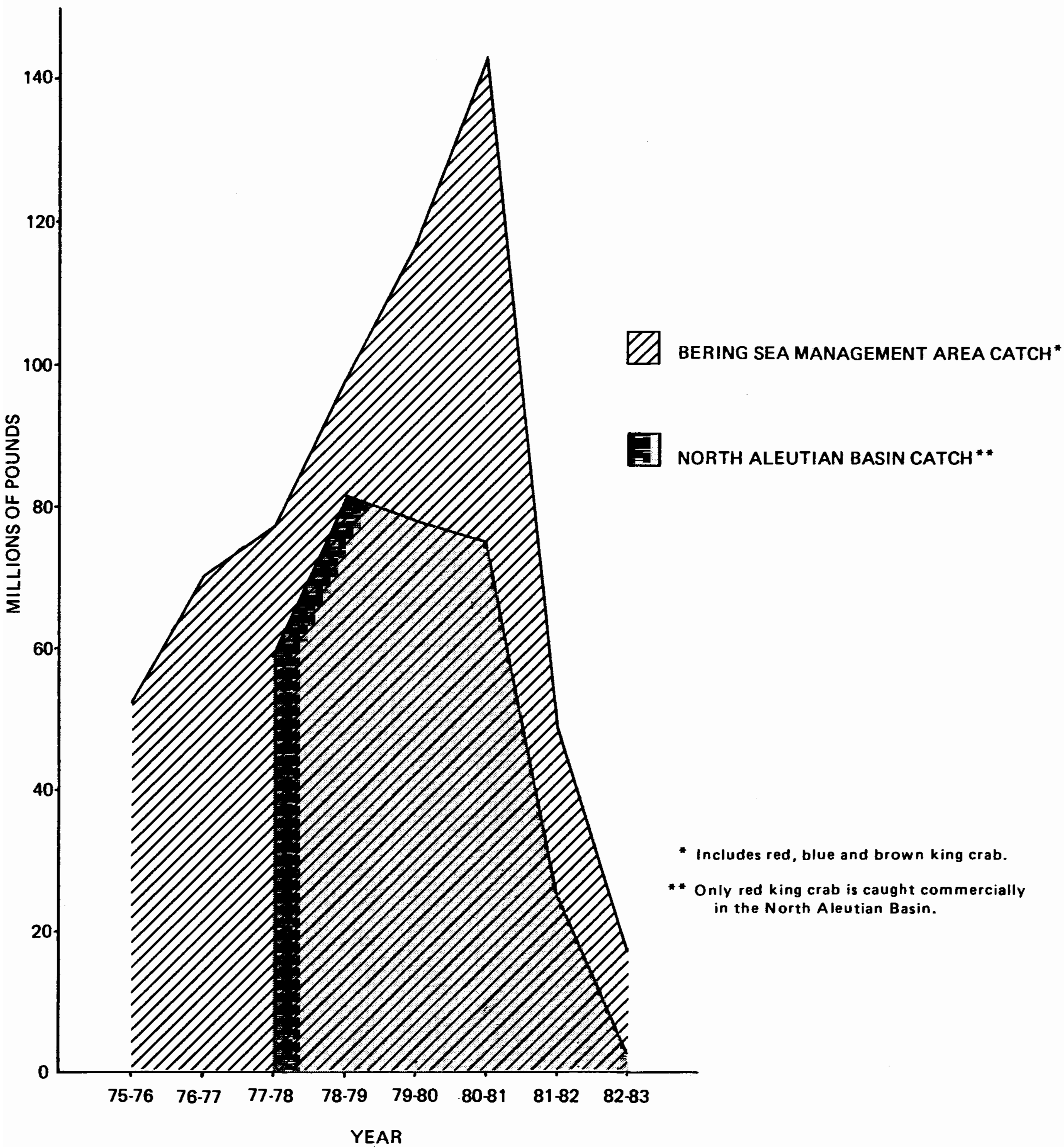
2/ In pounds, times 1,000.

3/ In dollars, times 1,000.

4/ Red king crab only.

FIGURE III–26

KING CRAB CATCH IN THE BERING SEA MANAGEMENT AREA AND IN THE NORTH ALEUTIAN BASIN, 1975-76 to 1982-83



Source: State of Alaska, Dept. of Fish and Game, 1984.

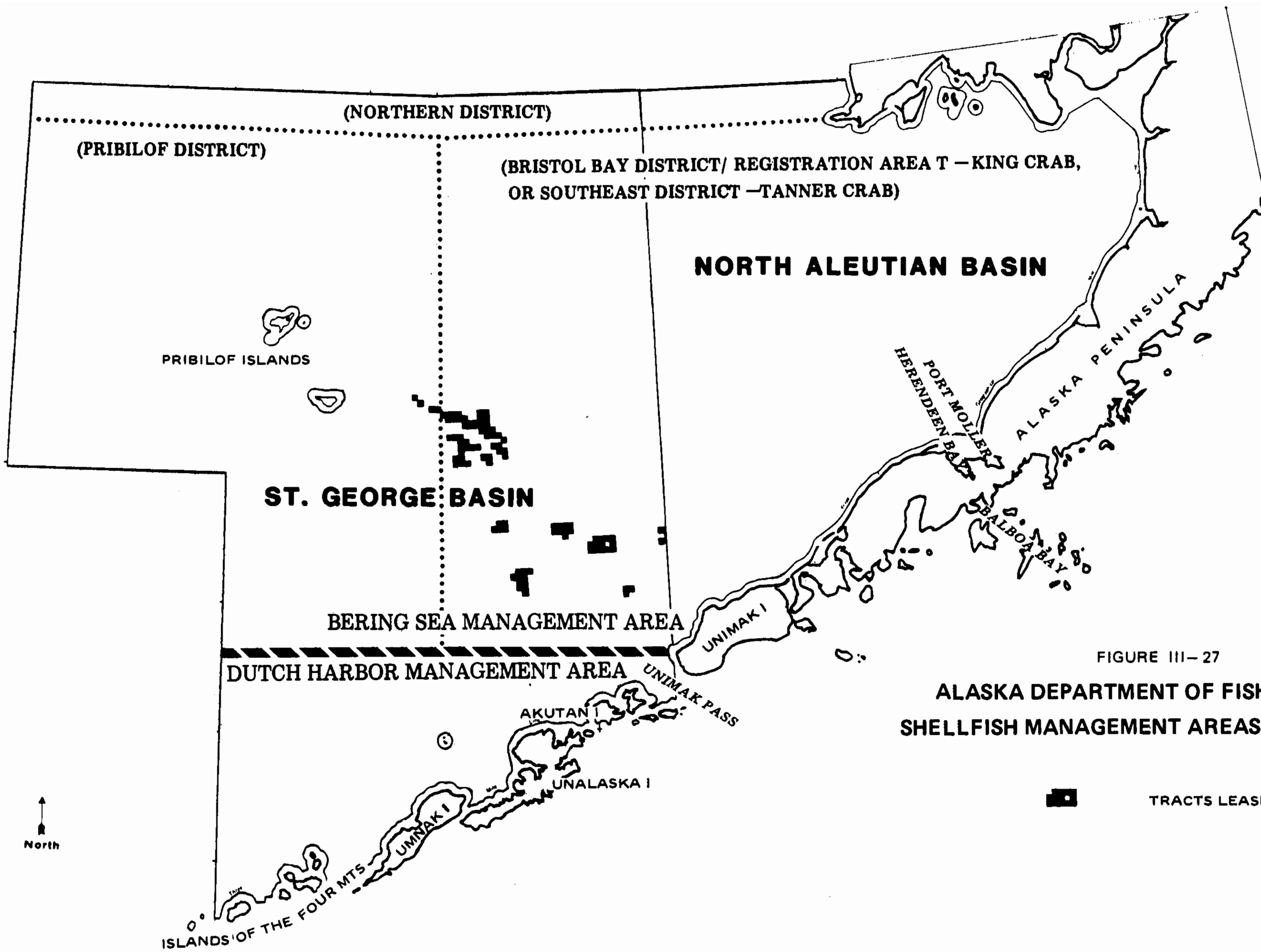


FIGURE III– 27

ALASKA DEPARTMENT OF FISH AND GAME SHELLFISH MANAGEMENT AREAS AND DISTRICTS

Source: Alaska Dept. of Fish and Game, 1983 and 1984.

Table III-29
Red King Crab Catch and Ex-Vessel Value
in the North Aleutian Basin Lease Area

Year	Catch (1,000 Pounds)	Ex-Vessel Value ($1,000)
1977-78	59,360	$65,890
1978-79	80,965	$99,588
1979-80	78,121	$78,903
1980-81	75,264	$67,738
1981-82	24,790	$37,185
1982-83	2,651	$ 8,087
1983-84	CLOSED	
6-Year Average	53,525	$59,565

Source: ADF&G, 1984, Westward Region Shellfish Report, Dutch Harbor.

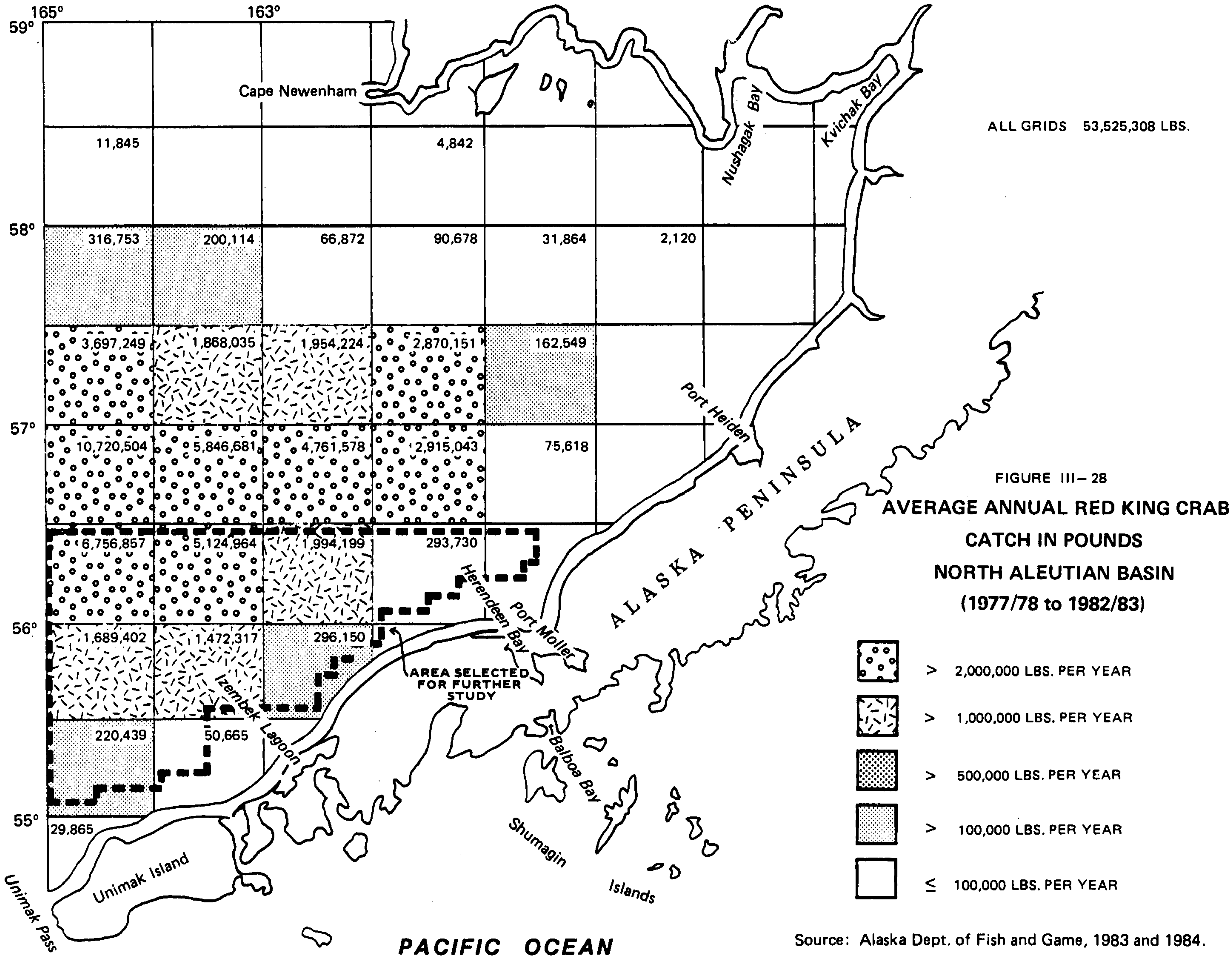


FIGURE III–28

AVERAGE ANNUAL RED KING CRAB CATCH IN POUNDS NORTH ALEUTIAN BASIN (1977/78 to 1982/83)

Source: Alaska Dept. of Fish and Game, 1983 and 1984.

Although averages are somewhat meaningless for a fishery that has risen and fallen so rapidly, they do give an idea of which parts of the North Aleutian Basin have been most productive over time (Fig. III-28). Most of the red king crab has come from the middle to southern and western parts of the planning area; very little to none is taken in the inner part of Bristol Bay or the northern part of the planning area. Over the base period 1977-1982, about one-third of the North Aleutian Basin red king crab was taken within the proposed lease area (an average of 17.5 million lbs per year, compared with 53.5 million lbs per year for the entire planning area). The two most productive grids are just north of the lease area--at 56° to 57°N latitude, 164°W longitude, on the western edge of the North Aleutian Basin. Together, these two very productive grids yielded an average of 20.5 million pounds per year, which was almost 40 percent of the red king crab taken in the entire planning area.

Although closed during 1983-84 due to the depleted stocks, the red king crab fishery in the North Aleutian Basin normally takes place between September and February, with most of the harvest being taken in September and October (ADF&G, 1984).

The most productive red king crab areas of the St. George Basin border the western boundary of the North Aleutian Basin. In fact, the St. George grids bordering the North Aleutian Basin account for over half of all the red king crab caught in the St. George Basin (see St. George Basin [Sale 89] FEIS, [USDOI, MMS, 1985]). This points to the tremendous importance of the area north of Unimak Pass as a red king crab-production area. Because of this importance, what happens on the western border of the North Aleutian Basin lease area could affect red king crab fisheries in the St. George Basin and vice versa.

(3) Crab Ex-vessel and Wholesale Values and Income of Fishermen: The ex-vessel value of the North Aleutian tanner crab catch was highest in 1978-79 at $23 million. This also was the year of peak catch in the area. The ex-vessel value fell to $5 million in 1982-1983; however, due to the increase in tanner crab prices since the late 1970's, the fall in value has not been as steep as the fall in catch (Table III-30). In 1977-1978, fishermen got $.38 per pound for *C. bairdi*; but by 1982-1983, this price had risen to $1.20 per pound. In the same time period, *C. opilio* prices rose from $.30 to $.43 per pound. Almost all (86%) of the economic value of tanner crab in the North Aleutian Basin has come from *C. bairdi*.

The ex-vessel value of the red king crab catch was highest at almost $100 million in 1978-1979, which also was the peak year of the fishery in the North Aleutian Basin (Table III-27). The average for the base period 1977-1982 was $60 million. After the collapse of the fishery in 1982-1983, the red king crab prices tripled (from $.90 to $3.05/lb), reflecting the extreme shortage of red king crab. Thus, revenues to the fishermen from the red king crab fishery did not decline as sharply as their catches did. Furthermore, after the Bristol Bay red king crab fishery declined, some fishermen were able to switch over to the Pribilof blue and red king crab fishery and the Dutch Harbor brown king crab fishery (ADF&G, 1984).

The values of king and tanner crab increase substantially at the first-wholesale level and then again at the retail level. Although retail values are not available, in 1982 the value added for king crab from ex-vessel to wholesale

Table III-30
1982 Shellfish Catch
Estimated Ex-Vessel Values and First Wholesale Values
for the North Aleutian Basin

	1982 Catch (Pounds)	Ex-Vessel Price/Pound	Ex-Vessel Value	First Wholesale Price/Pound	First Wholesale Value
Tanner Crab					
C. bairdi	3,905,000	$1.20	$4,686,000	$3.50	$13,667,500
C. opilio	760,000	$ .42	$ 319,200	$3.50	$ 2,660,000
	4,665,000		$5,005,200		$16,327,500
Red King Crab	2,651,000	$3.05	$8,085,550	$7.46	$19,776,460

Sources: Catch data: Westward Region Shellfish Report. ADF&G, 1984; IPHC, 1983.
Price data: Seafood Business Report, Winter 1983-84 (1982 prices), as quoted in Centaur Associates, 1983.

was over $11 million. The total first-wholesale value for king and tanner crab caught in the North Aleutian Basin was $36 million (Table III-30); and 1982 was considered a very poor year due to the sudden drop in red king crab harvest. If the average annual catches for king and tanner crab for the base period 1977-1982 are used (60 million and 32 million lbs, respectively), and if 1980 wholesale prices are used ($2.93/lb for king crab and $1.32/lb for tanner crab; Centaur and Associates, 1983), the average first-wholesale value would approximate $218 million.

Figures on average income per crab fisherman in the North Aleutian Basin are not available, but the average annual gross income per fishing vessel from crab caught in the relevant crab management area can be approximated. From 1977-1982 (before its collapse), the Bristol Bay king crab fishery brought a yearly average of over $400,000 per vessel. On the other hand, the southeastern Bering Sea tanner crab fishery averaged only about $95,000 per vessel. Vessels 91 feet and larger typically participated in king crab fisheries in the North Aleutian Basin and were each crewed by five people (Natural Resource Consultants, 1984). Each vessel usually participated in more than one fishery, not only in the Bristol Bay king crab area and in the southeastern Bering Sea tanner crab area, but also in other fisheries in the Bering Sea and the Aleutians, and in Chignik and Kodiak. However, the amount of overlap between fisheries is unknown. Also, it is impossible to separate out the vessels by lease area or to determine the degree to which each vessel fished in each lease area.

As the king and tanner crab fisheries have declined, the numbers of vessels participating have not declined accordingly. This has reduced the economic return per vessel (Tables III-29 and III-30). In the long run, this trend will force more vessels out of the fishery since some will not earn enough to cover boat payments and other fixed costs. Although some vessels may convert to groundfish equipment, this also is expensive.

Well over 80 percent of the king crab vessels and their crews operating in the Bering Sea area are non-Alaskan residents who come primarily from Seattle. About 5 percent of the vessels are local, and their crews are residents of Dutch Harbor. The balance are from other Alaskan areas, primarily Kodiak (NRC, 1984). These same proportions are likely to be similar for tanner crab.

The average size of the red king crab vessels fishing in Bristol Bay Registration Area T increased steadily each year, from 91 feet in 1976-1977 to 109 feet in 1982-1983. The size of the vessel influences the amount of income earned in the crab fishery; in general, the larger the vessel, the higher the gross income. The smaller vessels tend to be owned by Alaskan residents, and the larger vessels tend to be owned by fishermen from outside the state. For example, in 1979 and 1980 for all of Alaska, 60 percent of the crab vessels of all sizes were owned by Alaskan residents. For those vessels under 59 feet, 90 percent were owned by Alaskans, whereas only 28 percent of those vessels over 90 feet long were owned by Alaskans (National Resource Consultants, 1984). Thus, it appears that declines in the crab fishery may affect the gross income of Alaskans proportionately more than they affect non-Alaskans, because the smaller boats may not be able to compete with larger boats when there are few fish available.

f. Mollusk Fishery: At this time there is no commercial mollusk fishery in Bering Sea areas. Interest in developing commercial clam fisheries has been expressed, but current market conditions and clam fisheries already developed elsewhere preclude economic commercial development of this resource. A few clams are harvested and sold for use as bait in the crab fisheries.

The Japanese have pot fished for snails on the continental slope by setting small pots at intervals on a longline. In 1984, the Japanese took 230.1 metric tons of shucked meats in this fishery (USDOI, NOAA, NMFS, 1984). In 1984, a total of 3,105.9 metric tons of squid were harvested by Korea, Japan, the U.S.S.R. and Poland (USDOI, NOAA, NMFS, 1984).

g. Groundfish:

(1) Catch: Many different species of groundfish, also called bottomfish, are caught in the North Aleutian Basin, primarily by foreign fishermen but increasingly by joint U.S./foreign ventures. These species are lumped into four categories for record-keeping and economic-analysis purposes: pollock, flatfish, Pacific cod, and other roundfish. Pollock, which is by far the most numerous, is called both walleye and Pacific pollock. The flatfish category includes but is not limited to yellowfin sole, turbot, rock sole, flathead sole or Bering flounder, Dover sole, other flounder, and Alaska plaice.

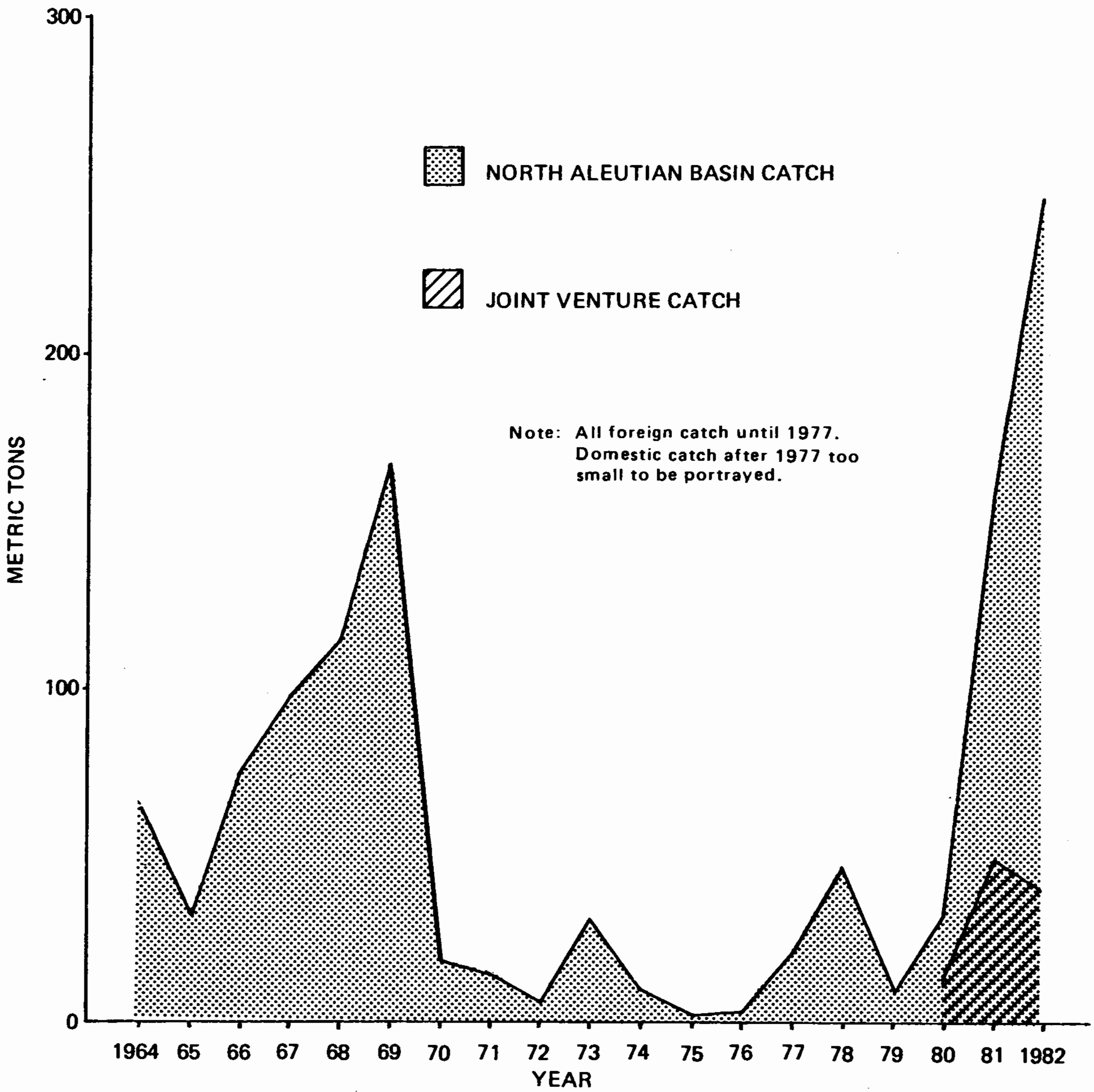
Only a small part of the total annual groundfish catch in the eastern Bering Sea comes from the North Aleutian Basin. Since 1973, of the 1 to 2 million metric tons harvested each year from the Bering Sea, an average of 55,000 metric tons, or less than 5 percent, has come from this area. Between 1970 and 1980, catches were extremely low, even less than 5,000 metric tons in 1975 and 1976 (Fig. III-29). North Aleutian Basin catches are increasing, however; in 1982, the groundfish catch in the North Aleutian Basin was almost 250,000 metric tons, or about 20 percent of the catch in the eastern Bering Sea. This was the highest catch ever recorded for the North Aleutian Basin.

About two-thirds of the groundfish taken in the North Aleutian Basin are pollock; another 20 percent fall into the flatfish category; and the rest are cod and other roundfish. Until 1977, the entire recorded harvest in the Bering Sea was caught by foreign fishermen. But in 1977, a domestic inshore fishery began, primarily for cod. In 1980, joint ventures combining domestic and foreign capital began taking a significant amount of groundfish, primarily yellowfin sole, rock sole, and cod. In a typical joint-venture arrangement, the fish are caught by U.S. fishermen and processed by foreign processors. In the North Aleutian Basin, the joint-venture catch--with Soviet and Korean processors--has accounted for about one-fourth of the total groundfish catch since 1980 (an average of about 34,000 metric tons/year [Table III-31 and Fig. III-29]). The domestic take (almost all cod) represented just 1 percent of the total groundfish catch in 1982, but the 6,600 metric tons taken was a dramatic increase from the 9.6 metric tons caught when the fishery began in 1977.

Currently, most pollock harvested in the Bering Sea is processed by large Japanese factory ships into surimi, which is a kind of fish paste. The rest of the pollock catch is frozen. Fish larger than about 17 inches are filleted, while the smaller fish are headed or headed and gutted. Pollock offal is made into fish meal. Some Alaskan pollock is imported back into the United States from Japan and Korea in frozen fillets or mince blocks for reprocessing into sticks and portions. A very small amount of Alaskan pollock enters the U.S. market as individual quick-frozen fillets.

FIGURE III–29

GROUNDFISH CATCH IN THE NORTH ALEUTIAN BASIN, 1964-1982



Source: U.S. Dept. of Commerce, National Marine Fisheries Service, 1983.

Table III-31
Groundfish Catch in the North Aleutian Basin
Lease Sale Area, 1964-1982[1/]
(Metric tons)

Year	Pollock	Flatfish	Cod	Other Roundfish	Total
1964	27,818	36,187	1,430	10	65,445
1965	17,923	13,089	1,282	8	32,302
1966	60,565	11,061	3,063	74	74,763
1967	69,002	23,704	3,624	28	96,358
1968	92,623	19,227	2,290	549	114,689
1969	110,507	53,599	2,724	802	167,632
1970	10,074	7,865	283	288	18,510
1971	4,034	8,252	21	2,731	15,038
1972	215	5,658	3	266	6,142
1973	3,660	27,654	66	450	31,830
1974	1,293	7,832	11	1,003	10,139
1975	69	1,229	4	502	1,804
1976	1,887	1,223	50	1,058	4,218
1977	12,719 Foreign	8,157 Foreign	725 Foreign	689 Foreign	22,290 Foreign
	0.0 Domestic	1.2 Domestic	7.6 Domestic	.8 Domestic	9.6 Domestic
	12,719	8,158	732	690	22,291
1978	31,085 Foreign	13,872 Foreign	849 Foreign	520 Foreign	46,326 Foreign
	11.6 Domestic	0.0 Domestic	15.4 Domestic	.8 Domestic	27.8 Domestic
	31,097	13,872	864	521	46,354
1979	5,394 Foreign	3,846 Foreign	220 Foreign	81 Foreign	9,541 Foreign
	3.8 Domestic	0.0 Domestic	390 Domestic	0.0 Domestic	393.8 Domestic
	5,398	3,846	610	81	9,935
1980	10,964 Foreign	4,790 Foreign	333 Foreign	489 Foreign	16,576 Foreign
	28 J.V.	11,512 J.V.	2,023 J.V.	280 J.V.	13,843 J.V.
	30.2 Domestic	44.1 Domestic	1,216 Domestic	0.0 Domestic	1,290.3 Domestic
	11,022	16,346	3,572	769	31,709
1981	87,469 Foreign	13,837 Foreign	2,634 Foreign	1,234 Foreign	105,174 Foreign
	16,775 J.V.	21,942 J.V.	6,782 J.V.	3,077 J.V.	48,576 J.V.
	0.0 Domestic	0.0 Domestic	1,932 Domestic	.1 Domestic	1,932.1 Domestic
	104,244	35,779	11,348	4,311	155,682
1982	164,715 Foreign	24,559 Foreign	4,365 Foreign	3,759 Foreign	197,398 Foreign
	6,548 J.V.	26,196 J.V.	6,718 J.V.	536 J.V.	39,998 J.V.
	33.7 Domestic	2.4 Domestic	6,562 Domestic	64.0 Domestic	6,662 Domestic
	171,297	50,757	17,645	4,359	244,058
Total	735,447	345,338	49,622	18,500	1,148,899
Average 1964-1982	38,708	18,176	2,612	974	60,468
Average 1977-1982	55,963	21,460	5,795	1,789	85,005

Sources: ADF&G, 1982; USDOC, NOAA, NMFS, 1983.

1/ All recorded catch was foreign until 1977. The domestic catch for the North Aleutian Basin is estimated by dividing the catch from the southeastern Bering Sea INPFC area in half. Domestic estimates are minimum and do not include landings made in Seattle.

J.V. = Joint Venture.

Pacific cod is processed into fillets; or headed, gutted, and frozen; or salted. Most of the current product is being shipped to Norway for further resale in European markets.

Yellowfin sole is a small flounder which cannot be economically filleted. The larger flounders are most often filleted and frozen. Pacific Ocean perch is commonly headed and frozen in the round. Sablefish is a highly prized fish for smoking and for the fresh and salted markets.

Beginning in 1980, U.S. fishermen have conducted a joint-venture yellowfin sole fishery with the Soviet Union. Some cod and rock sole are taken as well. In 1983, this fishery employed eight U.S. trawlers during a 5-month period from April through September and transferred the catch to four Soviet freezer ships. A smaller-scale U.S./Korean joint-venture fishery, which employed three U.S. trawlers and one Korean processing ship for 2 to 3 months, was initiated in 1983. Virtually all of the joint-venture fishery for yellowfin sole in the Bering Sea has been conducted within the North Aleutian Basin (Natural Resource Consultants, 1984).

It is expected that a major U.S. groundfish fishery will develop in the Bering Sea to gradually displace the foreign harvesters. The development of this fishery will most likely be accomplished through the increased use of joint ventures. Domestic floating-processing vessels also may develop in this fishery.

Judging from the pattern of expansion of domestic and joint-venture fisheries operations since 1980, it is likely that the North Aleutian Basin will play an increasingly important role. Even though only a small portion of the all-nation Bering Sea groundfish catch comes from the North Aleutian Basin, to date about half of the domestic and joint-venture catch has come from this area.

The foreign and joint-venture fisheries are generally located in separate parts of the North Aleutian Basin. While the foreign fishery operates in the central Bering Sea, the joint-venture fishery occurs mostly inshore and well into Bristol Bay. Most of the foreign groundfish catch in the North Aleutian Basin comes from the outer one-third of the area, within 60 miles of the boundary of the St. George Basin. The annual catch varies significantly according to the latitudinal-longitudinal grid. Catch statistics by grid are available for the foreign catch. Since 1964, some grids have produced no groundfish at all, whereas the most productive grid (at 56°N latitude, 164°W longitude, some 60 mi north of Unimak Island) has yielded an annual average of over 10,000 metric tons or almost one-fifth of all foreign-caught groundfish in the North Aleutian Basin. The area being offered for lease (Fig. III-30) contains this most productive grid, as well as parts of four grids that have yielded no groundfish at all. Over one-third (37%) of all foreign-caught groundfish taken in the North Aleutian Basin since 1964 has come from within the lease sale area.

Although pollock dominates the foreign catch in nearly all grids, productive areas for one species also are usually productive for the other groundfish species. The most productive groundfish grid referred to above is the most productive grid for pollock, the second-most productive grid for foreign-caught flatfish, and the third most productive grid for foreign-caught cod.

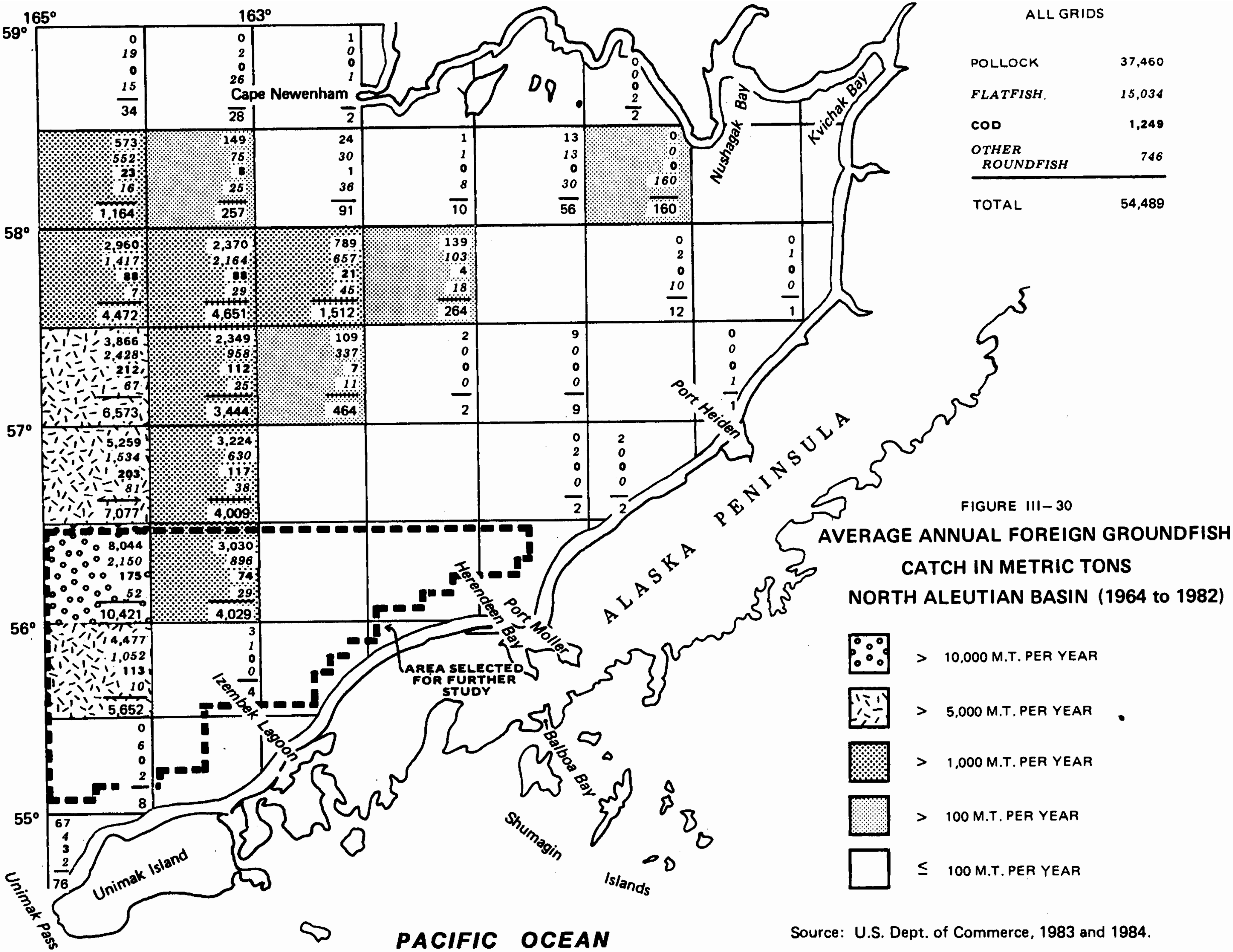


FIGURE III-30

AVERAGE ANNUAL FOREIGN GROUNDFISH CATCH IN METRIC TONS NORTH ALEUTIAN BASIN (1964 to 1982)

Source: U.S. Dept. of Commerce, 1983 and 1984.

The grid 30 miles to the north (57°N latitude, 164°W longitude) is the most productive for foreign-caught flatfish and cod. A very small amount of fish in the "other-roundfish" category is taken in the North Aleutian Basin, and the catch has been highly erratic. Since the late 1970's, most of the catch has come from the same grids that are most productive for other groundfish (Appendix L; Figs. L-11 through L-14).

In contrast to the foreign fishery, the joint-venture fishery operates in inner Bristol Bay and along the Alaska Peninsula. Catch figures for yellowfin sole constitute 40 to 50 percent of the joint-venture fishery. The most productive grids are in inner Bristol Bay (at 57°30'N latitude, 159°-158°W longitude). These grids accounted for over half of the 1982 yellowfin sole catch of 9,700 metric tons, and are well outside the boundaries of the lease sale area. Up to one-fourth of the 1982 yellowfin sole catch came from within the boundaries of the lease sale area. The rest of the joint-venture fishery in the North Aleutian Basin has consisted of rock sole and cod, plus a limited amount of other flounder. The ability to catch substantial amounts of cod along with yellowfin sole was undoubtedly an important consideration in the choice of Bristol Bay and inshore grounds off the northern Alaska Peninsula as a fishing area, rather than operating like the foreign fishery does in the central Bering Sea. Also, due to their relatively small size compared to foreign processing ships, U.S. trawlers have opted to operate closer to shore, where they may seek protection from storms at Port Moller. These vessels utilize facilities at Dutch Harbor for fuel, water, repairs, and other supply needs, since Port Moller does not have facilities to accommodate the yellowfin sole fleet (Natural Resource Consultants, 1984).

(2) Groundfish Ex-vessel and Wholesale Values: In 1982, the ex-vessel value of the groundfish caught by all nations in the North Aleutian Basin was approximately $72 million. The processing of the groundfish has a very high value-added, which in 1982 increased the value of the product about seven times--to over $500 million dollars at the first-wholesale level (Table III-32).

In 1982, pollock accounted for 70 percent of the groundfish catch in the North Aleutian Basin; but because it brings such a low ex-vessel price per pound relative to the other species, it accounted for less than one-third of the all-nation value to the fishermen in that year. However, it is somewhat more valuable once it is processed, and it accounts for slightly over half of the total groundfish value at the wholesale level.

The flatfish category, including yellowfin sole, turbot, and several species of flounder, brings the highest price per pound, both to the fishermen and at the wholesale level. In 1982, 21 percent of the groundfish catch consisted of flatfish, but flatfish accounted for one-third of the all-nation wholesale value and over half of the value to the fishermen.

Since the groundfish fishery in the North Aleutian Basin is international, most of its proceeds go outside the U.S. However, the U.S. is increasingly importing groundfish back into the country after it has been processed, creating a substantial gain to the economy at the retail level. And the increasing numbers of joint ventures operating in the North Aleutian Basin are bringing more money into the U.S. economy. Since, in a joint-venture arrangement, domestic harvesters commonly deliver their catch to foreign factory-

Table III-32
1982 Estimated All-Nations Ex-Vessel and First-Wholesale Values
for North Aleutian Basin Groundfish

	Catch (metric tons)	Ex-Vessel (Price/Pound)	Ex-Vessel Value($)	1st-Wholesale (Price/Pound)	1st-Wholesale Value($)
Pollock					
Foreign	164,715.0		$21,791,795		$261,501,534
J.V.	6,548.0	$.06	866,300	$ 0 .72	10,395,605
Domestic	33.7		4,458		53,502
Total	171,297.0		$22,662,553		$271,950,641
Flatfish					
Foreign	24,559.0		$17,870,356		$ 81,770,418
J.V.	26,196.0	$.33	19,061,519	$ 1.51	87,220,892
Domestic	2.4		1,746,360		7,990,920
Total	50,757.0		$36,933,621		$168,999,300
Cod					
Foreign	4,365.0		$ 2,309,958		$ 10,683,556
J.V.	6,718.0	$.24 1/	3,555,166	$ 1.11	16,442,641
Domestic	6,562.0		3,472,610**		16,060,823
Total	17,645.0		$ 9,337,734		$ 43,187,020
Other Roundfish					
Foreign	3,759.0		$1,574,833		$ 8,868,797
J.V.	536.0	$.19 2/	224,557	$ 1.07	1,264,612
Domestic	64.0		27,232		150,998
Total	4,359.0		$1,826,622		$ 10,284,407
All Groundfish					
Foreign	197,398.0		$43,546,942		$362,824,305
J.V.	39,998.0		23,707,542		115,323,750
Domestic	6,662.0		5,250,660		24,256,243
Total	244,058.0		$72,505,144		$502,404,298

Sources: Catch data: Computer Printouts, NMFS, 1983. S. Murai and R. Nelson, personal communication, ADF&G, 1982. Alaska Peninsula-Aleutians Management Report. Price -Data: Pacific Fishing, 1983 Yearbook; Seafood Business Report, Winter 1983-84 (1982 prices), as quoted in Centaur Associates, 1983 (except for pollock).

1/ The cod price used by Centaur Associates in making value projections is a bait price; the food-fishery price is below $.20/lb, so this estimate probably is high. The ADF&G estimates that the 1982 domestic ex-vessel value of cod and a small amount of other groundfish was $2.3 million.

2/ The 1980 sablefish price was $.39/lb; it makes up a small portion of the "Other Roundfish" category, so this estimate probably is low.

J.V. = Joint Venture

processing vessels, the domestic harvesters reap the ex-vessel value even though the value added by the foreign processors goes to the foreign country. The ex-vessel value of the joint-venture fishery in the North Aleutian Basin in 1982 was $24 million, or one-third of the all-nation value (Table III-32).

The value of the domestic groundfish catch (i.e., the catch that is processed in the U.S.) has increased dramatically each year since the domestic fishery began in 1977. Cod accounts for almost all of this catch and value. In 1982, an estimated $16 million of the all-nation first-wholesale value of cod, or 37 percent, went to the U.S.

As shown in Table III-32, the joint-venture and domestic-groundfish fisheries have concentrated on the higher-valued groundfish species. While only 4 percent of the ex-vessel value of pollock went to U.S. fishermen, 56 percent of the flatfish income and 75 percent of the income from cod went to U.S. fishermen.

h. Onshore-Processing Employment: Salmon is the principal species processed onshore in the North Aleutian Basin region. Crab, herring, and a limited amount of domestically caught cod also are processed. Most processing employees come from outside Alaska--they are annually imported from Seattle and San Francisco by the processors. Thus, the income they earn from the fishery probably is spent on the West Coast.

In Bristol Bay, processors have employed 4,000 to 6,000 people per year over the past several years. Employment figures are available from some of the major onshore processors (Table III-33). Less than 10 percent of the employees of these major processors reside in Bristol Bay; 60 percent come from outside Alaska.

On the Alaska Peninsula in 1980, an even smaller percent of the employees of major processors were local (4%; Table III-34); approximately 92 percent of the workers came from Seattle in that year.

2. Local Economy: This section provides a general description of the economy of the Aleutian Islands Census Division, with emphasis on selected communities. Economic effects from the proposed North Aleutian Basin (Sale 92) are expected to be relatively unimportant in other parts of Alaska. The Aleutian Islands Census Division includes that part of the Alaska Peninsula west of approximately 158°W longitude, as well as the Aleutian Islands and the Pribilof Islands (Fig. III-31).

Within this census division, as in most of Alaska, military activities have constituted the largest single source of wage and salary employment from World War II to the present. As recently as 1979, 17 percent of all wage earners in Alaska were active-duty military personnel or federal-government civilian employees in military-related jobs (State of Alaska, Department of Commerce and Economic Development, June 1980). In the Aleutian Islands Census Division, an even larger share of the cash economy is based on national defense. In 1980, approximately 50 percent of all wage and salary workers were full-time, uniformed military personnel or military-related federal civilian employees (Appendix D, Table D-1). However, in the Aleutian Islands Census Division, unlike many other parts of Alaska, the large military operation has almost no effect on the nonmilitary sectors of the economy. This is due to

Table III-33
Employment by Residency for Bristol Bay Large Processors

District	Seasonal Peak		Local		Other Alaska		Outside Alaksa	
	1980	1981	1980	1981	1980	1981	1980	1981
Dillingham/ Nushagak								
Queens Fisheries	260	300	0	0	86	100	174	200
Peter Pan	210	225	120	120	20	20	70	85
Naknek/Kvichak								
Nelbro	280	225	6	6	134	110	140	109
Red Salmon	197	197	20	20	10	10	167	167
Whitney	120	120	10	10	20	20	90	90
Kodiak King	80	85	0	0	19	20	90	90
Diamond E	263	263	0	0	66	66	197	197
Columbia Ward	275	300	0	0	150	175	125	125
TOTALS	1,685	1,715	156	156	505	521	1,024	1,038
Percent of Total	100	100	9.2	9.1	30	30	60	61

Source: Nebesky, 1984.

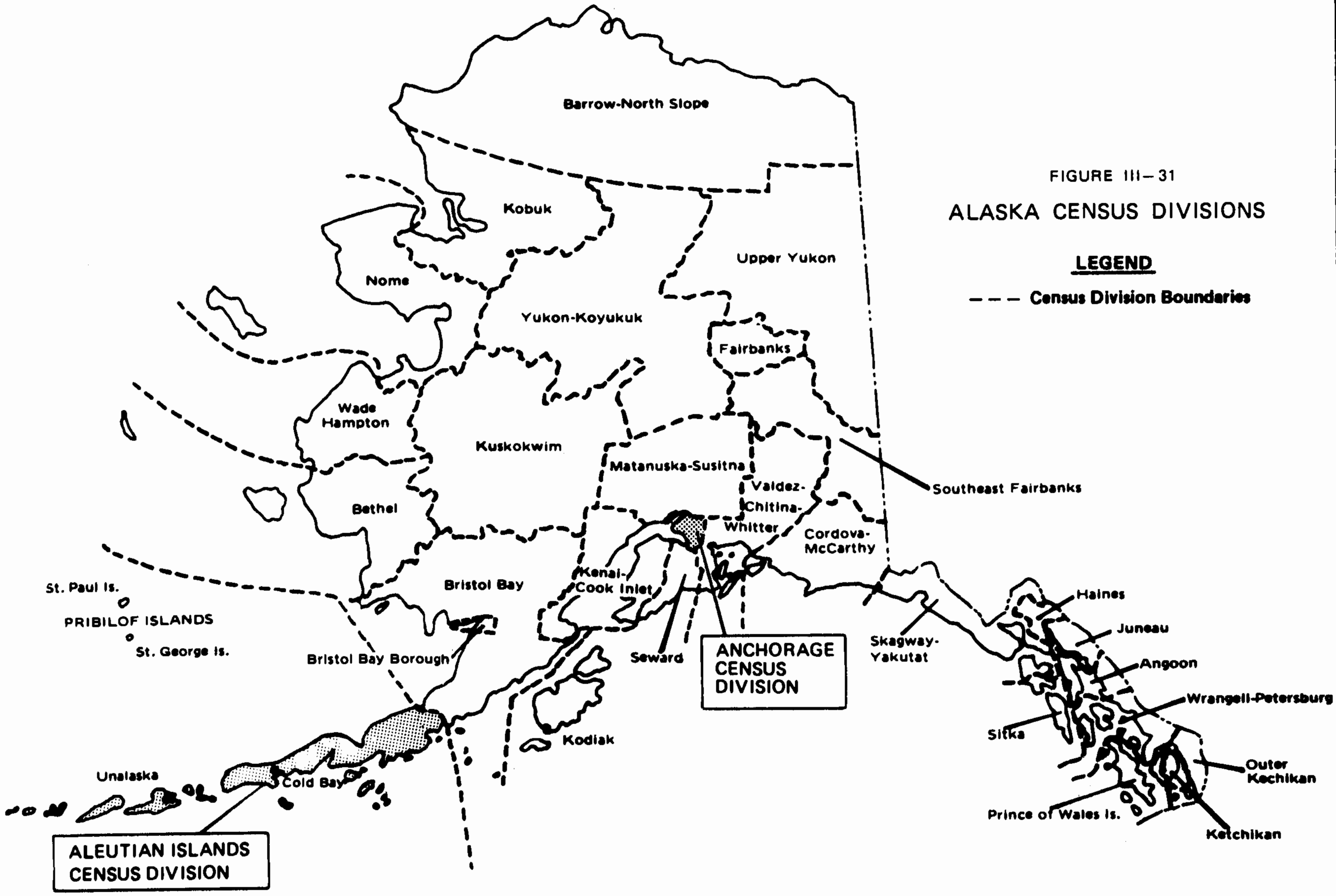
Table III-34
1980 Alaska Peninsula Processing Employment
by Residency (Large Processors)

Community	Total	Local	Other Alaska	Outside Alaska
Sand Point				
Ocean Beauty	11	2	-	9 (Seattle)
Peter Pan	10	1	-	9 (Seattle)
Aleutian Cold Storage	111	1		110 (Seattle)
	25 other (more of these are local)			
King Cove				
Peter Pan	295	10		285 (Seattle)
False Pass				
Peter Pan	240	12		228 (Seattle)
(Cannery burned in 1981)				
Port Moller				
Peter Pan	120	1-5	20-25	95 (Seattle)
Port Heiden				
Christensen & Sons	7	3	2	2
TOTALS	794	32	27	738
Percent of Total	100	4	4	92

Source: Earl R. Combs, Inc., 1982.

FIGURE III–31

ALASKA CENSUS DIVISIONS



Note: Census Division boundaries shown above are for geographic areas used by the U.S. Department of Commerce prior to the census survey of 1980. The census divisions shown above (rather than the 1980 census areas) continue to be used for the reporting of wage and salary employment, personal income, and several other types of economic statistics.

Source: Alaska OCS Office

the unusual nature of the Aleutian Islands Census Division, which consists of a number of very isolated communities with almost no economic interactions. The vast majority of the military personnel within the census division are at Adak and Shemya Station, neither of which is expected to be directly affected by the proposed OCS petroleum development. Therefore, even though national defense is by far the largest source of employment in the census division, this aspect of the economy is not relevant to evaluation of the effects of proposed OCS development.

The commercial fishing industry is the second largest source of employment in the Aleutian Islands Census Division. A detailed description of the region's fishing industry is provided in Section III.C.1. For that reason, only the most important economic aspects of the region's fisheries are discussed here.

Jobs in seafood processing constitute by far the largest source of civilian wage and salary employment in the Aleutian Islands Census Division. The figures for manufacturing employment in Table D-1 (Appendix D) are virtually all seafood-processing jobs. Manufacturing employment increased from 6 percent of all wage and salary jobs in 1969 to 29 percent in 1980. Note, however, that Table D-1 shows figures only for wage and salary employment. Almost all fishermen are either fishing-vessel operators or crew members working for shares of the catch and are therefore not included in the employment figures in Table D-1. An estimated 756 nonwage fishermen were employed in the Aleutian Islands Census Division in 1978 on a 12-month-average basis (University of Alaska, ISER, 1981). If the figure of 756 is used as a rough estimate of the number of fishermen in 1980, the job total including fishermen was 6,623 in 1980, with fishermen and fish-processing workers accounting for 37 percent of that total.

Salmon, halibut, king crab, tanner crab, and shrimp are the most important domestic (U.S.) fish and shellfish harvests from waters adjacent to the Aleutian Islands Census Division. Total payments to fishermen for these fish and shellfish exceeded $200 million in both 1978 and 1979 (University of Alaska, Sea Grant Program, 1980).

The harvesting of fish by foreign fleets near the Aleutians has little or no economic effect on the Aleutian Islands Census Division, since the catch is not landed in the U.S. However, the foreign catch is significant as an indication of additional amounts which U.S. fishermen may harvest in the future. Federal legislation enacted in 1976 prohibits foreign harvesting of fish within 200 miles of U.S. shores if U.S. fishermen have demonstrated the ability and desire to perform the harvest. Presently, foreign fleets continue to harvest vast quantities of groundfish from waters adjacent to the Aleutian Islands Census Division.

The total foreign catch of all species of groundfish in the waters adjacent to the Aleutian Islands Census Division has varied annually from about 1 million metric tons to over 2 million metric tons (ibid). The foreign catch in 1978 was about 1.3 million metric tons (USDOC, NOAA, NMFS, April 1980). The dockside value of this catch was over $200 million, computed on the basis of estimated 1980 prices paid to U.S. fishermen for the very small domestic-groundfish harvest from waters adjacent to the Aleutian Islands Census Division (University of Alaska, Sea Grant Program, 1980). The forecast for the domestic fisheries of the area includes a dramatic takeover by U.S. fishermen of the huge foreign harvest of groundfish.

Although national defense and the fishing industry dominate the cash economy of the area, two other developments have had important influences on the economic well-being of the area's permanent residents--the achievement of Alaska statehood in 1959 and the passage of the Alaska Native Claims Settlement Act (ANCSA) by Congress in 1971.

After Alaska statehood, area residents achieved access to services long enjoyed by virtually all other Americans, including medical services, education beyond the eighth grade, and improved transportation and communications. Of course, as these services were provided, additional job opportunities also were created in the area. Some of these new jobs appear in Table D-1 in the "State/Local Government" category, while others appear in the "Services" category. Beginning in 1976, some government-type services, including medical and job-training services, were contracted to private, nonprofit corporations. Employment in these nonprofit corporations is reported in Table D-1 under "Services," rather than under "State/Local Government."

The Alaska Native Claims Settlement Act established special corporations owned by Alaska Natives (Eskimos, Aleuts, and Indians) to administer the land and money awarded to Natives in settlement of their land claims. Native corporations were established for individual villages and also for regions. The boundaries of the Aleut regional corporation coincide almost exactly with the Aleutian Islands Census Division. Beginning in 1972, large amounts of money were distributed from the federal government to the Native corporations. A very small part of these cash distributions was passed on from the corporations to individual Native persons. During the 10-year period following passage of the Act, the amount of government funds received by an individual Native person under ANCSA totaled less than $500 in a typical case (Arnold, 1981). (The personal-income statistics published by the U.S. Bureau of Economic Analysis wrongly include all of the cash distributions to the Native corporations as personal income, thereby seriously distorting personal-income information for 1973 and the years immediately following.) The corporations retained much of the money for investments to be able to pay dividends to Native shareholders in future years.

Native-corporation benefits to area residents also included the creation of new wage and salary jobs in the administration of the corporations. Many of the positions in the new corporations were filled by Native (Aleut) residents. These jobs appear in Table D-1 in the "Finance, Insurance, and Real Estate" classification.

Very small amounts of additional employment are created by the personal-consumption expenditures of workers in the activities described above. These jobs are reflected mainly in the figures for "Wholesale-Retail Trade" in Table D-1. However, the wholesale-retail-trade job totals also include jobs created by sales to the military establishment or to the fishing industry.

Commercial trapping of fur-bearing animals also provides a small amount of cash income to area residents.

The above discussion focuses only on the cash economy of the area. Refer to Section III.C.4 of this EIS for a discussion of subsistence-use patterns (hunting, fishing, and gathering activities) of the Aleut residents of the area.

A limitation of the material presented above is the aggregation of employment totals for the entire Aleutian Islands Census Division. For this reason, the two communities that would be most affected by the proposed lease sale (Cold Bay and Unalaska) are described below.

Cold Bay: This community is basically an air-support enclave populated by federal- and state-government officials and airline staffs, plus a minimum of persons who perform support functions (Alaska Consultants, Inc., 1981). The population in 1980 was 228 (Appendix D, Table D-2). Cold Bay offers by far the best civilian airport in the region; consequently, any OCS petroleum activities in the region probably will use Cold Bay as a center for air support (USDOI, BLM Technical Paper No. 1, April 1981). Employment in 1982 is estimated in Table D-3 (Appendix D).

No unemployment statistics are presented for Cold Bay. Since almost all housing is provided by employers, virtually no housing for unemployed persons exists at Cold Bay; any person who became unemployed at Cold Bay probably would leave the community immediately. In addition to the lack of housing, the high cost of living, the isolation, and a great deal of rain and fog contribute to this situation.

No information is available on per capita income in Cold Bay.

Unalaska: This community is the second largest in the Aleutian Islands Census Division and is by far the largest community likely to be affected by the proposed OCS petroleum activities. The total population in 1980 was 1,322 (Table D-2); that figure includes 598 persons living in group quarters (U.S. Bureau of the Census, detailed census tapes). It is very likely that the harbor facilities at Unalaska/Dutch Harbor would be used to provide marine support for planned offshore petroleum activities.

Although Unalaska originated as a traditional Aleut village, recent increases in fish harvesting and processing have attracted many new immigrants, with the result that Aleuts are now a minority of the total population (Alaska Consultants, Inc., 1981). The 1980 total population, including persons living in group quarters, reflects an increase of 287 percent from 1970 (Table D-2).

There are no unemployment statistics available specifically for Unalaska. Unemployment rates for the Aleutian region as a whole are normally low, due in part to the presence of a large transient workforce. According to local officials at Unalaska, unemployment is insignificant among the resident workforce. Almost all workers in the seafood-processing plants are recruited from outside the Unalaska area, and the transient workforce leaves the community after the close of each fishing season. Fish-processing workers could not afford to live in Unalaska after the end of the fishing season, and might not wish to live there the entire year because of the isolation and the frequent rain and fog. Similarly, most fishermen are not permanent Unalaska residents. Therefore, although there is some seasonal unemployment, it is not as great as the community's overall seasonality of employment might suggest (Alaska Consultants, Inc., 1981).

Per capita-money income for permanent residents of Unalaska was estimated at $8,290 in 1977 (Table D-2). Per capita-money income is defined to include income in the form of cash or checks, but not to include the value of food obtained from subsistence activities or the value of noncash benefits such as food stamps or housing provided at less than cost (personal communication, Dan Burkhead, U.S. Bureau of the Census, July 30, 1984). The 1977 Unalaska income figure of $8,290 is more than the corresponding U.S. figure of $5,751 (Table D-2). In 1977, the index of living costs in the Aleutian Islands Census Division was estimated at 182 percent of average U.S. living costs (State of Alaska, Department of Commerce and Economic Development, 1979). If the $8,290 income figure is adjusted by the living-cost index, the adjusted per capita income is only 79 percent of U.S. per capita-money income in 1977.

The cost of living at Unalaska is almost certainly higher than the average cost of living for the Aleutian Islands Census Division. The cost-of-living index for the census division was prepared on the basis of all communities in the census division, including military communities where military personnel are able to purchase commodities at government-subsidized prices. Many rural Alaskan communities have cost-of-living indices substantially in excess of 200 percent of average U.S. living costs (ibid). It is likely that Unalaska also has living costs that are at least 200 percent of average U.S. living costs, indicating that per capita-money income at Unalaska may be 72 percent, or less, of the average U.S. figure when expressed in terms of comparative purchasing power.

In 1980, Unalaska was one of the leading fishing ports in the U.S. (Alaska Consultants, Inc., 1981). Although disastrous declines in king crab harvests occurred in the years 1981-1983, fish harvesting and processing continue to dominate the local economy. The only other significant economic activity is Unalaska's role as a transshipment point for freight to coastal locations in western and northern Alaska, and for fish products traveling between the West Coast of the U.S. and the Orient (ibid).

Employment in the community is summarized in Table D-4 (Appendix D) for the year 1980. The employment figures include a very large number of jobs held by transient workers who participate in fishing and fish-processing activities (Table D-4, Column 2).

Table D-4 classifies all jobs as either "basic" or "secondary." Jobs in activities that bring new money into the community are classified as "basic." Jobs in basic activities are considered the most important factor determining total employment and total population in a community. Most or all jobs in "secondary" activities (i.e., local government, utilities, personal services, and parts of retail trade) are considered to be the indirect effects of basic industry activities, because it is assumed that the community exists primarily as a result of the basic economic activities.

Basic-industry activities in Unalaska include the fishing industry, which brings new money into the community through the sale of fisheries products (Table D-4, Rows 1 and 2). Another basic activity is the transshipment function of the Port of Unalaska, which brings revenues into the community by providing shipping and warehousing services for goods being shipped to other communities (Table D-4, Row 5). In Table D-4 (Row 7), an additional 20 jobs in the "Finance, Insurance, and Real Estate" industry classification are treated as basic. These 20 jobs are positions with Alaska Native corporations created under terms of the Alaska Native Claims Settlement Act, discussed above. Basic employment also includes a small number of mining jobs (Table

D-4, Row 3) and government jobs with the U.S. Customs and the U.S. Coast Guard (Table D-4, Row 9). Table D-4 classifies all other employment as secondary.

The discussion above focuses only on the cash economy of the community. Subsistence activities are discussed in Section III.C.4 of this EIS.

Future of the Environment Without the Proposal: In the absence of the proposed North Aleutian Basin (Sale 92), total employment in Unalaska is projected to increase from 731 jobs in 1984 to 3,060 in the year 2000 (Appendix D, Table D-5). These figures are annual-average (12-month) estimates of total employment, including jobs held by transient workers housed in group quarters (enclaves) as well as jobs held by permanent residents of the community. The large increase in employment is projected on the assumption that the huge harvest of groundfish by foreign fleets will be taken over by the U.S. fishing industry by the year 2000. This assumption is based on federal legislation, enacted by the U.S. Congress in 1976, which prohibits foreign harvesting of fish within 200 miles of U.S. shores if U.S. fishermen have demonstrated the ability and desire to perform the harvest.

The takeover by the domestic fishing industry is now in the beginning stages, and no one can predict with any certainty the rate at which the takeover will proceed or the pattern of harvesting and processing that will develop. If a significant percentage of the groundfish in the region were harvested by U.S. vessels and processed onshore at Unalaska, or at other onshore locations in the Aleutian Islands Census Division, employment and population in the region would increase greatly. However, it is conceivable that nearly all of the groundfish would be processed offshore, in which case the employment and population effects in the Aleutian Islands Census Division, including Unalaska, would be minimal. Due to the high degree of uncertainty about future development of the domestic groundfish industry, future levels of employment at Unalaska could be much higher or lower than indicated by the projections in Appendix D, Table D-5. The projections of future employment at Unalaska also include petroleum-related jobs expected to result from the St. George Basin (Sales 70 and 89) and the Navarin Basin Lease Offering (Sale 83). For the North Aleutian Basin (Sale 92) base case, only exploration is assumed for each of the two St. George Basin lease sales, and the mean-case discovery (1.2 Bbbls) is assumed for the Navarin Basin lease sale. The total number of jobs at Unalaska expected to result from these three lease sales is small compared to the increases in employment projected to result from the expansion of the U.S. groundfish industry in the region.

In the absence of the North Aleutian Basin (Sale 92), the projections of employment at Cold Bay (see Appendix D, Table D-6) also include petroleum-related jobs resulting from exploration only (no discovery) for the two St. George Basin lease sales and the mean-case discovery (1.2 Bbbls) for the Navarin Basin Lease Offering (Sale 83). Due to the effects of these sales, projected employment at Cold Bay follows an erratic pattern throughout the period 1984-2000. (For more information about the assumptions used in projecting base-case employment at Unalaska and Cold Bay, see "Impact Analysis of the St. George Basin Lease Offering and the North Aleutian Shelf Lease Offering" [December 1984] prepared by the University of Alaska, ISER, 1984.)

3. Community Infrastructure: Infrastructure is the basic framework or support structure for a city or town. It includes a wide variety of

electrical power, water and sewage treatment, health care, and police- and fire-protection systems are described in this section. Cities whose infrastructure could be affected by oil exploration, development, and production activities associated with the North Aleutian Basin (Sale 92) are Cold Bay and Unalaska.

Cold Bay: The following information on Cold Bay was taken from Alaska Consultants, Inc., 1981; Impact Assessment Inc., 1983a; and Nebesky et al., 1983b.

In January 1982, Cold Bay was incorporated as a second-class city. The town has a mayor/council form of government, with seven council members from whom a mayor is selected. Due to the lack of local government, major employers have historically provided the bulk of utility services (water and sewer treatment). With the formation of a local government, these employers are interested in divesting responsibility for these functions.

Almost all housing in Cold Bay is provided by companies or government agencies. The 1980 census indicates that 226 people reside in Cold Bay; 60 percent live in 49 year-round housing units, and 40 percent reside in employer-provided group housing. Year-round housing units consist of 47 employer-owned rental units, provided by federal and state governments and private companies for their employees, and two owner-occupied units. Generally, there is no permanent housing available for nonemployed individuals; all housing is allocated to individuals who work for the town's employers. The lack of available private land compounds this situation--individuals are unable to obtain land on which to build. Lodging for short-term transients is available at the hotel. Educational services are provided by the Aleutian Region School District, a state-funded Rural Education Attendance (REA) area. Educational facilities are located in a single complex containing four classrooms and a combination library/media center. The community recently expanded the school with the addition of a multipurpose media room. The school is staffed by four teachers whose responsibility varies from year to year, depending on the student population and teacher experience. Generally, two teachers are responsible for elementary students and two for high school students. Student enrollment in the last decade has ranged between 20 and 30 students per year. Current enrollment averages around 50 students.

The electrical system in Cold Bay, operated by Northern Power and Engineering Diesel, is generally in good condition and has the potential to serve an increased population base. The power-generation system consists of two 800-kilowatt and one 600-kilowatt generators, which have a total capacity of 2,200 kilowatts. However, since there is no capability to parallel generators of unequal capacity, the actual power output could be only 1,600 kilowatts. Because peak power demands usually do not exceed 350 kilowatts in the summer and 600 kilowatts in peak winter periods, the system is adequate to meet the electrical requirements of the community and to provide for significant growth.

Cold Bay's municipal water system is operated by the Federal Aviation Administration (FAA) and includes five deep wells and two 15,000-gallon storage tanks for domestic and general use. Two additional underground tanks with a total capacity of 50,000 gallons provide water for firefighting purposes. Problems with the system include a storage capacity that is barely adequate to services and facilities in a community; however, only housing, education, meet current demands and a water source that could be seriously depleted by increased draws. Average daily consumption ranges between 20,000 and 30,000 gallons. The higher figure reflects periods during the winter when residents let water run to prevent damage to pipes. Due to budget cutbacks, the FAA is interested in divesting itself of responsibility for operating the water system. The incorporation of Cold Bay as a second-class city in 1982 provided a legal entity that can take responsibility for provision of basic services.

Cold Bay's sewage-treatment facilities are operated by the FAA and consist of a 22,500-gallon tank in which sewage is aerated and chlorinated prior to outfall in Cold Bay proper. The design capacity of the system is approximately 22,500 gallons per day; with current community water consumption averaging 30,000 gallons per day, the treatment facility is operating beyond its design capacity. The FAA is interested in foregoing responsibility for operating the sewage-treatment facilities. The failure of the system to meet Environmental Protection Agency (EPA) standards, primarily due to overdemand on the system, presents a problem in transferring the system from FAA to municipal control. The municipality wants the FAA to upgrade the system to EPA standards prior to transfer.

The level of health care in Cold Bay has improved greatly with the construction in 1982 of a clinic which is able to accommodate four or five patients. The clinic has three examination rooms, an emergency room, a laboratory, a pharmacy, and a kitchen. The city is negotiating with doctors in Kodiak and Unalaska to provide intermittent care at the clinic. Health services have been provided by a public health nurse who periodically visits the community. Serious health care needs are met in Anchorage.

Police- and fire-protection services are designed to support airport operations. Police protection is provided by an Alaska Department of Transportation and Public Facilities (DOTPF) employee--a police officer whose primary responsibility is airport security. A combination police/fire station contains a small office and holding cell that are in extremely poor condition. Fire protection for the airport and the community also is provided by the DOTPF. Firefighting equipment includes three fire trucks equipped with water pumpers, foam, or dry chemicals, and an all-terrain vehicle. The department also has a 17-foot crash-rescue fireboat for aircraft-rescue operations. The department is manned by a full-time chief and volunteers. Water sources for firefighting purposes include a hydrant system and two 25,000-gallon underground tanks. The hydrant system in the community pumps less than 500 gallons per minute above normal consumption for a period of at least 2 hours.

<u>Unalaska</u>: The following information on Unalaska's infrastructure was taken from Alaska Consultants, Inc., 1981; Impact Assessment, 1983b; and Centaur Associates, Inc., 1984.

Unalaska is a first-class city, incorporated in 1942. The city has a council/manager form of government with a nine-member council and a mayor-elect at large. The manager directs day-to-day operations and the mayor and council provide policy direction. Unalaska's tax structure includes both property and sales taxes.

Historically, one of the most serious problems facing Unalaska is a housing shortage. In 1981, 469 housing units--ranging from one-unit structures to mobile homes and trailers--existed in Unalaska (Alaska Department of Labor, 1981). Approximately 2.4 people occupied each housing unit. In 1981, the 48 vacant housing units represented a vacancy rate of approximately 10 percent. Vacant units included 32 one-unit structures, 7 two-unit structures, 1 three-unit structure, and 6 mobile homes. Almost all permanent residents live in one-unit structures, while most transients live in group quarters provided by their employers. One 13-unit motel and a 48-unit inn are available for short-term transients; however, these units are used almost exclusively by seafood-processing employees.

The Unalaska City School District provides elementary and secondary services for the entire school-aged population of Unalaska. The school is organized in two units (elementary and secondary); both are located in a single complex on a 5.5-acre site. The district is served by a superintendent, two principals, and 18 teachers. Existing facilities include 20 general classrooms, two special-education rooms, several shops, a gymnasium, a library, and numerous other rooms.

The school population grew at a rate of 12.5 percent per year between 1976 and 1981. Enrollment for the 1982 school year declined due to the decline in the local crab catch. Enrollment is expected to stablize for the next 2 to 5 years and then experience a small rate of growth. Existing facilities should be adequate to maintain current student/teacher ratios during this period. In 1981-1982, the student population of 165 accounted for about 13 percent of the total population due to the large number of transients and unattached adults in the population.

The City of Unalaska generates electricity for municipal and residential customers but not for industrial users, who generate power on an individual basis and are the major users of electricity in the Unalaska area. Existing municipal facilities include two 300-kilowatt and one 600-kilowatt generators. These generators cannot be operated in parallel, and they serve different areas of the city. Current average demand in Unalaska ranges between 220 and 240 kilowatts, with a peak demand of 320 kilowatts. Dutch Harbor is not served by the municipal power system.

The city plans to upgrade the existing generation system in two phases. Currently, the city is installing a 35-kilowatt distribution system to connect the boat harbor on the Dutch Harbor spit. Under this plan, most private generation by residential and small commercial users would be displaced. The city plans to add capacity in 2,500-kilowatt increments as industrial demand warrants. By 1990, power is expected to be supplied by a geothermal plant at the Makushin field or a heavy-fuel, low-seed diesel plant.

Unalaska's water supply is obtained from surface waters from Unalaska and Pyramid Creek and is augmented by two emergency wells capable of supplying 1,200 gallons of water per minute. Water yields from this supply can be lowered during periods of extended cold, when surface waters freeze. During these periods, water shortages can occur. Water is distributed to residential, commercial, and industrial users through 40-year-old, wood-stave pipes that are in need of repair. The water utility has recently replaced more than 1,000 feet of wood-stave water pipe with iron pipe. However, approximately 40,000 feet of line still need to be replaced. Because of the decayed condition of this distribution system, an estimated one-third of the water supply is lost through leakage. Existing water-treatment and storage facilities are inadequate. During periods of high use, chlorine-retention time is inadequate, resulting in the possible survival of pathogens. Also, residential areas upstream of the treatment plant must use untreated water. During periods of high use and low stream flow, little water is available for firefighting. The lack of adequate storage also contributes to treatment problems.

The water system in Unalaska is estimated to have a peak flow of 25.9 million gallons per day (MGD) and a peak consumption of 17.3 MGD, with system leakage estimated at 33 percent of the total flow (8.6 MGD). Present peak industrial consumption is about 16.8 MGD (estimated during periods of maximum employment by the seafood-processing industry), while peak nonindustrial consumption is about .50 MGD. Average flow and consumption are estimated at 17.3 and 11.5 MGD, respectively. The current average nonindustrial consumption is estimated at .33 MGD.

Unalaska does not have a community-wide sewage system. About half the community's residents use septic tanks or outhouses, while the rest are served by three waste-water-collection outfall lines, that were built by the U.S. Navy during World War II. Two of these lines discharge raw sewage into Iliuliuk Bay, while sewage in the third line is treated by one of the seafood processors and discharged into Captain's Bay. The volumes of waste being discharged are contributors to the degradation of the waters around Unalaska. The city plans to construct a primary treatment facility after renovation of the water-supply system. Initially, this facility would handle only domestic wastes, but industrial wastes may be processed later.

Health care is provided by the Iliuliuk Family and Health Services Clinic. The clinic has been in existence for 10 years and provides outpatient services, radiology, and general ambulatory and acute care to the city--including the fish-processing industry, domestic fishing-fleet crews, members of foreign vessels, and residents of Nikolski and Akutan. Currently, the clinic has the capability to accommodate three patients. Staff members include a full-time physician, a student physician's assistant, and a lab/X-ray technician. A dentist visits the community bimonthly and an ophthalmologist visits quarterly. The major problems with health care in Unalaska are the lack of qualified personnel and the high cost of medical care. The clinic has lost funding for a physician's assistant and, according to the resident physician, the clinic could use the services of two registered nurses, a licensed practical nurse, and a technician. The high cost of medical care in Unalaska is a result of the Aleutian/Pribilof Region's reliance on outside medical facilities. There are no plans to build a hospital in Unalaska in the near future.

The responsibility for police and fire protection in Unalaska is assumed by the Alaska Department of Public Safety. The police department is staffed by 17 to 18 full-time personnel who do dispatch and clerical duties and also serve as watch commanders and public safety and corrections officers. For its size, Unalaska has a large police force because of enforcement activities related to the high numbers of transient laborers in the city during crab season. Detention facilities contain three cells designed to separate women and juveniles from male prisoners. The present detention facilities are in good condition but are insufficient to accommodate peak needs. The city has plans to build a new jail facility within 5 years.

For a community of its size, Unalaska experiences a high level of criminal activity. In 1981, the police department responded to 13,200 calls, with the most serious crimes involving assaults, burglaries, and rapes. Crime has increased in the last 3 years and most assaults and rapes are alcohol-related.

The city's volunteer fire department provides fire protection throughout the road-connected area within Unalaska's corporate limits. The fire department is staffed by a fire marshal and two companies, one in Unalaska and one in Dutch Harbor, each with 13 volunteers. Firefighting equipment consists of four vehicle, two portable pumps, and a 1,000-gallon holding tank used for pumping and storing water in areas without hydrants. Major fire-protection problems are an inadequate hydrant system, particularly in Dutch Harbor, and a lack of water when water levels in Unalaska and Pyramid Creek are low.

Future of the Environment Without the Proposal:

Cold Bay: The resident population of Cold Bay is expected to decline from 225 residents in 1981 to 156 in 1994, due to the contraction of traditional FAA, military, and communications activities. After 1995, the resident population would begin to rise and stabilize at 210 residents. Because the resident population is anticipated to remain below current levels between the years 1985 and 2010, which equates to lower service-demand levels, all basic services except the water-supply and sewage- treatment systems would be adequate to meet the community's future needs. Projections of the future demand for public service in the absence of the lease sale are provided in Appendix E.

The contraction of FAA operations in Cold Bay would result in the city taking increased responsibility for the operation of the water- and sewage-treatment systems, which are currently operated by the FAA. Facility operation would force the city to come to terms with revenue-generation problems in financing improvements to these systems. In order to finance facility improvements and have sufficient revenues to operate the systems, the city would have to adjust the utility rate structure or institute a property and/or sales tax (Impact Assessment, 1983a). Even with the population reductions anticipated in Cold Bay, the sewage-treatment facilities would require upgrading to meet EPA standards, and the water system would require a greater storage capacity.

Unalaska/Dutch Harbor: It is anticipated that Unalaska will experience substantial population growth between the years 1985 and 2010, due to expansion of the groundfish industry. Based on the level of population growth projected to occur in Unalaska, all facilities and services would require expansion to meet community needs between the years 1985 and 2010.

Table III-35 displays the periods of time in which Unalaska's basic services would require expansion to meet the community's projected needs. Projections of future demand for public services in the absence of the lease sale are provided in Appendix E.

4. Subsistence-Use Patterns: This section deals with subsistence resources used by residents of Cold Bay, Unalaska, the Bristol Bay region, and the lower Alaska Peninsula subregion.

Table III-35
Time Periods When Basic Services Would Require Expansion in Unalaska 1/

Educational Service Needs	Water Needs	Sewage Treatment Needs	Health Care Needs	Law Enforcement Needs
1995-2000	1995-2000	1985-1990	1990-1995	1990-2010

Source: USDOI, MMS, 1984.

1/ Assuming that projected improvements to the electrical power system would be completed as planned, the system would meet community needs through the year 2010.

Cold Bay: As indicated by the recent Cold Bay case study, subsistence has no deep history in Cold Bay (Impact Assessment, Inc., 1983a). The urban-oriented residents do not practice food production in any intensive way beyond recreational hunting and fishing. However, many of the local residents take advantage of the fish and game which are abundant in the area, and some take advantage of subsistence set-netting for salmon. The local residents harvest other marine resources of the area--including cod, halibut, and crab--in moderation. Hunting is a popular pastime in Cold Bay, and waterfowl and caribou are taken in season and put away for winter. Trapping by local residents is very limited. The social consequences of hunting and fishing generally are to provide a means for reinforcing social groups and friendship patterns. Subsistence generally plays a minor role in the overall economy; most people are satisfied to import processed food from outside the community.

Unalaska: This discussion is derived from the description contained in the St. George Basin (Sale 70) FEIS and is augmented by a recent study done on the community (Veltre and Veltre, 1982). With the development of a major seafood-processing industry, Unalaska has grown in a relatively short period of time from a village to a booming frontier town. Geographically and socially, however, the original Aleut village remains intact. The community's subsistence harvest is generally characterized as a means of enhancing the quality of life, of being able to get outdoors, and of harvesting resources in conjunction with wage labor. Fishing, the principal subsistence activity, is undertaken by families and groups of friends and is sometimes associated with an all-day outing. To add a variety of special items to the diet, other subsistence resources--mushrooms, shellfish, seals, and trout--are exploited at various times of the year and provide a limited quantity of food. The primary orientation of the community as a whole, however, is toward other forms of employment--a characteristic also shared by the community's Aleut residents.

Good hunters and fishermen--both Native and non-Native--are highly respected for their skill in harvesting resources and their generosity in sharing such resources. Subsistence harvests generally are confined to Unalaska Bay, although increased population and pollution have forced people to travel farther from Unalaska to obtain desired resources. On occasion, crews of commercial fishing vessels will use the opportunity of a fishing venture to hunt and gather resources from traditional subsistence sites outside of Unalaska Bay. Cabins and camps around the bay are still in use for harvesting subsistence resources. Although only a portion of the community engages directly in acquiring such resources, networks for sharing food items involve virtually the entire resident community.

Resource-harvest activities are significant in the food they provide and in the interpersonal and cultural bonds they foster. For Aleuts in Unalaska, subsistence activities serve to reinforce the continuation of cultural tradition (an identity which emerged anew following the passage of the ANCSA in 1971). Cultural identification with subsistence resources occurs most strongly among the elderly, with such specific resource items as fur seal parts acquired from the Pribilof Islands, and other locally acquired marine mammal resources. In a dietary sense, however, most people view the need for subsistence resources as a way of putting food on the table. Salmon is the most important single resource for the entire population. Beyond that, halibut and shellfish generally are preferred by non-Natives, whereas halibut and seal or sea lion are most favored by the Native population.

While the entire community of Unalaska uses at least some local fish and game resources, such resources generally are used to a greater extent in the diet of Native households (ranging from 20-50% of their diet) and cover a wider range of resources than those used by the non-Native community.

Bristol Bay Region: The boundary of the Bristol Bay region coincides with the description used in Section III.C.5. A partial list of subsistence resources used by residents of the five subregions considered for Bristol Bay is shown in Table III-36 (extracted from the draft Bristol Bay Cooperative Management Plan [BBCMP, 1984], the primary reference for this discussion). According to the BBCMP report:

> Subsistence use is both flexible and opportunistic so that, even within the subregions, there are often significant differences between villages and substantial differences from one year to the next in harvest levels of different species. Factors causing fluctuations in the use of wild resources include abundance, distribution, household income, substitution, costs, and cultural values....[However,] how the mix of subsistence resources changes in response to environmental, economic, and sociocultural factors is not well understood (Nebesky et al., 1983a).

The quantification of subsistence-resource use by survey research or other means is subject to considerable variation in the reliability of the data, due in part to the political sensitivity of the issue. With these limitations in mind, average annual (1979-1981) quantities of salmon, caribou, and moose were estimated for each subregion as part of the BBCMP, in order to forecast consumption needs under alternative-plan configurations. Salmon, caribou, and moose were singled out as the most important subsistence resources to most all of the region's villages. Describing these base-case conditions, Table III-37 shows that the highest use of salmon and moose per household is made in the Iliamna and Nushagak subregions. Caribou is the most highly used resource per household in the Iliamna and upper and lower Alaska Peninsula subregions. The Togiak subregion makes relatively less use of moose and caribou than the other parts of the Bristol Bay region (largely due to limited nearby resource availability), but relies more intensively on marine mammal resources than other subregions in the region. Other species important in the different subregions are indicated in Table III-36.

Lower Alaska Peninsula Subregion: The communities covered in the lower Alaska Peninsula (a subregion of the Bristol Bay region) are Sand Point, King Cove, False Pass, and Nelson Lagoon. This discussion is derived from the description contained in the St. George Basin (Sale 70) FEIS and from research conducted by Earl R. Combs, Inc. (TR 71, 1982) for the Social and Economic Studies Program of the MMS, Alaska OCS Region.

The smaller villages of Nelson Lagoon and False Pass and the larger villages of King Cove and Sand Point, all of which are oriented toward commercial fishing, represent more similarities than differences in their characteristics of subsistence harvest and more positive integration of such activities with other work than seen earlier. This is especially true in King Cove and Sand Point, where the nature of their work (fishing) allows the time needed and provides the equipment to gain access to a variety of subsistence resources. The general range of mobility used to perform the subsistence harvest and the

Table III-36
Partial List of Subsistence Resources
Used in the Bristol Bay Study Area

Subsistence Resource	Lower Alaska Peninsula	Chigniks	Upper Alaska Peninsula	Iliamna Lake	Nushagak River	Nushagak Bay	Togiak	Kuskokwim Bay
1. Terrestrial Mammals								
Moose	0	X	X	X	X	X	X	0
Caribou	X	X	X	X	X	X	X	0
Brown bear	?	0		0	0	0	0	?
Black bear			?	X	X	0	0	?
Porcupine		?	X	X	X	X	X	?
Arctic hare		?	X	X	X	X	X	X
Snowshoe hare		X	X	X	X	X	X	X
Ground squirrel	?			X	X	X	X	X
Marmot							X	?
Beaver			X	X	X	X	X	X
Red fox	X	X	X	X	X	X	X	X
Arctic fox							0	X
Wolverine	X	0	X	X	X	X	X	X
Wolf	0	0	X	X	X	X	X	X
River otter	X	X	X	X	X	X	X	X
Mink	X	X	X	X	X	X	X	X
Marten				X	X	X	X	?
Muskrat				0	0	0	0	?
Lynx				X	X	0	0	?
2. Marine Mammals								
Harbor (spotted) seal	X	X	X	X	0	X	X	X
Ringed seal			?			X	X	X
Bearded seal						?	X	X
Sea lion						0	X	?
Walrus						X	X	X
Beluga				0		X	X	X
Whale (gray or other washed up on shore)	0					?	X	?
Porpoise (? species)							0	0

Table III-36
(Continued)
Partial List of Subsistence Resources
Used in the Bristol Bay Study Area

Subsistence Resource	Lower Alaska Peninsula	Chigniks	Upper Alaska Peninsula	Iliamna Lake	Nushagak River	Nushagak Bay	Togiak	Kuskokwim Bay
3. Birds								
Swans			X	X	X	X	?	?
Geese[1/]	X	X	X	X	X	X	X	X
Ducks[2/]	X	X	X	X	X	X	X	X
Cranes			X		X	X	X	?
Ptarmigan	X	X	X	X	X	X	X	X
Spruce grouse			X	X	X	X	X	?
Bird eggs[3/]	X	O	X		X	X	X	X
4. Shellfish								
Clams[4/]	X	X	X			X	X	?
Crabs[5/]	X	X					X	?
Octopus	X	X					X	?
Mussels, limpets	X	X					O	
Sea urchins	X							
Shrimp	X	X						
5. Salmonids								
King salmon	X	X	X	X	X	X	X	X
Red salmon	X	X	X	X	X	X	X	O
Silver salmon	X	X	X	X	X	X	X	X
Chum salmon	X	X	X	X	X	X	X	X
Pink salmon	X	X	X		X	X	X	O
6. Other fish								
Dolly Varden/Char	X	X	X	X	X	X	X	X
Rainbow/Steelhead	X		X	X	X	X	X	X
Lake Trout			X	X	X	X	X	?
Grayling			X	X	X	X	X	X
Whitefish			X	X	X	X	X	X
Pike			X	X	X	X	X	?
Burbot			X	X	X	X	?	?
Smelt			X	X	X	X	X	?

Table III-36
(Continued)
Partial List of Subsistence Resources
Used in the Bristol Bay Study Area

Subsistence Resource	Lower Alaska Peninsula	Chigniks	Upper Alaska Peninsula	Iliamna Lake	Nushagak River	Nushagak Bay	Togiak	Kuskokwim Bay
Halibut, sole, flounder	X	X	X			O	X	?
Herring (and their eggs)			X			X	X	X
Cod	X						X	?
Capelin							O	?
7. Berries, etc.								
Salmonberries	X	X	X	X	X	X	X	
Blueberries	X	X	X	X	X	X	X	X
Huckleberries			X	X	X	X	X	?
Crowberries	X	X	X	X	X	X	X	X
Cranberries	X	X	X	X	X	X	X	X
Strawberries	X	?						
Basketgrass	?	?	?			X	X	X
Firewood (spruce, birch, willow, poplar, alder, etc.)	X	X	X	X	X	X	X	X
Vegetables (wild celery, onions, potatoes, spinach, etc.)	X	X	X	X	X	X	X	X
Herbs	?	?	X	X	X	X	X	X

X = commonly used
O = occasionally used
? = uncertain
blank = use not documented

1/ Geese used include Canada, Brant, Emperor, White-front and Snow.
2/ Ducks used include Mallards, Pintails, Gadwall, Green-winged Teal, Shovelers, Wigeon, Scaup, Goldeneye, Bufflehead, Oldsquaw, Eiders and Scoters.
3/ Eggs of seabirds, gulls, terns, and waterfowl.
4/ Clams used include cockles, softshell, butter, razor, bidarkis, and emmas.
5/ Crabs used include king, tanner, dungeness, and horse.

Source: ADF&G, Subsistence Division, Extracted from Nebesky et al., 1983a, pp. III-39 and 40.

Table III-37

Estimated Average-Resident-Household Subsistence Harvests by Subregion, 1979-1981[1/]

Subregion	Total Households	Salmon/ Household	Total Salmon	Moose/ Household	Total Moose	Caribou/ Household	Total Caribou	Other Important Species
Togiak/ Kuskokwim	313	80	25,040	.10	32	.48	150	Seal, walrus, reindeer
Nushagak Bay and River	650	161	104,800	.31	200	.80	520	Beaver, fresh-water fish
Iliamna Lake	143	463	66,209	.40	57	1.70	243	Beaver, fresh-water fish
Upper Alaska Peninsula	445	69.5	30,919	.12	53	2.00	890	Waterfowl
Lower Alaska Peninsula	388	50	19,400	.02	8	2.00	776	Waterfowl, Crab, other salt-water fish
TOTAL	1,939	127	246,368	.18	350	1.33	2,579	

Source: Nebesky et al., 1983a, p. III-42.

1/ Estimates are based on data provided by the ADF&G Subsistence and Game Divisions, for all subregions except the Lower Alaska Peninsula, where estimates based on 1981 research by Langdon and Brelsford are used.

types of locations where harvests take place are shown on Figure III-32 for King Cove and Sand Point (such mapped data is not available for Nelson Lagoon and False Pass).

As with the communities previously discussed, a commonality in the types of subsistence resources available produces comparable types of subsistence resource use. Caribou and salmon (king, red, and silver) are the primary subsistence resources (Table III-38). Ducks and geese also are a highly prized food resource, and considerable expense and effort are devoted to this particular hunt. Other commonalities of the subsistence harvest include the use of intertidal organisms and vegetation, halibut and cod fishing, and gathering of greens and berries in season (Earl R. Combs, Inc., 1982). Fishermen from King Cove and Sand Point who convert to crab-fishing gear in the winter retain for personal use the crab caught too late to sell at the close of the commercial season (Fig. III-32) (USDOI, BLM, Kish Tu Addendum No. 3, 1981). Nelson Lagoon and False Pass residents also harvest crab. During the winter seals are hunted from the family vessel in King Cove, primarily by migrants from Belkofski (Earl R. Combs, Inc., 1982).

In terms of total pounds of protein harvested from local resources, caribou is the most important resource; salmon is the second most important resource. Caribou harvests are highest in False Pass (6 to 10 animals a year per household) and lowest in Nelson Lagoon (2 to 4 a year per household). Local harvesting of caribou has increased slightly in recent years due to better access with three-wheel Hondas. The subsistence-salmon harvest ranges from a low of 50 salmon per household per year in Sand Point to a high of 200; 150 to 200 per year in False Pass; 75 to 130 in Nelson Lagoon; and 50 to 150 per household per year in King Cove. Estimates of the total protein harvest from subsistence resources in the region ranges from 40 (Sand Point) to 60 (False Pass) percent (Earl R. Combs, Inc., 1982).

Although the pattern varies, salmon for subsistence purposes generally are taken with the same gear used for commercial fishing, or they may be taken from the commercial catch. In King Cove, king and red salmon are saved from the commercial catch, whereas silvers are caught locally for subsistence after the commercial fishing season (USDOI, BLM, Kish Tu Addendum No. 3, 1981). King salmon are retained from commercial nets on Sand Point vessels, with such vessels used after the commercial season to catch red and silver salmon with half-purse seines (USDOI, BLM, Kish Tu Addendum No. 3, 1981). In addition, several Sand Point and Nelson Lagoon residents set gillnets near the community in late summer after the commercial season (Earl R. Combs, Inc., 1982). In False Pass, subsistence salmon are obtained from two beach-seine sites and from the commercial drift-gillnet vessels (USDOI, BLM, Kish Tu Addendum No.1, 1981).

Caribou generally are hunted from early fall to spring, depending on local game unit regulations. In Sand Point, the main caribou hunt takes place in September in the bays along the coast of the mainland where small groups of men travel by boat. People from King Cove already on the mainland hunt caribou in the valleys north of the village, to the east of Cold Bay, or at the head of Pavlof bay (Earl R. Combs, Inc., 1982). In addition, caribou are hunted from boats within a 50-mile radius of the village (USDOI, BLM, Kish Tu Addendum No. 3, 1981). Residents of False Pass hunt caribou on the northern shore of Unimak Island from Swanson's Lagoon to Urilia Bay, and occasionally

Table III-38
Subsistence-Resource Utilization in the
Lower Alaska Peninsula Subregion

	Fish								Inter-tidal	Marine Mammals			Land Mammals		Birds			
	Salmon																	
	Red	King	Pink	Chum	Silver	Halibut	Shell-fish	Other Fish	Food	Seal	Sea Lion	Fur Seal	Caribou	Moose	Birds	Bird Eggs	Greens	Berries
Nelson Lagoon	(*)	(*)			(*)	*	*	*	*	*			(*)	*	*		*	*
False Pass	(*)	(*)			(*)	*	*	*	*	*			(*)		*		*	*
King Cove	(*)	(*)			(*)	*	*	*	*	(*)			(*)		*		*	*
Sand Point	(*)	(*)			(*)	*	*	*	*	*			(*)		*	*	*	*

Sources: Primary: USDOI, BLM, Kish Tu Addendum No. 3, 1981; Smythe, 1981. Other: Hayward et al., 1977; Bowden, 1981; Earl R. Combs, Inc., 1981; USDOI, BLM, Kish Tu Addendum No. 1, 1981.

(*) Denotes primary resource.

on the outskirts of False Pass (Earl R. Combs, Inc., 1982). Caribou hunting from Nelson Lagoon takes place on the Caribou-Sapsuck River drainages, which are reached primarily by skiff (Hayward et al., 1977).

The dependence on locally produced foodstuffs varies a great deal within these communities. Subsistence pursuits in Nelson Lagoon are somewhat lower than in King Cove and substantially lower than in False Pass. Recent prosperity in the salmon fishery has contributed to a general decline in the intensity of subsistence production. While the per capita-income figures from the fishery are extremely high, this income is not evenly distributed; some families continue to rely heavily upon subsistence resources. Beyond its strictly economic importance, the subsistence harvest also is culturally important. For many residents, harvesting and preparing local subsistence resources is a major form of continuity with their heritage and one that they resist giving up.

Future of the Environment without the Proposal: Cold Bay is not specifically addressed in this discussion since no change is expected in the limited subsistence harvest that takes place there. Trends in subsistence-resource-use patterns are based on population projections contained in Appendix C.

Unalaska: The centering of groundfish-industrial growth in Unalaska presents the most dramatic potential for effects on subsistence. Aleut subsistence had already changed considerably with the advent of crab processing in the community. A large increase in population over several decades and the solidification of a more family-oriented form of residency presents the potential to accentuate and intensify the urban orientation to subsistence (individualistic and nuclear-family oriented) that generally exists today in Unalaska. With the construction of facilities and the social infrastructure to accommodate the growth, there is the potential for the reduction of local habitat which supports existing local subsistence resources. An increased local subsistence demand by the larger population also could cause the need for increased harvest regulation, especially if resources are affected by other development activities. The combined effect of increased population pressures and reduced local resources could present the need for added income to provide the mobility to substitute resources from elsewhere, if available. For those residents unable or unwilling to gain access to opportunities provided by the rapid growth, the need for added income could result in unmet subsistence needs to the extent that added mobility would be required to procure subsistence resources. The result could mean an increased dependency on wage and other forms of income to purchase subsistence substitutes.

Bristol Bay Region: Local consumption needs for salmon, moose, and caribou were forecasted as part of the BBCMP, based on projected growth of households by community and an assumed constant level of demand per species at the household level. Such projections suggest several important points regarding future subsistence-resource use:

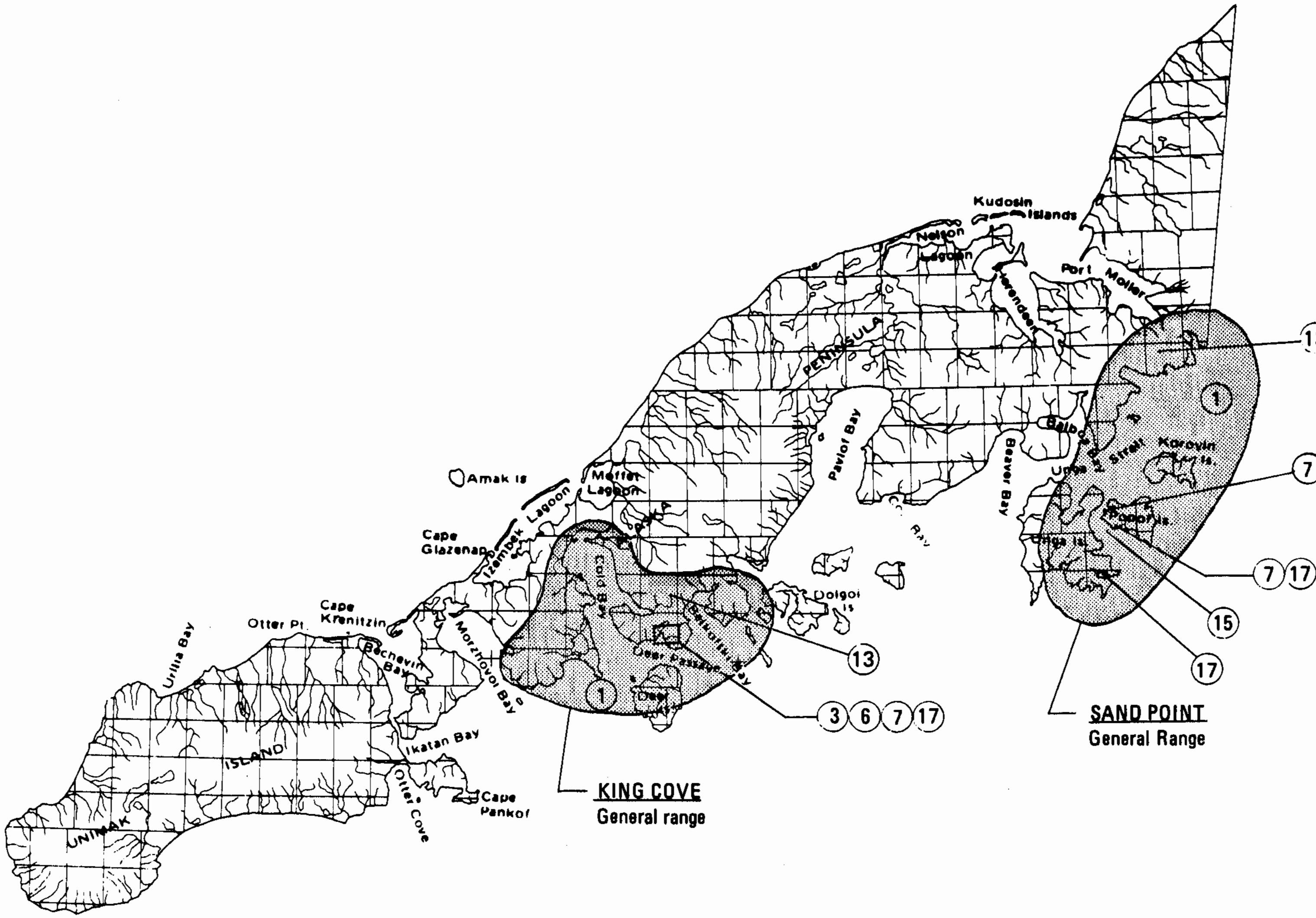
- In no subregion can the projected trends for average household-subsistence harvests of caribou or moose be sustained over the 20-year period of the forecast.

- In all subregions, salmon resources should be capable of sustaining significant growth in subsistence harvests.

FIGURE III–32

GENERALIZED LOCATIONS OF SUBSISTENCE CATCH FOR KING COVE AND SAND POINT

1 SALMON
2 HALIBUT
3 TROUT
4 SHRIMP
5 HAIR CRAB
6 CLAMS
7 INTERTIDAL FOOD
8 SEA MAMMALS
9 SEALS
10 FUR SEALS
11 SEA LIONS
12 HAIR SEALS
13 CARIBOU
14 BIRDS
15 BIRD EGGS
16 DUCKS, GEESE
17 BERRIES, GREENS



Source: Kish Tu Addendum No. 3, 1981.

- Significant growth in salmon-subsistence harvests, perhaps considerably in excess of base-case (1979-1981) levels, could likely take place due to declines in average household-harvest rates of caribou and moose.

- In addition to salmon, other subsistence resources presently being used less frequently could likely increase as a proportion of average household-subsistence harvests if the percentage of locally acquired protein per household and the subsistence ideology of household-production units are to be maintained.

Lower Alaska Peninsula Subregion: The patterns and characteristics of subsistence practices for Nelson Lagoon and False Pass should remain relatively unchanged during the foreseeable future. Sand Point and King Cove will be most affected by the fisheries-induced growth in the region. In the event that caribou harvests cannot be sustained over the forecast period (as forecasted by the BBCMP), the harvest of salmon and other subsistence resources probably would increase. In addition, economic growth could provide the cash needed for procurement of locally available subsistence resources; however, an improved economy also decreases the economic need for subsistence resources. Combined with an increasing population and the decreasing availability of caribou, subsistence harvests of salmon would increase above current levels in Sand Point and King Cove.

In summary, the increased pressure on locally available subsistence resources from the increased population and social-infrastructure growth at Unalaska could cause unmet subsistence needs and increased cash dependency within that segment of the population unable or unwilling to expend the funds to procure subsistence resources, if available, at greater distances from the community. For the community as a whole, however, participation in opportunities offered by the economic growth should provide the means for meeting subsistence needs, although perhaps with the expenditure of increasing amounts of income. In the Bristol Bay region, the required subsistence harvest of salmon could increase considerably beyond current levels due to a growing number of households in the region and a reduced ability to harvest moose and caribou. A greater reliance on less frequently used subsistence resources also could occur.

5. Sociocultural Systems: The topic of sociocultural systems deals with social, cultural, and political forms of human organization and the relationship among such factors at different levels of analysis. Socioeconomic organization, the dynamics of which interact with and strongly influence the behavior and change of sociocultural systems, is discussed in Section III.C.1 and 2. For the purposes of this discussion, community and regional levels of analysis are identified in the communities of Unalaska and Cold Bay, and in the Bristol Bay region and the lower Alaska Peninsula subregion.

Cold Bay: This discussion is based primarily on the ethnographic case study of Cold Bay (Impact Assessment, Inc., 1983a) conducted in 1982 for the Alaska OCS Office's Social and Economic Studies Program (SESP). This more recent information is used to augment the descriptions included in the St. George Basin (Sale 70) FEIS (USDOI, MMS, 1982); the Navarin Basin (Sale 83) FEIS (USDOI, MMS, 1983); and the St. George Basin (Sale 89) FEIS (USDOI, MMS, 1985).

Cold Bay exists as a means of performing specialized functions which are controlled by and serve the purposes of national, corporate, and regional interests. In a sense, it is a multicompany town composed primarily of transients who are brought there and housed on tours of duty to manage locally established facilities or services. People do not go to Cold Bay, as to other American towns, to find work; they have to be sent there if they expect to find housing or to be employed for any length of time. The social systems of Cold Bay are structured by the economic makeup of the community and, as a consequence, are quite different from those of other American towns.

The social organization in Cold Bay varies substantially from other communities in the region. There are no family units in Cold Bay beyond the nuclear family because of the relative newness of the community as well as the transient nature of the residents. In addition, single people form a disproportionate percentage of the people in town. These single males and other transient residents tend to have a cosmopolitan, outward-looking orientation. Due to the absence of extended families and a low percentage of nuclear families, strong friendship networks have replaced familial ties. Short-term residents have friendships based primarily on work relationships that are strengthened by housing patterns--houses leased in blocks to employees. Occupation and place of residency tend to exert less influence on social networks for long-term residents. Permanent residents form social networks based on the duration of their residency and are generally separate from other residents.

Although Cold Bay does not resemble a community in the sense of closely related individuals and families, the residents of Cold Bay are part of a larger social network that reflects the regional transportation/communication role of the town. People from surrounding communities regularly pass through Cold Bay on their way to Anchorage, Seattle, or other local communities. Residents of Cold Bay likewise travel to other communities in the region as part of their duties or for personal reasons, and they process information in regional terms--to the extent that the entire region can be considered a social network. This regional orientation provides a much richer and more dynamic perspective on the social systems of Cold Bay than could be perceived by examining the community out of its regional context.

Unlike other communities in the region, Cold Bay is almost entirely a Euro-American community; thus, the cultural values and belief systems of the Cold Bay residents vary considerably when compared to nearby villages. The cultural values of Cold Bay residents are comparable to the larger American society in which most residents were raised, although there is an increased emphasis placed on a desire to achieve success in accumulation of capital and material goods. Education and achievement are highly valued, as are individualism and pragmatism. There is no traditional subsistence culture or value placed on subsistence in the community's heritage.

Until incorporation in 1982, there was no formal political structure in Cold Bay; formal political power is now vested in the city council. Impact Assessment, Inc. (1983a), indicated that the State Department of Transportation maintains some degree of power within the community due to the state's possession of title to the majority of land in Cold Bay. There is no affiliation in Cold Bay with Native corporations on the local or regional level, since Cold Bay is not a traditional community and has few Alaskan Native residents.

The members of the city council are primarily long-term transients with a few permanent residents. A tendency toward local heads of companies serving on the city council was noted in the Cold Bay ethnography. Status in Cold Bay tends to be relatively ephemeral because of the transiency of the population and the tendency for the income scale to be compressed, thereby creating few social-class distinctions (Impact Assessment, Inc., 1983a).

Unalaska: This discussion is based primarily on the ethnographic case study of Unalaska conducted by Impact Assessment, Inc. (1983b), and sponsored by the Alaska OCS Region SESP. While the growth of Unalaska over the last decade has produced a diverse community, a majority of the total population are transient fishermen or laborers under contract to process seafood products. The resident community is predominantly non-Native, and most of the new residents are single or married couples below the age of 35. In the late 1970's, Aleuts comprised slightly more than 25 percent of the total population. It is estimated that this proportion declined to less than 10 percent of 1980's total population, with Asians representing the other significant minority group. (The 1980 census showed 15 percent of the population [200 persons] to be Alaskan Native, of which 92 percent [182] were Aleut.) Although it has not been considered an Aleut village for a number of years, Unalaska traditionally has been identified more closely with the Aleut community than has the Dutch Harbor area, where the seafood-processing industry is located and the bulk of the transients and newcomers have been housed. Interaction among the inhabitants of the City of Unalaska has improved since construction in 1979 of the bridge connecting these two parts of the community.

Social organization in Unalaska is characterized by several different social groups distinguished on the basis of length of residence, ethnicity, occupation, socioeconomic status, and religion. The clearest distinctions are between resident and transient, and between Aleut and non-Native. The resident and transient designations have been especially salient during the explosive growth of the seafood-processing industry in the last 10 years. This period also produced a differentiation between old and new residents, permanent and semipermanent residents, and long-term and short-term transient workers.

A second major distinction in the social organization of Unalaska is made between Aleut and non-Native residents. Although Aleuts are a minority numerically, their presence is prominent through the Ounalashka Corporation, which controls much of the local land base and serves as an important employer for local Aleuts. Many long-term, non-Native residents may resent such control of land which they generally perceive as control of the community's economic development. On the other hand, Aleut residents may perceive control over community affairs exercised within the non-Native community as a continuation of a long-term pattern of domination by others.

Traditionally, Aleut families were extended networks with ties to other communities in the region maintained through well-established patterns of intermarriage. The focus of the family now has shifted to the nuclear family, and the importance of the extended kinship network has begun to diminish. In conjunction with this shift in kinship patterns, less collective and more individualistic values, as well as a decrease in reciprocity and sharing of goods, have been observed.

Social interaction based on workplace relationships is most important among long-term transients, because of their increased involvement with work and decreased involvement in the community. Due to the formation of crews outside of Unalaska, social interaction among crew members is not of much importance in the community. Religious affiliation forms another basis for social interaction for residents who belong to one of the five denominations in Unalaska. The churches' partial takeover of the redistribution of goods and services to fellow members in time of need represents an institutionalization of the kinship-based collective. The churches also play an important role in the provision of social services, such as counseling and mutual aid. In addition, the churches have begun to play a political role by attempting to influence the direction of community development.

Although voluntary social organizations and community activities play a primary role in the patterning of social interaction, there are few occasions when interaction occurs on a community-wide basis. Such infrequent occasions include city-sponsored dances and dinners, basketball and softball leagues, and the annual Fourth of July and King Crab Festivals. There are only a few formal voluntary organizations, such as the Unalaska Volunteer Fire Department and Volunteer Emergency Medical Service. The Lions Club and the Chamber of Commerce are the only formal service clubs, although the Unalaska Aleut Development Corporation also performs social-service functions. The Alaska Native Women's statewide organization, which has 75 members in Unalaska, is another active voluntary organization.

The heterogeneity of Unalaska's population has created a diverse system of cultural values. The orientation and value systems of the different groups of residents in Unalaska vary according to the social group. According to Impact Assessment, Inc. (1983b), these value systems can be divided into three groups: "traditional, frontier, and modern." Some of these values are shared by each group. Associated with each of these value systems are different assessments of social status, different belief systems and world views, and different definitions of self and social identity. The "traditional" value system associated with the Aleut population also is possessed in varying degrees by the older, non-Native, permanent residents of Unalaska. Included in this value system are a rural orientation, a pattern of reciprocity based on kinship and locality, a respect for age and authority, an emphasis on self-reliance in work, a concern for the welfare of the community, and a preoccupation with subsistence activities. The "frontier" value system also is characterized by a rural orientation with an emphasis on individual initiative, acquisition, enterprise, and effort. There is a tendency for these values to be held by transient and semipermanent male residents. The environment is viewed as providing a wealth of resources to be exploited. The "modern" value system is that of the larger Anglo-American sociocultural system. An emphasis is placed on relationships based on contact rather than status, economic success, and occupational expertise. Education, income, occupation, and community involvement are determinants of social status. In addition to these defined value systems, the different ethnic groups (e.g., Filipino, Mexican, and Vietnamese) also maintain their own sets of cultural values. Within each social group there may be a variation in values, depending on such things as the age, sex, and education of the individual.

The sociopolitical system in Unalaska is dominated by the city government (incorporated as a first-class city in 1942) and the Ounalashka (village) Corporation, formed with the passage of the Alaska Native Claims Settlement

Act (ANCSA) in 1971. Although the corporation is not a political institution per se, it occasionally comes into conflict with the city over development issues. This conflict is a reflection of the increasing social differentiation brought on by the recent immigration of many non-Aleuts and the emergence of distinct social groups of permanent residents, semipermanent residents, and transients. There also are conflicts between the Aleut profit and nonprofit corporations because of differences in values, attitudes toward development, and opinions on how to best meet the needs of the Aleut community. Community development is the primary political concern in Unalaska; conflicts generally are centered on priorities, costs and benefits of development, and ordinances regulating construction activity. Another political force outside the municipal government and the Native corporation is the Unalaska Christian Fellowship, which formed Citizens for Responsive Government--a watchdog committee. The seafood processors currently hold no political power, but this situation is likely to change out of economic necessity. The Alaska Native Women's Organization also is becoming a focus of political power.

Bristol Bay Region: The boundary of the Bristol Bay region used here approximates that used in the Bristol Bay Cooperative Management Plan (BBCMP), with the exception that Cape Newenham serves as the northwesterly boundary (as is the practice with the Bristol Bay Native Association region); and the five communities comprising the Chignik area on the southern side of the Alaska Peninsula are not included (Nebesky et al., 1983a). The resulting region incorporates all other communities that make up the Bristol Bay Native Association (including Port Heiden along the Alaska Peninsula), as well as those communities located on the lower Alaska Peninsula that are part of the Aleutian Pribilof Islands (Association) region. So constituted, the Bristol Bay region is divided into five subregions for comparative purposes, as shown in Figure III-33. The settlement pattern of the region consists of 30 permanent communities, with Dillingham being the largest.

Table III-39 shows the distribution of civilian population among the subregions over the last several decades, with Dillingham shown separately. Between 1960 and 1980, the population of Dillingham changed the most--increasing from 424 in 1960 to 1,563 in 1980, an increase of 269 percent. The Togiak (Togiak, Twin Hills, and Manokatak) and lower Alaska Peninsula (False Pass, Cold Bay, Nelson Lagoon, King Cove, and Sand Point) subregions demonstrated the next-largest amount of growth over the same 20-year period. In contrast, the communities of the Nushagak, Iliamna, and upper Alaska Peninsula subregions experienced little or only marginal population change. In terms of ethnicity, the communities of the region are predominantly Alaskan Native, with the exception of Iliamna, Cold Bay, and King Salmon.

Several major national and state policy decisions, combined with the myriad of social betterment programs to modernize rural living (public housing, telecommunications, secondary and postsecondary education, health-services delivery, etc.), have strongly influenced change in the Bristol Bay region over the last several decades and should continue to do so in the next 20 years or more. Statehood, the Alaska Native Claims Settlement Act, and the Alaska National Interest Lands Conservation Act (ANILCA) divided Bristol Bay, and the rest of the state, into different land-ownership patterns; created for-profit village and regional Native corporations; and provided a means (in ANILCA) for addressing village-subsistence needs.

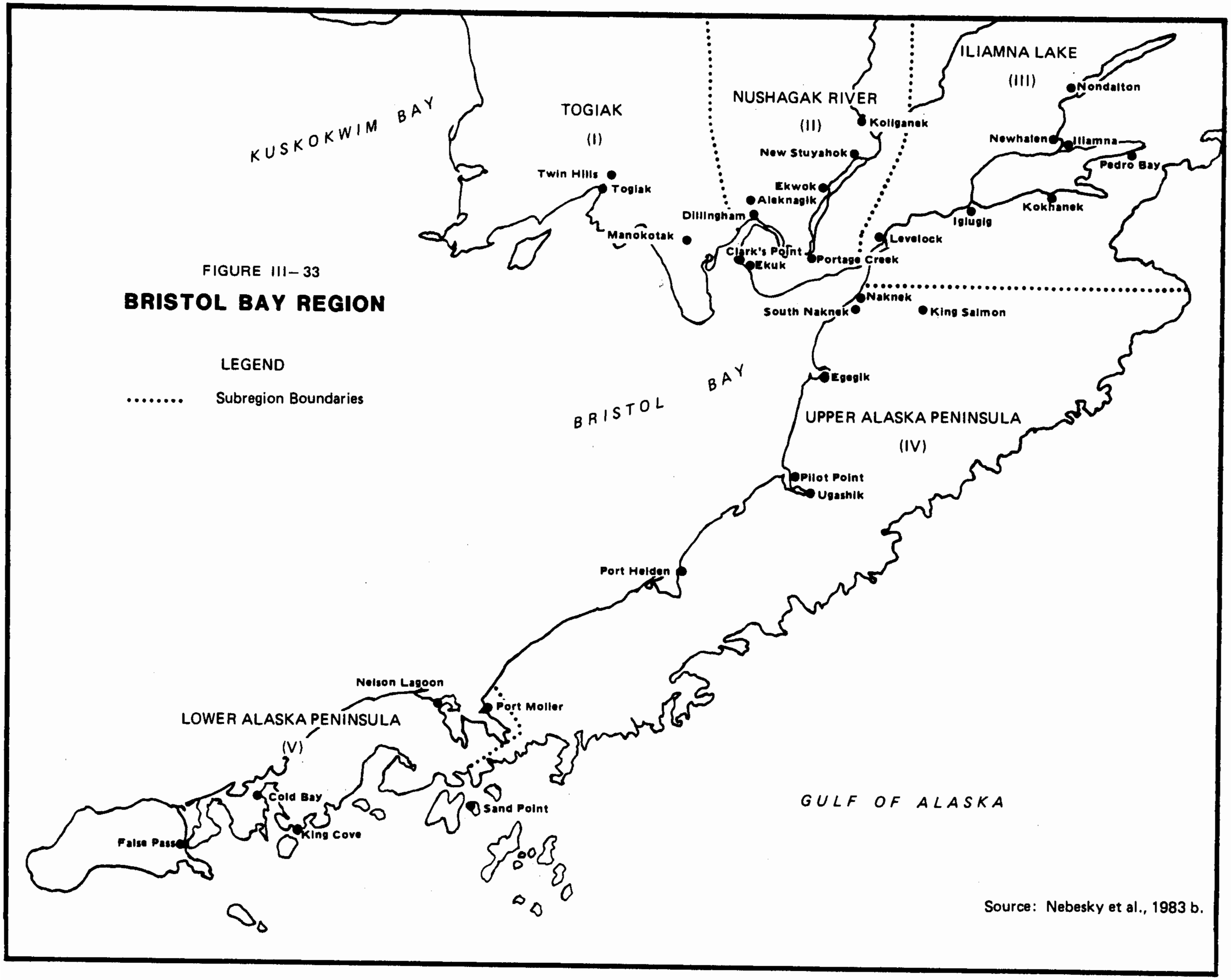


FIGURE III–33
BRISTOL BAY REGION
LEGEND
Subregion Boundaries
KUSKOKWIM BAY
TOGIAK
(I)
NUSHAGAK RIVER
(II)
ILIAMNA LAKE
(III)
UPPER ALASKA PENINSULA
(IV)
LOWER ALASKA PENINSULA
(V)
BRISTOL BAY
GULF OF ALASKA
Twin Hills
Togiak
Manokotak
Dillingham
Aleknagik
Ekwok
New Stuyahok
Koliganek
Clark's Point
Ekuk
Portage Creek
Levelock
Nondalton
Newhalen
Iliamna
Pedro Bay
Kokhanek
Igiugig
Naknek
South Naknek
King Salmon
Egegik
Pilot Point
Ugashik
Port Heiden
Nelson Lagoon
Port Moller
Cold Bay
King Cove
Sand Point
False Pass
Source: Nebesky et al., 1983 b.

Table III-39
Distribution of Civilian Population in the Bristol Bay Subregions between the Years 1960-1980

Subregion	1960	1970	1980	Change: 1960-1980 Amount	Change: 1960-1980 Percent
Togiak	369	664	834	465	126.0
Nushagak	760	735	813	53	7.0
(Dillingham)	424	914	1,563	1,139	268.6
Iliamna	513	592	582	69	13.5
Upper Alaska Peninsula	939	816	879	-60	-6.8
Lower Alaska Peninsula	671	1,004	1,442	771	114.9
Total	3,676	4,725	6,113	2,437	66.3

Percentage of Regional Civilian Population by Subregion (1960-1980)

Subregion	1960	1970	1980
Togiak	10.0	14.1	13.6
Nushagak	20.7	15.6	13.3
(Dillingham)	11.5	19.3	25.6
Iliamna	14.0	12.5	9.5
Upper Alaska Peninsula	25.5	17.3	14.4
Lower Alaska Peninsula	18.3	21.2	23.6
Total	100.0	100.0	100.0

Source: University of Alaska, ISER, 1984.

In addition to administering federal social welfare programs, state influence in the Bristol Bay region has been strongest in the areas of fishing, secondary education, and satellite communications. The Limited Entry Act of 1973 placed a ceiling on the number of units of purse-seine, drift-gillnet, and set-gillnet gear that could be operated in the region to commercially harvest salmon. This privileged-access system to regional salmon resources is such that additional entrants in the future will be primarily crewmen on vessels of permit holders--not vessel operators--unless new fisheries are developed or existing permits are purchased or inherited.

In other fields, village-centered secondary education is provided due to the settlement of the Molly Hootch lawsuit. Satellite telecommunication facilities not only serve the education establishment but also bring telephone and television communication into virtually all homes in the region. These factors have been the primary direct causal agents for change in the region for at least the last decade. What follows is extracted from the BBCMP description of social, cultural, and political patterns in the region (Nebesky et al., 1983a).

Kinship relationships have been of great importance to the organization of work, leisure, household formation, and ritual activity for a majority of the residents of the region. Over the last 20 years, the extended family has tended to give way to a nuclear-family orientation, encouraged in part by an increase in the available housing stock. Patterns such as this have been more pronounced in the larger, ethnically mixed, and more economically prosperous communities (such as Dillingham, Naknek, Iliamna, Sand Point, and King Cove) than in the smaller, predominantly Alaskan Native communities. Social and economic stratification, encouraged by limited entry, modernization, and land claims, is also most evident in the larger communities, which offer more access to individual economic opportunities and which function as havens for those unable or unwilling to maintain individual or social well-being at the smaller-village level. Subsistence-production and -distribution patterns continue to operate generally along kinship lines, regardless of place of residence. Where such support networks have broken down (generally in the larger communities), voluntary associations have tended to fill the void.

Cultural values and orientations rooted in such small-group practices as consensual decisionmaking remain, especially in the smaller villages. Ethnic identification among Alaskan Natives was formally recognized by Congress with the passage of ANCSA, but Native-language usage is not uniform in the region. Villages in the Togiak subregion and the Nushagak River villages/subregion appear to value continued use of the Yupik language and to seek to incorporate it into as many aspects of life as possible. Aleut- and Aleutiq-speaking communities, and residents of the upper and lower Alaska Peninsula subregions, display much less present Native-language use; and most have not sought to buttress its use through bilingual school programs or other mechanisms. The ideology of subsistence and commercial fishing as a means of livelihood are important values throughout the region. Residents of the region wish to retain such traditional practices and are likely to show unified opposition to any activities that threaten these practices.

As in most of rural Alaska over the last decade or so, there has been considerable growth in the formation of political institutions due to state and federal initiatives. In turn, these institutions have spawned exaggerated needs for political involvement, leadership, and decisionmaking capacities, as well as opportunities for political factionalism, at the community and subregional levels. Examples of formal institutions that were recently created include ANCSA village and regional for-profit corporations, city corporations, nonprofit and tribal associations, REAA school boards, and CRSA planning boards. There is considerable variability in the region regarding the extent of involvement in formal and informal institutional proceedings. The larger communities have tended to remain more involved than the smaller villages, because they have more well-defined objectives and the formal means for processing institutional information.

Lower Alaska Peninsula Subregion: The communities covered in this discussion are Sand Point, King Cove, False Pass, and Nelson Lagoon. Cold Bay, also in this subregion, was considered in the initial part of this section. The following discussion is based primarily on research sponsored by the Alaska OCS Office's Social and Economic Studies Program (Earl R. Combs, Inc., 1982), and on earlier descriptions contained in the St. George Basin (Sale 70) FEIS (USDOI, MMS, 1983).

The character of the lower Alaska Peninsula subregion is based on the traditional Aleut culture, blended with early historic Russian influence and the turn-of-the-century Scandinavian influence on the cod industry (Jones, 1973; Earl R. Combs, Inc., 1982). The region is predominantly Aleut. Sand Point has the lowest percentage of Natives (57% [1980 Census]), while King Cove, Nelson Lagoon, and False Pass range from about 80 to 92 percent Natives, with the percentage varying according to the season because of a high number of seasonal cannery workers (Earl R. Combs, Inc., 1982).

With the exception of Cold Bay, the social organization in the lower Alaska Peninsula subregion is centered primarily around kinship. These kin relationships are an important integrating institution in the economic, social, and recreational spheres of life. Of particular importance is the role kinship plays in the organization of subsistence activities. For example, crew members on gillnet vessels are drawn from the nuclear family as well as from extended kin ties; captains of vessels who are brothers generally fish together and work on their gear together; and berry picking is commonly done as a family unit. Other activities such as visiting, churchgoing, and child care are often done with family members. Local Aleut-owned stores in King Cove are primarily family businesses. A tendency exists in False Pass and Nelson Lagoon toward brothers of one family marrying sisters of another family, a pattern which will force all of the next generation in Nelson Lagoon to look outside the village for marriage partners. Kinship did not seem to be a factor in political mobilization in King Cove or Sand Point, where occupation and length of residence were more important in political elections. In Nelson Lagoon, however, the village council and the village-corporation board are composed of leading members of the three lineages in Nelson Lagoon. In addition to kin relationships, friendships and voluntary organizations (in the larger communities of Sand Point and King Cove) are important to the interaction of community members (Earl R. Combs, Inc., 1982).

The core values of all these communities are fishing as a livelihood, responsibility to families and close kinsmen, local determination, and subsistence. Other values, such as those placed on the length of residence, education, self-sufficiency, and local control exist in some of the communities. For example, Belkofski residents who have recently immigrated to King Cove hold a lower status than other King Cove residents. Nelson Lagoon and Sand Point residents place a higher value on education than do residents in other parts of the region, probably due to the influence of Scandinavian men who married into these communities. Between 50 and 66 percent of Sand Point students continue to postsecondary education, a rate much higher than in other rural Alaskan communities. Self-sufficiency is strong in King Cove, as evidenced by their tendency to avoid grants and their ability to tax canneries in the face of strong opposition. In Sand Point, there is a general fear that the balance of power will shift from locals to newcomers (Earl R. Combs, Inc., 1982). No other villages except King Cove demonstrated the sense of egalitarianism noted by Jones (1976). As indicated by Earl R. Combs, Inc. (1982), religion is an important secondary activity today which neither integrates nor factionalizes residents at the community level. The Russian Orthodox church continues to be the strongest religion in the area, although there is a trend toward non-Orthodox Christian sects in Sand Point and King Cove and toward secularization in Nelson Lagoon (Earl R. Combs, Inc., 1982).

King Cove incorporated as a first-class city in 1947, whereas Sand Point changed to first-class status in 1978. Incorporation as first-class cities has given them local control of the school and health-care facilities, as well as zoning and planning powers. Nelson Lagoon and False Pass are unincorporated villages; however, Nelson Lagoon has a highly organized, sophisticated, and integrated political system. A five-member village council formed in 1971 with the passage of ANCSA has maintained the same five members since 1971. The council members also are on the village corporation board, forming a strong, unified front in the community. In contrast, False Pass has had little interest in the village council, which meets only as needed. The False Pass Village Corporation has potential as a quasi-political institution, but there is little interest and consequently little power. Native-village corporations in Sand Point and King Cove maintain some political power due to their possession of land.

All communities in the region are members of the Aleutian/Pribilof Islands Association (APIA), and most Aleuts are shareholders in the Aleut (regional) Corporation. The APIA has had a more direct effect than the Aleut Corporation on the lives of residents--through housing construction, job training, education programs, cultural activities, elder conferences, and cultural heritage programs. On the regional level, all of the communities also have some involvement with the Peninsula Marketing Association (formed by commercial fishermen); however, the majority of the association board are Sand Point residents (four board members from Sand Point, one from King Cove, and two from Nelson Lagoon). The Coastal Zone Management regional unit has not been in existence long enough to determine much about its political role in the region (Earl R. Combs, Inc., 1982).

<u>Future of the Environment Without the Proposal</u>: The growth of the groundfish-processing industry in the southern Bering Sea is expected to be a driving force for social change centered in Unalaska. Elsewhere, the area potentially subject to effects from the lease sale is anticipated to undergo much less dramatic change. This discussion focuses on Cold Bay, Unalaska, the Bristol Bay region, and the lower Alaska Peninsula subregion as the basis for subsequently assessing the potential effects of the lease sale.

Cold Bay: Cold Bay is expected to lose population through the mid-1990's, and then to experience a rebound to early 1980 levels of population by the late 1990's. Table III-40 and Appendix C, Table C-2, indicate projected population levels in Cold Bay between the years 1985 and 2010.

Since the basis for these population dynamics is founded in the contraction and expansion of existing types of economic activity, the social characteristics, values, and orientations of the community should be little changed from the present time, with the possible exception of a reduction in single individuals as a proportion of total population. This facet of the community could be encouraged by the newly formed city government working with the state to release more land for residential development. It is unclear, however, whether such an action alone would automatically produce the desired social effect or whether other factors about the community, such as its isolation and harsh weather, would tend to discourage much proportionate change from the present condition. If present local staffing practices are continued within existing economic activities, however, it is likely that existing social patterns likewise would prevail, perpetuating the nonkinship orientation of social relationships and the outward-looking orientation of a transient population.

Unalaska: Unalaska is expected to remain and prosper as a major center for fisheries-oriented development in the Bering Sea. As a result, the community is anticipated to show the effects of a boomtown, with population approximately tripling by 2000 and leveling off generally beyond that. A transient component of the population is expected to continue as a community characteristic, resulting predominantly from fisheries but beginning to become apparent from OCS-related activities as well. Projected population levels are indicated in Table III-41 and in Appendix C, Table C-1.

During this growth experience, the institutions of public decisionmaking and civil governance can be expected to be taxed to new levels of endurance in determining and accommodating policies of growth management and in mediating the social effects of a boomtown. Existing sociocultural systems, in terms of leadership patterns, perceived vestments of authority, traditional methods of social control, and the like, could be further stressed if competing philosophies of growth were submitted as alternatives to open accommodation. New leadership and orientations to community life could result from the boom in the long term, as newcomers (numerically in the majority) divest the community of former leadership figures and their points of view.

As a group, the Aleut population of Unalaska is anticipated to play a major role as landowner in the projected growth--through holdings of the Ounalashka Corporation. Effects on this segment of the total population, already stressed from growth in the recent past, could be intensified for those unable or unwilling to participate in the economic opportunities of growth. Increased costs, reduced access to subsistence resources, and increased social discontinuity from the boomtown economy could further displace such people throughout the community, regardless of racial origin, and could place greater burdens on family members, church, and other social institutions. On the other hand, for those willing and able to grasp economic opportunities (such as through the institution of the village corporation), the boom conditions could provide heightened avenues for successful accomplishment unavailable locally in the past.

Table III-40
Projected Population Levels in Cold Bay Between
the Years 1985 and 2010

Year	Resident Population	Enclave Population
1985	186	76
1990	159	16
1995	156	10
2000	211	0
2005	210	0
2010	209	0

Source: Nebesky et al., 1983.

Table III-41
Projected Population Levels in Unalaska
Between the Years 1985 and 2010

Year	Resident Population	Enclave Population	Proportion Alaskan Native (Percent)
1985	756	322	30.2
1990	975	711	26.2
1995	1,427	1,555	19.7
2000	2,235	1,776	13.9
2005	2,224	1,776	15.3
2010	2,220	1,776	16.9

Source: Nebesky et al., 1983.

The degree to which the social organization may change will be influenced by the level of population and economic growth. The structure of social relations, based on length of residence, is expected to remain constant; however, the proportions of each group will change with an increase in the number of semipermanent residents, long-term transients, and nonresident transients (transient workers from outside Alaska). Traditional social networks based on length of residence or ethnicity may be cross-cut somewhat as income and occupation become more important in defining social class. Increased tensions between ethnic groups also might be expected, particularly with respect to competition for jobs. As the population grows, it will become more heterogenous with respect to social class and ethnic-group membership. Friendship and neighborhood are expected to continue as bases for forming social networks, while kinship ties most likely will continue the trend toward smaller, nuclear families and away from large, extended-family networks.

The anticipated increase in the social heterogeneity of the Unalaska population is expected to bring about a more heterogenous value system, most likely a synthesis of the "frontier" and "modern" values. Traditional Aleut-based values may decrease as the influence of the larger sociocultural system increases and the proportion of Aleuts decreases. This change in values is expected to manifest itself in the form of generational conflict, stress, and alcohol abuse. As the value system shifts, so will the ways of attaining social status. Occupation, wealth, and consumption of goods will play a stronger role in social status, with length of residence decreasing in importance.

Bristol Bay Region: Table III-42, prepared for the draft BBCMP, shows projections for the civilian population in the Bristol Bay region for approximately 20 years. In comparison with the growth experience of the decades 1960 through 1980 (Table III-39), the Togiak and lower Alaska Peninsula subregions and the community of Dillingham are expected to accommodate about the same numerical amount of growth. While growing, Dillingham and the respective subregions are expected to maintain the approximate proportion of regional population that was established in 1980. No subregion is anticipated to lose population in the aggregate, although this net effect may mask advances and declines of population among communities in the subregions.

The larger, ethnically mixed, and more prosperous communities should be more reflective of social, cultural, and political change in the region than should the smaller, predominantly Alaskan Native communities, where persistence of tradition is highly valued. The continuation of the trend toward smaller households and a greater degree of nuclear-family orientation should be most evident within the more diverse communities. The same trends also should contribute to social and economic stratification, which is partially the result of limited entry at the smaller-village level. The reduction of access to a fishing livelihood, in the context of heightened expectations resulting from increased education and communication, should be the major source of social disruption in the region. Spatial stratification also could result from income stratification, where the more mobile residents of the more prosperous and larger communities could be in direct competition for subsistence resources in the vicinity of the smaller villages.

Over the next 20 years, factionalism in political functioning is expected to increase in all communities of the region. Divergent goals and objectives for local, subregional, and regional development; increasing income and wealth

Table III-42

Projected Civilian Population Levels in the Bristol Bay Region (1982-2002)

Subregion	1982	1992	2002	Change: 1982-2002 Amount	Percent
Togiak	869	1,068	1,314	445	51.2
Nushagak	839	972	1,129	290	34.6
(Dillingham)	1,641	2,090	2,662	1,021	62.2
Iliamna	597	672	763	166	27.8
Upper Alaska Peninsula	906	1,047	1,224	318	35.1
Lower Alaska Peninsula	1,504	1,858	2,300	796	52.9
Total	6,356	7,707	9,392	3,036	47.8

Percentage of Regional Civilian Population by Subregion (1982-2002)

Subregion	1982	1992	2002
Togiak	13.7	13.9	14.0
Nushagak	13.2	12.6	12.0
(Dillingham)	25.8	27.1	28.3
Iliamna	9.4	8.7	8.1
Upper Alaska Peninsula	14.3	13.6	13.0
Lower Alaska Peninsula	23.7	24.1	24.5
Total	100.1	100.0	99.9

Source: University of Alaska, ISER, 1984.

differences; and values associated with language and religion should be significant contributors to faction formation. Political involvement will be increasingly required of communities, as part of the ongoing affairs of largely existing institutions. This factor serves not only as a stimulus for factionalism but also as the means for achieving community objectives, the lack of which are a likely stimulus for heightened factionalism and non-achievement. Large communities should be better able to perform satisfactorily in such an environment. Communities with little leadership or fluctuating leadership due to factionalism should be less capable of influencing local, subregional, and regional affairs. In these communities, it is expected that ethnic identification should heighten over the next 20 years. At the same time, the values and orientations associated with the subsistence ideology and fishing as a means of livelihood should persist throughout the region and result in some cases of unmet expectations or increased competition for resources.

Lower Alaska Peninsula Subregion: The effects of fisheries-induced growth on sociocultural systems in the lower Alaska Peninsula subregion are expected to be localized in King Cove and Sand Point. These effects are expected to contribute to higher diversification of existing maritime functions, projected at a rate capable of being gradually absorbed by the communities (see Table III-39). Social organization is expected to continue to be based primarily on kinship, with increases in voluntary organizations as population growth occurs. Nelson Lagoon residents will have to seek marriage partners outside of the community as a result of intermarrying, causing in- or outmigration. Typically, the pattern in rural Alaska has been for women to leave in search of marriage and for men to stay. There also may be some degree of social stratification with an increase in population in King Cove and Sand Point. More division between "newcomers" and "old-timers" can be expected. The political systems in all communities except False Pass appear to be sufficiently well organized to handle any growth and development. Core values will most likely remain unchanged. There may be a decrease in the value of fishing as a livelihood in Sand Point, due to the trend toward more participation in secondary education. The trend toward secularization in Nelson Lagoon will increase as the older, more religious generation decreases in relative size. The trend toward the increase of non-Orthodox Christian sects is likely to continue in Sand Point and King Cove, as the population of outsiders increases.

Summary: Fisheries-oriented industrial development is expected to introduce boomtown growth conditions in Unalaska through the year 2000, causing governance mechanisms to be considerably stressed; the Aleut residents to become more of a minority in the community; and traditional forms of social control used by long-term residents to be eroded more than in the past. As a result of the continuation of current population and employment patterns, the sociocultural systems of Cold Bay are expected to be little changed, despite a considerably long period of population loss and rebuilding. In the Bristol Bay region, social disruptions are expected to be magnified in the next several decades as a result of the inability of residents to satisfy their individual expectations and social obligations. Set in an objective context, these processes (such as limited entry)--originally initiated to increase social welfare--are expected to actually diminish the residents' means to do so.

D. Other Issues:

1. Water Quality: Water quality is based on numerous factors (including currents, freshwater inputs, nature and number of discharges, outfalls, and human activities) characteristically found in municipal and industrial waste discharges, runoff, oil spillage, dredging, etc. In the past, water quality has been defined as the degree to which chemical concentrations and physical parameters within a water mass approach the ambient state. Offshore-water quality within the Bering Sea is primarily pristine in nature, with some water-quality degradation occurring as a result of effluent discharges by offshore enterprises and marine-transportation sources. Coastal or onshore water quality varies and is primarily determined by river and stream outflows, tidal flushing, and point/nonpoint-source discharges into the Bering Sea.

Shaw and Smith (1981) examined organisms from various trophic levels in the Bering Sea and found no evidence of petroleum contamination. They concluded that hydrocarbons in the pelagic zone were biogenic. Cline (1981) also concluded from his investigation on low-molecular-weight hydrocarbons in Bristol Bay that hydrocarbons in this area were biogenic. He further showed that the lower-molecular-weight hydrocarbons originated in several areas within Bristol Bay. Methane distributions indicated that the Nushagak and Kvichak Rivers, the Port Moller Lagoon, and bottom sediments in St. George Basin were sources of methane. Within the St. George Basin, methane probably is produced by microbial action at the sediment-water interface.

Venkatesan et al. (1981) investigated hydrocarbon levels in the sediments of the eastern Bering Sea and agreed with Cline's findings on hydrocarbons within Bristol Bay. Their studies further indicated that the lagoons in this area are not a major source of hydrocarbons to the sediments. Robertson and Abel (1979) measured heavy-metal levels in the water and sediments (Table III-43), as well as in the biota. As in the other Alaskan shelf areas, they found that metal concentrations in the Bering Sea are variable but typical of those in midlatitude regions. Concentrations in the Bering Sea sediments are lower than those in the Gulf of Alaska.

Bristol Bay encompasses most of the North Aleutian Basin Planning Area and includes the drainages of the Nushagak and Kvichak Rivers and several small streams that enter the bay. The average rate of runoff for the area is approximately 3 cubic feet per second per square mile ($ft^3/sec/mi^2$), with the average peak runoff measuring about 20 $ft^3/sec/mi^2$. Dissolved solid concentrations in streams in the area are low, ranging from 25 to 75 milligrams/liter (mg/L). These ranges are higher during the winter, ranging from 80 to 100 mg/L. Iron content is generally low and water requires little, if any, treatment for general-use purposes. Suspended-sediment concentrations are estimated to range from 500 to 2,000 mg/L during the summer season in streams along the eastern boundary of the area. Streams draining from lakes within the area are estimated to carry less than 500 mg/L of suspended sediments (USDOI, USGS, Report No. 76-513, 1976). Nushagak Bay is a very-high-energy system due to extreme tidal fluctuations and the resultant high current velocities. The effect of turbulent wave activity eroding the surrounding bluffs composed of glacial till, combined with sediment sources of a lesser nature from the Nushagak River, has caused extreme sediment-laden conditions and turbidity of the estuarine waters (Everets, 1976).

Table III-43

Range of Trace-Metal Concentrations in the Water Column and Sediments of the Southeastern Bering Sea

	Suspended Particulates (ng/L)	Sediments (ppm)	Water (mg/L)
Arsenic	6.3-24	0.7-7.2	-
Barium	0.77-1.9 ppb	200-1070	-
Cobalt	1.06-14.6	7-14	0.015-0.57
Cesium	0.13-1.9	-	0.232-0.301
Iron	4.3-38.1 ppb	2.06-3.55(%)	4.78-35.9
Mercury	1.3-6.9	-	-
Rubidium	10-90	-	92-122
Antimony	0.42-2.0	0.46-0.96	0.248-0.236
Scandium	0.73-13.2	8-15	-
Selenium	0.58-2.5	-	-
Strdontium	90-670	-	-
Manganese	0.04-2.80 ppb	358-720	-
Aluminum	6.32-114 ppb	5.10-7.94(%)	-
Vanadium	0.007-0.085 ppb	77-126	-
Calcium	-	1.93-4.63(%)	-
Chromium	-	38-107	-
Uranium	-	-	-
Zinc	-	-	-
Silver	-	-	-
Bromine	-	-	-
Potassium	-	-	-
Sodium	-	-	-

Source: Robertson and Abel, 1979.

mg/L = milligrams per liter
ng/L = nanograms per liter
ppb = parts per billion
ppm = parts per million

During the salmon-canning season, large amounts of fish wastes from canneries are commonly discharged into the estuarine and marine environment. These wastes are composed of blood, viscera, heads, and tails. The largest concentration of salmon canneries in Bristol Bay is located on the Naknek estuary. These canneries process most of the Bristol Bay sockeye salmon catch. The canneries within this area use two methods of waste disposal. One method employs the grinding of salmon heads and offal into small pieces (one-half inch in diameter) prior to discharge, and the other involves direct discharge of the waste without grinding or other treatment. In both cases, the wastes are released directly into the Naknek estuary, with the point of release generally being below the cannery dock at between 13 to 16 feet above mean sea level. Wastes released under the docks were shown to accumulate in large piles during low tide, but they were swept away on the incoming/outgoing tides. Dissolved-oxygen (DO) content was one of the chemical factors affected by the release of offal products from the processing plants. Measured DO levels fell below 7 mg/L at low tide near the operating canneries. This depression was minor in nature and of a short duration, with replenishment of saturated water taking place on the incoming tide (Malick et al., 1971).

The discharge of sewage and domestic wastes is handled in a variety of ways by the use of cesspools, septic tanks, and leach fields, or by direct discharge into the surrounding rivers, streams, and bays. Samples taken in Nushagak Bay in 1983 by the Army Corps of Engineers showed contaminant levels to be relatively low; however, certain organic pollutants were shown to be high. These pollutants were assumed to be transported tidally into the harbor and to have a sewage outfall as their source (USDOD, Army Corps of Engineers, 1983).

2. Air Quality: Existing air quality in the lease sale area has not been defined by monitoring. There are only scattered and relatively small emission sources on the Pribilof Islands, the Alaska Peninsula, and the Aleutian Islands--the closest land areas to the lease area. Any emissions currently occurring within the lease area are released from vessels.

Because of the relatively low population and the limited emission, EPA (1978) has judged that the air quality nearest the lease sale area (Bristol Bay and Aleutian Islands Election Districts) meets national Primary Air Quality Standards. In addition, the state Air Quality Control Plan (State of Alaska, 1980) also specifies that the Southcentral Alaska Air Quality Control Region (including the lease area) must comply with state and national Ambient Air Quality Standards. The Alaska Air Quality Standards (Table III-44) are at least as stringent as the national standards.

The Prevention-of-Significant-Deterioration provisions of the Clean Air Act require that areas with air quality better than the national standards not be significantly degraded; such areas are designated Class I or Class II. The Class I designation applies only to St. Matthew Island, Simeonoff Island, and Tuxedni Island, which are National Wildlife Refuges, and Mount McKinley National Park. Other high-air-quality areas are designated Class II--the entire area affected by this lease sale is Class II. The allowable incremental amount of air-pollutant concentrations above background levels for Class I and Class II is given in Table III-44. The MMS regulates emissions from facilities used in exploration and development and production activities (i.e., drillships and platforms) under 30 CFR 250.57.

Table III-44
State of Alaska Ambient-Air-Quality Standards
Measured in Micrograms/Cubic Meter (ug/m³)

Criteria Pollutant	Averaging Time				
	Annual	24-hour1/	8-hour1/	3-hour1/	1-hour1/
Total Suspended Particulates	602/	150	--	--	--
Class II3/	192/	37	--	--	--
Class I3/	52/	10	--	--	--
Carbon Monoxide	--	--	10,000	--	40,000
Ozone	--	--	--	--	235
Nitrogen Dioxide	1004/	--	--	--	--
Lead	1.55/	--	--	--	--
Sulfur Oxide6/	804/	365	--	1300	--
Class II3/	204/	91	--	512	--
Class I3/	24/	5	--	25	--

Sources: 78 AAC 50.020; Alaska Dept. of Environmental Conservation, 1980; 40 CFR 52.21 (43 FR 26388).

-- = No standard for exposure interval indicated.
1/ = Not to be exceeded more than once each year.
2/ = Annual geometric mean.
3/ = The standards for Class I and Class II areas refer to the EPA Prevention of Significant Deterioration Program. The standards express maximum allowable increments in air quality attributable to proposed emission sources above baseline (existing) air-quality conditions.
4/ = Annual arithmetic mean.
5/ = Quarterly arithmetic mean instead of annual.
6/ = Measured as sulfur dioxide.

3. Cultural Resources: Cultural resources in the proposed North Aleutian Basin lease sale area and adjacent lands are mainly prehistoric sites, historic sites, and shipwrecks. These resources comprise the remains of the material culture of past generations of Native people. They are also basic to, and have implications for, the nonmaterial culture expressed as beliefs, art, customs, property systems, and other social aspects of the culture. The three categories of cultural resources in the North Aleutian Basin area are offshore, onshore, and shipwrecks.

In the proposed lease sale area, offshore blocks generally have a low probability of human habitation (Dixon et al., 1976). Areas within the proposed lease sale area that have some potential of human habitation are discussed in Appendix J. Because of insufficient information, a determination of the habitability and survivability of prehistoric sites in some blocks of the lease sale area is not possible at this time.

Onshore areas have a much greater potential for cultural resources than offshore areas (refer to the Sale 70 FEIS, Graphic 4, USDOI, MMS, 1983). Prehistoric peoples occupied the northern and southern coastal areas of the Alaska Peninsula. In Appendix J, onshore historic sites are labeled by the quadrant in which they are located. The number of sites in each quadrant is an indication of: (1) the amount of interest shown in the cultural resources of the area near the outer continental shelf and (2) the likelihood of cultural resources in the quadrant. Recent environmental assessment by the Corps of Engineers covers World War II sites (see USDOD, COE, ERDA-005, 1984). The following quadrants of the Pacific Ocean and Bristol Bay coasts contain traditional hunting and fishing sites and are sources of valuable cultural information: Simeonoff Island (XSI)--11 sites; Stepovak Bay (XSB)--7 sites; Port Moller (XPM)--27 sites; False Pass (XFP)--25 sites; Cold Bay (XCB)--31 sites; Chignik (CHK)--27 sites; Sutwik (SUT)--3 sites; and Unimak Pass (UNI)--55 sites (State of Alaska, Office of History and Archaeology, 1984). A detailed description of these sites (including National Register sites) and their locations is given in the State of Alaska, Department of Natural Resources, Heritage Resources File (1985).

The cultural sites in the Port Moller area (Fig. III-34) reveal a prehistoric-subsistence pattern exemplified by the remains of sea mammals, land animals, fish, shells, sea urchins, and birds, which provide clues to the wide variety of species used. Tools used for subsistence included stone weights (probably used in fishing); stone scrapers, knives, spearheads, and arrowheads; barbed-bone fishhooks; and bone points (Kotani and Workman, 1980). Many ancient housepits have been radiocarbon-dated from 3600 B.C. to 1340 A.D. Port Moller is an important source of information on the paleoecology of the Bristol Bay shore and deep-water areas.

The Port Moller-to-Balboa Bay transportation corridor (Fig. II-2) is an historic (possibly prehistoric) portage of considerable importance and is considered to have a high potential for cultural resources. The Balboa Bay area has a low-to-moderate potential for cultural-resource sites (BBRMP, 1985); only one site has been recorded in the Balboa Bay area. However, all probable areas have not been surveyed.

There have been approximately 300 shipwrecks in Alaskan waters. With some exceptions, most of these shipwrecks in the Bristol Bay area have occurred

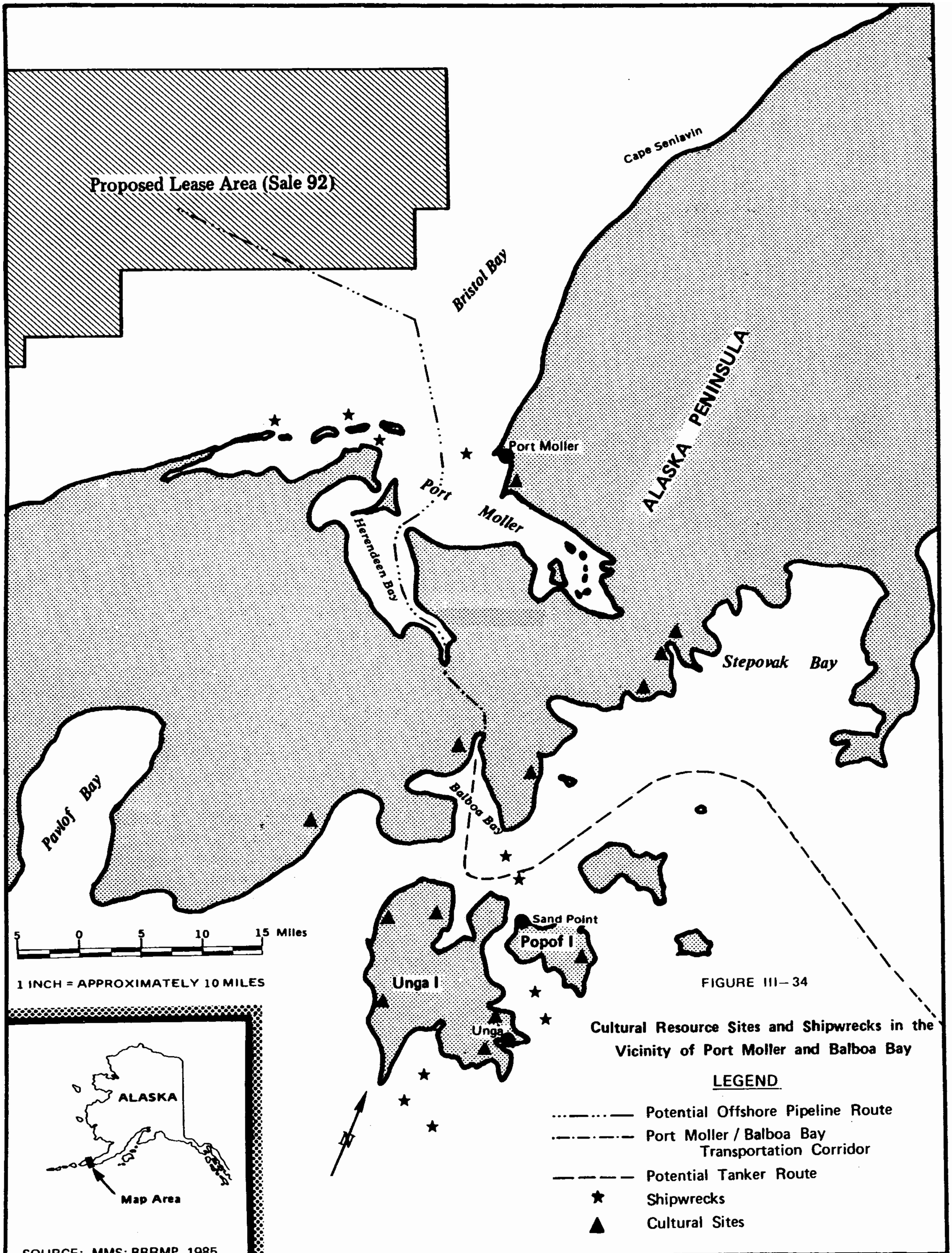


FIGURE III-34

Cultural Resource Sites and Shipwrecks in the Vicinity of Port Moller and Balboa Bay within the 3-mile coastal zone (Table III-45). Artifacts found in shipwrecks tell us a great deal about cultural practices; however, since the shipwrecks in Alaska occurred in historic times, other archeological records provide evidence of cultural practices; and shipwreck artifacts may add important detail to these records. Shipwrecks would provide information on the material culture of the Bristol Bay villages as well as on ships plying the waters between those villages. The best-preserved shipwrecks are likely to be found on the OCS, because waves cannot break up wrecks at depths beyond the 3-mile zone.

More details on the region's cultural resources may be obtained from the Alaska Heritage Resources file (1985). Other cultural information about prehistoric resources and shipwrecks is given in Technical Paper No. 2 (Tornfelt, 1981).

4. Transportation Systems: This section briefly describes those communities and locations that could be affected by the North Aleutian Basin leasing proposal. Descriptions of Cold Bay and Unalaska, communities that are assumed as transport-staging areas for the proposal, are herein summarized and incorporated by reference from the St. George Basin (Sale 70) FEIS, the Navarin Basin Lease Offering (Sale 83) FEIS, and the St. George Basin (Sale 89) FEIS (USDOI, MMS, 1982, 1983, and 1985, respectively).

Only those transportation facilities that may be directly affected by the proposed actions are described. This discussion includes marine and air facilities at Unalaska and air facilities at Cold Bay. The small marine facility at Cold Bay is not discussed.

Cold Bay: The Cold Bay airport is located on the western shore of Cold Bay--1,000 kilometers southwest of Anchorage, on the Alaska Peninsula. Landing facilities at Cold Bay airport consist of two asphalt runways; one is 1,562 by 46 meters and the other is 3,174 by 46 meters. The airport is owned and operated by the State of Alaska. Terminal facilities include a flight-service station, quonset huts for storage and minor maintenance, a post office, and a general store.

Table III-46 indicates the general traffic levels at the Cold Bay airport. Although freight tonnage moved through the airport has decreased since 1974, the number of passengers enplaned and total tonnage moved have risen sharply.

The runway length is adequate to serve existing and forecasted traffic through 1990. The FAA has predicted a 50-percent increase in air-carrier operations and a 100-percent increase in air-taxi operations between FY 1978 and FY 1990. Through FY 1990, the FAA has recommended construction of a new terminal and acqui- sition of a crash- and fire-rescue (CFR) vehicle. Air-navigation and air-traffic-control facilities planned through 1990 include an ODAL (omnidirectional approach light) on Runway 14-32.

There is not much variation between mean, maximum, and minimum temperatures in Cold Bay's maritime climate. On the average, the sky is overcast or obscured 50 percent of the time throughout the year. Generally, visual flying (VFR) is not possible 20 percent of the time. In the 3 summer months, fog is frequent and VFR conditions exist about 60 percent of the time or less. Strong and

Table III-45

Shipwrecks of Bristol Bay, 1885-1917 1/

Date	Vessel	Location
1885	Marion	NW Alaska Peninsula
1889	Wildwood	2 miles of Harkanoek
1891	Prosper	Harbor at Thin Point
1898	Sterling	SW by S of Cape Constantine
1898	Minerva	Kuskokwim River
1901	Lowre May	Kvichak Bay
1902	Leffie	Kudobin Island (Near Port Moller)
1904	Viking, Schooner	Entrance to Ugashik Bay
1905	Valent	Entrance to Ugashik Bay
1906	Mary D. Hume	Nushagak Bay
1906	Naomi	Cape Chichagof
1906	Excelsior	Kudobin Island (Near Port Moller)
1907	Alfe	Entrance to Ugashik Bay
1907	John Currier	Kudobin Island (Near Port Moller)
1908	Lucille	Entrance to Ugashik Bay
1911	Jessie Minor	Kudobin Island (Near Port Moller)
1912	Compoor	Cape Chichagof
1915	Sintram	Cape Chichagof
1917	Smedard	Nushagak Bay
1917	St. Katherine	Entrance to Ugashik Bay

Source: Huber, 1941.

1/ Value of vessels is unknown.

Table III-46
Traffic Data for Cold Bay Airport,
1974-1980

Year	Enplaned Passengers	Freight (Revenue) Tons	Mail (Revenue) Tons	Airline	Scheduled Service Operations	Nonscheduled Service Operations	All Services	Departures: Scheduled Departures	Departures: Scheduled Departures Completed	Departures: Completed as Percent of Departures Scheduled
1974	6,448	814.38	244.17	RV[1/]	1,291	195	1,486	1,059	910	85.93
1975	6,877	338.95	301.82	RV	1,251	47	1,298	1,138	887	77.94
1976	7,942	427.93	252.33	RV	1,244	56	1,300	982	894	91.03
1977	9,233	293.21	182.71	RV	1,021	11	1,032	961	821	85.43
1978	10,436	240.77	177.13	RV	1,146	7	1,153	949	925	97.47
1979	21,216	398.25	327.91	RV	1,272	13	1,285	1,137	1,080	94.98
1980	24,966	455.58	475.73	RV	1,303	5	1,308	1,185	1,163	98.00

Source: CAB Airport Activity Statistics, Annual; Louis Berger and Associates, Inc., 1982.

1/ RV = Reeve Aleutian Airways

hazardous winds (28 knots or higher) occur year-round but are most frequent in fall and winter, when conditions for flying are otherwise most favorable.

Unalaska: The City of Unalaska has three major deep-water moorages: Unalaska/Dutch Harbor, Iliuliuk Bay, and Captain's Bay. Unalaska also has an airport.

Dutch Harbor has two principal docks--the Sea Land city dock facility and the Standard Oil dock. The Sea Land dock is a wooden containerized-cargo dock constructed in 1979. It can load or unload an average of seven containers per hour. The dock is supported by 1.4 hectares of open-container storage area. The pier dimensions are 55 meters by 9 meters, with a depth alongside of 9.1 meters.

The Standard Oil dock is a T-shaped facility extending approximately 122 meters from shore. The dock face is approximately 102 by 15 meters, with water depths alongside the dock of 9.4 to 11.6 meters at mean lower low water (MLLW). The dock is not deep enough to allow a 35,000-DWT vessel to directly unload. As a result, petroleum products are lightered to the dock by barge; and it takes approximately 3 days to unload a tanker. However, the facility can refuel up to six fishing boats at a time.

Iliuliuk Bay contains one major facility--the American President Lines dock--and a host of fish-related dock facilities. They include East Point Seafoods, Whitney-Fidalgo, Unisea, Pacific Pearl, and Pan Alaskan Fisheries.

The American President Lines dock is a recently completed concrete structure that measures 107 by 46 meters. Water depths alongside the dock are approximately 12 meters at the face. The dock is supported by 4 hectares of storage space and 1,858 square meters of covered storage. This facility can process both break-bulk and containerized cargo.

The principal dock facility within Captain's Bay is Crowley Maritime's tank farm. Crowley uses the facility as a staging area and transshipment point for military resupply operations in western Alaska. Built in 1940 by the Corps of Engineers, the facility was rehabilitated in 1975. The dock extends 152 meters offshore and has a face of 107 meters. Water depths alongside the dock range to 12.8 meters.

Adjacent to the Crowley facility, Offshore Services Incorporated has constructed a 16-hectare oil-support base complete with its own service dock. ARCO leased this facility during the drilling of the 1983 Navarin Basin Continental Offshore Statigraphic Test well. Currently, several oil companies and industry-service companies are leasing facilities at the terminal to support exploratory drilling in the St. George Basin. Table III-47 shows total throughput tonnage by commodity group between 1972 and 1980. Iliuliuk Harbor (the generic name given by the Corps of Engineers to all bays in the Unalaska area) throughput tonnage is dominated by petroleum products. Between 1972 and 1979, throughput tonnage of petroleum products increased by 185 percent, or 322,158 tons. During this same period, throughput tonnage of fish and shellfish peaked in 1974 at 61,429 tons and dropped to a low of 6,226 tons in 1977. (Tons referenced are short tons used by the Army Corps of Engineers.)

Table III-47
Iliuliuk Harbor Throughput Tonnage
1972-1980

Year	Petroleum Products 1/	Food Products 2/	Fish-Shellfish 3/	All Other Commodity Groups 4/	Total Annual Tonnage
1972	173,460	36	14,508	2,105	190,109
1973	144,555	3,224	13,086	2,271	163,586
1974	88,790	3,237	61,429	4,021	157,477
1975	272,222	5,598	20,563	2,570	300,953
1976	321,290	9,241	15,738	3,591	349,760
1977	318,298	10,813	6,226	6,987	342,324
1978	333,240	6,053	22,831	28,329	378,501
1979	495,618	22,831	41,043	20,565	580,057
1980	420,719	21,269	21,930	20,028	483,946

Source: USDOD, COE, Waterborne Commerce Statistics, 1972-1980, Part 4.

1/ Includes gasoline, jet fuel, fuel oil, and miscellaneous petroleum and coal products.
2/ Includes salt, prepared fish, alcoholic beverages, groceries, and miscellaneous food products.
3/ Includes fresh fish and fresh shellfish.
4/ Includes all other commodities.

Note: Referenced tons are short tons as used by the U.S. Army Corps of Engineers.

The Dutch Harbor airport is presently classified as part of the state system of secondary airports. The airport is located on Amaknak Island, adjacent to Unalaska Island, and is within the city of Unalaska. The existing gravel runway, which is 1,311 by 30 meters, was originally built by the U.S. Navy during World War II.

The airport has several limitations--primarily, the runway length precludes the handling of larger aircraft. Extending the runway over filled land would be expensive. Another limitation is the safety hazard created by the 23- to 26-meter-high bluff located approximately 30 meters northeast of the runway centerline. Further, the mountainous terrain on Amaknak and other nearby islands creates navigational hazards, especially during poor visibility conditions. Taking off east-southeast from the runway is particularly hazardous because of a mountain located on Unalaska Island about 2.42 kilometers from the end of the runway.

Facilities at the airport include an old terminal building, now exclusively used by Reeve Aleutian Airways. Other facilities include a hangar, half of which is presently occupied by a tenant. The other half is being held vacant pending a U.S. Coast Guard offer to occupy. There is an underground storage tank for fuel.

Annual aircraft operations for the Dutch Harbor airport are forecasted to average between 2,000 and 3,000 per year throughout the 1980's (Berger, 1982). This forecast, however, does not assume a large-scale oil or gas discovery. In 1981, total freight moved by all carriers was estimated at 1,382 tons. Freight statistics for the subject air facility have sharply decreased since 1975; however, enplaned-passenger totals have increased from a 1974 low of 3,878 to a present high of approximately 14,000 (CAB Airport Activity Statistics, Annual).

Major scheduled passenger service from Anchorage to Dutch Harbor via Cold Bay is provided daily (except Sunday) by Reeve Aleutian Airways and other airlines. There also is a weekly scheduled cargo flight from Anchorage, via Port Heiden. The Nihon YS-11 aircraft is used for both passenger and cargo scheduled flights.

Unimak Pass Marine Traffic: The Unimak Pass, at its narrowest point between Ugamak and Unimak Islands, is approximately 19 kilometers wide. A subsidiary pass, Ugamak Strait, is located immediately west of Ugamak Island. Geographically, Unimak Pass represents the principal portal through which U.S.-generated traffic enters the Bering Sea region. Within the Unimak Pass area, the climate is similar to the rest of the Bering Sea and navigation is usually complicated by storms and heavy fog.

Current vessel use of Unimak Pass is difficult to estimate. Based on a study commissioned by the Alaska OCS Region, it is estimated that current vessel traffic through Unimak Pass ranges between 2,400 and 6,500 vessel trips per year (ERE Systems, 1982). Eighty (80) to 85 percent of this traffic is believed to be fishing-vessel traffic, with the remaining traffic composed of commercial and natural-resource shipping (both foreign and domestic).

Balboa Bay: Balboa Bay is a Y-shaped bay located on the southern side of the Alaska Peninsula southeast of Herendeen Bay and Port Moller. The shores of the bay and its hinterlands are unpopulated and lack any type of infrastructure. Balboa Bay is entered directly from the Unga Strait. The mouth of the bay is 8.8 kilometers wide; the main bay is 7.2 to 8 kilometers wide and extends 8 kilometers from the bay mouth before branching into its arms. The northern arm of the bay is Albatross Anchorage; the western arm is Lefthand Bay. Albatross Anchorage has an entrance approximately 4.5 kilometers wide. Once into the embayment, the channel becomes rapidly shallower and narrower. Vessels drawing 13.7 meters of draft could not proceed more than 2.6 to 3.2 kilometers into Albatross Anchorage.

Lefthand Bay is approximately 4 kilometers wide and 6.4 kilometers long. Water depths reach 24 meters at .8 kilometers from shore; the bay is protected from most bad weather and is considered a good anchorage for large vessels. The main bodies of Balboa Bay and Albatross Anchorage are not protected from southerly winds; however, they are deep and would accommodate safe passage for medium-sized crude carriers.

The lands surrounding Balboa Bay range from steep mountainous terrain to marsh. There are few areas in that locale which, in their present state, could be considered as good construction sites.

5. Land-Use Plans and Coastal Management:

a. Land-Use Plans: The majority of land adjacent to the North Aleutian Basin lease sale area is under State of Alaska, Native corporation, or federal ownership. Most state lands occur along the northern coast of the Alaska Peninsula, where the state has established a number of special management areas to manage and protect important wildlife resources in coastal regions. These include the Izembek Game Refuge and three critical-habitat areas (Port Moller, Port Heiden, and Cinder River). Descriptions of the wildlife species found in these areas are available in Sections III.B.2. and III.B.3. Native-village corporations own substantial tracts of land in the Cold Bay, Port Moller, and Port Heiden areas. Federal lands in the region occur on the Alaska Peninsula and Izembek National Wildlife Refuges, which are managed by the U.S. Fish and Wildlife Service (FWS).

The Bristol Bay Regional Management Plan and Environmental Impact Statement (1985) evaluated five land-use-planning alternatives, which ranged from development to preservation-oriented plans. The preferred alternative would allow opportunities for moderate economic growth while providing protection for significant fish, wildlife, and cultural resources.

The following discussions focus on the land uses and land-use plans of the communities of Unalaska and Cold Bay, potential support sites, and the lands within the proposed Port Moller/Balboa Bay transportation corridor.

Cold Bay: Development in Cold Bay has been associated historically with aviation activities and has occurred in a linear pattern adjacent to the airport. Private ownership of the waterfront and adjacent uplands has encouraged industrial development in the area. The Thirteenth Regional Corporation is the major private landowner in the city. The major constraints to development in Cold Bay have been the lack of a community government and the lack of available private land.

The city is currently negotiating with the State of Alaska and the federal government to gain access to land. The city is surrounded by federal land in National Wildlife Refuge (NWR) status; however, some of this land has little wildlife value. The FWS is interested in making some of this land available to the State of Alaska or the King Cove Native Corporation for residential or commercial purposes, in exchange for land having higher wildlife value.

Industry has renovated some existing buildings to develop a shore base at Cold Bay to support exploratory drilling in the St. George Basin.

Unalaska: A major factor that has affected the growth of Unalaska is the small amount of undeveloped land suitable for development. Approximately 10,300 acres of land exist within the corporate limits of the city, of which 8,404 acres (approximately 82%) are classified as undevelopable.

Undevelopable lands consist of areas containing slopes greater than 25 percent or lands in the floodplain of Unalaska Creek. Of the approximately 1,900 acres of land suitable for development within the city of Unalaska, 400 acres have been developed and approximately 1,500 remain as suitable and available for development (Tryck, Nyman, and Hayes, 1977). At this time, no land is available for purchase in Unalaska. Virtually all the land is owned by the Ounalashka Corporation, which has no short-term plans to make land available for sale. The Ounalashka Corporation has long-range plans to sell portions of their lands for private housing. City-owned lands are scattered around the community and are associated with existing facilities or are intended for municipal use.

In 1977, the Unalaska Community Development Plan (Tryck, Nyman, and Hayes, 1977) was completed to guide the future growth and development of the community. The plan identifies community goals and objectives, existing land uses, and the city land-use plan that was prepared around a 10-year timeframe (1977-1987). The plan identifies residential, general commercial, seafood-processing-industrial, and general-industrial land classifications.

The community development plan's residential classification allocated approximately 1,275 acres of land (85% of the total acreage suitable for development) for residential uses. Based on the development plan's density and utility requirements for its four residential classifications, the land area is capable of accommodating a capacity population of between 30,800 and 32,700 individuals. This assumes that residential land would be developed to the fullest. Residential areas include undeveloped sites in the Unalaska townsite, and the Unalaska and Pyramid Creek valleys. On Amaknak Island, residential areas lie west of Margaret Bay, on the Standard Oil hill, and north of the airport (Tryck, Nyman, and Hayes, 1977).

The commercial-land-use category contains 38 acres and could include retail stores, services, offices, eating and drinking establishments, and overnight accommodations. Lands designated for commercial use are located adjacent to centers of activity and residential areas.

The seafood-processing-industrial classification identifies land-area needs for accommodating the expected expansion of the seafood-processing industry. This classification assumes that the transient housing needs of the industry would be met by housing constructed in conjunction with the processing-plant facilities. This category contains 165 acres, with 25 already-developed waterfront acres. Almost all cannery development is located in Iliuliuk Harbor, which is fairly congested due to the number of cannery facilities. Areas that have been designated for future expansion include Margaret Bay, Rocky Point, Dutch Harbor, and Captain's Bay (Tryck, Nyman, and Hayes, 1977).

The general-industrial classification is intended to accommodate industrial uses not related to seafood processing. These include manufacturing uses, warehousing storage, and similar uses. Areas associated with this classification include land adjacent to the Chevron dock, the city dock, and the Captain's Bay dock facilities. The 70-acre Captain's Bay dock facility, owned by Crowley Maritime, is considered ideal for certain onshore OCS oil and gas activities such as a supply base (Tryck, Nyman, and Hayes, 1977). Offshore Systems, Inc., built a marine-support facility designed to oil industry specifications, with a deep-water dock face and open and covered storage for bulk fuel and water. The facility contains three well-equipped trailers that were designed to house crew members.

Port Moller/Balboa Bay Transportation Corridor: The Bristol Bay Regional Management Plan (1985) identified the proposed Port Moller-to-Balboa Bay pipeline route as a preferred transportation corridor for possible development. This corridor could be used for pipelines, roads, transmission lines, and other transportation systems. In the past, this area served as a transportation route and, because of its short overland distance and good Pacific ports, has potential for transpeninsula-transportation development. The corridor, which is about 69 kilometers long, extends from the Bering Sea through Herendeen Bay and Portage Valley to Balboa Bay. The Bristol Bay Area Plan for State Land (1984) also identified this route as a transportation corridor.

The Draft Comprehensive Plan for the Alaska Peninsula National Wildlife Refuge (1984) describes four alternatives for managing the National Wildlife Refuge. The preferred alternative would provide for a transportation corridor across the refuge and would permit the development of a pipeline from Port Moller to Balboa Bay. The land status of the pipeline-corridor route in the NWR is changing because refuge lands are being selected by Native corporations and the state as a result of the Alaska Statehood Act and the ANCSA. As of January 1984, the lands within this area were selected and/or conveyed to Native corporations or remained under FWS jurisdiction. The potential pipeline route is proposed as an intensive-management area and, if so designated, would be unsuitable for wilderness designation.

b. Coastal Management: The federal Coastal Zone Management Act (CZMA) and the Alaska Coastal Management Act (ACMA) were enacted in 1972 and 1978, respectively. Through these acts, development and land use in coastal areas are managed to protect valuable coastal resources. The provisions and policies of both the federal and state Coastal Management Programs (CMP's) described in MMS Reference Paper 83-1 (McCrea, 1983) are summarized and incorporated by reference in this EIS. Policies of the Alaska CMP may be refined through local coastal programs prepared by coastal districts according to state guidelines and standards and approved by the Secretary of Commerce.

Local coastal districts adjacent to the North Aleutian Basin lease sale area include the Cenaliulriit (Yukon/Kuskokwim Coastal Resource Service Area

[CRSA]), Bristol Bay CRSA, and the Aleutians East CRSA. The city of Bethel and the Bristol Bay Borough are coastal districts located within these CRSA's.

Although the western Aleutians and Pribilof Islands have not formed CRSA's, the cities of Akutan and St. Paul--communities within these CRSA's--recently initiated the process of developing district coastal programs (Fig. III-35).

District programs are currently at various stages of development (Table III-48). The following description of local CMP's focuses on the status and policies of the three CRSA's (Yukon/Kuskokwim, Bristol Bay, and Aleutians East). This focus coincides with that of the social systems and includes the coastal areas discussed in the section on biological resources. Since the shorelines of the Bering Strait CRSA and of Nome would be affected by cumulative effects, those CMP's plus the Bethel and Bristol Bay CMP's are included in the summary (Table III-48).

State Coastal Management Policies: The focus of the analysis in this EIS is the State of Alaska's CMP, which is based upon the Alaska Coastal Management Act (ACMA). Supplementing the legislation are guidelines, standards, and a series of maps depicting the boundaries of the state coastal zone. These four documents form the state's Coastal Management Program as initially approved by the Secretary of the U.S. Department of Commerce.

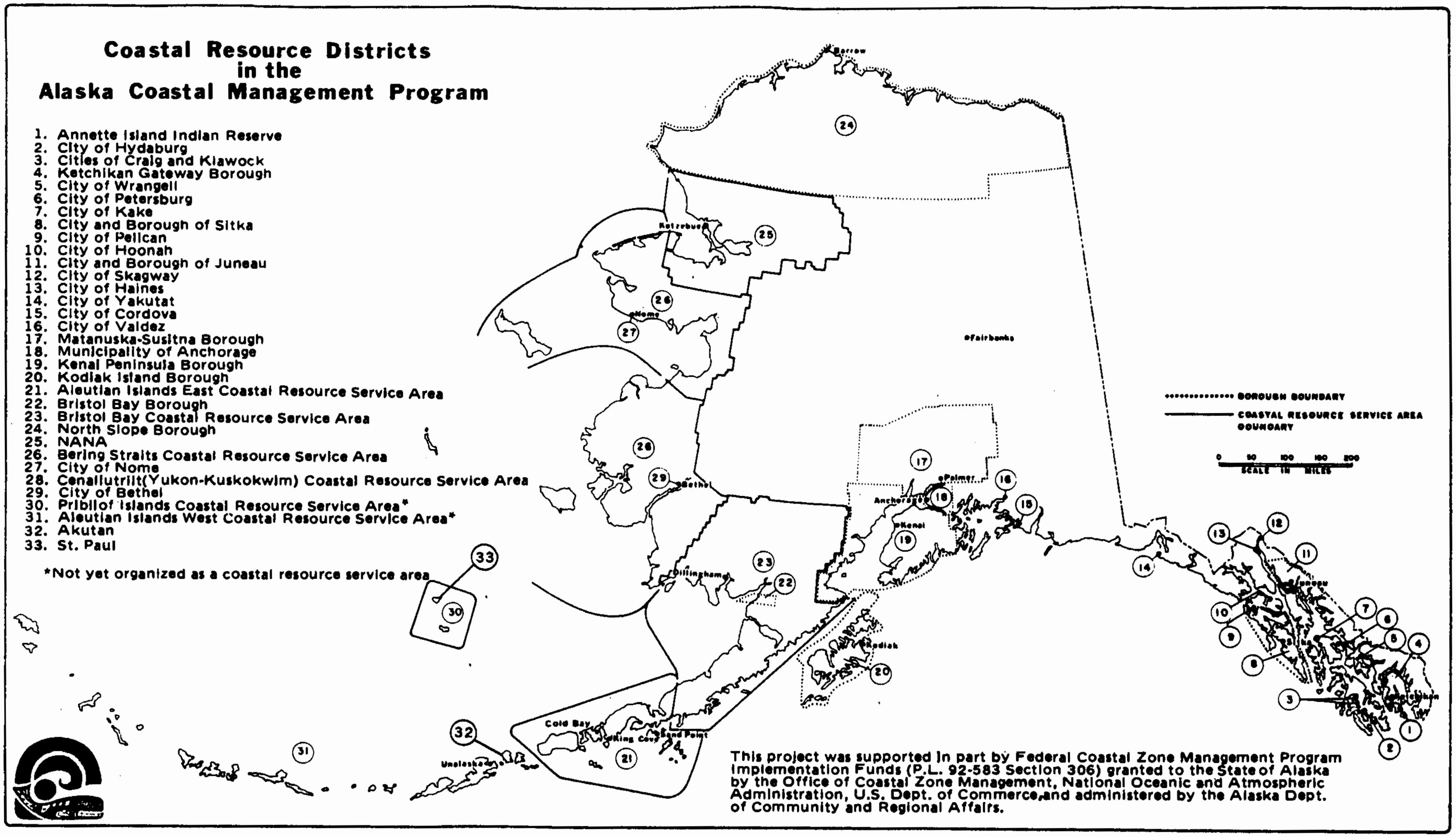
Policies contained in Alaska's Coastal Management Program parallel those of the federal CZMA. Standards developed by the Coastal Policy Council expand upon the statute and provide more specific policies covering coastal habitats, resources, uses, and activities. The policies that are potentially relevant to activities hypothesized in this EIS are summarized in the following paragraphs.

Coastal Habitats: Eight coastal habitats were identified in the standards: offshore; estuaries; wetlands and tidelands; rocky islands and sea-cliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important uplands. Each habitat has a policy specific to maintaining or enhancing the attributes that contribute to its capacity to support living resources. For example, "offshore areas must be managed so as to assure adequate water flow, circulation patterns, nutrients, and oxygen levels and avoid the discharge of toxic wastes, silt, and destruction of productive habitat" (Standards of the Alaska Coastal Management Program: 6 Alaska Administrative Code [AAC] 80.130.[C][1] and [2]).

Activities and uses that do not conform to the standards may be permitted if: (1) there are overriding public needs; (2) there are no feasible prudent alternatives; and (3) appropriate mitigation measures are incorporated to maximize conformance.

Coastal Resources: Two policy areas come under the heading of coastal resources: (1) air, land, and water quality and (2) historic, prehistoric, and archeological resources. In the first instance, the Alaska Coastal Management Program defers to the mandates and expertise of the Alaska Department of Environmental Conservation (DEC). The standards incorporate by reference all statutes, regulations, and procedures of the DEC that pertain to protecting air, land, and water quality (6AAC 80.140).

FIGURE III–35



Source: Alaska Coastal Management Program, June 1982.

Table III-48
Status and Policies of Coastal District Programs

District	Brief Summary of CMP Status	Policies
Bering Strait CRSA	The CRSA was formed in January 1980; boundaries include the coastal areas within Regional Education Attendance Area (REAA) 2. CRSA Board members were elected in April 1980; CRSA Board meetings have been held since September 1980. Draft policies were distributed for review in Spring 1985.	General policies and special-use-area policies emphasize the need to protect subsistence and cultural resources when a major use in the district is proposed. Through the CZM process, they have strived to ensure active local participation in the early stages of development.
Nome Coastal Management District	Nome is within the Bering Strait CRSA but has pursued a separate CMP. The first draft CMP was published in July 1981; an updated hearing draft was published in October 1982. The plan was adopted by the Nome Community Council in February 1, 1983 and forwarded to the Alaska Coastal Policy Council (CPC). The CPC adopted the district program in December 1983.	Policies are designed to facilitate development without development overwhelming local capabilities to plan and finance public facilities, The plan expands upon state policies, especially for: piers, docks, and related shoreline policies; energy-related facilities and storage of petroleum products and toxic-substance storage.
Yukon/Kuskokwim (Cenaliulriit) CRSA	Cenaliulriit was established and a CRSA Board elected in 1979. This area includes REAA's 3 and 4 and coincides with the coastal boundaries of the Calista Corporation. Cenaliulriit approved its program in October 1983. The Coastal Policy Council approved it in 1984.	State CMP policies are incorporated within the framework of local policies to ensure the continuation of residents' hunter-gatherer culture.
Bethel	The Bethel City Council authorized participation in the Alaska Coastal Management Program in 1980. A preliminary report containing a discussion of the issues, goals, and objectives; coastal management boundaries; and resource inventory and analysis was published in February 1982. A public hearing draft was published in March 1983. The CPC adopted the district program in September 1983.	Policies focus on development constraints associated with Bethel's location on the Kuskokwim River.
Bristol Bay Borough	The Bristol Bay Borough had several versions of its hearing draft. The final version was published in October 1982 and approved by the Borough on March 1, 1983. The CPC adopted the district program in September 1983.	Commercial fishing, subsistence activities, and an "outdoors" way of life receive preference in CMP policies. Support facilities for oil, gas, and mineral extraction are sanctioned if they promote positive economic effects and minimize negative environmental effects.

Table III-48
Status and Policies of Coastal District Programs
(continued)

District	Brief Summary of CMP Status	Policies
Bristol Bay CRSA	The Bristol Bay CRSA was formed and a CRSA Board elected in 1982. The CMP was developed in conjunction with the work being done on the Bristol Bay Cooperative Management Plan. The resource inventory and public hearing draft were released and approved locally in 1984. The CPC adopted the program in February 1985.	Policies emphasize the protection and maintenance of fish and wildlife resources, the fishing industry, and present lifestyle. Also, economic productivity and diversity are encouraged.
Aleutians East CRSA	A CRSA Board was elected in May 1982 and began meeting regularly in the fall of 1982. A draft resource inventory was completed in early 1984; a public hearing draft was published in early 1985.	Draft policies emphasize the protection and maintenance of commercial/subsistence-fishing activities and resources. Consistent with this overriding goal, policies reflect the region's interest in economic productivity and diversity.

Source: USDOI, MMS, 1985.

The policy addressing historic, prehistoric, and archeological resources requires only that the "areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory" be identified (6AAC 80.150).

Uses and Activities: Eight use areas are addressed under this heading: coastal development, geophysical-hazard areas, recreation, energy facilities, transportation and utilities, fish and seafood processing, timber harvesting and processing, mining and mineral processing, and subsistence. Uses and activities of particular relevance to the activities hypothesized for this OCS lease sale include coastal development, geophysical-hazard areas, energy facilities, transportation and utilities, and subsistence.

Development in coastal areas is guided by policies that grant top priority to water-dependent uses and activities. Water-related uses are next in order of priority. Last are uses that are neither water-dependent nor related but for which no feasible or prudent alternative is available to meet the public need for the use or activity.

Policies for geophysical hazards require the identification of areas of known hazard and highly probable hazard in areas of high development potential. Developments in these areas must be sited, designed, and constructed to minimize property damage and protect against loss of life (6AAC 80.050).

Both the federal CZMA and the state CMP require that uses of state and federal concern must be addressed and, in some way, accommodated in the local Coastal Management Program. Major energy facilities fall into this category. As a result, before a local coastal district can restrict or exclude these facilities in its coastal program, the district must demonstrate that the use is not compatible with the proposed site and that the district consulted with affected government agencies and identified reasonable alternative sites (AS 46.40.070[c]). Major energy facilities include "marine service bases and storage depots, pipelines and rights-of-way, drilling rigs and platforms, petroleum or coal separation, treatment, or storage facilities, liquid natural gas plants and terminals, oil terminals and other port development for the transfer of energy products, petrochemical plants, refineries and associated facilities, hydroelectric projects, other electric generating plants, transmission lines, uranium enrichment or nuclear fuel processing facilities, and geothermal facilities" (6AAC 80.900[22]).

Sixteen criteria were developed by the Coastal Policy Council to guide energy-facility-site selection. These criteria address constraints imposed by environmental, economic, cultural, and social considerations; harbor configurations and locations; and existing infrastructure. Mitigating measures may be included in the Alaska Coastal Management Program to ensure proper development practices (6AAC 80.070[b]).

State standards for transportation and utilities require that routes and facilities constructed in the coastal area be compatible with local CMP's. Moreover, routes and facilities must be located inland from beaches and shorelines unless the route or facility is water-dependent or there is no feasible and prudent inland alternative (6AAC 80.080).

In developing district policies, the district must recognize and assure opportunities for subsistence usage of coastal areas and resources. Areas that are used primarily for subsistence purposes must be identified and may be designated as special subsistence zones to the extent that this designation is compatible with the other districts' management plans for fish and game resources that are shared. Potentially conflicting uses or activities occurring within this designated area may be permitted only after a study is conducted to determine possible adverse impacts and safeguards are implemented to assure continued subsistence usage (6AAC 80.120).

Local Coastal Manangement Districts: Subparagraphs (1) through (3) of this section describe the coastal districts included in this analysis; the status of the districts' CMP's; and, in those instances where a public hearing draft is available, a summary of the relevant policies. Upon adoption of a district program by the Coastal Policy Council, district policies replace those of the state CMP only when they are more explicit. Frequently, district policies supplement those of the state. As a result, state policies retain relevance even after district programs are developed.

(1) Yukon/Kuskowim CRSA (Cenaliulriit): The CRSA was established and the CRSA Board was elected in 1979. The Cenaliulriit boundary extends from Pastol Bay, north of the Yukon Delta, to Hagemeister Strait at the entrance to Bristol Bay, and includes St. Matthew, Hall, and Nunivak Islands. This area includes Regional Education Attendance Areas (REAA's) 3 and 4 and coincides with the coastal boundaries of the Calista Corporation. The city of Bethel, which lies within these boundaries, opted to develop a CMP independent of Cenaliulriit's. Bethel's program was incorporated into the state CMP in January 1984.

Approved in October 1984, Cenaliulriit's program reflects the hunter/gatherer culture of the region, the residents' dependence upon the land and the renewable resources of the region, and the residents' preference for retaining their indigenous culture. The Cenaliulriit CMP incorporates the provisions of the state CMP within a framework of policies designed to ensure the continuation of the residents' subsistence way of life.

The goals, objectives, and policies of the Yukon/Kuskowim CMP are arranged under 14 issues. Unique aspects of the Cenaliulriit program are featured in the first five issues. The first two issues direct decisionmakers to be sensitive to local issues, perspectives, and knowledge, and to include these concerns in their decisions. Policies for Issues 3, 4, and 5 require developers to minimize the effects of development on current and historical aspects of the Yupik culture, including the game and habitat on which it depends. Studies are required before a potentially conflicting action can be authorized. Historical aspects of the culture are protected by policies which require that sites and artifacts receive (1) proper documentation, (2) ample opportunity to be studied, and (3) protection from development if a site is of exceptional historic or prehistoric value.

The goal for Issue 6 (Environmental Management) is to maintain the Yukon/Kuskokwim Delta in perpetuity as a self-sustaining ecosystem unspoiled by human-imposed disasters. The compatibility of a proposed action with the local ecosystem is to be determined by the local residents and recognized experts who have substantial knowledge of the local ecosystem. No activities may occur in a habitat used by migratory species when local populations of the species are likely to be present, if the action could harm the species.

Cenaliulriit relies on existing regulations and CMP standards to guide land use. Issue 7 sets standards for general types of development, i.e., housing, transportation and utility routes and facilities, communication, public safety, education, health and social services, timber harvesting, mineral and mining processing, and sand and gravel extraction. For all types of development, the policies require that plans be included for restoring the environment when a temporary facility is shut down. Water supplied to new activities must protect fish resources and habitat.

The term "essential" is defined for fish and wildlife habitats in Issue 8. Because Cenaliulriit policies for habitats parallel those of the state, they replace those state policies. Policies for industrial siting (Issue 9) are comparable to state policies for energy facilities, except that they apply to all types of industry. State standards not applicable to the region have been omitted (i.e., upland-habitat and siting policies dealing with existing infrastructure, vessel-traffic control, and cooperation among interested parties).

Areas of geophysical hazards (Issue 10) are not identified in the CMP. However, any activity or development in the Yukon/Kuskokwim district is required to conform to state and federal regulations for hazard-prone areas.

Policies related to pollution (Issue 11) refer to federal and state regulations but also include a policy on nonpoint-source sedimentation of anadromous fish streams. Recreational policies (Issue 12) are written to ensure that recreational uses, including sport hunting and fishing, are secondary to use by traditional hunters and gatherers. Public access to publicly funded marine facilities is required. Also, before public lands that are presently used for recreation or that have a high potential for future recreational use are converted to alternate uses, they must be evaluated for official recreational designation or management.

Waterfront developments (Issue 13) would be permitted if proper site characteristics exist; the land is not reserved for recreation or public access; the development is water-dependent or water-related; and priority is given to the continuation of food procurement if the site is a recognized hunting/gathering site essential to a family.

The final issue, village development, pertains only to development within village boundaries and provides a significant infusion of land-use planning into the coastal program. Topics for which policies were developed under this issue include waterfront usage, river-bank erosion, wetlands management, flooding and surface-water drainage, garbage and sewage disposal, and air quality.

Cenaliulriit recommended that 15 areas be studied to determine if they would be nominated as areas meriting special attention (AMSA's). These areas, ranked in the order in which they should be studied, include: the lower Yukon Delta from Pastol Bay to the Kwikluak Pass of the lower Yukon Delta and east to the 200-foot elevation; Bethel vicinity; Goodnews Bay and Platinum; Kokechik Bay; St. Matthew/Hall Islands; Cape Vancouver; Sheldon Point; Nash

Harbor; Kisaralik River from the Kuskokwim River upstream to the 200-foot elevation; Kuskokwim Bay; Pastol Bay; Old Yukon River Delta extending from the Askinuk Mountains to Nunivak Island and inland for 30 miles; Nunivak Wilderness; Yukon River riparian habitat between Mountain Village and Russian River; and Andreafsky Wilderness. Most areas were selected because they provide important habitat. Exceptions are the Bethel vicinity, where hunting and fishing pursuits are important; Goodnews Bay and Platinum, where habitat use, industrial activity, and recreational purposes may conflict; Kokechik Bay, where potential commercial development may conflict with existing habitat use; Cape Vancouver, where geologic hazards are a concern; Kuskokwim Bay, where onshore commercial fishing and seafood processing require protection; Nunivak Wilderness, where the federal government and residents hold conflicting management strategies; and Andreafsky Wilderness, where the potential for major recreational opportunities exists.

(2) Bristol Bay CRSA: The Bristol Bay CRSA was formed and a CRSA Board was elected in 1982. The resource inventory and public hearing draft were completed in March 1984, approved locally in October 1984, and approved by the Coastal Policy Council in February 1985. The CRSA boundaries include the coastal areas of REAA's 6 and 7 and the city of Dillingham.

The CRSA Board expanded the original boundary designated by the state because of the important links between upland uses in the watersheds and the health of the anadromous fish streams. The interim coastal boundary was expanded to include all water bodies designated in the Catalog of Waters Important for Spawning, Rearing, and Migration of Anadromous Fish, plus a 1-mile buffer from ordinary high water (OHW) on each bank and all tributaries to these aforementioned designated waterbodies, plus a 200-foot buffer from OHW on each bank. This determination is consistent with the three overriding goals of the district:

(a) To maintain and enhance the region's fish and wildlife populations and their habitats;

(b) To protect the existing culture and lifestyle of the region's residents and minimize their disruption; and

(c) To encourage economic productivity and diversity in the region, while minimizing conflicts with the fishing industry and the subsistence lifestyle.

Nine goals and several objectives for each goal provide direction for interpreting the enforceable policies. The goals cover fish and wildlife, subsistence, settlement and coastal development, oil and gas, minerals, transportation, energy, recreation, and historic/archeological resources. Oil and gas development is considered a primary issue in the Alaska Peninsula/Bristol Bay and Togiak subregions of the CRSA.

CMP policies, the portion of the CMP used for determining consistency of proposed activities with the program, are designed to relate the goals and objectives to development requirements. Several policies in the Bristol Bay CRSA program relate directly to oil and gas development and regulation of geophysical surveys; locations for activities with respect to fish and wildlife habitat and communities and other activities; pipeline design and location; oil storage; effluent control; and spill containment.

(3) Aleutians East CRSA: A CRSA Board was elected in May 1982. The board began meeting regularly in the fall of 1982. A resource inventory was completed early in 1984; and a public hearing draft was published in February 1985. Two goals provide the framework for policies that deal with oil and gas. First, opportunities to explore, develop, and produce oil and gas resources in the region must be pursued "in a manner that will benefit residents, minimize impacts on fish and wildlife populations and habitats, and not interfere with harvest of these resources." Second, plans for energy-facility siting must "minimize adverse impacts on the environmental, social, and economic resources of the Aleutians East Region."

Policies to implement these goals include: (1) seasonal and spatial limitations on offshore activities, including seismic work and flight patterns, and on dredge and fill activities; (2) limitations or prohibitions on the discharge of drilling muds and formation waters; (3) prohibition of offshore storage of oil; and (4) guidelines for siting pipelines and energy-related facilities. Public review of the Aleutians East hearing draft closed in April 1985. The Aleutians East CRSA Board should adopt a final set of policies by summer 1985 and submit them in June 1985 to the Coastal Policy Council for action in fall 1985.

6. Terrestrial Mammals (Brown Bear and Caribou):

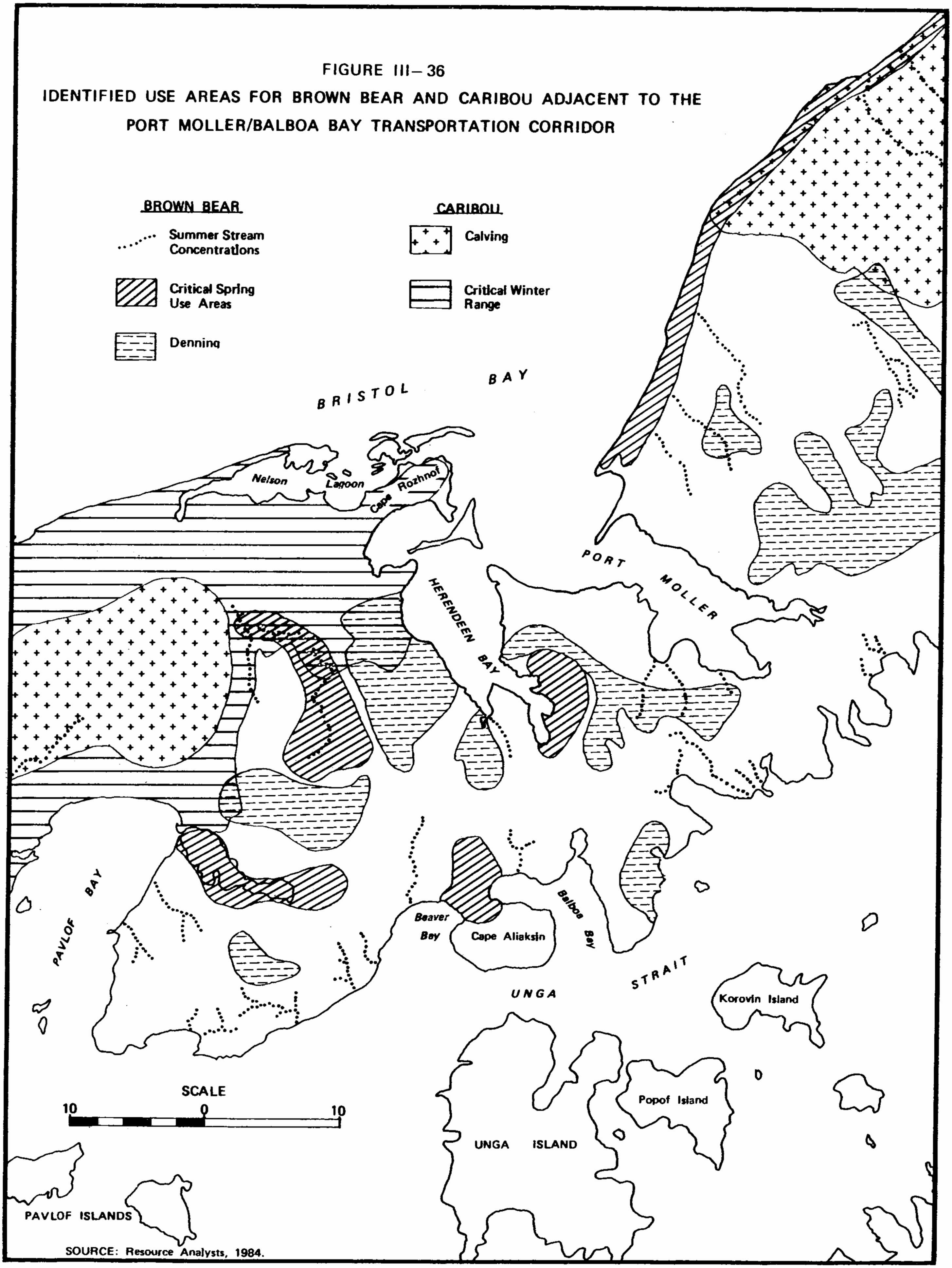
Brown Bear: An estimated 2,000 to 3,000 brown bears are found on the Alaska Peninsula south of the Naknek River, with the greatest density occurring north of Port Moller (USDOI, FWS, 1984). They also are common in the northern Bristol Bay area, but density is lower than on the peninsula. Bears are found in most habitats but are concentrated in coastal lowlands and mountain valleys of the Alaska Peninsula, particularly along salmon-spawning streams in summer and fall (June-December). Stream habitat is critical to the well-being of the brown bear population. They forage intensively along virtually the entire northern shoreline of the Alaska Peninsula and much of the southern shoreline, especially in spring. During winter and early spring they occupy denning areas in the adjacent Aleutian Range from Cold Bay to Naknek Lake (USDOI, FWS, 1984).

Intensive-use areas include northeast/southeast Unimak Island, the Cold Bay area and northeast, the Herendeen Bay area, the Port Heiden vicinity and southwest, and the Cinder River area (Alaska Land Use Council, 1984). On the southern side of the peninsula, important areas include Pavlof Bay to the head of Port Moller and numerous stream drainages from Pavlof Bay to Wide Bay (Fig. III-36) (USDOI, FWS, 1984).

Barren-Ground Caribou: Caribou range widely in foothill and coastal-plain habitats from Unimak Pass to the Naknek River and west to the Nushagak River drainage area. However, only those individuals seasonally occurring in the proposed Port Moller/Balboa Bay transpeninsula pipeline corridor (Fig. II-2), and rarely those ranging along shorelines of the Alaska Peninsula, could be affected. The Mulchatna herd (approximately 20,000 animals) winters in the

FIGURE III–36

IDENTIFIED USE AREAS FOR BROWN BEAR AND CARIBOU ADJACENT TO THE PORT MOLLER/BALBOA BAY TRANSPORTATION CORRIDOR



SOURCE: Resource Analysts, 1984.

northeastern Bristol Bay area and calves to the north. The Alaska Peninsula herd is comprised of three subherds: (1) the northern subherd (15,000-20,000 animals), which ranges between the Naknek River and Port Moller, winters north of Ugashik Bay/Ugashik Lake, and calves between the Cinder River, Port Heiden, and Ilnik; (2) the southern subherd (6,000-10,000 animals), which ranges from Port Moller to Cold Bay, winters over much of this area, and calves between the Black Hills and Pavlof Sister and areas to the northeast (Fig. III-36); and (3) the third subherd (1,500 animals), which inhabits Unimak Island, winters over much of the island, and calves on the western section.

Migratory habits of the peninsula herd are variable. Following the calving period (mid-May to mid-June), cows and calves of the northern subherd disperse over coastal lowlands, while bulls move to Aleutian Range foothills. Both move north to wintering grounds in late summer. Movements of the southern subherd are more erratic, with groups drifting to calving grounds in spring (February-May) and to wintering grounds in fall (late August-December).

IV.

ENVIRONMENTAL CONSEQUENCES

IV. ENVIRONMENTAL CONSEQUENCES

A. Basic Assumptions for Effects Assessment

The development scenario used in the analysis of this lease area provides a hypothetical framework of assumptions and estimates on the numbers, development schedules, and locations of onshore and offshore oil and gas facilities. It represents assumptions that were made to identify characteristic activities and any resultant effects on the environment. These assumptions do not represent a Minerals Management Service recommendation, preference, or endorsement of any facility, site, or development plan.

The proposed action (Alternative I) would involve offering for lease 2.27 million hectares (990 blocks; Fig. II-1). Basic transportation assumptions assume a pipeline-transportation scenario and offshore-loading scenario used for the analysis of the proposal. A summary of exploration, development and production activities is indicated in Table IV-1.

Pipeline-Transportation Scenario:

- Gas production from one offshore platform would be transported by pipeline across the Port Moller/Balboa Bay transpeninsula-transportation corridor to an LNG Plant at Balboa Bay.

- Oil production from one offshore platform would be transported by pipeline across the Port Moller/Balboa Bay transpeninsula corridor to a transshipment terminal at Balboa Bay (Fig. II-2).

- Oil would be transported from the Balboa Bay transshipment terminal to markets by tankers of the 80,000-DWT class. Gas would be transported by LNG tankers of the 125,000-cubic-meter class directly to a Pacific Rim terminal.

- Marine support for offshore operations would be based in Unalaska, while Cold Bay would serve as the primary air-support base.

Offshore-Loading Scenario:

- Oil production from one platform would be offshore loaded on 80,000-DWT tankers and transported through Unimak Pass to markets.

- Gas production from one platform would be transported to shore and across the Port Moller/Balboa Bay transportation corridor to an LNG plant at Balboa Bay.

- Gas would be transported directly by LNG tankers of the 125,000-cubic-meter class to a hypothetical Pacific Rim LNG terminal.

- Marine support for offshore operations would be based in Unalaska, and Cold Bay could serve as the primary air-support site.

Table IV-1

Summary of Basic Scenario Assumptions Regarding
Estimated OCS-Related Activities in the North Aleutian Basin

PHASE Facility or Event	Number or Amount	Timeframe
Exploration		
Exploration Well Drilling	5	1986-1990
Delineation Well Drilling		
Oil	3	1988-1990
Gas	2	1989-1991
Total Drilling Muds and Cuttings		
Drilling Muds (Tons)	3,500-7,000	1986-1991
Cuttings (Tons)	10,500-15,500	1986-1991
Seismic Activity (Trackline Miles)	1,135	
Development and Production		
Oil		
Platforms	1	1990
Production and Service Wells	20	1990-1992
Production		
Total (MMbbls)	364	1993-2011
Peak		
Yearly (MMbbls)	31	1994-1999
Daily (Barrels)	84,932	1994-1999
Gas		
Platforms	1	1992
Production and Service Wells	12	1992-1993
Production		
Total (TCF)	2.62	1994-2016
Peak		
Yearly (TCF)	.126	1995-2012
Total Drilling Muds and Cuttings		
Drilling Muds (Tons)	1,344	1990-1993
Cuttings (Tons)	38,400-54,400	1990-1993
Seismic Activity (Trackline Miles)	227	
Support Activity for Development Phase		
Helicopter Flights		
Daily (per platform)	2-3	1990-1993
Yearly (per platform)	750-1,095	1990-1993
Supply Boat Trips		
Daily (per platform)	2-3	1990-1993
Yearly (per platform)	750-1,095	1990-1993
Barges (trips)	18	1990-1993
Support Activity for Production Phase		
Helicopter Flights		
Daily (per platform)	1	1993-2016
Yearly (per platform)	365	1993-2016
Support Boat Trips	As Needed	1993-2016
Seismic Activity (Trackline Miles)	227	
Production Waters (MMbbls)	3.64-327.5	1993-2011
Pipeline Disturbed Sediments (million cubic yards)	0.542-1.41	1991-1993

Table IV-1
Summary of Basic Scenario Assumptions Regarding
Estimated OCS-Related Activities in the North Aleutian Basin
(continued)

PHASE Facility or Event	Number or Amount	Timeframe
Transportation and Support Facilities		
(1) Pipeline-Transportation Scenario		
Marine Pipeline		
Oil (km)	190	1991-1992
Gas (km)	190	1992-1993
Onshore Pipeline		
Oil (km)	20	1991-1992
Gas (km)	20	1992-1993
Roads (km)	20	1991-1992
Seismic Activity (Trackline Miles)	845	1991-1992
Oil-Tanker Trips (80,000-DWT) from Balboa Bay Terminal		
Terminal-Call Rate	1 visit every 5-7 days	1993-2011
Yearly Rate	52-73	
Gas-Tanker Trips (125,000-cubic meter) from Balboa Bay LNG Plant		
Terminal-Call Rate	1 visit every 10-12 days	1994-2016
Yearly Rate	36-73	1994-2016
LNG Plant (Balboa Bay)	80 hectares	1989-1993
Marine Terminal (Balboa Bay)	25-30 hectares	1990-1994
Air-Support Base (Cold Bay)	1	Expansion
Marine-Support Base (Unalaska)	1	Expansion
(2) Offshore-Loading-Transportation Scenario		
Marine Pipeline		
Gas (km)	190	1992-1993
Onshore Pipeline		
Gas (km)	20	1992-1993
Roads (km)	20	1992-1993
Seismic Activity (Trackline Miles)	20	1992-1993
Oil Tanker Trips from Offshore-Loading Terminal		
Terminal Call Rate	1 visit every 5-7 days	1993-2011
Yearly Rate	52-73	
Gas Tanker Trips from LNG Terminal		
Terminal Call Rate	1 visit every 10-12 days	1994-2016
Yearly Rate	36-73	1994-2016
LNG Plant (Balboa Bay)	80 hectares	1990-1994
Air-Support Base (Cold Bay)	1	Expansion
Marine-Support Base (Unalaska)	1	Expansion
Offshore Oil Terminal	1	1989-1993

Table IV-1
Summary of Basic Scenario Assumptions Regarding
Estimated OCS-Related Activities in the North Aleutian Basin
(continued)

Expected and Assumed Number of Oil Spills
for the Proposal (Alternative I)
and the Alaska Peninsula Deferral
(Alternative IV)

	Expected number of oil spills equal to or greater than 1,000 barrels	Assumed number of oil spills equal to or greater than 1,000 barrels	Expected number of oil spills equal to or greater than 100,000 barrels	Assumed number of oil spills equal to or greater than 100,000 barrels
Proposal				
Pipeline-Transportation Scenario	0.94	1	0.03	0
Offshore-Loading-Transportation Scenario	1.10	1	0.04	0
Alaska Peninsula Deferral (Alternative IV)				
Pipeline-Transportation Scenario	0.86	1	0.03	0

Source: USDOI, MMS, 1984, 1985.

1. Industry Development Assumptions:

a. Development Timetable: The exploratory period would begin in 1986 and end 6 years after the lease sale, in 1991 (Table IV-2). Five exploration and five delineation wells (3 oil and 2 gas) are expected to be drilled. The average depth of these exploration and delineation wells is expected to be about 3,048 meters in the eastern and central portions of the lease area and 1,524 meters in the western portion.

If commercial quantities of oil were located during the exploratory period, planning and construction of the oil platform would start around 1987. Final placement would occur in the year 1990. During this period, one oil and one gas production platform would be installed and 20 oil and 12 gas production and service wells would be drilled (Table IV-2). The average depth of a production well could range from 3,566 meters in the central and eastern portions of the lease area to 1,981 meters in the western portion.

Pipeline-Transportation Scenario: A pipeline would connect offshore oil and gas production wells to a loading and storage transshipment terminal and LNG plant on Balboa Bay, on the southern coast of the Alaska Peninsula, via the Port Moller-Balboa Bay transpeninsula-transportation corridor. Pipeline construction could begin in 1991 and end in 1993 (Table IV-2). Total pipeline mileage would vary with location of production platforms; however, about 210 kilometers of oil pipeline and 210 kilometers of gas pipeline are projected. The Balboa Bay transshipment terminal would be completed in 1993, while the LNG plant would be completed by 1994.

Offshore-Loading Scenario: An offshore loading terminal would be completed in 1993 to load 80,000-DWT oil tankers for transportation of oil through Unimak Pass to markets. A pipeline would connect offshore gas-production wells to an LNG plant at Balboa Bay. Total pipeline mileage would vary with location of the gas platform; however, about 210 kilometers of gas pipeline are projected to be constructed in 1992 and 1993. An LNG plant would be completed by 1994.

Oil production is expected to begin in 1993, with peak annual production of 31 MMbbls occurring between 1994 and 1999 (Table IV-2). The volume of recoverable hydrocarbons is expected to decline gradually after 1999, with oil output ceasing in the year 2011. Gas production is expected to begin in 1994, with a peak annual production of .126 TCF between 1995 and 2012. The volume of gas is expected to decline after 2012, with gas output ceasing in the year 2016.

b. Anticipated Geophysical Activity: The actual level of postsale seismic activity on federal OCS leases in the North Aleutian Basin would depend on whether there were a discovery, the number of fields discovered, and the areal extent of the fields. In the initial exploratory drilling phase, several prospect wells would be drilled, and future drilling and related seismic work would depend on these results. If the results were negative, drilling and seismic activity probably would cease. It should be noted that regional seismic-survey activities are conducted before a lease sale, and site-specific geohazard surveys are conducted at specific drill sites. The level of site-specific geohazard surveys to be conducted in the lease sale area is estimated in the following paragraphs.

Table IV-2
Estimated Schedule of Development and Production
(Alternative I)

Year	Exploration Wells	Delineation Wells Oil	Delineation Wells Gas	Platforms Oil	Platforms Gas	Production & Service Wells Oil	Production & Service Wells Gas	Trunk Pipeline (Kilometers) Oil	Trunk Pipeline (Kilometers) Gas	Production Oil (MMbbls)	Production Gas (TCF)
1985											
1986	1										
1987	1										
1988	1	1									
1989	1	1	1								
1990	1	1		1		4					
1991			1			12		162			
1992					1	4	3	48	162		
1993							9		48	9	
1994										31	.100
1995										31	.126
1996										31	.126
1997										31	.126
1998										31	.126
1999										31	.126
2000										27	.126
2001										24	.126
2002										21	.126
2003										17	.126
2004										14	.126
2005										12	.126
2006										11	.126
2007										11	.126
2008										9	.126
2009										8	.126
2010										8	.126
2011										7	.126
2012										0	.126
2013										0	.100
2014										0	.074
2015										0	.049
2016										0	.029
2017										0	0
2018										0	0
2019										0	0
2020										0	0
Total	5	3	2	1	1	20	12	210	210	364	2.62

Source: USDOI, MMS, Revision of Exploration and Development Report, 1984.

The level of postsale seismic activity would depend on the number of exploratory and delineation wells drilled and the number of production platforms installed from which production wells would be drilled. These surveys would use high-resolution instruments to evaluate shallow geologic hazards for drill-site clearance. This EIS uses the mean-case resource estimate to predict levels of drill-site activity. That estimate also is used to predict levels of seismic activity: (1) a total of 10 exploratory and delineation wells would be drilled, and (2) a total of 32 production and service wells would be drilled from two production platforms. Postsale seismic activity for site-clearance work would occur at 12 sites.

The lessee has the option of running a geohazard survey, which involves 39 trackline miles of data, or a block-wide survey, which involves 188 trackline miles of data. Most surveys probably would be site-specific due to cost considerations, but for the estimates made here it is assumed that half of the surveys would be block-wide and half would be site-specific. Therefore, the estimate of total activity may be somewhat high. For the 12 sites, it is estimated that a total of 1,362 trackline miles would be surveyed. The actual level of activity may vary from this estimate for the following reasons: (1) the amount of recoverable petroleum may differ from the mean-case resource estimate; (2) the proportion of site-specific surveys to the more extensive block-wide surveys may differ from the 50/50 assumption made here; (3) fewer than 12 site surveys may be required due to production platforms being sited on abandoned exploratory well sites that already have been surveyed; (4) and more than 12 site surveys may be performed if site-clearance work is done on lease blocks that are never drilled.

The timing of seismic activities is related to industry drilling plans. Preliminary seismic work for both exploratory wells and production platforms would be completed in the early years of each drilling phase. Geophysical surveys probably would begin about 1 year prior to drilling, with several months' time lag for data collection, data-processing report preparation, and presentation of results to regulatory authorities before drilling can commence. Due to weather considerations in the proposed lease area, seismic data is usually collected in the summer months. Due to the logistics of mobilizing a survey vessel to the remote Bering Sea area, most surveys probably would not begin before late May. Most survey activity probably would occur in July and August and terminate by late September. Some preliminary seismic data could be acquired during the remainder of the year if the lessee were willing to pay the high costs of downtime due to bad weather.

Geophysical surveys probably would begin in the first summer after award of leases. Due to the expense of surveying in the proposed lease area, several sites would be surveyed by the same vessel. It is unlikely that more than two vessels would be involved in drill-site clearance in any given year. The estimated average time required to survey a site is 1 week, allowing for downtime due to bad weather and equipment failure. For the first 6 years, an estimated one or two sites per year would be surveyed for the 10 exploration and delineation wells. For the two production-platform sites, one site probably would be surveyed in the fifth year and one in the eighth year after award of leases.

Pipeline-Transportation Scenario: In the event that economically recoverable oil and gas deposits were discovered, two 210-kilometer pipelines would be installed between the production platforms and an onshore terminal. Assuming 20 kilometers of overland routing for each line and 40 kilometers of shared routing in Herendeen Bay, a total of 340 kilometers of pipeline route would require surveying. Prior to pipeline installation, an estimated 4 kilometers of high-resolution seismic survey would be required for each kilometer of planned offshore pipeline. This represents an additional 1,360 kilometers (845 miles) of high-resolution seismic survey, which probably would be run either concurrently with drilling discoveries or in the first 1 or 2 years following a discovery. In summary, anticipated seismic activity in the 10-year period following the North Aleutian Basin lease sale would be less than 5 percent of the total seismic-survey activity in the presale period. These planned site-clearance seismic surveys also would be relatively localized compared to the previous regional exploration surveys, and the majority of post-lease seismic surveys also would involve higher-frequency and lower-intensity sound sources than previous regional surveys.

Offshore-Loading Scenario: In the event that economically recoverable oil and gas deposits were discovered, one 210-kilometer pipeline would be installed between the gas-production platform and an LNG terminal. Oil would be loaded offshore; thus a pipeline would not be required. Assuming 20 kilometers of overland routing for the pipeline, a total of 190 kilometers of offshore pipeline route would require surveying. Prior to pipeline installation, an estimated 4 kilometers of high-resolution seismic survey would be required for each kilometer of planned offshore pipeline. This represents an additional 760 kilometers (472 miles) of high-resolution seismic survey, which would be run either concurrently with drilling discoveries or in the first 1 or 2 years following a discovery.

c. Exploration-Infrastructure Estimates: During the exploratory phase, Unalaska and Cold Bay probably would serve as marine- and air-support bases, respectively.

Almost all marine-support operations could be conducted out of Unalaska. A strategic location near Unimak Pass, a good natural anchorage, and an existing infrastructure make Unalaska the best choice for a marine-support facility. Barges and/or container ships would offload bulk drilling materials (fuel, cement, mud, tubular goods, etc.) at Unalaska for storage and reloading onto supply boats. During the exploratory period Unalaska is expected to serve a maximum of two drilling rigs in any 1 year. Support boats from Unalaska would reach drilling rigs at least once every 2 days.

Cold Bay could serve as the primary air-support site. Existing airport facilities include two paved runways (3,175 and 1,562 meters), which are equipped with navigational aids, a complete lighting system, and adequate space for transit aircraft. Personnel and equipment could arrive via fixed-wing aircraft and be transported to exploration rigs via helicopters such as Bell 212's and/or Sikorsky S-61's. A small support facility--containing a hangar/warehouse complex, offices, and a helipad--could be constructed near the airport. During exploration, the Cold Bay airfield would support a maximum of two drilling rigs in any one season. Between 1986 and 1991, drilling rigs would be served at least once a day by helicopter-support flights.

Exploratory drilling is within the operational capabilities of semisubmersibles, drillships, and jackup rigs (in shallower areas). Due to the possibility of sea ice between January and April, reinforced drillships supported by icebreakers could make winter drilling feasible. Dynamically positioned semisubmersibles or drillships, possibly supported by icebreakers, also could be a winter-drilling option (Dames and Moore, 1980).

d. Development- and Production-Infrastructure Estimates: All marine-support operations would continue to operate out of Unalaska. Bulk drilling materials (cement, mud, tubular goods) would arrive by barge from Unalaska via Unimak Pass. Assuming the use of barges of the 6,000-short-ton class, 18 barges containing drilling materials, fuel, and tubular goods would enter the area between 1990 and 1993. In the development phase, each platform would be serviced at least once, if not twice, a day by workboats from Unalaska. During the production phase, supply-boat traffic would be expected to decrease to an as-needed basis.

It is not expected that Unalaska would provide air support for offshore drilling operations; air operations would occur only as a result of Unalaska's marine-support role. Air traffic would be limited to supply-boat crews and administrative and support-base crews flying to their work stations.

Cold Bay would serve as an air-support base during the development and production phases. Personnel and equipment could be transferred between the support base and two platforms by long-range helicopters, such as the Boeing 234. Helicopter-support trips could average two to three trips every day during the development phase and one trip per day during production.

Pipeline-Transportation Scenario: This development scenario is centered around the use of two pipelines to transport oil and gas resources from two (one oil and one gas) production platform (steel-gravity and/or steel-jacket) to a transshipment terminal at Balboa Bay on the southern coast of the Alaska Peninsula.

Two pipelines, each approximately 210 kilometers long, could be necessary to transport oil and gas from the production platforms to the Balboa Bay terminal. The Bristol Bay Regional Management Plan (BBRMP, 1985) and the Bristol Bay Area Plan (State of Alaska, 1984) identified a preferred transpeninsula transportation corridor from Herendeen Bay to Balboa Bay and recommended that it be developed for industrial and private use. Assuming that the pipeline were permitted, certain land-use restrictions might apply. The route would extend from Port Moller through Portage Valley to Balboa Bay. Depending on the port site selected, the route could range from 55 to 69 kilometers long. Port Moller and Herendeen Bays are shallow, with extensive mudflats and water depths averaging less than 4 meters; water depths in channels can exceed 18 meters. The pipeline is assumed to be buried for 8 to 13 kilometers in the Port Moller/Herendeen Bay area. The overland pipeline route (about 20 km) follows the righthand fork of Portage Valley River and descends into a narrow valley drained by Foster Creek into Left Hand Bay of Balboa Bay (Fig. II-2). The Bay--4 kilometers wide and 6.4 kilometers long--is considered a good anchorage for large vessels. A pipeline and construction-access road probably would require a 100- to 200-foot right-of-way (BBRMP, 1985). Pipeline development and maintenance would require air, ground, and marine support, which could include helicopter, other aircraft, bulldozers, all-terrain vehicles, barges, and ships. Pipeline construction is expected to begin in 1991 and to be completed in 1993.

By 1993, a major storage and loading terminal for oil tankers would need to be completed in the Balboa Bay area. The terminal, requiring about 25 to 30 hectares of land, should have onshore storage for up to 10 days of crude production and be able to handle a maximum production rate of about 85 Mbbls of oil daily. Tanker loading would occur every 5 to 7 days, with tanker size estimated to be 80,000 DWT. The terminal also would contain a small LNG facility which would liquefy natural gas with an air-, rather than a water-cooled, method. Small LNG tankers of the 125,000-cubic-meter class would visit the facility every 10 to 12 days. The terminal also would require air-support facilities to shuttle personnel from Cold Bay. The facility is expected to be self-contained and to possess all needed infrastructure (i.e., living quarters, sewage-treatment, electrical-generation, and ballast-water-treatment facilities).

Offshore-Loading Scenario: This development scenario is centered around the use of an offshore-loading terminal to transfer oil to tankers operating directly to markets. Gas would be transported by a pipeline to an LNG plant at Balboa Bay on the southern coast of the Alaska Peninsula.

By 1993, an offshore-loading terminal would need to be in place. Tankers estimated to be 80,000-DWT would load at the terminal every 5 to 7 days.

Gas would be transported from one gas-production platform to an LNG plant at Balboa Bay, following the Port Moller/Balboa Bay transportation corridor. The pipeline route is described in detail in the preceding section (Pipeline-Transportation Scenario).

A small LNG facility (80 hectares) at Balboa Bay would liquefy natural gas with an air-, rather than a water-cooled, method. Small LNG tankers of the 125,000-cubic-meter class would visit the facility every 10 to 12 days. The terminal also would require air-support facilities to shuttle personnel from Cold Bay. The facility is expected to be self-contained and to possess all needed infrastructure (i.e., living quarters, sewage-treatment, electrical-generation, and ballast-water-treatment facilities).

e. Estimates of Drilling Muds, Cuttings, and Formation Waters Produced during Drilling Operations and Sediments Disturbed by Pipelaying Activities: As a result of the proposed action, 10 exploration/delineation wells, 32 production wells, two platforms, and approximately 380 kilometers of offshore pipeline are estimated (Table IV-2).

The average exploratory well in the central and eastern portions of the proposed lease area would use about 700 tons of mud solids and produce about 1,550 tons of drill cuttings. In the western part of the area, an average exploration well would use about 350 tons of mud solids and produce about 1,050 tons of drill cuttings (USDOI, MMS, Exploration and Development Report, 1983). Between 1986 and 1991, exploration/delineation-well-derived mud solids and drill cuttings could range between 3,500 and 7,000 tons and 10,500 and 15,500 tons, respectively (Table IV-3). Drilling muds are recirculated during drilling and discharged into the marine environment in the vicinity of the

Table IV-3
Scenario Estimates of Possible Effluent Discharges Due to OCS Activities
as a Result of the North Aleutian Basin (Sale 92) Hydrocarbon Development

Year	Formation Waters (MMbbls)	Exploration- and Delineation- and Production-Well-Derived Solids: Cuttings (tons) Exploration and Delineation	Cuttings (tons) Production	Muds (tons) Exploration and Delineation	Muds (tons) Production 1/	Platform-Derived Domestic and Sanitary Wastes (gal/day)	Sediments Disturbed by Pipelaying Activities (yd^3)
1985	-	-	-	-	-	-	-
1986	-	1,050-1,550	-	350- 700	-	-	-
1987	-	1,050-1,550	-	350- 700	-	-	-
1988	-	2,100-3,100	-	700-1,400	-	-	-
1989	-	3,150-4,650	-	1,050-2,100	-	-	-
1990	-	2,100-3,100	4,800- 6,800	700-1,400	168	5,500	-
1991	-	1,050-1,550	14,400-20,400	350- 700	504	5,500	231,000-602,000
1992	-	-	8,400-11,900	-	294	11,000	271,000-706,000
1993	.090- 8.1	-	10,800-15,300	-	378	11,000	40,000-104,000
1994	.310-27.9	-	-	-	-	11,000	-
1995	.310-27.9	-	-	-	-	11,000	-
1996	.310-27.9	-	-	-	-	11,000	-
1997	.310-27.9	-	-	-	-	11,000	-
1998	.310-27.9	-	-	-	-	11,000	-
1999	.310-27.9	-	-	-	-	11,000	-
2000	.270-24.3	-	-	-	-	11,000	-
2001	.240-21.6	-	-	-	-	11,000	-
2002	.210-18.9	-	-	-	-	11,000	-
2003	.170-15.3	-	-	-	-	11,000	-
2004	.140-12.6	-	-	-	-	11,000	-
2005	.120-10.8	-	-	-	-	11,000	-
2006	.110- 9.9	-	-	-	-	11,000	-
2007	.110- 9.9	-	-	-	-	11,000	-
2008	.090- 8.1	-	-	-	-	11,000	-
2009	.080- 7.2	-	-	-	-	11,000	-
2010	.080- 8.1	-	-	-	-	11,000	-
2011	.070- 6.3	-	-	-	-	11,000	-
2012	-	-	-	-	-	11,000	-
2013	-	-	-	-	-	5,500	-
2014	-	-	-	-	-	5,500	-
2015	-	-	-	-	-	5,500	-
2016	-	-	-	-	-	5,500	-
Totals	3.640-327.5	10,500-15,500	38,400-54,400	3,500-7,000	1,344	11,000 2/	0.542-1.41 Million yd^3

Sources: USDOI, MMS, Exploration and Development Report, 1983; USDOI, MMS, Revision of Exploration and Development Report, 1984.

1/ Amount of mud solids used to drill 20 oil-production wells from one platform between the years 1990-1992 and 12 gas-production wells from one platform between 1992 and 1993 is based on the assumption that muds would be recycled between wells. It is assumed that about 10 percent of mud solids used per well would be lost in the well bore.

2/ Daily average for two platforms.

rigs, usually after the well casings are set or as the wells are completed. Drill cuttings also are discharged into the marine environment in the immediate vicinity of the rigs.

The average production well in the central and eastern portions of the proposed lease area would use about 850 tons of mud solids and produce about 1,700 tons of drill cuttings. A production well in the western part of the area would use about 450 tons of mud solids and produce about 1,200 tons of drill cuttings (MMS, 1983). Between 1990 and 1993, production-well-derived drill cuttings could range between 38,400 and 54,400 tons. Approximately 1,344 tons of mud solids could be used during this period (Table IV-3).

Formation waters could be produced from production wells over the life of the field. Between 1993 and 2011, the amount of formation waters produced could range from 3.640 to 327.5 MMbbls (Table IV-3).

Offshore-pipeline development in the years 1991 through 1993 could result in the disturbance of between 0.542 and 1.41 million cubic yards of sediment. However, this would occur only if and to the extent that trenching methods were used for emplacement of pipelines on the seafloor (Table IV-3).

During the development drilling and production phases (1990-2016), an average of 11,000 gallons per day of treated sanitary and domestic wastes is expected to be produced on the two production platforms (Table IV-3) and would be discharged in the immediate vicinity of the platforms.

2. Community Population Assumptions: The scenario for the proposal identifies the communities of Unalaska and Cold Bay as potential hosts for petroleum-industry personnel and operations. Potential levels of employment and population growth were projected for these communities (1) over the life of the lease conditions of the proposal, and (2) in the absence of the lease sale (the base case), using the Rural Alaska Model of the Institute of Social and Economic Research, University of Alaska (Knapp et al., 1984). The base-case projections were discussed in Section III.C.; this discussion contrasts the projections under conditions of the proposal with conditions under the base case.

The population projections associated with the lease sale for Unalaska and Cold Bay are found in Appendix C. The net differences between the base-case projection (in the absence of the lease sale) and the projections under conditions of the proposal are shown in Tables IV-4 and IV-5. According to these data, the net effect of the proposed lease sale on population, as an incremental addition to the base case, would be to increase resident population in Unalaska by from 2 to 7 percent and in Cold Bay by from 1 to 31 percent. In 1985, the lease-sale-related enclave population in Unalaska would account for not more than 6 percent of total enclave population. After 1985, the industry enclave population attributed to OCS operations would decrease. Between the years 1995 and 2010, the enclave population would be zero. Project-related enclave population in Cold Bay would constitute a high proportion of total enclave population in 1985 (25%) and 1990 (63%). However, this population would account for less than 23 individuals. The proportion of Alaska Natives to the total resident population would decline marginally in Unalaska (1% or less) as a result of the lease sale. Due to the general absence of Alaska Natives in Cold Bay, decline in this population segment is not measurable.

Table IV-4
Base- and Lease-Sale-Case Projections
of Resident, Enclave, and Alaskan
Native Populations for the City
of Unalaska

Resident Population

Year	Base Case	Lease-Sale Case	Added by Lease Sale	Percentage of Total
1985	756	779	22	2.8
1990	975	996	21	2.1
1995	1,427	1,536	109	7.1
2000	2,235	2,341	106	4.5
2005	2,224	2,326	102	4.4
2010	2,220	2,317	97	4.2

Enclave Population

Year	Base Case	Lease-Sale Case	Added by Lease Sale	Percentage of Total
1985	322	341	19	5.6
1990	711	744	33	4.4
1995	1,555	1,565	0	0
2000	1,776	1,776	0	0
2005	1,776	1,776	0	0
2010	1,776	1,776	0	0

Alaska Native Population as a Percentage
of Total Resident Population

Year	Base Case (percent)	Lease-Sale Case (percent)	Difference (percent)
1985	30.2	29.3	0.9
1990	26.2	25.6	0.6
1995	19.7	18.3	1.4
2000	13.9	13.2	0.7
2005	15.3	14.7	0.8
2010	16.9	16.2	0.7

Source: Knapp, 1984.

Table IV-5
Base- and Lease-Sale-Case Projections
of Resident and Enclave Populations
for the City of Cold Bay

Resident Population

Year	Base Case	Lease-Sale Case	Added by Lease Sale	Percentage of Total
1985	186	188	2	1.1
1990	159	161	2	1.2
1995	156	277	71	31.3
2000	211	282	71	25.2
2005	210	279	69	24.7
2010	209	276	67	24.3

Enclave Population

Year	Base Case	Lease-Sale Case	Added by Lease Sale	Percentage of Total
1985	76	101	25	24.8
1990	16	43	27	62.8
1995	10	10	0	0
2000	0	0	0	0
2005	0	0	0	0
2010	0	0	0	0

Source: Knapp, 1984.

3. Oil-Spill-Risk Analysis:

a. Estimated Quantity of Resource: Considerable uncertainty exists in estimating the volume of oil that may be discovered and produced as a result of an OCS lease sale. The oil-resource estimate used for the oil-spill-risk calculations in this EIS corresponds to a mean-case estimate. There is, however, an important qualification in the way that these calculations are used in this EIS. The resource estimates used in predicting the number of spills expected over the life of the field, and in the oil-spill-risk analysis for this EIS, are based on the "unrisked" mean estimates. This is the assumption that the resource will be discovered. Obviously, if hydrocarbons are not discovered, there would be no risk of a crude oil spill. The projected number of spills and, accordingly, the results of the oil-spill-risk analysis, reflect the expected oil-spill risks based on a mean resource of 0.364 Bbbls of oil for the proposal and 0.331 Bbbls of oil for Alternative IV.

b. Probability of Oil Spills Occurring: The probability of oil-spill occurrence is based on the fundamental assumption that realistic estimates and future spill frequencies can be based on past OCS experience. This analysis assumes that spills occur independently of each other, and that the spill rate depends on the volume of oil produced or transported. This last assumption--spill rate as a function of the volume of oil handled--might be modified on the basis of size, extent, frequency, or duration of the handling. Our analysis, with one exception for tanker spills, uses volume of oil handled, because other bases for estimates of spill frequency are necessarily derived from this quantity.

Spill Size: This analysis examines spills in two size ranges: 100,000 barrels or greater (being representative of a worst-case spill) and 1,000 barrels or greater (which also includes 100,000-barrel-or-greater spills). To place these sizes in perspective to the type of accident usually involved, spills in the larger category are generally associated with catastrophies, such as large blowouts or shipwrecks. Spills in the smaller category typically include these and other serious events, such as structural failures and collisions. The choice of the spill size to use depends upon the analysis to be performed. For example, if a particular effect could occur only from a massive oil slick, then only larger spills are examined. The spill statistics in this analysis were derived from Lanfear and Amstutz (1983).

Spills of an even smaller size occur more frequently than 1,000-barrel-or-greater spills but individually have a very low persistence or environmental effect. The causes of these small spills differ from those of larger spills; small spills tend to be caused by human error or carelessness and can be considered potentially mitigable by, for example, compliance with OCS operating orders concerning training or operating procedures. These small spills are not included as an additional category in the trajectory analysis, but are instead considered in Section IV.F.1. in a discussion of their effects on water quality.

Platform: Accident rates for platforms on the U.S. OCS were derived from U.S. OCS accident files and from USGS production records for 1964 through 1980. To date, there have been neither OCS oil production nor an OCS spill of 1,000 barrels or greater offshore of Alaska. All OCS production and major spillage have occurred either in the Gulf of Mexico or offshore of California. Between

1964 and 1980, there were no spills of 100,000 barrels or more; however, there were 12 spills of at least 1,000 barrels. During this period, U.S. OCS oil production was 4.42 Bbbls. This spill record demonstrates a statistically significant decrease in platform spills in more recent years. This decreasing trend has been incorporated into the platform-spill statistic, which now projects 1.0 spills of 1,000-barrels-or-greater per billion barrels of oil produced. A size-frequency correlation for spills indicates a projected spill frequency for 100,000-barrel-or-greater spills of 0.036 spills per billion barrels of oil produced (Lanfear and Amstutz, 1983).

Pipelines: As with platforms, the period from 1964 through 1980 was used to construct the OCS spill statistic. Our records include 1 spill of 100,000 barrels or greater and 8 spills of 1,000 barrels or greater (including the one of 100,000 barrels). The pipeline-spill rate has not improved over time, nor is there a good statistical correlation between pipeline length and frequency of spill occurrence. Because nearly all U.S. OCS production has been transported to shore by pipeline, the same production statistics used for platforms can be applied to the pipeline-accident rate, giving 1.6 spills of 1,000 barrels or more and 0.065 spills of 100,000 barrels or more per billion barrels transported.

Tankers: Tanker statistics require a different data base, derived from the worldwide tanker record. Comparison of post-1974 data with older spill records indicates that a sharp drop in spill rate occurred around 1974. The use of 1974-1980 data has significantly reduced the number of projected spills for tankers from that assumed in earlier EIS's. This revised data base also has enabled computation of spill-rate statistics for tankers at sea--in open, restricted, or unknown waters (including offshore loading)--and for tankers in port. At sea, 0.9 spills of 1,000 barrels or greater and 0.19 spills of 100,000 barrels or greater are projected per billion barrels transported. Per port call, 0.2 spills of 1,000 barrels or greater and 0.042 spills of 100,000 barrels or greater are projected per billion barrels of oil transported.

The reason for the drop in spill statistics for tankers and platforms is undemonstrated. Combinations of increased industry concern; increased public input or pressure; stricter regulations; and better, more advanced technology have been postulated but not statistically proven. In summary, the spill-rate statistics used in this document are as follows:

Table IV-6
Spills per Billion Barrels

	1,000 Barrels or greater	100,000 Barrels or greater
Platforms	1.0	0.036
Pipelines	1.6	0.065
Tankers		
At Sea	0.9	0.190
Per Port Call	0.2	0.042

Source: USDOI, MMS, Alaska OCS Region, 1984.

The projected number of spills is, therefore, the product of the appropriate spill-rate statistic and the projected amount of oil found and produced.

The Alaskan Record: Are these rate constants applicable to Alaska, since most of the existing data are from temperate climates? Because OCS statistics are compiled as "number of spills per volume of oil produced," the only possible comparisons of OCS statistics with Alaskan data are for the state-leased offshore Cook Inlet and onshore Prudhoe Bay/Kuparuk fields. Based on OCS spill statistics, and assuming that Alaska also experienced the post-1974 improvement in platform and tanker (not pipeline) performance seen in OCS statistics, the numbers of spills that would be projected for the Cook Inlet and Prudhoe Bay/Kuparuk fields are shown below:

Table IV-7
Number of 1,000-Barrel-or-Greater Oil Spills in Alaska
(through August 1983)

	Cook Inlet		Prudhoe Bay/Kuparuk	
	Projected	Observed	Projected	Observed
Platforms	1.79	0	3.0	1-3 1/
Pipelines	1.28	2 2/	4.8	6
Tankers	2.06	2	3.9	1
Total	5.13	4	11.7	10

Source: USDOI, MMS, Alaska OCS Region, 1984.

1/ Includes two airfield spills.
2/ From Gulf Research and Development Company, 1982.

For Cook Inlet, the probability of observing 0 (zero) platform spills is 17 percent. The above calculations indicate that we would have projected 5.1 spills to occur as a result of production and transportation of oil in Cook Inlet. In fact, 4 spills were observed. The probability of observing only 0 to 4 spills overall is 42 percent, almost an even chance. Thus, the OCS oil-spill-occurrence statistics applied to Cook Inlet production show a reasonable agreement with the observed number of spills.

The OCS statistics project 11.7 spills for Prudhoe Bay/Kuparuk production and transportation; we observed 10. OCS statistics projected 3 platform spills, and 1 to 3 spills (depending upon inclusion of airfield spills) were observed. We projected 4.8 pipeline spills; we observed 6. We projected 3.9 tanker spills; we observed 1. The probability of observing 0 to 1 platform spills is 20 percent, and the probability of observing 1 to 3 platform spills is 60 percent. The probability of observing 5 to 7 pipeline spills is 41 percent. The probability of observing 0 to 2 tanker spills is 25 percent. The probability of observing 0 to 10 spills overall is 38 percent.

In conclusion, the Alaskan record does not seem to be significantly different from that of the U.S. OCS.

Transportation Assumptions: The effects analyses for this proposed lease sale are based on a mean-case resource estimate. The all-pipeline-transportation scenario (within the sale area) that was chosen for analysis proposes to move the produced oil through offshore pipelines to Herendeen Bay, where it would be pipelined across the Alaska Peninsula to a transshipment facility in Balboa Bay. Graphic 5 depicts the modeled study area, the proposed sale area, and the launch points (points representing possible platform locations, pipeline routes, or tanker routes from which hypothetical oil spills originate) used in this analysis. Additionally, Figure II-2 shows the assumed pipeline-transportation scenario to be analyzed; this scenario is designated as the pipeline scenario in the OSRA tables.

An offshore tanker-loading scenario also was analyzed for this proposed lease sale. In this scenario, oil produced from proposed Sale 92 is offshore loaded at Launch Point B3 (see Graphic 5); tankered west through Launch Points D1, B2, B1, A1, F1, P20, and E24; through Unimak Pass; and then directly to market. This scenario is designated as the offshore-loading scenario.

In addition to the proposed action (Alternative I), a single block-deferral alternative is considered. Alternative IV, the Alaska Peninsula Deferral, defers all blocks within 40 kilometers of the Alaska Peninsula. The pipeline-transportation and offshore-loading scenarios assumed for Alternative I also are assumed for Alternative IV.

Projected Spillage: Spill-frequency estimates were calculated for production and transportation of oil from the North Aleutian Basin. Based on the spill rates previously described, Table IV-8 shows the statistically expected number of spills that could occur during the expected production life of this lease sale. The numbers of spills were calculated for the unrisked mean resource. For the purposes of the analysis, one must assume that the estimated resource would be found and produced. Note that spills of 1,000 barrels or greater are expected to occur 20 to 25 times as frequently as the larger spills of 100,000 barrels or greater.

Based on the proposed action, there is a 61- to 67-percent chance of 1 or more spills of 1,000 barrels or more occurring over the life of the North Aleutian Basin lease area, depending upon the transportation scenario. The expected number of spills of 1,000 barrels or greater is 0.94 for the pipeline scenario and 1.10 for the offshore-loading scenario. The probabilities decrease to 3 and 7 percent, respectively, for a spill of 100,000 barrels or greater. Probabilities of a spill in the Alaska Peninsula Deferral Alternative are slightly lower than in the proposed action.

Most Likely Number of Spills: For most of the subsequent analysis, we will use the "probability of 1 or more spills" occurring or contacting a resource. For situations where the probability of 2 or more spills becomes greater than the probability of 1 spill, we will in addition refer to and use the "most likely number of spills." The most likely number of spills is not the same as the expected number, nor is it necessarily the same as the expected number rounded off. For example, for the proposed action, pipeline scenario, the projected 0.94 spills of 1,000 barrels or greater does not mean that the most

Table IV-8
Oil-Spill Probability Estimates for Spills Greater than 1,000 and 100,000 Barrels Resulting over the Expected Production Life of the North Aleutian Basin, Prior and Future Lease Sales, and Canadian Tankering

	Expected number of spills from platforms 1,000 Barrels or Greater	Expected number of spills from platforms 100,000 Barrels or Greater	Expected number of spills from transportation 1,000 Barrels or Greater	Expected number of spills from transportation 100,000 Barrels or Greater	Total number of spills 1,000 Barrels or Greater	Total number of spills 100,000 Barrels or Greater	Probability of 1 or more spills (platforms) 1,000 Barrels or Greater	Probability of 1 or more spills (platforms) 100,000 Barrels or Greater	Probability of 1 or more spills (transport.) 1,000 Barrels or Greater	Probability of 1 or more spills (transport.) 100,000 Barrels or Greater	Probability of 1 or more spills (total) 1,000 Barrels or Greater	Probability of 1 or more spills (total) 100,000 Barrels or Greater
NORTH ALEUTIAN BASIN SALE 92												
Proposed Action (0.364)*												
Pipeline Scenario	0.36	0.01	0.58	0.02	0.94	0.03	0.30	0.01	0.44	0.02	0.61	0.03
Offshore Loading Scenario	0.36	0.01	0.74	0.06	1.10	0.07	0.30	0.01	0.52	0.03	0.67	0.07
Alaska Peninsula Deferral (0.331)*												
Pipeline Scenario	0.33	0.01	0.53	0.02	0.86	0.03	0.28	0.01	0.41	0.02	0.58	0.03
Offshore Loading Scenario	0.33	0.01	0.68	0.05	1.01	0.06	0.28	0.01	0.49	0.05	0.64	0.06
CUMULATIVE CASE												
ST. GEORGE BASIN												
(SALE 70) (0.570)*	0.57	0.02	1.23	0.07	1.80	0.09	0.43	0.02	0.71	0.06	0.83	0.08
(SALE 89) (1.124)*	1.12	0.04	2.42	0.20	3.54	0.24	0.67	0.04	0.91	0.18	0.97	0.21
NORTON SOUND												
(SALE 57) (0.470)*	0.47	0.02	1.06	0.09	1.53	0.11	0.37	0.02	0.65	0.09	0.78	0.10
(SALE 100) (0.282)*	0.28	0.01	0.63	0.06	0.91	0.07	0.24	0.01	0.47	0.06	0.60	0.07
NAVARIN BASIN												
(SALE 83) (1.510)*	1.51	0.05	3.40	0.31	4.91	0.36	0.78	0.05	0.97	0.27	0.99	0.30
(SALE 107) (3.28)*	3.28	0.12	6.72	0.52	10.00	0.64	0.96	0.11	0.99+	0.41	0.99+	0.47
TANKERING OF CANADIAN OIL (1.7)*	-	-	0.77	0.16	0.77	0.16	-	-	0.54	0.15	0.54	0.15

*Volume of oil in billion barrels.

Source: USDOI, MMS, 1984.

likely number of spills would be one. The most likely number of spills is calculated from the Poisson probability distribution and the expected number. There is a finite probability of having 0, 1, 2, 3, 4, 5 spills, etc. The number of spills with the highest probability of occurrence is the mode, or most likely number. Probabilities of the most likely and other numbers of spills are listed in Figures IV-1 and IV-2 for the proposal and cumulative case. The probability and number of spills for Alternative IV would be almost identical to those for the proposal. In practice, the result of the mathematical operation of calculating the most likely number from the expected number of spills is identical to rounding the expected number down to the nearest whole number. The proposed action, pipeline scenario, with an expected number of 0.94 spills, has a most likely number of zero spills of 1,000 barrels or greater.

c. Oil-Spill-Trajectory Simulations: Oil-spill trajectories for the proposal and the block-deferral alternative were simulated by the Rand Corporation in Santa Monica, California, using Rand's three-dimensional circulation model (Liu and Leendertse, 1979; 1981a,b,c; 1983a,b). The model is based on well understood physical relationships between tidal and wind-driven currents and is well documented (Liu and Nelson, 1977; Leendertse and Liu, 1978; Liu and Leendertse, 1978; 1979; 1981a,b,; 1983a,b). This model was initially developed for use in Bristol Bay and reflects over 10 years of continued development and refinement plus an equivalent number of years of model-related oceanographic studies. The model has been cited by the scientific community (Pearson et al., 1981) and has been referenced as "probably one of the most sophisticated circulation models for the Alaskan OCS" (Huang and Monastero, 1982).

The stochastic wind model (Fig. IV-3) was developed by the Rand Corporation, because the lack of marine-wind data over the vast coastal area of the Alaska OCS prevents the simpler approach of using observed wind roses for computing currents and slick trajectories. Currents generated from the sparse wind data contain error components that lead to serious problems in maintaining the mass conservation law of the computed current field over a large area.

To avoid such problems, and of necessity, Rand uses synoptic climatology and storm-track climatology. Rand uses these climatologies with corrections so that wind roses produced by the model agree with observed wind roses at areas with measured data. Synoptic climatology provides a continuous wind field over the area, including the zonal and meridianal variation of the entire Alaskan offshore. During model development, the Department of the Interior funded special studies to correlate the observed land winds versus the observed marine winds measured at the different buoy networks in the Bering and Beaufort Seas. The Bering Sea studies were conducted by Dr. Overland of NOAA. Variabilities of wind speed and direction associated with each weather pattern were then added for each month of the year. In deriving these variabilities, Rand used standard probability distributions adapted by the U.S. Weather Service.

In the storm-track computation, gradient winds computed from the pressure distribution were corrected for marine boundary layer effects associated with the average seasonal air-sea temperature differences over each computational grid. In the process, Rand used published update (1984) information on the shear-stress coefficients, as well as the most efficient method for computing the equation of state for moist air. Each of these two parameters can have

Figure IV-1

Distribution of Spills for the Proposal
and the Cumulative Case for Spills of 1,000 Barrels or Greater

---

```
EXPECTED NUMBER (MEAN) =  0.94                 Proposed Action, Pipeline Scenario
PROBABILITY OF ONE OR MORE =  61%
MOST LIKELY (MODE) =  0

                               10%  20%  30%  40%  50%  60%  70%  80%  90%
                           +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 = 39.06%  0 I********************
PROB. OF  1 = 36.72%  1 I******************
PROB. OF  2 = 17.26%  2 I*********
PROB. OF  3 =  5.41%  3 I***
PROB. OF  4 =  1.27%  4 I*
```

```
EXPECTED NUMBER (MEAN) =  1.10                 Proposed Action, Offshore Loading
PROBABILITY OF ONE OR MORE =  67%              Scenario
MOST LIKELY (MODE) =  1

                               10%  20%  30%  40%  50%  60%  70%  80%  90%
                           +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 = 33.29%  0 I*****************
PROB. OF  1 = 36.62%  1 I******************
PROB. OF  2 = 20.14%  2 I**********
PROB. OF  3 =  7.38%  3 I****
PROB. OF  4 =  2.03%  4 I*
```

```
                                               Cumulative Case

EXPECTED NUMBER (MEAN) = 24.40
PROBABILITY OF ONE OR MORE = greater than 99.5%
MOST LIKELY (MODE) = 24

                               10%  20%  30%  40%  50%  60%  70%  80%  90%
                           +----+----+----+----+----+----+----+----+----+----+
PROB. OF 14 =  0.77% 14 I
PROB. OF 15 =  1.25% 15 I*
PROB. OF 16 =  1.91% 16 I*
PROB. OF 17 =  2.74% 17 I*
PROB. OF 18 =  3.71% 18 I**
PROB. OF 19 =  4.77% 19 I**
PROB. OF 20 =  5.82% 20 I***
PROB. OF 21 =  6.76% 21 I***
PROB. OF 22 =  7.50% 22 I****
PROB. OF 23 =  7.96% 23 I****
PROB. OF 24 =  8.09% 24 I****
PROB. OF 25 =  7.89% 25 I****
PROB. OF 26 =  7.41% 26 I****
PROB. OF 27 =  6.70% 27 I***
PROB. OF 28 =  5.83% 28 I***
PROB. OF 29 =  4.91% 29 I**
PROB. OF 30 =  3.99% 30 I**
PROB. OF 31 =  3.14% 31 I**
PROB. OF 32 =  2.40% 32 I*
PROB. OF 33 =  1.77% 33 I*
PROB. OF 34 =  1.27% 34 I*
PROB. OF 35 =  0.89% 35 I
PROB. OF 36 =  0.60% 36 I
```

Source: USDOI, MMS, 1985.

Figure IV-2

Distribution of Spills for the Proposal and the
Cumulative Case for Spills of 100,000 Barrels or Greater

```
EXPECTED NUMBER (MEAN) =  0.03                Proposed Action, Pipeline Scenario
PROBABILITY OF ONE OR MORE =  3%
MOST LIKELY (MODE) =  0

                            10%  20%  30%  40%  50%  60%  70%  80%  90%
                         +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 = 97.04%   0 I*************************************************
PROB. OF  1 =  2.91%   1 I*
```

```
EXPECTED NUMBER (MEAN) =  0.07                Proposed Action, Offshore Loading
PROBABILITY OF ONE OR MORE =  7%              Scenario
MOST LIKELY (MODE) =  0

                            10%  20%  30%  40%  50%  60%  70%  80%  90%
                         +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 = 96.11%   0 I***********************************************
PROB. OF  1 =  6.65%   1 I***
```

```
EXPECTED NUMBER (MEAN) =  1.70                Cumulative Case
PROBABILITY OF ONE OR MORE =  82%
MOST LIKELY (MODE) =  1

                            10%  20%  30%  40%  50%  60%  70%  80%  90%
                         +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 = 18.27%   0 I*********
PROB. OF  1 = 31.06%   1 I****************
PROB. OF  2 = 26.40%   2 I*************
PROB. OF  3 = 14.96%   3 I*******
PROB. OF  4 =  6.36%   4 I***
PROB. OF  5 =  2.16%   5 I*
PROB. OF  6 =  0.61%   6 I
```

Source: MMS.

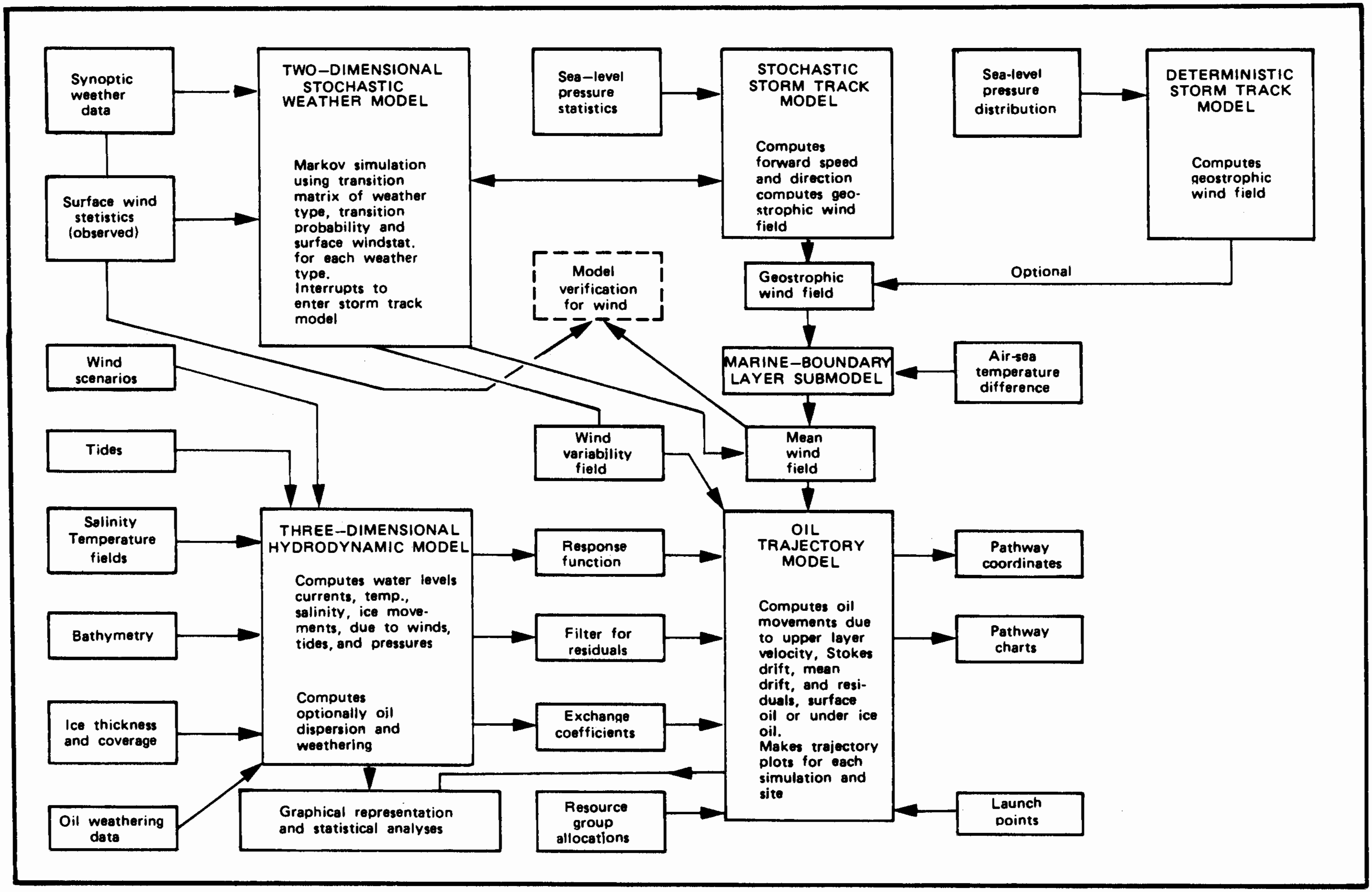


FIGURE IV-3

ESSENTIAL COMPONENTS OF THE TWO-DIMENSIONAL STOCHASTIC WEATHER SIMULATION MODEL; ALSO SHOWING THEIR INTER-RELATIONSHIP BETWEEN THE THREE-DIMENSIONAL HYDRODYNAMIC MODEL AND THE OIL-SPILL TRAJECTORY MODEL

SOURCE: Liu and Leendertse, 1983a.

pronounced effects on the computed speed and direction of oil movements. Again, simulated winds agree with observed winds at various points of measurement.

After the preliminary model development, the trajectories generated by the stochastic model near the North Aleutian Shelf were compared with deterministic trajectories forced by the winds computed according to the NOAA sea-level-pressure-data tape. This procedure has been followed by series of static checks, comparing the computed wind roses against the observed wind roses at various locations to evaluate their asymptotic behavior with increasing numbers of simulations.

Thirteen launch points were distributed around the proposed lease area and were selected as being representative of potential platform locations, pipeline routes, or tanker routes (see Graphic 5). In this analysis, the location of the center of mass for each hypothetical oil trajectory was reported every 12 hours. Oil-spill trajectories were simulated under two sets of environmental conditions. The first set was an ice-free period from late spring to early fall. Twenty-six trajectories were launched from each point during this period. The second set of conditions, late fall to early spring, represented a period with ice cover. Thirty-six trajectories were launched from each point during this period. The trajectories for these seasonal conditions were calculated by the Rand Corporation and transmitted to the MMS, Reston, Virginia. These trajectories were then applied to land/boundary segments and to biological resources identified by the MMS to determine the environmental-risk factors.

Weathering and Cleanup: If a trajectory contacts land or a boundary segment of the model, the trajectory is stopped. Otherwise, trajectories continue for 30 model-days. We emphasize that the trajectories simulated by the model represent only pathways of hypothetical oil slicks. They do not involve any direct consideration of cleanup, dispersion, or weathering processes which could determine the quantity or quality of oil that might eventually come in contact with targets. An implicit analysis of weathering and decay can be considered by knowing the age of simulated oil spills when they contact targets. For this analysis, three time periods were selected: 3 days--to represent diminished toxicity of the spill; 10 days--during which cleanup could be a mitigating factor, and 30 days--to represent the difficulty of tracking or locating spills after this time.

Results of the trajectory simulations are presented in terms of conditional and combined probabilities. The probabilities of an oil spill contacting either land/boundary segments or biological resources from a given launch point (assuming a spill has occurred) are termed conditional probabilities. These probabilities depend only on oceanographic and meteorological conditions and do not include the expected spill rate. In the calculation of these conditional probabilities, the assumption is made that a spill has occurred from the respective launch points. The conditional probabilities represent the percentage chance of oil contacting specific land/boundary segments and biological resources (Appendix G, Tables G-1 through G-9). The size of land/boundary segments was set as the minimum that could be effectively used within the resolution of the model. These probabilities are useful in identifying those areas that pose the highest risk to specific targets and land/boundary segments, should spills occur.

In the analysis, the conditional probabilities are combined with the expected spill rates, based on the unrisked resource estimates to yield the overall, combined (i.e., final) probabilities. The combined probabilities for biological resources for the proposed lease area are discussed in the following sections of this EIS, and those for the land/boundary segments are discussed below. A complete listing of the combined probabilities is given in Appendix G, Tables G-10 through G-26.

The combined probabilities that an oil spill would occur and contact the shores of the study area are shown in Table IV-9 for the proposed action, Alternative IV, and the cumulative case. For the proposed action, there is a 3- to 4-percent chance that a 1,000-barrel-or-greater oil spill would contact land within 3 days. The percentage increases to 8 to 9 percent within 10 days and to 23 to 27 percent within 30 days, depending upon the transportation scenario. Over 10 days, the risk of land contact occurs to the Alaska Peninsula from False Pass to Port Moller; however, the probabilities are low, ranging from less than 0.5 percent up to 5 percent for the pipeline scenario and up to 6 percent for the offshore loading scenario. Over 30 days, the entire northern shore of the Alaska Peninsula from False Pass (including the northern shore of Unimak Island) to Port Heiden is at risk of possible contact.

The deferral of blocks within 40 kilometers of the Alaska Peninsula does not appreciably reduce the combined probabilities of land contact from those for the proposal. However, 70 percent of conditional risk through 10 days from all 13 Launch Points within the proposed sale is derived from the 4 Launch Points (D1, B1, B2, F1) within the deferral portion of Alternative IV. In particular, conditional risk to Cape Seniavin (Land Segment 13) and Nelson Lagoon (Land Segment 11) would be greatly reduced by the Alternative IV deferral (Table G-9).

Oil-Spill Analysis: Southern Side of Alaska Peninsula: According to the pipeline scenario for Sale 92, 0.364 Bbbls of oil is to be pipelined across the Alaska Peninsula to a transshipment facility in Balboa Bay; from there, the oil will be tankered to southern markets. Appendix I of the Sale 70 FEIS contains a generic discussion of tankering Bering Sea crude to market; this discussion is incorporated herein by reference. In summary, the main point of the discussion is that shipments of Bering Sea crude would supplement shipments of TAPS crude to the U.S. West Coast, U.S. East Coast, and U.S. Gulf of Mexico. Using the oil-spill statistics for tankers and the volume of oil to be transported, Table IV-10 presents the expected number of spills and the probabilities of one or more occurring for that transshipment facility and for the tanker route to market. Under the offshore-loading scenario for the proposal, oil would be tankered through Unimak Pass, directly to market. Using the oil-spill statistics for tankers and the volume of oil to be transported, Table IV-11 presents the expected number of spills and the probabilities of 1 or more occurring for the portion of the tanker route south of Unimak Pass, to market.

SUMMARY: In the oil-spill-trajectory analysis for the proposed action, there would be a very unlikely chance (8% to 9%) of an oil spill of 1,000 barrels or greater contacting land within 10 days under either transportation scen-

Table IV-9
Combined Probability (percent chance) of One or More Oil Spills Contacting Land within 3, 10, and 30 Days over the Production Life of the North Aleutian Basin

	Trajectory 3 days		Trajectory 10 days		Trajectory 30 days	
	Spill Size (bbls) ≧1,000	Spill Size (bbls) ≧100,000	Spill Size (bbls) ≧1,000	Spill Size (bbls) ≧100,000	Spill Size (bbls) ≧1,000	Spill Size (bbls) ≧100,000
Proposed Action Pipeline Scenario:	3	n 1/	8	n	23	1
Offshore Loading Scenario:	4	n	9	1	27	2
Alaska Peninsula Deferral Alternative: Pipeline Scenario:	3	n	7	n	21	1
Offshore Loading Scenario:	3	n	8	1	24	2
Cumulative Case:	86	27	96	31	2/	42

Source: USDOI, MMS, 1984.

1/ = less than 0.5 percent.
2/ = greater than 99.5 percent.

Table IV-10
Expected Number of Spills and the Probability of One or More Spills Occurring from the Transshipment Terminal and Tanker Route, Proposed Action, Pipeline-Transportation Scenario

	Expected Number of Spills — Spill Size ≧1,000 (bbls)	≧100,000	Probability of one or More Occurring (percent chance) — Spill Size ≧1,000 (bbls)	≧100,000
Balboa Bay Transshipment Terminal	0.07	0.02	7	2
Tanker Route between Balboa Bay and Market	0.33	0.07	28	7

Source: USDOI, MMS, 1985.

For all categories, the most likely number of spills is 0.

Table IV-11
Expected Number of Spills and the Probability of One or More Spills Occurring between Unimak Pass and Market, Proposed Action, Offshore-Loading Transportation Scenario

	Expected Number of Spills — Spill Size ≧1,000 (bbls)	≧100,000	Probability of one or More Occurring (percent chance) — Spill Size ≧1,000 (bbls)	≧100,000
Tanker Route between Unimak Pass and Market	0.16	0.03	15	3

Source: USDOI, MMS, 1985.

ario. There are 0.94 spills of 1,000 barrels or greater projected to occur under the pipeline scenario, with a 61-percent probability of 1 or more spills occurring. There are 1.10 spills of 1,000 barrels or greater projected to occur under the offshore-loading scenario, with a 67-percent chance of 1 or more spills occurring. There are 0.03 spills of 100,000 barrels or greater projected for the proposed action, pipeline scenario, with only a 3-percent chance of 1 or more occurring. There are 0.07 spills of 100,000 barrels or greater projected for the proposed action, offshore loading scenario, with a 7-percent chance of 1 or more occurring. There is a less-than-0.5-percent chance of a 100,000-barrel-or-greater spill contacting land over 10 days under the pipeline scenario and a 1-percent chance under the offshore-loading scenario.

Under the Alaska Peninsula Deferral Alternative, the statistically expected number of spills is 0.86 spills of 1,000 barrels or greater for the pipeline scenario, slightly less than that for the proposal. Conditional probabilities indicate that 70 percent of the conditional-oil-spill risk to the Alaska Peninsula shoreline is attributable to spills within the deferral area.

d. Fate and Behavior of Spilled Oil: The fate and behavior of spilled oil in marine waters are very dependent upon the mode of spillage, the characteristics of the oil spilled, and the characteristics of the receiving waters. A variety of processes occur when oil is spilled on water, altering its chemical and physical characteristics. Collectively, these processes are referred to as weathering or aging of the oil and, to a large degree, they determine its fate.

In the following discussion, oil-spill cleanup is not considered. Although cleanup would most likely be attempted, the prediction of response effectiveness is uncertain. Success depends too greatly on local conditions, type and quantity of oil, logistics, and shoreline character. Generally, this EIS uses 10 days as the period of time during which effective mobilization of cleanup activities may be possible. Oil-spill response and cleanup is discussed as a separate topic in Section IV.A.4.

Oil spills would be either surface or subsurface spills. Pipeline spills would be the latter, unless they occurred in nearshore, shallow water. Tanker spills and most platform spills--including most blowouts--would be surface spills. Spills from all three sources--pipelines, platforms, and tankers--are more likely to be of crude oil, but also could be of fuel oils. On the OCS, 7 of the 12 recorded platform spills of 1,000 barrels or more were of stored oil, either crude or fuel oil.

Surface Spills: The major processes involved in oil weathering are spreading, evaporation, dispersion, dissolution, emulsification, and sedimentation. After a spill occurs, a "slick" forms because of the low solubility of most petroleum components. The principal forces influencing the spreading rate of a slick are gravity, viscosity, surface tension, inertia, and the turbulence of the water body. The spreading of the oil to a thin film is one of the most important processes; without it, many of the other dispersive processes would not occur. In the cold waters of the Bering Sea, an oil spill would spread less than in temperate waters and would remain approximately one-hundredfold thicker than a slick in a more temperate climate. The greater thickness of a northern slick slows, but does not stop, the other dispersive processes.

Evaporation of volatile components accounts for the largest percentage of crude loss, with evaporation loss on the order of 25 percent occurring in the first 24 hours (Fingas et al., 1979). Fuel oils (diesel) evaporate more slowly than crude, on the order of 13 percent within 40 hours at 23^{o} C; but a larger overall percentage of diesel will eventually evaporate. Over the life of an oil slick, evaporation accounts for one- to two-thirds of slick mass (National Academy of Sciences, 1983). The initial rate of evaporation increases with increasing windspeeds and increasing temperatures; however, the percentage of slick volume that escapes into the atmosphere is not appreciably increased.

Competing with evaporation for volume of crude loss from a slick is dissolution, which generally involves the aromatic fractions of spill volatiles. The low-molecular-weight aromatics such as benzene and toluene, which are acutely toxic, will rapidly dissolve into the water column. Dissolution, however, is very slow compared to evaporation; most volatiles usually evaporate rather than dissolve. Dissolved-hydrocarbon concentrations underneath a slick, therefore, tend to remain low.

Dispersion of oil droplets into the water--not dissolution--is the major mechanism for incorporating oil into the water column. Winds, waves, and currents naturally disperse oil by breaking small droplets from a slick and mixing them into the underlying water. The greater the turbulence, such as in a storm, the more rapildy oil is lost from the slick. An oil slick can be artificially dispersed by application of chemical dispersants. A dispersant alters the interfacial properties of oil and water and enables an oil layer to be broken up easily into very small droplets by either mechanical or natural agitation. The resulting dispersion of oil decreases the volume of oil on the water's surface and inhibits the oil's tendency to stick to surfaces. Dispersants work most effectively on thin, fresh oil slicks and at warmer temperatures.

The fate of oil droplets mixed into water depends upon the size of the droplets. Larger or coalesced droplets may resurface. Smaller droplets remain in the water column and are rapidly diluted by further dispersion, advection, and diffusion. Most of the oil droplets suspended in the water column will eventually be degraded by bacteria in the water column or deposited on the seafloor. The rate of sedimentation depends on the suspended load of the water, the nature of that load, water depth, turbulence, density of the oil and the presence of concentration pathways, such as incorporation into zooplankton fecal pellets.

At the same time that oil is being lost from the slick, the character of the slick changes and many oil types begin to form a mousse--a water-in-oil emulsion. As more of the lighter components are lost, the oil thickens. Mousse formation slows but does not stop dispersion from a slick. Winds in excess of 4.4 meters per second will often cause a slick to break into streaks or windrows; thus, slicks may typically spread discontinuously over a tenfold-larger area than is actually covered with oil. As weathering continues, the oil slick separates further into individual tar balls or pancakes which, although sticky, are much less hazardous to the environment than the initial slick. For arctic open waters, tar-ball formation can be expected to occur within 30 days of a spill. Roughly 40 percent of Prudhoe Bay crude can be expected to remain after initial weathering in the form of dispersed tar balls or pancakes. Payne (1982) states that "the ultimate fate of most tar balls at sea is believed to be their breakup and sinking within one year."

A speculative mass balance for Prudhoe Bay crude oil showing the estimated partitioning of crude oil after 10 days is shown in Figure IV-4.

Subsurface Spills: Subsurface spills could occur from leaks through seafloor pipelines or from subsea blowouts of wells. Blowouts or gathering-pipeline spills would disperse small oil droplets and entrained gas into the water column. If there is sufficient gas, turbulence, and the necessary precursors in the oils, mousse--water-in-oil emulsion--may form by the time the oil reaches the surface (Payne, 1982). Once mousse is formed, both weathering and dispersion of the oil are much slower. A leak from a trunk pipeline--with gas removed--would emit oil in larger droplets or as a continuous or discontinuous stream rising through the water but would not be as likely to immediately form mousse. A trunk pipeline spill would therefore be intermediate in character, between a subsurface blowout and a surface spill. For all three subsurface-spill types, oil would rapidly rise to the water surface to form a slick. Droplets less than 50 microns in size, a category including about 1 percent of blowout volume, may be carried several kilometers downcurrent before reaching the water surface (ESL Environmental Sciences Limited, 1982). Blowout simulations have shown that convective cells set up by the rising oil and gas plume result in concentric rings of waves around the central plume. Surface currents within the ring should move outward, and surface currents outside the ring should move inward--resulting in a natural containment of some oil.

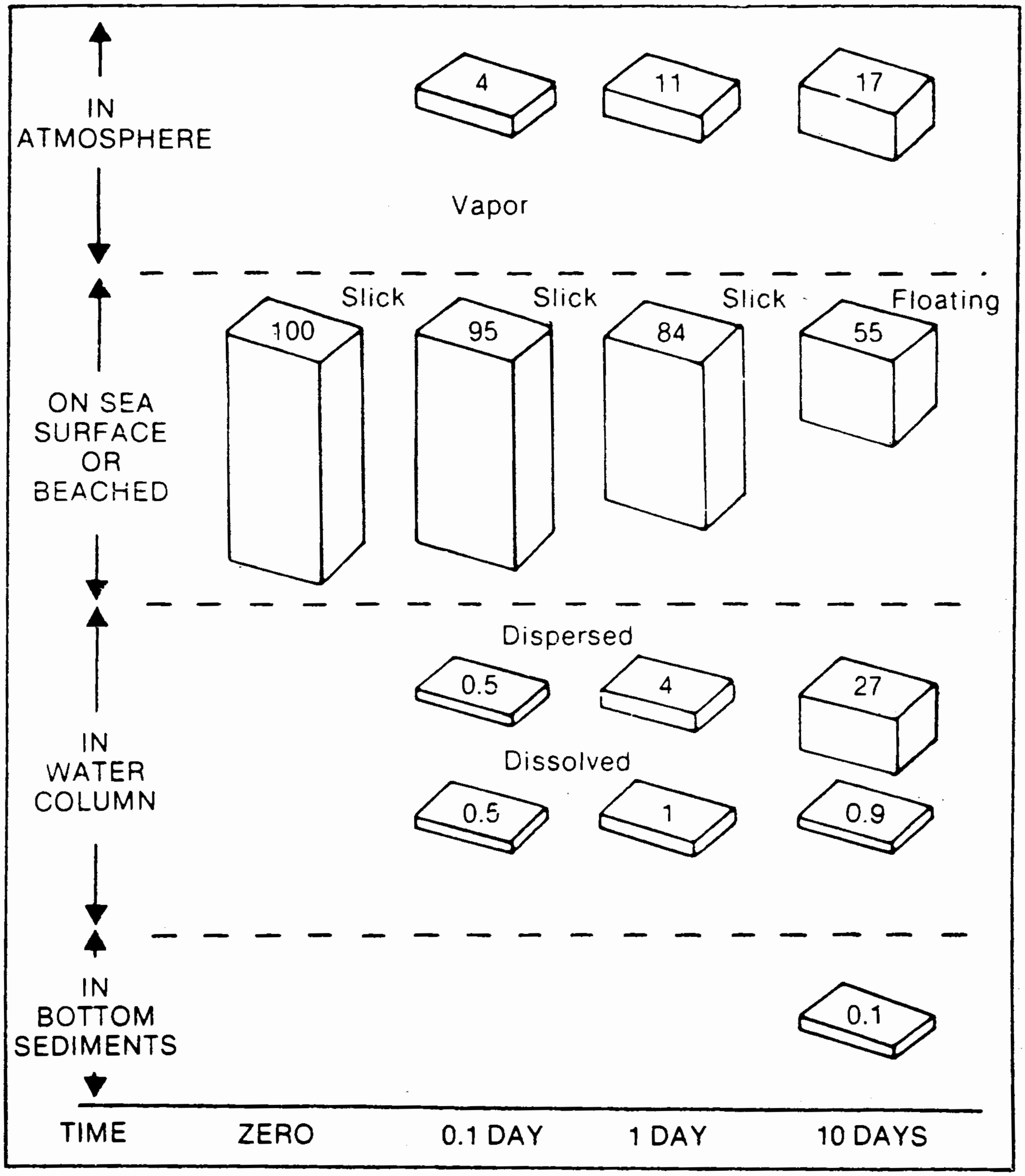
The release of oil droplets allows some increase in dissolution of oil, particularly for a blowout or gathering-pipeline spill; but the rapid rise of most oil to the surface suggests that the increase in dissolution--as a percentage of total spill volume--must be fairly small. The resulting concentrations of oil, however, could be substantial, particularly for dispersed oil in subsurface plumes (Sec. IV.F.1.). Oil reaching the surface would weather and behave similarly to a surface spill. In some cases, such as the Ixtoc I blowout, a well blowout may be accompanied by fire. A fire would consume a large quantity of oil and reduce the amount of oil remaining at the surface.

Extent of a Shoreline Spill: The length of coastline that could be oiled by a spill is difficult to specify. A typical subarctic spill would be expected to spread to a thickness of about 2 millimeters. However, depending upon the characteristics of the individual crude oil and upon the water temperature, the spill could spread to a thickness on the order of slightly less than a millimeter to a few millimeters (ABSORB, 1980; Thorsteinson, 1984). A spill of 5,000 barrels could cover up to 1 square kilometer. A spill of 100,000 barrels could cover up to 20 square kilometers.

Long-duration spills are depicted less precisely in the oil-spill-risk model than are instantaneous spills. The center-of-mass of the spill is still depicted accurately, but spreading of the oil over different trajectories through time would result in more frequent contacts but with smaller amounts of oil than indicated by the model.

FIGURE IV–4

Speculative Mass Balance for Prudhoe Bay Crude Oil



Distribution of an initial 100 volumes of oil, assuming wind of 5 meters/second and temperature of 0° C, at various times after the release.

Source: Manen and Pelto, 1984.

An example of how the oil-spill-risk model can be used, when necessary, to represent a long-duration spill, is shown below.

Table G-8 in Appendix G gives conditional probabilities of spills reaching individual land segments within 30 days from hypothetical launch points. If a spill occurs at launch point A1 in Graphic 5, for example, here are the probabilities that individual land segments would be contacted:

Land Segment 7	8 percent
Land Segment 8	2 percent
Land Segment 9	12 percent
Land Segment 10	13 percent
Land Segment 11	2 percent

For an instantaneous spill, the 8 percent for Land Segment 7 means that if such a spill occurred, there would be an 8-percent chance that Land Segment 7 would be contacted within 30 days. For long-duration spills, oil would likely be spread along the majority of trajectories radiating from a hypothetical launch point rather than along just one trajectory. That is, a long-duration spill would act like multiple smaller spills. For such a hypothesized spill, the percentages from Tables 6 through 8 in Appendix G must be interpreted differently. The 8 percent for Land Segment 7 now means that if such a spill occurred, 8 percent of the oil remaining (after up to 30 days of weathering, evaporation, and cleanup) would be expected to contact Land Segment 7 within 30 days of spilling. Additional amounts of oil would be expected to contact Land Segments 8 to 11, but no other land segments. Note also that the amount of land actually oiled would still be dependent, among many other factors, on how much oil was present. Thus, for an instantaneous spill, we would have a 28-percent chance that 100 percent of the spilled oil would contact Land Segment 7. But for the long-duration spill, we would have about a 100-percent chance that 28 percent of the oil would reach Land Segment 7 (in both cases ignoring any cleanup, etc.).

In addition to the above consideration, also note that long-duration spills should occur infrequently. For example, only 3 of 12 platform spills in OCS records persisted over 1 week. The platform spill of longest duration and greatest volume, the Santa Barbara blowout of 77,000 barrels over several months, spilled most of the oil in the first few days. Most other blowouts similarly and rapidly decrease flow because of clogging, local reservoir depletion, or the regaining of partial control.

Another complication is that even slicks from instantaneous spills at sea are generally discontinuous: they spread over a tenfold greater area than would be indicated by slick thickness and mass alone, but with only 10 percent of the water surface actually covered with oil. If this larger slick area were circular, it would still be simple to estimate the extent of possible damage; but, in reality, this calculation is not so simple because of the various physical factors (winds, currents, waves, and ice) operating on a spill. A spill could take on many shapes; it could be broken up into smaller, entirely separate slicks, driven into the water column and adsorbed onto the bottom sediments, trapped by ice, or any combination of the above.

Therefore, an offshore spill is not likely to reach one point of the shoreline in its entirety. Contact could occur with the shoreline in several locations, or it could be "smeared" along a single location depending on the nature of winds and longshore currents. The capability of predicting coastline coverage by an oil spill is thus very limited. For the purpose of this discussion, we conservatively state that spills are capable of contacting portions of vast segments of coastline (greater than 40 km; or roughly across 1 land segment--see Graphic 5). In other words, because our trajectory model tracks only the center-of-mass of the spill, we account for spreading or smearing of the spill along the coast by assuming that the entire land segment and possibly part of its closest neighbor could be contacted.

For a spill to be stranded in a marsh or on delta tidal flats, another condition must be satisfied. The tidal range for the North Aleutian Basin region is 1 to 7 meters (Brower et al., 1977). Inland portions of deltas and marshes become inundated by sea water only during high tides. The coincidence of necessary winds and tides, for example, sufficient to push an appreciable quantity of oil from a spill into a lagoon system such as Izembek is extremely unlikely. Furthermore, a spill reaching a lagoon such as Izembek Lagoon would not be "spread all over" marshes and tidal flats but, to the contrary, would be more likely stranded at and somewhat below the high-water mark.

Persistence of Stranded Oil: Persistence of oil on beaches, tidal flats, marshes, and other shoreline types has been investigated both experimentally through small, deliberate spills on test plots and by monitoring oil persistence following accidental spills of various compositions and magnitudes. In these studies, the persistence of oil is always highly correlated with shoreline type, largely because of the importance of physical processes in weathering and natural removal of oil.

The Bristol Bay coastline is a relatively diverse coastline, ranging from rocky cliffs to deltas. Based on empirical data and surveys, the Bristol Bay coastline can be partitioned into sections with low to very high oil-retention capabilities (Michel et al., 1982). Six (6) percent of the coastline is rocky headlands and wave-cut platforms, shorelines with low oil-retention capability. Waves, wind, and surf would wash oil off of these shorelines within weeks of oiling. Twenty (20) percent of the shoreline is low-biomass, exposed tidal flats or sand beaches--shorelines with moderate oil-retention capability. Such shorelines would be cleansed of oil within months of oiling by a spill.

Twenty-nine (29) percent of the coastline is mixed-sand-and-gravel beach, gravel beach, or moderate-biomass, exposed tidal flats--shorelines with high oil-retention capability. Such shoreline would take on the order of a year to cleanse itself of oil. Forty-five (45) percent of the coastline is sheltered rocky shore, sheltered tidal flat, eroding peat scarp, or marsh--shorelines with very high oil-retention capability. Oil incorporated into sediments or organic debris, or onto matted vegetation, on such shoreline could persist for several years.

Ratings reflect not only the retention capability of the substrate, but also the ineffectiveness or lack of natural, physical removing processes for oil. In general, the lower environmental temperatures and short thaw season in the cold climates result in greater persistence of spilled oil. Least persistence would occur in exposed rocky headlands and eroding wave-cut platforms. Greatest persistence would occur in marshes, sheltered rocky shores, tidal flats, or eroding peat scarps. Michel et al. (1982) considered that for these latter shoreline types, oil incorporated into sediments or organic debris, or onto matted vegetation, could remain for several years.

More recent cold-climate data suggest that Michel et al. (1982) may have been too optimistic. A revisit to the Metula oil-spill site in the Strait of Magellan, 6.5 years after the spill, suggests that spill persistence may be much longer than previously thought (Gundlach et al., 1982). At the Metula site, oil originally was projected to persist 2 to 3 years in mixed-sand-and-gravel beaches and up to 20 years in marshes. The lack of weathering of the oil in the 6.5 years since the spill now suggests cold-climate persistence of 15 to 30 years in mixed-sand-and-gravel beaches and over 100 years in sheltered marshes if very heavy oiling occurred. However, the longer the open-water season and the greater the fetch, the less time the oiling would persist.

Bristol Bay marshes and lagoons are often protected by barrier beaches or bars. The closed nature of the marsh reduces the probability that oil would penetrate into the marsh or lagoon, but leads to longer persistence of oil if oiling does occur. Again, however, because tides and winds are not unidirectional, only a fraction of an individual large spill could be expected to penetrate into such a protected marsh or lagoon.

A discussion of persistence necessarily relates to only the oil remaining after cleanup or to situations where cleaning up could cause more damage than leaving the original spill in place. Marshes, sheltered tidal flats, and eroding peat scarps which form much of the shoreline are areas where heavy equipment should not be used in cleanup operations because it could cause permanent scars on the landscape and ecosystem. Recent advances in cleanup technology for wet tundra (low pressure hosing coupled with clipping of oil vegetation [Pope et al., 1982]) provide both an ecologically and technologically sound means of cleaning some of these areas. Thus, cleanup is a viable option to mitigate problems caused by shoreline oiling and oil persistence.

4. Oil-Spill Response: Federal response capabilities and responsibilities in the event of an oil-pollution incident are prescribed by the National Oil and Hazardous Substances Contingency Plan, published July 16, 1982, by the Environmental Protection Agency. Since federal contingency planning in Alaska has been done in accordance with earlier national plans, information used here from Alaska regional planning documents is subject to revision, which is presently underway. Wherever possible, changes expected to be made in regional contingency plans to reflect the new national plan will be cited.

The national plan provides the framework for a geographically integrated federal response capability and encourages the participation of state and local governments in coordinated preparedness and action. The National Response Team serves as the model for regional response organizations, makes special forces and equipment available to regional organizations, and serves in an oversight capacity to evaluate and recommend improvements in response capabilities.

In Alaska, the entire coastal area is a geographic zone of responsibility covered by the Alaska Coastal Region Multi-Agency Oil and Hazardous Substances Pollution Contingency Plan. The plan specifies responsibilities among federal and state government agencies, and designates the primary responsibility for effecting a coordinated response to pollution incidents in the marine environment with the U.S. Coast Guard (USCG). In Alaska, as elsewhere in the nation, primary responsibilities for coastal and inland waters are divided between the USCG and the Environmental Protection Agency (EPA), with the EPA assuming primary responsibility in those geographic areas upstream of tidal influence; however, precise boundaries of jurisdiction are determined by USCG/EPA agreements.

The Alaska Coastal Region Plan specifies governmental response to a pollution incident primarily as a function of the Regional Response Team (RRT), the On-Scene Coordinator (OSC), and the Scientific-Support Coordinator (SSC). The RRT is composed of federal and state agency representatives and is chaired jointly by the USCG and the EPA. The RRT is responsible for planning and preparedness actions prior to a pollution discharge and for coordination and advice during a pollution emergency. Members of the Alaska Coastal RRT are designated representatives from the USCG, the State of Alaska, the EPA, the Federal Emergency Management Agency, and the following federal departments: Agriculture, Commerce, Defense, Energy, Health and Human Services, Interior, Justice, Labor, and State. Representatives of local governments also may be designated to participate in the activities of the RRT. As at the national level, the USCG additionally maintains and operates the Regional Response Center, located at the USCG District Headquarters in Juneau, Alaska.

Alaska coastal waters are divided into geographic zones of responsibility for which an On-Scene Coordinator (OSC) is predesignated by the USCG. The function of the OSC is to develop and maintain a federal local contingency plan for federal response in the area of the OSC's responsibility and, at the scene of a discharge, to serve as the single point of contact for advising the spiller on cleanup measures or, if necessary, to coordinate and direct the federal response and expedite pollutant-removal efforts. The OSC provides information to and receives advice from the RRT during a spill emergency. The Scientific Support Coordinator (SSC), provided by the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, is on the staff of the OSC at the scene of a spill to provide scientific advice and to coordinate advice from the scientific community.

The following are available to assist the RRT, OSC, and SSC in performing their duties: national special forces on call, such as the USCG's Pacific Strike Team and the Environmental Response Team established by the EPA; a computerized national inventory of pollution-response and support equipment for locating specialized equipment tailored to the characteristics of the spill; memoranda of agreement and interagency agreements to explicitly define areas of responsibility in cases where overlapping jurisdiction may exist; and specialized functional groups within the RRT to provide expertise and leadership in areas such as public information, pollution-control techniques, damage assessment, and protection of living marine resources.

a. Petroleum Industry Oil-Spill-Response Organization: The industry oil-spill response organization, Alaska Clean Seas (ACS), was organized by the petroleum industry to support industry activities in waters off the Alaskan coast, both state and OCS. The ACS organization is divided into Cost Participation Areas (CPA's). The current areas are the ABSORB CPA, the Norton Sound CPA, the St. George Basin CPA, the Navarin Basin CPA, and the Gulf of Alaska CPA (formerly the Gulf of Alaska Cleanup Organization). This cleanup organization and others (such as CIRO) operate through a voluntary private-industry agreement to jointly acquire oil-spill containment and cleanup equipment, to train personnel in its use, and to provide a pooled capability of response greater than any one company could provide.

b. Petroleum Industry Oil-Spill-Contingency Planning: Improvements in prespill contingency planning at all levels of government and private industry in the past few years have reduced confusion about and increased the implementation of an efficient and potentially effective cleanup response. Industry anticipates that either Alaska Clean Seas will form a new CPA for the North Aleutian Basin Sale 92 area or that the area of coverage of the St. George Basin CPA would be expanded to cover any leases sold in the proposed Sale 92 area. Alaska Clean Seas (1984); Chevron U.S.A. (1984); Exxon Company, U.S.A. (1984); Gulf Oil Exploration and Production Company (1984); Hooks, McCloskey and Associates, Inc. (1984); Marathon Oil Company (1985); Mobil Oil Corporation (1984); and Northern Technical Services, Inc. (1984) have recently completed oil-spill-contingency plans for Sale 70 leases in the St. George Basin.

By having on hand prior knowledge of the nature of the spilled material, slick dynamics, the characteristics of the threatened environment, plus the available equipment and manpower, the responsible party can prioritize and evaluate selected actions. Protection strategies (Michel et al., 1982) have been completed which classify vulnerable coastal resources by integrating biological and physical shoreline characteristics and by recognizing which habitats are most vulnerable to oil spillage, and by the cleanup operation itself.

Responses to spills from OCS activities are approached by prioritizing lines of defense to prevent spilled oil from affecting identified vulnerable environment. The first line of defense is always offshore containment. Open-water collection of spilled oil has not proven successful (see "Effectiveness of Oil-Spill Cleanup at Sea" below), but containment is useful in providing extra time for deployment of more equipment and manpower. For a blowout, well ignition is a drastic but potentially effective contingency measure. If conventional cleanup equipment cannot be deployed before spill contact with land is likely to occur, it may be appropriate to use chemical agents to disperse the slick, if permission for this use can be obtained. A second line of defense entails the booming of major inlets and the closure of washover channels and small inlets. Next, the defense uses booms to concentrate on preventing oil from entering enclosed waters of bays and lagoons where sensitive resources may occur. Finally, small channels that feed marshes and tidal-flat systems are boomed or closed; entranceways to small bays and coves are boomed; and deflection booming is used to protect fringing marshes and other sensitive environments.

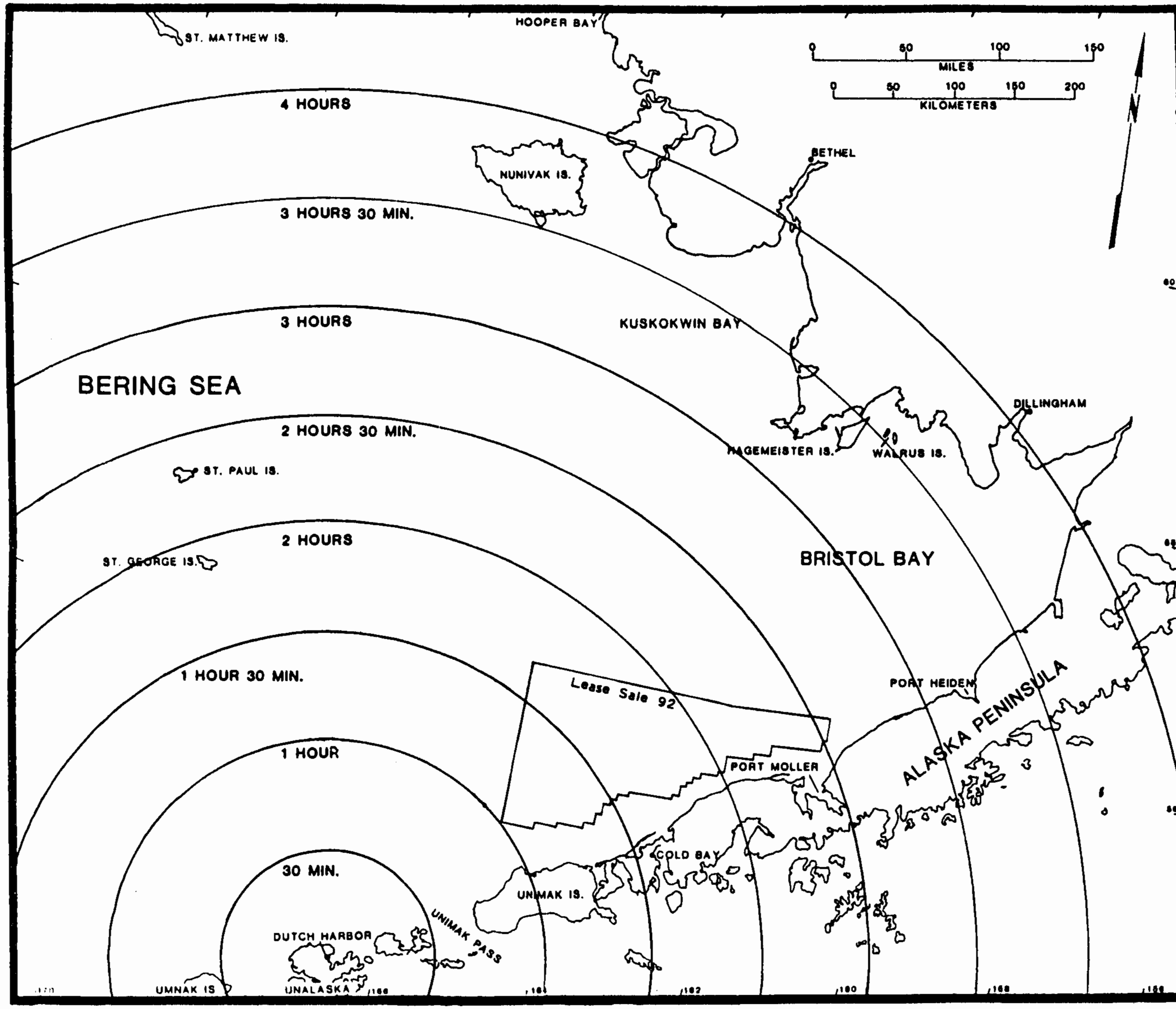
c. Locally Available Spill-Cleanup Equipment: The MMS Alaska OCS Region requires that a leaseholder have an initial spill-response capability of 1,000 barrels per day if the leaseholder wishes to drill. During drilling of St. George Basin (Sale 70) leases, this requirement has been met with equipment warehoused in Dutch Harbor by the St. George Basin CPA of Alaska Clean Seas and with equipment positioned on-site by individual leaseholders. Appendix M, Table M-1, lists the detection and recovery equipment of the St. George Basin CPA in Dutch Harbor. Additional equipment is moved from the Norton Sound CPA to Dutch Harbor in the fall when seasonal Norton Sound drilling ceases. Appendix M, Table M-2, provides an example of on-site capabilities, listing equipment provided on-site by ARCO during drilling of St. George Basin (Sale 70) leases during 1984. ("On-site" means either stored on the drilling vessel, or at ARCO's Unalaska shorebase.)

d. Mobilization Time: The MMS Alaska OCS Region requires that initial response activities be undertaken within 6 to 12 hours of a spill, geography permitting. However, the spiller must be prepared to respond before the spill reaches shore (in less than 6 hours if necessary). This initial mobilization time is for relatively small spills, although the MMS has not specifically defined size. For larger spills--those that could exceed the local cleanup-response capability--the MMS Alaska OCS Region requires that additional equipment be made available on-site within 48 hours. ARCO considers the list of equipment in Appendix M, Table M-2, to be capable of handling small operational spills of 50 barrels or less. Larger spills would require the mobilization of additional equipment (Hooks, McCloskey and Associates, Inc., 1984).

Additional response equipment to handle a large spill would be available from a multitude of sources. Many of these sources and their equipment lists have been inventoried for potential use in the neighboring St. George Basin, and readers are referred to Alaska Clean Seas (1984) and the eight company-specific oil-spill-contingency plans referenced earlier in this section for detailed listings. Estimated response times for mobilization and transport of equipment to Dutch Harbor from these additional sources are given in Appendix M, Table M-3, for air transport, and in Table M-4 for sea transport. Mobilization and air-transport times needed to airlift spill-cleanup equipment to Dutch Harbor would range from 4 to 17 hours from sources in Alaska, and on the West Coast, weather permitting. Mobilization and sea transport from other Alaskan ports to Dutch Harbor would require from 2.5 to 6.2 days. Only equipment airlifted to Dutch Harbor would be capable of meeting the 48-hour-response-time criteria set by the MMS.

Once spill-cleanup equipment reaches Dutch Harbor, it could be transported relatively quickly to the spill site, weather permitting. Travel times from Dutch Harbor to locations in the proposed sale area are shown in Figure IV-5 for helicopter flight and in Figure IV-6 for vessel travel. A helicopter can reach any location in the proposed lease area within 2.5 hours. By vessel, any point in the proposed lease area can be reached within 24 hours.

e. Effectiveness of Oil-Spill Cleanup at Sea: The 6-to-12-hour and 48-hour response times required of drilling permittees by the MMS Alaska OCS Region guidelines are mobilization and deployment requirements only, geography and weather permitting. The MMS has no regulations requiring that cleanup be accomplished within this timeframe nor within any other timeframe. If there were such a requirement, MMS would have to shut down drilling activities whenever high winds, waves, or fog--which could restrict



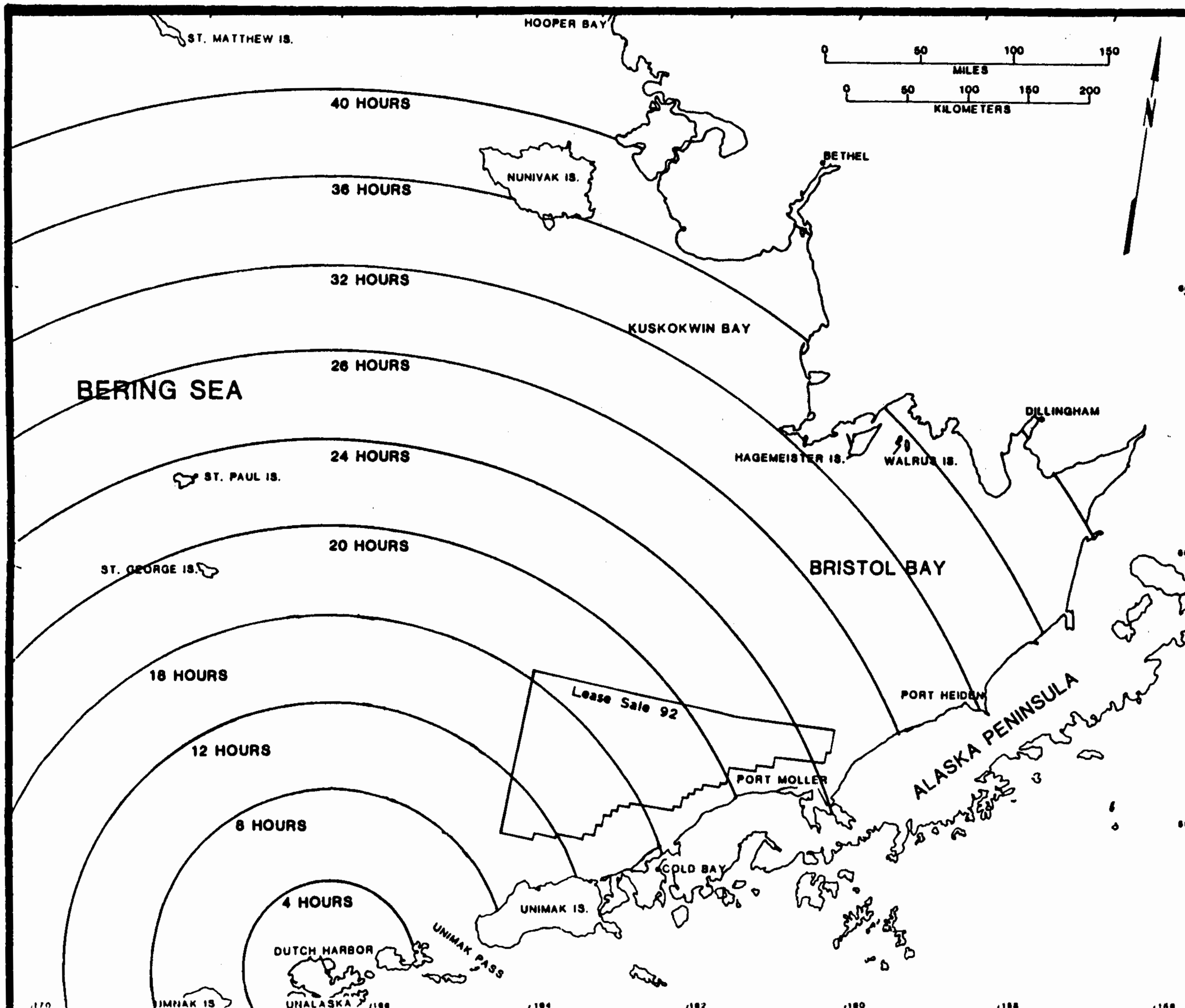
LEGEND

HELICOPTER RESPONSE TIME BASED UPON A LOADED FLIGHT SPEED OF 100 KNOTS

FIGURE IV–5

HELICOPTER RESPONSE TIMES TO THE NORTH ALEUTIAN BASIN LEASE SALE AREA FROM DUTCH HARBOR

Source: Alaska Clean Seas (1984)



LEGEND
VESSEL RESPONSE TIMES BASED UPON A VESSEL SPEED OF 10 KNOTS AND DOES NOT CONSIDER ADVERSE CLIMATIC FACTORS WHICH MIGHT BE ENCOUNTERED ENROUTE

FIGURE IV–6

VESSEL RESPONSE TIMES TO THE NORTH ALEUTIAN BASIN LEASE SALE AREA FROM DUTCH HARBOR

Source: Alaska Clean Seas (1984)

cleanup capabilities--occurred or were forecast. For the purpose of environmental assessment of offshore oil and gas sales, the MMS usually considers mitigation of major oil spills through cleanup to be possible through the tenth day of a spill.

Mechanical cleanup at sea is much more effective on low-viscosity oils or medium-viscosity oils than on high-viscosity oils (Fig. IV-7). A low-viscosity oil could be a diesel or fresh, light crude. A medium-viscosity oil could be a lubricating oil or a light, flowing emulsion. A high-viscosity oil would be weathered crude, bunker oil, or thick emulsion. An oil such as Prudhoe Bay crude would initially have low viscosity but would quickly weather and form an emulsion in about 2 days, becoming highly viscous. The effectiveness of mechanical recovery of a spill of Prudhoe Bay crude would decrease by a factor of two over these 2 days.

Chemical dispersion--the use of dispersants to mix the oil into the water rather than attempt to recover the spilled oil--is an alternative technique to mitigate spill damage. Dispersants lose effectiveness even more rapidly than mechanical recovery as oil weathers and becomes more viscous (Fig. IV-6). Best use of dispersants occurs when they can be applied immediately after the spill has occurred.

Use of dispersants to treat an oil spill, however, requires the On-Scene Coordinator to have concurrence of the EPA representative to the government Regional Response Team (RRT) and also the concurrence of the state. Historically, such permission has been difficult if not almost impossible to obtain. The reasons for this difficulty lie in the perceived toxicity of oil-dispersant mixtures, in questions regarding the effectiveness of the dispersant, and because dispersants remove oil only from the surface of the water and not from the water environment. Detailed information on the effectiveness of a specific dispersant on a specific spilled oil as a function of air and water temperature, dispersant concentration, and age or weathered state of the slick, as well as detailed information on the proposed dispersant-application system, are necessary for an informed RRT decision on dispersant use. Such information is not generally available in industry oil-spill-contingency plans. Alaska Clean Seas is considering development of a dispersant-use manual for arctic Alaska as part of the State of Alaska's Tier II research program. The American Society for Testing Materials is currently developing guidelines for dispersant use in the arctic. The products of these two studies would make dispersant use during a spill both more likely and more effective.

The effectiveness of mechanical recovery of spilled oil at sea decreases rapidly with increasing sea state while effectiveness of dispersants increases. Mechanical cleanup becomes nonfunctional between Sea States 3 and 4 (S. L. Ross Environmental Research Limited, 1983a). In the North Aleutian Basin, sea states of 3 or greater occur from 68 to 94 percent of the time (Fig. IV-8). Sea states of 4 or greater occur from 20 to 66 percent of the time.

In real spill situations, optimum efficiency of cleanup equipment, expressed in Figure IV-7, is seldom reached. In oil-spill-contingency plans for the St. George Basin, industry has generally assumed that on the order of 70 percent of oil spilled in a major blowout could be recovered mechanically or removed

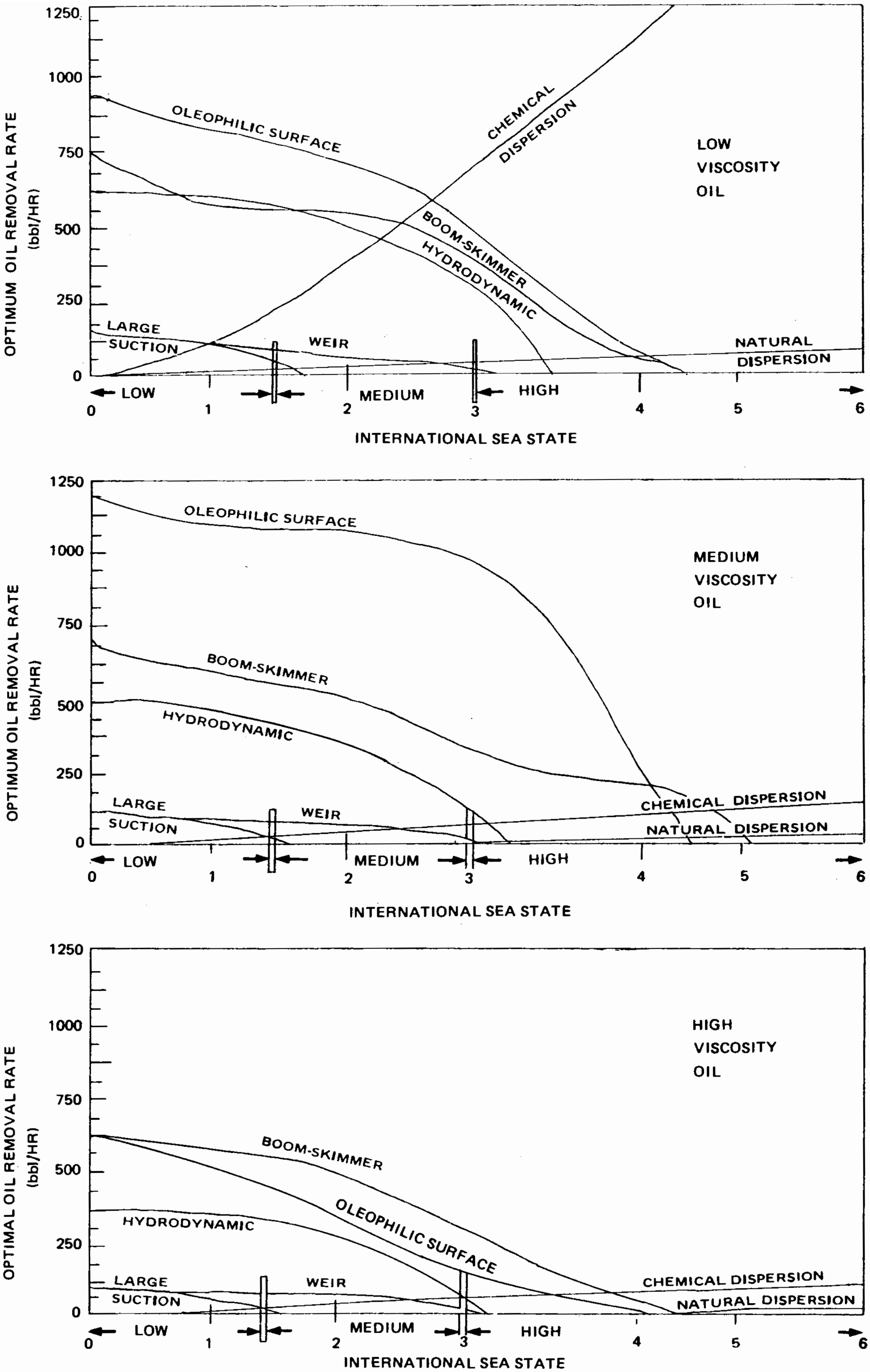
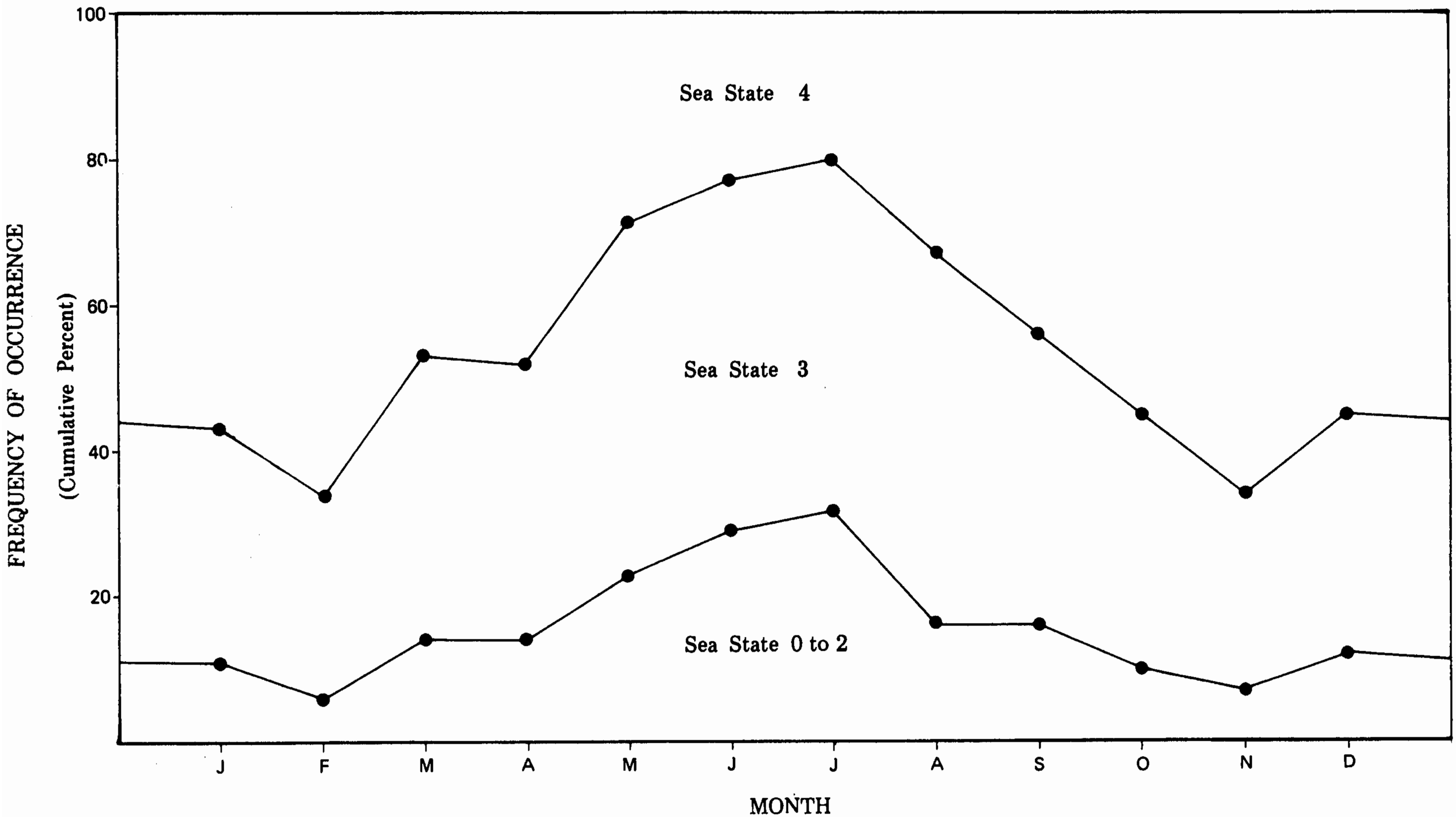


FIGURE IV–7 OPTIMUM OIL RECOVERY RATE FOR GENERIC CLASSIFICATIONS OF SKIMMERS VERSUS NATURAL AND CHEMICAL DISPERSION

SOURCE: S.L. Ross Environmental Research limited, 1983 a.

FIGURE IV-8

CUMULATIVE FREQUENCY OF OCCURRENCE OF DIFFERENT INTERNATIONAL SEA STATES IN OPEN WATER IN NORTH ALEUTIAN BASIN BY MONTH



Source: Derived from wave and wind data for Marine Area C in Brower et al., 1977.

through on-site burning (for example, see Exxon Company, U.S.A., 1984; or Hooks, McCloskey, and Associates, Inc., 1984; Marathon Oil Company, 1985). However, spill cleanup generally requires unexpected modification of procedures and equipment. Sometimes equipment or people do not work as well as hypothesized.

Two very recent examples illustrate this point. In one of the planned oil-spill exercises required for St. George Basin drilling rigs in the summer of 1984, the skimmer pump would not operate. Several hours of effort (with input from an on-scene manufacturer's representative) were necessary to fix the pump before the exercise could proceed. In the other example, 54,000 barrels of oil were spilled from the tanker Alvenus in August 1984 in the Gulf of Mexico. Despite the fact that the spill occurred within 20 kilometers of shore and in a region with much available spill-cleanup equipment, only a negligible percentage of the oil (0.1%) was recovered offshore (Oil Spill Intelligence Report, 1984a). In this case, a barge was hired to recover the spilled oil that had been contained by a boom. After arriving on-site, the barge owner declined to take on water-contaminated oil. A second barge was hired, but the weather worsened and boom containment failed before the oil could be recovered. Subsequent recovery operations attempted to pump the spilled oil into barges but failed because the oil became too viscous to pump.

The MMS Gulf of Mexico OCS Region (USDOI, MMS, 1983d) reviewed the historical record of oil-spill cleanup at sea and concluded that such cleanup is usually not very efficient:

> Offshore containment/cleanup operations are generally a major task requiring significant coordination and cooperation, transportation of large equipment, vessel support, aircraft support, set-up and maintenance of a command/coordination post in the field, and properly staged and available equipment. Often, the weather/sea conditions and crew fatigue become the critical factors during offshore operations. The effectiveness of containment/cleanup operations offshore are, in general, marginally effective. It is possible to contain a platform spill if environmental and logistical conditions are right; however, it has been found through experience that conditions are rarely ideal and full containment of a platform spill is not likely. The effectiveness of this type of containment and cleanup operation is estimated to be approximately 5 percent to 15 percent recovery.
>
> Inshore containment/cleanup operations can be either large-scale or moderately sized operations depending on any particular spill situation. Again, if the task becomes large it requires the same level of coordination and support as an offshore operation. The effectiveness of a containment/cleanup operation in an inshore area largely depends on the unique physical characteristics of the environment and the area of the operation. The range of effectiveness is from marginally successful to successful. Beach cleanup is normally effective utilizing hand labor, organic sorbents, and a wide variety of tools from rakes to bulldozers. Utilizing booms and skimmers, containment of a spill moving into an inlet is marginally successful depending almost entirely on the physical characteristics

of the inlet. Containment and cleanup in marshes is very controversial. Modern opinions often lean towards the 'NO ACTION' strategy for fear of cleanup operations causing even more damage. The effectiveness of inshore containment cleanup operations can often be much greater than offshore operations. Effectiveness is estimated to be 20 percent to 50 percent containment and cleanup of material moving into the area.

5. Constraints on Oil and Gas Development: This section briefly describes significant natural constraints to onshore and offshore oil and gas development and discusses the mitigating measures that could be applied to them. A detailed discussion of the constraints for the St. George Basin Planning area can be found in the St. George Basin (Sale 70) FEIS; because of the similarity in the two adjacent areas, we incorporate that discussion by reference.

a. Earthquakes and Related Hazards: Earthquakes are considered a greater threat to onshore sites than to offshore facilities. The probability for a great earthquake is high along the Alaska Peninsula and in the Aleutian Islands. Therefore, site and design criteria for any proposed oil and gas facilities located along the coastline must consider this potential threat.

Hazards to offshore facilities would be mitigated by strict adherence to OCS operating orders and to design criteria that are appropriate to areas of high earthquake risk.

b. Volcanoes: The southern boundary of this proposed lease sale area is one of the most active volcanic areas in the world. Aleutian volcanoes can be highly explosive; several erupted during the Holocene epoch. Much of the hazard for this activity can be mitigated by: (1) careful site selection, (2) prediction and warning systems, and (3) monitoring and surveillance of volcanoes located near onshore sites.

c. Faulting: Surface and subsurface faults have been identified in the southern portion of this planning area. Because of recent seismicity and seafloor expressions, many subsurface faults should be considered active.

Surface faulting can be a significant hazard or constraint. If not taken into consideration, any facilities in the planning area could be subject to earthquake shaking and vertical displacement. This threat could be mitigated by adherence to OCS Order No. 2, which requires predrilling surveys of shallow geological hazards.

d. Unstable Sediments: Geotechnical studies by NOAA (1983) indicate that hazards due to unstable sediments can be related to storm-wave and earthquake loading. Scour or wave-induced instability resulting from storm-wave loading may create engineering concerns in shallow depths. Surficial sediments located near major fault zones may liquefy during great earthquakes. These hazards can be mitigated by adherence to OCS operating orders, such as No. 2, and by site-specific-engineered rig designs that take these forces into consideration.

e. Gas-Charged Sediments: Acoustic anomalies that may represent gas-charged sediments have been identified in the southern portion of this planning area. Caution should be used in these areas--gas accumulations confined to zones of abnormal pressure are a threat to drilling programs because of their blowout potential. The low shear strength and bearing capacity of gas-charged sediments place a constraint on the siting of bottom-founded structures.

These risks can be mitigated by compliance with OCS operating orders and by design of a drilling program that takes their presence into consideration.

f. Sea Ice: From December to May, sea ice could be of concern to some offshore operations. A study by W.J. Stringer and R.D. Henzler (1981) shows that sea ice can be present 20 to 67 percent of the time (monthly rate) during that period, especially in areas north of 56°N latitude. Ice concentrations could range from 10- to 100-percent coverage.

The oscillatory motion of the broken ice near the ice edge would have to be taken into consideration in the design of any fixed offshore structures. This motion would be most severe during a storm or during periods of large swells.

Much of the threat associated with this environmental hazard could be mitigated by ice observations and monitoring programs that would forecast the ice movements. Other mitigating measures would include compliance with OCS Operating Orders, the MMS Platform Verification Program, and the Minerals Management Service BAST Program. These requirements deal with the design criteria that are necessary to effectively mitigate the effect of the environmental hazards of the area.

CONCLUSION:

Earthquakes, their related hazards, and volcanoes are the most significant threats to oil and gas development within this planning area. However, these hazards can be mitigated by site selections and engineering designs that consider their presence and potential threat.

6. Cumulative-Effects-Assessment Assumptions: Cumulative-effects-assessment assumptions describe development activities, for other than the proposal, that may contribute to significant cumulative effects. The Council on Environmental Quality (CEQ) definition of cumulative effects recognizes past, present, and reasonably foreseeable future development activities. Past and ongoing actions in the North Aleutian Basin region are identified in Section III.C. (Social and Economic Systems) for each identified topic. The effects of past, present, and future actions, and of the proposal (Alternative I), are considered as part of the cumulative-effects sections within the assessment of each topic. In cumulative-effects assessment, it is often difficult to differentiate the incremental (past, present, and future) effects of each action because of uncertain conditions and methodological difficulties. In these circumstances, it is assumed that the aggregate effect across all types of actions constitutes the cumulative effect.

a. Major Actions Affecting the North Aleutian Basin Planning Area: This section contains a brief description of the major actions which may occur in the near future within or close to the proposed lease area. The major actions listed below have been considered in the cumulative-effects sections of Section IV.

(1) Federal and State Oil and Gas Lease Sales:

Federal Sales: Federal oil and gas lease sales in the Bering Sea region that could contribute to cumulative effects in the North Aleutian Basin area are the potential exploration and production activities in the St. George Basin (Sales 70 and 89), Norton Sound (Sale 57), and the Navarin Basin (Sale 83).

- St. George Basin (Sales 70 and 89): The St. George Basin (Sale 70) was held April 12, 1983, with 96 blocks leased. Potential cumulative effects could result from tankering, oil spills, and the use of Cold Bay and Unalaska as support-base sites. A summary of the hypothetical exploration, development, and production activities anticipated in the St. George Basin is contained in Table IV-12. The effects of the development scenario are analyzed in the St. George Basin (Sale 70) FEIS. The St. George Basin (Sale 89) FEIS was released in April 1985, and the sale is scheduled to be held in September 1985. The types of activities that could create cumulative effects would be similar to those identified for Sale 70.

- Norton Sound (Sale 57): The Norton Sound lease sale was held March 15, 1983, with 57 blocks leased of the 418 blocks offered. Because of Norton Sound's distance (over 400 miles) from the North Aleutian Basin Planning Area, cumulative effects potentially could result from transportation of oil adjacent to the area and from any potential oil spills.

- Navarin Basin (Sale 83): The Navarin Basin lease sale was held on April 17, 1984. One-hundred-eighty-six (186) blocks were leased from a total of 5,036 blocks offered. Based on the development scenario (Table IV-12), cumulative effects could result if Cold Bay and Unalaska were used as support-base sites, or from oil spills, tankering of oil, and the development of a transshipment terminal. Table IV-12 provides a summary of hypothetical exploration, development, and production activities resulting from the lease sale.

The following lease sales are included in the Department of the Interior's 5-year schedule for Alaska:

- Shumagin (Sale 86)
- Norton Basin (Sale 100)
- St. George Basin (Sale 101)
- Navarin Basin (Sale 107)
- Barrow Arch (Sale 109)

State Sale Areas:

- Bristol Bay Uplands (Sale 41): In September 1984, the State of Alaska held an oil and gas lease sale for the Bristol Bay uplands. The sale area, containing about 4 million acres, is located south of the Kvichak River and north of Port Heiden on the Alaska Peninsula. Of the 1.4

Table IV-12
Summary of Hypothetical Exploration, Development, and Production Activities in the Navarin and St. George Basins

	Navarin Basin (Sale 83)	St. George Basin (Sale 70)	St. George Basin (Sale 89)
Exploration and Delineation Wells	The exploration period is expected to begin in 1986 and end in 1992. During this period, 28 wells are anticipated to be drilled.	The exploration period is expected to begin in 1984 and end in 1988. During this period, 55 wells are anticipated to be drilled.	The exploration period is expected to begin in 1986 and end in 1993. During this period, 27 wells are anticipated to be drilled.
Platforms	The development period could begin in 1991; by 1995, 9 oil platforms would be in place.	The development period could begin in 1991; by 1995, 11 platforms would be in place.1/	The development period could begin in 1990; by 1995, 11 platforms would be in place.
Production and Service Wells	Production and service wells (20) would be drilled between 1993 and 2000.	Production and service wells (251) would be drilled between 1987 and 1992.1/	Oil/gas production and service wells (108) would be drilled between 1990 and 1996.
Oil Production	Oil production could begin in 1994 and cease between 2011 and 2013. Total production is estimated to be 1.510 Bbbls.	Oil production could begin in 1990 and cease about 2010. Total production is estimated to be 1.120 Bbbls.1/	Oil and gas production could begin in 1995 and cease about 2015. Total production is estimated to be 1.124 MMbbls.
Transportation of Oil	Oil would be processed and loaded on tankers offshore for shipment to markets.	Oil would be processed and loaded on tankers offshore for shipment to markets.	Oil from the northern subunit could be transferred from the production platform to a terminal on St. George Island. Tankers would transport the hydrocarbons from the terminal directly to market. In the southern subunit, offshore loading would be the primary development scenario. Construction of a 130-kilometer pipeline would begin in 1992.
Transshipment Terminals	None.	None.	St. George Island.
Air-Support Sites	Cold Bay.	Cold Bay (primary). St. Paul (secondary).	Cold Bay.
Marine-Support Sites	Unalaska.	Unalaska.	Unalaska and St. George.

Sources: USDOI, MMS, 1982; USDOI, MMS, 1983; USDOI, MMS, 1984.

1/ The numbers of platforms and production and service wells include both oil and gas.

million acres offered, 278,938 acres recieved bids. The state does not plan to lease tide and submerged lands south of Cape Menshikof to Unimak Pass for oil and gas exploration until at least 1994.

- Alaska Peninsula (Sale 56): The proposed sale area contains about 1 million acres on the northern side of the Alaska Peninsula between Cape Liesko and Port Heiden. No decision has been made on whether to hold the lease sale; however, the call for comments will be distributed in July 1986. If it is determined that the sale is in the best interests of the state, a written decision and notice of sale would be issued in July 1988 (State of Alaska, 1984b).

(2) Tankering of Canadian Oil: The Geological Survey of Canada estimates the Mackenzie Delta/Beaufort Sea oil reserves to be 9.2 Bbbls (Oil and Gas Journal, 1984). Current development strategies of Canadian oil companies and Canadian government regulations will require that initial shipments of any of this oil be made to Canadian users, in effect to the Canadian east coast via the Northwest Passage. However, starting no sooner than 1990, but continuing for the remaining life of the Canadian Beaufort Sea fields, we hypothesize that perhaps one tanker a week might be routed westward through the U.S. Beaufort, Chukchi, and Bering Seas to Asian markets, for a total westward tankering of a potential 1.7 Bbbls.

(3) Apollo and Sitka Mines: The Alaska Apollo Gold Mines, Ltd., headquartered in Vancouver, British Columbia, is currently exploring the Apollo and Sitka lode systems on Unga Island. These veins, which comprise the most westerly gold mine in North America, were discovered in 1884 and mined from 1894 until 1906.

In 1983, exploratory drilling by Alaska Apollo identified the presence of a major ore zone. Metals discovered in the ore vein include gold, silver, copper, and zinc. Long-range plans under consideration for the Apollo and Sitka mines include a potential road link between Delarof Bay and deep-water port on Baralof Bay, conversion of a beached tanker into a processing facility, local power generation with Unga Island coal, and construction of a runway at the head of Baralof Bay.

(4) Proposed Airport Expansion at Unalaska: The State of Alaska, Department of Transportation and Public Facilities, has filed an application with the U.S. Army Corps of Engineers to upgrade the facilities at the Unalaska airport. According to the latest facility master plan, the improved airfield would be able to handle jets (DC-9, Boeing 737) and to accommodate about 45 operations per day.

The project would require extending the airport runway 2,000 feet offshore into the Bering Sea. A 2-mile haul road would be required to transport armor rock from a quarry site at Arch Rock. The southwest shoulder of Ballyhoo Mountain would be excavated and used as the core of the required fill. This excavation would improve airspace-safety clearance. The paved runway surface would be 150 feet wide and would require a usable, level strip 350 feet wide. Some 19.5 acres of taxiway and parking apron would be added by filling with approximately 5,000 cubic yards of gravel and/or crushed rock and by paving to the south and west. This area would be bordered on the southwest and west by approximately 11 acres of buffer, portions of which would be available for commercial development.

b. Cumulative Oil-Spill Analysis: Oil production and transportation from the proposed lease sales (Norton Sound, Navarin, and St. George Basins) and from tankering from the Canadian Beaufort Sea constitute the cumulative case in the oil-spill-risk analysis (Table IV-8).

For this analysis, additional spill points were analyzed for Norton Sound (Sales 57 and 100), Navarin Basin (Sale 83, proposed Sale 107), St. George Basin (Sales 70 and 89), and for hypothesized Canadian tankering. The spill points and transportation scenarios analyzed are shown on Graphic 5.

The Geological Survey of Canada estimates the Mackenzie Delta/Beaufort Sea oil reserves to be 9.2 Bbbls (Oil and Gas Journal, 1984). Current development strategies of Canadian oil companies and Canadian government regulations will require that initial shipments of any of this oil be made to Canadian users, in effect to the Canadian east coast via the Northwest Passage. However, starting no sooner than 1990, but continuing for the remaining life of the Canadian Beaufort Sea fields, we hypothesize that perhaps one tanker a week might be routed westward through the U.S. Beaufort, Chukchi, and Bering Seas to Asian markets, for a total westward tankering of a potential 1.7 Bbbls. In our analysis for the cumulative case, we assume that this Canadian oil is tankered through the modeled area. This estimate, however, is obviously extremely tenuous because there are no plans for westward oil tankering at this time.

An assumption is made for the oil-spill-risk analysis that only 50 percent of the oil spills from Canadian tankers would occur in the modeled area (Chukchi and Bering Seas). This is because only a fraction of the entire tanker route, which neither originates nor ends in the U.S. OCS, lies within the study area. The remaining 50 percent of the spills are assumed to occur in the Beaufort Sea and in the Pacific Ocean. In this analysis, Canadian tankering of oil is considered only within the boundaries of the modeled area.

For the cumulative case, the combined probabilities that an oil spill would occur and contact shores of the modeled study area are shown in Table IV-9 and are found in Tables G-10 through G-15 of Appendix G. Over 10 days, there is a 96-percent chance of 1 or more oil spills of 1,000 barrels or greater contacting land, with a most likely number of 3 such spills occurring and contacting land. Figures IV-1 and IV-2 give the oil-spill-probability estimates for spills of, and greater than, 1,000 and 100,000 barrels for the cumulative case. In the cumulative case, a most likely number of 24 spills of 1,000 barrels or greater is projected to occur with more-than-a-99.5-percent chance of 1 or more occurring. For the larger spill category, a most likely number of 1 spill is projected with an 82-percent chance of 1 or more occurring.

The analyses of environmental consequences for the Proposal (Alternative I) and the Alaska Peninsula Deferral (Alternative IV) are based on the leasing proposals (Sec. II.C.), resource estimates (Sec. II.A.), transportation scenarios (Sec. II.B.), and the basic assumptions for effects assessment (Sec. IV.A.). The site-specific oil-spill analyses in this EIS are based on the expected and assumed number of oil spills that are indicated below:

	Expected number of oil spills equal to or greater than 1,000 barrels	Assumed number of oil spills equal to or greater than 1,000 barrels	Expected number of oil spills equal to or greater than 100,000 barrels	Assumed number of oil spills equal to or greater than 100,000 barrels
Proposal (Alternative I)				
Pipeline-Transportation Scenario	0.94	1	0.03	0
Offshore-Loading Transportation Scenario	1.10	1	0.04	0
Alaska Peninsula Deferral (Alternative IV)				
Pipeline-Transportation Scenario	0.86	1	0.03	0

B. Alternative I - Proposal

Effects of Oil on the Ecosystem: The effects of oil on the ecosystem will depend on the effects on particular species, interactions among or between species, and persistence of oil within habitats. In addition, the type of oil spilled, conditions of the spill, degree of weathering, etc., also will affect the magnitude and extent of effects.

Since biological communities can be defined as sets of interacting or recurring organisms, an examination of the effects of oil on the marine ecosystem can be initiated with a look at the effects of oil on communities. Investigation of communities following oil spills, and laboratory and mesocosm experiments, indicate that major shifts in species composition can take place. These shifts appear to take place when the predominant species are more sensitive to oil than other species in the community. Changes in species composition or predominance may qualitatively change food-web dynamics and could lead to a decreasing efficiency of energy transfer to higher trophic levels if the number of linkages is increased (Ryther, 1969). Indirect effects also can occur when the interactions between or among species are altered. For example, if zooplankton are more sensitive to oil than phytoplankton, then phytoplankton productivity may be stimulated by a decrease in grazing pressure.

Pelagic Communities: Because of the fluid, mobile nature of planktonic communities, the broad distributions of the species components, and the believed ease of recolonization, the persistent effects of oil are unlikely for these communities unless chronic discharges occur. If a spill occurred nearshore, or in more open-ocean areas, plankton abundance and dynamics within the plankton could be affected. Zooplankton composition varies somewhat across the North Aleutian Basin (Cooney, 1981) and, concomitantly, the efficiency with which phytoplankton are grazed varies. Throughout most of the North Aleutian Basin, phytoplankton are not grazed very efficiently; and much of the ungrazed plant material settles to the benthos. The effects of an oil spill would depend on whether the species composition within either the zooplankton or phytoplankton changes due to differing relative sensitivities to oil, and whether zooplankton or phytoplankton are relatively more sensitive. If phytoplankton are affected by oil to a greater extent than zooplankton, then all involved foodwebs should be negatively affected. If zooplankton are more negatively affected, then in regions where small copepods already graze phytoplankton inefficiently, the level of inefficiency should increase and an even greater proportion of the phytoplankton bloom should sink to the benthos. In the deeper waters (greater than 100 m deep) of the North Aleutian Basin, where more mixed zooplankton assemblages are found, a decrease in large zooplankton relative to phytoplankton could have a negative effect on pelagic foodwebs that are dependent on these larger zooplankton. While pelagic predators might suffer, benthic organisms could receive a higher carbon input from settling, ungrazed phytoplankton. If a spill occurred, planktonic populations within the region would be likely to show localized reductions. There is some evidence to suggest that reproduction or recruitment of plankton can be affected by exposure to oil (Cowles and Remillard, 1983). Therefore, since some phytoplankton and zooplankton have very short lifespans, an oil spill could affect several generations of these organisms.

If pelagic fishes or fish larvae were affected, then decreased populations could result, but it might be quite difficult to ascribe the change to spilled oil, since large fluctuations in recruitment of fishes take place naturally and the causes are not well understood.

Benthic Communities: Changes in species composition have been observed following a number of spills due to massive kills of species present, followed by colonization or proliferation of more resistant, opportunistic species. Shifts in composition in benthic communities are likely to be persistent, especially if sediments (which are the major substrate in the North Aleutian Basin) become contaminated with oil. Most macroscopic benthic organisms are longer-lived than species in planktonic and epontic communities, and shifts in species composition may be very long-lasting if the newly predominant species inhibit recruitment or recolonization of previously predominant species. Initially, sublethal effects also may result in mortality and potential changes in species composition (i.e., if disruption of chemotactic feeding, mating, or habitat selection behaviors occurred). If sediments became contaminated, chronic exposure to oil could affect fecundity of associated fauna; and larval settlement might be eliminated, reduced, or those species that are settling might change. Thus, long-term changes in species composition could result, especially if larval settlement patterns were affected. In areas where sediments become contaminated, sensitive organisms that immigrate may die, and the overall density of such organisms in an area may decline if the sediments remain toxic for some time. Amphipods, especially ampeliscids, are very sensitive to oil pollution and have disappeared from areas as a result of spills and chronic pollution (d'Ozouville et al., 1979; Elmgren et al., 1980; Sanders et al., 1980; Cabioch et al., 1981; Elmgren and Frithsen, 1982; Teal and Howarth, 1984; Howarth, 1985). In nearshore areas of the Alaska Peninsula, ampeliscid amphipods may be important in the diets of other invertebrates as well as fish and, most notably, of gray whales. If oil were to become incorporated in sediments of these areas, where ampeliscid amphipods and other invertebrates are fed on by migrating gray whales, then both the amphipods and whales could be adversely affected.

Spilled oil contacting intertidal and subtidal communities is likely to produce moderate effects, since many organisms may die, and recruitment into affected areas is likely to be reduced. Intertidal areas have a higher probability of being affected than subtidal areas due to their location; the dilution and dispersion of oil in the water column means subtidal areas are less likely to be affected. Sensitive organisms within estuarine and soft-sediment environments are likely to suffer negative effects if these habitats are contacted by oil, since oil can persist for some time (Gundlach et al., 1982) and can be released chronically.

Trophic Considerations: In addition to the effects on communities that result from the trophic interactions discussed above, other trophic linkages could be affected. Numbers of fishes, marine mammals, and birds feed, migrate through, and/or rest within the North Aleutian Basin. Some of these organisms feed on benthic prey (i.e., gray whales) while others feed on pelagic or planktonic organisms (i.e., salmon, kittiwakes, auklets). The complexity of the foodweb in this area is illustrated in Figure III-1. Decreases or increases in a species' population might be difficult to ascribe to a particular oil spill because large fluctuations can occur naturally and may be related to physical factors (climate, hydrography), biological factors (competition, predation), or a combination of factors. For example, recent changes in populations of auklets (which feed on copepods) and fish-eating seabirds suggest that interactions among multiple species occur in the Bering Sea (Springer and Roseneau, 1985). Both pollock and auklets feed on pelagic copepods. Pollock populations have apparently declined (as measured by catch-per-unit effort), as has the reproductive success of the black-legged kittiwakes on the Pribilof Islands, which feed on pollock. Auklets, on the other hand, which may be potential competitors of the pollock for copepods, have increased in abundance in some locations (Springer and Roseneau, 1985). Thus, multiple species interactions can occur over a broad scale, and the decline of a single species' population may be difficult to attribute to a single cause. The large variation in recruitment to fish stocks is another example of little-understood natural variation.

Thus, although an oil spill could have direct effects on organisms, populations, and communities, it is also possible that the cause(s) of population changes might be difficult to determine, given the complexity of interactions among organisms, and between organisms and their environment.

1. Pipeline-Transportation Scenario:

a. Effects on Biological Resources:

(1) Effects on Fisheries Resources:

(a) General Discussion (Types of Effects):

Oil spills, discharges of drilling fluids (muds), cuttings, and formation waters, dispersants, and seismic activities are the potential factors that may result in adverse effects on fisheries resources in the North Aleutian Basin lease sale area.

Oil-Spill Effects: An oil spill that results in the contact of petroleum hydrocarbons and fish or marine invertebrates can result in direct mortality or sublethal effects that reduce the ability of the affected organisms to survive or reproduce. The effects of an oil spill depend on numerous biotic and abiotic factors. Oceanographic and meteorological conditions, including temperature, salinity, wind, currents, and wave height, influence the disposition of oil through evaporation, dissolution, dispersion, and sinking, which in turn determine the concentration and distribution of hydrocarbons. The concentrations and length of hydrocarbon exposure and species-specific hydrocarbon sensitivities of the organisms exposed determine whether effects are lethal or sublethal in nature. The lifestages and the seasonal, geographic, and diurnal movements of organisms exposed to hydrocarbons also influence the potential effects of oil spills on the biota.

Concentrations of hydrocarbons in oil-polluted marine waters are usually substantially less than 1 part per million (ppm) (Malins and Hodgins, 1981). For example, benzene concentrations in the water following the release of an estimated 3.3 MMbbls of oil from the Ixtoc I blowout in June 1979 were 0.06 to 0.1 ppm (Lewbel, 1983). Hydrocarbon concentrations following the *Argo*

Merchant spill ranged up to 0.21 ppm down to the 20-meter depth (Vandermeulen, 1982). A relatively uniform contamination of the column was found following the Amoco Cadiz spill, with hydrocarbon concentrations up to 0.1 ppm down to a depth of 100 meters (Marchand, 1978). Total dispersed and dissolved hydrocarbons may be on the order of hundreds of ppm near the source of a large oil spill, but the highly toxic aromatic compounds rapidly evaporate into the air. Aromatic compounds in crude oil spilled in the southeastern Bering Sea have been estimated to weather in 10 to 12 days (Hameedi, 1982). Payne (1981) reported that aromatic hydrocarbons of crude oil are generally weathered in 3 days. Hydrocarbons that become incorporated into benthic sediments may persist over months or years, depending on sediment size, and may result in long-term release of hydrocarbons into the water column (see following discussion on benthic habitat). In fine-grained sediments, hydrocarbons may persist for 6 to 12 years or longer (Gilfillan and Vandermeulen, 1978).

Concentrations of soluble aromatic hydrocarbons of 1 ppm or lower can be lethal to adult fish and crabs, and concentrations of 0.1 to 1 ppm or lower can be lethal to the more sensitive egg and larval stages. Existing bioassay results indicating the relative sensitivities of lifestages of various groups to the water-soluble fraction of petroleum hydrocarbons are summarized in Table IV-13. It must be cautioned that these are laboratory LC_{50} values which cannot be used to predict precise effects on marine organisms following an oil spill in situ.

Table IV-13
Lethal Concentrations (96-hr LC_{50}) of the Soluble Aromatic Compound of Crude Oil to Various Fish Groups and Lifestages (in ppm)

Ecological Group	Egg	Larvae	Juvenile	Adult
Shellfish:				
Shrimp	.01-1	.01	.1-1	.1-1
Crab	---	.1-2	1-4	1-4
Finfish:				
Flatfish	.1-1	.1-1	5+	5+
Semi-demersal	.1-1	.1-1	1-3	1-3
Pelagic	---	---	1-3	1-3

Source: Summarized from Thorsteinson and Thorsteinson, 1982.

Moore and Dwyer (1974) summarized the sensitivities of marine organisms by lifestages to the seawater-soluble fractions of petroleum:

Table IV-14
Marine-Organism Sensitivity to Seawater-Soluble-Petroleum Fractions

Concentration	Effect	Lifestage
1-100 ppm	lethal	adult
0.1-1.0 ppm	lethal	larvae, some eggs
0.01-1.0 ppm	sublethal	adult, larvae

Source: Moore and Dwyer, 1974.

Experimental results suggest that pelagic fish (i.e., salmonids and herring) are generally more sensitive than benthic species (Wilson, 1972; Rice et al., 1979). The concentration that kills 50 percent for total aromatics (96-hr median-tolerance limit) was 1.22 ppm for herring and 1.69 ppm for pink salmon, but greater than 5.34 ppm for flounder (Rice et al., 1979). They also reported that pelagic fish and shrimp were the most sensitive to Cook Inlet crude oil concentrations; benthic fish, crabs, and scallops were intermediate in sensitivity; and intertidal fish, crabs, and mollusks were the most tolerant.

Although the toxic components of crude oil can be expected to be largely weathered after 10 to 12 days, direct mortality of fish and invertebrates occurs rapidly after exposure to oil. Fish exposed to seawater-soluble fractions of Cook Inlet crude oil died rapidly, showing little additional mortality 2 to 4 days after exposure (Rice et al., 1979). Following contact with an oil spill, high mortality of fish may occur as a result of coating and asphyxiation, contact poisoning, or exposure to water-soluble toxic components of the oil (Malins et al., 1981). The toxicity of the water-soluble fraction may result from dissolution of fatty acids, which alters cell-membrane permeability and causes loss of the ability to regulate salt balance (Rice, 1981).

Marine fish and invertebrates also may experience numerous sublethal effects resulting from the incorporation of hydrocarbons into skin, liver, muscle, gonadal, or other tissue when exposed through diet, sediments, or the soluble fraction in the water column. These changes can result in reduced reproductive success or survivability.

Sublethal concentrations of hydrocarbons have been found to cause numerous physiological changes in fish and invertebrate species at concentrations as low as 0.002 ppm to 0.010 ppm (Johnson, 1977; Steele, 1977, as cited in Howarth, 1985; Jacobsen and Boyland, 1983). Documented physiological alterations on dysfunctions resulting from exposure to hydrocarbons include: changes in heart and respiration rates (Malins and Hodgins, 1981); delayed hatching of eggs (Kuhnhold et al., 1978); reduced fecundity and delayed ovarian development (Akeson, 1975; Linden, 1976a,; Carr and Reish, 1977; Tatem, 1977); abnormal energy consumption (Rice, 1981); impaired chemoreception (Armstrong et al., 1983); damage in cells, tissues, and organs (Rice, 1981); decreased resistance to disease and reduced survivorship (Rice, 1981); reduced tissue regeneration rates (Fingerman, 1980); increased incidence of tumors (Malins and Hodgins, 1981); fin erosion (Minchew and Yarborough, 1977; Giles et al., 1978; Malins and Hodgins, 1981); reduced growth (Dow, 1975; Keck et al., 1978; Rossi and Anderson, 1978; Thomas, 1978; Herbert and Poulet, 1980; Stekoll et al., 1980); and decreased survival of fish eggs, embryos, and larvae resulting from exposure of females to oil just prior to spawning (Struhsaker, 1977; Kuhnhold et al., 1978). Slower growth and development exposes eggs and larvae to more predation, and lengthening the exposure of larvae to predation has been hypothesized to be the most important factor controlling recruitment (Cushing, 1976).

Behavioral changes following oil exposure also have been reported for fish and invertebrates. The inability of fish and invertebrates to detect and respond to food (Whittle and Blumer, 1970; Percy, 1981) can result in decreased growth rates and reduced fitness (Fletcher et al., 1981), particularly important for winter survival. Reproductive behavior, such as impairment of locating and identifying mates, homes, or spawning times, may be disrupted (USDOI, BLM, 1979). Social behavior, such as schooling, also may be disrupted (Malins and Hodgins, 1981). Changes may occur in equilibrium, swimming performance, and spontaneous activity following exposure to low concentrations of hydrocarbons (Malins and Hodgins, 1981). Feeding, social, and reproductive behaviors have been disrupted by exposure to aromatic derivatives in concentrations as low as 10 to 100 ppb (Sondheimer and Simeone, 1970; Todd et al., 1972). Some species of fish (i.e., salmon) detect and avoid low concentrations of hydrocarbons in water (Rice, 1981).

Marine fish and invertebrates are most sensitive to hydrocarbon effects during the egg and early embryonic stages and during the transition period from yolk-dependent larvae to feeding juveniles (Rice et al., 1975; Rosenthal and Alderice, 1976; Moles et al., 1979; Rice, 1981). The earlier an embryo is exposed to oil, the greater the resulting damage (Rice, 1981), although damage to an embryo may not be expressed until it fails to hatch, dies upon hatching, or exhibits some abnormality as a larva which affects its survival, such as the inability to swim (Malins and Hodgins, 1981). The effects of hydrocarbon exposure on eggs include the development of deformities (Malins et al., 1981) and delayed or accelerated hatching (Ernst et al., 1977; Linden, 1978; Sharp et al., 1979; Malins and Hodgins, 1981). The hatching success of herring eggs spawned after the Tsesis spill was only half as great in oil-contaminated areas as in control areas (Nellbring et al., 1980). Larval stages are the most sensitive of these early invertebrate lifestages. Eggs are less sensitive because they are afforded some protection by chorion, the membrane surrounding the egg. After larvae hatch, their sensitivity to hydrocarbons increases to the critical point at which the yolk is absorbed and the larvae must feed on their own (Rice, 1981). Documented larval effects include deformities, tissue destruction, reduced growth, and inability to swim (Linden, 1975; Linden, 1976; Smith and Cameron, 1979). Malins (1980) reported that fish embryos and larvae may have abnormal growth and development following 96-hour exposure to Prudhoe Bay crude oil at concentrations as low as 27 ppm. Exposure to levels as low as 25 ppb resulted in fewer numbers of herring eggs hatching, and in abnormal growth and development of larvae.

The embryos and larvae of fish and invertebrates are particularly at risk to oil-spill effects because they lack the organs to detoxify hydrocarbons; they are exposed intimately to the environment; and they do not have mobility sufficient to avoid oil exposure. In addition, many are concentrated in surficial waters, where they are most likely to encounter an oil slick. With high natural prehatching and larval mortalities, additional mortalities resulting from an oil spill could seriously reduce these year-classes.

Sublethal Effects on Juvenile Salmon: Hydrocarbons taken into fish tissue after exposure to oil in water, food, or sediment may result in physiological, pathological, or behavioral aberrations. Sublethal effects may be transient (associated with stress), more persistent but only slightly debilitating, or more serious (i.e., eventually causing mortality). Even physiologically reversible sublethal effects may reduce the survival of juveniles as they enter the sea (Rice, Moles, and Short, 1975). Outmigrants of pink and sockeye salmon that were acclimated to seawater were found to be approximately twice as sensitive to the water-soluble fraction of Prudhoe Bay crude oil as outmigrants tested in fresh water (Moles et al., 1979).

Metabolic changes resulting from hydrocarbon exposure have been documented in juvenile salmon. Cough responses (i.e., convulsive respiratory reactions) developed in pink salmon fry shortly after exposures to sublethal concentrations of Prudhoe Bay crude oil, Cook Inlet crude oil, and No. 2 fuel oil. Other studies also have shown increases in opercular breathing and cough rates in pink salmon fry following exposure to petroleum compounds (Thomas and Rice, 1975; Rice et al., 1977). Juvenile chinook salmon exposed to benzene in varying concentrations show either increased respiration levels or narcosis with decreased respiration (Brocksen and Baily, 1973). Pink salmon fry exposed to toluene, naphthalene, or the water-soluble fraction of crude oil have shown increased oxygen consumption and breathing rates believed to be related to the additional energy required to metabolize and excrete aromatic compounds (Thomas and Rice, 1979). Juvenile coho and sockeye salmon exhibited muscle hypertension and hyperactivity following exposure to crude oil (Morrow, 1974).

Growth rates may be reduced by exposure to hydrocarbons and may affect the survival of young salmon. When exposed to toluene and naphthalene, coho fry grew less than control fry (Moles et al., 1981). Reduced growth of pink salmon fry resulting from exposure to sublethal concentrations of oil can influence the ability of young salmon to survive and cope in the new environment through effects on size (Rice et al., 1975). Because smaller fry are more susceptible to predation and less able to capture food than larger fry, inhibited growth of salmon fry may significantly reduce their survival (Moles et al., 1981).

Pathological changes and increased vulnerability to disease also have been correlated with exposure of young salmon to hydrocarbons. Coho fry exposed to the water-soluble fraction of crude oil developed gill lesions, indicating the loss of surface cells or cell layers (Hawkes, 1977). There also is a relationship between hydrocarbon exposure and parasitism (Moles, 1980).

Hydrocarbon exposure is known to cause changes in equilibrium and swimming ability. Juvenile coho and sockeye exhibited a loss of equilibrium within 24 hours after exposure to crude oil, and subsequently weakened swimming (Morrow, 1974). After as little as 45 minutes, they began to swim at the surface of the water with dorsal fins and upper lobes of caudal fins in the oil film. Korn et al. (1984) found a significant reduction in swimming performance of juvenile coho salmon (which was a reversible effect) from sublethal exposures to Cook Inlet crude oil.

Changes in predator and prey feeding behavior following exposure to hydrocarbons also have been documented. Oil-exposed salmon predators capture fewer prey (Malins et al., 1981). Exposure of coho salmon predators to the seawater soluble fraction of Cook Inlet crude oil resulted in a significant reduction in the numbers of fry prey eaten by the oil-exposed predators as compared to the numbers of prey consumed by nonoil-exposed predators (Malins et al., 1981). Coho fry feeding behavior was altered by exposure to toluene and naphthalene. Initially, the fry lost equilibrium and did not feed; later, they resumed feeding, but at reduced rates (Moles et al., 1981). Oil-exposed salmon fry experienced increased predation by nonoil-exposed predators (Malins et al., 1981).

Detection and Avoidance of Hydrocarbons by Salmon: Adult salmon can detect even sublethal concentrations of hydrocarbons (Rice, 1973; Weber et al., 1981). Increase in electroencephalograph (EEG) responses of salmon exposed in the lab to aromatic hydrocarbons have been documented at concentrations of 1.9 to 2.8 ppm, which indicate olfactory detection of hydrocarbons at these concentrations (Maynard and Weber, 1981); however, these may not be the minimum levels detectable. Response to these hydrocarbon concentrations indicates detection by adult salmon at concentrations less than the 2.8 to 3.7 ppm, concentrations that result in avoidance (Maynard and Weber, 1981). Salmon fry also have the ability to detect concentrations of hydrocarbons that are considerably lower than acutely toxic concentrations. Rice (1973) found that pink salmon fry discriminated between the interface of water with low (sublethal) oil concentrations and water without oil.

Postemergence lifestages of salmon also demonstrate avoidance of hydrocarbon-contaminated waters. Tests with mature salmon indicate that they may avoid hydrocarbons in the marine environment and in fresh water during spawning runs. In lab and field studies, adult salmon were found to avoid seawater-soluble-fraction hydrocarbon concentrations less than 1.6 ppm, but not those less than 0.75 ppm (Patten, 1977). Substantial numbers of mature salmon (primarily coho) migrating upstream at the peak of the spawning run distinguished between a fish ladder with natural water and one with a mixture of monocyclic aromatic hydrocarbons at concentrations as low as 3.2 ppm, and avoided the contaminated water (Weber et al., 1981).

Fry and juvenile salmon also avoid hydrocarbon-contaminated waters. Rice (1973) found marked avoidance of oil by salmon fry, and that avoidance of the water-soluble fraction of Prudhoe Bay crude oil by pink salmon fry varied with the stage of development, temperature, and salinity. Rice found that pink salmon fry avoided the water-soluble fraction of Prudhoe Bay crude oil in both fresh water and seawater, but exhibited different avoidance thresholds. In early summer (June), fry avoided a lethal concentration of 497 ppm in fresh water, but not a concentration of 89 ppm. In June, pink salmon fry that were adapted to seawater avoided 16 ppm, but not 8.8 ppm. Fry showed the most sensitive reactions in seawater in August, when they avoided 1.6 ppm. These avoidance levels were for nonmotivated salmon fry, however, and may not necessarily be accurate for motivated fry in natural situations. Avoidance in coho salmon fry also has been documented with a difference in avoidance thresholds between presmolt coho, which avoided 3 to 4 ppm concentrations of aromatic hydrocarbons, and smolting coho, which avoided concentrations of less than 2 ppm (Maynard and Weber, 1981). This study also found that presmolt coho did not significantly avoid 2.8 ppm in January and February, as they did

4 months later. Furthermore, they found that regardless of water temperature, more smolts consistently avoided a given concentration of aromatic hydrocarbons than did presmolts. This differential avoidance of petroleum hydrocarbons may be because presmolts resist displacement due to their aggressiveness and territoriality, thus tolerating higher concentrations of hydrocarbons than smolting coho (which, under natural conditions, are undergoing displacement during their seaward migration). Maynard and Weber (1981) suggested that juveniles (downstream migrants) probably would avoid acutely lethal concentrations of petroleum hydrocarbons. The stress associated with the physiological adaptations that juvenile salmon undergo in adapting from fresh water to salt water are believed to make the young salmon more susceptible and sensitive to oil in seawater than in fresh water (Rice et al., 1975; Moles et al., 1979).

It has been suggested that salmon-migration routes could be altered as a result of detection and avoidance of oil, such as that observed of pink salmon fry (Rice, 1973); however, homing instinct may override avoidance. Weber et al. (1981) suggested that, during the homing migration, adult salmon have an appetitive homing behavior that may override the aversion to hydrocarbon contaminants exhibited by juveniles. This study found that adults avoided hydrocarbon concentrations greater than 3.2 ppm but passed through levels up to 3.2 ppm, which approach acutely toxic levels. Malins et al. (1981) found that the homing ability of salmon was not prevented by hydrocarbon exposure, but that a delay in homing return was positively correlated with hydrocarbon concentration. Maynard and Weber (1981) stated that more than 50 percent of the presmolt coho exposed would not avoid a potentially toxic concentration of hydrocarbons (AL_{50} of 3.71 compared to the LC_{50} of 3.6 found by Moles et al., 1979). Mature salmon migrating upstream during the peak of the run did not distinctly avoid hydrocarbon concentrations less than 3.2 ppm, whereas smolt had an AL_{50} of 1.9 (Maynard and Weber, 1981).

Effects of Oil on Herring: Crude oil and refined oil products may cause mortality in various lifestages of herring. Nearly 100-percent mortality of herring eggs occurred following exposure to up to 6 ppm of the water-soluble fraction of outboard gasoline fuel (Stekoll, 1984). Exposure of herring eggs (days 0,1,2,3) to benzene in concentrations ranging from 35 to 45 ppm resulted in approximately 15 percent less hatching survival, and illustrated that the 96 hour LC_{50} value was 40 to 45 ppm (Struhsaker et al., 1974). Ninety (90) to 100 percent mortality has been documented following exposure of herring eggs to three types of crude oil in concentrations of 100 to 10,000 ppm (Kuhnhold, 1969). Mortality of herring eggs has been documented resulting from 0.1 to 1 ppm (Hameedi, 1982). Fertilized herring embryos exposed to 1-ppm concentrations of Prudhoe Bay crude oil for 6 days had 100-percent mortality (Smith and Cameron, 1979). Hatching success of herring eggs spawned in oil-contaminated areas after the Tsesis spill was only half that of eggs spawned in control areas (Nellbring et al., 1980). When female herring are exposed to benzene at parts-per-billion (ppb) levels immediately preceding spawning, the subsequent survival of embryos and larvae is reduced (Struhsaker, 1977). Larvae have been killed by 96-hour exposures to 3 ppm of Cook Inlet crude oil (Rice et al., 1976). Struhsaker et al. (1974) found 48-hour LC_{50} values for larval herring of 20 to 25 ppm of benzene, and larval survival reduced by exposure to 10 to 15 ppm. Lethal effects have been reported on larvae from exposure to hydrocarbon concentrations greater than 0.75 ppm (Hameedi, 1982). Juvenile and adult herring experience mortality at hydrocarbon concentrations of 1 to 3 ppm (Hameedi, 1982). The 96-hour LC_{50} values reported for adult herring include 1.22 ppm for total aromatics (Rice et al., 1979) and 20 ppm for No. 2 fuel oil (Vaughn, 1973). Sublethal effects of hydrocarbons on herring also have been documented. Rice and Gharrett (1984) found that uptake of hydrocarbons from 0.5 ppm of the water-soluble fraction of Cook Inlet crude oil was rapid, and that tissue burdens were dependent on concentrations rather than exposure length. Exposure to hydrocarbon concentrations greater than 25 ppb may result in sublethal effects on herring eggs, including reduced hatching success and abnormal growth and development (Hameedi, 1982). The effects of two crude oils and a fuel oil on herring include alterations in embryonic activity and heart rate, and premature or delayed hatching (Linden, 1978). Herring embryos exposed to outboard-gasoline fuel in concentrations up to 6 ppm showed aberrant swimming movements and possible spinal deformities (Stekoll, 1984). Documented sublethal effects of benzene on herring larvae include alterations in feeding, respiration rates, and developmental rates following exposure to concentrations of 5 to 35 ppm (Struhsaker et al., 1974). Abnormal growth, development, and behavior have been reported in herring larvae following exposure to hydrocarbon concentrations greater than 25 ppb (Hameedi, 1982). Probable accumulation of hydrocarbons, pathological effects, and behavioral changes occur in juvenile and adult herring at concentrations of less than 1 ppm (Hameedi, 1982). Following 48-hour exposures to less than 1 ppm of Prudhoe Bay crude oil, a significantly greater incidence of gross morphological abnormalities in developing herring has been documented (Smith and Cameron, 1979).

Effects on *Fucus*: Contact with oil may result in lethal or sublethal effects on macroscopic algae. Because penetration through the mucilaginous coating may take some time, expression of oil effects may be delayed (Clendenning and North, 1959). Oil may affect the growth or reproduction of rockweed. Very low concentrations of No. 2 fuel oil (i.e., 0.2 ppb) eliminated fertilization in *Fucus edentatus*, presumably by interfering with the chemical attraction of sperm to eggs (Steele, 1977; Darenbach and Gerek, 1980). Growth of *Fucus* zygotes may be reduced or inhibited following oil exposure (Steele, 1977). Photosynthesis may be depressed by a reduction in gas exchange resulting from coating with oil (Schramm, 1972).

Fucus also may be killed by exposure to oil, and effects in the community may persist for years; however, considerable variation exists in the effects of oil on rockweed. Following the *Arrow* spill, *F. vesiculosus* was reduced in vertical distribution for 5 years, and *F. spiralis* was killed and had not reappeared in the oiled region after 6 years (Teal and Howarth, 1984). *F. vesiculosus* was not measurably affected after the *Tsesis* spill (Teal and Howarth, 1984). *F. distichus*, an Alaskan species, showed little effect after lab exposure to 7 ppm of Prudhoe Bay crude oil for 2 to 4 hours (Shiels et al., 1973). Differences in effects may be related to varying sensitivities of species or length of exposure. Mortality of *Fucus* could greatly reduce suitable herring spawning sites for several years.

Plants in the intertidal and shallow subtidal zones may be exposed to oil for prolonged periods during and after a spill if the oil contacted the nearshore area (Clark et al., 1978). In addition, it has been suggested that the presence of macrophytes may increase retention of oil, and thus increase the exposure period for associated fauna. For example, *Fucus* plants were not measurably affected following the *Tsesis* oil spill, but macrofauna associated with *Fucus* were greatly reduced (Teal and Howarth, 1984).

Effects on Eelgrass: Photosynthetic processes are the physiological functions most likely to be affected by hydrocarbon contamination (McRoy and Williams, 1977). In examining hydrocarbon effects on eelgrass, McRoy and Williams (1977) concluded that seagrass exposed to hydrocarbons, in vitro, exhibited productivity reduced up to 2.2 times that of unexposed plants. Plants exposed to toluene were visibly affected at the end of 5.5 hours of exposure. Plants that were allowed a recovery period in clean seawater after hydrocarbon exposure exhibited less severe reductions of productivity. They also found that eelgrass exposed to hydrocarbons in natural situations (i.e., in boat harbors) or in situ experiments showed no serious effects, and in fact, are able to flourish in chronic low-level exposures. McRoy and Williams (1977) hypothesized that, while a major spill at low tide in Izembek Lagoon may have a serious effect on eelgrass beds, low-level, continuous exposure (i.e., oil slicks of boat fuels in small boat harbors) may not affect the ability of seagrass to survive and grow. Pearson (1976) hypothesized that the heavy wax cuticle of eelgrass may serve as a protective barrier to alkyl aromatics and naphthalene, which are toxic to many other marine biota.

McRoy and Williams (1977) also pointed out that hydrocarbon effects on eelgrass may result in deleterious effects on the nearshore environment. Despite the high productivity of the seagrasses, recovery after disruption is slow because it involves ecosystem development; the microbial aspects of detrital processes must build up sediment-nutrient levels sufficient to support the grass and the ecosystem. For example, effects of disruption by the wasting disease of eelgrass (in the 1930's on the East Coast) persisted for 30 years (Cottam and Munro, 1954; Rasmussen, 1977).

Effects on Capelin Spawning Habitat: Long-term effects of oil contamination on capelin spawning habitat have not been specifically documented. Michel et al. (1982), however, addressed predicted oil behavior on the variety of shoreline types found within the Bristol Bay region, including the type of habitat preferred for spawning by capelin: coarse sand or gravel beaches. Oil contacting coarse-grained sand or gravel beaches could percolate deeper into the sediments, and remaining there, expose spawning capelin to an oiled substrate over several years.

Effects on Red King Crab: Exposure of red king crab to hydrocarbons may result in behavioral or physiological effects. Armstrong et al. (1983) reviewed potential effects of oil toxicity on crustaceans. Bioaccumulation may occur causing a decline in general vigor evidenced by reduced growth, increased susceptibility to disease, inhibition of feeding and/or failure to swim or molt (all of which may eventually result in mortality). Impaired chemoreception could result in behavioral changes affecting feeding and/or mating, and consequent reproductive changes that may eventually be expressed in reduced brood sizes. Hydrocarbon exposure may result in carcinogenic and mutagenic changes resulting in tumors or morphological abnormalities. Reproductive success may be reduced by impaired viability of gametes and the arresting of embryonic development.

Other studies have shown various effects of hydrocarbon exposure. Molting success in premolt juvenile tanner and king crabs was lowered (Karinen and Rice, 1974; Mecklenberg et al., 1976). Legs were lost in postmolt juvenile tanner crabs following low-level exposures to Prudhoe Bay crude oil (Karinen and Rice, 1974). King crab gills were found damaged after 6-day exposures to Cook Inlet crude oil (Smith and Bonnet, 1976). Respiration rates were decreased in juvenile king crab (Rice et al., 1976).

Juvenile king crab were exposed to the water-soluble fraction of Cook Inlet crude oil (flow-through, stable concentrations for 30 days) or to oiled sediments for 3 months. The higher exposure concentrations of the water-soluble fraction were toxic and affected survival, growth, feeding rate, and scope for growth with adverse effects visible in just a few days. In contrast, the oiled sediments did not cause any measurable adverse effects on survival, feeding rate, growth, molting success, or scope for growth during the 3-month exposure, including those crabs exposed to the highest concentration (i.e., 2%). Aromatic hydrocarbons were detected in some tissues of the crabs, including crabs exposed to oiled sediment. Most experimental evidence suggests that exposures to oiled sediment will have minimal direct effects on survival and growth of juvenile king crab. The fact that hydrocarbons were detected in the tissues, however, means that there is some contact with the hydrocarbons, and adverse effects are possible, although exposures longer than 3 months would be required for expression of these effects.

Two recent studies (McMurray, 1983; Pearson, 1983) showed that juvenile crabs live and feed primarily in shell-hash and rocky-cobble environments. These are relatively high-energy environments where oil, if spilled, would not tend to accumulate. Thus, there is little reason to suspect that oil would accumulate in sediments and be present long enough to affect the settling and recruitment of food organisms of juvenile crabs.

No studies have specifically investigated the potential for direct hydrocarbon uptake by king crab eggs. Armstrong et al. (1983), however, synthesized the literature on oil toxicity on crab reproduction and hypothesized that protracted exposure of eggs to hydrocarbons could result from oil spills that contact extensive reproductive grounds during the 11 months that female king crab brood their eggs. The most extreme result inferred for such a situation was a significant reduction in the release of larvae. This lethal effect has been demonstrated in a study on shrimp exposed to 1.44 ppm for 72 hours, which resulted in a reduction in larval release of approximately 80 percent (Tatem, 1977). It also has been postulated that significant proportions of a year-class of king crab eggs could be lost if oil is transported to areas of the benthic environment that are occupied by gravid female crabs, and sediment levels of oil remain toxic to crab eggs over a period of months.

Effects on Chemoreception and Reproductive Behavior in Crabs: Chemoreceptors are essential to reproductive behaviors in crustaceans. For viable eggs to be produced, a female must be located and mated within 5 days after molting (Armstrong et al., 1983).

Takahashi and Kittredge (1973) described a study on sex-pheromone activity in male crabs (*Pachygrapsus crassipes*, *Cancer antennarius*, and *C. anthonyi*) by Kittredge et al. (1971). A female crustacean releases a sex pheromone signaling her presence and physiological state, which at low concentrations (below 10^{-13} M) stimulates a search behavior in males and, at higher concentrations, triggers a mating stance in males. Behavioral evidence suggests that, as the male approaches the female, he releases a sex pheromone that may function as an aphrodisiac. In addition to the initial female sex pheromone, which functions to attract the male, the female releases two additional sex pheromones that function as attractants and may signal the receptiveness of the female.

Hydrocarbons have been found to disrupt chemoreception in crabs and other crustaceans, which may result in behavior changes affecting reproduction. In juvenile and adult dungeness crab, chemosensory organs can detect water-soluble fractions as low as 0.1 ppm, which may be encountered following an oil spill (Pearson et al., 1980). Disruption of chemosensory cues may affect reproduction through: (1) failure to locate a female, (2) altered reproductive behavior, or (3) failure to copulate within 5 days following ecdysis, which results in a high proportion of infertile eggs (Armstrong et al., 1983). For example, the numbers of gravid crab and lobster were drastically reduced in 1978 and 1979 following the *Amoco Cadiz* spill, which suggests that breeding was impaired (Hood and Calder, 1981).

Takahashi and Kittredge (1973) studied the effect of hydrocarbon exposure on the response of male *Pachygrapsus crassipes* to the female sex pheromone, crustecdysone. When exposed to a 10^{-8} M solution of the pheromone in controls, males exhibited a mating stance within 3 minutes. Twenty-four-hour exposures of crabs to water-soluble extracts of two crude oils completely inhibited the mating response of males when exposed to the sex pheromone. An inverse relationship between the hydrocarbon concentration and the length of exposure prior to expression of the inhibition of chemoreception was indicated. This inhibition was found to be persistent for 8 to 13 days following exposure to polynuclear hydrocarbons, but transient (recovery in 30 minutes to 1 hour) following exposure to monoaromatic hydrocarbons.

Discharge Effects: In addition to the effects of oil spills on marine biota, there are potential effects of drilling fluids (muds), cuttings, and formation waters discharged during offshore drilling and production. Drilling fluids, cuttings, and formation waters may have lethal or sublethal effects on marine organisms through toxicity, direct burial, or alterations in physical qualities of the environment (i.e., increased suspended sediments in the water column or accumulation of solids on the benthic substrate). Fluids and cuttings that are discharged into the marine environment form (1) an upper plume composed of liquids, finer silts, and clays that may affect planktonic and nektonic organisms in the pelagic habitat, and (2) a lower plume that constitutes the bulk of the solids, muds, and cuttings that may affect demersal species. Section IV.F.1. of this EIS evaluates the effects of these discharges on water quality.

Drilling fluids and cuttings contain toxic components including trace metals, biocides, and petroleum hydrocarbons in varying compositions and concentrations. Bacteriocides in drilling fluids (i.e., diomine salts, quaternary amines) can be quite toxic with LC_{50} values of less than 1 ppm (USDOI, BLM, 1981a). Toxicity bioassays for marine organisms exposed, in situ, to drilling fluids and cuttings, however, show relatively high LC_{50} levels. For example, salmonids had LC_{50}'s ranging from 4,000 to 190,000 ppm; and shrimp showed an LC_{50} of 1,400 ppm (B.C. Research, 1976; Dames and Moore, 1978). The LC_{50} values for other species tested in the Lower Cook Inlet COST-Well Study (including amphipods, mysids, isopods, and brine shrimp larvae) ranged from 500 to 2,000 ppm (Dames and Moore, 1978).

Although drilling fluids and cuttings have the potential to be lethal, there is considerable evidence that lethal concentrations are present only within a few meters of a discharge point and result in little mortality of marine organisms. Dilution rates of 10,000:1 have been found to occur within 100 meters of a discharge point (Ayers et al., 1980a, 1980b; Houghton et al., 1981); however, a dispersion study has not been conducted in the North Aleutian Basin. Dames and Moore (1978) reported that toxic components are rapidly diluted upon discharge into lower Cook Inlet and are generally well below concentrations expected to cause mortalities within a few meters of the discharge point, except for short periods (up to 3 hours) of discharges during "cementing of the well" and at the end of the well, which can result in concentrations of drilling fluids that exceed LC_{50} values. Within a few meters of the downpipe, whole-mud concentrations greater than the measured LC_{50} values for many species could be experienced infrequently for 15 minutes to 3 hours by organisms that maintain themselves in the plume. From a few to 100 meters from the discharge, whole-mud concentrations greater than measured LC_{50} values for more sensitive species could be experienced infrequently for up to 3 hours. Beyond 100 meters, LC_{50} values for tests to date show no acute effects. Pink salmon fry in live-boxes at three depths (surface, midwater, and bottom), at 100- to 2,000-meter distances from a drilling-fluid-discharge point for 4 days, showed no mortality (Houghton et al., 1980).

The knowledge of sublethal long-term effects of exposure to drilling fluids and cuttings is not complete. Sublethal effects may result from bioaccumulation of heavy metals, although some studies show no bioaccumulation of heavy metals in exposed organisms (Monaghan et al., 1980; Northern Technical Services, 1981). However, many sublethal effects have been documented. For example, the National Research Council (1983) reported that:

> Responses to sublethal concentrations of drilling fluids that have been measured include alterations in burrowing behavior and chemosensory responses in lobsters; patterns of embryological or larval development or behavior in several species of shrimp, crabs, lobsters, sand dollars, and fish; feeding in larval and adult lobsters and cancer crabs; food assimilation and growth efficiency in opossum shrimp; growth and skeletal deposition in corals, scallops, oysters, and mussels; respiration and nitrogen excretion rates in corals and mussels; byssal thread formation in mussels; tissue enzyme activity in crustaceans; gill histopathology in shrimp and salmon fry; tissue-free amino-acid ratios in corals and oysters; and polyp retraction, mucus hypersecretion, ability to clean surfaces, photosynthesis, extrusion of zooanthellae, and survival of corals.

Formation (produced) waters, which may be discharged if oil is found, also can be toxic to organisms, particularly in shallow, stagnant waters (Armstrong et al., 1979). The effect of discharging formation waters depends upon the dilution after discharge. Discharge into Trinity Bay (Gulf of Mexico) with waters averaging 2.5 meters deep, with poor circulation, resulted in reduced benthic populations (Armstrong et al., 1979), but formation waters show little effect on areas 20 meters deep or on more shallow areas with dissipating tidal or current action (Mackin, 1973; Howard et al., 1980; Rose and Ward, 1981).

Suspended sediments from discharges may have a number of effects on fish. Sediments may interfere with respiration by clogging or damaging fish gills

(Lynch et al., 1977; Northern Technical Services, 1981), which may decrease oxygen exchange and result in suffocation (Lynch et al., 1977). Sediment also may reduce vision, a means of locating prey, which may interfere with feeding (Darnell et al., 1976). Some fish species appear to avoid areas of concentrated suspended sediments; others do not avoid them; and some fish may be attracted to turbid waters (Northern Technical Services, 1981). Most of the documentation of effects of suspended sediments on fish has been in fresh-water habitats. With rapid dilution and alternate habitat available in marine situations, there may be little serious effect on fish populations (Lewbel, 1983).

Drilling fluids and cuttings also may accumulate on the seafloor and may alter the benthic habitat. Water depth is a major controlling factor on bottom deposition (Boothe and Presley, 1983). The majority of fluids and cuttings are deposited on the seafloor within 1,000 meters of the discharge point (National Research Council, 1983). The length of time during which the settled material remains concentrated in these depositional sites varies from hours to years (ibid.).

Dispersant Effects: Following an oil spill, chemical dispersion is one of the methods available for controlling the disposition of oil at sea. In situations where mechanical containment and recovery of spilled oil is infeasible or ineffective because of environmental conditions (i.e., rough seas, poor visibility), equipment availability or limitations, or response time, chemical dispersion of oil, prior to contact with sensitive habitats, may be desirable. Dispersants generally are used to protect sensitive areas (i.e., nearshore waters, shorelines) that are threatened by contact with surface-oil slicks. Biological, physical, chemical, geographical, and climatic factors must be considered in evaluating whether or not dispersants should be employed following an oil spill. Chemical dispersion of oil has both advantages and disadvantages that must be weighed in a specific situation. The comparison of trade-offs is not between the effects of dispersed oil and no oil, but rather between the effects of dispersed oil and undispersed oil. The On-Scene Coordinator may decide to mimimize oil-spill effects on certain species by employing a dispersant that results in increased exposure of other species to hydrocarbons in the water column. For example, in a situation where birds and marine mammals are particularly at risk to oil effects, dispersant use may be preferable despite some increased hydrocarbon exposure to fish species. Historically, the use of dispersants has been considered undesirable, and they have not been applied as an oil-spill-control mechanism in Alaska. Currently, however, industry, state, and federal agencies are developing guidelines for dispersant use to facilitate the decisionmaking process in the event of an oil spill.

There are a number of advantages of chemical dispersion of oil. Once chemically dispersed, oil does not adhere to birds, marine mammals, fish, or fish eggs, and thus precludes effects caused by physical coating with oil. Dispersants prevent the formation of mousses (water-in-oil emulsions), which have viscosities higher than the original oil and result in delayed weathering. Dispersion accelerates the weathering of oil by increasing the surface area of oil exposed to water (i.e., the surface-to-volume ratio), which enhances the physical, chemical, and biological processes. Solution and subsequent evaporation of volatile hydrocarbons (particularly C_1 to C_{10}) are accelerated for dispersed oil droplets compared to untreated slicks (McAuliffe, 1977; McAuliffe et al., 1980). Increased surface-to-volume ratios in smaller droplets also increase biodegradation by bacteria at the oil-water interface, which results in more rapid biodegradation of dispersed droplets than large droplets or nondispersed oil (Gatellier et al., 1973). Dispersed oil in the water column moves more slowly with subsurface currents, rather than at approximately 3 percent of the windspeed as surface oil moves. The effectiveness of chemical dispersants has been investigated in field tests and following accidental spills. The 1978 East Coast Studies test sponsored by EPA and the American Petroleum Insitute (API) found that a dispersant resulted in 50 and 90 percent of the total volume of two types of oil being dispersed, and in more rapid evaporation of the low-molecular-weight (highly toxic) aromatic hydrocarbons. McAuliffe et al. (1981) evaluated the effectiveness of dispersants on Prudhoe Bay crude oil and found up to 78 percent of the oil dispersed. A dispersant was used successfully during the Ixtoc I well blowout to protect beaches, and "effectively dispersed the Ixtoc I crude from the surface into the upper 3 m of the water column" (Linton and Koons, 1983).

There also are disadvantages to using chemical dispersants. Although the use of a dispersant does not increase the toxicity of a crude oil, it does increase the amount of oil dispersed throughout the water column and consequently its immediate availability and toxicity to aquatic organisms (Foy, 1982). Thus, short-term effects may be increased by exposing more organisms to higher hydrocarbon concentrations. Although chemically dispersed oil generally shows greater toxicities than untreated oil, this is because the oil is made more available to organisms, not because the oil, per se, is made more toxic by the dispersants. Generally, this means the difference between short-term effects of oil dispersed in the water column and longer-term effects of an oil slick contacting sensitive areas (i.e., shorelines). Trudell (1978) found that chemically dispersed (Corexit 9527) and mechanically dispersed crude oil were equally toxic to natural phytoplankton populations. Oil emulsions are generally more toxic than both unemulsified crude oil and newer dispersants (Swedmark, 1974).

The first-generation dispersants used at the Torrey Canyon spill in 1967 were highly toxic. Use of dispersants resulted in massive destruction of shoreline intertidal organisms; however, no changes in local fish populations were observed (Wilson, 1974). The surfactants in these dispersants were aromatic hydrocarbon solvents that were fairly effective in dispersing oil (with the application of sufficient mixing energy), but also were highly toxic. High concentrations of these early dispersants were used directly on beaches as cleaning agents and resulted in more extensive effects than did oil contamination on untreated shoreline areas. Second-generation dispersants that have been developed since the Torrey Canyon spill are much less toxic than the earlier dispersants (Foy, 1982; American Petroleum Institute, 1984).

Toxicity varies greatly among dispersants, and the sensitivity of an organism to a dispersant also varies. Acute toxicities (LC_{50}'s) generally range between 1 and 1,000 ppm (Norton et al., 1978). Dodd (1974) found that 48-hour LC_{50}'s for Crangon crangon ranged from 6 ppm for BP1002 (a hydrocarbon solvent with 60-70% aromatics) to greater than 3,300 ppm for Corexit and Dispersol formulations. ESSO Chemicals (1976) reported an LC_{50} of 6,600 ppm for brown shrimp (unclear as to whether it was applied as a concentrate or diluted formulation). Foy (1982) found that a fish species, Myoxocephalus quadricornus (four-horn sculpin), was more sensitive to Corexit 9527 with an LC_{50} of less than 40 ppm than were the amphipods, which had a range of 70-175 ppm.

Exxon reported maximum concentrations of dispersants at water depths of 1, 2, 3, and 4 feet. At an average dosage rate of 5 gallons per acre, the concentrations ranged from 15.33 to 3.83 ppm. Even a relatively high dose of 15 gallons per acre resulted in concentrations below the LC_{50} value for second-generation dispersants, ranging from 45.87 to 11.47 ppm.

Although the acute toxicities of some of the current dispersants are comparatively low and direct mortalities from the concentrations used would be low (Foy, 1982), ecological predictions can be complicated by sublethal or indirect toxic effects that affect survival. Effects on locomotory behavior, food responses, defense reactions, and growth, development, and hatching of eggs or larvae have been associated with dispersants (Baker and Crapp, 1974; Swedmark, 1974). Olfactory damage may be much greater from exposure to dispersants and dispersant/oil mixtures than from crude oil alone (American Petroleum Institute, 1984). Indirect effects also have been suggested. For example, following exposure to dispersants, organisms may retract to their shells and roll or be swept away from shore to areas where they are more susceptible to predation, from which they cannot recover and return to shore (Baker and Crapp, 1974). In ecosystems where competition for food and space is essential to survival and where predator-prey systems are operative, these sublethal effects can result in alterations in the ability to survive.

Geophysical (Seismic)-Survey Effects: Historically, there has been concern over the mortalities of fish and marine invertebrates that can result from seismic surveys. The seismic-energy sources employed and their effects on fish vary. A discussion of seismic equipment appears in the St. George Basin Supplemental FEIS, which is incorporated herein by reference. Formerly, seismic-recording instruments required considerable energy to collect usable seismic data, which was generated by the use of explosives lethal to nearby fish, particularly in shallow waters. With improved seismic technology, nonexplosive energy sources have been employed and yield better seismographic records; currently, explosives are rarely used in seismic exploration. For marine surveys, airguns have been the preferred energy source since the 1960's (Lewbel, 1983).

The airgun releases high-pressured air directed into the surrounding area. The peak pressure is relatively low and is distributed intermittently over short time periods. Airgun detonations have been found to be far less harmful to fish than explosive energy sources. For example, a 10-pound charge of 60-percent Goegel (detonated 10 feet below the surface in 15 feet of water) killed fish over a 25,450-square-foot area (Falk and Lawrence, 1973). Wienhold and Weaver (1971) exposed caged coho salmon smolt to varying airgun detonations at distances of 1, 4, and 5 meters from both a single airgun and a linear arrangement of eight airguns. No mortalities or injuries were observed during the 72-hour period following the exposure. Falk and Lawrence (1973) exposed Arctic coregonids to seismic airguns in the waters of the Mackenzie River Delta, and found that a few fish suffered swimbladder damage, which was assumed to result in subsequent mortality. Based on that assumption, they estimated the 300-cubic-inch airgun to have a potentially lethal radius of 0.6 to 1.5 meters. Sublethal effects, such as disturbance to and dispersal of schooled fish, such as salmon, where lasting effects occur remain undocumented. Although studies have not specifically addressed the effects of seismic surveys on developing eggs and larvae, mortalities may occur in the immediate vicinity of pressure detonations. Considering the widespread distribution of groundfish eggs and larvae in the eastern Bering Sea, however, any mortalities resulting from seismic activities associated with siting exploration and development platforms would result in effects within a very restricted area.

For the small number of exploratory and production wells projected (42), seismic surveys in the North Aleutian Basin are estimated at a total of 2,191 kilometers (1,362 miles). Based on the limited effects and the small potential radius within which effects may be experienced, it is expected that the seismic surveys would have a negligible effect on the fisheries resources of the North Aleutian Basin lease sale area, provided that explosive-energy sources are not employed.

Effects by Habitat Type: This section describes the potential generic effects of oil spills and discharges of drilling fluids, cuttings, and formation waters on fisheries resources in pelagic, benthic, and nearshore habitats. The potential effects of discharges and oil spills vary among these habitats with the different lifestages of marine organisms utilizing them. Physical characteristics of these habitats (i.e., water depth and circulation) and their locations relative to projected activities (i.e., drilling, discharges, transportation) also result in different generic effects.

Pelagic Habitat: Fisheries resources in the pelagic habitat may be affected by discharges of drilling fluids, cuttings, and formation waters, or by oil spills. This habitat is used by many pelagic organisms, including adult stages of salmon, pollock, herring, and other fish; juvenile rockfish; planktonic crab and shrimp larvae; and various egg and larval stages of demersal fish, including pollock, halibut, Pacific cod, yellowfin sole, Alaska plaice, Pacific Ocean perch, and sablefish. The potential effects of discharges and oil spills on pelagic organisms using nearshore areas are discussed in the following section on the nearshore habitat.

The discharge of drilling fluids, cuttings, and formation waters during offshore drilling and production is expected to have very limited, localized effects on organisms in the pelagic habitat. Fish may be affected by increased suspended-sediment levels resulting from drilling and production discharges. Although the concentration of suspended solids in the upper-surface plume of discharges is expected to be elevated in the immediate area of the discharge, dilution of these discharges would be rapid in the North Aleutian Basin. In addition, vast areas of alternate habitat are available for fish that may encounter the increased sediment level of a discharge surface plume.

Discharges also may have limited toxicity effects on pelagic organisms. Within a few meters of the downpipe from which cuttings and fluids are discharged, fish may be exposed to lethal toxicities (as high as parts per hundred), but few fish would encounter and remain in this limited area long enough to experience mortality. A larger number of planktonic organisms and early planktonic lifestages, (i.e., eggs, larvae) of other marine organisms may die of exposure to lethal toxicities because they are sensitive to lower toxic concentrations; and they are relatively immobile and, consequently, unable to avoid exposure to discharge plumes. Effects on planktonic organisms would be localized around a maximum of 42 exploration and production wells over the life of the project, and would affect a small portion of the planktonic organisms in the North Aleutian Basin region.

Discharges into the North Aleutian Basin lease sale area with water depths of 30 to about 100 meters would be diluted rapidly. Within 100 meters of a discharge, toxic concentrations on the order of parts per thousand may affect some organisms that remain in the plume. Beyond 100 meters from a discharge, concentrations should be diluted to parts per million and may result in sublethal effects. Considering the maximum number of 32 production and 10 exploration wells over the life of the project, the size of the plumes in relation to the volume of the North Aleutian Basin, and the alternate habitat available, the effects of these discharges would be very localized and limited to a number of individuals, and would not affect a species at a regional-population level.

Marine organisms inhabiting the pelagic habitat also may be affected by oil spills. Ward et al. (1980) found dissolved-oil-hydrocarbon concentrations in the North Sea elevated within 15 kilometers of oil rigs as a result of chronic discharges. A major oil spill (i.e., a tanker accident) of 100,000 barrels might spread to cover 200 square kilometers and might have lethal or sublethal effects on pelagic organisms within that area. Planktonic organisms, which cannot avoid a slick, are more sensitive to oil, and lack the organs to degrade the toxic components, would be particularly at risk. These early planktonic lifestages, however, are abundant and widely distributed in marine areas. Consequently, the portion of pelagic organisms affected by a major oil spill covering 200 square kilometers would be very small compared to the total numbers of these organisms in the North Aleutian Basin. It has been documented that oil spills in other open-water areas (i.e., the Ekofisk blowout, the Argo Merchant tanker spill, spills in Cook Inlet) resulted in no measurable decrease in planktonic population densities (Kinney et al., 1969; Kuhnhold, 1978; Lannergren, 1978). The effects of even a major oil spill on pelagic organisms in the North Aleutian Basin would be limited to a number of individuals in a localized area and would not affect regional populations.

Benthic Habitat: The benthic habitat may be exposed to hydrocarbon contamination resulting from oil spills and to discharge effects from drilling fluids, cuttings, and formation waters. This habitat is used by adult groundfish (i.e., pollock, halibut, yellowfin sole, Pacific cod, rockfish, and sablefish) for feeding and/or spawning; by herring for overwintering; by adult crab at seasonally varying depths; and by various other invertebrates. The potential effects of discharges and oil spills on benthic organisms using nearshore areas are discussed in the following section on the nearshore habitat.

Organisms using the benthic habitat may be affected by discharges of drilling fluids, cuttings, and formation waters through: (1) lethal or sublethal toxicities; (2) mortalities resulting from burial or smothering; or (3) alterations of habitat through the accumulation of cuttings. Infaunal organisms and demersal eggs of Pacific cod and rock sole in the immediate vicinity of a discharge point may be buried or smothered by cuttings that are discharged directly at the seafloor during the first 50 to 150 meters of drilling. The accumulation of sediments from these discharges, which settle to the bottom, also may alter physical aspects of the benthos. The accumulation of sediments may yield increased microrelief which, in some cases, has resulted in a temporary increase in demersal fish in areas of drilling (Menzie et al., 1980). Fish are not affected directly through the accumulation of cuttings, but may be affected indirectly through a reduction in the productivity of their infaunal prey, resulting in less available food. The reproductive patterns of fish also could be affected through accumulation of fines in coarse sediments used for spawning, but any resultant decrease in reproduction would be limited to the immediate vicinity of the discharge.

The accumulation of sediments in benthic areas would be limited by currents or tidal actions that disperse cuttings. Drill cuttings discharged in lower Cook Inlet did not result in accumulation on the benthos; the dynamic condition of the area precluded the formation of a cuttings pile (Houghton, 1981). Offshore accumulation of sediments in the North Aleutian Basin and resultant effects are expected to be minimal.

The toxicity of discharges may have a limited effect on benthic organisms. Brandsma and Sauer (1983) found that toxic concentrations in the lower plume of a discharge are approximately an order of magnitude higher than in the upper plume. Lethal concentrations of drilling fluids may be encountered within a few meters of discharge points and may result in decreased benthic infaunal densities and biomass within a very localized area (Crippen and Hood, 1980). Fish, however, may avoid these toxic concentrations and use alternate habitat. Any effects on fish or benthic infauna would be localized around a maximum of 42 exploration and drilling wells over the life of the project, and would affect a small portion of the benthic organisms in the North Aleutian Basin.

Heavy metals in drilling fluids (i.e., chromium, zinc, lead) may accumulate in benthic sediments, as observed within 1 kilometer of platforms in the Gulf of Mexico. Heavy metals may bioaccumulate in benthic-detritus feeders, but bottomfish are unlikely to accumulate heavy metals because of the limited benthic area affected and the continual redistribution of fish.

Following an offshore oil spill, the water-soluble fraction may reach the sea bottom and benthic organisms in offshore areas. Hydrocarbon concentrations of the water-soluble fractions that reach the seafloor in offshore areas would be more dilute than those higher in the water column (i.e., closer to the slick), which are generally well below 1 ppm. Benthic infauna exposed to concentrations below 1 ppm could experience some localized lethal or sublethal effects. Juvenile and adult lifestages of crabs and fish using the benthic habitat, have LC_{50} values of 1 to 5 ppm and may be killed by, or experience sublethal effects from, contact with the water-soluble fraction that reaches the benthic environment.

Sedimentation of oil occurs following most oil spills (Howarth, 1984) and may result in toxic effects on benthic fauna. In several fields in the North Sea, there has been evidence of sediment contamination within 30 kilometers of oil rigs following chronic discharges (Ward et al., 1980). Following the Argo Merchant spill, however, very little oil was detected in bottom sediments or benthic fauna, except in the immediate vicinity of the accident (Macleod et al., 1978). Hydrocarbon concentrations in the contaminated sediments directly beneath an oil slick may range as high as thousands of parts per million (National Research Council, 1983). Lethal or sublethal effects are possible from the uptake of contaminated benthic sediments (ibid.). In the case of at least one platform, oil contamination appears to be associated with decreased numbers of animals and decreased numbers of animal species (Addy et al., 1978). Amphipods, for example, are sensitive to hydrocarbons and disappear rapidly following an oil spill or chronic oil discharges (Elmgren and Frithsen, 1982; Howarth, 1985), and these are important food for demersal fish. Sedimented hydrocarbons also may be assimilated by detritus feeders and may be transmitted to commercially important bottomfish. Hydrocarbons that have been incorporated into the benthic sediments may persist over months or years, depending on the sediment size. Coarse sediments may be free of hydrocarbons within a year of contamination, as documented following the Amoco Cadiz spill (Beslier et al., 1980). Hydrocarbons in more fine-grained sediments may persist for 6 to 12 years or longer after a spill (Gilfillan and Vandermeulen, 1978) because the anoxic conditions in such sediments favor their preservation (Howarth, 1984). Ongoing release of these hydrocarbons over time may result in long-term mortality, reduced fitness, and decreased reproductive success.

Nearshore Habitat: The nearshore habitat is particularly important to various lifestages of a number of fish and invertebrate species. Adult salmonids congregate in estuaries of their natal streams prior to ascending to fresh-water spawning areas. Chum salmon, pink salmon, and other fish species (i.e., Atka mackerel and capelin) spawn in nearshore areas including intertidal zones, shallow subtidal zones, and gravel beaches. Pacific herring use shallow subtidal areas (rocky beaches) for spawning, intertidal and shallow subtidal areas for eggs and larvae, and nearshore surface areas (bays and inlets) for juveniles. Nearshore areas also are important habitat for planktonic egg or larval stages of fish species including walleye pollock, Atka mackerel, Pacific cod, yellowfin sole, and some Pacific halibut. Juvenile salmon use estuaries for feeding. Other juvenile fish, including Pacific cod, sablefish, yellowfin sole, halibut, and rock sole, also inhabit nearshore areas. King, dungeness, and tanner crabs use nearshore benthic areas for feeding, spawning, and rearing. Juvenile crabs concentrate in nearshore bays and inlets. Pandalid shrimp inhabit the nearshore plankton for several months while feeding and molting.

Although discharges of drilling fluids, cuttings, and formation waters are potentially toxic to fish and invertebrates, discharges during exploration and/or production of the North Aleutian Basin would not affect the nearshore habitat. Discharges are not permitted within state waters (i.e., within 3 miles of the coastline). The lease sale area is approximately 18 kilometers from land at its closest proximity, and although its boundary reaches a minimum water depth of approximately 30 meters, depths within the lease sale area generally range from 40 to 70 meters. Discharges would dissipate rapidly in waters of these depths, and they would not be introduced into nearshore waters, where toxic concentrations could persist or sediments could accumulate in shallow, nonturbulent waters. Therefore, drilling and production discharges would not have any effect on nearshore organisms.

In contrast, hydrocarbons may have a significant effect on nearshore habitats and organisms. These areas may be exposed to hydrocarbons through an oil slick resulting from a spill, or through discharges from onshore oil-handling facilities in bays or estuaries that have restricted circulation of shallow waters.

The lifestages of a number of the species present in nearshore areas would be vulnerable to hydrocarbon exposure. Planktonic eggs and larvae would be most vulnerable because they lack the organs to detoxify oil, are intimate with the environment, lack the mobility to avoid contaminated areas, develop at or near the surface where exposure to an oil slick is maximized, and are rapidly incapacitated by low hydrocarbon exposures (Kuhnhold, 1972; Rice, 1981). The egg and/or larval stages of herring, yellowfin sole, halibut, sablefish, shrimp, and crabs using nearshore areas would be particularly sensitive to lethal and sublethal hydrocarbon effects. The juvenile stages of salmon, Pacific cod, sablefish, yellowfin sole, halibut, crab, and shrimp concentrated in nearshore areas may develop abnormally or die following oil exposure. Adult fish may avoid nearshore areas, so they may have a more limited exposure period during which to take up lethal concentrations and die. Adult prespawning salmon, however, may pass through toxic hydrocarbon concentrations in nearshore areas that may result in decreased viability of eggs or other sublethal effects. Pink and chum salmon spawning intertidally may be particularly vulnerable to nearshore oil-spill effects. Juvenile salmon show a greater sensitivity to crude oil in seawater than in fresh water (Moles et al., 1979), so juveniles using nearshore areas may be particularly vulnerable to lethal and sublethal oil-spill effects. Invertebrates also may be killed by nearshore oil spills. For example, the Arrow spill in Chedabucto Bay resulted in the smothering of bivalves; and the Amoco Cadiz spill near the Brittany coast resulted in the decimation and/or contamination of bivalves, echinoderms, and amphipods (National Research Council, 1983) as a result of the combined effects of oil/dispersant exposure on the intertidal and beach zones.

If oil is incorporated into benthic sediments where degradation rates are reduced, there is the potential for long-term contamination of shallow, nearshore areas (Vandermeulen and Gordon, 1976). Oil incorporated in beach sediments may be released into shallow sublittoral zones over a period of 6 to 12 years or longer (Gilfillan and Vandermeulen, 1978). As discussed in the previous generic-effects section, the effects of exposure of organisms to chronic, sublethal hydrocarbon concentrations are not well understood.

In summary, oil in nearshore waters may directly kill organisms, affect them by reducing the foodweb resources upon which they depend, subject them to physiological and behavioral alterations that may affect their survival or reproduction, or cause them to avoid nearshore habitats. Because these nearshore areas are used by such a diversity of species for important lifestages, they are particularly vulnerable to oil-exposure effects. A major or chronic spill contacting nearshore areas where egg and larval stages of fish and crab species are present could result in a decrease in abundance of one or more species in the localized area affected, and have possible long-term effects.

(b) Site-Specific Effects of Oil Spills: The analysis that follows is based on an oil-spill-risk analysis (OSRA) described in detail in Section IV.A.3. A hypothetical spill of 1,000 barrels or greater of crude oil existent over a period of 10 days from random and selected spill points in the lease area is used. Based on a statistical projection of 0.94 spills of 1,000 barrels or greater, it is assumed that 1 spill in this category would occur. These hypothetical spills would occur from platforms or pipelines.

Effects on Salmonids: The various lifestages of all five species of Pacific salmon may be affected by activities associated with the exploration and development of the lease area. In the spring, summer, and fall, prespawning adults pass through nearshore waters and bays in and adjacent to the lease sale area on their return to natal streams. After the young hatch in fresh water and migrate to the sea, they spend several months or more as fry (or juveniles) in estuarine and nearshore waters in or adjacent to the lease sale area before moving seaward to join the adults. During the summer, the epipelagic adults inhabit the open ocean, including the lease sale area. For the purpose of analysis, the regional populations of salmon species are defined as all salmon stocks spawning along the northern coast of the Alaska Peninsula and in Bristol Bay drainages.

During their oceanic phases, salmon are expected to experience limited effects from contact with discharges of drilling fluids, cuttings, and formation waters. Offshore discharges into the open water of the North Aleutian Basin area would occur at a minimum of 18 kilometers from land and, consequently, would dilute rapidly. Lethal concentrations might be encountered within a few meters of a discharge, or concentrations that cause sublethal effects might occur within approximately 100 meters. Increased levels of suspended sediments in the upper plume from a discharge in the immediate area also may adversely affect salmon. The effects of sedimentation, however, would be limited because adult fish may avoid these areas and use the extensive areas of alternate, pelagic habitat available. The number of salmon affected by these localized discharges from a maximum of 42 (10 exploration and 32 development) wells over the life of the project would be a small portion of a regional population and thus would experience only minor effects. The fry and juveniles are concentrated in nearshore areas and, consequently, would not experience effects from discharges into waters at a minimum of 18 kilometers from land.

Salmon that contact hydrocarbons as a result of an oil spill in the lease sale area may experience mortality or varying degrees of sublethal effects, depending on the lifestages contacted, the location and areal extent of the spill, and the degree to which the oil has weathered prior to contact. As discussed in the generic-effects section, the sublethal effects of hydrocarbon exposure may affect the ability of a fish to survive or reproduce. Adult salmon, having a 96-hour LC_{50} of 1 to 3 ppm (Wilson, 1972; Rice et al., 1979), are more sensitive to hydrocarbon exposure than are benthic fish. Newly emerged salmon fry are the most susceptible lifestage (Rice et al., 1975; Moles et al., 1979).

Pelagic adults in the upper water column contacted by an offshore oil slick or the water-soluble fraction around and below a slick, may experience mortality or sublethal effects. Mortalities are expected to be limited because concentrations in open-water areas are low. Adult salmon have demonstrated LC_{50} values of 1 to 3 ppm in laboratory studies. Hydrocarbon concentrations of 0.21 ppm at 20 meters deep (Vandermeulen, 1982) and 0.1 ppm at 100 meters deep (Marchand, 1978) have been observed following oil spills, which could result in mortalities and sublethal effects. However, even for a major offshore oil spill of 100,000 barrels or greater, which spreads to cover 200 square kilometers, the portion of a regional salmon population affected would be limited because of the widespread distribution of salmon in pelagic habitats. In addition, there is extensive alternate fish habitat available in the North Aleutian Basin area. The effects of an offshore oil spill on pelagic, adult salmon could be minor.

An offshore oil spill would not be transported to upstream natal areas, but could contact nearshore and estuarine areas and affect (1) adults migrating to their spawning streams, or (2) fry or juveniles using these areas prior to migrating offshore. An oil spill contacting nearshore areas could result in mortality of salmon (particularly the more susceptible fry) or in sublethal effects that may affect their ability to develop, reproduce, or survive natural environmental stresses. The stresses associated with the physiological adaptations that salmon undergo in adapting from fresh water to salt water result in increased susceptibility to hydrocarbon effects (Moles, Rice, and Korn, 1979). However, even assuming high mortalities in nearshore areas contacted by a major oil spill of 100,000 barrels that spreads to cover 200 square kilometers, the portion of a regional population killed would be limited by the size and temporal segregation of spawning distributions, resulting in a moderate effect at worst. The magnitude of resultant population reductions depends on the areas and lifestages affected, the portion of a regional population affected, and the concentration of hydrocarbons contacted.

Table IV-15 indicates oil spill risk to the various salmon stocks along the northern coast of the Alaska Peninsula and inner Bristol Bay. The highest risk is associated with salmon congregating at Nelson Lagoon and in the Port Moller/Bear River areas. The probabilities of an oil spill of 1,000 barrels or greater occurring and contacting these two areas within 30 days are 9 and 3 percent, respectively. Salmon stocks in inner Bristol Bay, which represent about 95 percent of the regional population, have negligible risks (less than 0.5 percent) of an oil spill occurring and contacting these populations when they are most vulnerable. Even if there were high mortalities to adult salmon in Nelson Lagoon, Port Moller, and Bear River from a large spill, it would represent less than 5 percent of the regional population.

Studies have shown that various lifestages of salmon can detect even sublethal hydrocarbon concentrations (Rice, 1973; Weber et al., 1981) and may avoid contaminated areas. Adult salmon avoided hydrocarbon concentrations greater than 3.2 ppm, but passed through concentrations up to 3.2 ppm which exceed LC_{50} values (Weber et al., 1981). Smolting coho avoid concentrations half that avoided by presmolt coho (Maynard and Weber, 1981). The avoidance of spawning streams due to an oil spill that contacted estuarine areas could have an adverse effect on a portion of a population by reducing spawning success, but Malins et al. (1978) found that the salmon's homing ability was delayed, but not prevented, by contact with hydrocarbons. Following a spill, hydrocarbon concentrations in open-water areas are usually less than 1 ppm; such concentrations should not divert or delay migrating salmon. Any alterations or delays in migration probably would not be significant. Oil-spill slicks generally occur in patchy configurations and salmon would not be exposed to continuous areas of contamination. Adult and juvenile salmon could move deeper to avoid detectable concentrations or, at worst, could move away from and around these contaminated areas. Open-ocean concentrations, however, are not expected to approach levels at which salmon have been observed to demonstrate avoidance behavior. A large nearshore spill that resulted in higher concentrations of hydrocarbons contacting estuaries at spawning-run

Table IV-15
Probabilities of Oil-Spill Contact with Nearshore Salmon Habitats and Statistical Summaries of Catch, Escapement, and Run-Size for Each Area

Fishery Habitat	OSRA Land Segment Number[1/]	Probability of Oil-Spill Contact (Percent)[2/] 3 days	10 days	30 days	1983 Catch (Thousands of Fish)[3/]	1983 Escapement (Thousands of Fish)[3/]	1983 Total Run (Thousands of Fish)[3/]
Urilia and Bechevin Bays (Cape Mordvinof, Urilia Bay, Swanson Lagoon, Bechevin Bay)	7, 8	n[4/]	n	1	16.7	38.3	55
Izembek and Moffet Lagoons	9	n	n	1	170.0	191.8	361.8
Black Hills	10	n	1	3	.4	7.4	7.8
Nelson Lagoon	11	2	5	9	283.0	155.3	438.3
Herendeen Bay and Port Moller	12	n	1	3	67.4	126.5	193.9
Bear River Section (Frank's Lagoon, Bear River, Sandy River, Muddy River)	12	n	1	3	1,228.6	374.5	1,603.1
Three Hills and Ilnik Lagoon	13, 14	n	n	7	759.4	51.3	810.7
Port Heiden	14	n	n	2	8.6	24.0	32.6
Cinder River	16	n	n	n	.8	33.4	34.2
Ugashik	16	n	n	n	3,341.9	1,001.4	4,343.3
Egegik	18	n	n	n	6,740.3	792.3	7,532.6
Naknek/Kvichak	18	n	n	n	21,314.3	4,544.5	25,868.8
Nushagak	19	n	n	n	5,296.3	1,948.5	7,244.8
Togiak	21, 22	n	n	n	584.1	239.6	823.7
Total							47,763.8

1/ Refer to Graphic 5 for Oil-Spill-Risk-Analysis (OSRA) land segments. This column indicates OSRA land segments that coincide with fishery habitat areas along the northern side of the Alaska Peninsula and Bristol Bay.
2/ Probabilities (expressed as percent chance) of 1 or more spills occurring and contacting land segments over the expected production life of the lease sale area, for spills of 1,000 barrels or greater within 3, 10, and 30 days. Refer to Table G-14 (Appendix G). Land segments are used because they represent areas most vulnerable to salmon (nearshore areas or habitats where salmon congregate prior to spawning).
3/ Alaska Department of Fish and Game harvest and escapement data for North Peninsula and Bristol Bay statistical areas (Mike Nelson, ADF&G, personal communication, 1985).
4/ n = less than 0.5 percent.

time could result in either a delay of migration until the hydrocarbons dispersed to lower concentrations or in some diversion or alteration of migration. If this occurred near the mouth of a spawning stream, one possibility is that fish would mill about in areas where oil concentrations exceed detection levels. Escapement into the stream system could occur when concentrations were below detection levels. Another possibility is that salmon could move through contaminated waters regardless of concentrations at the urging of their homing instinct. Depending on the duration and concentration of exposure, fish could be killed or experience sublethal affects. The most extreme case would be that most fish in a particular run (stream population) would be killed or prevented from spawning. This would represent a serious effect on a local run, but would result in a moderate effect, at worst, on the regional population. In such an event, it could take several generations to rebuild the run-size to prespill levels. Considering that concentrations high enough to elicit avoidance responses or mortalities are not likely, these extreme effects are not expected to occur. Overall, the effect of oil spills on spawning migrations of salmon is expected to be minor.

Data from the OSRA cited in the following sections reveal that the probabilities of a major oil spill occurring and subsequently contacting important nearshore areas are very low for most areas. For a moderate adverse effect on salmon to occur, a major oil spill would have to contact nearshore areas during periods when larvae and fry were present. Even an oil spill of 100,000 barrels that spread to cover 200 square kilometers and resulted in extensive mortalities within that area would affect only a portion of a regional spawning population of one or more of these species.

Outmigrating juvenile salmon also could be contacted by an oil spill and could experience mortality or sublethal effects. Sockeye juveniles move along the northern side of the Alaska Peninsula in a band extending 48 kilometers offshore (Thorsteinson, 1984), including water depths to 70 meters or greater, until they eventually turn north or head south to the Aleutian passes. Assuming a speed of 3.7 to 4.3 kilometers per day, juveniles could be exposed to a massive oil slick for several days (Thorsteinson, 1984). Hydrocarbon concentrations of 0.1 ppm to 100 meter depths (Marchand, 1978) or 0.21 ppm to 20 meter depths (Vandermeulen, 1982) could result in some mortalities. A massive oil spill that contacted a nearshore area with more shallow waters could result in higher hydrocarbon concentrations and resultant mortalities. Even assuming a nearshore spill that resulted in lethal concentrations, however, juvenile salmon migrating along the Alaska Peninsula are staggered over time by age, origin, and species. Consequently, only a small portion of a regional population would be contacted and killed during the time within which concentrations would be lethal.

Salmon-prey species, including copepods, euphausiids, amphipods, crustacean larvae, squid, herring, capelin, sand lance, and other small fish, also could be killed by exposure to an oil spill. Oil spills contaminating sediments or mudflats within nearshore areas could reduce or eliminate salmon prey species in the contaminated areas for several years. Tidal action in nearshore zones would continue to dissolve hydrocarbons trapped in sediments, thereby repeatedly exposing nearshore areas to contamination. A reduction in these species, however, would be localized and would affect only a small portion of these widely distributed populations. With salmon being relatively omnivorous and able to move to alternate feeding areas, a localized reduction of prey would result in a minimal effect on salmon within the localized area affected by an oil spill.

The aggregate effect of salmon mortalities (particularly the more susceptible fry), sublethal effects, and a localized reduction in prey could result in the reduction of a local stock of one or more salmon species. In a local context, such effects would be very serious. Because salmon have extensive and widely distributed populations in the Bristol Bay/southeastern Bering Sea area. A reduction in a localized area would not affect the regional population and thus would result in a moderate effect at worst.

Pink salmon may be the species most vulnerable to oil-spill effects because lifestages of different year-classes use nearshore areas nearly year-round. Pink salmon also have alternating high- and low-year spawning populations that vary by region. It is possible that a major oil spill, which contacted the nearshore area at the mouth of a stream supporting a major spawning run while large numbers of fry were present, could cause relatively high mortalities and/or sublethal effects, which could reduce the ability of these young salmon to develop or reproduce normally. This could reduce the high-year levels of pink salmon in a localized area for some years, which could result in a moderate effect on the regional populations. A major oil spill that contacted nearshore areas in a low year could be even more detrimental and could reduce that years's normally low populations even further. This effect might not be evident until reflected in the commercial catch of adults, after the catch has reduced the low-year numbers even further.

Effects on local salmon stocks in streams located along the proposed pipeline route from Herendeen Bay to Balboa Bay could occur from oilspills and construction activities. Construction of the pipeline could result in increased siltation and turbidity in the streams along the route. This could result in a reduction in salmon production in these streams due to the decline in habitat quality. An oil spill from a pipeline break would provide a more serious threat, should oil enter one of the streams. If the spill occurred above the spawning grounds, contact of eggs or fry and oil could result in the potential loss of an entire year's salmon production. Oil entering the bay at the mouth of the stream could prevent adult spawners from entering the stream. In either case, the worst possible outcome would be the loss of a year-class for the particular stream affected. Portage Valley supports a run of chum salmon. Johnson Creek, flowing into Balboa Bay, supports relatively small runs of pink and chum salmon. Effects on either of these two drainages would be considered minor from a regional perspective.

Cinder River to Cape Newenham: Streams entering Bristol Bay within this area, particularly the Cinder, Ugashik, Naknek, Kvichak, Nushagak, and Togiak Rivers, support major runs of all five Pacific salmon species. The OSRA data show a probability of 0.5 percent or less of a spill of 1,000 barrels or greater occurring and subsequently contacting nearshore areas within 30 days. If an oil spill did occur, the conditional probabilities reveal a probability of 0.5 percent or less for contact with land and nearshore areas within 30 days. After 30 days of weathering, hydrocarbons would be expected to be of sufficiently low concentrations to preclude mortalities, delay or diversion of migration, and most sublethal effects.

Port Heiden: The Meshik River system in the Port Heiden area supports significant numbers of spawning chinook and coho salmon. The OSRA data show a less-than-0.5-percent probability of an oil spill of 1,000 barrels or greater occurring and subsequently contacting important nearshore areas (Resource Area 6) within 10 days, and a 5-percent or lower probability within 30 days. If an oil spill did occur, the conditional probabilities for this area reveal a less-than-0.5-percent probability of contact with land and important nearshore areas within 10 days while hydrocarbons are likely to be in concentrations that may cause sublethal effects. The conditional probability for 30 days rises to 25 percent or less; but following 30 days of weathering, hydrocarbon concentrations would be low, with minimal, if any, sublethal effects on the more vulnerable lifestages of salmon in the Port Heiden area, and would not detain or divert spawning migrations.

Port Moller: Major runs of salmon occur in streams in the area of Port Moller, including sockeye (from the Sandy River to Port Moller), chinook (the Sapsuk River system/Nelson Lagoon), coho (Nelson Lagoon), and chum (the Sapsuk River system/Nelson Lagoon and Herendeen/Port Moller Bays). The OSRA data for this area indicate that the area is more at risk to oil spills than other areas. The probability of an oil spill of 1,000 barrels or greater occurring and subsequently contacting important nearshore areas (Resource Area 7) within 3 days is 17 percent; and the final probability for an oil spill of 100,000 barrels within 3 days is 1 percent. If an oil spill of 1,000 barrels or greater did occur, the conditional probability for the Port Moller area reveals an up-to-99.5-percent chance of contact with the nearshore areas within 3 days. Effects of a major oil spill contacting nearshore areas within 3 days while hydrocarbon concentrations are relatively high could include mortalities, sublethal effects, and possibly a delay in spawning migrations, depending on the hydrocarbon levels. This could result in a change in distribution and/or abundance of a portion of the regional population of one or more salmon species over more than one generation (i.e., a moderate effect).

Izembek/Moffet Lagoons and Bechevin Bay: River systems in this area support major runs of sockeye, coho, pink, and chum salmon. The OSRA data for the area show a very low probability, 1 percent for an oil spill of 1,000 barrels or greater occurring and subsequently contacting this area within 30 days. If an oil spill did occur, the conditional probabilities for Bechevin Bay reveal a 2-percent or lower probability of contact within 3 days and a 5-percent or lower probability of contact within 10 days while hydrocarbons may be great enough to have direct (mortality) or sublethal effects on salmon. The species most likely to be affected (i.e., pink and chum salmon), however, also are present in large numbers in other streams in Bristol Bay. Given an oil spill and contact with these areas while salmon are present, the portion of a regional population affected would be small.

Unimak Pass: Salmon are vulnerable to oil-spill effects in this area because many use this pass during spawning migrations. Although the pass is approximately 80 kilometers wide, a major spill in May to July resulting in high hydrocarbon concentrations in the immediate area could delay or alter migrations or result in exposure to sublethal concentrations. The OSRA, however, shows a less-than-0.5-percent probability of an oil spill of 1,000 barrels or greater occurring and subsequently contacting this area within 30 days. If an oil spill did occur, the conditional probabilities for this area reveal a 5-percent-or-lower probability of contact with the area within 3 or 10 days.

Southern Coast of the Alaska Peninsula: On the southern coast of the Alaska Peninsula, salmon runs occur in the Stepovak and Chignik Rivers, streams on the Shumagin and Deer Islands, and streams out of Balboa, Volcano, Canoe, and Belkofski Bays. Pink salmon is the major species on the southern side of the Alaska Peninsula. Oilspill-trajectory data and specific land-segment-contact probabilities are not available for the southern coast of the Alaska Peninsula; however, the probability of an oil spill occurring is indicated below. There is a 7-percent-or-lower probability of an oil spill of 1,000 barrels or greater occurring at the Balboa Bay transshipment terminal and a 33-percent-or-lower probability of an oil spill of 1,000 barrels or greater occurring for tankering out of Balboa Bay south to a receiving facility. If a major spill occurred and contacted nearshore areas while vulnerable life-stages of salmon were present, mortalities or sublethal effects could occur; however, even a major oil spill of 100,000 barrels, which spread to cover 200 square kilometers, would affect only portions of the salmon populations on the southern side of the Alaska Peninsula and, at worst, would have a moderate effect on regional populations.

SUMMARY (Effects on Salmonids):

Seismic activities from the projected level of activity (1,882 trackline miles) are expected to result in negligible effects on salmon. This is primarily due to the limited radius of effects produced by the nonexplosive seismic devices (airguns and sparkers) expected to be employed. These devices have been demonstrated to be innocuous to fish beyond a short distance (0.6 to 1.5 m) of the detonation source. Few, if any, salmon are expected to be within the limited range of effects for these seismic devices.

Effects on salmon from discharges of drilling fluids, cuttings, and formation waters from the 42 (10 exploration and 32 development and production) wells projected over the life of the field also would be limited. This is because of the rapid dilution expected following discharges and the limited radius of effects. Discharges from all wells would occur in water depths from 30 to about 100 meters, and therefore, would be expected to dissipate and dilute rapidly. Under these conditions, lethal effects from such discharges on pelagic salmon would be expected only within a few meters of the discharge point, and sublethal effects would be expected out to 100 meters. Given the relatively small area of contamination from these projected wells at two platform sites compared to the extensive habitat available to adult and juvenile salmon in offshore areas of the Bering Sea, minor effects from these discharges would be expected.

Oil-spill effects on the pelagic lifestages of salmon also would be limited, considering that only 1 offshore oil spill (1,000 barrels or greater) is assumed reasonable for the 26-year life of the project. Effects on salmon would be restricted to the area affected by the spill, which would be relatively small compared to the extensive alternative habitat available to adult and immature salmon in the pelagic environment. Furthermore, concentrations in the water column associated with the spill would approach lethal concentrations for adult and juvenile salmon only a short distance from the spill site. Beyond this, concentrations would diminish with distance and over time (several days) to concentrations well below those shown to produce lethal effects (see Table IV-13) on adults and juveniles. Therefore, only a small portion of the widely dispersed regional population of salmon in the pelagic environment potentially could be affected.

The aggregate lethal and sublethal effects of seismic activities, drilling and production discharges, and an offshore oil spill are expected to affect only localized groups of pelagic salmon in the immediate vicinity of such events. Given the extensive numbers and distribution of salmon in the southeastern Bering Sea, the localized effects resulting from this lease sale are expected to affect individuals in localized offshore areas, and to result in a minor effect.

Effects on salmon from a major oil spill that occurred and contacted a nearshore area when vulnerable lifestages were present could be moderate. If a major oil spill contacted an area where juvenile salmon were congregated, all or most of the salmon contacted could be killed or could be subjected to sublethal effects that might affect their ability to develop, reproduce, or survive natural environmental stresses. Adult salmon could be prevented from entering their natal stream and reproducing, which could result in very serious, but localized (i.e., Port Moller) effects. A localized change in the distribution and abundance of the affected portion of the regional population over more than one generation would result in a moderate effect. The probabilities of a spill occurring and contacting nearshore areas are less than 0.5 percent for all of inner Bristol Bay, Port Heiden, Izembek and Moffet Lagoons, and Bechevin Bay. The probability of a major spill of 100,000 barrels or greater occurring and contacting the Port Moller area within 3, 10, or 30 days is 1 percent.

CONCLUSION (Effects on Salmonids):

Overall, effects of activities associated with this lease sale on regional populations of salmon are expected to be MINOR. If an oil spill occurred and contacted nearshore areas while prespawning adults, fry, and juveniles were present, MODERATE effects could result.

CUMULATIVE EFFECTS (Effects on Salmonids):

Activities that are analyzed for their potential to produce cumulative effects on salmon include the proposed Apollo and Sitka mines on Unga Island, State of Alaska onshore leasing, other federal offshore oil and gas leasing, tankering of Canadian oil through the Bering Sea, and commercial fishing.

The proposed Apollo and Sitka mines on Unga Island could result in effects on a small localized stock of salmon that utilizes the stream at the head of Delarof Bay for spawning. Contamination of the streambed from mining wastes or increased siltation from construction activities could result in a reduction in egg and fry survival and/or a reduction in available spawning habitat, leading to a decline in overall productivity for this particular stream. These effects could occur only by assuming that no mitigation of protection measures are in place for this project. Considering that the state provides stringent requirements for the protection of anadromous-fish habitat, the above effects are not expected.

State of Alaska leasing in the Bristol Bay Uplands (Sale 41), and proposed leasing on the Alaska Peninsula (Sale 56) could likewise result in some degradation to salmon spawning habitat and subsequent small declines in productivity of local stocks. This would occur primarily from food and/or pipeline construction, which could increase sediment runoff into streams. However, assuming that state and federal landowners provide stringent mitigation to protect anadromous-fish habitats, these effects would not be expected. A decision for state offshore leasing in this region will not occur until at least 1994.

Federal oil and gas lease sales in this region that could contribute to cumulative effects on the regional salmon stocks include existing and proposed leasing in the St. George Basin (Sales 70, 89, and 101), North Aleutian Basin (Sale 92) Navarin Basin (Sales 83 and 107), Norton Sound (Sales 57 and 100), and the Shumagin Basin (Sale 86). Oil spills resulting from these lease sales are the factors of greatest concern. A possible 24 spills of 1,000 barrels or greater could occur from Sales 57, 70, 83, 89, 92, 100, and 107, and tankering of oil from the Canadian Beaufort Sea. These spills are projected to occur over broad areas of the Bering Sea and over about 30 years. These areas are geographically distant from the Sale 92 area and, therefore, from most of the important salmon habitats. Therefore, oil spills occurring in these lease sale areas would have little or no effect on the portion of the regional salmon population that spends its adult existence in these areas. Concentrations of hydrocarbons from offshore spills in these areas would likely be well below concentrations found to be lethal to adult salmon.

A portion of the salmon that overwinters in the Bering Sea could be contacted by an oil spill resulting from the increased risk in the cumulative case. However, even a major oil spill of 100,000 barrels, which spread to cover 200 square kilometers, would contact only a small portion of the pelagic salmon overwintering in the Bering Sea. Although these salmon are concentrated in the upper 10 to 13 meters of the water column, where they are likely to come in contact with a slick or the water-soluble fraction around and beneath it, hydrocarbon concentrations in open-water areas are generally well below 1 ppm, whereas adult salmon experience mortality following exposure to concentrations in excess of 3 ppm. Consequently, mortalities would be limited in number. Given the extensive pelagic distributions of these species, the limited areal extent of a spill, and the relatively low concentrations expected in open-water areas, cumulative-case oil-spill effects are not expected to be increased over those associated with the proposal.

Of greatest concern would be oil spills that occur from tankering of oil from these Bering Sea basins through Unimak Pass, where adult salmon bound for Alaska Peninsula and Bristol Bay stream systems would pass. A major oil spill of 100,000 barrels in or near Unimak Pass just prior to or during salmon migrations through the pass could result in a limited number of mortalities and some alteration (avoidance behavior) of migration routes. Because salmon migrating through the pass are temporally staggered by age, origin, and stock, even an oil spill that resulted in lethal or sublethal concentrations for 10 days (an improbable event) would affect only a small portion of the regional population.

Final probabilities for most nearshore areas used or traversed by salmon have small, if any, increases in the cumulative case over those for the proposal.

Other nearshore areas that are used by prespawning adults migrating toward natal streams or fry or juveniles (prior to moving offshore) do not experience increases in oil-spill risk in the cumulative case (i.e., Resource Areas 4, 5, 6, 7, and 14). Final probabilities within 3 and 10 days for oil spills of 1,000 barrels or greater for the Unimak Pass (Biological Resource Area 8) area are increased in the cumulative case. The final probability within 3 days of an oil spill of 100,000 barrels or greater also rises slightly in the cumulative case (Table IV-16).

Proposed tankering of Canadian oil through the Bering Sea would pose little or no additional risk to the salmon resources of the North Aleutian areas because the proposed route to Asian markets is distant (approximately 400 miles) to the proposed lease sale area and to migration corridors used by the regional salmon stocks. An oil spill occurring along this route would pose no risk to these salmon.

Commercial fishing continues to be a primary contributor of cumulative effects on regional salmon stocks. For analysis purposes in this EIS, it is assumed that these stocks remain in equilibrium, even with commercial-fishing-harvest mortalities. However, regulation of salmon harvest and escapement is not a perfect science and is fraught with many uncertainties; therefore, significant population effects could result from certain fishery-management decisions. For instance, overescapement into spawning areas could result in overpopulation of available spawning and rearing habitat. This could result in rapid transmittal of diseases in local salmon stocks, with resulting mortalities. Overharvest could result in too few spawners being allowed to escape with resultant declines in productivity. In these two examples it is possible that significant effects on regional salmon stock could accrue from regulation of commercial fishing.

Conclusion (Effects on Salmon): In the cumulative case, the effects on salmon would be MINOR.

Effects On Forage Fish: These pelagic forage fish (herring, capelin, Pacific sand lance, boreal smelt, and eulachon) use areas in and adjacent to the North Aleutian Basin lease sale area during various aspects of their life histories. These species traverse the lease area as they move between their offshore overwintering grounds and shallow, coastal areas or streams, where they spawn. Vulnerable lifestages of these species, including eggs, larvae, and juveniles, inhabit nearshore areas along the northern side of the Alaska Peninsula which are adjacent to the lease sale area or along the southern side of the Alaska Peninsula (which could be exposed to an oil spill as a result of tankering out of Balboa Bay). For the purpose of analysis, forage fish inhabiting the eastern Bering Sea will be considered the regional population for each species.

Forage fish are expected to experience limited effects from contact with discharges of drilling fluids, cuttings, and formation waters. Offshore discharges in the North Aleutian Basin lease sale area would occur in waters ranging from 30 to about 100 meters deep with dissipating current action, and consequently, would dilute rapidly. As discussed in the generic-effects section, lethal toxicities could be encountered by adult or juvenile fish

Table IV-16
Comparison of Final Probabilities for the Proposal and Cumulative Case

Target		1,000 barrels or greater				100,000 barrels or greater			
		3 days		10 days		3 days		10 days	
		Proposal	Cumulative	Proposal	Cumulative	Proposal	Cumulative	Proposal	Cumulative
Resource Area	7	17	17	20	20	1	1	1	1
	8	n	37	n	41	n	9	n	10
	10	n	3	n	25	n	1	n	5
	11	n	n	n	16	n	n	n	2
Sea Target	1	n	n	n	2	n	n	n	n
	2	n	n	n	6	n	n	n	1
	3	1	1	3	6	n	n	n	1
	4	1	1	3	3	n	n	n	n
	5	1	1	4	4	n	n	n	n
	8	n	n	n	18	n	n	n	2
	23	20	20	22	22	1	1	1	1
Land Segment	7	n	n	n	n	n	n	n	n
	8	n	n	n	n	n	n	n	n
	10	n	n	1	1	n	n	n	n
	11	2	2	5	5	n	n	n	n
	12	n	n	1	1	n	n	n	n

Source: USDOI, MMS, 1984.

Note: n = less than 0.5 percent. Targets cited in the cumulative discussion that have less-than-a 0.5-percent probability of 1 or more contacts are not shown.

within a few meters of the discharge, and sublethal effects could be experienced within 100 meters of the discharge. Fish may avoid these areas, however, and use the extensive alternate habitat available. These pelagic fish also may be affected adversely by the increased suspended-sediment levels in the immediate area around a discharge. Eggs and planktonic larvae of these species are generally concentrated in nearshore waters, and consequently, would experience minimal effects from discharges into waters that are a minimum of 18 kilometers from land. Some larvae of Pacific sand lance and capelin inhabit offshore areas, and those in the immediate vicinity of a discharge could be killed or experience sublethal effects. The numbers of various lifestages affected by these discharges in the pelagic environment, however, would be only a portion of the regional population, resulting in a minor effect.

As discussed in the generic-effects section, contact of fish and hydrocarbons may result in mortality or numerous sublethal effects that may affect the ability of a fish to survive, develop, or reproduce. Forage fish that contact hydrocarbons as a result of an oil spill in the lease sale area may experience these effects to varying degrees, depending on the lifestage affected, the location and areal extent of a spill, and the degree to which the oil has weathered prior to contact.

Oil-spill effects on herring and other forage fish could be augmented by mortality of prey, including copepods, amphipods, euphausiids, and larval or small fish. Reductions in prey, however, would be localized to the area of the oil spill, and forage fish could move to alternate feeding habitats. Reduction of prey in the area of an oil spill could have a localized effect on the forage fish feeding on them, but would not affect a species at the regional population level.

An offshore oil spill that contacted adult or juvenile forage fish in the pelagic environment could affect exposed individuals. Fish contacting spilled oil in the pelagic environment may be killed. Concentrations of hydrocarbons in oil-polluted waters have been documented at 0.1 ppm to 100-meter depths (Marchand, 1978) and 0.21 ppm to 20 meters (Vandermeulen, 1982). Adult herring have an LC_{50} value of 1.22 ppm (Rice et al., 1979) and could experience some mortalities following an oil spill. While offshore, herring (in particular) concentrate at or near the surface (often in localized schools), where they are most likely to be exposed to a slick or the water-soluble fraction beneath it. Fish that remain in oil-polluted waters also may experience sublethal effects. An offshore oil spill also may affect these pelagic species in transit by diverting them from the immediate area of a spill or by reducing their food supply. Adult herring traversing the lease sale area on their way to or from spawning grounds on the northern shore of Bristol Bay or as far north as Kuskokwim Bay could contact an offshore oil spill. Even a major oil spill of 100,000 barrels that spreads to cover 200 square kilometers, however, would affect only a small portion of the regional population widely dispersed in the pelagic environment. In summary, an oil spill that did not contact nearshore areas would have a minor effect on regional populations of adult and juvenile herring, capelin, Pacific sand lance, boreal smelt, and eulachon in the pelagic environment.

An oil spill that contacted a nearshore area being used by the reproductive stages of herring would have a more serious effect. Fish spawning in shallow waters adjacent to the lease sale area (i.e., Port Moller or Port Heiden) contacted by an oil spill in the spring could be killed as described in the previous discussion on effects of an offshore oil spill. Prespawning adults are in a weakened physiological state, which may increase their vulnerability to hydrocarbons effects (Warner and Shafford, 1977). Because herring spawn repeatedly, a number of year-classes of adults could be affected. The most serious effects, however, would be on roe (eggs) and larval herring concentrated in nearshore areas because these stages are more susceptible to hydrocarbon effects than adult herring. Herring embryos exposed for 6 days to a 1-ppm concentration of Prudhoe Bay crude oil had 100-percent mortality (Smith and Cameron, 1979), and mortality resulting from exposure to concentrations of 0.1 ppm (Hameedi, 1982), which could be encountered following an oil spill (Marchand, 1978; Vandermeulen, 1982), has been documented. In addition, they are immobile and concentrated in shallow-water areas where they are likely to encounter a slick or the water-soluble fraction around and beneath an oil spill which contacts the nearshore area. Eggs and larvae contacted by an oil spill in nearshore areas may experience lethal toxicities which, in addition to the high natural prehatching and larval mortalities, may seriously reduce their numbers in the localized area contacted. Natural herring egg mortalities have been estimated to be 60 to 90 percent due to failure of fertilization, dessication of eggs during low tides, uprooting of substrates, and predation, and up to 99 percent for the 6- to 8-week planktonic larval stage (Smith et al., 1976). Juvenile herring, which consolidate in schools at the mouths of bays and inlets during the summer prior to moving offshore in the fall, also may be killed. Thus, a massive or chronic spill that contacted a nearshore area being used by herring during the reproductive period could result in mortality of spawning adults, roe, larvae, and juveniles, and could result in reductions in several year-classes (i.e., 0-7).

Sublethal effects also may result from exposure of various lifestages of herring to an oil spill that contacted a nearshore area. When female herring are exposed to hydrocarbons just prior to spawning, decreased survival of eggs, embryos, and larvae can result. Struhsaker (1977) demonstrated such an effect with Pacific herring exposed to concentrations of a few parts per billion. Abnormal growth, development, and behavior have been documented in herring larvae following exposure to hydrocarbon exposures greater than 25 ppb (Hameedi, 1982). Probable accumulation of hydrocarbons, pathological effects, and behavioral changes occur in juvenile and adult herring at concentrations of less than 1 ppm (Hameedi, 1982). These sublethal effects may affect the ability of exposed organisms to develop, survive, or reproduce although the aberrations may not be expressed until later lifestages.

An oil spill that contacted *Fucus* species (macroscopic algae) or *Zostera* species (eelgrass) in a nearshore area could have lethal or sublethal effects on these spawning substrates, which could have serious consequences for herring. As discussed in the generic-effects section, contact of eelgrass or macroscopic algae and oil can result in mortality of these species, which may take years to ameliorate. Sublethal effects that reduce growth or productivity (i.e., reduction in photosynthesis) or disrupt reproductive success (i.e., elimination of fertilization) can further reduce the availability of these important herring spawning substrates. Mortality of *Fucus* species, in particular, could greatly reduce suitable herring spawning sites. This effect could result from contact of spawning substrates and oil, with resultant mortality of *Fucus* species, at any time of year, whether or not susceptible lifestages were in these nearshore areas. If oil contacted a nearshore area, plants in the intertidal and shallow subtidal zones could be exposed to oil for prolonged periods (Clark et al., 1978). Furthermore, the presence of macrophytes may increase retention of oil and thus increase the exposure period for associated fauna (Teal and Howarth, 1984), which could be particularly serious for spawning adult herring and for roe attached to *Fucus* species. Consequently, oil-spill effects on *Fucus* species or eelgrass could result in (1) increased exposure to hydrocarbons that results in additional mortalities and sublethal effects on these lifestages of herring and (2) reduced reproductive success over a number of years through elimination of spawning habitat. Such an effect resulting from a major oil spill occurring and contacting a nearshore area (i.e., Port Moller/Herendeen Bay) used by herring for spawning could seriously reduce reproductive success of herring in that localized area for a number of years.

In summary, a major oil spill of 100,000 barrels that contacted Port Moller could seriously reduce the number of herring of various age-classes (from age-0 eggs or larvae through spawning adults of 5 or more years of age). Numbers could be further reduced as sublethal effects result in decreased survival or reproduction over time. Finally, reduction of suitable herring spawning habitat (through direct mortality of *Fucus* species or decreased reproductive success of this macroalgae) and long-term contamination of these nearshore spawning areas could substantially decrease herring reproductive success over a number of years. This could result in a decrease in the distribution and/or abundance of the regional herring population beyond which it would not be expected to return to its former level within several generations, which would be a major effect.

Adult capelin spawning on gravel beaches and shallow shoals along the northern side of the Alaska Peninsula adjacent to the lease sale area (from Moffet Point to Cape Menshikof), and their eggs which adhere to the gravel substrate, could be affected similarly to herring; they may be killed or may experience sublethal effects that affect their subsequent survival or development. Larvae of these species are assumed to inhabit nearshore waters adjacent to the beaches from Moffet Point to Cape Menshikof, but also are believed to extend offshore from coastal waters. Some portion of the capelin larvae in a nearshore area contacted by an oil spill also may be killed. An oil spill that contacted capelin spawning habitat also could have long-term effects on capelin reproduction in a localized area. As Thorsteinson (1984) summarized, the Oil Spill Vulnerability Index, which rates oil persistence to shoreline features and coastal processes (on a scale of 1 to 10, with 10 being most vulnerable), assessed approximately 40 percent of the coastline along the northern side of the Alaska Peninsula as having a vulnerability rating of 9 to 10. It can be expected that oil contacting these areas would penetrate into sand and gravel beaches, persist, and subsequently be released for over several years (Sanborn, 1977). Consequently, oil may render spawning beaches unsuitable for capelin reproduction for a number of years. Because capelin have very specific grain-size requirements for spawning substrates, this could result in a reduction of available spawning habitat and decreased spawning success. Effects on spawning success, egg development, and viability of exposed offspring cannot be predicted specifically. A major oil spill of 100,000 barrels that spread to cover 200 square kilometers would reduce only a portion of the regional population of capelin spawning between Moffet Point and Cape Menshikof over more than one generation. This could result in a moderate effect on the regional population.

Other forage fish species using areas in and adjacent to the lease area may be affected by an oil spill that contacts nearshore areas, although probably to a lesser extent than herring, because not all of the other species' lifestages are concentrated in nearshore areas during the reproductive period. Boreal smelt and eulachon, anadromous species, could experience delayed or disrupted spawning migrations if they encounter high concentrations of hydrocarbons in nearshore waters or estuaries as they approach their spawning streams (particularly in the Port Heiden/Meshik River area). Some portion of their pelagic larvae, which drifts downstream to estuaries adjacent to the lease area, also may be exposed to lethal or sublethal effects. Portions of these regional populations also could be reduced by an amount, depending on the areal extent of the spill, the concentration of hydrocarbons in nearshore waters, and the portion of susceptible lifestages in that area during hydrocarbon contact. This could result in a moderate effect on the regional population of these species in the eastern Bering Sea.

Pacific sand lance would be affected to a lesser degree by an oil spill that contacted a nearshore area than other forage fish species. Their demersal, adhesive eggs and pelagic larvae are more widely distributed (i.e., not restricted to nearshore environments), so the portion of these lifestages contacted and affected in a nearshore area would be only a portion of those in the southeastern Bering Sea. Concentrations of adults observed in and out of Port Moller during late June to mid-July, and in Izembek Lagoon from mid-August to mid-September, could be affected by an oil spill that contacted these nearshore areas during these periods. However, resultant moralities or sublethal effects affect only a portion of the regional population of this most abundant forage fish species of the southeastern Bering Sea, and would result in a moderate effect.

Cape Newenham/Togiak: This is an important spawning area for a large portion of the Bristol Bay herring population. The OSRA data show a very low probability (less than 0.5 percent), of an oil spill of 1,000 barrels or greater occurring and subsequently contacting any land segments between Egegik Bay and Kuskokwim Bay (including Kulukak Bay, Togiak Bay, and Cape Newenham) within 30 days. If an oil spill did occur as a result of this lease sale, the conditional probabilities also reveal a less-than-0.5-percent probability of contact with these areas within 10 days or 30 days, while hydrocarbon concentrations might be high enough to cause lethal or sublethal effects.

Port Heiden: This area is important for herring, boreal smelt, and eulachon. Port Heiden supports herring spawning and is consequently inhabited by spawning adults, roe, larvae, and juveniles. Boreal smelt and eulachon traverse the lease area to spawn in rivers in the Port Heiden/Meshik River area (Land Segment 14). The OSRA data show a very low (less-than-0.5-percent) probability of an oil spill of 1,000 barrels or greater occurring and subsequently contacting this area within 10 days, and a 2-percent or lower probability within 30 days, by which time hydrocarbon concentrations would be expected to be so low as to cause minimal, if any, effects. If an oil spill did occur as a result of this lease sale, the conditional probability reveals a less-than-0.5-percent probability of contact with this area within 10 days, and a 25-percent-or-lower probability of contact with the area within 30 days.

Port Moller/Herendeen Bay: An oil spill that contacted the Port Moller/Herendeen Bay area could affect spawning herring and capelin and the vulnerable early lifestages of these species using nearshore areas and spawning habitat. Following spawning, nearshore areas are used by herring roe, larvae, and juveniles, and by capelin eggs and some pelagic larvae. The probability of an oil spill of 1,000 barrels or greater occurring and contacting the nearshore area around Port Moller within 3 days, is 17 percent. If an oil spill did occur, the conditional probabilities reveal a 99.5-percent chance of contact with the Port Moller area within 3 days while hydrocarbon concentrations may be high enough to cause serious effects. The OSRA data show that the Port Moller area has a greater probability of oil-spill contact than other areas on the northern side of the Alaska Peninsula.

Southern Coast of the Alaska Peninsula: Herring spawn in various bays on the southern coast of the Alaska Peninsula, including Canoe, Stepovak, Pavlof, Beaver, Coal, Volcano, Balboa, and Belkofski Bays. These spawning populations, however, are much smaller than those in the Togiak area, Port Moller, or Port Heiden. Oil-spill-trajectory data and specific land-segment-contact probabilities are not available for the southern coast of the Alaska Peninsula. A major spill that occurred as a result of tankering out of Balboa Bay could contact herring spawning in that area. Any mortalities that resulted would affect only a portion of the herring population spawning along the southern side of the Alaska Peninsula.

SUMMARY (Effects on Forage Fish):

Seismic activities from the projected level of activity (1,882 trackline miles) are expected to result in negligible effects on forage fish. This is primarily due to the limited radius of effects produced by the nonexplosive seismic devices (airguns and sparkers) expected to be employed. These devices have been demonstrated to be innocuous to fish beyond a short distance (0.6 to 1.5 m) of the detonation source. Few, if any, forage fish are expected to be within the limited range of effects for these seismic devices.

Effects on forage fish from discharges of drilling fluids, cuttings, and formation waters from the 42 (10 exploration and 32 development and production) wells projected over the life of the field also would be limited. This is due to the rapid dilution expected following discharges and the limited radius of effects of 1,000 meters around each of the two platforms compared to the 2.27 million acres covered by the lease sale. Discharges from all wells would occur in water depths from 30 to about 100 meters, and therefore would be expected to dissipate and dilute rapidly (both vertically and horizontally). Under these conditions, lethal effects from such discharges on pelagic forage fish in the eastern Bering Sea would only be expected within a few meters of the discharge point, and sublethal effects would be expected out to only 100 meters. Given the relatively small area of contamination from these projected wells, compared to the extensive habitat available to forage fish in the pelagic environment, minor effects would be expected from these discharges.

Oil-spill effects on forage fish also would be limited, considering that only 1 offshore oil spill (1,000 barrels or greater) is assumed reasonable for the 26-year life of the project. Effects on forage fish would be restricted to the area affected by the spill, which would be relatively small compared to the extensive alternate habitat available to forage fish in the pelagic environment. Furthermore, concentrations in the water column associated with the spill would approach lethal concentrations for adult and juvenile forage fish only in the immediate vicinity of the spill site. Beyond this, concentrations would diminsh with distance and over time (several days) to concentrations well below those shown to produce lethal effects on adults and juveniles. Therefore, only a small portion of the regional population of forage fish potentially could be affected.

The aggregate lethal and sublethal effects of seismic activities, drilling, and production discharges, and an offshore oil spill are expected to affect only localized groups of forage fish in the immediate vicinity of such events. Given the extensive numbers and distribution of forage fish in the eastern Bering Sea, the localized effects resulting from this lease sale are expected to affect individuals in localized offshore areas, and result in a minor effect.

Effects on forage fish from a major oil spill that occurred and contacted a nearshore area when vulnerable lifestages were present could be more serious. The regional populations of capelin, Pacific sand lance, boreal smelt, and eulachon could experience moderate effects from a major oil spill that contacted a nearshore area being used by various reproductive lifestages of these, species, and resulted in mortalities and sublethal effects that may affect their abiltiy to develop, reproduce, or survive natural environmental stresses. A localized change in the distribution and abundance of the affected portion of the regional population over more than one generation could occur, resulting in a moderate effect.

A major oil spill that contacted a nearshore area being used by the reproductive stages of herring, however, could result in a major effect on the regional population. Spawning adults, roe, larvae, and juveniles could be killed or could experience sublethal effects following an oil spill that contacted a nearshore area (particularly Port Moller or Port Heiden). Oil-spill mortalities of roe and larvae would further reduce these year-classes, which experience high natural mortalities. Because herring are repeat spawners, a number of adult year-classes could be reduced. Contact of hydrocarbons and herring spawning substrates (<u>Fucus</u> or <u>Zostera</u>) could result in (1) mortality of these species and a resultant reduction in suitable spawning habitat or (2) increased or prolonged exposure of herring reproductive lifestages to hydrocarbons, both of which could result in reduced reproductive success over a number of years. The aggregate effect of mortalities of various lifestages of herring and their spawning substrates could result in a decrease in the distribution and/or abundance of the regional herring population, beyond which it would not be expected to return to its former level within several generations, which would be a major effect.

<u>CONCLUSION (Effects on Forage Fish):</u>

Overall, effects of activities associated with this lease sale on regional populations of herring and other forage fish are expected to be MINOR. If a major oil spill occurred and contacted nearshore areas inhabited by the susceptible lifestages of capelin, Pacific sand lance, boreal smelt, or eulachon, a MODERATE effect could occur. If a major oil spill occurred and contacted a nearshore area (i.e., Port Moller or Port Heiden) while spawning adult herring, roe, larvae, and juveniles were present, a MAJOR effect could result.

CUMULATIVE EFFECTS (Effects on Forage Fish):

Activities that are analyzed for their potential to produce cumulative effects on forage fish species include other federal offshore oil and gas leasing, tankering of Canadian oil through the Bering Sea, and commercial fishing. Federal oil and gas lease sales in this region that could contribute to cumulative effects on forage fish species include existing and proposed leasing in the St. George Basin (Sales 70, 89, and 101), North Aleutian Basin (Sale 92), Navarin Basin (Sales 83 and 107), Norton Sound (Sales 57 and 100) and the Shumagin Basin (Sale 86). Oil spills resulting from these sales are the factors of greatest concern. The possible number of spills of 1,000 barrels or greater from Sales 57, 70, 83, 89, 92, 100, and 107, and tankering of oil from the Canadian Beaufort Sea would be 24. These spills are projected to occur over broad areas of the Bering Sea, over about 30 years. Two of these areas (the Navarin and St. George Basins) are geographically distant from most of the important forage fish spawning and rearing habitats.

In assessing cumulative effects on Pacific herring, the primary concern is the effect of oil spills near spawning and rearing areas in the Sales 57 and 100 areas in Norton Sound, and in the area of this proposal (Sale 92). Even though Pacific herring are believed to overwinter offshore between the Pribilof Islands and St. Matthew Island, offshore spills probably would have little or no effect on the regional population. Both the St. George and Navarin Basin lease areas overlap this overwintering area for adult herring; however, oil spills occurring in these areas probably would be sufficiently weathered such that hydrocarbon concentrations (i.e., oil to 0.21 ppm) in the water column would not affect adult herring, even if a spill occurred or was transported into this overwintering area.

A major oil spill that contacted a nearshore area being used by reproductive stages of herring in Norton Sound or the North Aleutian Basin could result in a major effect on the regional population. Spawning adults, roe, larvae, and juveniles could be killed or could experience sublethal effects. Oil-spill mortalities of roe and larvae would further reduce these year-classes, which experience high natural mortalities. A number of adult year-classes could be reduced because herring are repeat spawners. Contact of hydrocarbons and herring spawning substrates (Fucus or Zostera) could result in (1) mortality of these species and a resultant reduction in suitable spawning habitat or (2) increased or prolonged exposure of herring reproductive lifestages to hydrocarbons, both of which could result in reduced reproductive success over a number of years. The aggregate effect of mortalities of various lifestages of herring and their spawning substrates could result in a decrease in the distribution and/or abundance of the regional herring population, beyond which it would not be expected to return to its former level within several generations--a major effect.

Capelin spawning on gravel beaches and shallow shoals along the northern shoreline of Norton Sound and along the Alaska Peninsula also could be affected similarily to herring. Oil spills from Sales 57, 92, and 100 could occur and contact these areas, resulting in effects on adults, larvae, and eggs. An oil spill that contacted spawning habitats in these nearshore areas could result in oil retention and, therefore, long-term effects (several years) on capelin spawning in the areas affected by the spill. However, a major spill of 100,000 barrels that spread to cover 200 square kilometers would reduce only a portion of the regional population in either area for more than one generation, resulting in a moderate effect.

Other forage fish species using areas in and adjacent to the lease areas in the Norton Sound and the North Aleutian Basin may be affected by an oil spill that contacts nearshore areas, although probably to a lesser extent than herring because not all of the other species' lifestages are concentrated in nearshore areas during the reproductive period. Boreal smelt and eulachon (anadromous species) could experience delayed or disrupted spawning migrations if they encountered high concentrations of hydrocarbons in nearshore waters or estuaries as they approached their spawning streams. Some portion of their pelagic larvae, which drifts downstream to estuaries adjacent to the lease sale area, also could be exposed to lethal or sublethal effects. Portions of these regional populations also could be reduced by some amount, depending on the areal extent of the spill, the concentration of hydrocarbons in nearshore waters, and the portion of susceptible lifestages in that area during hydrocarbon contact. This could result in a moderate effect on the regional population of these species in the eastern Bering Sea.

Pacific sand lance would be affected by an oil spill that contacted a nearshore area to a lesser degree than other forage fish species would be. Their demersal, adhesive eggs and pelagic larvae are more widely distributed (i.e., not restricted to nearshore environments), so the portion of these lifestages contacted and affected in a nearshore area would be only a portion of those in the southeastern Bering Sea, resulting in a moderate effect.

The number of large oil spills (1,000 barrels or greater) assumed for the Norton Sound area (Sales 57 and 100) and the North Aleutian Basin (Sale 92) are 2 and 1, respectively. The probabilities of spills (1,000 barrels or greater) occurring and contacting nearshore spawning and rearing habitats within 30 days in Norton Sound are 5 percent or less for important herring areas, and as high as 35 percent for capelin. In the North Aleutian Basin, the probabilities for the cumulative case do not change from those described for the proposal.

Commercial fishing would continue to be a primary contribution of cumulative effects on regional herring stocks. Herring fisheries are extremely difficult to regulate due to the intensive nature of the harvest activity, which occurs during a very short period. Overharvest of adult herring may result in a decline in overall strength of a given year-class, resulting in subsequent declines in a portion of the regional population that may not recover for several generations.

Conclusion (Effects on Forage Fish): In the cumulative case, effects on forage fish could be MODERATE. However, if a major oil spill occurs and contacts a nearshore area while spawning adults, roe, or larvae are present, a MAJOR effect could result.

Effects On Groundfish: Although adult groundfish generally inhabit deeper offshore waters, many of these species use shallow, surficial, or nearshore waters that may be in or adjacent to the lease sale area during their earlier lifestages. Spawning generally occurs in more shallow waters. One to 3 months after fertilization, the eggs of some species (i.e., pollock and sablefish) become buoyant and float at or near the surface for an additional 1 to 3 months. Other species have demersal eggs. Pollock, sablefish, halibut, Greenland turbot, Alaska plaice, flathead sole, and other species have larval stages that inhabit surface waters. Some larvae, including those of sablefish, yellowfin sole, and arrowtooth flounder, are concentrated in nearshore waters. After metamorphosing to juveniles, many species use shallow nearshore waters prior to moving offshore to deeper waters as they mature. Pacific cod, sablefish, yellowfin sole, halibut, rock sole, flathead sole, and arrowtooth flounder are among the species that use nearshore areas as juveniles. For the purpose of analysis, groundfish inhabiting the eastern Bering Sea will be considered regional populations.

Groundfish are expected to experience limited effects from contact with discharges of drilling fluids, cuttings, and formation waters. Offshore discharges in the North Aleutian Basin lease sale area would occur in waters ranging from 30 to about 100 meters deep with dissipating current action, and consequently, would be diluted rapidly in this open-water environment. As discussed in the generic-effects section, the radius of effects from a discharge point could be out to 100 meters from a discharge downpipe. Groundfish encountering a lower plume of a discharge might be exposed to lethal toxicities within a few meters of the discharge, or could experience sublethal effects up to 100 meters from the discharge. Groundfish also may be adversely affected by the increased suspended-sediment levels in the immediate area around a discharge. Adult groundfish, however, may avoid these areas and use alternate available habitat. The number of groundfish affected by lower discharge plumes would be a small portion of the regional population of these species, resulting in a minor effect. Planktonic eggs or larvae in the pelagic environment also could experience limited toxicity and suspended-sediment effects from the upper plume of a discharge. The effects of these discharges on a small portion of these widely distributed planktonic forms could result in a minor effect. In addition, these planktonic lifestages are often concentrated in more shallow, coastal waters that are not affected by discharges a minimum of 18 kilometers offshore. Overall, the effects of offshore discharges on groundfish are expected to be minor.

As discussed in the generic-effects section, contact of fish and hydrocarbons as a result of oil spills may result in mortality or numerous sublethal effects that may affect the ability of a fish to survive or reproduce. Groundfish that contact hydrocarbons as a result of an oil spill in the lease sale area, or south of the Alaska Peninsula as a result of tankering out of

Balboa Bay, may experience these effects to varying degrees, depending on the lifestages affected, the location and areal extent of a spill, and the degree to which the oil has weathered prior to contact.

Adult demersal fish inhabiting water depths of 70 to 750 meters are not likely to be exposed to high hydrocarbon concentrations. In addition, adult groundfish have higher tolerances to hydrocarbons than other lifestages. Adult benthic fish also are less susceptible to hydrocarbons than pelagic fish (Wilson, 1972; Rice et al., 1979). Thorsteinson and Thorsteinson (1982) reported an LC_{50} of greater than 5.34 ppm for adult flatfish and an LC_{50} of 1 to 3 ppm for adult semidemersal fish. Because the concentrations of hydrocarbons in oil-fouled waters are usually less than 1 ppm (Malins and Hodgins, 1981), a limited number of adult groundfish are likely to experience mortality from an offshore oil spill, particularly considering their use of deep water. Sublethal effects on adult flatfish result from exposure to concentrations of less than 5 ppm, and some sublethal effects may occur on adult semidemersal fish from exposure to concentrations of less than 1.5 ppm. Even following a major oil spill of 100,000 barrels which spreads to cover 200 square kilometers, however, the number of adult groundfish contacted and affected would be small in comparison to the widely-distributed regional populations of the Bering Sea. An offshore oil spill could be expected to have a minor effect on adult groundfish.

The more serious oil-spill risk for groundfish is to the planktonic egg and larval stages. Groundfish eggs or larvae inhabiting surficial waters which are contacted by an oil slick, or by the water-soluble fraction around and below the slick, may be affected adversely. Hydrocarbon concentrations of up to 0.21 ppm down to the 20-meter depth (Vandermeulen, 1982) and up to 0.1 ppm down to the 100-meter depth (Marchand, 1978) have been documented following oil spills. Groundfish eggs and larvae which have LC_{50} values of 0.1 to 1.0 ppm (Thorsteinson and Thorsteinson, 1982) may be killed as a result of encountering a slick or surficial waters with hydrocarbon concentrations of less than 1 ppm. Sublethal effects also may occur following exposure to concentrations greater than 25 ppb (Thorsteinson and Thorsteinson, 1982), although these effects may not be expressed until the eggs develop into larvae or the larvae develop into juveniles with abnormalities that affect their survival or reproduction. Groundfish using nearshore areas in one or more lifestages (where turbulent mixing and higher suspended-sediment levels may enhance sinking and incorporation of oil into benthic sediments, and result in subsequent release of hydrocarbons over a period of years), may experience longer-term effects. In addition to the potential effects from contact with an oil slick or the water-soluble slick around and below it, groundfish species that are associated with benthic sediments may be exposed to oil-contaminated sediments, tar balls, or emulsions. This would most likely affect species that have juveniles associated with sediments in shallow, nearshore areas. Although toxicity levels for groundfish encountering contaminated sediments or tar balls are not documented, some mortality and sublethal effects would be assumed to occur.

If an oil spill occurred and contacted nearshore waters important to egg or larval stages of some groundfish species, these populations could be reduced by an amount that would depend on the area contacted, the areal extent of the spill, the hydrocarbon concentrations present in the water, and the portion of a regional population's susceptible lifestages present within that time and area. A massive or chronic oil spill that contacted nearshore areas when eggs and larvae were concentrated and exposed them to lethal-hydrocarbon concentrations, could adversely affect a regional population, although this effect might not become apparent for several years--until the reduced year-class entered the fishery as adults. Even a major spill of 100,000 barrels that spread to cover 200 square kilometers would not affect a large portion of the widely distributed planktonic lifestages (eggs and larvae), juveniles, or adults of these eastern Bering Sea regional populations. Given the limited areal extent and limited influence of even a major spill in relation to the total regional spawning distribution, only a small portion of the affected year-classes would be lost, even if it is assumed that all eggs and larvae, and some juveniles and adults, are killed upon contact with hydrocarbons in the water column or sediments. A reduction in abundance of one or more genera- tions in a portion of the regional population could result in a moderate effect on a species. Because natural recruitment would be expected to occur and return the population to its former level within several generations, a major effect would not be expected, even following a major oil spill nearshore.

Pollock, yellowfin sole, and halibut stocks in the North Aleutian Basin have experienced declines and could be affected more seriously by oil-spill effects than other species whose stocks remain abundant. The more susceptible, early lifestages of these species that inhabit surficial waters (i.e., pollock eggs, larvae, and juveniles) or shallow, nearshore, inner-shelf waters (i.e., yellowfin larvae and juveniles; halibut later-larval stages and juveniles; pollock juveniles) are particularly vulnerable to oil-spill effects. A major oil spill that contacted nearshore areas (particularly during the reproductive period) could result in the loss of a portion of the affected year-classes of one or more of these species, depending on the hydrocarbon concentrations and the length of exposure. This could have a serious effect on these reduced stocks. However, the effect of a major oil spill of 100,000 barrels that spread to cover 200 square kilometers, would be localized compared to the distribution of these lifestages in and adjacent to the lease sale area and in other areas of the eastern Bering Sea, and is expected to affect a portion of the regional population and result only in a moderate effect.

Groundfish-prey species, including benthic and planktonic invertebrates and other fish species, may experience localized population reductions as a result of hydrocarbon exposure. Groundfish species feed on numerous organisms and can move to alternate feeding areas, so the effects of a reduction in numbers of prey organisms within the area contacted by even a major oil spill should have only a minor effect on groundfish. Halibut, which feed heavily on yellowfin sole, could be affected by a localized reduction in numbers of this prey species; however, the number of halibut affected would be limited to the localized area contacted by the oil spill. Yellowfin sole larvae also could be affected in a localized area by a reduction of plankton, upon which they feed heavily.

<u>SUMMARY (Effects on Groundfish):</u>

Seismic activities from the projected level of activity (1,882 trackline miles) are expected to result in negligible effects on groundfish. This is primarily because of the limited radius of effects produced by the nonexplosive seismic devices (airguns and sparkers) expected to employed. These devices have been demonstrated to be innocuous to fish beyond a short distance (0.6 to 1.5 m) of the detonation source. Few, if any, groundfish are expected to be within the limited range of effects for these seismic devices.

Effects on groundfish from discharges of drilling fluids, cuttings, and formation waters from the 42 (10 exploration and 32 development and production) wells projected over the life of the field also would be limited. This is because of the rapid dilution expected following discharges and the limited radius of effects. Discharges from all wells would occur in water depths from 30 to 100 meters, and therefore would be expected to dissipate and dilute rapidly.

Under these conditions, lethal effects from such discharges on planktonic eggs or larvae in the pelagic environment or on demersal juvenile or adult groundfish would be expected only within a few meters of the discharge point, and sublethal effects would be expected out to 100 meters. Given the relatively small area of contamination from these projected wells, compared to the widespread planktonic and demersal lifestages of groundfish species, minor effects from these discharges would be expected.

Oil-spill effects on groundfish also would be limited, considering that only 1 offshore oil spill (1,000 barrels or greater) is assumed reasonable for the 26-year life of the project. Effects on various lifestages of groundfish would be restricted to the area affected by the spill, which would be relatively small compared to the extensive alternate habitat inhabited by groundfish in the eastern Bering Sea. Furthermore, concentrations in the water column associated with the spill would approach lethal concentrations only a short distance from the spill site. Beyond this, concentrations would diminish with distance and over time (several days) to concentrations well below those shown to produce effects on groundfish. Therefore, only a small portion of the regional population potentially could be affected.

The aggregate lethal and sublethal effects of seismic activities, drilling, and production discharges, and an offshore oil spill are expected to affect only localized groups of various lifestages of groundfish in the immediate vicinity of such events. Given the extensive numbers and distribution of groundfish in the eastern Bering Sea, the localized effects resulting from this lease sale are expected to affect individuals only in localized offshore areas, and result in a minor effect.

Effects on groundfish from a major oil spill that occurred and contacted a nearshore area when vulnerable lifestages were present could be moderate. More susceptible, early lifestages of groundfish (eggs and larvae) and juveniles, which inhabit shallow, nearshore waters, would be particularly vulnerable to an oil spill that contacted a nearshore area. Mortalities and sublethal effects resulting from such a spill could reduce portions of several year-classes. However, the effect of even a major oil spill would be localized compared to the widespread distribution of these lifestages in the eastern Bering Sea, and is expected to affect only a portion of the regional population of a groundfish species, thus resulting in a moderate effect.

CONCLUSION (Effects on Groundfish):

Overall, effects of this lease sale on regional populations of groundfish are expected to be MINOR. If an oil spill occurred and contacted nearshore areas while egg and larval stages of groundfish species were present, MODERATE effects on those species could occur.

CUMULATIVE EFFECTS (Effects on Groundfish):

Activities that may produce cumulative effects on groundfish include projects listed in Section IV.A.6., other federal and state ongoing and proposed petroleum development, commercial fishing operations, and other nonpetroleum industry activities. Table G-22 in Appendix G considers cumulative spill probabilities from spills of 1,000 barrels or greater occurring over the expected production life of the lease areas. The cumulative (final) probabilities cited incorporate the likelihood of discovering oil, the probable transportation routes, the conditional probabilities, and the development assumptions given in Section II.A. Therefore, these final probabilities reflect the overall probability of oil spills occurring and contacting particular locations.

In the cumulative case, final probabilities for the nearshore areas north of the Alaska Peninsula and around Bristol Bay that are used by earlier, more vulnerable lifestages of groundfish do not increase over those of the proposal. Land Segments 9 through 28 (from Cape Newenham to Unimak Pass) do not experience an increased probability of oil-spill occurrence and contact in the cumulative case (Table IV-16). Consequently, both oil-spill risk and effects are the same as for the proposal in these nearshore areas, which are used by egg, larval, and juvenile lifestages of numerous groundfish species.

In the cumulative case, adult groundfish using offshore waters for overwintering may be exposed to increased oil-spill risks. For example, groundfish overwintering along the shelf break near Sea Targets 1, 2, or 8 would be exposed to increased final probabilities in the cumulative case (Table IV-16). Effects on regional populations, however, are expected to be the same as for the proposal (i.e., minor). Even a major oil spill would contact only a small portion of the offshore area inhabited by regional populations of these species. In addition, groundfish species are distributed throughout a wide range of water depths (i.e., 100-400 m or greater), and many species overwinter in the deeper waters of the outer continental shelf and slope. Adult flatfish generally have LC_{50} values greater than 5 ppm and adult semidemersal fish have LC_{50} values of 1 to 3 ppm. These LC_{50} values exceed the hydrocarbon concentrations expected in open-water areas (i.e., 0.1 to 0.21 ppm). Although mortalities occur below the LC_{50} values, the number of mortalities from these low concentrations are expected to be limited. Following a tanker spill, the water-soluble fraction may not even extend to deeper waters where groundfish are overwintering.

Conclusion (Effects on Groundfish: In the cumulative case, groundfish are not expected to experience greater effects than the MINOR effects expected from the proposal.

Effects On Red King Crab: Various lifestages of red king crab inhabit benthic, pelagic, or nearshore waters that are in or adjacent to the lease sale area or south of the Alaska Peninsula (where they may be affected by tankering out of Balboa Bay). Red king crabs are most vulnerable in the nearshore waters adjacent to the lease area. Adults spawn in nearshore waters, move offshore during the winter, and 11 months later return to nearshore waters for their eggs to hatch. Following larval release, their planktonic larvae are concentrated in nearshore and upper waters. Subsequently, larvae drift northeastward with the prevailing water currents, and by August, large concentrations are found 200 kilometers offshore. After metamorphosing to juveniles and settling to the bottom, they inhabit shallow, nearshore areas until joining the seasonal feeding and breeding migrations at 5 or 6 years of age. For the purpose of analysis, red king crab inhabiting the southeastern Bering Sea will be considered a regional population.

Red king crab using offshore benthic and pelagic habitats may experience some localized effects of discharges of drilling fluids, cuttings, and formation waters. Offshore discharges in the North Aleutian Basin lease sale area would occur in waters ranging from 30 to 100 meters deep with dissipating current action and, consequently, would dilute rapidly. The lower plume of a discharge may affect crabs using the benthic habitat at seasonally varying depths including: adult crabs, eggs carried by females offshore for 11 months, and larger juveniles (60 to 110 mm). These lifestages could experience mortality from lethal concentrations contacted within a few meters of a discharge. Other individuals may experience sublethal effects or a localized reduction of food supply where their prey have been killed or buried. These effects, however, would be limited to individuals within the immediate vicinity of a discharge point. The upper plume of a discharge could affect planktonic crab larvae developing at 40- to 70-meter depths or those that have drifted 200 kilometers or more offshore with the prevailing currents. Thus, discharges could result in localized losses of individuals. With the limited radius of effects (estimated to be 100 m), however, discharges would affect only a portion of the widely distributed larval-drift population (Fig. III-11). As a result of these discharges, a portion of a regional population could be reduced, but the effect on the regional population of red king crab would be minor.

Red king crab exposed to hydrocarbons may not experience immediate mortality, but may experience sublethal effects that affect their ability to survive, develop, or reproduce. For example, postmolting tanner crabs were observed to lose a number of legs following oil exposure, and subsequently to die an "ecological death," being unable to survive in the normal environment (Karinen and Rice, 1974). Molting success was decreased in premolt juvenile king crabs following exposure to hydrocarbons (Karinen and Rice, 1974; Mecklenberg et al., 1976). Crab larvae may be rendered moribund after an exposure of 10 minutes, which may leave them increasingly vulnerable to predation and physiological changes. In affected lifestages, exposure may cause a decline in general vigor, evidenced by reduced growth, increased susceptibility to disease, inhibition of feeding and/or failure to swim or molt (all of which may eventually result in mortality).

The extent of chemoreceptive feeding by crab larvae is unknown, but could be affected by very low concentrations of hydrocarbons, disrupting food consumption important to this rapidly growing lifestage. Hydrocarbon exposure also can have effects on the reproductive success of crabs through: (1) reduced fecundity (Tatem, 1977); (2) undetermined effects of hydrocarbon deposition in gametes on egg/sperm viability; (3) absorption of sedimented hydrocarbons by embryos carried on benthic females, resulting in reduced hatching success; and (4) disruption of hormone extrusion or detection, resulting in reproductive behavioral aberrations (Takahashi and Kittredge, 1973). For example, in juvenile and adult dungeness crab, chemosensory organs can detect water-soluble-fraction concentrations as low as 0.1 ppm (Pearson et al., 1980), which may be encountered at depths of 100 meters following an oil spill (Marchand, 1978). Disruption of these chemosensory cues may affect reproduction through: (1) failure to locate a female; (2) altered reproductive behavior; or (3) failure to copulate within 5 days following ecdysis, which results in a high proportion of infertile eggs (Armstrong et al., 1983).

Red king crab also may be affected by an oil spill that results in a reduction of their prey, but these effects would be localized. Crabs are relatively omnivorous, feeding on a variety of benthic organisms. Oil-spill effects on these benthic-prey species would be localized; and crabs, being opportunistic feeders, should be able to compensate for localized reductions in prey. Prey-reduction effects on crabs would be localized to the contaminated benthic area and, given the widespread distribution of crabs in the southeast Bering Sea, would affect only a portion of the regional population. Larval red king crab may experience effects of a localized reduction in phytoplankton and zooplankton, upon which they must feed within 2 days after hatching, or die. these larvae are so sensitive to hydrocarbons, however, that they are more likely to experience direct mortality from concentrations as low as 0.1 ppm than from prey-reduction effects. Prey-reduction effects on juvenile red king crab would be minimal because these crabs live and feed primarily in shell-hash and rocky-cobble environments (McMurray, 1983; Pearson, 1983), which are relatively high-energy environments where spilled oil would tend not to persist or accumulate sufficiently to affect settling and recruitment of food organisms.

An offshore oil spill could contact and affect various lifestages in the pelagic and benthic environments, and could result in mortality and sublethal effects that may reduce the abundance of these lifestages. Contact of hydrocarbons with offshore benthic areas could affect adults (including spawning and ovigerous adults), embryos carried on females, and larger juveniles (3 years of age or older). For example, hydrocarbon concentrations of 0.1 ppm were found at depths of 100 meters following the Amoco Cadiz spill (Marchand, 1978), which could have lethal and sublethal effects for the various lifestages occupying benthic areas. An offshore spill could contact some portion of the crabs inhabiting deeper waters (90-450 m) during the winter, including ovigerous females and older juveniles. Adults and juveniles have LC_{50} values of 1 to 4 ppm (Thorsteinson and Thorsteinson, 1982). Some mortalities of these lifestages could result from exposure to hydrocarbon concentrations of 0.1 ppm; however, since the LC_{50} value of 1 ppm indicates the concentration at which 50 percent of the exposed organisms are killed, exposure to 0.1 ppm in 100-meter-deep benthic areas would result in a lower percentage of mortality of exposed organisms. Although specific LC_{50} values for red king crab eggs have not been established, eggs are more sensitive than adults, and some individuals would be expected to experience mortality. During the summer, the portion of the spawning adults occupying offshore depths to 70 meters, older juveniles between 50- and 100-meter depths, and eggs carried on the adults in offshore areas could experience mortality. Sublethal effects such as those previously discussed also may affect the development, survival, or reproduction of these lifestages. Sedimentation of oil also may occur following an oil spill (Howarth, 1984). Hydrocarbons presisting in benthic sediments and being released over 6 to 12 years or longer (Gilfillan and Vandermeulen, 1978) can result in long-term mortalities or sublethal effects on exposed benthic lifestages. Over a period of years, this could result in reduced numbers of year-classes within the area affected.

Following an offshore oil spill, planktonic crab larvae in the pelagic environment also may experience mortality or sublethal effects. Although larvae hatch in the nearshore waters from Unimak Island to Port Moller, they subsequently drift northeastward with the prevailing water currents along the Alaska Peninsula toward Bristol Bay. By August, highest densities are found 200 kilometers offshore between Cape Seniavin and Port Heiden. As larvae drift offshore, they could be contacted by an oil spill in the pelagic environment. Crab larvae, which develop at 40- to 70-meter depths have LC_{50} values as low as 0.1 ppm (Thorsteinson and Thorsteinson, 1982), and would experience mortality of some individuals from exposure to hydrocarbon concentrations of 0.1 ppm, which have been documented to 100-meter depths following oil spills (Marchand, 1978). Sublethal effects, such as those previously discussed, also may result from contact with water-soluble fraction concentrations from 0.001 to 0.1 ppm (Moore and Dwyer, 1974). As Armstrong et al. (1983) pointed out, the entire year-class of larvae enters the water column during a relatively short time period and is not followed weeks later by other cohorts for that year. Consequently, an oil spill that kills a significant portion of the larvae while they are concentrated in offshore areas will not be mitigated by later larval release after oil disperses below toxic levels. Furthermore, molting is an extremely sensitive physiological event for crabs, and larvae would be particularly susceptible to hydrocarbon effects during their 3 to 4 molts prior to metamorphosing into juveniles. By late July and August, when larvae have molted several times, the fourth-stage zoeae represent only a few percent of the original numbers of larvae. At this time, a major oil spill could seriously reduce the larval year-class.

An offshore oil spill that contacted red king crab lifestages in the pelagic and benthic habitats could reduce the numbers of several year-classes including eggs, larval zoeae, older juveniles (possibly age-classes 3 through 5) and adults (age-classes 5+). Reduction of the number of large males can affect reproductive success because insemination of females by smaller males results in smaller clutch sizes and reduced breeding success (through fewer females extruding eggs). It is believed that the decrease in abundance of male red king crabs in the southeastern Bering Sea since 1981 is related to a number of factors including: predation by halibut, Pacific cod, and yellowfin sole; competition; fishery effects; disease; and temperature. A further decrease in the abundance of adults, particularly large males, because of oil-spill mortality and sublethal effects could reduce reproductive success, which might be masked until being evidenced in the fishery 7 to 8 years later. Mortality of juveniles that are contacted in the offshore benthic habitat could augment the already detectable decline in prerecruit males, and further reduce the numbers of adults surviving to reproduce. Additionally, the number and location of spawning adult females may significantly influence larval survival and location of megalopae relative to optimal substrates at metamorphosis (Armstrong et al., 1983). A reduction in the number of larvae concentrated in offshore pelagic areas, resulting from contact with hydrocarbons, would be particularly serious. Cycles of abundance suggest that year-class failure or success may be based on survival of critical lifestages (i.e., larvae or young juveniles) in nearshore areas (Armstrong et al., 1983). Because the instantaneous mortality rates of juvenile and sublegal, sexually mature crab are estimated to be low (approximately 10% per year) until entering the fishery (Balsinger, 1976; Reeves and Marasco, 1980), the size of a future fisheries cohort is believed to be determined predominantly by reproductive success and survival of larvae and young of the year (0+ crab) in nursery areas. Mortality from hydrocarbon exposure could augment high natural mortalities of these critical lifestages related to water temperature, food supply, and predation. Although the magnitude of initial larval hatch and numbers surviving to metamorphosis is important in determining year-class strength, the geographic location of survivors at metamorphosis also may be very important if refuge habitat is scarce or patchy. If optimal bottom type (currently undetermined) does not occur uniformly along the North Aleutian Shelf into Bristol Bay, location of placement, and survival rates of larvae over optimal bottom types at metamorphosis, may be extremely important in the success of a year-class. Furthermore, it is hypothesized that a reduction of larvae may alter the community composition on the middle and outer shelves, where crabs comprise 55 and 82 percent, respectively, of the epifaunal biomass (Jewett and Feder, 1981). This could result in slowing the recovery of the already depressed red king crab population faced with large populations of competitors that increase in response to the loss of one or two year-classes (larvae and/or young of the year). A significant loss of any year-class should be considered damaging to the fishery 7 to 8 years later, because more than 60 percent of any year's fishery may be comprised of new recruits from a single year-class.

In summary, the decline in the red king crab population appears to have resulted from the occurrence of weak year-classes recruiting to the fishery and increased mortality among adult, and especially sublegal, crabs of the weaker year-classes (Reeves, 1985); an offshore oil spill could result in reductions in eggs and larvae, and thus in weaker year-classes for future recruitment, and additional reductions in numbers of larger (sublegal) juveniles and adults (including reproductively important large males). A further reduction in the abundance of more than five year-classes, resulting from an offshore oil spill (and considering the current depressed regional population), would delay the regional population's recovery more than several generations, and thus could result in a major effect on the regional population of red king crab.

The final probabilities for Sea Targets 22 and 23, which are in offshore areas occupied by the benthic and pelagic lifestages of red king crab, are less than 0.5 percent for spills of 1,000 or 100,000 barrels or greater for 3, 10, and 30 days for Sea Target 22; and range from 20 to 23 percent for a spill of 1,000 barrels or greater within 3, 10, or 30 days, and 1 percent for a spill of 100,000 barrels or greater within 3, 10, or 30 days for Sea Target 23.

An oil spill that occurred and contacted nearshore areas (i.e., Port Moller) could have similar, but more serious, effects on the regional population of red king crab than those discussed for an offshore oil spill. As discussed, reductions in year-classes following an offshore spill would occur for newly released larvae, spawning adults (age 5+), embryos carried by ovigerous females, and younger juveniles (to age-class 3) that are concentrated in nearshore waters. Because the size of a future cohort is believed to be determined predominantly by reproductive success and survival of larvae and young-of-the-year crab (which inhabit nearshore nursery areas), mortalities and sublethal effects on these lifestages resulting from contact of hydrocarbons with a nearshore area such as Port Moller could be particularly serious. Reductions in eggs, larvae, young of the year, juveniles (age-classes 1-3) and adults of this depressed regional population would not be recovered within several generations, thus resulting in a major effect on the regional population of red king crab in the southeastern Bering Sea.

Red king crab females (including ovigerous individuals), spawning adults, and newly released larvae are known to be abundant in the Port Moller area. Information on the distribution or habitat preferences of the 0- to 2-year classes of juveniles is not complete, but juveniles inhabit shallow bays and estuaries, and ages 3 to 5 are known to be abundant 50 to 70 meters off Port Moller. This area is believed to have the most vulnerable concentration of red king crab lifestages that could be seriously affected by contact with hydrocarbons.

For red king crab use, the area most at risk to oil-spill effects is Port Moller. The probabilities of an oil spill of 1,000 barrels or greater occurring and contacting the nearshore area around Port Moller within 3, 10, and 30 days are 17, 20, and 24 percent, respectively. The final probabilities of a spill of 100,000 barrels or greater are 1 percent for contact within 3, 10, and 30 days. If an oil spill did occur, the conditional probabiltiy reveals a 99.5-percent chance of contact with the Port Moller area within 3 days.

<u>SUMMARY (Effects on Red King Crab)</u>:

Seismic activities from the projected level of activity (1,882 trackline miles) are expected to result in negligible effects on red king crab. This is primarily due to the limited radius of effects produced by the nonexplosive seismic devices (airguns and sparkers) expected to be employed. These devices have been demonstrated to be innocuous to fish beyond a short distance (0.6 to 1.5 m) of the detonation source. Few, if any, red king crab are expected to be within the limited range of effects for these seismic devices.

Effects on red king crab from discharges of drilling fluids, cuttings, and formation waters from the 42 (10 exploration and 32 development and production) wells projected over the life of the field also would be limited. This is due to the rapid dilution expected following discharges and the limited radius of effects. Discharges from all wells would occur in water depths from 30 to 100 meters and, therefore, would be expected to dissipate and dilute rapidly. Under these conditions, lethal effects from such discharges on the exposed lifestages of red king crab would be expected only within a few meters of the discharge point, and sublethal effects would be expected out to 100 meters. Given the relatively small area of contamination from these projected wells compared to the extensive habitat inhabited by red king crab, minor effects from these discharges would be expected.

Although only 1 offshore oil spill (1,000 barrels or greater) is assumed for the 26-year life of the project, oil-spill effects could affect the depressed red king crab population more seriously than other species. Although effects on red king crab would be restricted to the area of the spill (which would be relatively small compared to the alternate habitat available to benthic and pelagic lifestages) and concentrations would be lethal to adult red king crab only a short distance from the spill, several lifestages (including spawning adults, embryos carried on females, pelagic larvae, and larger juveniles) could be affected. Mortalities and sublethal effects could result in reductions in numbers of several year-classes, including eggs, larval zoeae, and juveniles and adults of age-classes 3+. These reductions, combined with the extant depressed population level of red king crab in the southeastern Bering Sea, could result in a further decline in the population, from which it would not be expected to recover within several generations, thus resulting in a major effect on the regional population of red king crab.

The aggregate lethal and sublethal effects of seismic activities, drilling, and production discharges, and an offshore oil spill are expected to result in a major effect on red king crab. The recent decline in the red king crab population appears to have resulted from the occurrence of weak year-classes recruiting to the fishery and increased mortality of adult, and especially sublegal, crabs of the weaker year-classes. This decline is expected to be augmented by the aggregate lethal and sublethal effects of the project, and the population is not expected to recover within several generations, thus resulting in a major effect on the regional population of red king crab.

A major oil spill that contacted a nearshore area being used by red king crab could be even more serious. A reduction in year-classes of larvae, spawning adults, embryos carried by females, and younger juveniles concentrated in nearshore waters would be expected. Effects could be even more severe than those expected following an offshore oil spill, because reproductive success could be reduced and survival of larvae and young of the year (particularly important in determining the size of a future cohort) could be decreased. Reduced numbers of eggs, larvae, young of the year, juveniles (age-classes 1-3), and adults of this depressed regional population would not recover within several generations, thus resulting in a major effect on the regional population of red king crab in the southeastern Bering Sea.

CONCLUSION (Effects on Red King Crab):

Port Moller, the area that contains the most vulnerable concentrations of red king crab lifestages, is the area most at risk to oil-spill effects. Overall effects of this lease sale on the regional population of red king crab are expected to be MAJOR.

CUMULATIVE EFFECTS (Effects on Red King Crab):

Activities that are analyzed for their potential to produce cumulative effects on red king crab include other federal offshore oil and gas leasing, tankering of Canadian oil through the Bering Sea, and commercial fishing.

Federal oil and gas lease sales in this region that could contribute to cumulative effects on the regional red king crab population include existing and proposed leasing in the St. George Basin (Sales 70, 89, and 101), Navarin Basin (Sales 83 and 107), and North Aleutian Basin (Sale 92). Oil spills resulting from theses sales are the factors of greatest concern. The possible number of spills of 1,000 barrels or greater assumed for Sales 70, 83, 89, 92, 101, and 107, and tankering of oil from the Canadian Beaufort Sea would be 24. These spills are projected to occur over broad areas of the Bering Sea and over about 30 years. The Navarin and St. George Basin areas and the proposed Canadian-tanker route are geographically distant from the Sale 92 area and therefore from important red king crab spawning and rearing habitats. Thus, oil spills occurring in these lease areas would have little or no effect on the portion of the regional red king crab population that spends its adult existence in these areas.

Oil spills that occur offshore in areas distant from the Sale 92 area could potentially affect adult crabs, should oil be transported to the benthos. However, there are several factors that would serve to limit such effects. The greater depths in these planning areas (greater than 50 m) would inhibit (through greater dissolution and mixing) concentrations in lethal or even sublethal ranges to red king crab from reaching the benthic environment. In addition, there is a much lower density of adult red king crab in the St. George and Navarin Basin areas than in the North Aleutian Basin area. Therefore, considering the relatively small area that could be contacted by even a large spill (100,000 barrels), only a very small segment of the total adult population could be affected.

The potential for more serious effects would occur as a result of the proposed action for Sale 92. This could occur because the entire regional population of red king crab for the southeastern Bering Sea spawns and rears in or near the North Aleutian Basin Planning Area. The more vulnerable lifestages (larvae, eggs, juveniles, and spawning adults) would be in or near the area during the spring and summer. Effects on these lifestages are more fully described in the analysis of effects for the proposed action, a summary of which follows.

Although only 1 offshore oil spill (1,000 barrels or greater) is assumed for the 26-year life of the project, oil-spill effects could affect the depressed red king crab population more seriously than other species. Although effects on red king crab would be restricted to the area of the spill (which would be relatively small compared to the alternate habitat available to benthic and pelagic lifestages) and concentrations would be lethal to adult red king crab only a short distance from the spill, several lifestages (including spawning adults, embryos carried on females, pelagic larvae, and larger juveniles) could be affected. Mortalities and sublethal effects could result in reductions in numbers of several year-classes, including eggs, larval zoeae, and juveniles and adults of age-classes 3+. These reductions, combined with the extant depressed population level of red king crab in the southeastern Bering Sea, could result in a further decline in the population from which it would not be expected to recover within several generations, thus resulting in a major effect on the regional population of red king crab.

A major oil spill that contacted a nearshore area being used by red king crab could be even more serious. Reduction in year-classes of larvae, spawning adults, embryos carried by females, and younger juveniles concentrated in nearshore waters would be expected. Effects could be even more severe than those expected following an offshore oil spill because reproductive success could be reduced and survival of larvae and young-of-the-year (particularly important in determining the size of a future cohort) could be decreased. Reduced numbers of eggs, larvae, young-of-the-year, juveniles (age classes 1-3), and adults of this depressed regional population would not recover within several generations, and would result in a major effect on the regional population of red king crab in the southeastern Bering Sea.

In the cumulative case, final probabilities for the nearshore areas north of the Alaska Peninsula that provide important habitat for red king crab do not increase over those of the proposal. The final probabilities for Land Segments 6 through 15 from Unimak Island to north of Port Heiden do not increase in the cumulative case (Table IV-16). These nearshore areas north of the Alaska Peninsula, which do not experience increased risk of oil-spill contact, are used by spawning and ovigerous adults, planktonic crab larvae, and juvenile crabs. In the cumulative case, the final probability for Biological Resource Area 7 (Port Moller), which is particularly important habitat for red king crab larvae, does not increase.

Commercial fishing also poses a significant potential cumulative threat to red king crab. The harvest of red king crab in the Bristol Bay Registration Area plummeted from a high of about 130 million pounds in 1980-81 to 3 million pounds in 1982-83. This fishery was closed during the 1984-85 season. Over-harvest of the resource is considered one of the major contributing factors in the recent depression of the red king crab stocks in the Bering Sea.

Effects from commercial fishing include direct harvest mortality, as well as potential mortalities on sublegal adult crabs and female crabs incidentally harvested and handled during harvest activities. It is not currently known how "handling mortality" affects the total population. Further, it is not fully known how direct fishing mortalities affect this population. However, it is known that direct, intensive harvest pressure--working in tandem with other natural phenomena--have produced a serious depletion of the existing stocks of red king crab in this region.

Conclusion (Effects on Red King Crab): In the cumulative case, the effects on red king crab would be MAJOR.

Effects On Other Invertebrates: Various lifestages of other invertebrates inhabit benthic, surficial, or nearshore waters that are in or adjacent to the lease sale area or south of the Alaska Peninsula (where they may be affected by tankering out of Balboa Bay). Crab species are most vulnerable in nearshore waters adjacent to the lease sale area. Generally, adults spawn in nearshore waters, move farther offshore, and 7 to 11 months later return to more shallow waters for their eggs to hatch. Their planktonic larvae are concentrated in nearshore waters and/or upper levels of the water column (to 60 m) for several months. After metamorphosing to juveniles and settling to the bottom, they inhabit shallow, nearshore areas. Adult shrimp, which are generally pelagic organisms, use coastal shallows for spawning. Planktonic shrimp larvae use surficial, nearshore areas for 2 to 3 months, and juveniles inhabit shallows before becoming semidemersal as adults. Bivalves, which occupy shallow shelf waters, have planktonic egg and larval stages before becoming sedentary juveniles. For the purpose of analysis, invertebrate species inhabiting the eastern Bering Sea are considered regional populations, except for Dungeness crab, which are present in limited numbers along the northern and southern coasts of the Alaska Peninsula--the northern limit of their distribution in Alaskan waters. Dungeness crab using these areas are considered part of a regional population that extends south.

Crab species using benthic and pelagic habitats and pelagic adult shrimp may experience some localized effects of discharges of drilling fluids, cuttings, and formation waters. Offshore discharges in the North Aleutian Basin lease sale area would occur in waters ranging from 30 to about 100 meters deep with dissipating current action and, consequently, would dilute rapidly. The lower plume of a discharge may affect adult crabs using the benthic habitat at seasonally varying depths. These benthic adults have higher hydrocarbon tolerances than larvae or juveniles. Mortality of crabs may result from exposure to lethal concentrations contacted within a few meters of a discharge. Other crabs may experience sublethal effects or a localized reduction of food supply where their prey have been killed or buried. However, these effects would be limited to adult crabs using the benthic habitat within the immediate vicinity of a discharge point. The upper plume of a discharge could affect planktonic crab larvae in the pelagic environment. Discharges could result in localized losses of individuals; but with the limited radius of effects (estimated to be 100 m), discharges would affect only a small portion of the widely distributed larval drift population. The upper plume of a discharge also may result in limited-toxicity effects on pelagic adult shrimp, but these organisms are so widely distributed in the lease area that the area of toxic concentrations within 100 meters of a discharge point would affect only a small portion of the regional shrimp population. Discharge effects on these regional populations would be minor.

Planktonic crab and shrimp larvae, juvenile crabs and shrimp, spawning adult shrimp, planktonic clam eggs and larvae, and adult clams using nearshore habitats would not be affected by discharges into waters a minimum of 18 kilometers offshore and 30 meters deep. Offshore discharges would disperse before reaching nearshore areas and, consequently, would not result in burial, accumulation of sediments, or toxic effects on nearshore organisms.

Adult crabs inhabiting offshore benthic areas may be contacted by hydrocarbons following an offshore oil spill and may experience lethal or sublethal effects. Adult tanner and Korean hair crabs generally inhabit deeper waters (to 360 m) during the winter and more shallow waters (to approximately 100 m) during the summer. Dungeness crab occupy waters to approximately 100 meters deep. Offshore benthic areas inhabited by these species may be exposed to hydrocarbons following an oil spill. For example, hydrocarbon concentrations of 0.1 ppm were found to a depth of 100 meters following the Amoco Cadiz spill (Marchand, 1978). Adult crabs have LC_{50} values of 1 to 4 ppm (Thorsteinson and Thorsteinson, 1982). Some mortalities of adult crabs could result from exposure to hydrocarbon concentrations of 0.1 ppm; however, since the LC_{50} value of 1 ppm indicates the concentration at which 50 percent of the exposed organisms are killed, exposure to 0.1 ppm at 100-meter depths would be expected to result in a considerably lower percentage of mortality. Sedimentation of oil also may occur following an oil spill (Howarth, 1984). Hydrocarbons may persist in benthic sediments over months or years, and be released over time. This could result in long-term mortalities of adult benthic crabs.

Adult crabs that do not experience immediate mortality may fail to survive after damage resulting from exposure to sublethal concentrations. For example, postmolting tanner crabs were observed to lose a number of legs following oil exposure and subsequently to die an "ecological death," being unable to survive in the normal environment (Karinen and Rice, 1974). Hydrocarbon exposure also can have effects on the reproductive success of crabs through: (1) reduced fecundity (Tatem, 1977); (2) undetermined effects of hydrocarbon deposition in gametes on egg/sperm viability; (3) absorption of sedimented hydrocarbons by embryos carried on benthic females, resulting in reduced hatching success; and (4) disruption of hormone extrusion or detection, resulting in reproductive behavioral aberrations (Takahashi and Kittredge, 1973). For example, in juvenile and adult dungeness crab, chemosensory organs can detect water-soluble fractions as low as 0.1 ppm (Pearson et al., 1980), which may be encountered at depths of 100 meters following an oil spill (Marchand, 1978). Disruption of these chemosensory clues may affect reproduction through: (1) failure to locate a female; (2) altered reproductive behavior; or (3) failure to copulate within 5 days following ecdysis, which results in a high proportion of infertile eggs (Armstrong et al., 1983).

Given an offshore oil spill that exposed offshore benthic areas to hydrocarbons, some adult crabs might be killed and others might experience sublethal effects that affect their ability to survive or reproduce. The individuals affected in the localized area of effects would comprise only a small portion of the widespread regional populations in the Bering Sea, thus resulting in a minor effect. Furthermore, many tanner and Korean hair crabs occupy benthic areas in excess of 100 meters deep that are likely to be exposed to lower concentrations of hydrocarbons than those observed at 100-meter depths, and consequently would experience a reduced level of lethal and sublethal effects.

Planktonic invertebrate lifestages in the pelagic environment may experience mortalities or sublethal effects following an oil spill. These offshore, planktonic organisms include juvenile and adult stages of shrimp, shrimp eggs carried offshore by females in the winter, and some crab larvae. These lifestages have LC_{50} values as low as 0.1 ppm (Thorsteinson and Thorsteinson, 1982) and may experience mortality from exposure to hydrocarbon concentrations of 0.1 to 0.21 ppm that have been documented following oil spills (Marchand, 1978; Vandermeulen, 1982). Sublethal effects also may result from contact with the water-soluble fraction. However, these lifestages are widely distributed during their pelagic existence, and even a major oil spill of 100,000 barrels that spread to cover 200 square kilometers would kill or affect only a limited number of these pelagic organisms in a localized area. The individuals affected would constitute only a portion of the regional population and thus would experience a minor effect.

The most serious effects of an oil spill on fisheries resources would occur following a spill that contacted nearshore areas along the northern or southern coasts of the Alaska Peninsula, which are used by vulnerable lifestages of invertebrates. Lifestages that concentrate in these nearshore waters include: planktonic larvae, juvenile, and spawning shrimp; all stages of surf clams; and eggs, larvae, juveniles, and spawning adult crabs. Because of variations in habitat use by different lifestages, these groups of species are discussed individually.

Nearshore, shallow waters are used by concentrations of various lifestages of shrimp including: planktonic larvae, juveniles, spawning adults, and eggs carried by females. Larvae are particularly sensitive to hydrocarbon exposure having an LC_{50} value of .01 ppm (Thorsteinson and Thorsteinson, 1982). During the most sensitive period--the molt--larvae exposed to 8 ppb of napthelene have been found to experience narcosis and death (USDOI, BLM, 1981a). In addition, they are immobile and concentrated in surficial waters, where they are most likely to encounter an oil slick. Juvenile and adult shrimp also are sensitive to hydrocarbon toxicities having LC_{50} values of 0.1 to 1 ppm (Thorsteinson and Thorsteinson, 1982). Hydrocarbon concentrations such as 0.21 ppm (Vandermeulen, 1982) or 0.1 ppm (Marchand, 1978), observed following offshore oil spills, could result in the death of shrimp eggs, larvae, juveniles, and adults. A chronic or massive oil spill in nearshore areas, where the more sensitive shrimp lifestages are concentrated, could result in a localized reduction of shrimp. The extent of a population decrease would depend on the lifestage(s) and numbers affected, the areal extent of the spill, the hydrocarbon concentrations, and the length of contact. A major oil spill in a reproductively important nearshore area could cause a localized reduction in numbers of shrimp of various age-classes, but this reduction would not be expected to affect the regional population of the eastern Bering Sea, and consequently, could result in a moderate effect.

An oil spill that reached nearshore waters also could affect the clam resources adjacent to or in the North Aleutian Basin lease area, or along the southern side of the Alaska Peninsula in the event of a tanker spill originating from Balboa Bay. Many razor clams were killed following the Amoco Cadiz tanker spill off the coast of France (USDOI, BLM, 1981a). In addition to the mortalities resulting from smothering or toxicity from an oil spill, chronic exposure of clams to hydrocarbons can result in the inability to attach to the substrate, a depressed rate of shell closure resulting in more vulnerability to predation, or inhibition of oxygen uptake (Dunning and Major, 1974). Numbers of surf clams could be reduced in localized areas as a result of an oil spill. The extent of such a reduction would depend on the concentrations of hydrocarbons to which the clams were exposed immediately, or on hydrocarbon concentrations that were incorporated into beach or benthic sediments and the length of time over which they were released. Because oil may persist in sediments and be released over a relatively lengthy time period (for example 6 to 12 years or longer [Gilfillan and Vandermeulen, 1978]), long-term effects could result in localized areas. In addition, clam larvae are planktonic for 1 to 4 months before settling to the bottom, during which time they are particularly sensitive to hydrocarbons and are exposed to surface oil slicks. A major oil spill that contacted nearshore surf clams between Cape Seniavin and Port Heiden could affect adult clams and planktonic larvae, and could reduce a portion of the regional population. Furthermore, these effects could take years to ameliorate because the species is long-lived and slow to reach sexual maturity (5 years or longer). However, only a portion of the regional surf clam population would be affected, so the effect on the regional population would be moderate in the event of a major oil spill of 100,000 barrels contacting nearshore areas.

The oil-spill risk to the surf clams concentrated in the Cape Seniavin/Port Heiden area, however, is low. The OSRA data reveal a less-than-0.5-percent probability of an oil spill of 1,000 barrels or greater occurring and subsequently contacting nearshore areas within 10 days (while hydrocarbon concentrations could cause mortalities) between Cape Seniavin and Port Heiden. The probability of a major oil spill of 100,000 barrels or greater occurring and subsequently contacting these nearshore areas is less than 0.5 percent within 30 days.

Tanner, dungeness, and Korean hair crabs would be most seriously affected by an oil spill that contacted a nearshore area they were inhabiting. All lifestages of these crab species use nearshore areas at various times, and dungeness crab, in particular, occupy shallow waters (to 100 m) along the northern and southern coasts of the Alaska Peninsula during all lifestages. Adult tanner and Korean hair crab, which use nearshore waters for breeding in the spring and summer and for feeding (primarily females) prior to migrating offshore for the winter, could be affected by an oil spill. Adult dungeness crab occupy shallow waters year-round. Adult crabs could be killed by exposure to hydrocarbons in shallow waters. Crab eggs that are carried by females during feeding in nearshore areas also could be killed by contact with hydrocarbons, although specific LC_{50} values for this lifestage have not been established. Planktonic crab larvae concentrated in nearshore, surficial waters also could be killed by contact with a slick or the water-soluble fraction beneath it. Crab larvae have LC_{50} values as low as 0.1 ppm (Thorsteinson and Thorsteinson, 1982). Hydrocarbon concentrations of 0.1 ppm to 100-meter depths (Marchand, 1978) or 0.21 ppm to 20-meter depths (Vandermeulen, 1982) or greater could be expected in nearshore waters and could result in mortality of larvae. Crab larvae may be rendered moribund after an exposure of 10 minutes, which could leave them increasingly vulnerable to predation and physiological changes. Caldwell et al. (1977) reported larval Dungeness crab bioassay results at 0.04 ppm. Larvae would be particularly susceptible to hydrocarbon effects during their three to four molts prior to metamorphosing into juveniles. As juveniles, crabs inhabit shallow bays and estuaries (often forming dense pods of thousands of individuals) for 1 to 5 years before joining adult migrations. While concentrated in nearshore areas, these juveniles could be seriously affected by an oil spill that contacted nearshore waters and resulted in mortality. Mortalities probably would be greatest in the larval lifestage, because juveniles and adults have higher LC_{50} values, indicating that they are more tolerant of hydrocarbons, and because they inhabit benthic areas that are likely to be exposed to lower hydrocarbon concentrations than the waters just beneath the slick inhabited by planktonic larvae.

Crabs of various lifestages that do not experience immediate mortality as a result of contact with hydrocarbons following an oil spill may fail to survive or reproduce after damage resulting from exposure to sublethal concentrations. Sublethal effects similar to those discussed for an offshore oil spill could be expected, including reduced fitness leading to eventual mortality or reproductive aberrations. In addition, dungeness crab, in particular, could be affected by mortality of eelgrass, which they inhabit as juveniles.

The extent of the effect of an oil spill on nearshore lifestages of crabs would depend on the time of year (i.e., lifestages present), the amount of oil spilled, its concentration and persistence, the areal influence of the spill, and the numbers of individuals of vulnerable lifestages contacted. A major oil spill of 100,000 barrels that spread to cover 200 square kilometers and exposed nearshore areas to hydrocarbons in the spring or summer could result in mortality of some portion of the adults, eggs, larvae, and juveniles present, and sublethal effects on another portion of these lifestages that may affect their ability to survive or reproduce. This could result in a serious reduction in a localized area for one or more age-classes. However, with the widespread distribution of these species in the southeastern Bering Sea, even a major oil spill would affect only a portion of a regional population of any of these species, thus resulting in a moderate effect on the regional population.

These invertebrate species also may be affected by an oil spill that results in a reduction of their prey, but these effects would be localized. Shrimp prey on benthic organisms that may experience mortalities in a localized area following an oil spill. In addition, shrimp are widely dispersed pelagic species, so oil-spill effects on their prey would have very localized effects on a portion of the regional shrimp population. Crabs are relatively omnivorous, and feed on a variety of benthic organisms. Oil-spill effects on their benthic-prey species would be localized; and crabs, being opportunistic feeders, should be able to compensate for localized reductions in prey. Any prey-reduction effects on crabs also would be localized to the contaminated benthic area and, given the widespread distribution of crabs, should affect only a small portion of the regional population.

<u>SUMMARY (Effects on Other Invertebrates):</u>

Seismic activities from the projected level of activity (1,882 trackline miles) are expected to result in negligible effects on other invertebrates. This is primarily due to the limited radius of effects produced by the non-explosive seismic devices (airguns and sparkers) expected to be employed. These devices have been demonstrated to be innocuous to fish beyond a short distance (0.6 to 1.5 m) of the detonation source. Few, if any, invertebrate species are expected to be within the limited range of effects for these seismic devices.

Effects on invertebrates from discharges of drilling fluids, cuttings, and formation waters from the 42 (10 exploration and 32 development and production) wells projected over the life of the field also would be limited. This is due to the rapid dilution expected following discharges and the limited radius of effects. Discharges from all wells would occur in water depths from 30 to 100 meters and, therefore, would be expected to dissipate and dilute rapidly. Under these conditions, lethal effects from such discharges on invertebrates would be expected only within a few meters of the discharge point, and sublethal effects would be expected out to 100 meters. Given the relatively small area of contamination from these projected wells, compared to the extensive habitat available to invertebrates in the pelagic or benthic environment, minor effects would be expected from these discharges.

Oil-spill effects on invertebrate species also would be limited, considering that only 1 offshore oil spill (1,000 barrels or greater) is assumed for the 26-year life of the project. Effects on invertebrate species would be restricted to the area affected by the spill, which would be relatively small compared to the extensive alternate habitat inhabited by benthic and pelagic lifestages of invertebrate species. Furthermore, concentrations in the water column associated with the spill would approach lethal concentrations for invertebrates only a short distance from the spill site. Beyond this, concentrations would diminish with distance and over time (several days) to concentrations well below those shown to produce effects on invertebrates. Therefore, only a small portion of the regional populations of invertebrates in the eastern Bering Sea could be affected.

The aggregate lethal and sublethal effects of seismic activities, drilling and production discharges, and an offshore oil spill are expected to affect only localized groups of invertebrates in the immediate vicinity of such events. Given the extensive numbers and distribution of invertebrates in the eastern Bering Sea, the localized effects resulting from this lease sale are expected to affect individuals in localized offshore areas, and to result in a minor effect.

A major oil spill that contacted a nearshore area being used by eggs, planktonic larvae, juveniles, or spawning adults of invertebrate species could have a more serious effect. These lifestages could experience mortality or sublethal effects that affect their ability to develop, reproduce, or survive natural environmental stresses. A localized change in the distribution and/or abundance of the affected portion of the regional population over more than one generation could result in a moderate effect.

CONCLUSION (Effects on Other Invertebrates):

Overall, effects of this lease sale on regional populations of invertebrates are expected to be MINOR. If an oil spill occurred and contacted a nearshore area inhabited by concentrations of breeding adults, planktonic larvae, juveniles, or other vulnerable lifestages of invertebrates, MODERATE effects could occur.

CUMULATIVE EFFECTS (Effects on Other Invertebrates):

Activities that may produce cumulative effects on invertebrates include projects listed in Section IV.A.6., other federal and state ongoing and proposed petroleum development, commercial fishing operations, and other nonpetroleum activities. Table G-10 through G-15 in Appendix G considers cumulative-spill probabilities for spills of 1,000 barrels or greater occurring over the expected life of the lease area activity. The cumulative (final) probabilities cited incorporate the likelihood of discovering oil, the probable transportation routes, the conditional probabilities, and the development assumptions given in Section II.A. Therefore, these final probabilities reflect the overall probability of oil spills occurring and contacting particular locations.

In the cumulative case, final probabilities for nearshore areas north of the Alaska Peninsula, which provide important habitat for invertebrates, generally do not increase over those of the proposal. Final probabilities for the cumulative case for Land Segments 6 through 15 (from Unimak Island to north of Port Heiden) were compared to those of the proposal. For these 10 land segments, the final probabilities of a spill of 1,000 barrels or greater in the cumulative case increased slightly only for Land Segment 6 (from less than 0.5 to 6% for 30 days) and for Land Segment 7 (from 1 to 7% for 30 days). In the cumulative case, final probabilities for a spill of 100,000 barrels or greater do not change for any of these land segments. These nearshore areas north of the Alaska Peninsula, which experience little change in risk of oil-spill contact, are used by planktonic crab and shrimp larvae, juvenile crab and shrimp, spawning adult shrimp, planktonic clam eggs and larvae, and adult benthic clams.

Sea Targets 21, 22, and 23, located in offshore areas that are inhabited by adult tanner and Korean hair crab in the winter, do not have increased final probabilities in the cumulative case. Other offshore areas inhabited by adult crab may have slightly increased final probabilities in the cumulative case; however, oil-spill effects on regional crab populations are not expected to increase from those expected for the proposal (minor). Crabs are much more widely distributed than the areal influence of even a major oil spill.

In the cumulative case, planktonic invertebrate lifestages in the pelagic environment may inhabit areas with increased oil-spill risk; however, effects on these regional populations are still expected to be minor. Although these offshore, planktonic organisms include crab larvae and juvenile and adult shrimp, which may be killed by hydrocarbon concentrations below their 0.1-ppm LC_{50} value, they are widely distributed during their pelagic existence. Even a major oil spill of 100,000 barrels that spread to cover 200 square kilometers would kill or affect only a localized number of these organisms that constitute a portion of a regional population.

Conclusion (Effects on Other Invertebrates): In the cumulative case, invertebrates are not expected to experience greater effects than the MINOR effects expected from the proposal.

(2) Effects on Marine and Coastal Birds: The principal factors that may adversely affect birds in the lease sale area are oil pollution and disturbance.

(a) Oil Spills: Birds that spend much time on the surface (i.e., shearwaters, cormorants, sea ducks, and alcids) are especially vulnerable to oil spills (King and Sanger, 1979). Direct mortality results primarily from hypothermia (excessive heat loss) as oil mats the plumage and destroys the thermal barrier (air trapped beneath the feathers), and drowning. Direct contact of birds by oil in appreciable amounts usually is fatal.

The effects of an oil spill on birds would vary with season, duration of exposure, and volume and composition of oil. Winter spills in the southeastern Bering Sea could affect overwintering cormorants, sea ducks, gulls, and alcids. In addition, fulmars, shearwaters, storm petrels, dabbling ducks, shorebirds, and alcids could be affected by summer spills. Loons, ducks, geese, shorebirds, and alcids would be the groups most adversely affected by spills during their spring and fall migrations. In August and September, large numbers of flightless adult and young murres and other alcids are concentrated on the water surrounding colonies prior to post-breeding dispersal. Embayments containing marshes or major river deltas, and nearshore areas where prey organisms are concentrated, are the most vulnerable habitats.

Abnormalities in reproductive physiology and behavior resulting from ingestion of oil (Hartung and Hunt, 1966; Holmes and Cronshaw, 1977; Patten and Patten, 1977; Stickel and Dieter, 1979; Ainley et al., 1981; Holmes, 1981; Peakall et al., 1981; Gorsline and Holmes, 1982; Leighton et al., 1983; Holmes, 1984) could have substantial adverse effects on egg production in seabird and waterfowl populations. In addition, transfer of oil from adults to eggs results in reduced hatchability, increased incidence of deformities, and reduced growth rates in young (Grau et al., 1977; Albers, 1978; Miller et al., 1978; Szaro et al., 1978; Patten and Patten, 1979; Stickel and Dieter, 1979). Reduction in growth also may result indirectly when affected parents fail to deliver sufficient food to nestlings (Trivelpiece et al., 1984). Holmes et al. (1978) has shown that stress from ingested oil can be additive to ordinary environmental stress (i.e., low temperature). Presumably, the effects of external oiling also would be more severe when birds are under environmental stress (i.e., winter) or physiological stress (i.e., molting, migration).

Seabird population models (Wiens et al., 1979; Ford et al., 1982; Samuels and Lanfear, 1982; Wiens et al., 1984) project that recovery periods as long as 20 to 50 years may be required if the breeding adults of groups such as alcids and storm petrels, which are characterized by very low reproduction rates, suffer substantial losses from a major spill. A major oil spill coincident with a period of high natural mortality (i.e., caused by limited food resources, etc.) could substantially increase bird mortality and retard natural recovery of the population. Recovery of colonies exposed to chronic hydrocarbon presence (resulting in decreased reproductive success) could be equally as slow (Holmes et al., 1981; Ford et al., 1982).

Birds may be affected indirectly by oil spills if food resources decline as a result of hydrocarbon-induced mortality or displacement. Even a relatively short-term adverse effect on a major food resource during the nesting period, migration stopover, or in an overwintering area could decrease reproductive success or survival of local bird populations. Contamination of food resources and habitats over longer periods could result in the accumulation of toxic concentrations of hydrocarbon residues that may adversely affect physiology, reproduction, and behavior.

Disturbance: In pelagic areas, helicopter and vessel traffic to and from drill rigs would constitute the most important source of disturbance affecting marine birds. Onshore, air traffic, human presence, and construction activities associated with construction and operation of support facilities near seabird colonies and waterfowl and shorebird staging and nesting areas can significantly disrupt breeding activities and preparation for migration. Low-flying aircraft, especially helicopters, can frighten large numbers of cliff-nesting birds (i.e., murres) from the nesting ledges, resulting in displacement of eggs and/or young to the rocks below. Those not displaced from the ledges by adults are left exposed to the elements and predators (Hunt, 1976; Hunt et al., 1978; Jones and Petersen, 1979). In recent years, repeated aircraft flights near several colonies in the Bering Sea region may have been one factor contributing to fewer nesting attempts and reduced reproductive success (Biderman and Drury, 1978; Hunt et al., 1978). Disturbance of birds in important feeding, staging, and overwintering areas can cause excessive expenditure of energy and displacement to less favorable habitats during critical periods in the annual cycle.

Most marine and coastal birds occurring in the Bering Sea region are protected under the convention with the U.S.S.R. on the Conservation of Migratory Birds and Their Environment, which regulates the taking of migratory birds, prohibits disturbance of nesting colonies, and directs signatories to mitigate against degradation of migratory-bird habitat. While acts pursuant to this treaty and others with Canada, Japan, and Mexico regulate certain bird/human interactions, they do not prohibit industrial or other activities that may adversely affect birds or their habitats. Compliance with these treaties by the U.S. can be facilitated by mitigation against potential adverse effects of petroleum development, such as pollution, disturbance, and habitat degradation.

(b) Site-Specific Effects of Oil Spills: In the following discussion, percentages used to indicate the probability of oil contacting Biological Resource Areas (Appendix G, Fig. G-2), unless otherwise noted, are 10-day conditional probabilities (Appendix G, Tables G-1 through G-9), which assume that oil has been released at a hypothetical spill location. Such percentages do not reflect the probability of oil actually being released at that location, but the probability of oil, if released there, making contact with specific target areas. Since the likelihood of a spill entering any given target area is in part a function of the distance between spill point and target, these values are strongly influenced by the placement of hypothetical spill points relative to target areas. Much higher contact probabilities would be expected if spills were to occur closer to target areas. Combined probabilities cited in this discussion (Appendix G, Tables G-10 through G-15) incorporate the conditional contact probabilities, the estimated petroleum resources, the likelihood of oil-spill occurrence, and the development assumptions given in Section IV.A.1. Hypothetical spill points are shown on Graphic 5. Definitions of terms that summarize projected effects (i.e., major, minor) are given in Table S-2. The term "regional population" refers to all individuals of a species or group of species that occupy the following areas (species groups may vary with the season): (1) coastal Bristol Bay/Alaska Peninsula (seabirds, waterfowl, shorebirds); (2) Alaska Peninsula bays and lagoons (geese); (3) Pribilof Islands (seabirds); (4) Shumagin Islands and the surrounding area south of the Alaska Peninsula (seabirds, waterfowl); and (5) Unimak Pass area (seabirds).

North Aleutian Basin/Alaska Peninsula: Approximately 4.5 million marine birds nest in the vicinity of the North Aleutian Basin lease sale area and the proposed pipeline and tanker facility on the Alaska Peninsula. While those occupying the large colonies in northern Bristol Bay are relatively far removed from the immediate area of potential platform spills, colonies in the Shumagin Islands south of the Alaska Peninsula adjacent to tanker routes serving the proposed pipeline terminal in Balboa Bay could be vulnerable to oil spills. Likewise, substantial overwintering seabird and waterfowl populations would be vulnerable to oil spills in this area. The vulnerability of Unimak Pass, adjacent to the southwestern corner of the lease sale area, also is of concern because of the many thousands of marine birds and waterfowl that traverse it during migration, and the large numbers of birds foraging there in summer. In addition, the potential exists for substantial oil-spill effects on the immense shearwater flocks that forage throughout this area. On the northern coast of the Alaska Peninsula, concentrations of waterfowl and shorebirds, which use the lagoons for stopover and staging during spring and fall migration, would be extremely vulnerable to any oil spills entering these areas. Although only 1 spill of 1,000 barrels or greater is projected for the lease period, occurrence as a result of a tanker incident could bring the point of spill origin near many of these populations.

Northern Bristol Bay: Large colonies in northern Bristol Bay (Capes Peirce and Newenham and the Walrus Islands) do not appear to be at risk from spills that could originate in the lease sale area or in associated transportation corridors. Model oil-spill trajectories of such origin do not contact foraging areas surrounding these colonies, or nearby offshore targets, even after 30 days (Tables G-3, G-6 in Appendix G), at which time the oil would be well weathered. Likewise, the probability of 1 or more spills of any size occurring and contacting these areas is negligible (less than 0.5%).

Southern Coast of the Alaska Peninsula/Shumagin Islands: Seabird nesting colonies are numerous on the southern coast of the Alaska Peninsula and in the Shumagin Islands adjacent to probable tanker routes serving a proposed pipeline terminal in Balboa Bay. The ultimate risk to particular populations would depend on the actual route used to approach or depart the bay, the size of the spill, the season of occurrence, etc. A western route, past the west side of Unga Island, has several reef areas to be avoided, but would place fewer birds at risk (an estimated 51,000 plus unsurveyed nocturnal species) than an eastern route. A route east of the Shumagin Islands appears more favorable for navigation but would traverse areas where an estimated 615,000+ birds could be present during the nesting season.

The probability of 1 or more 1,000-barrel-or-greater spills occurring along the tanker route between Balboa Bay and southern ports is a relatively high 28 percent (Table IV-10). From 52 to 73 tanker visits per year are projected. The southwesterly current drift along this route potentially could further increase the likelihood and severity of oil spills near the Shumagin colonies. Densities as high as 1,092 birds/km^2 have been observed in this area in summer, although more typical densities recorded over much of the region fall below 300 birds/ km^2 (typically 60-175/km^2). At these more widespread densities, a 1,000-barrel spill could affect as many as 18,000 individuals (3,600-10,500 at typical densities), equivalent to about 10 percent of one of the larger colonies in this area. A population (i.e., murre, kittiwake) experiencing mortality of this magnitude could require 5 to 15 years (or more, depending on the influence of other adverse factors), equivalent to one or more generations, for recovery to its original level. Greatest mortality could result from a spill contacting a large shearwater flock, but even losses of tens of thousands of individuals would not constitute a major event for a population of many millions summering in Alaskan waters. Thus, during summer, throughout most of this region, oil spills could have moderate effects on regional populations.

In the vicinity of the several major nesting colonies (i.e., Castle Rock, Spitz Island, Karpa Island), mortality may exceed 30,000 individuals and 15 to 20 percent of certain regional populations. Recovery from such losses is expected to require 15 to 20 years or more (depending on the influence of other adverse factors). Losses of this magnitude could result in major population effects, which could occur with relatively high probability, given the 44-percent chance of a transport-related spill occurring (Table IV-8).

South-side bays and islands adjoining the peninsula also are used by substantial numbers of seabirds and waterfowl in fall and winter. Inshore densities in fall, while not specifically determined for Balboa Bay (28% probability of 1 or more spills), range up to 279 birds/km^2 in this region (mainly geese), suggesting the potential for moderate oil-spill effects during this season. Likewise, moderate effects could result from spills farther offshore (but within the 200-m isobath), where densities generally are less than 400 birds/km^2. Densities of overwintering seabirds and waterfowl reach 124 birds/km^2 in the Shumagin region, again with the potential for moderate oil-spill effects.

Northern Coast of the Alaska Peninsula: Along the northern coast of the Alaska Peninsula, coastal bird populations, primarily waterfowl and shorebirds, are most vulnerable during spring- and fall-migration periods, when large numbers concentrate in a few bays and lagoons. Areas of major importance for which there is substantial risk of contact should a spill occur include Port Moller, Nelson Lagoon, and Izembek Lagoon. These areas are of particular concern because large percentages of several waterfowl populations concentrate there for premigratory staging.

Under the influence of winds from westerly directions in summer (June-August) and fall (September-November), model oil-spill trajectories move toward Bristol Bay, generally paralleling the Alaska Peninsula (Liu and Leendertse, 1981a; Thorsteinson, 1983). A spill originating in that portion of the sale area nearest the peninsula is very likely to contact points within the 25-mile-wide nearshore zone within 10 days (i.e., Biological Resource Area 7, probability [p] = 17 to 99+%); the probability of shore or lagoon-entrance contact (Land Segments 10-12; Sea Target 4) is reduced to between 5 and 33 percent, probably as a result of currents trending northeastward along the peninsula. Likewise, most trajectories originating farther offshore seldom make contact with shoreline targets (p = less than 0.5%). However, the occurrence of a spill in the inshore zone coincident with strong onshore winds (a relatively rare event) could enhance shoreline oil contact or lagoon entry. In addition, risk to birds concentrated in the nearshore zone or in lagoons could be higher than expected, both as a result of spills associated with a projected pipeline through the Port Moller area, and the potential (low) for vessels grounding along the shoreline.

During the summer, when recorded bird densities are less than 75 birds/km^2, oil spills in the inshore zone are likely to have only minor effects on most species. However, when large (occasionally immense) flocks of shearwater occur in this zone, typical recorded densities exceed 1,300 birds/km^2; if contacted in such large numbers (i.e., 82,000 by a 10,000-barrel spill) certain of their breeding populations could be subject to moderate effects. If spills enter or occur in the lagoons in summer, effects on the relatively low breeding populations are likely to be minor. However, Aleutian terns breeding in Port Moller (800-1,200 individuals), which represent 10 to 30 percent of the world population and probably 60 percent of the regional population, could experience a major effect. For example, if 20 percent of the breeding adults (i.e., at a density of 25 birds/km^2) were killed by a 1,000-barrel spill, as many as 20 years or 6 generations could be required for population recovery. Residual environmental effects of oil in these lagoons could carry over into fall.

The entry of oil into bays and lagoons during the fall-migration season is likely to have severe consequences. Large proportions (75-100%) of several waterfowl populations, including brant, emperor goose, Steller's eider, and Canada goose, as well as substantial numbers of other waterfowl species and shorebirds, feed in the lagoons to build fat reserves that will be used to complete the migratory journey; of particular concern are the declining populations of several goose species (brant, emperor, cackling Canada). Major effects could result if oil were present during this period. Such effects could be further intensified if there were residual effects from an earlier spill (for example, if food resources become less available as a result of oil contact). Also, unless waterfowl avoid oil, the population effects of a spill that enters a critical lagoon could become more widespread if additional flocks were to move into the vicinity of a slick from other foraging areas, or through repeated contact of individuals sublethally oiled during initial contact. However, in experiments with mallard ducks, individuals were hesitant to enter an oiled pond and demonstrated an increased avoidance after initial contact (Custer and Albers, 1980). With observed fall densities ranging from 249 to 1,044 birds/ km^2 (Arneson, 1980) and large flocks (10,000 or more individuals) a frequent occurrence, even a relatively small spill in these confined lagoon waters could contact a substantial proportion (10-20%) of several staging goose populations with potentially major effects. Currently declining goose populations are especially at risk. Outside the lagoon-forming barrier islands, contact is more likely, but densities of 65 to 332 birds/km^2 suggest that only minor to moderate effects would be experienced by populations utilizing the inshore zone.

Spill trajectories in winter and spring periods (December-May) trend mainly to the west and southwest, away from the peninsula or toward Unimak Pass; some of those originating in the inshore zone do contact the peninsula. Most contact probabilities in this season fall below 10 percent and, together with the generally low bird densities recorded (most winter samples show fewer than 100 birds/km^2), suggest that effects are likely to be minor. Bird densities reported for the peninsula increase in spring with the influx of migrants (emperor goose, brant, Steller's eider, ducks, shorebirds, gulls). Reported values range from 44 to 358 birds/km^2 through much of the area, with a high of 849/km^2 in Nelson Lagoon. Although the spring-contact probability is not differentiated from the winter probability (p=8%), and trajectories still trend generally away from the peninsula, the high bird densities suggest that the risk of oil-spill effects, moderate in much of the inshore and lagoon habitat and potentially major in Nelson and Izembek Lagoons, is relatively low.

For the purpose of assessing risk to certain biologically important areas, the above discussion assumes oil is spilled and traces its potential effects on bird populations. The actual risk, which incorporates the probability of a spill occurring, may more accurately reflect the risk from the lease area but underestimates the probability of spills outside the area, and thus may underestimate the off-lease-area risk. The probability (p) of a 1,000-barrel- or greater spill occurring and entering the inshore zone in the vicinity of Nelson Lagoon/Port Moller remains relatively high (p=20%); the number of spills of this size expected to occur is 0.2. The chance of such a spill (which originates in the lease area) actually contacting the shoreline declines from between 5 and 19 percent (conditional probability) to 5 percent. Elsewhere, probabilities are low and probable oil-spill effects of the lease sale are minor. Consideration of the probability of oil-spill occurrence and contact, the expected number of spills, the model trajectories, and the seasonal distribution and abundance of birds suggests that, in the inshore zone, oil-spill effects of the lease sale are likely to be minor except in summer, when elevated shearwater density increases the potential for moderate effects. Within critical lagoons, oil-spill effects in spring- and fall-migration periods are potentially major. In summer and winter, effects are likely to be minor.

Pelagic Areas: Spill trajectories, which exhibit a strong westerly or southwesterly component from December through May, move toward pelagic areas of relatively low density (fewer than 200 birds/km^2--most sample transects have fewer than 50/km^2). The probability of spill contact with sea targets ranges as high as 33 percent, but most values fall below 24 percent. However, as a result of the projected distribution of oil resources, the probability of occurrence and contact (combined probability) with sea targets in the area likely to be affected during this period is less than 5 percent. The estimated number of spills of 1,000 barrels or greater which could be released in the lease area (1) (Table IV-8), and the relatively high probability that released oil (conditional probability) could contact sea targets suggests that effects of this lease sale could be substantial; however, the combined spill probability (less than 5%) and the relatively low bird density during this period suggest that the potential risk to overwintering individuals in the area would be minor. In late spring (April-May), densities may be elevated well above winter values with the passage of migrants, but highest densities appear to be located west and southwest of the lease sale area, where contact probabilities are low; thus, effects during this period are likely to remain minor.

As a result of an influx of southern-hemisphere shearwaters, and other species associated with the eastern Aleutian nesting areas, summer pelagic densities typically range up to about 500 birds/km^2. Highest densities occur toward the shelf break and Unimak Pass, and along the peninsula in the vicinity of the 50-meter depth contour, where shearwaters often forage. Since spills would move generally northeast along the peninsula in both summer and fall, birds foraging in western and southwestern portions of the lease area and beyond are likely to experience only minor effects. This also is suggested by the relatively low (5-7%) probability of oil-spill contact southwest of the lease sale area. However, large shearwater flocks which forage in areas adjacent to the peninsula in summer, as well as concentrations of fall migrants, could be at considerable risk from oil spills. Bird densities approaching 2,500/km^2 have been recorded in this region; with a 20-percent probability of oil-spill occurrence and contact, the potential for moderate effects exists during both seasons.

Large-Spill Scenario: The consequences of a very large spill (i.e., 100,000 barrels) potentially could be catastrophic where large numbers of marine or coastal birds are concentrated. An event of this magnitude, however, is not expected to occur (potential for 0.03 spills of this size from platforms and transportation combined, Table IV-8). Given the extended period over which one might occur (approximately 20 years), the distance from the lease area to most high-density bird-use areas, and the low probability (3%) of such a spill occurring in or adjacent to the lease sale area, it appears unlikely that a large spill would occur coincidentally with a vulnerable population.

In two areas, however, such constraints on the coincidence of a large oil spill and vulnerable populations appear less certain because of proximity to potential spill sources. A pipeline through Port Moller places bird concentrations in adjacent Nelson Lagoon at greater risk than would an alternative transportation scenario. A pipeline spill of 7,500 barrels (average for U.S. outer continental shelf; Lanfear and Amstutz, 1983) reaching Nelson Lagoon could contact as many as 28,000 waterfowl in fall (density = 605 birds/km^2, slick area = 45 km^2), approximately 26 percent of the individuals present at peak migration. Likewise, nesting marine bird concentrations in the Shumagin Islands are at greater risk from tankering out of Balboa Bay than they would be from alternative routes. In this case, mortality resulting from dispersal of the contents of a grounded 80,000-barrel tanker (the largest-capacity tanker likely to service the Balboa Bay terminal) in the Shumagin Islands could be as high as 194,400 individuals if densities averaged 405 birds/km^2 (range, 62-1092/km^2; Gould et al., 1982) and the slick area were 480 km^2. This is equivalent to about 20 percent of the 0.9 million birds present here during the nesting season (April to November).

If such an event occurred, the principal result would be to lengthen the recovery period for populations of vulnerable species experiencing substantial oil-spill-related mortality. For example, Wiens et al. (1979) estimated that a population of common murres experiencing a one-time 25-percent mortality of all age-classes could require approximately 30 years for recovery to pre-spill levels; a large spill resulting in 50-percent mortality of all age classes could require nearly 80 years for recovery. These values could be increased during periods of otherwise unfavorable conditions.

Site-Specific Disturbance: On the southern shore of the Alaska Peninsula, tanker traffic serving a pipeline-terminal facility (projected 2 vessels/week) could disturb flocks of birds foraging in the Shumagin Islands area in summer and individuals overwintering there. In summer, such an effect could result in locally decreased survival of young if parents were sufficiently disturbed to cause a decrease in the amount of food delivered to them. In winter, frequent disturbance could increase metabolic costs for birds and could result in some decline in overwinter survival. However, in neither case would the effects be expected to exceed a minor degree of severity.

Given the low density of seabird colonies on the northern coast of the peninsula, waterfowl, shorebirds, and summering shearwaters would be the groups most subject to disturbance. Shearwater flocks are not likely to be disturbed significantly by vessel or air traffic associated with this lease sale; thus, effects are likely to be minor to negligible.

However, increased air traffic from Cold Bay in support of offshore operations could significantly disturb staging waterfowl and shorebirds in Izembek Lagoon during spring (April-May) and especially during fall (mid-August to late November) migration periods. Of particular concern are brant, most of whose Pacific population occupies the lagoon during these periods. In recent years, brant have experienced a substantial population decline. Since brant are extremely sensitive to aircraft, especially helicopters, overflights of the lagoon (generally occurring at about 1,500-3,000 foot elevation) often flush hundreds or thousands of birds into flight.

The most heavily used portion of the lagoon, where 75 to 80 percent of the staging brant population (90,000-100,000 of the total staging population of approximately 123,000) often are concentrated, extends from Grant Point to Applegate Cove and south to the southern terminus of the lagoon. During peak concentration periods in this area, as many as 30 to 60 percent of the brant population (35,000-75,000 individuals) could experience effects from routine helicopter overflights ranging from a relatively modest alert or alarm reaction by individuals 2 to 3 miles from the flight path, to massive flights involving all birds within 2 miles of the flight path. Estimates of brant flushed by a helicopter traversing the area of greatest concentration range from 5,000 to 15,000 to, potentially, as many as 50,000 (40% of the current population) when peak numbers are coincident with direct overflights of Applegate Cove (USDOI, FWS, 1985, personal communication).

Recent (late summer-fall, 1984) exploration support-aircraft activity (for St. George Basin, Sale 70) from Cold Bay averaged 5 helicopter flights per day, with as many as 10 some days (Sarvis and Dau, USFWS, personal communications, January and March 1985), over heavily used portions of the lagoon. Similar numbers of overflights (28-42 helicopter flights per week, more during crew changes, Table IV-1) are projected for development of the field.

Such disturbance could displace brant from primary foraging areas for varying periods, which in turn may result in both elevated metabolic costs from additional flying, and decreased energy intake from decreased foraging time in less productive foraging areas, where competition may be more intense. The latter may result in even greater adverse effects than appears obvious, since observations by Izembek National Wildlife Refuge personnel suggest that most foraging takes place in two intensive (tide-related) periods per day. Thus, any disturbance occurring during these periods is likely to have much greater consequences than would be implied simply by the elimination of a certain interval from the day's activities. Energetic stress associated with alarm reactions probably would be of minor consequence unless frequent, in which case some interference with foraging would be expected. In combination, these adverse effects could cause a decline in physiological condition and/or delayed attainment of readiness for completion of the next phase of the annual cycle. In spring, such adverse effects could delay arrival at the nesting areas, and result in reduced egg production and reproductive success; in fall, the effects could include the inability to successfully undertake or complete migration to traditional overwintering areas under the most favorable weather conditions which occur sporadically, as well as decreased winter survival. That this may in fact occur is suggested by observation of greater numbers of brant (6,000-10,000) overwintering in the Izembek area in years when there has been heavier-than-usual air traffic (USDOI, FWS, 1985, personal communication). This possibility has not been rigorously tested. Also the fact that brant make less intensive use of the area near the IFR flight corridor is suggestive of a disturbance effect, although lower-quality forage in this area also could produce or contribute to such a result.

It is difficult at this point to determine if the regional brant population would change in abundance as a result of the disturbance effects discussed above, since no evidence for, or against, correlation between disturbance and effects on breeding activities or survival leading to changes in abundance is available. However, based on the anticipated disturbance scenario, it does appear a reasonable supposition that, if patterns of lagoon use by brant are altered on a daily basis over many years, changes in distribution could result, at least for the duration of the disturbing factors. In sum, the preceding suggests that since the potential exists for a substantial portion of the brant population to experience changes in distribution, the effect of disturbance on this population could be moderate. However, although evidence documenting a definite causal relationship between disturbance and decline in distribution and/or abundance persisting for several generations currently is lacking, the extreme sensitivity of brant to disturbance suggests that, under exceptional circumstances, the potential for major effects on the population may exist. These conditions potentially could be met if repeated helicopter overflights of the lagoon (28-42/week projected) routinely displaced a large proportion of the brant population (potential for up to 75% in fall) from their primary foraging areas during the limited foraging time available each day (primarily the several hours before and after high tides), particularly during the fall—migration period, when virtually the entire population is present. Persistence of such adverse nutritional circumstances during these critical periods could result in inferior physiological preparation for breeding (spring), or migration (fall), and subsequent population decline from decreased productivity or survival, from which recovery could require relatively long-term recruitment.

The emperor goose, although not as sensitive to disturbance as brant, could experience moderate effects because of its limited distribution and declining population. As a result of their large populations and widespread distribution, effects on other waterfowl and shorebirds are not likely to exceed minor. Aircraft disturbance also could cause minor effects in nesting swans in this area in summer. Disturbance of waterfowl in the vicinity of the IFR flight corridor over the northern part of the lagoon, in which aircraft potentially affect about one-third of the lagoon's area in the case of sensitive species such as brant, does not presently appear amenable to significant mitigation. However, disturbance of migratory waterfowl would be reduced if aircraft used an environmentally preferable air corridor around the southern end of the lagoon whenever flight conditions permited.

Air and vessel traffic in the vicinity of Nelson Lagoon (Port Moller) and Balboa Bay during construction of a transpeninsula pipeline and terminal facilities is not likely to be sufficiently intense in areas of bird concentration to exceed minor adverse effects in generally numerous and widespread waterfowl and shorebird populations.

Because of the relatively low bird densities (fewer than 50 birds/km^2) observed in most offshore areas likely to be traversed by OCS-associated helicopters, tankers, workboats, and seismic vessels, adverse effects in the pelagic environment are likely to be minor or negligible.

SUMMARY (Effects on Marine and Coastal Birds):

Seabirds are expected to be subject to major oil-spill effects only in the vicinity of large colonies in the Shumagin, Islands where an estimated 52 to 73 tankers per year would pass in transit from a projected pipeline terminal in nearby Balboa Bay. During the nesting season, when large numbers of foraging birds are on the water, mortality resulting from a 10,000-barrel spill may exceed 30,000 individuals (15-20% of a large colony). Recovery from such an event could require 10 to 20 years (or more, depending upon the influence of other adverse factors), equivalent to several generations. The probability of 1 or more spills occurring in the Balboa Bay area is 28 percent, suggesting that populations here could be at considerable risk from oil spills.

Elsewhere south of the Alaska Peninsula, and north of the peninsula in that portion of the inshore zone including the 50-meter depth contour, oil-spill effects are not likely to exceed moderate, primarily as a result of fewer birds affected at lower densities, or effects restricted to just a portion of a regional population. At typical densities in these regions a 10,000-barrel spill could affect 3,600 to 10,500 individuals (18,000 at the higher recorded densities), and populations experiencing losses of this magnitude may require 5 to 15 years (one or more generations) to recover from such an event. Greatest mortality could result from a spill contacting a large shearwater flock, but their immense numbers would negate this as an event of major consequence. On the northern side of the peninsula, the moderate effects described above would most likely occur in summer or fall when spill trajectories have the highest probability of entering the inshore zone (17-99+%) and bird densities are relatively high. The Aleutian tern population breeding in Port Moller, representing 10 to 30 percent of the world population, could experience major effects if contacted by an oil spill in this area.

With few exceptions, winter, spring, and summer bird densities in the inshore zone are less than 125 birds/km^2; thus, a spill is likely to have only minor effects on the populations of most species. In areas farther offshore, where pelagic densities are even lower (generally below 50 birds/km^2) and the probability of oil-spill occurrence and target contact is less than 5 percent, effects are not likely to exceed minor. Also, since the probability of oil spills contacting seabird-nesting areas in northern Bristol Bay does not exceed 0.5 percent, the effect of the lease sale on this area would be negligible.

Certain waterfowl and shorebird populations occupying lagoons and bays along the northern side of the Alaska Peninsula during spring and fall migration are vulnerable to major effects at these times. Brant, cackling Canada, white-fronted, and emperor goose populations are particularly vulnerable because most (75-100%, except in the case of white-fronted geese) of their Pacific or world population concentrates in one or two limited areas. The world population of Steller's eider also is concentrated here during migration. For example, fall waterfowl densities in the most heavily used portion of Izembek Lagoon, mostly brant, Canada, and emperor geese, are about 1,000 birds/km^2. If a 5,000-barrel spill were to enter the lagoon during peak brant presence, nearly 30,000 individuals of an approximate population of 120,000 brant, plus numerous emperor geese, conceivably could be contacted. Twenty-five percent mortality in a population already declining from other factors could represent a major effect. Other goose species whose populations have fallen to critically low levels (i.e., cackling Canada and white-fronted) are even more vulnerable than brant and emperor goose; However, their staging areas are in Ugashik Bay, outside the immediate area of high potential risk. Effects on populations of most duck species using the lagoons are not expected to exceed minor as a result of their more dispersed distribution and/or greater population size. Because of their concentration in Izembek Lagoon, Steller's eiders could experience moderate effects.

The probability of a spill contacting the entrance areas of Nelson or Izembek Lagoons is moderate, ranging from 5 to 19 percent, but could be elevated by onshore winds and/or tidal action. Contact would be most likely in summer and fall, when model spill trajectories indicate movement to the vicinity of the peninsula. However, the probability of a spill actually occurring and contacting targets in this area is less than 5 percent.

In the inshore zone and in most lagoons and bays, the potential for moderate effects exists in fall as a result of possible spill contact with bird densities ranging from about 100 to over 300 birds/km^2. Elsewhere and in other seasons, effects resulting from spills are expected to be minor or negligible.

Air traffic between Cold Bay and two offshore platforms is likely to be the only significant source of adverse effects from disturbance associated with this lease sale. Brant are the most sensitive species, especially to helicopters (28-42 flights/week projected), and most overflights of Izembek Lagoon in spring and fall flush hundreds or thousands of these geese from the water. Repeated disturbance could displace brant, and other waterfowl species, from favored foraging areas to portions of the lagoon where food is less plentiful or of lower quality, and competition may be greater. This may result in decreased energy intake during these critical periods of premigratory fattening, and overall poorer condition prior to extended migratory flights. In addition, frequent disturbance of flocks is likely to result in elevated stress and utilization of stored fat, thereby delaying the completion of premigratory fattening, and conceivably preventing brant, at least, from embarking on the final segment of their migration under the most favorable weather conditions, which occur sporadically. Any elevated mortality resulting from forced overwintering in Alaska could contribute to the decline of the brant population. Although the potential for decreased energy intake and increased metabolic demand with repeated disturbance has not been documented in waterfowl, from a physiological perspective it would seem likely that if it occurred, the combination of these factors could have substantial effects on these waterfowl populations over the long term. As a consequence, brant, because of their sensitivity to disturbance, and emperor geese, might experience moderate effects, while effects on other geese and Steller's eider would not exceed minor. The potential for short-term minor disturbance effects on waterfowl exists in Port Moller and Balboa Bay as a result of activities associated with construction of a pipeline and terminal facilities. Elsewhere, disturbance effects are likely to be negligible.

CONCLUSION (Effects on Marine and Coastal Birds):

Throughout most of the region potentially affected by this lease sale, where marine and coastal birds concentrate, particularly in coastal areas north of the Alaska Peninsula, in the Shumagin Islands, or where large shearwater flocks occur, the effect of this lease sale on regional populations is expected to be MODERATE. However, if a spill entered the area surrounding a major seabird nesting colony in the Shumagin Islands in summer, or heavily used waterfowl staging area (e.g., Izembek and Nelson Lagoons) in spring or fall, MAJOR effects could result. Effects in northern Bristol Bay would be NEGLIGIBLE; MINOR effects could occur in inshore and pelagic areas. Effects of disturbance-related physiological stress are likely to be MINOR or NEGLIGIBLE throughout most of the region; but in Izembek Lagoon, the potential for MODERATE effects on certain goose populations exists in spring and fall. In particular, long-term disturbance of brant could result in decline of the population. Disturbance effects potentially could intensify any oil-spill-related effects that result.

CUMULATIVE EFFECTS (Effects on Marine and Coastal Birds):

Activities that may produce cumulative effects on marine birds include projects listed in Section IV.A.6., other federal and state ongoing and proposed petroleum development, commercial fishing operations, and subsistence or other harvests.

Although increasing transport of oil in the eastern Bering Sea would substantially increase risk to marine bird populations occupying several areas adjacent to the North Aleutian Basin, the latter contributes relatively little to the cumulative effects of petroleum development and transport in this region (Table IV-8).

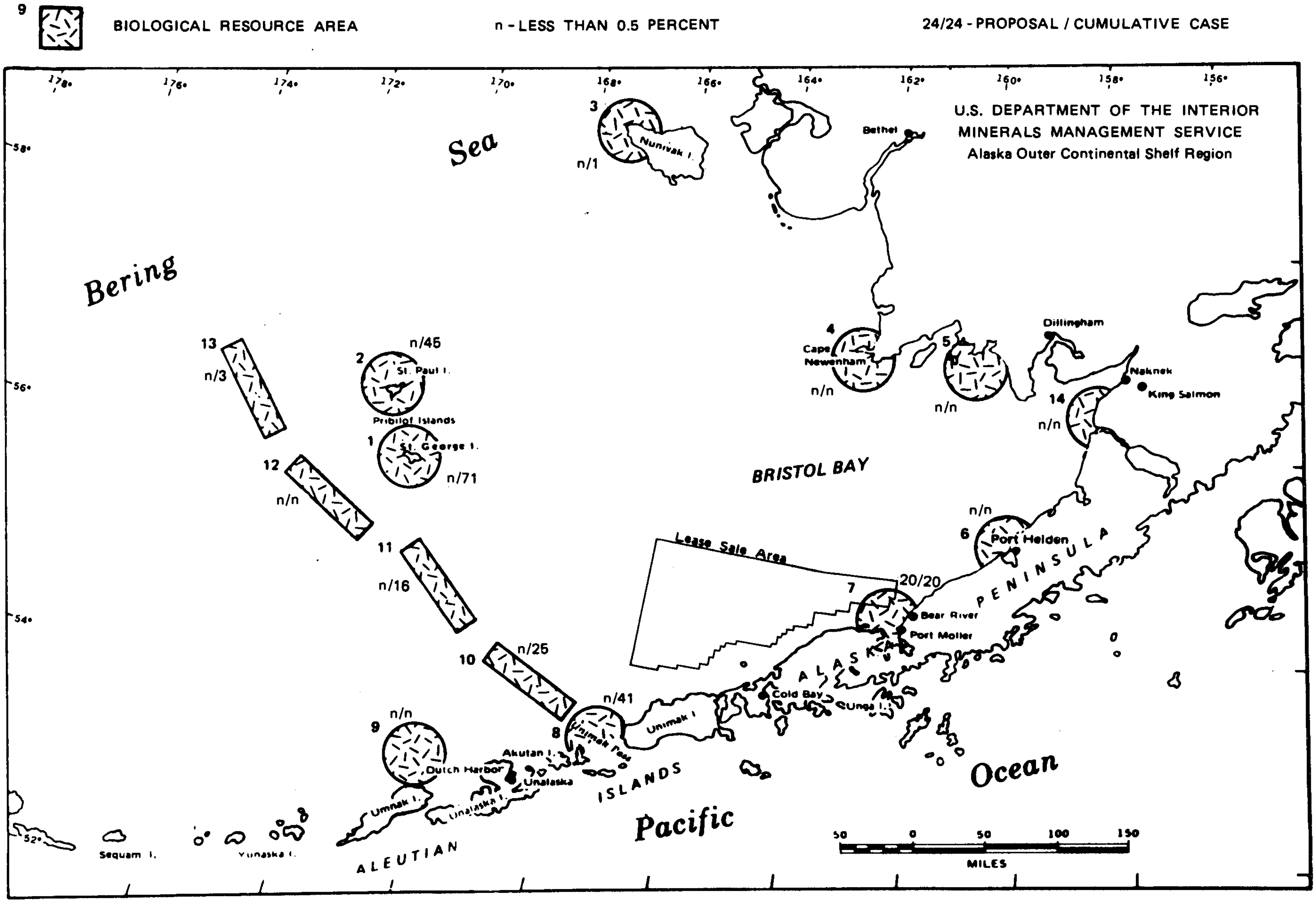
The potential for cumulative effects is most notable in Unimak Pass, and nearby shelf-break areas (Table G-10; Fig. IV-9). Port Moller also has a high cumulative contact probability (20%), but this is because of the present sale alone. The cumulative probability of spills occurring and contacting the western Unimak Pass area and shelf break within 10 days ranges from 20 to 41 percent; and although the expected number of spills projected for these specific areas ranges from only 0.2 to 0.5, the cumulative probability of 1 or more spills occurring somewhere in this region over the period of development, where birds that occupy the North Aleutian Basin for part of the year could be affected, is 99+ percent. Potentially, 24.4 spills of 1,000 barrels or greater (1.7 of 100,000 barrels or greater) could be associated with lease sales (57, 70, 83, 89, 100, 109) in the eastern Bering Sea (Table IV-8). If a spill occurred in the Unimak Pass area in late spring, summer, or fall, marine bird populations, including those nesting in the adjacent eastern Aleutians, could experience moderate to major effects.

In the North Aleutian Basin, the cumulative risk of spills occurring and contacting offshore targets (especially large shearwater flocks) increases above the proposal but remains well below 12 percent throughout most of the area (Table G-12). This likelihood of exposure reinforces the suggestion that only minor effects will occur in offshore areas. Elsewhere and in other seasons, (i.e., along the shelf break in summer or in the eastern Aleutian or ice-edge overwintering areas), effects are not likely to exceed moderate.

Spills originating within the boundaries of other federal lease areas have a less-than-0.5-percent (negligible) chance of contacting targets in and adjacent to the North Aleutian Basin lease sale area.

FIGURE IV–9

PERCENTAGE PROBABILITY OF ONE OR MORE SPILLS OF 1000 BARRELS OR GREATER OCCURRING AND CONTACTING BIOLOGICAL RESOURCE AREAS WITHIN TEN DAYS, NORTH ALEUTIAN BASIN SALE AREA



While many marine birds do not undertake extensive migration, some migrate through or overwinter in or near other lease sale areas or areas of elevated risk (i.e., St. George Basin, Unimak Pass), and therefore are subject to increased oil-spill risk. In addition, storm petrels, for example, may feed at a considerable distance from their colonies that potentially could bring them into contact with spills in other lease areas. Spills and/or disturbance that adversely affect breeding stocks of certain species at more than one major nesting area could result in a substantial reduction of their regional populations and longer intervals required for recovery to their former levels. Most waterfowl and shorebirds are highly migratory and thus are likely to migrate through, overwinter in, or nest near other state or federal lease sale areas where they could experience adverse effects that might intensify any problems resulting from petroleum development in the North Aleutian Basin. Several goose species utilizing Alaska Peninsula lagoons are the most likely to experience such cumulative effects.

Other factors that may make a substantial contribution to cumulative effects include mortality resulting from birds accidentally captured in salmon drift-nets (estimated to number up to 500,000 birds annually in the North Pacific/ Bering Sea area [Ainley et al., 1981]), and the long-term effects of habitat degradation, hunting pressure on certain waterfowl populations, possible altered distribution or reduction of prey-species population, and disturbance.

In recent decades, several Alaskan goose populations (especially cackling Canada, brant, emperor, and white-fronted) have undergone substantial population reductions as a result of continued intensive hunting pressure in both nesting and wintering areas, a reduction in winter habitat, and perhaps other factors. In addition, aircraft disturbance (particularly of brant) in the vicinity of Izembek (and potentially Nelson) Lagoon(s) during spring and especially fall-migration periods, and hunting pressure in fall, may make these populations more vulnerable to oil in the environment. Major effects could occur as a result of the combination of several adverse factors.

Reduction in prey availability itself may have extremely adverse effects, as illustrated by recent nesting seasons when the apparent decline in suitable prey species was the most likely cause of the nearly total reproductive failure documented at several major Alaskan seabird colonies (Springer et al., 1983), and by the poor condition observed among nonbreeding shearwaters (and adults of other species at colonies), many of which were emaciated and moribund when found (Roseneau, Springer, Sowls, Gould and others, personal communications, 1984). The cause of apparent prey-species decline may be linked to climatic factors, increased commercial fishing effort in Alaskan waters, and/or other factors (Springer et al., 1983, 1984, 1985). In combination with the adverse effects of oil development over longer periods, such failures could result in major declines of regional seabird populations.

In addition to the potential spill effects of oil transport from a bay on the southern side of the Alaska Peninsula (i.e., Balboa Bay), marine bird populations nesting on Unga Island in the Shumagin Islands could experience increased disturbance and displacement from construction, air traffic, and mining activity associated with development of the Apollo and Sitka mines. As a result of this activity, some colonies could experience a long-term decline in numbers of birds nesting; but the overall effects of these projects are expected to be minor in comparison to the proposal (moderate with potential for major effects from oil spills). The proposed airport expansion at Unalaska would result in negligible cumulative effects on marine and coastal bird populations. Likewise, cumulative effects of proposed State of Alaska oil and gas lease sales (Bristol Bay Uplands, and especially Alaska Peninsula, for which no lease sale decision has been made) are expected to be negligible.

Although the cumulative oil-spill risk to marine and coastal bird populations over much of the lease sale area may not exceed the moderate degree of severity projected for the proposal, the effects discussed above are likely to occur with greater likelihood and/or frequency. Where major populations are coincident with a high cumulative risk of oil-spill contact, such as in the Unimak Pass shelf-break area and the adjacent eastern Aleutians, moderate to major effects could be experienced by regional marine bird populations. Other perturbations of the environment which affect the survival and productivity of marine and coastal bird populations are likely to intensify any effects of petroleum development. Chronic exposure to oil in the environment, together with other substantial sources of effects noted above, is likely to have the most significant long-term adverse effect on bird populations, especially with regard to recovery from excessive loss of breeding individuals or low productivity resulting from various factors.

Conclusion (Effects on Marine and Coastal Birds): Cumulative effects on regional marine bird populations would be MINOR to MODERATE within the North Aleutian Basin. MODERATE to MAJOR effects could occur, however, in the Unimak Pass area, and in Izembek and Nelson Lagoons.

(3) Effects on Pinnipeds and Sea Otters: Five noncetacean marine mammals--sea otter, Steller sea lion, harbor seal, Pacific walrus, and northern fur seal--commonly occur in the North Aleutian Basin lease area and are likely to have some interaction with offshore oil and gas exploration and development activities. Oil pollution, noise disturbance, and adverse habitat changes due to human activity could adversely affect marine mammal populations found in the proposed lease sale area.

This section briefly discusses the nature of oil-spill and disturbance effects on noncetacean marine mammals that commonly occur in the lease area. The predicted levels of effects of the proposal on pinnipeds and sea otters as defined in Table S-2 are in respect to the regional populations, which are defined here as the populations of pinnipeds and sea otters occurring within the North Aleutian Basin Planning Area (Fig. III-1).

(a) Effects of Oil: Direct contact with spilled oil may cause mortality of some mammals and have no apparent long-term effect on others, depending on factors such as species involved, age, and physical condition of the animal. Sea otters, fur seals, and newly born seal pups are likely to suffer direct mortality from oiling through loss of fur/water repellency and subsequent loss of thermo-insulation resulting in hypothermia (Kooyman et al., 1976, and Costa and Kooyman, 1980). Of the above species, sea otters are probably the most vulnerable to loss of thermal insulation due to oiling because they rely entirely on their fur for thermo-insulation, while fur seals and other pinniped pups possess some subdermal fat layers, depending on age and physical condition. Adult harbor and spotted seals and walrus are likely to suffer some temporary adverse effects, such as eye and skin irritation with possible infection. Such effects may increase physiological stress and perhaps contribute to the death of some individuals (Geraci and Smith, 1976; Geraci and St. Aubin, 1980). Deaths attributed to oiling are more likely to occur during periods of natural stress, during molting and times of fasting, food scarcity, and disease infestations. The few recorded mammal deaths attributed to oil spills in case histories occurred during winter months--a season of increased natural stress (Duval et al., 1981).

Oil-spill contact with pinnipeds and sea otters could interfere with olfactory senses, and hydrocarbons in the water column or in sediments could affect possible chemoreception in marine mammals. Oiling of pinniped fur could mask olfactory recognition of young pups by nursing females. The sense of smell has been reported to be important in mother/pup bonds in harbor seals (Renouf et al., 1983) and probably is important in other seals. Benthic feeders, such as walrus and bearded seal, may rely on chemoreception in locating food. Contamination of bottom sediments may interfere with prey identification in contaminated habitats.

Oil ingestion by pinnipeds and sea otters through grooming, nursing, or consumption of contaminated prey, could have pathological effects, depending on the species and the physiological state of the animal. Although literature indicates that ringed seals and probably other pinnipeds rapidly absorb oil in body fluids and tissues (Geraci and St. Aubin, 1980), ingestion of relatively large quantities of oil for a short period of time showed no apparent acute organ damage (Geraci and Smith, 1976). However, with longer periods of ingestion, accumulation could increase.

<u>Oil-Spill Avoidance</u>: Review of oil-spill case histories (Duval et al., 1981) indicates that pinnipeds were contaminated following several oil spills. An oil spill in the Kodiak/Cook Inlet area reported oiled harbor seals, sea lions, and sea otter (USDOI, Federal Water Quality Administration, 1970). These accounts strongly suggest that pinnipeds and sea otters occurring in the lease area are not likely to avoid oil spills in all situations. Thus, if an oil spill contacted high-density sea otter habitat areas along the northern coast of the Alaska Peninsula, or occurred near seal and sea lion rookeries and major haulout areas, a few to several thousand individuals could be contaminated and could suffer the above effects. Contact with oil may also cause pinnipeds and sea otters to avoid or abandon, at least temporarily, specific habitat areas that become contaminated, such as pinniped haulout sites and rookeries.

<u>Indirect Oil-Spill Effects</u>: The indirect consequences of oil pollution on pinnipeds and sea otters would be those associated with changes in availability or suitability of various food sources. Toxic-pollutant levels from oil spills and other industrial discharges that are concentrated enough to cause large scale die-offs of prey could occur near the immediate spill site or in other localized areas where pollutants have accumulated. Toxic-pollutant levels from oil that could become trapped in sediments, and could have long-term sublethal effects on prey organisms, are also more likely to affect localized areas rather than expansive habitat areas. Because they live year-round within limited home ranges or territories and feed generally on sedentary benthic prey, sea otters are probably the species most sensitive to adverse changes in locally available food sources. If an oil spill widely contaminated bottom sediments, walrus, which feed primarily on sedentary benthic organisms, also may be affected by possible population reduction or

contamination of clams or other prey organisms within the wintering habitat areas of Bristol Bay. Oil-pollution effects on the pelagic prey of seals, sea lions, and fur seals are likely to temporarily reduce the numbers or availability of these food sources within localized areas near the immediate spill site and in areas where the oil slick is found. Because seals and sea lions in the southern Bering Sea are very versatile in diet and exhibit highly mobile foraging habits, adverse effects of oil on prey species are likely to have little effect on these pinniped populations in general.

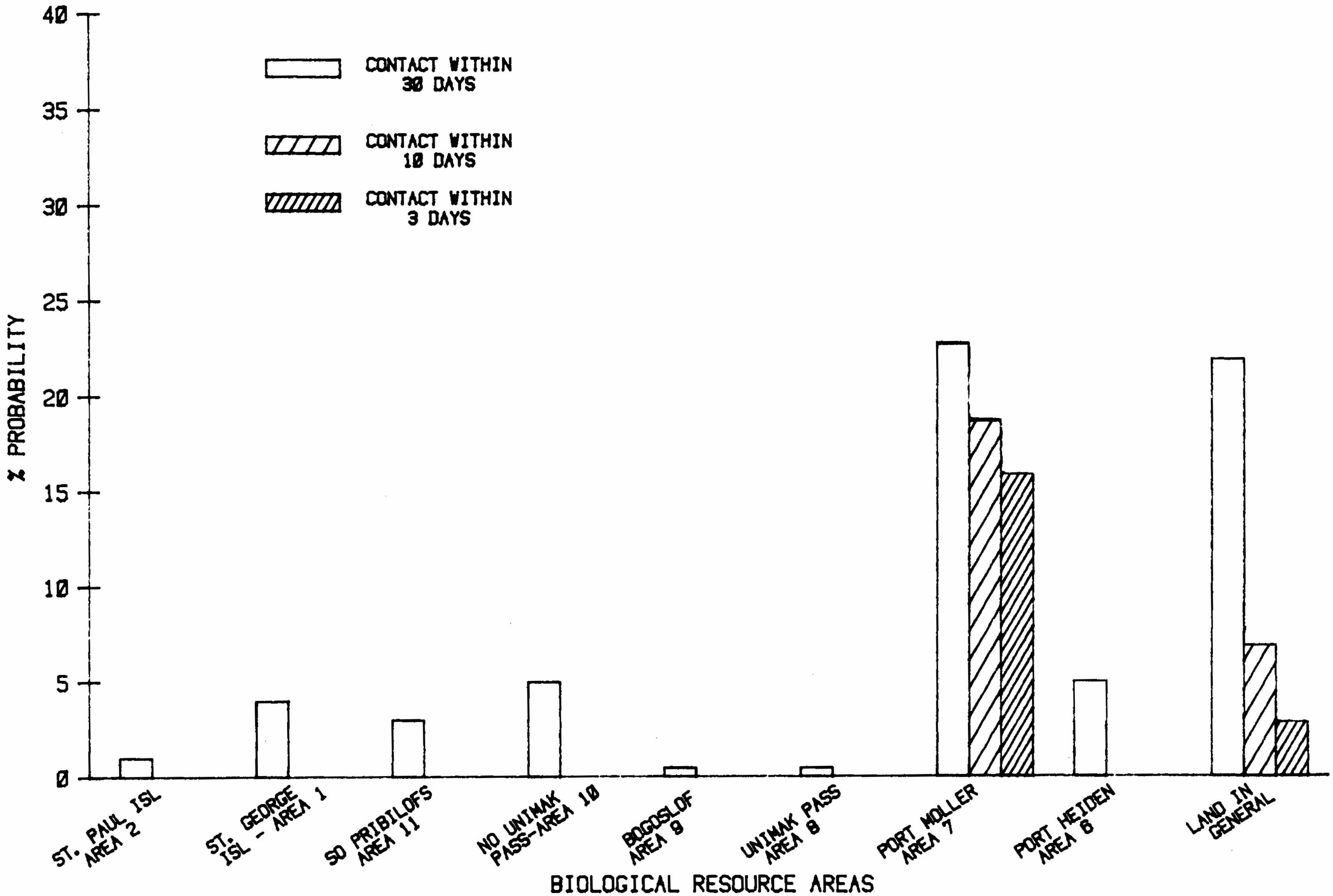
(b) Site-Specific Effects of Oil Spills: Unless otherwise specified, oil-spill contact and probabilities referred to in this section assume the occurrence of development to the extent estimated herein (Sec. IV.A.1.) and its associated spill rates (Sec. IV.A.3.). Most attention is devoted to spills greater than or equal to 1,000 barrels that have a trajectory period of up to 10 or 30 days. Combined probabilities of oil spills occurring at any time of year and contacting some major biological resource areas important to pinniped and sea otter populations are shown in Figure IV-10.

Sea otter, harbor seal, and walrus populations occurring in the Port Moller area are at the comparatively highest risk of oil-spill contact under the proposal primarily from lease blocks near the Alaska Peninsula. Oil-spill-contact risks to other marine mammal coastal habitats in Bristol Bay are less than 0.5 percent for up to 10-day trajectories and less than 10 percent for up to 30-day trajectories (Fig. IV-10). Oil-spill-contact risks to other marine mammal populations and coastal habitats, such as sea otter concentrations along the coast of Unimak Island/Izembek Lagoon, and marine mammal migration corridors through Unimak Pass, are less than 0.5 percent within 10 days and only 1 percent within 30 days (Fig. IV-10, Resource Area 8). While the probabilities of an oil spill contacting land adjacent to the lease area from 10-day and 30-day trajectories are 8 and 23 percent, respectively, most of the risk is to the coastline between Port Moller and Port Heiden. Based on the estimated oil reserves for the North Aleutian Basin (Table II-1), there is a 61-percent chance of 1 or more spills of 1,000 barrels-or-greater projected over the life of the field. As indicated by the oil-spill-risk analysis, a spill is most likely to contact coastal habitats from Port Moller east to Port Heiden (Fig. IV-10).

Among marine mammals common or abundant along the northern coast of the Alaska Peninsula, sea otters are most likely to suffer direct mortality from spill contact, and they could be affected by reduction in locally available food sources if coastal benthic fauna are contaminated in this area (see above discussion on oil-spill effects). Approximately four to seven sea otters per square kilometer could be adversely affected by an oil spill contaminating nearshore waters along the northern coast of the Alaska Peninsula. Sea otters could be directly affected by surface oil and oil/water emulsions, and indirectly affected by oil that may reduce local productivity of benthic fauna. The amount of surface area contaminated by an oil spill is highly variable, depending on the size of the spill, the type of oil, the water temperature, the sea state, evaporation, the timing and success of cleanup efforts, and many other factors. For example, a 2,000-barrel-per-day spill over 5 days (total 10,000 barrels) could spread over a 100-km^2 area as discontinuous slick patches (Manen and Pelto, 1984). In the above case, a maximum of 400 to 700 sea otters could be oiled and killed by an oil spill occurring in nearshore waters along the northern coast of the Alaska Peninsula (this estimate assumes

FIGURE IV-10

PERCENTAGE PROBABILITY OF ONE OR MORE SPILLS OF 1,000 BARRELS OR GREATER OCCURRING AND CONTACTING MARINE MAMMAL HABITATS (BIOLOGICAL RESOURCE AREAS) OVER THE EXPECTED PRODUCTION LIFE OF THE LEASE AREA (PIPELINE–TRANSPORATATION SCENARIO) [a]



a) See Figure G-2 Appendix G for map location of biological resource areas.

four to seven sea otters per km^2, where all otters directly contacted by oil are killed). Losses of this nature resulting from an oil spill contacting the Port Moller area or northern coast of the Alaska Peninsula could consititute a 4 percent reduction in the Port Moller/Unimak Pass sea otter population, assuming Schneider's (1976) population estimate for this area. Considering the relatively low reproductive rate of sea otters (one pup per mature female every 2 years), and their relatively slow dispersal to available habitats, the recovery of the population to previous levels, in this marginal habitat, would take more than one generation. Thus, this loss could be considered a moderate effect on the northern Alaska Peninsula regional population.

Among the other marine mammal species that occur along the coast of the Alaskan Peninsula near Port Moller, there are several thousand harbor seals that could be exposed to oil pollution. Fewer seals (400 to about 1,000) could be exposed if a spill contacted coastal habitats around Port Heiden. However, the oiling of harbor seals would not likely result in the death of several thousand animals. Some individuals weakened by disease or highly stressed may die from the added physiological stress of being oiled. If an oil spill directly contaminated a rookery during the pupping season or oiled molting seals, some additional deaths could result. Pup survival could be reduced for that season, and the regrowth of hair cells during molting could be retarded. If an oil spill occurred along the Alaska Peninsula coast during the summer months, some groups of male walrus (perhaps in the hundreds or thousands) potentially could be exposed to oil pollution. However, the chance of several thousand walrus being directly exposed to an oil spill in the Round Island area is less than 0.5 percent (Appendix G, Table G-10, Resource Area 5). Also, the probability of an oil spill contacting walrus winter- and spring-habitat-concentration areas in northern Bristol Bay within 30 days would be very low (Appendix G, Table G-12, Sea Targets 12-21, Fig. G-2). Under ice conditions, even a large oil spill would not cover a great surface area (100 to several hundred km^2) of Bristol Bay, and the amount of oil that reaches bottom sediments and affects the benthic food sources of walrus would represent a very small portion of the available habitat. An oil spill may reduce local food sources and contaminate some walrus near the spill site; however, walrus can easily move to unaffected habitats as they do when they naturally deplete the clam resource of local areas (Fay and Lowry, 1981). As with harbor seals or sea lions, walrus are not likely to suffer direct mortality from oil-spill contact, with the exception of weakened individuals and perhaps young animals. The number of walrus that eventually die from direct oil-spill contact and indirect effects through loss or contamination of food sources may be somewhat higher if the population is under natural environmental stress due to high intraspecific competition and subsequent depletion of winter food sources. However, the number of walrus killed or adversely affected by an oil-spill event in the lease sale area is not likely to represent more than a minor effect on the Pacific walrus population.

Specific oil-spill effects on Steller sea lions would be similar to those effects described above for harbor seals. If an oil spill contacted the rookery on Amak Island during the pupping season or contacted haulout areas during molting, some sea lion mortalities could result. However, large numbers of sea lions are not likely to be killed by an oil spill or seriously affected by short-term local changes in prey that may be associated with an oil spill (see the previous discussion of indirect oil-spill effects).

Oil-spill risks to northern fur seals and their primary habitats on and near the Pribilof Islands and Unimak Pass and the shelf-break area in the southern Bering Sea are less than 10 percent for spill contacts within 30 days (Fig. IV-10). Given that even a large 100,000-barrel spill would be highly weathered and dispered within this period of time (mostly tar balls and thick, highly weathered patches), oil-spill contact with even a small number of fur seals is very remote. The effects of potential oil spills on northern fur seals that may be associated with the proposal are, therefore, likely to be negligible. The oil-tanker terminal and oil transportation assumed to occur out of Balboa Bay on the southern coast of the Alaska Peninsula would pose an additional oil-spill risk to sea otter, harbor seal, and Steller sea lion populations in the Shumagin Islands area. If a tanker spill occurred in this area, the spill also could be a threat to the northern fur seal, particularly if the spill were present during fur seal spring or fall migrations to and from Unimak Pass and the Bering Sea. Such a spill could result in the one-time loss of perhaps a few thousand to possibly several thousand fur seals, representing a moderate effect on the population.

The local sea otter population in the Shumagin Islands/Balboa Bay area is low in comparison to the other populations on the northern coast of the peninsula and to the west (see Graphic 3). If an oil spill substantially reduced this population, sea otter recovery could take several years, representing a moderate effect. Natural mortality of sea otters due to severe winter conditions on the northern side of the Alaska Peninsula (1971, 1972, and 1974) greatly reduced sea otter numbers in the Port Moller area and eliminated or forced sea otters from the Port Heiden area. The population has not yet recovered from this natural event. Thus, high mortality from an oil spill could have similar effects on the sea otter population in the Shumagin Islands area.

Possible tanker-spill contamination of sea lion and harbor seal haulout areas and sea lion rookeries (Graphic 3) on the southern coast of the Alaska Peninsula could lead to the displacement of some sea lions and harbor seals in contaminated areas and could result in the loss of some individuals. However, harbor seals and sea lions probably would return to contaminated haulout sites within 30 days or no more than 1 year to the sites after the spill contamination is weathered and dispersed. Thus, this effect on the regional population is not likely to be more than minor. If a spill occurred in the Shumagin Islands area during the peak fur seal migration, perhaps a few thousand to several thousand fur seals could be contaminated and killed; this one-time loss could represent a moderate effect on the regional population.

<u>Effect of Gas and LNG Development:</u> Assuming that natural gas is discovered and is economic, it is estimated that one production platform similar in design to the oil-production platform would be present in the lease sale area and that approximately 190 kilometers of offshore pipeline would be laid and would feed into an LNG plant to be constructed on about 24 hectares of land at Balboa Bay. The most likely effects of gas production in the proposed lease area would come from noise and disturbance associated with aircraft to and from the production platform and, to a lesser degree, from LNG tanker traffic passing to and from the assumed Balboa Bay facility. Approximately 2 helicopter trips per platform per day and about 60 to 73 LNG tanker passages to and from Balboa Bay per year are assumed to occur. Noise and disturbance associated with this traffic would be additive to the oil-development dis-

turbance of marine mammals. However, the additive temporary displacement of sea otters, harbor seals, and sea lions near vessel and air traffic from gas development activities is likely to cause no more than a minor or temporary change in marine mammal distribution. Effects of noise and disturbance on marine mammals and alterations in the availability of some food organisms due to gas-production-platform installation and pipelaying are likely to be short-term and local during the construction period and of minor consequence.

If an LNG accident or natural gas blowout occurred, with possible explosion and fire, marine mammals in the immediate vicinity probably would be killed, particularly if the explosion occurred under the water surface. LNG accidents are extremely rare; natural-gas-platform blowouts do occur on occasion. Natural gas and condensates that did not burn in the blowout would be highly toxic and would kill organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the spill site. It is not likely that they would affect any marine mammals except individuals present in the immediate vicinity of the spill. For any marine mammals to be exposed to lethal concentrations of gas vapors or condensates, the spill would have to occur below or on the surface of the water, not from the top of the drill platform. The effects of natural-gas blowouts on pinnipeds and sea otters are likely to be negligible to regional populations. However, an LNG tanker-accident explosion could have far greater effects.

Thus, the effect of natural gas and of LNG development and transportation on nonendangered marine mammals is likely to be minor.

Effects of Noise and Disturbance: Offshore activities that may disturb marine mammals are caused mainly by airborne or underwater noise and human presence. Major sources of mobile-airborne noise disturbance are low-flying aircraft and high-speed motorboats, as well as other high-frequency, high-pitched sounds. Low-flying aircraft are known to panic hauled-out seals. If such disturbance occurs at pinniped rookeries during the pupping season, a significant increase in pup mortality and reduced pupping success are likely to occur (Johnson, 1977). Disturbed adult seals are likely to crush pups when they stampede into the water, and nursing females are likely to abandon their pups during the first 3 weeks of nursing if disturbance separates the mothers and pups. If seals and sea lions are frequently disturbed during the molting period at haulout areas, the successful regrowth of skin and hair cells may be retarded. The physiological stress on seals and sea lions would thus increase during an already stressful period. Other sources of airborne noise include drill platforms, pipelaying, and onshore support-facility construction and operations. These noise sources may disturb marine mammals within a few kilometers of these sources; however, underwater noises borne from some of these sources could influence marine mammals over a greater area.

Effects of Waterborne Noises: The primary sources of industrial underwater noise include marine vessels, aircraft, drill rigs, and offshore production and processing facilities. Underwater noise may affect marine mammals by disturbing or alarming the mammals and causing them to flee the sound source. For example, Fraker et al. (1978) reported the startled response and flight of beluga whales 2,400 meters from barges and boats traveling through a whale concentration area. Underwater noise also may interfere with or mask reception of some marine mammal low-frequency-communication signals, or interfere with reception of other environmental sounds used by marine mammals for navigation (Terhune, 1981). Intense noise could damage the hearing of marine mammals or cause them other physical or physiological harm (Geraci and St. Aubin, 1980; Hill, 1978). Frequent and/or intense noise that causes a flight or avoidance response in marine mammals could permanently displace animals from important habitat areas.

The presence of sea lion, elephant seal, and sea otter populations in close proximity to human development and intensive industrial activity and marine-vessel traffic along the California coast and the presence of sea lions and seals near commercial fishing traffic in Bristol Bay strongly suggests that some marine mammals have adjusted to human development activities with no apparent adverse effects. However, some species of marine mammals, such as fur seals, are probably more sensitive to human presence and disturbance, particularly during the nursing and breeding seasons. The presence of sea otter populations in close proximity to human development and intensive industrial activity and marine-vessel traffic along the California coast strongly suggests that this species has adjusted to most human development activities with no apparent adverse effects. Playback recordings of industrial noise, and actual seismic sounds from airguns had no apparent effect on California sea otters (Riedman, 1984). Sensitive species may adjust to human presence and industrial noise to a certain degree, with a portion of the population remaining in industrial areas. Noise and disturbance could conceivably exceed the tolerance level of sensitive species and may eventually displace these species' entire populations from development areas; however, such permanent displacement has not been demonstrated.

Site-Specific Noise Disturbance and Habitat Effects: Major sources of noise and disturbance to pinnipeds and sea otters would be centered at the air- and marine-support facilities at Cold Bay and Unalaska, respectively, and at the pipeline landfall and tanker terminal at Balboa Bay. Another potential disturbance source would be seismic surveys (vessel noise and air guns), with an estimated 12 site-specific seismic surveys covering about 1,362 trackline miles over the life of the field. One minor source of noise and disturbance would be the exploration/delineation and production platforms assumed in the proposal.

Harbor seals, which inhabit major haulout and breeding habitats in the Cold Bay/Izembek Lagoon and Port Moller areas, are likely to be exposed to some noise and disturbance from the two to three helicopter trips per platform per day and the two to four vessel-traffic trips per day from onshore facilities to the drill platforms. Small groups of walrus that seasonally haulout near these locations also may be exposed to air and vessel traffic; and sea lions breeding on Amak Island also may be exposed to aircraft overflights. Marine-support traffic (two to four boat trips per day) out of Unalaska to offshore platforms is not likely to transect or approach major harbor seal or sea lion-breeding areas. However, such traffic and seismic surveys would transect fur seal summer-feeding habitat and may pass near sea lion-haulout areas along the coast of the Alaska Peninsula and Unalaska Island (Graphic 3).Approximately 50 to 75 oil tanker trips to and from the Balboa Bay terminal could temporarily displace marine mammals (primarily sea lions and seals) as the vessels pass near the animals. However, the short-term effect is likely to be negligible to the regional or local populations. The startle-and-flight response of pinnipeds to aircraft and vessel traffic and to seismic activities is likely to be very transitory and brief in duration, lasting a few minutes, with animals returning to normal behavior and prior distribution within a few hours. The frequency of disturbance events is likely to be low and of little apparent consequence unless pupping activities are disturbed. However, disturbance during molting also could increase physiological stress.

Disturbance of harbor seal and sea lion rookeries during the breeding and pupping season could significantly reduce pup survival by perhaps 10 to 20 percent, as discussed above. However, the Marine Mammal Protection Act and existing U.S. Fish and Wildlife Service regulations could help to prevent excessive disturbance of harbor seals and other marine mammals. Thus, the overall levels of noise and disturbance effects would probably be minor.

Disruption and alteration of pinniped and sea otter habitats associated with 380 kilometers of pipeline laying, construction at Herendeen Bay, dredging (disturbance of .542-1.41 million cubic yards of sediment if trenching occurs), platform installation, and pipeline and tanker-terminal development of 40 hectares at Balboa Bay would be site-specific and generally local in nature. Dredging that would be associated with burial of 8 to 13 kilometers of pipeline in Port Moller and dock and port construction at Balboa Bay could temporarily remove or displace some pinnipeds, and sea otters and their food sources from these sites. These local effects are likely to be very short-term (one season, or a year) in duration.

Drilling-platform discharges (350 tons of muds and 1,050 tons of cuttings per well) would have very local effects on benthic fauna in the immediate vicinity of the two drill platforms (Sec. IV.B.1.a.(1)). Such effects on the available benthic prey of walrus are very likely to be negligible.

<u>SUMMARY (Effects on Pinnipeds and Sea Otters):</u>

Sea otters, numbering 15,000 to 20,000, are the population of marine mammal species at greatest risk from oil spills associated with the North Aleutian Basin lease area. Sea otters are likely to suffer direct mortality from oil-spill contact and may be most affected by local reduction in the availability of food sources due to oil pollution. Sea otter, harbor seal, and walrus populations occurring in the Port Moller area are at the highest risk of oil-spill contact from the pipeline assumed to occur in this area and from the lease blocks closest to the Alaska Peninsula coast. If, for example, an oil spill occurred in the Port Moller area or nearshore along the Alaska Peninsula, an estimated 400 to 700 sea otters could be killed. Considering the relatively low reproductive rate of sea otters, and their relatively slow dispersal rate to available habitats, the recovery of the population to previous levels, in this habitat area, would probably take more than one generation. Thus, this loss could be considered a moderate effect on the northern Alaska Peninsula regional sea otter population. Moderate effects on fur seals are possible if several thousand fur seals were contaminated from a possible tanker accident on the south side of the Alaska Peninsula associated with the assumed Balboa Bay terminal.

Although several thousand harbor seals, sea lions, and walrus could be exposed to oil spills in the lease sale area, fewer numbers (in the hundreds, at most) are likely to come in direct contact with a spill; and only weakened or highly stressed individuals are likely to be seriously injured or to die as a result of the spill. Some local populations could be displaced if haulout and breeding sites were contaminated. The Pacific walrus possibly could be affected by a reduction in the quality of its locally available benthic food sources due to an oil spill. However, the amount of benthic fauna and habitat affected by even a large oil spill is likely to be small in comparison to that which is available. Walrus can easily use other available habitats. In general, oil-spill effects on pinnipeds are likely to be no more than minor, while effects on sea otters are likely to be no more than moderate.

Harbor seals inhabiting major breeding and haulout habitats in the Cold Bay/Izembek Lagoon, Port Moller, and Port Heiden areas are likely to be exposed to some noise and disturbance from the 2 to 3 helicopter and 2 to 4 support-vessel trips per day centered out of onshore support or development facilities at Cold Bay and Dutch Harbor, respectively. Sea lions breeding in the Amak Island area may be disturbed by the 2 to 3 aircraft overflights. Also, some herds of walrus that seasonally haulout near some of the above locations may be disturbed by air and vessel traffic. However, noise and disturbance from aircraft and vessel traffic would be very transitory and brief in duration. The frequency of disturbance is likely to be low and of little apparent consequence, unless pupping activities are disrupted. Disturbance of harbor seal and sea lion rookeries during the pupping season could significantly reduce pup survival. However, the Marine Mammal Protection Act and other existing regulations could help to prevent excessive disturbance of harbor seals and other marine mammals. Thus, overall levels of disturbance effects are likely to be minor.

Disruption and alteration of some marine mammal habitats associated with the laying of 380 kilometers of oil and gas pipelines to Herendeen Bay, installation of two platforms, and development of a 40-hectare tanker terminal at Balboa Bay would be site-specific and local in nature. Effects on food sources for marine mammals are likely to be of very short-term duration (probably 1 year or less). Drilling-platform discharges (muds and cuttings) would have very local effects on benthic fauna in the immediate vicinity of the two drill platforms. Such effects are very likely to be negligible on the overall benthic prey of walruses and other marine mammals.

CONCLUSION (Effects on Pinnipeds and Sea Otters):

The combined effects of oil spills, disturbance, and habitat changes on northern fur seals and sea otter populations associated with the proposal are likely to be no more than MODERATE; while effects of the proposal on other pinniped species are likely to be MINOR.

CUMULATIVE EFFECTS (Effects on Pinnipeds and Sea Otters):

Among major ongoing and proposed future projects listed in Section IV.A.6., federal OCS oil and gas lease-sale projects pose most of the potential cumulative effects on pinnipeds and sea otters. Ongoing and proposed oil and gas exploration and possible development in the Norton, St. George, Navarin, and the North Aleutian Basins and Barrow Arch Planning Areas could have cumulative oil-spill, noise-and-disturbance, and habitat effects on pinnipeds and sea otters in the Bering Sea. A total of about 30 to 40 production platforms; 2,000 to 3,500 kilometers of pipeline; and about 800 to 1,000 tanker trips through Unimak Pass and the southern Bering Sea per year are projected for cumulative oil and gas development in the Bering Sea region. Oil-spill risks to important pinniped and sea otter habitats from cumulative federal OCS lease sales (including the proposal) and future tanker transportation in the Bering Sea were compared with oil-spill risks from only the proposed North Aleutian Basin lease sale in Figure IV-11. Oil activities in the St. George Basin (Sales 70 and 89) contribute nearly all the oil-spill risk to fur seal and sea lion populations occurring on the Pribilof Islands and along the southern Bering Sea shelfbreak (Fig. IV-11, Resource Areas 1, 2, 10-13). Cumulative tanker traffic through Unimak Pass from OCS lease sales in the Navarin, Norton, and St. George Basins contribute almost all the oil-spill risk to marine mammals that migrate through Unimak Pass (Fig. IV-11, Resource Area 8). Oil-spill risks to marine mammal coastal habitats in Bristol Bay, such as Port Moller and Port Heiden, are related to the proposal.

Cumulative effects on sea otter populations along the Alaska Peninsula coast and eastern Aleutians would come primarily from oil spills that may be associated with the proposal and from assumed oil-tanker traffic through Unimak Pass and from Balboa Bay on the southern side of the peninsula. Oil spills that contact near Port Moller or in the Balboa Bay/Shumagin Islands area could cause substantial mortality (several hundred) in local sea otter populations. This could represent a moderate effect (see analysis under the proposal). However, the broad distribution of sea otters along the coast and the rapid dispersion of oil spills would greatly reduce the probability that several concentrations of sea otters would be contacted by oil. Thus, the overall North Aleutian Basin sea otter population or the Shumagin Basin population are not likely to be significantly reduced, even though a portion of the lease sale area population may be adversely affected.

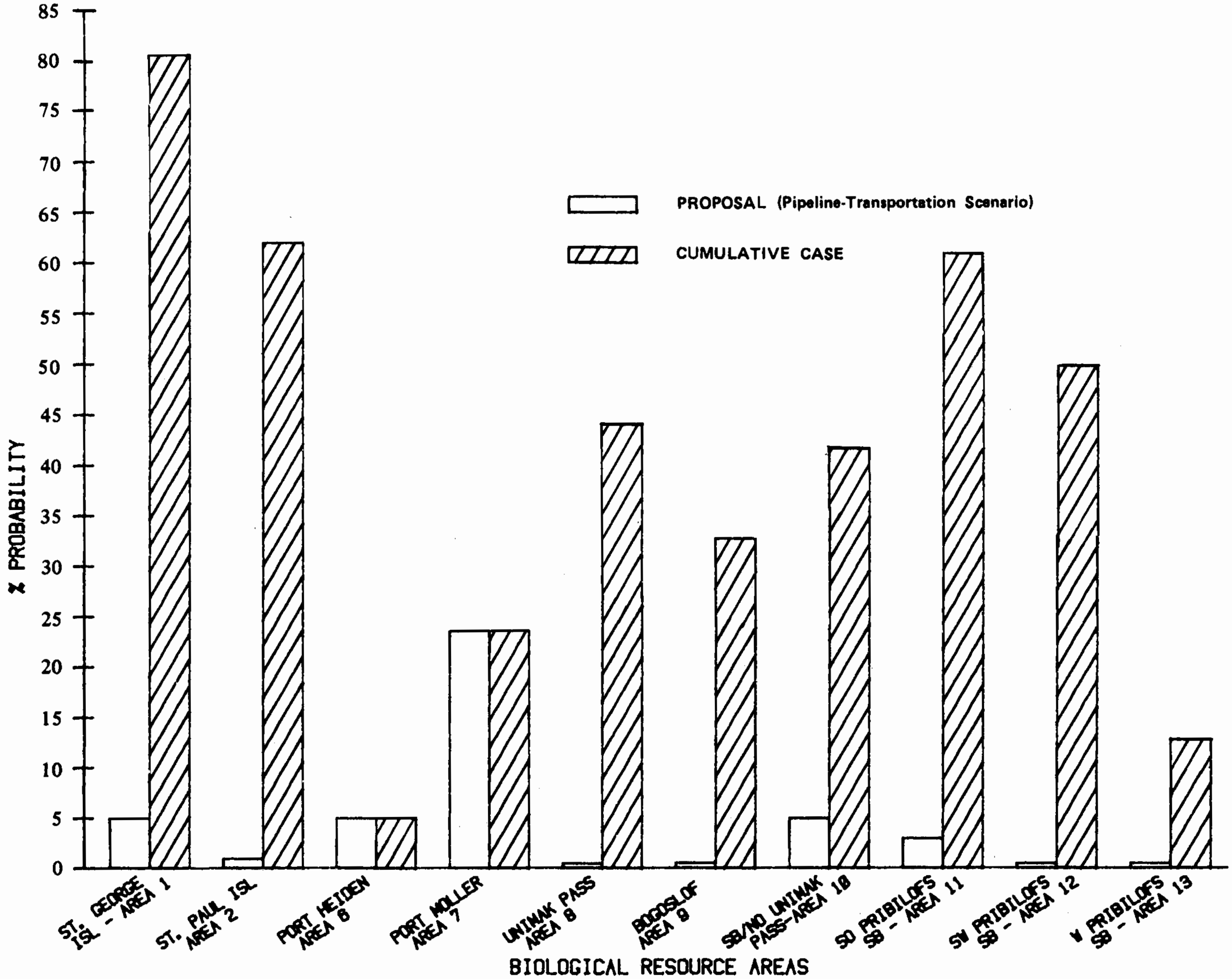
Over 70 percent of the northern fur seal breeding population, and a fairly large local population of Steller sea lions occurring on the Pribilof Islands and along the southern Bering Sea shelf break are likely to have some portion of their foraging or breeding habitat contacted by oil if an oil spill occurs (Fig. IV-11, Resource Areas 10-13). If a Pribilof fur seal rookery were contaminated, moderate effects on northern fur seals could occur with perhaps the loss of several thousand pups and females from one rookery. Oil spills occurring in or contacting offshore habitats are likely to kill a lot fewer fur seals than any oil spill contacting the Pribilof rookeries. Perhaps only a few hundred to a few thousand seals would be killed by an oil spill contacting foraging habitat. This loss is likely to have a minor or negligible effect on the overall population because fur seals are widely distributed on their foraging grounds into small groups or single individuals and the spill would disperse and evaporate before large numbers of seals are contacted.

Cumulative oil-spill effects on Steller sea lions as well as harbor seals and walrus may result, particularly if breeding or haulout areas are contaminated by oil. However, these species are considered far less sensitive to oil-spill contact than sea otters or fur seals (see previous discussion of oil-spill effects of the proposal) and are unlikely to suffer any appreciable mortalities as a result.

Potentially, the entire Pacific walrus population could be exposed to oil spills and disturbance sources over its entire range from the cumulative, ongoing, and proposed OCS oil exploration and development. The greatest potential cumulative oil-spill effects on walrus could come from adverse effects on benthic food sources. Recent findings indicate that the Pacific

FIGURE IV-11

PERCENTAGE PROBABILITY OF ONE OR MORE SPILLS OF 1,000 BARRELS OR GREATER CONTACTING BIOLOGICAL RESOURCE AREAS WITHIN 30 DAYS OVER THE EXPECTED PRODUCTION LIFE OF THE LEASE AREA [a]



a) See Figure G-2 Appendix G for map location of biological resource areas.

walrus population has reached or exceeded the carrying capacity of its primary food source and is beginning to show a decline in population productivity. If oil spills from these above projects occurred and significantly reduced clam productivity, at least on a local level near the spill sites, further decline in walrus productivity is possible, and the eventual recovery of local benthic food sources and recovery of the walrus population could be retarded. However, the amount of benthic food organisms reduced in quantity or quality as a result of even several oil spills would be small in comparison to that which is available. Cumulative oil-spill effects on walrus through food-source reduction are likely to be no more than minor.

Walrus also may be disturbed by cumulative noise and human presence near haulout sites, particularly at the Walrus Islands and St. Matthew, St. Lawrence, and Little Diomede Islands, or during spring migration of walrus nursery herds. These effects could increase physiological stress in an environmentally stressed population. However, laws and regulations such as those under the Marine Mammal Protection Act serve to prevent excessive disturbance of marine mammals. Such effects are likely to be no more than minor.

<u>Proposed State Oil and Gas Lease Areas</u>: The proposed Bristol Bay Uplands (Sale 41) and Alaska Peninsula (Sale 56) lease sales could offer 1.2 million and 1 million onshore acres, respectively, for oil and gas leasing adjacent to proposed OCS Sale 92 area. Onshore oil and gas exploration and development activities that may occur if these lease sales are conducted could cumulatively increase potential noise and disturbance of harbor seals and walruses at haulout locations along the northern coast of the Alaska Peninsula. Some blocks included in both proposed sale areas are immediately adjacent to major harbor seal breeding and haulout areas at Izembek Lagoon, Port Moller, Port Heiden, Ugashik Bay, and Egegik Bay, and secondary walrus haulout sites in some of the same areas.

Cumulative noise and disturbance of hauled out and breeding seals from drilling, seismic, and construction activities could temporarily displace harbor seals from some of these habitat areas and possibly reduce seal productivity to some degree. However, the presence of harbor seals in other development areas suggests that the species can adapt to some levels of disturbance. Cumulative noise and disturbance from OCS activities and state oil and gas leasing is not likely to have more than minor effects on the North Aleutian Basin/Bristol Bay region harbor seal population. Temporary disturbances of hauled-out walrus from noise associated with oil and gas activities on state leases also would have no more than minor additional noise-disturbance effects on herds of male walrus that haul out adjacent to these proposed lease sale areas.

<u>Apollo-Sitka Mine on Unga Island of Shumagin Islands</u>: Recent discovery of a major ore zone in the Apollo and Sitka lode systems on Unga Island could result in increased industrial traffic in the Shumagin Islands area, and may increase noise and disturbance of marine mammals such as harbor seals over those effects associated with the tanker terminal assumed to occur at Balboa Bay in association with the proposal (see previous discussion of site-specific effects of the proposal). Such activities probably would represent no more than a minor additional disturbance effect on marine mammals. However, accidental fuel-oil spills that could be associated with barge or shipping

traffic in support of the mining process would be a threat to local sea otters of the Shumagin Islands and could have an additional moderate effect on sea otters.

Proposed Airport Expansion at Unalaska: The improvement and expansion of the airport at Unalaska could increase potential aircraft disturbance of marine mammals along traffic routes near this airport. However, the cumulative increase in noise and disturbance associated with this local project is likely to have no more than minor effects on local marine mammal populations.

Conclusion (Effects on Pinnipeds and Sea Otters): The combined effects of oil spills, disturbance, and related adverse habitat changes associated with the above projects are likely to result in MODERATE cumulative effects on sea otters and northern fur seals. Cumulative effects on walrus, Steller sea lions, harbor seals, and other pinnipeds are likely to be no more than MINOR. MAJOR cumulative effects on sea otters or northern fur seals are possible if several thousand sea otters were killed, probably as the result of more than 1 spill, or if several fur seal rookeries were heavily contaminated during the pupping season. Either of these events is very unlikely.

(4) Effects on Endangered and Threatened Species: Major effect-producing agents which could affect endangered and threatened species include oil and gas pollution, noise disturbance, and habitat alteration.

Pursuant to requirements under the Endangered Species Act of 1973, as amended, a formal Section 7 endangered species consultation of the MMS with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) was conducted on June 25, 1980, regarding exploratory phases of the proposed oil and gas lease sale in the Bering Sea.

On January 22, 1982, a biological opinion was received from NMFS regarding the effect of the OCS oil and gas leasing program and associated exploration activities in the Bering Sea region on endangered whales; it concluded: "There is insufficient information to make a reliable determination concerning the likelihood of jeopardizing the continued existence of endangered whales. The NMFS believes that it is possible for the U.S. Department of the Interior (USDOI) to plan OCS exploratory activities in the Bering Sea region that are not likely to jeopardize the continued existence of endangered whales."

On March 21, 1984, a biological opinion (Appendix H) was received from NMFS regarding the potential effects of exploration activities on endangered whales in the St. George Basin and North Aleutian Basin. It concluded that: (1) the general conclusions of the Bering Sea Regional and Sale 70 biological opinions remain valid; (2) the proposed activities are not likely to jeopardize the continued existence of the fin, humpback, bowhead, sei, blue, or sperm whales; (3) an uncontrolled blowout or major oil spill during peak gray whale migration periods and when right whales are present is likely to jeopardize the continued existence of these species; and (4) deep seismic surveys would be likely to (a) jeopardize the continued existence of gray whales if they were forced to alter their normal migration, routes and/or to (b) disturb the feeding, mating, or calf-rearing activities of right whales. The NMFS also stated that they believe it is possible for the USDOI to plan these activities in such a manner as to avoid effects to the right and gray whales and therefore avoid the likelihood of jeopardizing the continued existence of these species.

(a) General Discussion - Potential Effects of Hydrocarbon Pollution: Cetaceans occupy surface waters to breathe, and some to feed, potentially exposing them to spilled oil by contact, inhalation, or ingestion (Geraci and St. Aubin, 1982). There is little evidence that endangered cetaceans are able to detect hydrocarbon pollution. Accounts from past oil spills show that marine mammals such as seals and sea lions may not avoid oil (Geraci and St. Aubin, 1979). Toothed whales may be more likely to detect oil due to certain sensory capabilities (Geraci and St. Aubin, 1980). In addition, Geraci and St. Aubin (1982) suggested that bottlenose dolphins, studied under optimum light and water-clarity conditions, used echolocation alone to detect thick patches of heavy oil, particularly if the oil patch contained air bubbles as a result of churning by wind and wave action. Laboratory studies on bottlenose dolphins by Geraci and St. Aubin suggested that avoidance behavior was clear and consistent--the species repeatedly avoided a controlled slick of nontoxic, colored mineral oil that the authors knew they could detect. Each time a dolphin contacted oil, it responded overtly by abruptly diving and quickly returning to an oil-free area, even though the mineral oil was innocuous.

Direct effects of oil spills on free-ranging cetaceans have only recently been observed (Geraci and St. Aubin, 1982). Swimming speeds, surfacing and diving times, and respiratory rates of small groups of gray whales migrating through an area containing naturally occurring oil seeps were compared to the presence and extent of oil. Typically, the whales were observed swimming through the oil at a modified speed but without a consistent pattern. Geraci and St.Aubin (1982) noted some changes in the respiration behavior of whales when they were in oil-contaminated areas. In oiled waters, the whales seemed to spend less time at the surface, blowing less frequently but at a faster rate. If this reaction is interpreted as an avoidance response, it suggests that gray whales can detect oil. Whales showing no response either could not detect the amount or type of oil present or were indifferent to it (Geraci and St. Aubin, 1982). A study by Kent et al. (1983) observing migrating gray whales in the vicinity of oil seeps near Coal Oil Point, California found that most whales observed showed apparent indifference to the oil. Other times whales were observed to radically change their swimming direction. There appears to be an offshore movement away from the oiled areas. This movement offshore could be an adaptive avoidance response to oil reflecting long-term exposure to such seeps by the population. It is clear that gray whales do travel through these areas without apparent harm.

The nature of cetacean skin suggests that they may be vulnerable to the effects of surface contact with hydrocarbons (Geraci and St. Aubin, 1979). The epidermis is not keratinized but is composed of live cells (Geraci and St.-Aubin, 1979). However, some evidence exists that the bowhead whale's skin is keratinized (Albert, 1981). Geraci and St. Aubin (1979) reported that cetacean epidermis is virtually unshielded from the environment and may react to substances such as crude oil and gas condensates in a manner similar to sensitive mucous membranes.

In addition to potential cutaneous contact with hydrocarbons, inhalation of toxic substances or plugging of blowholes by oil have been cited as possible threats to cetaceans. Certainly the former is a possibility to the extent that whales may be in the vicinity of a spill prior to the evaporation of toxic compounds. The latter event would be very unlikely to occur. The typical breathing cycle of cetaceans involves an "explosive" exhalation followed by an immediate inspiration and an abrupt closure of the blowhole (Geraci and St. Aubin, 1979). This mechanism prevents inhalation of water and should be discriminatory of gas condensates and oil; however, toxic hydrocarbon gas could be inhaled. Geraci and St. Aubin (1982) suggested that the more toxic volatile fractions of crude oil evaporate more quickly. They suggested that within 2 to 4 hours of being exposed to the air, the oil would have lost most of these vapors and the vapors in the adjacent air would be down to less harmful levels. The effects of gas condensate or gas-vapor inhalation on cetaceans may result in respiratory stress. Cetaceans that are already stressed by lung and liver parasites and adrenal disorders might be particularly vulnerable to the effects of even low levels of hydrocarbon vapors (Geraci and St. Aubin, 1982). If a spill occurred and such natural weathering factors as diffusion, dispersion of the slick, wind, and a more gradual release of the hydrocarbons (half life of 60-90 minutes for most C_6-C_{10} substances) were taken into account, it is unlikely that vapor concentrations could reach critical levels for more than a few hours (Geraci and St. Aubin, 1982). It is unlikely that cetaceans would stay in a harmful environment for any length of time.

Reduction of food sources from acute or chronic hydrocarbon pollution is a possible indirect effect of oil and gas activities. Most of the baleen whales of the North Pacific are seasonal feeders relying on the abundant food sources of the Gulf of Alaska, Bering Sea, and Arctic Ocean for nourishment, and living off stored blubber reserves while migrating and in their winter range. It is unlikely that whales would be adversely affected by changes in food resources, as they have various food habitats and are widely distributed in the lease area during their summer feeding period. Individual whales may experience indirect effects on a localized or temporary basis. Local, temporary contamination or chronic pollution that may result in reduced productivity of plankton or other important food items may stress endangered whale populations. However, this physiological stress that may occur to the whales, should oil spills interact with prey items, may be difficult to correlate with reductions in fecundity or migration fitness. Goodale et al. (1981) and Gruber (1981) reported sightings of whales and dolphins swimming and feeding in oil slicks.

Cetacean vulnerability to hydrocarbon ingestion would vary with the species, the type of hydrocarbon, and the nature of the spill. Tomilin (1955) reported that cetaceans, especially benthic feeders, have a poorly developed sense of taste. The presence of foreign bodies (such as sand and rocks) in cetacean stomachs attests to this. Thus, whales may not be able to differentiate between hydrocarbon-contaminated and uncontaminated food. However, since foreign bodies may simply be ingested with a large volume of food, the presence of foreign bodies in cetacean stomachs does not necessarily imply a poorly developed sense of taste.

The massive Nowruz slick (Iranian oil field) heavily oiled several small offshore islands (in territorial waters of Saudi Arabia), and the marine life there has been severely affected. The spill caused the death of several endangered marine mammals, turtles, sea snakes, and fish. The Water Resources and Environment Division of the University of Petroleum and Minerals Research Institute in Dhahran, Saudi Arabia, conducted autopsies on the dead animals and found they had died of respiratory stress, presumably as a result of inhaling oil (Oil Spill Intelligence Report, 1983a). Virtually the entire known Gulf population of the endangered dugong (50 individuals) has died since the Nowruz spill began.

Noise and Disturbance Effects: Refer to the Diapir Field Lease Offering (June 1984) FEIS (USDOI, MMS, 1984), Technical Paper No. 9 (Cowles et al., 1981), the St. George Basin (Sale 70) Supplemental FEIS, and the Santa Maria Basin (Sale 73) Biological Opinion (NMFS) for general information on underwater noise sources and characteristics. Those analyses are incorporated herein by reference. The response of animals to acoustic stimuli has generally shown variance in behavioral and physiological effects, depending on species studied, characteristics of the stimuli (i.e., amplitude, frequency, pulsed or nonpulsed), season, ambient noise, previous exposure of the animal, physiological or reproductive state of the animal, and other factors.

Noise, including seismic exploration, may be the most likely byproduct of normal OCS industrial activities to affect whales significantly (Fraker et al., 1982). Noise-producing activities would include: air and vessel traffic, semisubmersibles, drillships, geophysical seismic exploration, and drilling platforms. According to the NMFS Biological Opinion for the St. George Basin (Sale 70), geophysical-seismic exploration produces loud sounds which may propagate long distances from their source. Source levels of 240 to 250 decibels (dB) relative to 1 micro Pascal at 1 meter and frequency ranges of 100 to 300 Hertz (Hz) characterize common depth-point geophysical-seismic noise. Received-noise levels will be less than produced levels, and the rate of decay will depend on bottom absorption ability, the type of spreading (cylindrical or spherical), and other physical factors. The Acoustical Society of America (1980) also has estimated maximum source levels at 230 to 250 dB relative to 1 micro Pascal at 1 meter for various types of activities associated with seismic exploration. These are classified as the highest sound pressure levels associated with offshore oil and gas operations--the pulses are of short duration (generally less than 1 second) and are generated intermittently for relatively short survey periods (on the order of a few months) in any given area (Gales, 1982). Seismic surveys also may be interrupted for a period of several hours or days. Fraker et al., (1982) indicates that bowhead whales are known to produce sounds at 175 to 185 dB relative to 1 micro Pascal at 1 meter and that right whales can produce sounds at 172 to 187 dB relative to 1 micro Pascal at 1 meter.

Concern has been expressed by some cetacean researchers that, if the sound source is close enough and the intensity is loud enough, disturbance and displacement of whales, and perhaps some physical impairment of cetacean hearing, could occur (Braham et al., 1982). Possible auditory effects from high-level sounds include startle and flight (rapid escape) responses, hearing loss, and auditory discomfort due to excessive loudness (Gales, 1982). Another possible effect would be the masking of wanted sounds, such as communication. Although little information is currently available on the sounds perceived by large whales (absolute hearing thresholds in baleen whales have not been measured), it is generally assumed that most animals can hear sounds similar to those that they produce (Gales, 1982). Therefore, it is assumed that whales are able to perceive normal geophysical sounds associated with OCS activities.

It seems unlikely to expect adverse responses to even very high-pressure-noise disturbances from animals which are adapted to life in the sea, where pressure changes on the order of many atmospheres in magnitude are routinely experienced in ocean margin earthquakes (Northrop, 1972) or in diving. Adverse responses are unlikely, particularly for cetaceans that normally jump free of the surface and return with a diving splash that creates a sudden large increase in pressure. As a rough estimate, this pressure might easily correspond to that of 3 feet of water (approximately 0.1 atmosphere). This corresponds to a peak sound pressure of about 1.5 pounds per square inch, or approximately 200 dB relative to 1 micro Pascal. No steady-state sound-pressure levels associated with oil and gas operations come even close to such levels. Only impulse sources used for seismic surveys produce such high pressures. Levels for sources normally used in seismic work (nonexplosive) are estimated at 230 to 270 dB at 1 meter (Acoustical Society of America, 1980). Even for these very high pressure sources, the sound pressure level is expected to be under 200 dB at distances beyond 100 yards (Gales, 1982). It does not appear likely that marine mammals would suffer any of the nonauditory effects (pain, feeling, orientation) of noise from oil and gas operations, including seismic surveys, at distances beyond 100 yards.

Hearing damage is a cumulative process, requiring a combination of high sound level and extended periods of exposure. The damage process involves a "fatigue" of the auditory sensory nerves. These nerves are able to recover partially during periods of quiet; thus, the time sequence of exposure is important. A continuous exposure is generally more serious than an interrupted one; the latter giving intermittent periods of recovery. Malme et al. (1983) concluded that the cumulative effects of multiple seismic operations along a migration path are potentially disruptive.

Marine mammals may be expected to hear the sounds of offshore oil and gas operations out to distances as far as 185 km and even farther under highly favorable conditions of sound propagation and ambient noise (Gales, 1982). Acoustical studies and observations at offshore oil and gas platforms in Cook Inlet, Alaska, and Santa Barbara, California (Gales, 1982), indicated that platform noise was unlikely to interfere with cetacean echolocation and was expected to interfere with certain other acoustic communication in signals only very close to a platform. Observations indicated that whales either ignored or easily avoided platforms, without an appreciable change in behavior.

The effect of a sonic boom, which has a sound pulse somewhat similar to seismic pulses, on animals has recently been studied in connection with proposed launches of the Space Shuttle over offshore waters near Point Conception, California (Evans et al., 1980; Cooper and Jehl, 1981). These studies concluded that occasional peak overpressures in air of 30 pounds per square foot, which corresponds to about 184 dB relative to 1 micro Pascal at 1 meter, would have no significant physiological effect on the marine mammals of the area--either pinnipeds or cetaceans.

(b) Effects on Gray Whales: Gray whales are one of eight endangered cetaceans that are frequently observed in the North Aleutian Basin lease sale area. Potential effects on gray whales may result from several noise-producing activities such as drilling platforms, drillships, semisubmersibles, and air and vessel traffic.

Reeves (1977) identified potential conflicts of disturbance sources to breeding gray whales in Baja, California. Consiglieri and Braham (1982) reported that the use of Laguna Guerrero Negro as a calving area for gray whales declined for 6 years and was not used for a subsequent 7 to 8 years from intensive use by Mexican salt barges and due to the channel dredging from 1957 to 1972. When the dredging stopped (by federal action to protect the whales), the animals gradually returned to the lagoon in their original numbers over a 6-year period. Subsequently, Swartz and Jones (1978) reported that, although boat traffic in the Laguna San Ignacio (a gray whale breeding habitat) increased 30 percent over the previous season, boat activity did not affect large scale movements or distribution of gray whales. Although localized avoidance behaviors were observed, gray whales became accustomed to boat traffic as the period of exposure to such disturbance increased (Swartz and Jones, 1978). Geraci and St. Aubin (1979) concluded that species such as the gray whale seem to coexist well with human activities, and most animals became accustomed to low-level background noise such as that associated with most ship traffic and petroleum activities. Shipping records show that more than 28,000 vessels arrive in the coastal waters of northern and central California each year: the southern portion of the gray whale range. (This figure does not include arrivals at the major port of Los Angeles). At least 7,263 marine fishing vessels were registered in California from 1976 to 1977 (Oliphant, 1979), and probably more than 24,000 marine fishing vessels operate throughout the gray whale's range in Alaska, Washington, Oregon, and California. Additionally, large numbers of recreation boats and other sources of underwater noise subject this species to noise effects. In spite of the large amount of acoustic energy introduced throughout their range, the gray whale population recovery has been dramatic. Current evidence suggests that the gray whale population has not responded adversely to existing sources of disturbance and, therefore, may not be particularly sensitive to many types of noise associated with offshore petroleum industry operations.

Available information indicates that gray whales display a high degree of tolerance to geophysical seismic noise in certain areas. Extensive geophysical exploration has been conducted off the California coast for more than 35 years, yet during that same period the gray whale has recovered to population levels at or above precommercial whaling levels. Reilly (1981) estimates that over the last 13 years the population has been increasing at an average annual rate of 2.5 percent, in spite of increased vessel traffic, offshore mineral exploration (including deep and shallow seismic activities) and development, and a Soviet harvest of 1.2 percent of the gray whale population. This rate of growth and the apparent fitness of the population are not consistent with the hypothesis that geophysical exploration may be damaging to the gray whale population.

A recent Task Force Report on Geophysical Operations (1982) submitted to the executive officer of the California State Lands Commission has increased the understanding of the effects of geophysical seismic noises on marine mammals.

Among other things, this report determined that no evidence was found to suggest that airguns and other nonexplosive acoustic sources cause injury to marine mammals, including gray whales. As stated in the Task Force report, NMFS believes that "sufficient information is available in the literature to conclude that geophysical exploration does not result in physical harm or mortality of marine mammals in the vicinity of operations." Additionally, this report determined that geophysical exploration off the California coast does not constitute "harassment" of migrating gray whales, as defined under the Endangered Species Act. The NMFS determination also may apply here, since gray whales, when in the North Aleutian Basin, are primarily in a migratory mode.

Experiments were conducted during the gray whale migration off California using both a single airgun and an airgun array (Malme et al., 1983, 1984). Estimated peak sound levels produced in the areas of the whales were 180 dB ±10 dB relative to 1 micro Pascal at 1 meter. No reactions by mother/calf pairs (April/May experiments) were noted during line runs of seismic airgun arrays at distances of 5 to 83 kilometers. The whales came as close as 5 kilometers to the airguns before some behavioral changes were noted. Some changes in the swimming patterns of the cow/calf pairs were observed, the most obvious at the 1.6 and 0.84 kilometer test ranges. The whale groups were seen to change direction (orienting south), to exhibit confused swimming, to move inshore into the surf zone, and to mill about for varying lengths of time--often followed by rapid swimming to avoid the source area. On four occasions, whales were observed moving into the surf zone and within the sound shadow of a nearshore rock or outcropping. It is important to note that, in each of these cases, the airgun array was turned on when whales were within 1 kilometer; therefore, they were immediately exposed to a level greater than 160 dB. This dramatic response could, therefore, be considered a startle response. The distances between the airgun array vessel and a group when it showed a response, obvious at the time of observation, were consistently on the order of 2 kilometers. The distance at which these groups resumed normal migration ranged between 3.6 and 4.5 kilometers.

Experiments and single-gun measurements were conducted at 5, 1.6, 0.84, and 0.15 kilometers. Obvious swimming behavior changes were observed at ranges from 640 to 900 meters. The behavior observed was similar to that seen previously for the full array at the 1.6-kilometer range. However, the number of observations obtained with the single airgun was limited by the decline in the migration density. In addition, it should be noted that the above study used a deep seismic system on both the single-airgun and array tests. This system is far more powerful than the relatively quiet, high resolution, shallow systems which are predominantly used in post-lease activities.

Ljungblad et al. (1982) reported observing normal behavior of gray and fin whales in the Chukchi Sea during exposure to geophysical exploration sounds from a vessel using an airgun array at a distance of 36 kilometers. Behaviors observed included feeding, and a cow nursing a calf. No reactions to audible airgun noises were observed. Peak levels were estimated to be approximately 150 dB relative to 1 micro Pascal at the location of the whales.

The level of effects on endangered species may range from negligible to moderate, depending on the species and the population's well-being. It is anticipated that the level of seismic activity associated with the lease sale area would depend upon the number of exploratory/delineation wells and production platforms installed. It is anticipated that, in the North Aleutian Basin, seismic activity will involve 12 sites and an estimated 1,362 trackline miles. The seismic surveys probably would begin about 1 year prior to drilling, and most activity probably would take place from May through September, with approximately 1 week per survey site. It is anticipated that an additional 28,000 trackline miles (low resolution) would be shot by industry between 1986 and 1991 in the North Aleutian Basin. This compares to a total of approximately 61,000 trackline miles (low resolution) already acquired by industry between 1964 and 1983 in the North Aleutian Basin. In the event that economical reserves of oil and gas were discovered, two 210-kilometer pipelines would be installed between the production wells and an onshore terminal. Prior to pipeline installation, an estimated 4 miles of high-resolution seismic surveys would be required for each mile of the planned offshore pipeline route. This represents an additional 520 high-resolution trackline miles, which probably would be run concurrently with drilling discoveries or in the first 1 or 2 years following a discovery.

In summary, geophysical seismic activities associated with the lease sale are not expected to adversely affect endangered whales. Behavioral responses (brief flight response, changes in surface and dive times, and temporary changes in migration routes) can be expected, although only a few animals may be temporarily disturbed by seismic activities. These short-term responses are not expected to preclude a successful migration, disrupt feeding or mating activities. The cumulative consequences of seismic activities throughout the migration route are potentially disruptive (Gales, 1982). However, population fitness is not expected to be altered due to exposure to seismic activities, and effects to the population should be minor.

Malme et al. (1983) also conducted playback experiments during the gray whale migrations off central California. The playback tests demonstrated that gray whales have hearing thresholds below those of the prevailing ambient-noise levels in the observation area (central California). Whales exposed to drilling-platform, helicopter, and production-platform stimuli showed avoidance responses in which migration tracks (routes) were deflected away from the source of the playback stimulus. The sound levels at this range were about 111 to 118 dB relative to 1 micro Pascal at 1 meter. An annoyance reaction was considered to have occurred since an avoidance of the source area (playback stimulus) occurred out to ranges of about 250 meters from the drilling platform and the helicopter sounds. Avoidance reactions to drillship sounds began at about 2.7 kilometers from the source. A decrease in swimming speeds occurred in reaction to these noises. Other industrial-noise stimuli with smaller short-term fluctuation levels, but with equal or somewhat louder sound levels, did not produce a detectable annoyance reaction. The behavior observations for the playback stimuli suggest that only the loudest, most raucous industrial-noise sources have an observable behavioral effect on migrating gray whales.

Of the project phases (exploration, development, and production), the development phase probably would generate the greatest amount of noise and disturbance which could be transmitted into the whales' environment. Disturbance responses due to air traffic would be most likely to occur during this phase. Noise from petroleum related boat traffic, drilling, or geophysical exploration may be substantial in other phases as well. If the degree of tolerance to loud seismic noise, as demonstrated elsewhere by whales, is used as an index, disturbances due to activities associated with the lease sale are unlikely to significantly affect whales (see USDOI, MMS, St. George Basin [Sale 70] FEIS and Supplemental FEIS, 1983). Gray whales have been shown to temporarily deflect their migration route in the presence of seismic activities. During the production phase, noise from construction of pipelines to Herendeen Bay or tankering to and from Balboa Bay may affect gray whales. Noise from tankering in an area where gray whales have previously not been exposed to such noise may cause them to change their migratory routes. Migratory behavior expressed in California indicates that such a change would probably be short term; and previous migratory routes would be used once whales become familiar with the nonthreatening noise produced by oil tankers. Support boats from Unalaska would reach drilling rigs at least once every 2 days during the exploration phase. The rigs would be served at least once a day by helicopter support flights based in Cold Bay. During the development and production phases, tanker loading would occur every 5 to 7 days in Balboa Bay for oil loading and every 10 to 12 days for gas loading. In the development phase, each platform would be serviced at least once a day, if not twice a day, by workboats from Unalaska. The workload scheduled would be on an as needed basis during production. Helicopter support trips would average two to three trips per day during development and one trip per day during production (except during crew rotation).

The potential for harm to whales from contact with spilled oil may result from cutaneous contact, inhalation of toxic vapors and/or ingestion of hydrocarbons. The nature of cetacean skin suggests that they may be vulnerable to the effects of surface contact with hydrocarbons (Geraci and St. Aubin, 1979). Geraci and St. Aubin (1979) reported that cetacean epidermis is virtually unshielded from the environment and may react to substances such as crude oil and gas condensates in a manner similar to sensitive mucous membranes. Gray whales are known to pass through natural oil seeps with no direct evidence of acute reactions. In 1969, the entire northward migration of gray whales passed through or near the area contaminated by the SantaBarbara Channel oil spill, yet the number of gray whale strandings was not significantly different from previous years (Brownell, 1971). Gas chromatograph analysis of tissues from gray whales stranded in the vicinity of the oil spill did not indicate the presence of crude oil, so none of the strandings were linked to the oil spill. Geraci and St. Aubin (1982) conducted a 3 week field program to observe the reactions of migrating gray whales to various concentrations of oil films, from thick oil to small patches and light sheens. On several occasions, aerial observers noted that the whales, when approaching oil, changed their swimming direction; however, some whales would swim through the oil, modifying their swimming speed. In oiled waters, the whales seemed to spend less time at the surface, blowing less frequently but at a faster rate.

Baleen whales face a peculiar threat from oil spills in that the hair-like fringes of the baleen can become fouled, even after only a brief exposure to oil. Geraci and St. Aubin (1982) monitored water flow through gray whale baleen plates before and after contaminating them with three types of crude oil. Light- to medium-weight oils caused transient changes in water flow, which returned to normal within 40 seconds. Repeated oiling of the same preparation did not produce an additive effect. A heavy residual oil (Bunker C) restricted water flow for up to 15 minutes. Thereafter, although the plates were still noticeably fouled, normal patterns were restored. Geraci and St. Aubin (1982) found that light oils were undetectable on the baleen plates after 1 hour of flushing, whereas the heavier fractions persisted for 15 to 20 hours. Results from these experiments indicated that crude oil does not irreversibly obstruct water flow through gray whale baleen and that filtering efficiencies might be jeopardized for less than 24 hours after a feeding foray in oil. However, prolonged impairment caused by repeated fouling may affect feeding activity, possibly diminishing blubber stores which would be essential for lactating females and during migration. The probability of such fouling and effects on feeding efficiencies would be directly linked to the probability of spills and whale contact with such spills.

If spilled oil was to reach the bottom sediments, gray whales may ingest some oil when feeding. Gray whales predominantly feed on benthic amphipods which are sucked from the bottom sediments. Oil can reach bottom sediments by various mechanisms. One is direct mixing of oil with sediments by wave action in shallow water and subsequent transport to deep water by density currents. Sorption onto particulate matter suspended in the water column, with subsequent sinking, can also occur in deeper water. Another mechanism for sedimentation of oil is uptake by zooplankton, packaging as fecal pellets, and the subsequent sinking of the pellets. Heavier molecular weight hydrocarbons will typically reach ocean sediments in proportion to the supply in surface waters. Once in the sediments, hydrocarbons are taken up by benthic organisms with greater uptake of the heavier, relative to the lighter, molecular weight aromatic compounds. Howarth (personal communication) stated that available evidence suggests that the dilution of oil contaminated sediments following a spill in an offshore area (i.e., Georges Bank) is sufficient to keep oil concentrations low enough so as to cause little harm. Therefore, oil transported and incorporated into the sediment by sorption or fecal pellet transport will probably not reform into the thickened, weathered oil that gray whales may incidentally ingest. Transport of heavy, weathered oil from the intertidal wave zone into deeper water probably will not persist in a localized area for long periods of time (over 2 years). Observations of oil in the sediments 6.5 years after the Metula spill indicated that the entire area below the low tide line was free of oil. The oil that persisted in the sediments was above this area (Gundlach et al., 1982). Therefore, the data do not support the theory that gray whales are likely to ingest heavy, weathered oil that has settled to the bottom. It is not anticipated that gray whales will ingest heavy, weathered oil but may ingest oil contaminated amphipods and thereby indirectly ingest oil in some form. In the worst possible case, the flora and fauna will return to a normal state after about 2 or 3 years in areas exposed to waves, and after 10 to 15 years in protected areas.

Kuhnhold (1978) indicated that after the Argo Merchant oil spill significant contamination was found in pelagic crustaceans, especially the dominant species of copepods. The spill of Bunker C from the USNS Potomac resulted in copepods and amphipods with ingested oil and microbial degradation of the oil not occurring during the first 2 weeks (Petersen, 1978). In laboratory and field experiments of Prudhoe Bay crude and indigenous arctic benthic amphipods, amphipods avoided recolonizing oil contaminated areas. Sublethal behavioral changes in feeding, movement and burrowing activities were also evident. The amphipods selectively burrowed in unoiled areas and recolonization of oiled areas was significantly different in species composition from that formed in reference unoiled areas (Busdosh et al., 1978). Therefore, in summary, gray whales could be affected by hydrocarbons if it fouls baleen, is ingested, kills prey, or modifies behavior.

Gray whales enter the Bering Sea through Unimak Pass from March through June on their northbound migration and from October to December on the southbound migration. The northbound migration (spring) route generally follows within 3 kilometers of shore along the northern shore of the Alaska Peninsula and around Bristol Bay. A secondary migratory route proceeds directly northwest from Unimak Pass toward the Pribilof Islands and then on to more northerly summer feeding grounds. A small portion (several dozen) of these whales has been observed annually around the Pribilof Islands from April through July. The southbound migration (fall) from the summer feeding areas generally begins in October. Whales migrating through the St. George Basin pass in a broad front across the shelf from Nunivak Island to Unimak Pass. Gray whales generally follow the same nearshore migratory pathway during both the spring and fall migrations through Bristol Bay. The areas along the gray whale migration route and the summer feeding areas with the highest conditional spill probabilities are: (1) Resource Area 7 (Port Moller)--from Spill Point D1, greater than 99.5 percent, and from Spill Point B3, 35 percent; (2) Sea Target 23 (Port Moller)--from Spill Point B3 greater than 99.5 percent; (3) Sea Target 4 (Izembek Lagoon)--from Spill Point A1, 3-percent probability of contact; and (4) Resource Area 8 (Unimak Pass) -- from Spill Point E24, greater than 99.5 percent.

Tables G-1 to G-9, Appendix G, show conditional probabilities of an oil-spill risk to certain areas (the probability of spills hitting certain areas if they originated at specific points). Conditional probabilities assume that oil has been released at a hypothetical spill location. Such percentages do not reflect the probability of oil actually being released at that location, but rather the probability of oil, if released there, making contact with a specific resource area or sea target. Unless otherwise noted, combined probabilities referenced in this discussion refer to spills greater than or equal to 1,000 barrels and for a simulated 10-day spill duration. For the following discussion, these terms and associated probabilities relating to the OSRA will be used: very unlikely (less than or equal to 10%), unlikely (from 11 to 30%), likely (from 31 to 60%), and very likely (greater than 60%). Refer to Section IV.A.3. for descriptions of spill locations, resource areas, and sea targets. Under the proposal, if a spill occurred at any of the spill sites located within the lease sale area, there would be a wide range of probabilities (greater than 99.5% to less than 0.5%) that oil would contact some portion of an endangered whale feeding habitat and/or migration route within 10 days. However, most spill probabilities are less than 0.5 percent (very unlikely). Even though the spills listed are hypothetical, this does not negate the fact that should an oil spill occur, the chance of oil contacting a whale habitat is likely. The probabilities (Appendix G) express the chance of an oil spill contacting a whale and/or habitat when it is in that particular resource area or sea target.

It is anticipated that disturbance of benthic fauna due to the construction of pipelines in the proposed lease area would not have significant effects on the feeding habits of the gray whales, since their primary source of prey is taken in the Chirikov Basin.

During the spring and fall migration, between 13,000 and 15,000 gray whales enter the Bering Sea primarily through Unimak Pass. The spring migration has a 15- and 23-percent probability of being contacted within 10 days from Spill Points A1 and F1, respectively, at Sea Target 3, while Sea Target 4 has a 33-percent probability of contact. Sea Target 23 has a greater than 99.5-per-cent-contact probability from Spill Point B3 within 10 days. The spring and fall migrations have a 9-percent probability of contact from Spill Location P20 and greater than 99.5 percent from Spill Point E24 at Resource Area 8 (Unimak Pass).

The gray whale migratory route, from Unimak Pass along Bristol Bay, has a greater than 99.5-percent probability of contact at Resource Area 7 (Port Moller); Port Moller/Nelson Lagoon is used during the summer as a feeding area by gray whales. Ugashik Bay also is used as a summer feeding area. Between late May and early July 1982, over 1,000 gray whales were observed in the bay (Gill and Hall, 1983). Land Segments 12 and 11 (Port Moller/Nelson Lagoon) have a 6- and 19-percent probability, respectively, of contact within 30 days from Spill Points B1, B2, and D1. The final probability (including the probability of an oil spill occurring) of an oil spill contacting Biological Resource Area 7 within 10 days for a 1,000-barrel-or-greater spill is 20 percent over the life of the field. For Sea Target 23, there is a 22-percent probability of contact.

The probability of oil spills coming in contact with gray whales or their habitats within the North Aleutian Basin is generally less than 0.5 percent. A few whales may die either due to cow/calf separation or increased stress to diseased individuals as a result of an oil spill, which would represent a worst case. The probability of a 100,000-barrel-or-greater spill (representing the worst case) occurring over the life of the field is 3 percent, as compared to a 61-percent probability of a 1,000-barrel-or-greater spill occurring.

Based on a statistical projection of 0.94 spills of 1,000 barrels or greater, it is assumed that whales could be exposed to one spill in this category over the life of the field. There is a 61-percent probability of one or more of these spills occurring. The risk of oil spills from tankering (44%) is greater than that for platforms (30%). If a spill occurred during the time period when whales were in the area, Port Moller/Nelson Lagoon has the highest probability of contact (greater than 99.5%). Localized effects to summering gray whales could be moderate due to loss of habitat and a possible loss of calves. Since only a small portion of the gray whale population uses this area during the summer, regional effects would be minor.

SUMMARY (Effects on Gray Whales):

In summary, gray whales are affected by geophysical seismic activities and aircraft and vessel traffic. Reactions are generally short term and temporary in nature consisting of movements away from the sound source and deflections in the migratory route for sound levels greater than 160 dB. It is not anticipated that a successful migration would be precluded by oil and gas industrial-noise activities in the North Aleutian Basin during exploration, and effects would be minor. Gray whale reaction to an oil spill may include abandonment of a summer feeding habitat and/or deflection of a migratory route away from an oil contaminated area. The gray whale population completed a successful migration in 1969, even though many whales passed through the Santa Barbara oil spill. It is possible that an oil spill/gray whale interaction would not significantly adversely affect whales migrating through the area, although effects could be minor.

CONCLUSION (Effects on Gray Whales):

The potential effects on gray whales from noise disturbance and oil spills associated with the proposal are expected to be MINOR.

CUMULATIVE EFFECTS (Effects on Gray Whales):

In this discussion, the term cumulative effects as defined in NEPA is "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably forseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Factors which may produce cumulative effects on endangered whales include those projects listed in Section IV.A.6., proposed or future state and federal offshore oil and gas lease sales, and other nonpetroleum industry sources of oil spills or disturbance.

Certainly of concern is the cumulative effect of oil spills and other pollution associated with the projects described in Section IV.A.6. Cumulative effects would increase if all the potential developments took place, especially for gray whales, which are known to migrate through several proposed lease areas (i.e., southern and central California, Gulf of Alaska/Cook Inlet, St. George Basin, and Chukchi Sea). Cumulative indirect effects on endangered whales also will occur if future development takes place in important feeding areas to the south and north of this proposed lease sale area, primarily from Kodiak Island to the Bering Strait. As suggested previously, the long-term, ecosystem wide, cumulative effects of chronic pollution will be of concern, since changes in total ecosystem productivity are a possibility. Before development and production begin, an EIS will be prepared that will more closely analyze the cumulative effects on endangered cetaceans.

Cumulative acoustical disturbance associated with proposed state and federal lease sales will affect endangered cetaceans, although habituation to acoustical disturbance is a distinct possibility. Responses to the increased ambient noise levels would be similar to those described in the proposal but may last several years instead of the season or two that would be expected in the proposal. For the gray whale, offshore development associated with the proposal may constitute a minor portion of the total acoustical stimuli to which they are exposed. If several proposed lease sales yield large discoveries of oil and gas (intensive production activities, resultant increases in human activity, increased localized or shipping-corridor disturbance, and increased pollution), then cumulative effects from noise disturbance could be moderate. Cumulative industrial disturbance, especially during migratory periods, may be greatest at locations where tanker traffic would be focused due to several lease sales, (i.e., Unimak Pass) which may result in alterations of migratory routes and/or timing or abandonment of feeding areas.

Cumulative oil-spill effects also would be greatest at locations where tanker traffic is focused, i.e., Unimak Pass and Balboa Bay. Table G-10, Appendix G, considers cumulative spill probabilities from spills of 1,000 barrels or greater occurring over the expected production life of the lease area. Cumulative probabilities cited incorporate the conditional probabilities, the likelihood of discovering oil, and assume the development assumptions given in Section IV.A. and therefore reflect the overall probability of oil spills occurring and contacting particular locations. Oil-spill risks from the proposal, existing leasing, and existing tankering show probabilities for Port Moller/Nelson Lagoon (24%) and Port Heiden (5%), which are utilized by whales during their summer feeding period and during their migrations. Other areas at risk include Sea Target 23 (23%), St. Paul Island (63%) and St. George Island (81%). There is a 1 percent chance of a 100,000-barrel-or-greater spill contacting the Port Moller/Nelson Lagoon area and 11 percent chance of contacting Unimak Pass.

The estimated occurrence of oil spills would increase from 0.94 for the proposal to the most likely number of 23 spills for the cumulative case (Alaska OCS only), with a 100-percent chance of 1 or more spills of 1,000 barrels or greater occurring. The most likely number of spills of 100,000 barrels or greater is one. In the current transportation scenarios, all produced oil from Sales 57, 83, 107, 70, 89, and 100 would be transported through Unimak Pass to market. Oil produced from sale 92 would be piped across the Alaska Peninsula to a transshipment facility in Balboa Bay on the southern shore of the Alaska Peninsula. Oil then would be transported from Balboa Bay to market. If the projected mean-conditional resources for the Bering Sea are discovered and produced, 3.6 spills of 1,000 bbls or greater are expected to occur in the Unimak Pass area as oil is tankered to market. These nearshore waters provide habitats and a migratory corridor for gray whales. The Alaska Department of Fish and Game (1983) prepared maps for the Bristol Bay Cooperative Management Plan which indicate that gray whales use several of these areas for feeding and migrating (i.e., Morzhovoi Bay, Cold Bay, Pavlof Bay, and Wide Bay). Therefore, there are increased risks to gray whales from potential oil spills and increases in ambient-noise levels. In a cumulative scenario, effects on gray whales from oil spills would be moderate, as compared to minor for the proposal.

<u>Conclusion (Effects on Gray Whales)</u>: The cumulative effects of oil spills and noise disturbance on gray whales would be MODERATE, as compared to MINOR for the proposal.

(c) <u>Effects on Bowhead and Right Whales</u>: The right whales are the closest living relatives of the bowhead whales. The right whale's appearance and behavioral repertoire are very similar to those of the bowhead whale (Wursig, personal communication). The similarities in behavior between the bowheads and right whales have been described by researchers familiar with both species (Wursig et al., 1982). Therefore, since the effects of geophysical seismic activities and oil-spill contact have been observed on bowhead whales, but not on right whales, the knowledge gained from these observations of bowhead whales can be extrapolated to effects on the right whale. Until recently, sensitivities of endangered whales to seismic disturbance were largely unknown for most species. In recent years, however, the expanding data base has increased our understanding of the effects of geophysical seismic noises on cetaceans, and information is now available on gray and bowhead whales. Two right whales were observed near St. Matthew Island in 1982; this was the first sighting of right whales in the Bering Sea for many years. Due to their low numbers, it is unusual to see right whales in the Bering Sea.

Gales (1982) postulated that most whales can hear sounds similar to those they produce. The majority of bowhead vocalizations center around 200 Hz but some vocalizations extend perhaps as high as 6 kHz (Ljungblad et al., 1980). Norris and Leatherwood (1981) predicted an upper hearing threshold of approximately 12 kHz for bowhead whales. They also concluded that the available evidence supports a tentative conclusion that the auditory response capabilities of bowhead whales range from high-infrasonic or low-sonic to low-ultrasonic or high-sonic frequencies. Although bowhead whales appear to be most sensitive to low-frequency noises (i.e., low-resolution seismic surveys), they also may be sensitive to high-resolution seismic surveys which utilize high-frequency-source levels.

Richardson et al. (1984) has studied the reactions of summering bowhead whales to oil and gas associated noise disturbance in the Canadian Beaufort Sea for the past several years. Available information indicates that the potential zone of influence of most drilling noises may be limited to an area near the drill site (Malme and Mlawski, 1979). All offshore drilling produces underwater noise mainly below 1,000 Hz (Richardson et al., 1983). Underwater noise from drilling usually can't be distinguished from the noise associated with the support craft. Bowheads have been observed within 4 to 20 km of drillships in the Canadian Beaufort Sea. The whales' activities appeared to be characteristic of undisturbed whales, although a few exceptions occurred.

Industry personnel have reported whales from 0.2 to 5 km from drillships (Richardson et al., 1984). Therefore, bowhead whales have been observed in areas ensonfied by drillships and they were engaged in normal activities. These sightings do not prove that whales are unaffected by drillships, as it is unknown how many more bowheads might have been present had drillships been absent (Richardson et al., 1984). Play-back experiments (received levels of 100-113 dB) showed that some bowheads reacted to drillship noise at intensities similar to those that would be found several kilometers from a real drillship, although not strongly.

Observations of bowheads from 1980-83 near island construction and active dredges indicate that some bowheads occasionally tolerate noise levels associated with these activities (Richardson et al., 1984). In 1983, a few whales remained near the Amerk dredging operations for a couple of days and in 1980, many whales were in the vicinity of the Issungnak dredge site for approximately 17 days. Playback experiments, in the Canadian Beaufort Sea, showed that bowheads responded to the onset of strong dredging noise even when the noise level was gradually increased. Some whales moved away from the noise source and others oriented away.

Experiments with bowheads indicate that they react strongly to close approaching vessels of any size. Reactions began when boats were as far away as 4 km; by 2 km traveling away from the approaching vessel was more pronounced. Other behaviors consisted of changes in surfacing and respiration patterns and increased spacing within grouped whales. Orientation away from the boat persisted for some time after the boat had passed and sometimes even after the engine had stopped. Reactions to boats were stronger than to any other type of disturbance tested, however, the flight response did not persist for long after the boat had moved away. The scattering of grouped bowheads continued longer than the flight reaction which indicated that some degree of social disruption occurred.

Reactions to aircraft were evaluated mostly by assessing bowhead responses to the Islander observation aircraft. Bowheads seem more sensitive to aircraft than are other species of whales, but sensitivity to aircraft varies with season, whale activity, and water depth (Richardson et al., 1984). Bowheads engaged in socializing appear less sensitive to aircraft than are bowheads engaged in other activities. Reactions to the observation aircraft were conspicuous when it was below 457 meters above sea level, occasionally at 457 meters, and seldom at 610 meters. Under near calm conditions, the aircraft is usually audible for less than 30 seconds when monitored by hydrophones at 9 and 18 meters deep (Greene, 1982). Underwater noise is more detectable farther ahead, behind, and to the side of a passing aircraft, and when the water is shallower than when it is deep (Greene, 1984). No reactions to the two helicopter overflights were detected but conditions were not favorable for detailed behavioral observations.

Fraker et al. (1981) observed a group of seven bowheads within 13 kilometers of a seismic-exploration vessel, and they showed no obvious disturbance of behavior. Surface times, intervals between blows, and blows per surfacing were normal. The sound level at the whale's location was stated to be at least 135 dB relative to 1 micro Pascal, and possibly as high as 146 dB. On eight occasions in 1980 to 1982, Richardson et al. (1983) observed bowhead behavior in the Canadian Beaufort Sea in the presence of noise from seismic operations. The source level was 248 dB, and the received noise levels at 6 to 8 kilometers were approximately 141 to 150 dB, respectively. There was no clear evidence that these whales attempted to move away from the seismic ships. The bowheads generally continued to produce their usual types of calls in the presence of distant seismic sounds, and they did not swim away from seismic vessels operating 6 kilometers or more away. In addition, data on distribution of whales indicate that bowheads continue to return to summering areas where seismic exploration has been in progress each summer for many years (Richardson et al., 1983).

Reeves and Ljungblad (1983) observed bowheads on 14 geophysical-monitoring-survey flights in the Alaskan Beaufort Sea. Whales seen as little as 9 kilometers from active geophysical operations were not observed to vacate the area or to display avoidance behavior. The observations did, however, suggest some changes in behavior related to seismic sounds. The mean surface time of adults in the presence and absence of seismic sounds was 1.67 ±0.84 minutes standard deviation, and 1.36 ±0.58 minutes standard deviation, respectively; this difference is statistically significant. However, no significant differences were detected for mean dive times, mean blow intervals, or mean number of blows per surface period in the presence and absence of seismic sounds. These same researchers hypothesized that an observed "huddling" of whales may have been related to geophysical-exploration sounds.

Reactions of summering bowheads to the presence of seismic noise has been studied for the past several years (Richardson et al., 1984). Reactions were generally short term consisting of a reduced number of blows per surfacing, reduced duration of surfacing and dives, and increased intervals between successive blows. Observations of bowheads, 6 to 99 km away from active seismic vessels, showed them engaged in normal activities (received levels 158 dB relative to 1 micro Pascal). Limited data suggests that bowheads react strongly when firing begins and move away at increased speeds. They can apparently determine the direction from which intense noise impulses are arriving and move in the opposite direction. However, strong avoidance reactions do not appear to occur unless the seismic impulses are very intense. Although specific behavior in the presence and absence of seismic noise may be variable, the above data suggest that bowhead whales (and possibly right whales) are generally tolerant of geophysical seismic noise, at least in ranges of 6 to 8 kilometers, but show avoidance behaviors at ranges of less than 5 kilometers. Richardson et al. (1983) postulated that the apparent inconsistencies in these results are a product of two main factors: (1) differences in the responses of the whales to seismic noise on different occasions, including possible habitation to ongoing seismic activities; and (2) difficulties in detecting subtle behavioral effects in the presence of great natural variability in behavior. Subtle behavioral responses (brief flight responses or temporary changes in migration routes) are possible, although only a few animals would be expected to be temporarily disturbed by seismic activities. Direct injury (physical impairment of hearing), even at close range, is unlikely.

Bowheads were numerous in the Canadian Beaufort Sea around the main industrial area in 1976, 1977, and 1980, but not in 1978, 1979, 1981-83. Given the presence of many whales in the area in 1980 does not indicate a clear trend of decreasing bowhead use after the onset of industrial activity in this area since 1976. However, industrial activity has increased since 1976 so it is possible that industry activity has begun to affect bowhead distribution in this area since 1980 (Richardson et al., 1984). From 1980-82 there was progressively less whale use of areas where drilling, dredging, and island construction occurred, but there was no similar trend of decreasing use of the larger area where seismic exploration occurred. In 1983, generally fewer whales were found inside the areas of seismic exploration than in 1980-82 (Richardson et al., 1984). These observations suggest that seismic exploration has not caused large scale abandonment of parts of the summer range. Nothing is known, however, about the recurrence of specific individual whales in places where they were exposed to seismic noise in previous years.

In summary, bowhead whales have indicated a tendency to not react to seismic testing when the source sound is further than 6 km from the whales and the received levels are lower than 150 dB. Reactions to aircraft seldom occur if planes remain at an altitude of 457 m or higher above the whales. Vessels approaching whales generally closer than 3 to 4 km will result in bowhead whales moving away from the approaching boat. A weak tendency to orient away from drillship- and dredge-noise playback occurs.

The anticipated levels of geophysical seismic activities associated with the proposal would be the same as described in the gray whale section. Data from the NMFS Platforms of Opportunity Program (1966-1980) indicate that only three bowhead whales have been sighted in or adjacent to the North Aleutian Basin lease area (Hameedi, 1982). Bowhead whales are most likely to be in the lease area during the winter, when heavy ice years force them south of their traditional overwintering areas. Since geophysical seismic activities are most likely to occur between May and September, bowheads would not be in the area;

therefore, effects would be negligible. The North Pacific right whale population probably numbers around 200 individuals. Historic whaling records indicate that right whales were most abundant in the Gulf of Alaska during the summer, but smaller numbers were found between the Pribilof Islands and Bristol Bay.

The most recent sighting of a right whale was in an area northeast of the Pribilof Islands (see Sec.III.B.4). Right whales may be biologically extinct; therefore, effects from seismic activities may interact with a larger portion of the population in their historic summer grounds. If right whales are in the area during seismic activities, effects could range from minor (short term) to moderate. Bowhead whales (the closest living relatives of right whales) have shown some avoidance behavior to geophysical seismic activities at ranges of less than 5 kilometers, but can be classified as generally tolerant at ranges farther than 6 km. Considering the wide range of habitat available to right whales and the general paucity of sightings in the lease area, interactions between right whales and seismic activities are not anticipated. However, if negative reactions occur due to a right whale/noise-producing-activity interaction, effects to the local population may result in moderate effects to the regional population, depending on what portion the local population is of the regional population. Considering that most right whales have been sighted in the Gulf of Alaska, and the tolerance to seismic activities displayed by bowhead whales, it is most likely that effects to the right whale regional population would be minor.

Reactions to effects from oil spills on right and bowhead whales would probably be similar to those described in the previous section. Concern has been expressed that bowhead skin and eyes may be sensitive to oil contact, and toxic effects may occur if oil globules are swallowed. It is difficult to evaluate these concerns, since no relevant experiments have addressed them. At present, these comments should be viewed as concerns rather than demonstrated effects of oil. In laboratory studies of bowhead whale skin, Albert (1981) showed that crude oil adhered to preserved bowhead whale skin, particularly roughened skin areas. He also indicated that only two out of the six whales examined had roughened skin areas (skin lesions). The lesions examined appeared to be confined to the external layer, with little or no degenerative changes occurring in the deeper layers of the epidermis. Geraci and St. Aubin (1979) reported that cetacean skin was not keratinized but composed of live cells and therefore virtually unshielded from the environment. Albert (1981), however, found evidence of keratinization in bowhead skin. Concern has been expressed that oil globules which may be swallowed could block the entrance to the third stomach. Albert (personal communication) indicated that this opening can be as large as 5.1 centimeters (cm) (inside diameter). Examinations of the esophagus (Albert, 1981) indicated that this opening is generally around 3 cm (inside diameter). It does not seem likely that oil globules large enough to block the entrance to the third stomach would pass through the esophageal opening. The largest food item recovered from a bowhead stomach was an 8-gram snail with dimensions of 3.4 cm x 2.6 cm (Lowry and Frost, 1984), which indicates that these openings can stretch to accommodate larger items.

Another potential direct effect of spilled oil on baleen whales is the fouling of baleen plates, which results in a subsequent decrease in feeding efficiency. The probability of such fouling and effects on feeding efficiency is directly linked to probabilities of spills and whale contact with such spills. Studies by Braithwaite et al. (1983) showed that the filtration efficiency of bowhead whale baleen could be reduced, but not to a high degree, after contact with crude oil in the water. He found, in flow through experiments, that on an average, reduction of bowhead baleen filtering efficiencies was between 5.9 to 11.3 percent. Bowhead baleen plates fouled with 10 millimeters of Prudhoe Bay crude oil showed a decrease in filtering efficiencies that persisted for as long as 30 days; but 8 hours after fouling, the filtering efficiencies began to increase because the baleen hairs did not tend to stick to one another as much. These observations essentially alleviate the concern that crude oil would irreversibly obstruct water flow through baleen. Prolonged impairment caused by repeated fouling may affect feeding activity and, therefore, possibly diminish blubber stores which would be essential for lactating females and during migration. However, the eventual population response of endangered whales as a result of baleen fouling would be directly related to the number of animals fouled. Cumulative long-term effects to baleen integrity and bowhead fitness may occur if bowhead whales persist in feeding in areas that are oil contaminated.

Sea Target 13 has the highest probability (23%) of oil contacting bowhead whales when they might be in the lease area. Other probabilities range between 15 to 30 percent, but generally are less than 0.5 percent. Since bowhead whales infrequently enter the North Aleutian Basin (mainly during heavy ice years), the actual probability of them contacting spilled oil would be less than indicated in Appendix G. Therefore, effects on bowhead whales from oil spills are expected to be negligible.

Right whales may be anywhere in the North Aleutian Basin during their summer feeding period. Although right whales historically fed in the lease area, only one sighting has been recorded adjacent to this area (Berzin and Rovnin, 1966). The probabilities expressed in the previous section also would apply to the summer feeding period of the right whales (ranging from less than 0.5% to greater than 99.5%). Due to the current low usage of the North Aleutian Basin by right whales, effects on the local population could be moderate but are more likely to be minor on a regional basis. Tankering associated with the proposal (low case) would not be expected to affect bowhead whales, as their use of the North Aleutian Basin would occur at the opposite time of the year. Tankering effects on right whales would be low due to the right whale's current infrequent usage of the lease area. In the mean and high cases, produced oil would be transported by pipeline to an onshore facility.

CONCLUSION (Effects on Bowhead and Right Whales):

Noise disturbance and oil spills associated with the proposal would have NEGLIGIBLE effects on bowhead whales and MINOR effects on right whales.

CUMULATIVE EFFECTS (Effects on Bowhead and Right Whales):

See Section IV.B.1.a.(4) (gray whales) for a general discussion of cumulative effects which apply to all endangered whales. The proposal would add a minor increment of effects on bowhead whales, which would experience effects from oil and gas activities throughout their range. Risks to bowhead whales from oil spills (1,000 bbls or greater) in the cumulative case range from a 1- to 34-percent probability of contacting Sea Targets 5 through 19. The North

Aleutian Basin is used infrequently, suggesting that other areas used are more important to the bowhead whale's survival. Cumulative effects on bowhead whales could be minor, as compared to negligible for the proposal, due to increased exposure to tanker traffic.

Cumulative effects on right whales will be difficult to determine, since their winter range is unknown and the North Pacific population appears to number only a few hundred. Leatherwood et al. (1982) stated that only stragglers seem to venture south of Oregon. There are a few sightings of right whales off Washington in January. The historic summer grounds where right whales were intensively hunted ranged from Vancouver Island, Canada, to Kodiak Island and the Gulf of Alaska. Since right whales seem to have a range from Oregon to the Bering Sea, cumulative effects from Alaska OCS activities may have a major effect on the right whale population, assuming all projected scenarios occur. However, if it is assumed that the entire North Pacific population of right whales (best estimate--200 individuals) occurred in the area evaluated in the Gulf of Alaska (preferred historic summer range) Sale 88 FEIS (USDOI, MMS, 1984), which is comprised of 25 million acres, this would result in one whale per 125,000 acres. Right whales in the North Pacific seem to be distributed in more pelagic waters than those whales observed in the North Atlantic which seem to frequent more nearshore waters. Considering the vast range of the right whales and their very low population numbers, the probability of right whales interacting or being affected by OCS activities on a cumulative basis could be low. The probability of a 1,000-barrel-or-greater spill contacting Resource Areas 8 through 13 (where right whales are likely to be) ranges from 13 to 61 percent. Cumulative effects on right whales would be minor.

<u>Conclusion (Effects on Bowhead and Right Whales)</u>: The effects from cumulative oil spills and noise disturbance on bowhead and right whales would be MINOR.

(d) <u>Effects on Sei, Fin, and Blue Whales</u>: There have been only two sightings of sei whales recorded in the St. George Basin and none in the North Aleutian Basin (see Graphic 4). Leatherwood et al. (1982) reported that sei whales generally do not range north of the Aleutian Islands. Their presence in the North Aleutian Basin would be a very infrequent occurrence.

One of the three major summer feeding areas for blue whales occurs south of the Aleutian Islands between 160°W and 180°W longitude. Whales are generally present there from June through August, feeding in the deeper pelagic waters and along the continental slope. Berzin and Rovnin (1966) stated that, in the Bering Sea, blue whales have been observed only south of the Pribilof Islands, and they infrequently enter the Bering Sea. There have been no recent sightings in the Bering Sea (Braham, personal communication).

The fin whale is more likely to be present in the Bering Sea than the other <u>Balaenoptera</u> species (blue and sei whales). In summer, fin whales range throughout the Bering Sea and are common along the continental slope between the Pribilof Islands and Unimak Pass; fin whales have washed ashore on St. Paul Island. There are no recent sightings in the North Aleutian Basin.

Although no direct testing of effects due to seismic activity has occurred for the blue, sei, or fin whale, it is anticipated that reactions would be similar to those of gray and bowhead whales. Fin whales would be more likely to be disturbed from noise activities associated with the proposal than blue or sei whales, which generally do not enter the shallow water found in the North Aleutian Basin. Fin whales feed in the upper portions of the water column and therefore may be exposed more frequently to seismic noises than whales which feed deeper in the water column. Effects to fin whales from noise disturbance would be minor; since they are seldom in the North Aleutian Basin, effects on blue and sei whales would be negligible.

Geraci and St. Aubin (1982) reported that fin whale baleen plates showed conclusive evidence that crude oil temporarily reduced filtering efficiencies but that normal flow patterns were restored after 15 minutes. Since all the Balaenoptera whales prefer euphausiids and copepods as their primary prey, oil-spill effects on the whales would be more indirect by locally eliminating prey which would be killed by the toxic components of an oil spill.

Fin whales would be exposed to similar probabilities of contacting oil spills as described previously for summering gray whales. Sea Targets 3 to 5 correspond to the areas where fin whales are most likely to occur in the lease area. There is a 33-percent probability of an oil spill contacting Sea Target 4 and a 23-percent probability of contacting Sea Target 3. Based on a statistical projection of 0.94 spills of 1,000 barrels or greater, it is assumed that 1 spill in this category will occur. Effects to summer feeding fin whales along the continental slope and in the lease area should be minor. Effects to blue and sei whales would be negligible, since the probability of an adverse oil-spill/whale interaction would be very low.

CONCLUSION (Effects on Sei, Fin, and Blue Whales):

Effects of noise disturbance and oil spills on fin whales could be MINOR, while effects on blue and sei whales would be NEGLIGIBLE.

CUMULATIVE EFFECTS (Effects on Sei, Fin, and Blue Whales):

See Section IV.B.1.a.(4) for a general discussion of cumulative effects which would apply to all endangered whales. The proposal would add only negligible effects to the blue and sei whales, compared to effects from all other Alaska OCS activities that they may experience along migrations and in overwintering or summer feeding areas. Since so few blue and sei whales enter the Bering Sea, the probability of negative effects to these whales would be negligible in the cumulative case and would be most likely to occur from tanker traffic between offshore loading points and markets.

Fin whales range from Baja, California to the Chukchi Sea. There appear to be three main summering areas: (1) outer Prince William Sound to Middleton Island; (2) the shelf break from St. George Island to Unimak Pass; and (3) the Commander Islands and western Aleutian Islands. Effects on fin whales from tanker traffic and oil spills in the North Aleutian Basin could result in a shift to other summer feeding areas. The probability of oil spills from the proposal is generally less than 0.5 percent. Resource Area 10 and Sea Target 2 have a 42-percent and a 21-percent probability, respectively, of being contacted by a 1,000 bbl or greater spill in the cumulative case. However, on a cumulative basis, effects would be minor, since all these hypothetical spills may not occur (23 spills expected over the life of the field in the cumulative case) and contact the summer feeding areas. Effects also may be expected in the vicinity of Balboa Bay and along the tanker routes.

Conclusion (Effects on Sei, Fin, and Blue Whales): Effects from cumulative oil spills and noise disturbance on blue and sei whales would be NEGLIGIBLE, and effects on fin whales would be MINOR.

(e) Effects on Humpback Whales: Humpback whales migrate from wintering areas around the Hawaiian Islands and Mexico to summer feeding areas off the Gulf of Alaska, around the Aleutian Islands and in the Gulf of Anadyr. Areas adjacent to the North Aleutian Basin where humpbacks have been sighted include the shallow waters north of Unalaska Island, along the shelfbreak, and from the Pribilof Islands northeast to Nunivak Island.

Humpback whales may be more sensitive to noise and other disturbance factors than other endangered whales found in the North Aleutian Basin. The NMFS biological opinion (Leitzell, 1979) concluded that "Uncontrolled increases of vessel traffic, particularly of erratically traveling charter/pleasure craft, probably has altered the behavior of humpback whales in Glacier Bay, and thus may be implicated in their departure from the Bay the past two years." However, other factors also may have affected humpback use of the bay. Baker et al. (1982) and Miles and Malme (1983) indicated that humpback whales in Glacier Bay showed markedly different behaviors in response to approaching boats. The most frequently observed behavior was an increase in aerial behaviors as the boats got closer to the whales. Evidence of humpback sensitivity to disturbance has been reported in their wintering grounds (Norris and Reeves, 1978), although Payne (1978) listed numerous instances of apparent insensitivity of humpback whales to noise.

Humpback whales are most often sighted seaward of the 50-meter isobath but have been observed in shallower waters. The areas where these whales are most likely to be seen correspond to Sea Targets 3 to 6, 13, and 14 and to Resource Area 8. The highest probability of contact is 33 percent to Sea Target 4 and 9 percent to Resource Area 8. Other areas in the lease area have probabilities ranging from greater than 99.5 percent to less than 0.5 percent.

CONCLUSION (Effects on Humpback Whales):

Effects on humpback whales from noise disturbance and oil spills associated with the proposal could be MINOR.

CUMULATIVE EFFECTS (Effects on Humpback Whales):

See Section IV.B.1.a.(4) for a general discussion of cumulative effects which would apply to all endangered whales. Humpback whales appear to migrate to separate summer areas from a common winter area. Therefore, it is possible that whales migrating to the North Aleutian Basin vicinity and northward to the Gulf of Anadyr may not be affected by OCS activities in the Gulf of Alaska. Conversely, whales migrating to the Gulf of Alaska may not be affected by OCS activities in the Bering Sea. An exception would occur if tankering from these areas bisected the migrating humpback whales before they split into separate summering groups. On a cumulative basis, Resource Area 9 has a 38-percent probability of contact from a 1,000-barrel-or-greater spill. Assuming production occurs as proposed, in combination with all other OCS activities, cumulative effects to certain portions of the regional population may be moderate but overall would probably be minor to the entire regional population. Humpbacks are not known to frequent the area between Unimak Pass and Balboa Bay.

Conclusion (Effects on Humpback Whales): Cumulative effects on humpback whales from noise disturbance and oil spills would be MINOR.

(f) Effects on Sperm Whales: Sperm whales are the only toothed whale listed as endangered. Sperm whales that may venture into the North Aleutian Basin are probably males; females generally do not venture north of lat. 50°N. (Leatherwood et al., 1982). Sperm whales are seldom found in waters less than 200 meters deep, so it would be unusual for them to be in the North Aleutian Basin.

Sperm whales use their acoustical system, which generally operates at high frequencies (1-100 kHz), to echolocate and communicate. Because they operate at high frequencies of shorter wavelengths, the acoustical receiving and transmitting system of sperm whales tends to be directional and is capable of discriminating against unwanted sounds. It does not appear that any serious interference with their communication is likely, especially since the more powerful geophysical seismic noises are produced at low frequencies. The sperm whale's hearing system is designed to receive mostly the high frequencies of short wavelengths and, therefore, is probably not very receptive to the low frequencies produced by OCS activities. Effects on sperm whales from noise disturbances associated with the proposal are expected to be negligible.

Sperm whales feed at great depths and lack baleen (present in mysticete whales), which can become fouled upon contact with spilled oil. Their deep-feeding habitats mainly preclude oil ingestion by not swallowing oil contaminated surface waters (where prey of baleen whales are located). The areas with the highest probability of contact by an oil spill (within 10 days) are Resource Area 7 (greater than 99%) and Sea Target 4 (33%), which are located in areas where sperm whales have not been sighted. Although the probabilities of contact are high, sperm whales predominantly feed outside the lease area; therefore, based on a statistical projection of 0.94 spills of 1,000 barrels or greater, it is assumed that one spill in this category will occur. The chance of a spill contacting and adversely affecting sperm whales would be very low. Effects on sperm whales from oil spills associated with the proposal would be negligible.

CONCLUSION (Effects on Sperm Whales):

Effects on sperm whales from oil spills and noise disturbance associated with the proposal would be NEGLIGIBLE.

CUMULATIVE EFFECTS (Effects on Sperm Whales):

See Section IV.B.1.a.(4) for a general discussion of cumulative effects which would apply to all endangered whales. Sperm whales prefer the deeper pelagic waters off the continental slope. This area currently is not being developed by industry but possibly will be, depending on future technology. Assuming that production occurs as proposed, in combination with other OCS activities, cumulative effects to sperm whales may be minor on a regional basis.

Conclusion (Effects on Sperm Whales): Cumulative effects on sperm whales from oil spills and noise disturbance may be MINOR.

(g) Effects on Endangered and Threatened Birds: On August 22, 1980, a biological opinion was received from FWS regarding the potential effects of exploration activities on endangered birds. On November 4, 1983, a biological opinion (Appendix H) was received from FWS regarding potential effects of exploration activities on endangered and threatened birds in which it was concluded: "There is no new information on the occurrence of the Eskimo curlew, short-tailed Albatross, Arctic peregrine falcon and the American peregrine falcon within the lease offering areas and we find the 1980 opinions to be current and entirely appropriate for these species. The Aleutian Canada goose nests in terrestrial habitats at high elevations and they seldom frequent estuarine habitats during the nesting season. Since the probability of an oil spill during exploration is minimal and the trajectory data indicate that the net transport of oil would probably be northward away from Chagulak Island, it's my biological opinion that the proposed oil and gas leasing and exploratory activities in the St. George Basin and in the North Aleutian Shelf are not likely to jeopardize the continued existence of the endangered Aleutian Canada goose, or the other endangered species previously considered."

Effects on the Aleutian Canada Goose: As discussed in Section III.B.4., the Aleutian Canada goose has been reported to nest near the St. George Basin on Chagulak and Buldir Islands in the Aleutian Islands. Another possible nesting area that has been reported is on Kiliktagik Island in the Semidi Islands. The probability of an oil spill occurring near and contacting Chagulak Island is very unlikely (less than 0.5% within 30 days). The known nesting areas and migration route of the Aleutian Canada goose make it unlikely to be affected by oil spills associated with this proposal. Although the FWS annual narrative report for the Izembek National Wildlife Refuge (NWR) (USDOI,FWS, 1980) stated that the Aleutian Canada goose may occur on the Izembek NWR during the spring or fall migration to and from their western-Aleutian nesting areas, this use has not been documented by observation. It is unlikely that oil spills and noise disturbance would significantly interact with or affect the endangered Aleutian Canada goose.

CONCLUSION (Effects on the Aleutian Canada Goose):

Effects on the Aleutian Canada goose are expected to be NEGLIGIBLE.

CUMULATIVE EFFECTS (Effects on the Aleutian Canada Goose):

This proposal is not expected to contribute significantly to cumulative factors which may affect the Aleutian Canada goose. This is due to the location of the lease area and the very low numbers of the Aleutian Canada goose, which is distributed over its extensive ranges.

Conclusion (Effects on the Aleutian Canada Goose): The potential for cumulative oil-spill and noise-disturbance effects on the Aleutian Canada goose would be NEGLIGIBLE (same as for the proposal).

Effects on the Short-Tailed Albatross: An oil spill or blowout probably would have a minor effect on the short-tailed albatross (DeGange, 1981). This is more a result of a small population being dispersed over a vast marine range than any other factor. With increased exploratory activity in other Alaskan lease sale areas within the range of the albatross, cumulative effects could occur. Because no short-tailed albatross have been sighted in the North Aleutian Basin and only two birds have been sighted in the Bering Sea south of 58°N latitude, it is unlikely that this species would interact with oil spills or be disturbed by noise activities associated with the lease sale area.

CONCLUSION (Effects on the Short-Tailed Albatross):

Effects on the short-tailed albatross are expected to be NEGLIGIBLE.

CUMULATIVE EFFECTS (Effects on the Short-Tailed Albatross):

This proposal is not expected to contribute significantly to cumulative factors that may affect the short-tailed albatross. This is due to the distance of any proposed or leased areas from the short-tailed albatross' range, and to its very low population numbers distributed over extensive ranges.

Conclusion (Effects on the Short-Tailed Albatross): The potential for cumulative oil-spill and noise-disturbance effects on the short-tailed albatross would be NEGLIGIBLE (same as for the proposal).

Effects on the Peregrine Falcon and the Eskimo Curlew: The American and Arctic peregrine falcon (*Falco peregrinus anatum* and *F. p. tundrius*) and the Eskimo curlew (*Numerius borealis*) have not been sighted in the lease area for many years. The historic range of the Eskimo curlew included St. Matthew and St. Paul Islands. It is very unlikely that these species would be affected by an oil spill or noise disturbance associated with this proposal. Peregrine falcons sited near the lease area are most likely to be the nonendangered Peale's subspecies. The American peregrines nest along the Kuskokwim River, and their migratory route may infrequently come near the lease area.

CONCLUSION (Effects on the Peregrine Falcon and the Eskimo Curlew):

Effects on the peregrine falcon and/or Eskimo curlew are expected to be NEGLIGIBLE.

CUMULATIVE EFFECTS (Effects on the Peregrine Falcon and the Eskimo Curlew):

This proposal is not expected to contribute significantly to cumulative factors which may affect the peregrine falcon and the Eskimo curlew. This is due to the location of the lease area and the very low numbers of the peregrine falcon and Eskimo curlew, which are distributed over extensive ranges.

Conclusion (Effects on the Peregrine Falcon and the Eskimo Curlew): The potential for cumulative oil-spill and noise-disturbance effects on the peregrine falcon and the Eskimo curlew would be NEGLIGIBLE (same as for the proposal).

(5) Effects on Nonendangered Cetaceans: There are at least 10 nonendangered cetacean species that may occur in or adjacent to the lease area. The marine mammal species discussed are protected under the

Marine Mammal Protection Act of 1972 and the International Convention for the Regulation of Whaling of 1946. The more commonly sighted species include the minke whale (Balaenoptera acutorostrata), killer whale (Orcinus orca), beluga whale (Delphinapterus leucas), Dall's porpoise (Phocoenoides dalli), and harbor porpoise (Phocoena phocoena). Other species less frequently observed in or adjacent to the lease area include the short-finned pilot whale (Globicephala macronhynchus), giant bottlenose whale (Berardius bairdii), goosebeak whale (Ziphius cavirostris), Bering Sea beaked whale (Mesoplodon stejnegeri), and the Pacific white-sided dolphin (Lagenorhynchus obliquidens). Several of the more common species are year-round residents in the North Aleutian Basin lease area.

(a) Direct and Indirect Effects of Hydrocarbon Pollution: See Section IV.B.1.a.(4) for a general discussion on the effects of hydrocarbon pollution on endangered cetaceans. These effects are also applicable to nonendangered cetaceans, especially Geraci and St. Aubin's (1982) work on bottlenose dolphins. Effects on nonendangered cetaceans are not expected to differ significantly from effects on endangered cetaceans. Direct consequences and adverse effects from spilled oil could result from contact, inhalation, and/or ingestion. In Alaskan waters, two killer whales (one sick and one dead), were observed in association with an oil spill, but a precise causal relationship was not established. Dugay (1978) reported the presence of petroleum hydrocarbons in the intestine of a stranded bottlenose dolphin; however, there was no evidence to suggest that oil ingestion had been responsible for the stranding and death of the animal. The massive Nowruz slick (Iranian oil field) heavily oiled several small offshore islands (in territorial waters of Saudi Arabia), and the marine life there has been severely affected. The spill has resulted in the death of several endangered marine mammals, turtles, sea snakes, and fish. The Water Resources and Environment Division of the University of Petroleum and Minerals Research Institute in Dhahran, Saudi Arabia, conducted autopsies on the dead animals and found that the animals had died of respiratory stress, presumably as a result of inhaling oil (OSIR, 1983). Virtually the entire known Gulf population of the endangered dugong (50 individuals) has died since the Nowruz spill began. Accounts from past oil spills show that marine mammals (such as seals and sea lions) may not avoid oil (Geraci and St. Aubin, 1979).

Goodale et al. (1981) and Gruber (1981) reported two accounts of whales and dolphins swimming and feeding in oil slicks. Geraci and St. Aubin (1982) suggested that bottlenose dolphins, studied under optimum light and water-clarity conditions, used echolocation alone to detect thick patches of heavy oil, particularly if the substance contained air bubbles as a result of churning by wind and wave action. Further laboratory studies on bottlenose dolphins by Geraci and St. Aubin suggest that avoidance behavior was clear and consistent. The species repeatedly avoided a controlled slick of nontoxic, colored mineral oil that the authors knew the dolphins could detect. Each time a dolphin contacted oil it responded overtly by abruptly diving and quickly returning to an oil-free area, even though the mineral oil was innocuous. At sea, this response might be modified by social interaction, feeding, agonistic behavior, migration, or human activity (Geraci and St. Aubin, 1982).

More recent laboratory studies by Geraci and St. Aubin (1982) revealed that bottlenose dolphin skin exposed to gasoline and crude oil showed no gross evidence of damage or loss of integrity. Although the exposed skin turned a pale gray in color, it returned to a normal color within 2 hours. On the other hand, human skin similarly treated showed more extensive irritation. Other histological and ultrastructural studies on dolphins by Geraci and St. Aubin (1982) showed that petroleum hydrocarbons produced mild and transient damage to cells of the epidermis, although the cells showed signs of recovery within 3 to 7 days. Other surface-contact studies by Geraci and St. Aubin (1982) include studies to determine the healing progress of oil-contaminated versus uncontaminated cetacean wounds, and studies of the biochemical processes of epidermal cells for evidence of functional damage due to oil. In all of these surface-contact studies, the morphological changes were reversible even after an exposure of 75 minutes. However, persistent biochemical changes impairing the functional integrity of the skin were not determined.

Physiological stress that may occur to nonendangered cetaceans, should oil spills interact with prey items, may be difficult to correlate with reductions in fecundity or migration fitness. Feeding behavior may be altered to avoid an oil slick, and/or the availability of prey may temporarily change. Direct effects of an oil spill would be expected to affect zooplankton primarily and finfish secondarily. Oil-spill effects on zooplankton or euphausiids are considered to be minimal due to their rapid fecundity rate, diurnal migrations, and distribution. Acute or chronic pollution that results in reduced productivity of zooplankton and/or other prey items may stress local cetacean populations, but effects are not anticipated at the regional level. Therefore, the probability that consequences from interactions between spills and nonendangered cetaceans would occur is unlikely. It is not reasonable to expect that cetaceans would stay in a harmful environment for any length of time.

A potential direct effect of spilled oil on baleen whales is the fouling of baleen plates, resulting in a subsequent decrease in feeding efficiency. The probability of such fouling and its effects on feeding efficiency are directly linked to probabilities of spills and whale contact with such spills. Recent studies by Braithwaite et al. (1983) showed that filtration efficiency of bowhead whale baleen could be reduced, but not to a high degree, after contact with crude oil in the water. He found that in the flow-through experiments, on an average, reduction of bowhead baleen-filtering efficiencies was between 5.9 to 11.3 percent. Even though the reduction in efficiency was significant, the reduction's effect on an individual whale's overall health or energy acquisition is not known. Bowhead baleen plates fouled with 10 millimeters of crude oil showed a decrease in filtering efficiency that persisted for as long as 30 days; but 8 hours after fouling, the filtering efficiency began to increase because the baleen hairs did not tend to stick to one another as much. Geraci and St. Aubin (1982) reported that fin and gray whale baleen plates showed conclusive evidence that, although filtering efficiency of baleen was temporarily reduced by crude oil for up to 15 minutes, normal flow patterns were restored. These observations essentially alleviate the concern that crude oil would irreversibly obstruct water flow through baleen. Prolonged impairment caused by repeated fouling may affect feeding activity and therefore may possibly diminish blubber stores which would be essential for lactating females and during migration. Cumulative long-term effects on baleen integrity and cetacean fitness may occur if cetaceans persist in feeding in areas that are oil-contaminated.

Noise and Disturbance: See Section IV.B.1.a.(4); Technical Paper No. 9 (Cowles et al., 1981); and the St. George Basin (Sale 70) Supplemental FEIS (USDOI, MMS, 1983) for a general discussion of the effects of noise and disturbance on cetaceans. The response of animals to acoustical stimuli has shown variances in behavorial and physiological effects, depending on the species studied and the characteristics of the stimuli.

The acoustical sense of aquatic animals probably constitutes their most important distance-receptor system (Gales, 1982). Studies of the acoustical activities of marine animals suggest that an animal's acoustical system can and does provide appropriate information on a variety of functions relative to feeding, social activities, and breeding. If a sound is perceived as a threat, a retreating or flight reaction may occur. If the sound is perceived as nonthreatening, no change in observed behavior is likely.

The odontocetes (toothed whales) use their acoustical system, which generally operates at high frequencies (1 to over 100 kHz), to echolocate and communicate. Because they operate at high frequencies of shorter wavelengths, the acoustic receiving and transmitting systems of these species tend to be directional and are capable of discriminating against unwanted sounds. Since their receiving systems (hearing) mainly employ these high frequencies, they are the least likely to be affected adversely by oil-platform noises which generally are emitted below these high frequencies. Audibility of oil platform sounds by marine animals ranges from a theoretical high of over 2,000 miles to a low of 15 yards, depending on the many factors affecting sound detection and propagation (Gales, 1982).

The effects of platform noise on animal echolocation and communication may be summarized as follows. The echolocation signals are generally at high frequencies, at which platforms emit little noise and propagation is poor due to absorption of sound in the sea. This, coupled with probable directional discrimination of the animals at the high frequencies, makes it unlikely that any significant interference with echolocation will occur. Communication in mysticete whales tends to take place at lower frequencies, at which platforms emit relatively large amounts of noise, underwater sound propagation is good, and animal directivity is small. Interference with communication is possible in some cases. Although slight interference may be possible out to a range of 350 miles under extreme conditions, it is much more likely to expect the range of effects to be less than 4 miles (Gales, 1982). The odontocete whales use frequencies in the 2,000-Hz range which are generally complex and modulated signals less likely to be susceptible to interference. It does not appear that any serious interference with their communication is likely. It should be noted that the effect of masking is to shorten the distance at which a signal may be heard.

Beluga whales have excellent hearing at frequencies from 1 kHz out to and beyond 100 kHz. Their frequency range used in echolocation pulses ranges from 25 to 35 kHz. For humans, sounds tend to become uncomfortably loud at levels on the order of 100 to 120 dB above threshold. This would correspond to sound levels of approximately 143 to 180 dB for the beluga whale in the frequency range of their greatest sensitivity (1-5 kHz). Levels measured at various platforms are generally well below 110 dB at 50 feet for frequencies in this region, so it is unlikely that platform noise would be uncomfortably loud to belugas at distances beyond 50 feet. To predict a substantial adverse effect on a species, it must be determined whether or not such an effect is deleterious to the existence of the species or its ecological interactions. Even a sustained effect of the noise disturbance, such as denying a favored habitat, may simply displace the animals by a mile or two with no serious adverse consequences.

Most nonendangered cetaceans inhabit nearshore waters more often than most endangered cetaceans. Therefore, tolerance levels to noise and disturbance may be higher for nonendangered cetaceans than for endangered cetaceans. Dall's porpoise have been observed to "play" around moving vessels, whereas bowhead whales exhibit a strong avoidance reaction to nearby moving vessels. Beluga whales have shown an avoidance reaction to boat and barge traffic within 2.5 kilometers of them in the Beaufort Sea (Fraker et al., 1979). Nonendangered cetaceans may not be particularly sensitive to many types of noise associated with offshore oil and gas operations, and they also may display a certain degree of tolerance to loud seismic noise above ambient levels.

Of the project phases (exploration, development, and production), the development phase would probably generate the greatest amount of noise and disturbance which could be transmitted into the cetaceans' environment (see Sec. II.A). Disturbance responses due to air traffic would most likely occur during this phase. Noise from petroleum-related boat and tanker traffic, drilling, or geophysical exploration may be substantial in other phases as well. If the degree of tolerance to loud seismic noise--as demonstrated elsewhere by endangered whales--is used as an index, disturbances due to activities associated with the lease sale are unlikely to significantly affect cetaceans (see the St. George Basin [Sale 70] Supplemental FEIS [Sec. IV.B.1.d.]). Noise associated with vessels and aircraft has affected bowheads in the Beaufort Sea and, therefore, could possibly affect other cetacean species during their feeding period in the lease area. It appears that disturbance effects are likely to be temporary brief flight responses. It is unlikely that significant population wide effects on nonendangered cetaceans would occur as a result of disturbances associated with the proposal.

Other potential effects on cetaceans include marine disposal of drilling muds, formation, and cooling waters; facility siting; dredging/filling; secondary development and seismic activities. The extent of these activities should not be a major influence on nonendangered cetaceans during exploration.

(b) Site-Specific Oil-Spill Analysis: Of the eight species of nonendangered cetaceans observed in the North Aleutian Basin area, the most frequently observed cetaceans are the beluga, killer, and minke whales and the harbor and Dall's porpoise. The Bering Sea beaked, giant bottlenose, and goosebeak whale are occasionally in the area. The short finned pilot whale is an infrequent visitor to the North Aleutian Basin area. The peak number of cetaceans in the Bering Sea seems to occur from June through November.

Tables G-1 to G-9, Appendix G, show conditional probabilities of an oil-spill risk to certain areas (the probability of spills affecting certain areas if they originated at specific points). Conditional probabilities assume that oil has been released at a hypothetical spill location. Such percentages do not reflect the probability of oil actually being released at that location, but the probability of oil, if released there, making contact with a specific resource area or sea target. For the following discussion, these terms and associated probabilities relating to the OSRA will be used: very unlikely (less than or equal to 10%), unlikely (11 to 30%), likely (31 to 60%) and very likely (greater than 60%). Refer to Section IV.A.2. for descriptions of spill locations, resource areas, and sea targets. Under the proposal, if a spill occurred at any of the spill sites located within the lease area, there would be a wide probability (greater than 99.5% to less than 0.5%) that oil would contact some portion of a nonendangered cetacean feeding habitat and/or migration route within 10 days. However, most spill probabilities are less than 0.5 percent (very unlikely).

Unimak Pass: Unimak Pass is used as a major migratory route between the Bering Sea and the Gulf of Alaska by nonendangered and endangered cetaceans. Nonendangered cetaceans have been observed in Unimak Pass from early April through November. The highest probability of an oil spill contacting Unimak Pass (Resource Area 8) is greater than 99.5 percent from Spill Point E24 within 3 days. It has been hypothesized that the beluga and minke whales and the Dall's and harbor porpoise remain in the North Aleutian Basin area year-round. The probability for an oil-spill/cetacean interaction for these species would be likely. The other whales may be present in the area from March through December; therefore, actual probabilities of an oil-spill/cetacean interaction will be lower, as the probabilities expressed represent year-round exposure. Sea Segment 3 has a 26 percent probability of contact within 30 days. The overall probability of an oil spill affecting Unimak Pass is likely.

The Alaska Peninsula: The waters off the Alaska Peninsula are used throughout the year by some species and seasonally by others. The main portion of the Bering Sea beluga population will be found in waters associated with the ice front during winter and spring. A portion of the population remains along the Alaska Peninsula during the summer, feeding on the several species of migrating salmon (both returning adults and outmigrating smolts). The minke and killer whales and Dall's and harbor porpoise feed in the nearshore coastal waters and lagoons along the Alaska Peninsula and Bristol Bay. These species may be present from March to December. The areas with the highest spill probabilities are: (1) Resource Area 7 (Port Moller/Nelson Lagoon) with a greater-than-99.5-percent probability from Spill Point D1, and 49-percent probability from Spill Point B3; and (2) Resource Area 6 (Port Heiden) from Spill Point B3, with a 25-percent probability. Gurevich (1980) reported twice-daily movements of 50 to over 500 belugas during May and most of June up the Kvichak River (20-30 km upstream) foraging on red salmon and smelt (less than 0.5% probability of contact). Although cetaceans may be in the North Aleutian Basin area all year, chances are good that they don't remain in any one particular area for any length of time. Therefore, actual exposure rates and probabilities of an oil-spill/cetacean interaction may be lower. The probability of an oil-spill/cetacean interaction in the aforementioned areas would range from very unlikely to very likely. Even though the spills listed are hypothetical, this does not negate the fact that should an oil spill occur, the chance of oil contacting a cetacean habitat is likely. The probability of an oil spill originating from Spill Point D1 and contacting Resource Area 7 after 3 days is greater-than-99.5-percent. Sea Target 23 (offshore of Port Moller/Nelson Lagoon) has a greater-than-99.5-percent and a 32-percent chance of being contacted by an oil spill from Spill Points B3 and D1, respectively. If an oil spill occurred during the migration or summer feeding periods, the probability of an oil-spill/nonendangered cetacean interaction is likely.

During the spring-to-fall migration period, interaction of nonendangered cetaceans or their habitat with oil spills originating in the lease area could range from very unlikely to very likely. The probability of spills coming in contact with cetaceans or their habitats within the North Aleutian Basin area is generally less than 0.5 percent. Based on the cetaceans' broad distribution, relatively mobile population, and the recent data on direct and indirect effects of hydrocarbon pollution on cetaceans (Geraci and St. Aubin, 1982), their populations are unlikely to be affected by spilled oil. The probability of a nonendangered-cetacean/oil-spill interaction is considered unlikely.

During the summer feeding season, interactions of nonendangered cetaceans or their habitat with oil spills originating in the North Aleutian Basin is generally very unlikely (less than or equal to 10%). Certain cetacean habitats along the Alaska Peninsula show a higher probability of coming in contact with spilled oil. Therefore, there is a wide range of probabilities (less than 0.5% to greater than 99.5%) that oil spills would interact with nonendangered cetaceans and/or their habitat within this broad area. It is unlikely that such interaction, if it occurred, would significantly adversely affect the cetacean populations using the area.

Direct oil-spill consequences to zooplankton or other cetacean food sources are considered to minimally affect summer feeding cetaceans due to the zooplanktons' rapid fecundity and the secondary food source they provide to most nonendangered cetaceans. The toothed nonendangered cetaceans feed mainly on finfish. Physiological stress that may occur to the cetaceans should oil spills interact with prey items may be difficult to correlate with reductions in fecundity or migration fitness.

If development of hydrocarbon resources occurs to the extent estimated (see Sec. IV.A.1), and if associated spill rates occur (see Sec. IV.A.3.), there exists a generally low probability of oil contacting nonendangered cetaceans or their habitats. However, risk levels to Port Moller/Nelson Lagoon and Unimak Pass are higher. It is unlikely that spilled oil could contact Port Moller/Nelson Lagoon (20%) in the final probabilities within 10 days, but more likely (24%) within 30 days. It should be emphasized that the probability figures cited above are most applicable to the relative risk to cetacean habitats. Since most nonendangered cetacean species are not present in the area at all times, and given the assumptions of the oil-spill-trajectory model, the absolute probability of direct effects on cetaceans would be lower. Therefore, significant adverse oil-spill/cetacean interaction from development of hydrocarbon resources within the lease area is unlikely. Based on a statistical projection of 0.94 spills of 1,000 barrels or greater, it is assumed that one spill in this category will occur, with a 61-percent probability, over the life of the North Aleutian Basin field.

Effects from Noise and Seismic Activities: Another element of exploration, production, and development involves seismic activities. The level of effect on nonendangered species may range from negligible to minor, depending on the species and the population's well being. It is anticipated that the level of seismic activity associated with the lease area would depend upon the number of exploratory/delineation wells and the number of production platforms installed. It is anticipated that North Aleutian Basin seismic activity will involve 12 sites and an estimated 1,362 trackline miles. The seismic surveys would probably begin about 1 year prior to drilling and most activity would probably take place from late May through September, with approximately 1 week per survey site.

The cetaceans most likely to be in the area during the summer months are the minke and killer whales and Dall's and harbor porpoise. Although no direct testing of effects of seismic activity has occurred for the nonendangered whales, it is anticipated that effects would be minor. Subtle behavioral responses (brief flight responses or a temporary change in migration routes) have been demonstrated, although only a few animals are expected to be temporarily disturbed by seismic activities during migration periods. Direct injury (physical impairment of hearing), even at close range, is unlikely. Considering the wide range of habitat available to nonendangered cetaceans and the general paucity of site-specific observations in the lease area, interactions between nonendangered cetaceans and seismic activities are not anticipated.

Of the project phases (exploration, development, and production), the development phase probably would generate the greatest amount of noise and disturbance which could be transmitted into the cetaceans' environment. Disturbance responses due to air traffic would be most likely to occur during this phase. Noise from petroleum-related boat and tanker traffic, drilling, or geophysical exploration may be substantial in other phases as well. If the degree of tolerance to loud seismic noise, as demonstrated elsewhere by whales, is used as an index, disturbances due to activities associated with the lease sale are unlikely to significantly affect cetaceans (see St. George Basin [Sale 70] FSEIS, USDOI, MMS, 1983). Noise associated with vessels and aircraft has affected belugas in the eastern Beaufort Sea and, therefore, could possibly affect other species of whales during their summer feeding period in the lease area. Gray whales have been shown to temporarily deflect their migration route in the presence of seismic activities.

It is possible that noise and disturbance associated with the proposal may have localized effects on cetacean behavior or distribution, especially in the vicinity of platforms or pipeline/tanker transportation terminals, during the development and production phases. It is unlikely that significant population-wide effects of noise and other disturbance to nonendangered cetaceans would occur as a result of the lease sale.

SUMMARY (Effects on Nonendangered Cetaceans):

Potential Effects of Oilspills: Because of broad distributions, seasonal use, low probability of oil spills, and the size of the North Aleutian Basin lease area, it is unlikely that oil spills associated with the proposal would come in contact with high population levels of nonendangered cetaceans. While it is possible that some nonendangered cetaceans could be affected, it is unlikely that such interaction, if it occurred, would significantly adversely affect the cetaceans frequenting the area. Oil spills can be considered unlikely to have: (1) significant adverse effects on nonendangered cetacean populations, and (2) significant indirect adverse food chain related effects on nonendangered cetaceans.

Potential Effects of Noise and Disturbance: Although disturbance due to activities associated with the proposed lease sale is unlikely to significantly affect cetacean populations adversely, noise associated with aircraft and vessel activity may affect cetaceans during the summer feeding or migration periods. It is likely that such interaction, if it occurred, would be localized and short-term. These short-term responses are not expected to preclude a successful cetacean migration or to disrupt use of feeding areas by nonendangered cetacean species.

CONCLUSION (Effects on Nonendangered Cetaceans):

The potential effects of this proposal on nonendangered cetacean species are expected to be MINOR.

CUMULATIVE EFFECTS (Effects on Nonendangered Cetaceans):

In this discussion, the term cumulative effects as defined in NEPA is "the impact on the environment which results from the incremental impact of the action when added to other past present and reasonably forseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Factors which may produce cumulative effects on nonendangered cetaceans include those projects listed in Section IV.A.6., other proposed or future federal offshore oil and gas lease sales, and other nonpetroleum industry sources of oil spills or disturbance.

Certainly of concern are the cumulative effects of oil spills and other pollution associated with the projects listed above. Cumulative effects could increase if all the potential developments took place, especially for cetaceans which migrate through several proposed lease sale areas (i.e., southern and central California, Gulf of Alaska/Cook Inlet, St. George Basin, and Chukchi Sea). Cumulative indirect effects on nonendangered cetaceans also will occur if future development takes place in important feeding areas to the south and north of this proposed lease area, primarily from Kodiak Island to the Bering Strait. Although the size of the sale, total number of spills, total traffic levels, and production life of the field are hypothesized, more accurate analysis of cumulative effects will be made in the development and production phases. Due to the extreme uncertainty regarding (1) the extent of development in these areas, and (2) the probability of the effects of such development on nonendangered species, it is difficult to predict the type or magnitude of future cumulative and pollution-related effects on nonendangered species. Before development and production begins, an EIS may be prepared that will more closely analyze the cumulative effects on nonendangered cetaceans.

Cumulative spill effects may be greatest at locations where tanker traffic may be focused (i.e., Unimak Pass, Balboa Bay). Table G-10 in Appendix G considers cumulative spill probabilities from spills of 1,000 barrels or greater occurring over the expected production life of the lease area. Cumulative (final) probabilities cited incorporate conditional probabilities, the likelihood of discovering oil, and the development assumptions as given in Section IV.A.1, and therefore reflect the overall probability of oil spills occurring and contacting particular locations. Oil-spill risks from the proposal, existing leasing, and existing tankering generally show an increase in spill probabilities on habitat known to be important for nonendangered species.

The estimated occurrence of oil spills would increase from 0.94 spills for the proposal to 23 (most likely number of) spills for a combined case, with a 100-percent chance of 1 or more spills of 1,000 barrels or greater. The most likely number of 100,000-barrels-or-greater spills is one. In the cumulative case, all produced oil from Sales 57, 83, 107, 70, 89, and 100 would be transported through Unimak Pass to market. Oil produced from Sale 92 would be piped across the Alaska Peninsula to a transshipment facility in Balboa Bay on the southern coast of the Alaska Peninsula. If the projected mean conditional resources for the Bering Sea are discovered and produced, 3.6 spills of 1,000 barrels or greater are expected to occur in the Unimak Pass area as oil is tankered to market. Areas with the highest contact probability are St. George Island (81%), the shelfbreak (61%) and Unimak Pass (44%). These nearshore waters provide habitat for several nonendangered cetaceans; therefore, there is an increased risk to nonendangered species from potential tanker spills and increases in ambient-noise levels. Overall effects on nonendangered species in a cumulative scenario could be moderate, as compared to minor for the proposal.

Cumulative acoustical disturbance with proposed state and federal lease sales may affect nonendangered cetaceans, although habituation to acoustical disturbance is a distinct possibility. Although it is not feasible to predict accurately the long-term and population-wide behavioral responses of cetaceans to cumulative noise, such a prediction would include all noise sources throughout the species range. For some species, such as the minke whale, offshore development associated with the proposal may constitute a minor portion of the total acoustical stimuli. If several proposed lease sales yielded large discoveries of oil and gas (intensive production activities and resultant increases in human activity, increased localized or shipping-corridor disturbance, and increased pollution), cumulative oil spills or disturbance could be moderate. Cumulative industrial disturbance, especially during migratory periods, may be greatest at locations where tanker traffic would be focused (i.e., Unimak Pass and Balboa Bay) due to several lease sales, and may result in alterations of migration routes and/or timing, or discontinued use of feeding areas. As suggested previously, long-term ecosystem-wide cumulative effects of chronic pollution will be of concern because change in total ecosystem productivity is a possibility.

Conclusion (Effects on Nonendangered Cetaceans): The potential for cumulative oil-spill and noise-disturbance effects on nonendangered cetaceans could be no greater than MODERATE, as compared to MINOR for the proposal.

b. Effects on Social and Economic Systems:

(1) Effects on Commercial Fishing Industy: Factors that could result in adverse effects on the commercial fishing industry include:

- Elimination or foreclosure of fishing area by the presence of exploration rigs, production platforms, subsea completions, and pipelines, resulting in a possible loss of harvest;

- Gear conflicts, resulting in loss or damage to fishing gear, harvest loss, and business downtime;

- Oil spills resulting in gear fouling, preemption or closure of fishing area, or direct loss or contamination of harvest;

- Loss or damage to fishing vessels through collisions with oil industry vessels;

- Competition for support services, infrastructure, and labor.

The Oil/Fisheries Group of Alaska was organized in 1983 to help mitigate adverse effects of offshore oil development on the commercial fishing industry. Consisting of representatives from several major oil companies and the major fishing and processing organizations operating in Alaska, the Group provides a forum for interindustry communication, education, and resolution of potential problems. By exchanging information on fishing areas of high gear concentration, season, and geophysical vessels and schedules, the group should be successful in reducing adverse effects.

(a) Space and Catch Loss: Space occupied by surface and subsurface oil and gas structures, including exploration rigs, production platforms, subsea pipelines, and subsea completions, can potentially foreclose areas to fishing particularly trawling. These area foreclosures could potentially reduce fishing industry harvests. However, individual fish will tend to move into and out of the foreclosed zone. When the fish move out of the foreclosed zone, they still have some probability of being caught. Thus, the actual catch loss would be considerably less than proportional to the areas foreclosed.

It is assumed that under calm sea conditions groundfish trawls do not operate within one-quarter mile (0.4 km) of production platforms, within one-quarter mile of the extended anchoring system of exploration rigs, or within one-quarter mile of either side of pipelines. The two production platforms assumed for Alternative I would remove about 0.4 square miles of fishing area available for trawling. The 190 km (119 mi) of offshore pipeline would also deny fisherman access to an additional 60 square miles. The area preempted from trawling would account for only 0.006 percent of the lease offering area and a much smaller area of the eastern Bering Sea commercial fishing area (about 150,000 to 200,000 square miles). While storms and periods of poor visibility dictate greater leeway, the overall space loss does not increase significantly as compared with the total fishing area available.

Space and catch loss associated with production platforms and pipelines would have little effect on the crab fishery. The 60+ square miles of space and catch loss associated with production platforms and pipelines would have little effect on the crab fishery. Under normal sea conditions crab vessels may lay and retreive gear in near proximity (approximately 100 m) to offshore structures. Crab pots may be set next to pipelines (approximately 10 m) without hazard to either the gear or the pipeline.

(b) Gear Conflicts:

Crab-Pot Loss: Vessel traffic associated with oil exploration and development in the North Aleutian Basin could contribute to loss of crab-pot gear by fishermen. Seismic and supply vessels traveling between the anticipated OCS marine-support base at Unalaska/Dutch Harbor and the lease sale area in the North Aleutian Basin would likely travel through the Bristol Bay king crab fishery as well as the southeastern Bering Sea Tanner crab fishery.

Seismic-vessel activity associated with the North Aleutian Basin lease sale is projected to consist of approximately 1,362 trackline miles of surveys for exploration and delineation wells and 520 trackline miles for the oil pipeline route over the total period of exploration and development. The total 1,882 trackline miles of surveying would be expected to take place over the period of 1985 through 1992. It is estimated that one or two sites per year would be surveyed, and that no more than two vessels would be involved in preliminary site surveys in any given year.

Seismic activity is expected to take place from late May through September. The present season for red king crab and Tanner crab harvest in the Bering Sea are from October though June 15. These harvest periods are outside the season when seismic survey vessels operate. Because of depressed stocks, the red king crab fishery has a harvest quota. The season now usually extends until harvest quotas are reached and lasts only about 2 weeks.

Seismic vessels traveling between Unalaska/Dutch Harbor and any of several points within the proposal area during the crab season could into contact with crab pots located in the southwestern part of the proposal area above Unimak Pass. This is also the area of greatest pot concentration for the *C. bairdi* and *C. opilio* tanner crab fisheries. Interference with crab pots by seismic vessels would be negligible because seismic surveys are usually performed when the crab fishery is closed.

Interference with crab pots by supply boats and barge traffic is potentially greater due to the greater amount of activity. Also, supply boats would be operating all year so potential conflicts could occur throughout the king and tanner crab seasons. During the exploratory period, supply boats from Unalaska would serve a maximum of two drilling rigs at least once every two days. When the development phase began in 1990, barge and supply-boat traffic would increase. In addition to the barges, each of the two platforms would be serviced at least once a day by at least three to four workboats from Unalaska. During the development phase (1990-1993), interference with crab pots could cause moderate effects on the crab fisheries. However, supply boat activity would decrease during the production phase beginning in 1994, and potential effects on the crab fisheries would drop to minor.

Drift-Net- and Purse-Seine-Gear Damage: Seismic vessels and supply boats and barges would be traveling between Unalaska/Dutch Harbor and the proposal area and through Unimak Pass. However, the salmon fishery occurs close to shore some distance from supply vessel routes. Any interference with this type of gear is highly unlikely. Effects on drift net and purse seine fishermen from the proposal are expected to be negligible.

Longline-Gear Damage: Vessel traffic associated with oil development in the North Aleutian Basin could potentially cause loss or damage to longline gear. This could affect foreign groundfish fisheries. It also would affect the joint-venture yellowfin sole fishery and the domestic Pacific cod fishery which are developing in the North Aleutian Basin.

Longline-gear consists of a line lying on the bottom to which short lengths of line with hooks called gangions are attached. Each length of longline gear is called a skate and is usually about 1,800 feet long. Each end of the skate is attached to a line running to the surface which is suspended from a buoy. These are usually inflatable buoys similar to those used in the crab-pot fisheries. Closely attached to the buoys is a floating marker pole about 17 feet high with a flag and sometimes a radar reflector. It is most unlikely that any longline buoys would be lost to oil-industry-vessel traffic. Longline-gear loss is expected to be negligible because these isolated buoyed poles could be damaged only by direct collision with industry vessels, a remote possibility given the dimensional area of the gear.

Trawl-Gear Damage: Oil development has the potential for causing damage or loss to trawl fishing gear. Nets and associated equipment can be damaged by debris deposited on the ocean bottom or by bottom obstructions such as abandoned wellheads.

Judging from historical data from the North Sea (which shows a significant decrease in gear loss in recent years [55 settled claims in 1979], Centaur Associates, 1983) on the number of gear-damage claims relative to the level of fishing activity and the level of offshore oil and gas development, and given the greater current awareness of the problem and means to reduce it among offshore developers today, it is expected that trawl-gear damage due to oil development in the North Aleutian Basin will be negligible--amounting to considerably less than one incident per year (Centaur Associates, 1983).

(c) Effects of Oil Spills:

Effects on Fishing Operations: If an oil spill occurred, fishing operations could be affected through fouling of gear or temporary preemption or foreclosure of fishing grounds. It also is possible that the catch could be tainted if fish were brought aboard a vessel in an area of oil contamination. As perceived by the public, tainting could be a marketing problem even if the fish were not actually tainted. If gear fouling occurred, expenses or lost time could be incurred while gear was being cleaned or replaced. Alternatively, fishermen probably would choose to avoid fishing in an oil-contaminated area if possible. In some instances (if alternative fishing opportunities were not available), this would result in lost fishing time and lost catch and income.

The degree of these effects on fishing operations would depend on the location, size, and areal extent of the spill relative to the concentrated fishing areas. Based on a statistical projection of 0.94 spills of 1,000 barrels or greater, it is assumed that 1 spill in this category would occur. It is possible that this spill could occur in or near a concentrated fishing area, with the result that this area would be closed to fishing for the period during which an oil spill is present.

On the southern side of the Alaska Peninsula, oil spills resulting from tanker traffic could potentially affect salmon, herring, crab and shrimp fisheries. These effects are discussed at the end of this section.

Effects on Fisheries: Fisheries that potentially could be affected include the Alaska Peninsula salmon fishery, the Bristol Bay salmon fishery, the herring fishery of the Port Moller area, the southeastern Bering Sea tanner crab fishery, the Bristol Bay king crab fishery, and the groundfish fisheries.

Salmon and Herring: Salmon and herring gill nets and purse seines probably have less chance of being contacted by oil than crab pots or other fishing gear, simply because of the short time frame that the gear is in the water. This gear is deployed over a period of hours while fixed gear may be fished for several days. Finally, there is less chance of an oil spill contacting these nearshore fisheries than of contacting crab pots or groundfish gear which is actually located in the proposal area. On the other hand, if an oil spill did occur and reach salmon fishing areas, consequences for salmon fishermen could be more devastating than for crab or groundfish fishermen. First of all, the salmon and herring fisheries are gauntlet fisheries taking place in a very short time period. If the spill did take place during this time period, the fishermen would have no alternative time period in which to fish because the fish would be gone. They could not make up for lost fishing time or lost catch, as could be done with fisheries that are spread out over a period of months. Secondly, salmon fishermen, because of the small size of their boats, the localized and stationary nature of the salmon fishery, and management regulations, could not switch to alternative fishing areas in the short run. In general, local salmon fishermen would be more adversely affected by this than fishermen from outside the region because they tend to have smaller boats and no alternate sources of employment.

Crab: Crab fisheries could be affected through fouling of the pot-marker buoys and polypropylene lines and through temporary foreclosure of fishing grounds. If buoys and lines were fouled, potential cleaning expense, replacement costs, or lost fishing time could be incurred. Delays in cleanup of more than 7 days could cause excessive damage to plastic buoys and lines, in the form of swelling. Fishermen would be forced to avoid large areas as a result of an oil spill to avoid oil-contamination of live-crab holding-tanks.

The extent to which crab gear could be fouled by an oil spill would be dependent on the period in which the spill occurred and the size and areal extent of the spill. For both the king and C. bairdi and C. opilio tanner crab taken in the North Aleutian Basin, there is considerable variation in catch, and thus crab pot density, within the lease area.

Groundfish: The groundfish fishery in the North Aleutian Basin would be affected to a negligible-to-moderate extent, depending on where the oil spill occurred. The North Aleutian Basin foreign groundfish catch is fairly concentrated in the area north of Unimak Pass; it is mostly for pollock. All of it is in the northwestern part of the proposal area. The joint-venture groundfish fishery is mostly for yellowfin sole, with some cod. It is concentrated more towards the inner part of Bristol Bay, including the eastern corner of the lease area.

Trawls could be fouled and/or catch could be tainted if deployment or retrieval were attempted in an oil-fouled area. Trawlers would likely avoid fishing in any oil-contaminated area; however, total catch and income to the groundfish fishery could decline, and competition for fish in other parts of the lease area could increase if trawlers were forced to avoid the highly concentrated groundfish area north of Unimak Pass.

Fisheries of the Southern Coast of the Alaska Peninsula: Under the proposal, no oil exploration or development activities will be occurring on the southern side of the Alaska Peninsula. However, if sufficient quantities of oil are discovered and production occurs, oil spills from tanker traffic could affect the southern Alaska Peninsula salmon, herring, crab, and shrimp fisheries. The salmon and herring fisheries on the southern coast are part of the Alaska Peninsula Management Area (Sec. III.C.1.), but the crab and shrimp fisheries are managed separately.

The production scenario calls for tanker traffic to leave Balboa Bay and pass by the Shumagin Islands, which are concentrated fishing areas for salmon, primarily pink salmon. The Popof Head section, including Korovin and Andronica Islands, was the most productive salmon area on the southern side of the peninsula in 1982, at almost 3 million fish (total southern coast catch was 11 million fish). Food bait and sac-roe herring fisheries also take place in the vicinity of where tanker traffic would be passing; however, the areas of highest yields have been away from the path of proposed tanker traffic and so would probably not be affected in the event of a spill (Sec. III.C.1.).

The southern coast king crab fishery takes place mostly in the Central District, between and including Sanak Island and the Shumagin Islands. Over 2 million pounds were taken from this district annually in the late 1970's and early 1980's; but the catch fell in 1982-1983, and the season was completely closed in 1983-1984 due to declining stocks. The king crab catch on the southern side of the peninsula is low compared to the more concentrated areas in the Bering Sea.

Tanner crab catch on the southern side of the peninsula is higher than the king crab catch--at between 3 and 9 eight million pounds per year since the late 1970's. In 1982-1983, most of the catch was in Pavlof Bay or west of Pavlof Bay, clearly out of the path of proposed tanker traffic from Balboa Bay. Balboa Bay does have some tanner crab catch, however (71,000 lbs in 1982 compared to 2,864,000 lbs for the entire southern side of the peninsula).

The dungeness crab catch on the southern side of the peninsula varies widely from year to year, but is generally very small compared to king and Tanner crab catches. However, in 1983-1984, the dungeness catch was over 500,000 pounds, partially due to the closed king crab season.

The southern Alaska Peninsula shrimp season has been closed since 1980 due to very low stocks. The future prospects for this shrimp fishery are unknown. Before this, the shrimp catch peaked at 45 million pounds in 1977-1978.

Judging from the record of present tanker traffic which has been transporting oil from Valdez through Prince William Sound with no accidents for several years, the likelihood of oil spills occurring in Balboa Bay or near the Shumagin Islands is extremely low. Oil-spill effects on these fisheries are expected to be negligible. However, in the very remote possibility that a major oil spill occurred, consequences for any of these fisheries could be major, if it occurred in a major fishing area during the fishing season.

Effects from Fish Mortalities: Section IV.B.1.a.(1) concludes that effects on the regional populations of salmon, herring, groundfish, and other invertebrates are expected to be minor and that effects on red king crab are expected to be major. When analyzed as relates to the commercial fisheries for these species the effects on commercial fising for salmon, herring, groundfish, and other invertebrates are assessed as minor. The principal salmon fisheries of the North Alaska Peninsula and Bristol Bay are short-term and well away from the source of oil spills or other potential adverse effects associated with oil and gas exploration/development. The principal herring fishery of the region, at Togiak in southwestern Alaska, also is at a sufficient distance (nearly 400 miles) from the proposed development and should not be affected by the project. The groundfish fisheries, primarily foreign with increasing domestic involvement, operates over vast areas of the southeastern Bering Sea, from Unimak Pass northward along the continental slope to the Pribilofs, and along the Aleutian chain into Bristol Bay. Over this large area (about 200,000 square miles), the chance of a potentially adverse effect occurring on any significant segment of these fleets is very unlikely because an oil spill spreading to 200 Km^2 would effect only this small portion of the total fishing area (300,000 Km^2); thus, the potential for adverse effect is minor. The other commercial shellfish species are distributed (both as larvae and adults) over an areal range to the extent that their populaitons would not sustain significant reductions from the effects of oil and gas exploration/development in the region.

On the other hand, effects on the red king crab fishery, could be major; the presently reduced Bristol Bay regional population could be further reduced by the effects of an oil spill and extended season closures might be necessary to restore the species to former population levels. The effect of oil spills on red king crab could have major consequences. The analysis on red king crab for Sale 92 (Section IV.B.1.a.(1)) concluded that major effects could occur from a large oil spill. Such an effect could lead to the eventual closure of the fishery to allow stocks to rebuild for 1 or more years. The subsequent loss to the commercial fishing industry could total millions of dollars. Under current prices ($2.60/pound) and quotas (2.5 to 6 million pounds), the loss for one season could total from $6.5 to $15.6 million.

(d) Other Effects:

Infrastructure and Service-Support Conflicts: Unalaska would be the location of the primary marine-support base for the offshore oil industry. While a number of other ports would be utilized by the fishing industry, Unalaska would also continue to have the greatest concentration of fishing-vessel port activity. This is particularly true for the larger crab vessels and for the growing numbers of domestic trawlers which will be harvesting groundfish in the Bering Sea. Thus, while some potential exists that the proposal could exacerbate congestion at Dutch Harbor, the effect of congestion in harbor facilities will be minimized because the oil industry is expected to develop dedicated support bases for the offshore-oil vessels.

Cold Bay would serve as the air-support base during the development and production phases. Cold Bay is not a fishing port and is used to only a very limited extent by the fishing industry, so competition for air-support services would be minimal.

There may be some competition for marine-repair and other support services used by both the offshore oil and the fishing industries. However, OCS development also would spur the development of a more extensive support-services infrastructure. This could actually benefit the fishing industry by increasing the local availability of such skilled services as welding, diesel repair, and electronic repair.

Collisions: Oil development, by bringing more air and vessel traffic into the area, will provide safety and other benefits to fishermen in the form of better communications and transportation, increased air-sea rescue capabilities, and more commercial amenities in port communities. At the same time, increased air and vessel traffic may decrease safety by increasing the probability of vessel collisions, to an indeterminate degree. At present, most vessel collisions occur in restricted areas (i.e., bays and harbors) during times of limited visibility. The incidence is very low, and the oil-vessel increment should not appreciably increase this already low rate. Analysis of the potential for collisions by Centaur Associates, Inc.(1983), under contract to MMS, indicates a collision rate in the open ocean, in ports, and in transit of less than one-tenth of a collision per year for 20 years for all areas of Bering Sea oil and gas development. Therefore, the incremental increase in the risk for collisions as a result of this lease sale would be negligible.

Competition for Labor: It is not likely that there will be significant competition for local labor between the offshore oil and the fishing industries, because the two industries will draw employees from a very large labor market outside the local area.

SUMMARY (Effects on Commercial Fishing Industry):

Potential adverse effects on the commercial fishing industry of the North Aleutian Basin include elimination or foreclosure of fishing areas by the presences of offshore facilities, with subsequent loss of harvest; gear conflicts resulting in loss or damage to fishing gear, harvest loss, and business downtime; oil spills resulting in gear fouling, closure of fishing areas, and direct loss or contamination of harvest; loss or damage to fishing vessels through collisions with oil industry vessels; and competition for support services, infrastructure, and labor. This amounts to a MINOR effect.

Loss of harvest through foreclosure of fishing areas by offshore facilities (platforms and pipelines) would be negligible because the maximum projected space-catch loss is a small fraction of one percent for any of the fisheries in the North Aleutian Basin. Crab-pot loss through seismic surveys in southeastern tanner crab and Bristol Bay king crab fisheries would be negligible. Crab-pot loss due to supply-boat and barge traffic is expected to be negligible. Damage to drift-net and purse-seine gear due to vessel traffic is expected to be negligible, because the fishery is well away from vessel-traffic routes. Longline-gear loss is expected to be negligible. Trawl-gear damage due to oil development also is expected to be negligible, amounting to less than one incident per year.

Oil spills, if they occurred in or near fishing areas while the season was in progress, could foul gill nets, purse seines, crab-pot buoys and/or groundfish trawls, and could cause temporary foreclosure of fishing grounds. In the case of the salmon and herring fisheries, there is less chance of a spill occurring during the fishing seasons simply because the seasons are so short. However, because of the gauntlet nature of these fisheries, if a spill did occur during this short season, economic consequences to fishermen would be more severe than for any other fishery due to the inability to switch to an alternate fishing time or area. In the event that a major oil spill occurred in the Port Moller area during the herring and/or salmon seasons, effects on these fisheries could be major.

Chances of oil spills contacting crab and groundfish fisheries are higher due to the larger areas fished, the longer seasons for tanner and brown king crab fisheries, and the year-round operations of the groundfish fisheries. There may be economic alternatives for these fishermen; they may be able to switch to alternative fishing times and areas in the event of a spill. If spills occurred in the most highly productive areas, competition in alternative fishing areas could increase only 1 spill of 1,000 barrels or greater occurring over the life of the project. The probability a spill of this magnitude contacting fishing areas off Port Moller ranges up to 49 percent for 3-, 10-, and 30-day trajectories. Combined probabilities indicate a 17- to 24-percent chance of an oil spill occurring and contacting the Port Moller area. Effects on the red king crab fisheries are expected to be major because of the restricted fishing area and the effect on the red king crab population (Sec. IV.B.1.a.(1)). Effects of oil spills on groundfish fisheries would be minor due to the large areas encompassed by these fisheries.

Competition for marine-support services and infrastructure would be negligible, with some positive effects from oil-related increases in local employment and in the local availability of repair services. Collision risks through increased vessel traffic would increase slightly. Competition for labor between the two industries would not be significant (Centaur Associates, 1983).

CONCLUSION (Effects on Commercial Fishing Industry):

Overall adverse effects of this lease sale on the commercial salmon, herring, and groundfish fisheries are expected to be MINOR. MAJOR effects are anticipated for the red king crab fishery, which is concentrated in a comparatively small area off the northern coast of the Alaska Peninsula.

CUMULATIVE EFFECTS (Effects on Commercial Fishing Industry):

Activities resulting in cumulative effects on the commercial fishing industry of this region include existing and proposed federal OCS lease sales in the Bering Sea--Sales 70, 89, and 101 in the St. George Basin; Sales 83 and 107 in the Navarin Basin; and Sale 92 in the North Aleutian Basin. All of these lease sales would result in increased oil-industry vessel-traffic in and out of Unalaska, an increased number of platforms and pipelines in the southeastern Bering Sea, and the potential for additional oil spills from tankering oil production from the above areas through Unimak Pass.

The potential adverse effects on commercial fisheries of the southeastern Bering Sea would include the elimination or foreclosure of fishing areas by the presence of offshore facilities, with subsequent loss of harvest; gear conflicts from supply-boat or seismic-boat traffic, resulting in loss of fixed gear (crab pots or longlines), loss of harvest, and downtime; gear fouling, closure of portions of fishing areas, and direct loss or contamination of harvest resulting from oil spills; loss or damage to fishing vessels through collisions; and competition for support services, infrastructure, and labor.

Gear conflicts could increase from those of the proposal, especially in the areas north of Unimak Pass. Unalaska would be the marine-support base for lease sales in the St. George, North Aleutian, and Navarin Basins, and supply boats and seismic vessels would be travelling back and forth between Unalaska and these areas. In addition, oil-industry-vessel traffic would be travelling through Unimak Pass to these areas and to the Diapir, Barrow Arch, and Norton Sound lease sale areas. If several of the lease sale areas were developed at once, gear conflicts in the area north of Unimak Pass would be minor in the cumulative case.

Centaur and Associates (1983) recently analyzed the magnitude of the effects from these cumulative Berring Sea lease sales on the commercial fishing industry of this region, in line with their projected increase in domestic fishing activity. The scenario assumptions used in their analysis deviate somewhat from those of this EIS; however, the conclusions are considered to approximate what could occur.

Centaur's document is, therefore, incorporated by reference. In summary, their projected harvest loss resulting from preemption of the fishing area by oil industry facilities was less than $24,000 (1982 dollars) in the year 2007 (peak year). Pot loss for all Bering Sea lease areas was calculated not to exceed 1,205 pots lost during 1997, the peak year of oil-industry-vessel traffic according to the existing schedule. Longline-gear-loss incidents in 1997 are projected not to exceed two in the halibut fishery and 599 in the Pacific cod fishery. Trawl-gear-damage incidents are estimated to number 25 in 2007 (peak year), averaging $45,000/year in gear damage and $25,000/year in lost fishing time. Collisions with fishing vessels would be at the rate of one every 79 years as of 1997, instead of the projected rate of one every 69 years without oil industry development.

The port of Unalaska would likely be the major marine-support staging area for almost all Bering Sea oil development activities. Harbor congestion from the cumulative lease sales probably would be minimal, considering current plans for dedicated oil-industry-dock space in Captain's Bay, which is located south of the major concentration of fishing-industry activity. Competition for labor also would be minimal, with the possibility of a positive benefit from additional employment opportunities during periods of poor earnings in the fisheries. Further, the increase in local availability of repair services also could benefit the fishing industry.

The most likely number of oil spills projected for all of the Bering Sea lease areas, including tankering from the Norton Sound and Barrow Arch areas and Canada, would be 24 spills of 1,000 barrels or greater and 0.03 spills of 100,000 barrels or greater. Considering that these spills would occur over all of the Bering Sea lease areas, and over the varying periods of exploration and development of each field (25 years or greater), it is conceivable that only a relatively small area would be affected by a spill at any one time. The severity of effect on commercial fisheries would depend on what area the spill occurred in; some relatively small areas of the Bering Sea are very productive fisheries, where activity and gear are concentrated and where catch and income loss due to gear fouling or closures could be high if a spill occurred during the fishery. On the other hand, other areas contain very low concentrations of fish, so commercial fisheries would be only negligibly affected by a spill. Generally speaking, inner Bristol Bay, the Port Moller area, the Aleutians area near Unimak Pass, the area north of Unimak Pass as far as 57°N latitude, and the Pribilof Islands area are locations where an oil spill could do damage to commercial fishing operations if the spill occurred around the time that the season was in progress.

A spill contacting a major salmon- or herring-harvest area immediately prior to or during the harvest could result in closure of the grounds and a subsequent loss to the industry of thousands to millions of dollars. An occurrence such as this in inner Bristol Bay or near Port Moller on the Alaska Peninsula would be considered a major effect on the fishing industry. The OSRA for the North Aleutian Basin, however, shows probabilities less than 0.5 percent of an oil spill of 1,000 barrels or greater occurring and contacting any nearshore areas in inner Bristol Bay. Oil spills from other lease areas in the Bering Sea appear to pose no risk to inner Bristol Bay areas. Oil-spill risk to Port Moller and other Alaska Peninsula salmon and herring areas in the cumulative case is the same or virtually the same as for the proposal.

The effect of oil spills on red king crab could have major consequences. The analysis on red king crab for Sale 92 (Sec. IV.B.1.a.(1)) concluded that major effects could occur from a large oil spill. Such effects could lead to the eventual closure of the fishery to allow stocks to rebuild for 1 or more years. The subsequent loss to the commercial fishing industry could total millions of dollars. Under current prices ($2.60/pound) and quotas (2.5 to 6 million pounds), the loss for one season could total from $6.5 to $15.6 million.

Conclusion (Effects on Commercial Fishing Industry: Overall cumulative effects on the southeastern Bering Sea fisheries are likely to be MINOR for the commercial salmon, herring, and groundfish fisheries. A MAJOR effect is anticipated for the commercial red king crab fishery.

(2) Effects on Local Economy:

Cold Bay: Employment effects would begin in 1986, with two additional jobs held by permanent residents of the community and 31 more jobs held by workers expected to be housed in a petroleum industry enclave. The enclave workers would commute to residences outside of Cold Bay, and would typically spend equal numbers of days on the job at Cold Bay and at their permanent residences elsewhere. Most commuters would maintain a permanent residence in Anchorage, in other urban centers of Alaska, or in communities outside of Alaska. The 31 new jobs held by commuters, together with the 2 additional jobs held by permanent residents, would increase total employment in 1986 from a projected

263 in the no-sale case to 296, for a gain of 13 percent above the no-sale case. (See Table D-6 for annual projections of resident, enclave, and total employment, with and without the proposed lease sale).

During the years 1987-1991, the total employment effects of the lease sale, including jobs held by commuters as well as jobs held by permanent community residents, would range from a low of 6 jobs to a high of only 29 jobs. Peak employment effects would occur in 1992, with 141 additional jobs, of which 8 would be jobs held by community residents and 133 would be jobs filled by commuters housed in the petroleum enclave. These employment effects would increase total employment in 1992 to 258, a gain of 121 percent above the 117 jobs projected in the no-sale case. The effect on employment would decline rapidly to 45 to 50 jobs in 1994 and subsequent years, but all of these additional jobs are expected to be filled by permanent community residents. All figures for jobs held by new residents include jobs created by the indirect effects of the sale, such as new jobs in retail trade or local government as well as jobs in the petroleum industry.

The general pattern is one of small employment effects in the exploration phase and fairly large effects during the development phase (peaking in 1992), with most jobs in both the exploration and development phases filled by commuters living in the petroleum industry enclave. By contrast, it is expected that the moderate number of new jobs created during the production phase (beginning in 1994) would be filled entirely by permanent residents of the community.

The projected increase in employment among local residents would not decrease joblessness, because current and projected unemployment is negligible at Cold Bay. The proposed lease sale is unlikely to have any significant effect, good or bad, on current residents.

Unalaska: Employment effects of the proposed lease sale would begin in 1986 with 13 additional jobs held by residents of the community and an additional 25 jobs held by workers expected to be housed in a petroleum industry enclave. The 13 new jobs held by community residents include jobs created by the indirect effects of the proposed sale, such as new jobs in retail trade or local government, as well as jobs in petroleum activities. The enclave workers would commute to residences elsewhere and would typically spend equal numbers of days on the job at Unalaska and at their permanent residences.

Most commuters would maintain a permanent residence in Anchorage, in other Alaskan urban centers, or in communities outside of Alaska. The 25 jobs held by commuters, together with the 13 additional jobs held by community residents, would increase total employment in 1986 from a projected 879 in the no-sale case to 917, for a gain of 4 percent above the no-sale case. (See Table D-5, Appendix D, for annual projections of resident, enclave, and total employment, with and without the proposed lease sale.)

Employment in sale-related activities would range from 6 to 46 jobs in the years 1987 to 1991. In 1992, total employment would be increased from 1,640 jobs in the no-sale case to 1,825 as a result of the lease sale, for a projected gain of 11 percent. The total gain of 185 jobs in 1992 would include 53 new jobs held by fulltime residents of Unalaska and 132 jobs held by commuters. By 1994, the total number of additional jobs in Unalaska as a result of the proposed sale would drop to 70 and would remain at 60 to 70 jobs through the year 2010. During the years 1994-2010, all of the sale-related jobs are projected to be held by residents of the community. During this period, the increase in employment due to the proposed sale would be no more than 3 percent of the employment projected in the absence of the proposed sale. The percentage increase over the no-sale case is relatively small because total employment in Unalaska is expected to grow rapidly in the no-sale case during the years 1983 to 2000, due to expansion of the domestic groundfish industry. The increase of 60 to 70 jobs in the years 1994-2010 would include jobs created by the indirect effects of the proposal, such as new jobs in retail trade or local government as well as jobs in petroleum activities.

The general pattern is one of small employment effects in the exploration phase and fairly large effects during the development phase (peaking in 1992), with most jobs in both the exploration and development phases filled by commuters housed in the petroleum enclave. By contrast, it is expected that the moderate number of new jobs created in the production phase (beginning in 1994) would be filled entirely by permanent community residents.

Because unemployment is believed to be extremely low among permanent residents of Unalaska, it is doubtful that the proposed lease sale would decrease joblessness in the community. However, because petroleum industry jobs generally pay well, it is possible that average incomes in the community would be increased as a result of the lease sale. Possible negative economic effects include crowding of port facilities, a slightly increased rate of price inflation, and housing shortages. Any effect on price levels would probably be limited to prices charged by hotels, restaurants, and bars, and to residential rental rates. (See section IV.B.1.b.(1) for a discussion of possible effects on the fishing industry and Section IV.B.1.b.(4) for a discussion of possible effects on subsistence activity.)

SUMMARY (Effects on Local Economy):

Expected economic effects include increases in the job totals for Unalaska and Cold Bay, but no decline in joblessness in those communities. Possible negative economic effects could occur at Unalaska in the form of port congestion, housing shortages, and increased rates of price inflation--including rental housing prices.

CONCLUSION (Effects on Local Economy):

Economic effects on the local economy are expected to be MINOR.

CUMULATIVE EFFECTS (Effects on Local Economy):

The base-case (no-sale) projections of employment used in the preceding analysis include estimates of employment resulting from the St. George Basin (Sale 70), assuming no discovery is made, and employment resulting from the Navarin Basin (Sale 83), assuming the discovery and development of the mean-resource estimate. The base-case projections also include estimated employment resulting from only exploration activities associated with the St. George (Sale 89). In addition, the base-case projections reflect the assumption that the large foreign harvest of groundfish in the region would be taken over by the domestic fishing industry, and that some of the groundfish would be processed onshore at Unalaska.

If either or both of the St. George Basin lease sales (Sales 70 and 89) should result in a substantial discovery, with resulting development and production activities, the additional cumulative effects on the communities of Cold Bay and Unalaska would be similar in nature to the effects described above for the North Aleutian Basin (Sale 92). The higher levels of employment, if either or both St. George Basin sales resulted in a discovery, would consist largely of additional jobs filled by commuters. During work periods, most of these commuters would be housed at locations offshore or at remote sites onshore. Those commuters whose jobs are in the communities of Cold Bay or Unalaska would be housed in petroleum industry enclaves.

Because unemployment is currently at extremely low levels in both Cold Bay and Unalaska, the cumulative employment effects could not be expected to further decrease joblessness in those communities. The cumulative effects could include negative economic effects at Unalaska in the form of port congestion, housing shortages, and possible increased rates of price inflation--including prices for rental housing.

<u>Conclusion (Effects on Local Economy):</u> The cumulative economic effects are expected to be MAJOR, consisting primarily of the very large projected increases in employment resulting from the expected expansion of the domestic-groundfish industry.

(3) <u>Effects on Community Infrastructure</u>: The development scenario for the mean-resource level indicates that an air-support base would be located at Cold Bay and that marine support would be based out of Unalaska/ Dutch Harbor. The resident populations generated by onshore activities of the above nature are the major effect-causing agents to the infrastructure. Population increases can result in an increased demand for and use of infrastructure, and severe adverse effects can occur when such uses exceed a facility's capacity or an agency's ability to provide services. Expenditures necessary for public services and facilities generally rise in response to demand generated by economic and population growth. However, although revenues generated from onshore OCS activities should be adequate to cover long-term expenditures, there could be a lag between the time that the demand for services arises and the time that tax revenues can fill the demands for services. During this period, a community could experience hardships (i.e., crowding of facilities, shortages of supply, and/or reduction of service standards).

The following analysis identifies the effects that OCS-related population growth would have on the capacities of existing and/or projected services in Cold Bay and Unalaska. This analysis is based on the following assumptions: (1) industry would provide facilities and services for all employees residing in an enclave, and only employees who became permanent residents of a community would use local infrastructure, and (2) industry would develop electrical and water-supply capacity to meet support-base functions. More detailed information concerning the projection of demand levels for the communities of Cold Bay and Unalaska can be found in Appendix E.

Cold Bay: If a commercial discovery of oil were made, an OCS-generated population of 72 residents could be expected to occur in Cold Bay by the year 1994. Development of an air-support facility would in itself provide very little additional strain on existing facilities, since the increase in demand from OCS activities would be offset by population losses as a result of reduction of the labor force in the transportation, communication, and government sectors. The largest additional demand would be placed on the community infrastructure during the production phase (1994-2010). During this period, OCS-generated residents would be at a peak (72 individuals); however, due to the projected population decline, this would constitute a population gain of 56 residents over the 1981 population (225) (University of Alaska, ISER, 1984). As a result, there would be little additional demand on community infrastructure.

Housing should pose very few problems for the community. Operating cutbacks by several companies and the FAA would result in population reductions and a subsequent oversupply of housing. During the period of base-case population declines, OCS activities would result in a small influx of new residents. The OCS demand for housing units would begin in 1986, reach a peak of about 17 units in 1996, and remain stable at this level over the rest of the forecast period. Up to the year 1996, the oversupply of housing resulting from base-case population declines would be offset by demands created from an influx of OCS residents. The potential uses of the available housing are uncertain; however, housing may be leased or rented to new residents. After 1996, population increases would create a demand for about 11 additional residential units. Land available for private development is currently limited. The city is conducting negotiations with the State of Alaska and the federal government in an effort to gain access to land. The planning group for the Bristol Bay Cooperative Management Plan projects that the city would acquire about 1,000 acres of land by the end of the century (Impact Assessment, 1983a). If the efforts are successful, adequate amounts of land would be available for residential purposes.

Little change is anticipated in the nature of educational service in Cold Bay. Enrollment increases attributed to OCS activities would not be anticipated until the beginning of the production phase (1993-1994). During the exploration and development phases, most workers would be unattached or without dependents due to the short-term nature of construction jobs.

An enrollment increase of 1 student could be expected by 1992; by 1994, an increase to 10 students would remain at this level through the year 2010. The reduction in school enrollments resulting from FAA retrenchments would not be offset by the increased enrollments attributed to service-base activities. During the years of peak OCS enrollments (1996-2010), total enrollment in Cold Bay's school systems is projected at about 40 students. This is less than the current enrollment of between 45 and 50 students.

The current capacity of Cold Bay's generation system is 1,200 kilowatts (kW), which is over twice the current peak demand on the system. Assuming an installed generation capacity of 3.75 kW per resident (Alaska Consultants, 1981), a peak OCS-generated demand of about 125 kW would occur between 1995 and 2010. Considering that the total demand would peak at about 1,060 kW during this same period, the generation system would be able to accommodate the total resident population over the forecast period.

The water- and sewage-treatment systems are overused at the current population levels. Because these systems are substandard, and considering the current negotiations between the city and the FAA regarding responsibility for system improvements, these systems probably would be expanded and improved within the next decade. Prior to 1994, OCS-generated residents would put very little demand on these systems (about 1% of total demand). These demands would be offset by the projected losses in the base-case population through this period. After 1994, OCS-generated water use is estimated to average about 10,000 gallons per day (GPD). The minor population increase projected from OCS activities over the next decade and the decline in the base-case population would create a lag period in the mid-1990's, when repairs and upgrading of these systems could be made.

Cold Bay's health services would not undergo substantial changes. A new health clinic was constructed in 1982. It is likely that health care would continue to be provided by a visiting public health nurse and a physician. Serious health-care needs would continue to be provided in Anchorage.

Police protection in Cold Bay is currently adequate, and a full-time officer would not be required solely due to the influx of OCS workers. Fire protection would be adequate in terms of equipment and storage capacity. The system currently does not meet the standard of pumping 500 gallons per minute above normal water-flow conditions for a 2-hour period.

Unalaska: If a commercial discovery of oil were made, a maximum OCS-generated population of 112 residents could be anticipated in Unalaska by the year 1994. Between 1994 and 2010, the resident OCS population would decline slightly and stabilize at 100 to 105 residents (University of Alaska, ISER, 1984). The effects on individual services provided in Unalaska due to population growth attributed to OCS activities are discussed in the following paragraphs.

Housing demands from OCS activities in Unalaska would peak at about 45 units in the late 1990's. This would constitute about 5 percent of the total housing demand. Because of the small amount of land available for development, the increased demand for housing, however small, could be expected to fuel land speculation. This could manifest itself in higher land-purchase and house-rental prices.

The facilities and staffing necessary to accommodate base-case growth in the Unalaska school system should be adequate to accommodate OCS-generated growth over the forecast period. Only one additional classroom would be necessary. Enrollment increases would begin in 1986 and increase to a peak of about 24 students between 1995 and 2010. Peak OCS-generated enrollments would constitute about 4.5 percent of the total enrollment in the system.

Improvements planned for Unalaska's utilities (power generation, water and sewage treatment) probably would be completed within the next 4 or 5 years. Even with the planned improvements, these systems may not be able to accommodate the projected increased demands. Improvements to the water and sewage treatment also could be delayed, due to decreases in city revenues for public facilities. The demands generated by OCS-resident populations on these services would exacerbate the existing conditions associated with these systems; however, the demand increases would be minimal when compared to the projected base-case-demand levels.

The city's plan indicates that the current power-generation system would be augmented in increments of 2,500 kW as demand warrants and that, by 1990, power is expected to be supplied by a geothermal plant or a heavy-fuel, low-speed diesel plant. Assuming these goals are achieved, OCS-residential-power demands would have a negligible effect on the community's generation system. Installed capacity requirements for OCS-residential needs could range from about 80 kW in 1990 to about 400 kW in 2010, assuming an installed capacity of 3.75 kW per resident. Generally, these needs would account for about 5 percent of the generation system's total capacity. OCS companies operating out of Unalaska probably would generate their own power until the city develops a reliable central power system; thus, they would have little effect on the city's system. As OCS activities and the fishing industry are phased into this system, service-base demands could reduce power available to other users (processors) if the system does not possess adequate peaking capacity. In these instances, users would be required to generate power during peak-loading periods, thus increasing costs (Centaur Associates, Inc., 1984).

The economic growth expected in Unalaska over the next 30 years would increase considerably the demand on the city's water system. Based on economic and population-growth figures, future average demands for industrial and residential purposes are expected to increase from current levels (11.5 million gallons per day [MGD]) to a peak of about 24 MGD between 2000 and 2010. The majority of this growth is attributed to an expanded seafood-processing industry. Assuming that planned improvements to the system are completed and system leakage is reduced to near zero, the present system--with a flow of 17.3 MGD--would be adequate through the early 1990's. OCS domestic demands would account for less than 1 percent of the total demand over the forecast period. The use of city water by the oil industry for industrial purposes is expected to be minimal. Fresh water is currently available from an abandoned military water reservoir on the Offshore Systems, Inc., terminal property.

Due to the correlation between wastewater and water consumption, the effects of OCS activities on Unalaska's sewage-treatment system would be similar to those of the water-supply system. Existing collection and treatment facilities are extremely inadequate and pose a health hazard to the community, due to large quantities of sewage and water being dumped into the waters around Unalaska. Increases in sewage and wastewater production from current levels to about 700 MGD by the year 2000 could aggravate existing problems. However, OCS activities would contribute only about 3 percent of the total wastewater production.

Construction of support bases would not affect the city infrastructure or the fishing industry. Operators of the Offshore Systems, Inc. facility have indicated that a septic tank and a leach field would be built to handle wastes generated by the OCS work force. The potential Captain's Bay support-base site in Unalaska is also far enough away from fishing industry activities (Iliuliuk Harbor) that any discharges from the support base would not interact with the seafood industry (Centaur Associates Inc., 1984).

OCS activities would increase the local population and put an additional strain on health, police, and fire services; however, no additional staff or facilities would be necessary to meet the additional demand. In the long term, increased OCS activity could increase the availability of aircraft and vessels in the region which could aid local personnel in medical-emergency situations.

SUMMARY (Effects on Community Infrastructure):

Development of respective air and marine bases in Cold Bay and Unalaska, to support offshore operations would increase these cities' resident populations and thus increase demand on community services.

An OCS-generated population of 72 residents could be expected in Cold Bay by the year 1994. Air-support-facility operations would provide little additional strain on existing community facilities since increases in demand from OCS activities would be offset by demand decreases resulting from baseline population decreases. During the production phase (1994-2016) OCS residents would be at a peak, however due to projected base case population decline, this would constitute a net population gain of 56 residents over the 1981 population. As a result, there would be little additional net demand on community infrastructure.

An OCS-generated population of 112 residents could be anticipated in Unalaska by 1994 due to marine support activities. This influx of new residents would increase demand on community services by less than 5 percent.

CONCLUSION (Effects on Community Infrastructure):

Population increases associated with the development of an air-support base in Cold Bay would have a NEGLIGIBLE effect on all basic services. Population increases resulting from an OCS marine-support base in Unalaska also would have a NEGLIGIBLE effect on all services and facilities.

CUMULATIVE EFFECTS (Effects on Community Infrastructure):

The cumulative effects on the infrastructure of Cold Bay and Unalaska are based on the assumption that (1) commercial quantities of hydrocarbons would be discovered and produced from the following planned OCS lease sales: St. George Basin (Sale 70), Navarin Basin (Sale 83), St. George Basin (Sale 89), North Aleutian Basin (Sale 92); (2) Cold Bay and Unalaska would serve as air- and marine-support bases, respectively, for the above-mentioned sales; and (3) base-case demands on these communities' infrastructures would be the same as outlined in the future environment without the proposal (Sec. III.C.3.).

Cold Bay: The population of Cold Bay is expected to decline from its 1981 level (225) through the early 1990's. This is due to contraction of the labor force in the communication, transportation, and government sectors; resulting in emigration of residents. After the early 1990's, the resident population should reach a peak population in the early 2000's. Cold Bay's existing education facilities and electrical, health-care, police, and fire-protection systems should be adequate to accommodate community needs to the year 2010. Only the sewage-treatment and water-supply systems should require upgrading.

The reduction of FAA operations in Cold Bay would result in the city taking increased responsibility for the operation of the water-supply and sewage-treatment systems, which are currently operated by the FAA. Facility operation would force the city to come to terms with revenue-generation problems to finance improvements in the systems. To finance facility improvements and to have sufficient revenue to operate the systems, the city would have to adjust the tax-rate structure or institute a property and/or sales tax (Impact Assessment, Inc., 1983a). Even with the population reductions anticipated in Cold Bay through the year 1992, the sewage-treatment facilities would require upgrading to meet EPA standards and the water system would require a greater storage capacity. The current capacity of the water-supply (.030 MGD) and sewage-treatment systems (.0225 MGD) would be exceeded in the early 1990's.

Unalaska: The expansion of the OCS and groundfish industries and the resultant increase in residents would place pressure on the municipal government to provide adequate services. The city's capacity to meet community needs would depend largely on municipal sales and use taxes, since federal and state revenue-sharing funds are expected to decline. The decline in the king crab fishery has resulted in a reduction in use-tax revenues over the past several years, and this trend is expected to continue until the groundfish industry expands. Through the 1980's, revenues are expected to decline; however, as the groundfish industry becomes established and sales- and use-tax revenues increase in the 1990's, the city would be in a more favorable position to improve the existing infrastructure (Impact Assessment, Inc., 1983b).

The school-age population in Unalaska is projected to increase from its current level (165 in 1981-1982 school year) to over approximately 565 students between the years 2000 and 2010. Despite these projections, school enrollments have been declining over the past several years. This decline is due primarily to the decline in the crab fishery and resultant outmigration of families with school-age children. As the groundfish industry develops, this trend would reverse (Impact Assessment, Inc., 1983b). Existing facilities and staffing levels should be adequate to support the projected student populations at or below a 20-student/one teacher/classroom until about 1995.

The Unalaska power utility has an installed capacity of 1,200 kW, with improvements to the distribution system and centralization of power generation scheduled for completion by 1988. At that time, most residential and small commercial businesses would be online and the utility would offer seasonal and/or peak power to industrial users; however, industry would continue to generate the majority of its own power. By 1990, it is expected that power would be provided by a geothermal plant or heavy-fuel, low-speed diesel plant.

Given the estimated increase in Unalaska's population and fishing industry, the demand for city water is anticipated to increase. The depression in shellfish-industry activities is anticipated to cause a decline in water consumption through 1985; however, the development of the groundfish industry and associated population increases after 1995 would reverse this trend. The future average water demand for domestic and industrial uses is projected to peak at 24.5 MGD prior to the year 2000. Given an average water flow of 17.3 MGD, the water system should be able to accommodate the increased demand into the mid-1990's. This assumes that programmed distribution improvements are completed to ameliorate water-system-leakage problems. Planned improvements probably would be completed in the next 4 or 5 years; however, they may be delayed because of decreases in revenues used for public purposes.

Domestic wastewater and sewage are anticipated to increase from existing levels (.33 MGD). With existing collection and treatment facilities being severely inadequate and posing potential health problems, the anticipated additional sewage load would aggravate potential community-health hazards. These problems could be alleviated only with the development of a primary sewage-treatment plant.

Health-care needs are projected to increase, primarily due to stress-related disorders associated with a short-term declining economy (depressed shellfish industry) and stress in the 1990's associated with boom-town conditions resulting from an expanding groundfish industry. The quality of medical care probably would remain basically the same until the mid-1980's. As the demand for health care increases, expansion of facilities and services provided by the Iliuliuk Health and Family Services Clinic would be necessary. By 1995, Unalaska should be large enough to support two physicians, and the clinic probably would require two or three additional rooms for treatment and short-term stays.

Groundfish-industry-associated population increases are expected to increase Unalaska's crime rate. Within the next 5 to 7 years, crime would consist primarily of misdemeanors. As the growth rate increases in the 1990's, more felonies would be observed (Impact Assessment, Inc., 1983b). Unalaska would continue to have a large number of police officers in relation to its population due to the influx of transient labor during the fishing season.

The projected residential and industrial growth would necessitate the upgrading of fire-protection facilities. Because residential areas are anticipated to be developed on several locations, several new stations may be needed to provide adequate protection. With increased development of the waterfront; it also may be advisable to develop a marine firefighting capability. The community water system also should be designed to have a minimum-flow rate of 500 GPM (gallons per minute) above normal consumption.

<u>Conclusion (Effects on Community Infrastructure)</u>: The population trends projected for Cold Bay would generally have a NEGLIGIBLE effect on the community's infrastructure, the same as for the proposal. Only the water-supply and sewage-treatment systems would experience MODERATE effects. The residential and industrial growth projected for Unalaska would have a MAJOR effect on the community's infrastructure, as compared to NEGLIGIBLE effects resulting from the proposal.

(4) <u>Effects on Subsistence-Use Patterns</u>: The characteristics of local use of locally available fish and wildlife resources in the communities potentially affected by the proposal are discussed in Section III. C.4., along with a forecast of future subsistence trends in relation to the biological productivity of the resources. For the purpose of this effects assessment, please refer to Section IV.B.1.b.(4) for the assessment of effects on biological populations and habitats. This assessment focuses primarily on localized subsistence resources in terms of risks from population increases and oil-pollution events and, to a lesser degree, seismic activity. As discussed in Section IV.B.1.a.(1), seismic activity would have a negligible effect on fisheries resources in the North Aleutian Basin.

Cold Bay and Unalaska: There is the possibility of population increases accruing from the proposal in Unalaska and Cold Bay, which are designated as potential host communities in the proposal scenario. Based on RAM (mathematical model) projections, the proposal could increase the resident population of Cold Bay by 25 to 31 percent, with the addition of about 70 new residents. The population of Unalaska could be expected to increase by 4 to 7 percent, with the addition of about 100 new residents in a community of about 2,300. Subsistence-use patterns in Cold Bay should not be materially affected by the increase in resident population due to the limited extent of subsistence practices and the relative abundance of fish and wildlife resources in reach of Cold Bay residents. In Unalaska, effects on subsistence-use patterns from an increased resident population contributed by the proposal should prove marginal to the increased competition for subsistence resources brought about by residents associated with the groundfish industry, as discussed in Section III.C.4. The groundfish industry is forecasted to about triple the resident population of Unalaska over the 15 years from 1985 to 2000, thus increasing this population from 756 to 2,235. Such a magnitude of population change is expected to be a major agent for change in subsistence-use patterns in the community. Increased competition for locally available subsistence resources, in conjunction with a potential reduction of habitat resulting from the construction of added community infrastructure, could cause the need for increased local harvest regulation and a resultant need for increased investment and cash outlay in transportation to gain access to subsistence resources, if available, at a farther distance. That segment of the population unable or unwilling to acquire the income necessary for such expenditures could experience unmet subsistence needs. The result could mean an increased dependency on wages and other forms of income (such as transfer payments) to purchase subsistence-resource substitutes. Effects of the proposal, although of potentially the same nature, should be considerably less because of the relatively minor increase in population attributed to the proposal, as indicated earlier.

The potential loss of subsistence resources or habitat from offshore oil-spill events is more likely in Cold Bay than in Unalaska, due largely to the proximity of the offshore field. However, the OSRA shows an extremely low probability (1%) of spilled oil reaching the northern coast near Cold Bay within 30 days, and no contact within 3- or 10-day periods. As a consequence, the combined agents of potential population increases and oil-spill events have the highest potential in Cold Bay, but the net result on Cold Bay subsistence-use patterns should be minimal due to the limited demand for resources and the relative abundance of resources in the area. Due to the geography of the lease sale area, potential oil spills from the lease sale area should have little or no effect on local subsistence resources of Unalaska.

Bristol Bay Region: No further OCS-related facilities are expected to be established in the Bristol Bay region beyond the Cold Bay air-support facility and the oil terminal at Balboa Bay. Potential effects from those facilities are discussed in the following section (lower Alaska Peninsula subregion). For the region as a whole, however, increased pressure on subsistence resources from increased OCS-associated population should be minimal and relatively inconsequential due to the general absence of such population in the region.

Oil-spill incidents comprise another important source of potential direct effects on subsistence-use patterns. Direct effects on subsistence-use patterns in specific communities could be realized if an oil spill were to contact coastal habitats or harm or redistribute marine resources within community subsistence-harvest domains. Such results could tend to reduce the amount and/or accessibility of subsistence resources in places where they are normally harvested, resulting in the need to travel farther to harvest the same or comparable resources, if such were available and the knowledge of the new terrain were present. If the funds for added mobility were not available or the resources in question were not within reasonable procurement range, conditions could result in an increased use of available subsistence resources (if the supply could accommodate the added demand), or in an increased dependency on wage labor or transfer payments to purchase resource substitutes. Some degree of negative long-term effects on the health of family members could be set in motion if a pattern were established, beyond that of the present situation, where processed foodstuffs high in carbohydrates were substituted for natural protein sources.

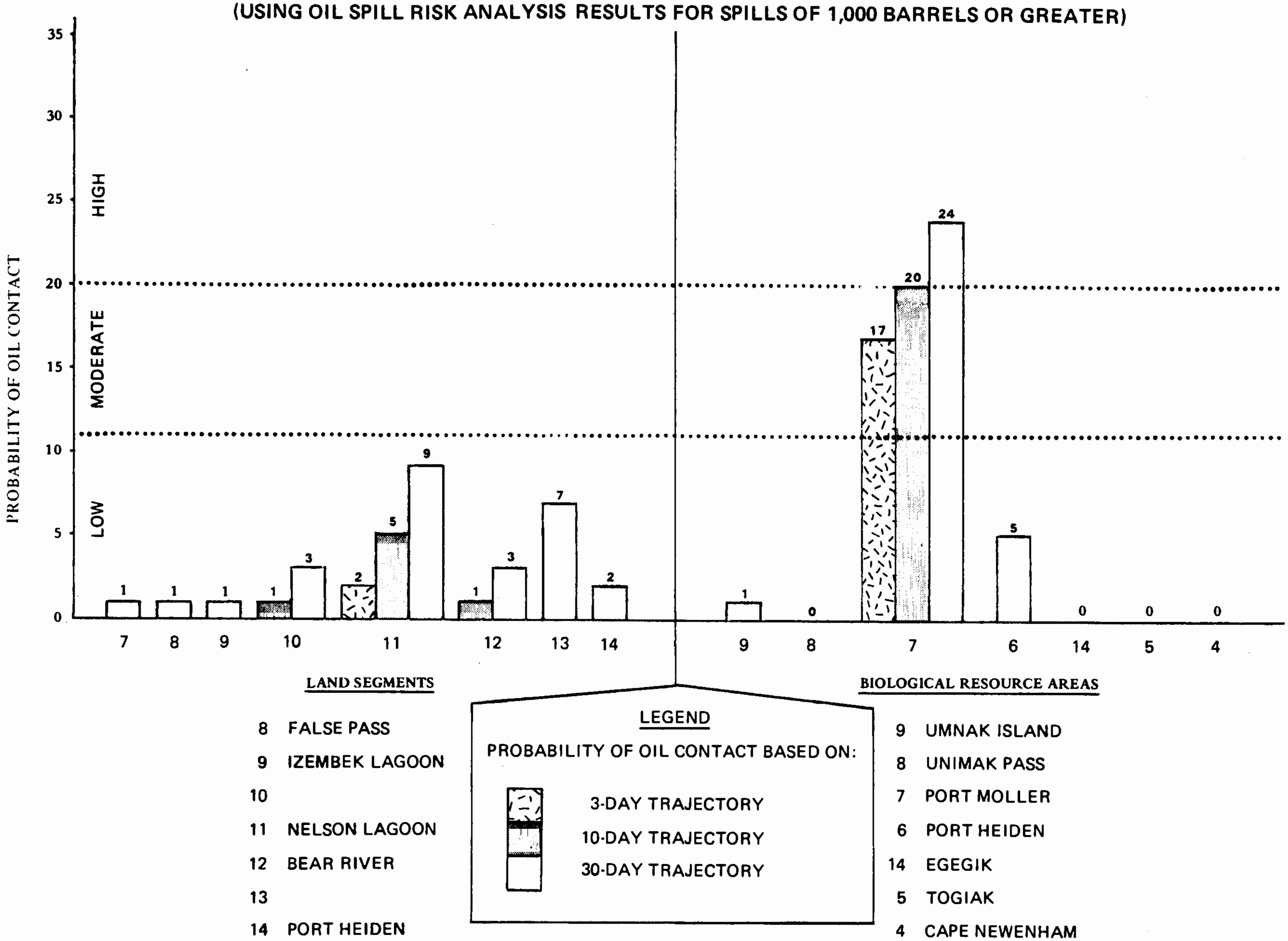
According to the OSRA data, there appears to be a relative absence of direct oil-spill contacts with land segments and biological resource areas in the Bristol Bay region as a whole, as shown in Figure IV-12. Where such segments or areas are contacted by oil-spill trajectories, the probability of contact in most cases is low (1%-or-less probability). The Port Moller area on the northern coast of the Alaska Peninsula is the exception to these OSRA statistics; potential effects on subsistence-use patterns in the Port Moller area and on comparable patterns near Balboa Bay are discussed in the following section on the lower Alaska Peninsula subregion of Bristol Bay.

Despite the relatively low potential for direct effects from oil spills on subsistence-use patterns in the Bristol Bay region, indirect effects could accrue if subsistence resources or habitats were tainted from a spill or if a tainting scare were to cause the state (the salmon fishery manager) to close or sharply curtail the commercial salmon fisheries along the Alaska Peninsula or in Bristol Bay. The latter case could cause increased pressures on marine and terrestrial subsistence resources as a short-term strategy for dealing with the income shortfall. The possibility of tainting, of course, is conditioned on the assumption that an oil spill of sizable proportions would occur during the time of adult salmon migration or during the rather short period devoted to commercial salmon fishing.

It is unlikely that the tainting of adult salmon by an oil-spill event would curtail subsistence fishing unless the spill effects were maintained over a considerable period of time. The subsistence fishery has a long history of harvest consistency (see Sec. IV.B.1.b.(1)), seemingly related more to cultural requirements than to fluctuations in income from commercial fishing. Reduction or curtailment of the commercial fisheries, however, would provide a context of a greater-than-usual economic necessity to the subsistence salmon catch, with the catch expected to be larger than normal despite the potential of the meat being tainted. The harvest of other subsistence resources also could be expected to increase, with increased subsistence-harvest pressure expected to be brought about on moose and caribou, which provide a relatively large return of protein for the effort expended. Such increased subsistence demand, coupled with existing patterns of sport hunting, could produce the

FIGURE IV-12

PROBABILITY OF OIL CONTACT IN SUBSISTENCE-HARVEST AREAS (USING OIL SPILL RISK ANALYSIS RESULTS FOR SPILLS OF 1,000 BARRELS OR GREATER)



Source: MMS, Sale 92 DEIS, 1984 (Appendix G, OSRA Table G-10 and G-14).

need for establishing a subsistence-use priority in the hunting of moose and caribou in affected parts of the Bristol Bay region. Additional effort for resource procurement also would be expected, since a wider-than-normal spectrum of resources would be harvested in the region. These increased harvest activities, again, are based less on the lack of marine-resource availability and more on a short-term strategic response to dramatic income shortfalls should the commercial fishery be sharply reduced or curtailed in response to an offshore oil-spill incident.

Effects from an income shortfall on commercial fishermen would not be expected to be evenly distributed in the Bristol Bay region. Marginal commercial fishermen, or villages only marginally involved in commercial fishing (such as in the Lake Iliamna subregion), could be more affected than others by a shortfall in the primary (and in some cases the sole) means of locally available cash-income production. Such individuals, families, or villages would be characterized as gaining less income than the norm from commercial fishing as a result of technological and/or cultural reasons, and would be generally more engrossed in subsistence-based livelihood patterns than those more oriented to urban values and sets of behavior. In this region an important and tenuous relationship exists between subsistence production and the cash income necessary to subsist, not only for methods and means of production (snow machines, weapons, fuel, traps, skiffs, kickers, etc.) but also for the means of family residence (fuel, family transportation, food staples, clothing, etc.) in the area where the subsistence resources are found.

Lower Alaska Peninsula Subregion: The lower Alaska Peninsula subregion (both northern and southern coasts) could be more affected by the proposal than other parts of the Bristol Bay region due to the proximity of the lease sale area, the extension of a pipeline from the lease area through Port Moller, and the designation of Balboa Bay as a potential site for a major oil and gas terminal. The communities involved include False Pass, Nelson Lagoon, Port Heiden, King Cove, Sand Point, and Cold Bay. Effects on subsistence-use patterns in Cold Bay from added population associated with an offshore air-support function and the operation of an oil and gas terminal on the Alaska Peninsula were discussed in Section IV.B.1.b.(2). Elsewhere in the subregion, effects of added population associated with the lease sale on subsistence-use patterns (such as added harvest pressure producing more restrictive harvest regulations) could be realized in Nelson Lagoon and Sand Point. Nelson Lagoon would be expected to be visited by construction crews for a brief period of time during construction of the pipeline through Herendeen Bay, but no lasting changes should ensue in the subsistence-use patterns of Nelson Lagoon residents. Additional caribou-hunting pressure could result, given the availability of the resource; but this would be marginal to the local effort and the combined effort of fly-in Anchorage meat hunters or guided trophy hunters. In the long run, the added personnel needed to operate and maintain the pipeline would contribute little or no added change to subsistence-use patterns at Nelson Lagoon, due to the limited number of personnel presumed to be involved.

Subsistence-use patterns at Sand Point could be affected if the Alaska Peninsula terminal were to attract service industries, U.S. Coast Guard family housing (as in Valdez), or migrants attracted to the community in hopes of finding work. The level of effect from population increases, however, should be minimal. Salmon and other marine resources are relatively plentiful and potentially not subject to harvest conflict. Terrestrial wildlife, especially moose and caribou, must be hunted on the mainland, a condition which should limit access to such resources due to the transportation costs involved. Residents normally fly or use the family fishing vessel for such excursions, whereas newcomers likely would have less access due to the level of technology owned or the level of discretionary income available. Should commercial salmon fishing be affected, direct effects on subsistence-use patterns at Sand Point may be lower in terms of direct effects on subsistence resources than indirect effects among segments of the population.

For communities on both coasts of the lower Alaska Peninsula, the potential for indirect effects on subsistence-use patterns from direct effects of commercial salmon fishing looms more prominent than the potential direct effects from the lease sale. As elsewhere in the Bristol Bay region, tainting or the fear of tainting of adult Bristol Bay salmon (which migrate along and are caught commercially on both coasts of the Alaska Peninsula as well as in Bristol Bay), also would affect the fishing communities of the lower Alaska Peninsula subregion. Such short-term phenomena could put added pressure on marine and terrestrial subsistence resources available locally, with perhaps added hunting pressure on caribou. The lack of a commercial salmon catch should not affect the availability of salmon for subsistence use, although--due to the cost involved--a means other than the family fishing vessel may have to be used to acquire these staples. Within these communities, however, the subsistence-use patterns that could be most affected would be those of the marginal commercial fisherman, due to a potentially tenuous relationship between cash- and subsistence-income production. A drastic shortfall in income from commercial fishing to such individuals or families could considerably reduce the customary level of subsistence harvest and result in unmet subsistence needs. Marginally successful fishermen of the lower Alaska Peninsula subregion are more apt to be found in the larger communities, such as King Cove and Sand Point, due to the ability of these communities to substitute for kinship-support systems with other social- and institutional-support networks.

<u>SUMMARY (Effects on Subsistence-Use Patterns)</u>:

Increased population from marine-support facilities should contribute only marginally to changes in subsistence-use patterns among the population of Unalaska because of the relatively minor increase in resident population attributed to the proposal, which would be the chief causal agent for subsistence effects. Subsistence-use patterns in Cold Bay are not expected to undergo a material change from those brought about by the normal growth of the community, let alone from OCS-related air operations, due to the relative abundance of local resources combined with the limited subsistence practices carried out in the community. Within the Bristol Bay region and the lower Alaska Peninsula subregion, subsistence-use patterns are not likely to be directly affected by the lease sale (from population pressure or oil-spills directly reducing the populations of subsistence resources). These patterns could be indirectly affected, to a limited degree, should an oil-spill event cause a major reduction or closure of the Bristol Bay or Alaska Peninsula commercial salmon fisheries for fear of producing a tainted product for market. If such an event occurred, the short-term income shortfall to commercial fishermen would affect primarily those commercial fishermen/families or villages which are more marginal to the fishery than the norm, due to technological and/or cultural reasons. Unmet cash-income requirements to this segment of the population could result in unmet subsistence needs, which could cause added burdens to family- or institutional-support networks. The absence of satisfactory support from these networks could result in increased hardship or outmigration until such time as the fishery revived. Thus, effects on subsistence-use patterns in the Bristol Bay region would be more the result of effects on the cash means of resource acquisition or the satisfaction of other economic requirements by marginal commercial fishermen, than the result of effects on subsistence-resource availability for all local residents.

CONCLUSION (Effects on Subsistence-Use Patterns):

Effects of the proposal on subsistence-use patterns would be NEGLIGIBLE in Unalaska and Cold Bay, among the communities of the lower Alaska Peninsula subregion, and for the Bristol Bay region as a whole.

CUMULATIVE EFFECTS (Effects on Subsistence-Use Patterns):

Cumulative effects on subsistence-use patterns in Unalaska, Cold Bay, the Bristol Bay region, and the lower Alaska Peninsula subregion are assessed as the aggregate result of current trends in the absence of the lease sale (Sec. III.C.4. [Future of the Environment without the Proposal]), the lease sale itself, and other activities or projects identified in Section IV.A.6 as additional causes for potential effects. Federal offshore oil and gas leases considered in the cumulative case include all present and future sales in the St. George and Navarin Basins, Norton Sound, Chukchi Sea, and Shumagin Basins. State onshore lease sales include Sale 41 in the Bristol Bay Uplands and Sale 56 on the northern coast of the Alaska Peninsula.

Unalaska and Cold Bay are designated as marine- or air-support bases, respectively, for most all offshore lease sale areas in the southern Bering Sea because of the facilities available at each location and the competitive advantage accrued with succeeding lease sales for continued industrial investment in support-base facilities. The expanded role of Unalaska as a marine-support base for OCS and related operations in the southern Bering Sea should contribute marginally to the level of effects on subsistence-use patterns expected from the predicted growth of groundfish-oriented industrial development, as discussed in Section IV.B.1.b.(2). This and other forms of industrial development should be more readily accommodated with the expansion of the airport to handle jet aircraft. Historically, the community already has experienced considerable change in subsistence-use patterns, most recently as a result of the growth of the king crab industry. For a majority of the population, subsistence-use patterns are now beginning to resemble urban patterns of resource acquisition and use (individualistic, with few species used). Accelerated population growth resulting from groundfish-associated industrial development may increase the harvest pressure on selected subsistence resources and may require increased regulation of resource harvests as a result. Development and operation of the infrastructure to support industrial development also may remove or otherwise influence local habitat for subsistence resources. These factors could increase the cost to acquire subsistence resources through the need for wider mobility or the need to substitute for resources not acquired. Although a segment of the population that is unable or unwilling to gain sufficient income may be adversely affected by the growth experience, effects on the Unalaska population as a whole should result in the perpetuation of current patterns with only minor modification.

As an outpost for metropolitan functions, Cold Bay has no deep historical tradition in subsistence practices and should experience little change in currently practiced subsistence-use patterns, which consist primarily of some setnetting for salmon, setting of crab pots, or beachcombing. The added population associated with OCS air support and a southern Alaska Peninsula oil and gas terminal may cause a need for added regulation of sport hunting and fishing because of increased harvest pressure, since hunting and fishing are the primary renewable-resource-harvest patterns in the community. The rich level of resource abundance near the community, however, suggests that such effects would be negligible.

In the Bristol Bay region, the density of use of the Balboa Bay oil and gas terminal for transporting oil should be comparable to the level forecast for the proposal, since oil from the Norton, St. George and Navarin Basins is expected to be tankered directly to market rather than transshipped through Balboa Bay. State onshore oil and gas lease Sales 41 (Bristol Bay Uplands) and 56 (Alaska Peninsula) may increase vessel traffic to some extent if the Balboa Bay terminal is used and thus increases the likelihood of oil-spill risks to marine subsistence resources on the southern coast of the Alaska Peninsula and to Bristol Bay salmon that migrate along the Alaska Peninsula.

Indirect effects on subsistence-use patterns could be realized, to a limited degree (as explored in the proposal), from direct (or the potential for direct) oil-spill effects on mature salmon which could result in a drastic reduction or curtailment of the commercial salmon catch to avoid marketing a tainted or thought-to-be tainted product. Under the proposal, the income shortfall to commercial fishermen could affect the subsistence-use patterns of the marginal fishermen or villages within the Bristol Bay region due to the transportation effects of state lease sales. More fish than usual probably would be put up by people in the region, should such an event take place; and increased pressure could occur on moose and caribou resources of the region.

Conclusion (Effects on Subsistence-Use Patterns: Effects on subsistence-use patterns would be NEGLIGIBLE in Cold Bay, in the Bristol Bay region as a whole, and among the communities of the lower Alaska Peninsula subregion. There could be MINOR effects on subsistence-use patterns in Unalaska.

(5) Effects on Sociocultural Systems: This discussion is concerned with those communities or regions of the state that could be directly or indirectly affected by the North Aleutian Basin lease sale. The proposed lease sale area extends eastward from Unimak Pass along the Alaska Peninsula to Port Moller. It does not include the entire planning area and does not extend into Bristol Bay proper. According to the proposal, communities that potentially could host petroleum-industry offshore-support facilities include Unalaska, as a marine-support base, and Cold Bay, as an air-support base. Oil and gas produced from the lease sale area is anticipated to be transported via pipeline to a terminal on Balboa Bay. This terminal site, on the southern shore of the Alaska Peninsula, lies north of Popof Island, the site of the community of Sand Point. The pipeline connecting the terminal

with the offshore field is expected to traverse Herendeen Bay, located within the Port Moller bay complex. Nelson Lagoon is the permanent settlement nearest to the proposed pipelines.

For the purpose of effects assessment, it is assumed that effects on social, cultural, and political systems of organization could be brought about at the community- or regional-analysis level, predominantly by added population and industrial activities associated with the lease sale. Potential effects are evaluated relative to the central tendency of introduced social forces to support or disrupt existing systems of organization, and to the duration of such behavior.

Cold Bay: As a result of the lease sale, the small, predominantly non-Native community of Cold Bay is expected to experience an increase in resident population of about 70 new residents (70 out of 225 to 280 persons), or 25 to 31 percent of the total resident population. The net effect of such a population change in Cold Bay should only marginally affect social, cultural, and political institutions existing there, since the character of activity and cultural orientation of the persons expected to be involved should be compatible with the historical experience of the community. Therefore, few, if any, changes are expected in the cultural values and orientations of the community. However, social systems may be expected to change somewhat to the extent of an increased emphasis being placed on socioeconomic status as a means of social identification and interaction. As more relatively permanent residents are added to the community, there should be a growing tendency for families to increase in importance as social groups, suggesting a more mature character of the population and its social composition. Politically, the community should be in the process of gaining increased control over governmental functions and land acquisition, more as a function of time and experience at the community level than as a result of the proposal.

Unalaska: Unalaska, the larger of the two potential host communities, should experience the boomtown effects of groundfish-induced industrial development (see Sec. III.C.1., Future of the Environment without the Proposal) and already introduced offshore-marine-support functions resulting from St. George and Navarin Basin lease sales. From these aggregate activities (commercial fishing and oil development), but primarily from groundfish processing, the resident population is expected to approximately triple by the year 2000, with enclave population also expected to be of substantial proportions. The added contribution of the proposed sale to the population (as shown in Sec. IV.A.2.) is marginal at best, contributing about 100 residents to a population of some 2,300 (or about 4 to 7% of the total population) and an insignificant addition (33 persons) to the overall enclave population in 1990. Alaska Natives are expected to constitute a reduced proportion of total population in the absence of the lease sale (declining from 30% in 1985 to 13% in 2000), with the lease sale contributing about an added 1-percent reduction over the life of the project.

Although relatively insignificant in magnitude, the added population introduced into Unalaska should contribute to the transiency and single-male-dominated social structure of the community. Whatever social discord may have ensued initially from the introduction of the OCS marine-support function (with previous lease sales) should not be aggravated to any great extent by the proposed sale. Perhaps more than other social effects, the added population attributed to the lease sale should be expected to contribute to the trend of marginality and public dependency among the elderly and others unable and unwilling to gain financially from the boomtown conditions.

The trend toward the displacement of rural values and orientations, already evident in Unalaska, is expected to continue with the proposed lease sale and the urban-industrial cultural system it represents. The resulting heterogeneity of value systems in the community should continue to cause intergenerational identity conflicts among residents, which could result increasingly in conflict, stress, and problems associated with substance abuse. Politically, the government structure of Unalaska (municipal administrators, the city council, commissions, and boards) should continue to be pressed to develop and maintain community growth-management policies, provide community facilities and services, and mediate the social effects (increased substance abuse, family disorders, child abuse, displaced individuals, etc.) of expected boomtown conditions. Interethnic relations may become politicized due to the declining proportion of Alaska Natives to total population and the strategic role of the Ounalashka (village) Corporation as landowner in the physical growth of the community. Each of these complex political environments would be affected only marginally by the projected needs of the population attributable to the lease sale, because of their relatively minor numerical significance in the total scheme of events in Unalaska.

<u>Bristol Bay Region</u>: The boundary of the Bristol Bay region approximates the boundaries of the Bristol Bay Regional Management Plan (BBRMP) (see Sec. III.C.5.). Effects of the proposal on the lower Alaska Peninsula, one of the five subregions in the Bristol Bay region, are discussed in the following section. Added population and industrial activities associated with the lease sale are expected to be the primary agents of change on social, cultural, and political systems in the region.

In the Bristol Bay region, the only communities expected to experience population growth as a result of the lease sale are the sites for an air-support facility in Cold Bay (effects are discussed separately in the preceding section) and an oil and gas terminal at Balboa Bay on the southern shore of the Alaska Peninsula (effects are discussed in the following section, lower Alaska Peninsula Subregion). No further OCS-related facilities are expected to be established in the Bristol Bay region; therefore, effects caused by oil-industry population growth will be minimized except where facilities are placed.

Oil spills from industrial activities in the lease sale area could affect the social and cultural systems as a result of disturbances in subsistence-use patterns. No direct effects on subsistence-use patterns are expected in Bristol Bay (see Sec. IV.B.1.b.(4)); however, indirect effects from a major oil spill could temporarily cause a reduction or closure of the Bristol Bay commercial salmon fisheries for fear of producing a tainted product. The result of such a closure could cause a temporary shortage of cash income which would result in unmet subsistence needs, thereby causing a burden to family- or institutional-support networks. Such an occurrence could have ramifications in the social structure of the community and in subsistence values, orientations, and dependencies.

Due to the interrelationship of kinship to subsistence production and distribution patterns (see Sec. III.C.5.), alterations in subsistence patterns could create some disintegration of the kinship system. In the smaller, predominantly Native communities, this effect would be more severe, since there are no institutional-support systems and such an effect would necessitate a heavier reliance on kinship networks to aid those in need when there is an inadequate subsistence harvest. In the event that there was unsatisfactory support from family or institutional networks, outmigration could occur and cause a break-down in family relationships and the kinship structure. Additional social and psychological stress also could occur from a lack of stability in the social structure as residents seeking employment move to other communities. In addition, since subsistence and fishing as a means of livelihood are both core cultural values, the inability to pursue subsistence fishing, or even the threat to the residents' ability to fish could cause psychological stress in the communities. Despite the potential for such effects occurring as an indirect result of an oil spill, these effects are likely to be short-term and concentrated in the larger communities of King Cove and Sand Point, and to primarily affect marginal fishermen. Although short-term effects from an oil-spill incident may occur, long-term change to the social and cultural systems would depend on the relative weakening of traditional stabilizing institutions through prolonged stress and disruption effects which are unlikely to occur under the proposal.

Politically, the Bristol Bay region already has been affected by the proposed lease sale and should continue to stay involved through such organizations as the Bristol Bay Native Association, the Aleutian-Pribilof Islands Association, and the various coastal resource service areas responsible for coastal-zone management. Such effects within regional organizations include the need to expend the time and energy to create an informed village public, identify and respond to issues, mobilize support for positions taken, and maintain contact with the information sources and the acting forces involved. Several communities on the lower Alaskan Peninsula are more likely than others to become individually involved from the lease sale, in that they may be affected by onshore-facilities siting as well as offshore development and operations. The political ramifications of such involvement, among other related subjects, are discussed in the following section.

Lower Alaska Peninsula Subregion: Effects of the proposal on social, cultural and political systems of the lower Alaska Peninsula subregion are anticipated to be a consequence of industrial activity and population growth. In terms of industrial activity, the indirect effects of an oil-spill incident in the Bristol Bay region also apply to communities in the lower Alaska Peninsula subregion (False Pass, Nelson Lagoon, Port Heiden, Cold Bay, King Cove, and Sand Point). These effects were discussed in the preceding section.

Cold Bay and Sand Point are the only communities in the subregion that could be expected to have population growth as a result of the lease sale. Cold Bay is the proposed site for an air-support facility (see the preceding discussion of sociocultural effects on Cold Bay). Sand Point is situated on Popof Island, south of the proposed oil and gas terminal site in Balboa Bay. At the time of proposed oil and gas activities, Sand Point and King Cove should be the only communities in the lower Alaska Peninsula subregion experiencing the effects of population growth from groundfish-industry development (see Sec. III.C.5., Future of the Environment without the Proposal). Without the lease sale, the population of Sand Point is estimated to increase from 625 in 1980 (U.S. Bureau of the Census, 1980) to 1,300 by the year 2000 (City of Sand Point, 1981). The distance of the terminal site from Sand Point will encourage the development of an enclave population at the site and lessen the resident-population growth in Sand Point; however, population growth could occur in Sand Point from outsiders seeking employment at the terminal or from growth in service industries, placement of a U.S. Coast Guard station in Sand Point, and construction of new housing. It is anticipated that a majority of the inmigrants will be non-Natives.

The changes in population size and structure could have an effect on the social organization of Sand Point. The percentage of Aleuts to the total population is expected to be reduced in the absence of the lease sale, a trend which will be intensified with the lease sale. This will result in a magnification of the division between "old-timers" and "newcomers," a division between ethnic groups, and therefore a more stratified society. The social organization of Sand Point will continue to be based primarily on kinship, with or without the lease sale; however, as population growth from inmigration occurs, it is likely that there will be increases in voluntary organizations and a greater reliance on friendship-support networks.

As the Sand Point population grows, as outsiders move into the community, and as the percentage of Aleuts decreases, it is likely that there will be an increased trend toward a displacement of rural cultural values and orientations (a trend which has occurred in Unalaska [see Sec. III.C.5]). Another factor which could decrease the value placed on fishing as a livelihood is the high percentage of students choosing to continue their education past high school; this is even more likely to occur as other types of employment become available as the community grows. The increase in local-employment opportunities also will discourage outmigration by Sand Point residents.

Political involvement associated with the proposal in the lower Alaska Peninsula subregion is likely to occur at the region level as previously discussed, and at the community level, and perhaps most strongly at Nelson Lagoon, where a pipeline is involved; at Sand Point, due to its proximity to the Balboa Bay oil and gas terminal on the nearby mainland; and at Cold Bay, where an offshore-air-support operation is expected to occur. Among these forms of facilities, the oil and gas terminal could have the greatest potential for generating political ramifications. Primarily as a source of an ad valorem tax base, the community of Sand Point may attempt to annex the terminal or others may seek to form a lower-peninsula borough to spread the tax benefits beyond a single community. Whatever the attempts employed or the results achieved, considerable and relatively short-term political effects could be realized within the lower Alaska Peninsula subregion in terms of local governmental decisionmaking and state/community relations over the appropriate form of governmental organization for the area. In the long term, however, effects from the oil terminal should be more economic than political in both the public and private sectors.

<u>SUMMARY (Effects on Sociocultural Systems)</u>:

Effects on the sociocultural systems of Unalaska, from added population associated with marine operations in support of offshore oil and gas operations, are expected to be minimal and marginal compared to the effects of growth conditions created by groundfish-industry development. In Cold Bay, the character of the population associated with lease sale air-support activities would be compatible with the sociocultural system of the community and easily absorbed into the community with minimal disruption. In the Bristol Bay region as a whole, the relative absence of resident population and low probability of oil-spill events directly affecting marine-subsistence-resource populations suggests that effects on sociocultural system from the disruption of customary subsistence-use patterns should be negligible. Short-term social and cultural effects, however, could be realized as the indirect byproduct of a tainting scare in the commercial salmon fishery brought about by a major oil-spill event, causing temporary disruption to the kinship structure, a weakened sense of loyalty toward fishing as a means of livelihood, and possibly some outmigration. Although such short-term effects from an oil-spill incident may occur, long-term change to the social and cultural systems would depend on the relative weakening of traditional stabilizing institutions through prolonged stress and disruption effects which are unlikely to occur under the proposal.

Siting an oil and gas terminal in Balboa Bay could intensify changes already occurring in Sand Point as a result of population growth due to groundfish industry development. The social organization of Sand Point could be altered somewhat due to population growth, creating a more diversified and stratified community as well as creating a decrease in the ability to depend on the kinship structure for a support network. The current trend toward displacement of Aleut cultural values and orientations is expected to continue as the population grows and more employment opportunities become available. This trend could be intensified somewhat with the lease sale, although the effects would be minor in view of the changes already occurring with the development of the groundfish industry at Sand Point.

CONCLUSION (Effects on Sociocultural Systems):

MINOR effects on sociocultural systems are possible in Sand Point. Effects on sociocultural systems would be NEGLIGIBLE elsewhere in the lower Alaska Peninsula subregion, as would also be the case in Unalaska, Cold Bay, and the Bristol Bay region as a whole.

CUMULATIVE EFFECTS (Effects on Sociocultural Systems):

Cumulative effects on sociocultural systems are assessed as the aggregate result of current trends in the absence of the lease sale (Sec. III.C.5., Future of the Environment without the Proposal), with the lease sale, and with other activities or projects identified in Section IV.A.6. as constituting additional causal agents for potential effects in Unalaska, Cold Bay, the Bristol Bay region, and the lower Alaska Peninsula subregion. Federal offshore oil and gas leases considered in the cumulative case include all present and future sales in the St. George, Navarin, and Shumagin Basins and in Norton Sound and the Chukchi Sea. State onshore oil and gas lease sales include Sale 41 in the Bristol Bay uplands and Sale 56 on the northern coast of the Alaska Peninsula. Unalaska and Cold Bay are assumed to serve as the primary locations for respective marine- and air-support facilities for offshore development and operations in the southern Bering Sea.

Despite the expanded role of Unalaska as a marine-support facility in the cumulative case, the growth of the groundfish industry is expected to be the dominant force for change in the community. In the aggregate, however, the effect on sociocultural systems at Unalaska should be one more of duration and degree of disruption than of institutional change beyond that which was initiated with the crab-industry boom. This should be true of Cold Bay as well, in that the character of the community, as discussed in Section III.C.5., is not expected to change substantially because of the similarity in employment relations in OCS-related activities (hired prior to transfer, some working on a rotation basis, predominantly male-dominated, etc.) to those that have historically prevailed in Cold Bay. In Unalaska, the unmet subsistence needs of a segment of the Aleut population, resulting primarily from fisheries development but reinforced by increasing OCS marine-support activity, could increase the tendency toward disruption of social systems that as of yet has not been experienced by the population of Unalaska. Transformation of the Unalaska airport to accommodate jet traffic (as indicated in Sec. IV.A.6.) could shift some of the offshore-air-support function from Cold Bay and increase the potential for cumulative effects on sociocultural systems at Unalaska.

In the Bristol Bay region, the increased risk to fisheries resources from increased tankering volume through Unimak Pass could reinforce the atmosphere of strained family relationships and weakened kinship structure already existing among that segment of the population affected by fisheries regulations that limit access to salmon vessel ownership to those holding limited-entry permits. Should commercial salmon fishing be curtailed or otherwise affected, there could be indirect effects on the population in general and on marginal fishermen in particular, where there is considerable annual dependency on income from commercial salmon fishing to support subsistence activities during the rest of the year. In the lower Alaska Peninsula subregion of Bristol Bay, effects on kinship relationships and cultural orientations could be magnified somewhat in the cumulative case, not only by the increased risk to resources brought on by an increased volume of tankering through Unimak Pass, but also by state onshore oil and gas lease Sales 41 and 56, which (if successful) would increase the need for an ice-free-terminal site on the Alaska Peninsula.

Conclusion (Effects on Sociocultural Systems): Effects on sociocultural systems are expected to be NEGLIGIBLE in Cold Bay and MODERATE in Unalaska, with such effects at a MINOR level in the Bristol Bay region, and the Alaska Peninsula subregion, as a whole.

2. Offshore-Loading-Transportation Scenario:

a. Effects on Biological Resources:

(1) Effects on Fisheries Resources: Transportation of oil from the lease sale area by tankers offshore loaded at Spill Point B3 (Graphic 5) would increase the risk of oil-spill contact to lifestages of fish species inhabiting coastal and nearshore habitats in the vicinity of Port Moller and Unimak Pass.

The coastal and nearshore areas surrounding Port Moller are important habitats for the various lifestages of salmon, forage fish, groundfish, red king crab, and other invertebrates. The potential effects of a spill emanating from a tanker or offshore-loading facility would be the same as those projected for the pipeline-transportation scenario because only 1 spill of 1,000 barrels-or-greater is expected. However, oil-spill risks would increase under the offshore-loading scenario. The probability of a 1,000-barrel-or-greater oil spill occurring and contacting Port Moller (Resource Area 7) would increase by 2 to 3 percent for 3-, 10-, and 30-day trajectories. The combined probabilities for 3-, 10-, and 30-day trajectories would be 19, 23, and 27 percent, respectively.

Tankering of oil through Unimak Pass would increase the oil-spill risks to salmon migrating through the pass during spawning migrations. The probability of a tanker spill occurring and contacting Unimak Pass (Resource Area 8) is relatively low (2-3%).

An offshore-loading-transportation scenario would eliminate all oil-spill risk from the southern side of the Alaska Peninsula and the potential effects of a pipeline spill on salmon spawning habitat on streams adjacent to the potential pipeline route.

CONCLUSION (Effects on Fisheries Resources):

The effects of the offshore-loading-transportation scenario on fisheries resources would be the same as under the pipeline-transportation scenario, with the exception that oil-spill risk would be eliminated from the southern coast of the Alaska Peninsula. The effects on salmon, forage fish, groundfish, and other invertebrates would be MINOR. Effects on red king crab would be MAJOR.

(2) Effects on Marine and Coastal Birds: Transport of oil from the lease sale area by tankers loaded at an offshore site (Spill Point B3, Graphic 5) in the northeastern sector places at special risk those species populations using coastal and inshore habitats in the vicinity of Port Moller/ Nelson Lagoon and Unimak Pass, and to a lesser extent those populations in pelagic waters surrounding the site. This site is just outside Biological Resource Area 7 (inshore waters surrounding Port Moller/Nelson Lagoon), which includes the zone frequented by large shearwater flocks in late spring, summer, and fall, and substantial numbers of migrants in spring and fall. Bird densities during these seasons (refer to Sec. IV.B.1.a.(2)) suggest that potential effects in this area from spills originating at a loading platform, like those projected for pipeline transportation of oil (see Sec. IV.B.1.a.(2), the proposal), are not likely to exceed moderate. However, there is a strong likelihood that a spill at the loading site would enter this area within 10 days (probability=49%), so the risk of adverse effects is considered high. When the probability of a spill occurring at the loading site is considered, the risk of oil entering Area 7 still remains moderately high (p=23%; p=20% if oil is transported by pipeline).

During spring and fall periods, migrant waterfowl and shorebird populations staging in Nelson Lagoon and adjacent waters are especially vulnerable to any spill that reaches the shoreline in the vicinity of the lagoon's entrance. If oil were to enter the lagoon during these periods, effects would be similar (major) to those described for pipeline transport of oil. The probability of shoreline contact from the loading site is 11 percent, although this could be elevated during a period of onshore winds. The probability of a spill both occurring at the loading site and contacting the shore at Nelson Lagoon is 6 percent (4% in the vicinity of Izembek Lagoon), suggesting that the actual risk of such an event is relatively low. By comparison, pipeline transport of oil through Port Moller, while not differing significantly from the offshore-loading scenario in shoreline-contact probability from the offshore launch point (5% vs. 6%), does bring oil directly through the area of greatest concern and thus may be considered to present greater risk to birds occupying the lagoon habitat. Elsewhere along the northern side of the peninsula, the potential risk from spills at the loading site is negligible. The probability of contact in pelagic waters from a combination of spills at the loading site and from tankers is only 4 to 5 percent; the relatively low bird densities in such areas suggest a potential for only minor effects, or less.

The most substantial result of offshore loading is the elimination of virtually all oil-spill risk from the southern side of the Alaska Peninsula, as well as a large proportion of that in the Port Moller/Nelson Lagoon area. The elimination of tanker traffic from the southern side of the peninsula essentially removes the potential for major effects near large seabird colonies during the nesting season, and for moderate effects elsewhere and in other seasons in this area. Vessel traffic serving a projected LNG-terminal facility in Balboa Bay represents the principal risk remaining in this area.

Effects from an LNG tanker grounding near a large seabird colony are not likely to exceed minor unless the combination of substantial fuel and LNG release affects a large area, in which case the potential for moderate effects may exist. Elsewhere, effects are likely to be minor or lower. The elimination of pipeline transport of oil through Port Moller is likely to result in a substantial reduction in the potential for occurrence of major effects in this area. A spill originating at the loading site still could enter Nelson Lagoon and produce a major effect, but the probability of this is a relatively low 6 percent.

Tankering of oil from the lease sale area through Unimak Pass potentially increases the risk in this important migration corridor and foraging area. The probability of a spill occurring and contacting the area surrounding western Unimak Pass (Biological Resource Area 8) is a relatively low 2 percent, primarily as a result of apportioning potential risk over the relatively long transportation route to southern ports. However, in the pass itself, risk from this source may be higher as a result of more hazardous navigation than along other segments of the route. Potential effects in the pass would be moderate to major in late spring, summer, and fall, when peak passage of birds is underway or large foraging flocks are present, similar to those described in Section IV.B.1.a.(2) of the St. George Basin (Sale 89) FEIS (USDOI, MMS, 1985).

<u>CONCLUSION (Effects on Marine and Coastal Birds)</u>:

Elimination of a large proportion of oil-spill risk from the southern side of the Alaska Peninsula and Port Moller area is the most substantial result of an offshore-loading transportation scenario. MAJOR effects still could occur, especially in Port Moller/Nelson Lagoon from any spills at the offshore-loading site, but are less likely to happen than under a pipeline-transportation scenario. In the inshore waters north of the peninsula, effects probably would not exceed MODERATE, even during periods of peak abundance. As a result of increased tanker traffic in Unimak Pass, effects could range from MODERATE to MAJOR during periods of peak bird presence.

(3) Effects on Pinnipeds and Sea Otters: The transportation of hydrocarbons from the proposed lease sale area by offshore loading of tankers (one every 5 to 7 days at the one oil-production platform) would greatly reduce the amount of pipeline construction from 190 kilometers for oil to no more than a few kilometers of feeder lines, and would eliminate the need for 20 kilometers of onshore oil pipeline and an oil tanker facility at Balboa Bay on the southern side of the Alaska Peninsula. This offshore transportation scenario would avoid disturbance of sea otters and pinnipeds in Port Moller and Herendeen Bay that would be associated with the above pipeline-transportation scenario.

Offshore loading would not appreciably reduce the risks of oil spills to sea otters and pinnipeds in the Port Moller area (Appendix G, Table G-10, Resource Area 7); however, oil-spill risks to sea otters and pinnipeds living in Balboa Bay would be avoided. Perhaps a few hundred fewer sea otters would be affected under this transportation plan; concentrations of thousands of sea otters in the Izembek Lagoon/Bechevin Bay area (see Graphic 3) still could be affected by a potential oil spill originating from the oil platform, feeder pipelines, or tanker traffic through Unimak Pass associated with the offshore loading of oil. This transportation plan is likely to pose the same oil-spill-contact risks to northern fur seals as does the transportation scenario, because offshore loading of oil from the production platform would necessitate the transporting of the oil to the west through Unimak Pass, where a potential oil spill would pose as much, if not more, of a risk to northern fur seals as tanker traffic from Balboa Bay. The offshore-loading scenario would entail the same level of air and vessel-support traffic as the onshore-loading scenario, with support traffic coming from Cold Bay and Dutch Harbor; however, offshore loading would eliminate local disturbance of harbor seals and other pinnipeds at Herendeen and Balboa Bays. Harbor seal and sea lion rookeries along the northern coast of the Alaska Peninsula still would be subject to the same level of potential disturbance from air- and vessel-support traffic as with the onshore-loading scenario. In summary, the offshore-loading scenario could reduce oil-spill, noise, and disturbance effects on pinnipeds and sea otters in the Balboa Bay area and also could avoid disturbance of pinnipeds occurring in the Port Moller area by eliminating the onshore development in these areas. However, the several thousand sea otters and pinnipeds that frequent the nearshore environment of the rest of the northern Alaska Peninsula coast would be subject to the same level of oil-spill and disturbance effects as under the onshore-pipeline scenario. Northern fur seals also would be subject to the same, if not greater, oil-spill-contact risks, with loss of a few to several thousand fur seals if a spill occurred in association with tanker traffic from offshore loading.

CONCLUSION (Effects on Pinnipeds and Sea Otters):

Effects of the offshore-loading scenario on pinnipeds and sea otters inhabiting Port Moller and Balboa Bay may be reduced, but the overall level of effect is likely to be the same as under the onshore-pipeline scenario, with MODERATE effects on sea otters and fur seals and MINOR effects on other pinnipeds.

(4) Effects on Endangered and Threatened Species: The most important consequences of transporting oil from the North Aleutian Basin lease sale area by tankers loaded at an offshore site (Spill Point B3, Graphic 5) compared to pipeline transport are: (1) increased oil-spill risk from tankers along the northern side of the Alaska Peninsula and through Unimak Pass; (2) elimination of oil-spill risk of pipeline origin from the vicinity of Port Moller; (3) slight elevation of oil-spill risk (from the loading platform) in nearshore and coastal waters, especially in the vicinity of the projected loading site and Port Moller; and (4) elevated noise levels and disturbance from tankers along an Alaska Peninsula-Unimak Pass tanker route to southern ports. The gray whale is the species most likely to experience adverse effects as a result of an offshore-loading scenario.

Effects on Gray Whales: The transit of approximately 60 tankers per year through the gray whale migration corridor adjoining the Alaska Peninsula, and in Unimak Pass, could result in temporary displacement of some migrating individuals or permanent displacement of some summer residents. However, since the loading site is approximately 60 kilometers offshore, most of these vessels are likely to cruise at least 20 kilometers offshore, whereas most gray whales migrate within 3 kilometers of the coast. Thus, it appears unlikely that significant interactions would occur in this area. Likewise, tanker traffic through Unimak Pass associated with this sale (120 vessel trips/year), which represents only a small percentage (2-4%) of current traffic in the pass, generally stays well offshore and is not likely to disturb migrating gray whales. Gray whales are subject to large amounts of vessel noise in the southern part of their range, and their population continues to increase. California migration routes on the long-term suggest that an alteration of southbound migration routes in the presence of considerable vessel traffic may be occurring (Rice, 1965). However, evidence suggests that gray whales are tolerant of some industrial noise and, although they may exhibit an initial avoidance response to a noise source not previously encountered in a particular area, they apparently can become acclimated to stimuli perceived as nonthreatening. Short-term effects from tanker noise are not expected to disrupt foraging activities or migration. Potential disturbance from other sources of noise (i.e., helicopters, workboats, supply barges) would not be appreciably different from that discussed for pipeline transport of oil. Potential disturbance from construction of a pipeline through Port Moller would be eliminated. Thus, although noise levels associated with offshore-loading transportation are likely to be higher than with pipeline transport, effects of noise are expected to be minor.

The slight increase (2-3%) in risk of oil-spill occurrence and contact with the nearshore zone from the offshore-loading platform, a result of apportioning a small percentage of tanker spills to this area, is not expected to significantly alter the probability of minor effects projected under the pipeline-transportation scenario. The presence of tanker traffic along the peninsula and in Unimak Pass, where little existed before, could increase the area over which a spill might occur. Elimination of the pipeline from Port Moller, and thereby the risk of oil spills introduced directly into this area, reduces the potential for adverse oil-spill effects on gray whales, which frequently occupy this area in summer.

CONCLUSION (Effects on Gray Whales):

The potential effects on gray whales from noise disturbance and oil spills associated with offshore loading are expected to be MINOR.

Effects on Other Endangered Cetaceans: The other endangered cetaceans will be exposed to increases in noise levels along the tankers' path, including Unimak Pass. The increase in noise levels through Unimak Pass probably will represent only a minor increment of the total spectrum of noise these whales are exposed to. Slight deflection of migratory pathways and/or timing can be expected, although they probably will be short-term in nature. The expected number of spills will rise from 0.94 (pipeline-transportation scenario) to 1.10 (offshore-loading-transportation scenario). This slight increase in spills would affect the pelagic whales more than the gray whale (which is most frequently found within 10 km of shore) if the spill occurred between the loading facility and Unimak Pass. Therefore, gray whales would benefit slightly by the elimination of the oil pipeline, while the other species would be exposed to slightly increased risks from oil spills, should offshore loading occur.

CONCLUSION (Effects on Other Endangered Cetaceans):

Noise disturbance and oil spills associated with offshore loading would have minor effects on the other endangered cetaceans, except for bowheads, which would experience the same effects as for the pipeline scenario--NEGLIGIBLE.

Effects on Endangered and Threatened Birds: Effects on endangered and threatened birds would be the same as for the pipeline scenario, even though there would be an increase in the noise levels and oil spills associated with an offshore-loading scenario. This is due to the extremely rare occurrence of birds in this area.

CONCLUSION (Effects on Endangered and Threatened Birds):

Effects from offshore loading would be the same as for the pipeline scenario--NEGLIGIBLE.

(5) Effects on Nonendangered Cetaceans: Because of broad distributions, the low probability of oil spills, and the size of the North Aleutian Basin lease sale area, it is unlikely that oil spills associated with the proposal would come in contact with high population levels of nonendangered cetaceans. While it is possible that some nonendangered cetaceans could be affected, it is unlikely that such interaction, if it occurred, would significantly adversely affect the cetaceans frequenting the area. Oil spills can be considered unlikely to have: (1) significant adverse effects on nonendangered cetacean populations and (2) significant indirect adverse food-chain-related effects on nonendangered cetaceans.

Although disturbance due to activities associated with the proposed lease sale is unlikely to significantly affect cetacean populations adversely, noise associated with aircraft and vessel activity may affect cetaceans during the summer feeding or migration periods. These species will be exposed to increased noise levels and larger ensonified areas, especially in the vicinity of Unimak Pass. It is likely that such interactions would be localized and short-term. These short-term responses are not expected to preclude a successful cetacean migration or to disrupt use of feeding areas by nonendangered cetacean species.

CONCLUSION (Effects on Nonendangered Cetaceans):

The potential effects of this proposal on nonendangered cetacean species are expected to be MINOR.

b. Effects on Social and Economic Systems:

(1) Effects on Commercial Fishing Industry:

(a) Space and Catch Loss: Offshore structures associated with oil and gas exploration/development close limited ocean areas to commercial fishing operations. The offshore-loading terminal assumed to be located at Spill Point B3 (Graphic 5) would occupy about the same area as an offshore-drilling platform, and would preclude the 0.4 square miles from commercial trawling. This area, however, is barred to trawling because it is both a halibut nursery area and heavily fished for red king crab. Fixed gear, such as pots employed to catch crab, would not be unduly hampered by the presence of an offshore-loading facility.

(b) Gear Conflicts: Tanker and supply-vessel traffic associated with offshore loading would transit areas heavily fished for shellfish, principally red king crab and *C. bairdi* tanner crab. Present red king crab seasons in the North Aleutian Basin Planning Area are quite abbreviated since depleted stocks dictate a current harvest limit of 5,000,000 pounds annually. This quota was reached in just over 2 weeks during the 1984 fall season.

At this time, Bering Sea tanner crab seasons occur from January 15 through August 1 annually; hence, pots would be subject to loss from tanker and supply vessels over a considerable time period. The smaller-scale brown king crab fishery, with a year-round season by permit only, also would be subject to pot loss. The magnitude of this loss in the absence of a marine fairway is assessed as having a major effect on commercial crab fisheries. Mitigating measures, such as designation of marine transport corridors (fairways) and compensation to the fishermen for lost gear, catch, and fishing time through the Fisherman's Contingency Fund, would mitigate this major effect; however, the adverse effect on the crab fishing industry could remain at a moderate level.

Trawl fisheries and gillnet/seine fisheries away from the North Aleutian Basin lease sale area, but within proposed oil-tanker and supply-vessel routes, also would be affected, but to a smaller degree, because the normal maritime "rules of the road" would prevent conflict. Centaur Associates, Inc., (1983) estimated that under peak development conditions, as many as 1,200 crab pots could be lost to OCS vessel traffic if no mitigating measures were employed. This projected loss could be reduced as much as 90 percent by enforcing regulations and other measures designed to separate OCS-vessel traffic from fixed-gear commercial fisheries.

(c) Effects of Oil Spills:

Effects on Fishing Operations: As previously discussed under the pipeline-transportation scenario, commercial fishing could be affected by oil spills through fouling of fishing gear, foreclosure of fishing grounds, oil-tainted catches, and reduction in commercially fished populations by the toxic effects of an oil spill. The degree of these effects on commercial fishing is dependent on the location and time of the oil spill and its volume. Based on a statistical projection of 1.10 spills of 1,000 barrels or greater, 1 spill of this size or greater is projected over the life of this project. Under this scenario, the previously analyzed effects of oil spills on commercial fishing would be removed from the general areas of Balboa Bay, the Shumagin Islands, and areas south of the Alaska Peninsula.

Salmon and Herring: The fisheries that could be affected by this alternative are the salmon and herring fisheries north of the Alaska Peninsula, and the red king crab fishery of Bristol Bay.

Salmon and herring fisheries north of the Alaska Peninsula are vulnerable to the effects of oil spills from about mid-May through the end of August. However, only the Port Moller area has a significant probability of contact (Resource Area 7): 19-percent probability of contact by an oil spill of 1,000 barrels or greater over the course of 3 days, 23 percent after 10 days, and 27 percent after 30 days. A spill of this size contacting Port Moller would have a moderate adverse effect on the drift- and set-gillnet salmon fisheries operating in these waters.

Nelson Lagoon and Bechevin Bay are the major salmon-producing areas where drift gillnets, set nets, and purse seines are employed. The land segments containing these areas have a less-than-0.5-percent chance of being contacted should an oil spill result from this offshore-loading scenario. Therefore, an oil spill is not expected to contact these areas.

A herring-sac-roe fishery is developing in Port Moller/Herendeen Bay. In 1982, the harvest was worth about $252,000 to the fishermen. Under this scenario, the OSRA shows a 1-percent probability of contact by an oil spill of 1,000 barrels or greater over 3- and 10-day periods, and an only 3-percent probability within 30 days. This transportation alternative then would have a negligible adverse effect on the herring fishery.

Shellfish: Oil-spill effects on the shellfish fishery result from toxins that reduce the available biomass, the loss of fishing gear, and the loss of fishing in areas contacted by the oil spill. Harvested shellfish also might be tainted by exposure to oil-polluted water during holding.

This scenario has the potential to affect crab fishing areas off Port Moller (Sea Target 23). An oil spill of 1,000 barrels or greater has a 23-, 24-, and 25-percent chance of contacting this area over 3-, 10-, and 30-day periods, respectively. An oil spill of this size contacting the area while the fishery is in progress would have a moderate effect. Other open-ocean areas (Sea Targets) have a 0.5-percent to about an 7-percent chance (and this after 30 days) of contact by an oil spill of 1,000 barrels or greater resulting from this scenario.

Overall effect of this alternative on the shellfish fishery would appear to be negligible, except in the area off Port Moller, where adverse effects could be moderate.

Groundfish: This scenario would offshore load and transport oil from an area largely closed to trawling for groundfish and where longlining for cod and sablefish is a relatively small-scale, time-limited, joint-venture operation. This longline fishery has an oil-spill-risk probability of contact by a 1,000 barrel-or-greater spill of 23-, 24-, and 25-percent over 3-, 10-, and 30-day periods, respectively, for the area off Port Moller. The oil-spill-contact risk does not exceed 5 percent for other sea areas.

Effects on Fisheries South of the Alaska Peninsula: The offshore-loading scenario would eliminate oil-spill risks to Balboa Bay on the southern coast of the Alaska Peninsula. Thus, the potential for adverse effects on the commercial fisheries of Balboa Bay and other fishing areas in the immediate vicinity would be eliminated under this transportation scenario.

SUMMARY:

The offshore-loading scenario slightly increases the probability that fisheries resources and the commercial fisheries would be contacted and adversely affected by oil spills. Essentially, the effects would be limited to the general area of the proposed offshore-loading facility and along the transportation routes. Oil-spill risks to Balboa Bay commercial fisheries resources would be eliminated by implementation of this transportation scenario.

CONCLUSION (Effects on Commercial Fishing Industry):

Overall effects of the offshore-loading scenario are expected to be MINOR for the commercial salmon, herring, and groundfish industries. MAJOR effects are anticipated for red king crab.

(2) Effects on Local Economy: The offshore-loading scenario generally encompasses the same development scenario as the pipeline-transportation scenario, thus producing comparable levels of development activity and population growth. Because of this, the effects on the local economies of Unalaska and Cold Bay would be the same as for the pipeline-transportation scenario.

CONCLUSION (Effects on Local Economy):

Under the offshore-loading scenario, the effects of the proposal on the local economies of Unalaska and Cold Bay would be MINOR.

(3) Effects on Community Infrastructure: The offshore-loading scenario generally encompasses the same development scenario as the pipeline-transportation scenario, thus producing comparable levels of development activity and population growth. Because of this, the effects on the community infrastructures of Unalaska and Cold Bay would be the same as for the pipeline-transportation scenario.

CONCLUSION (Effects on Community Infrastructure):

The effects of the proposal on the community infrastructures of Unalaska and Cold Bay under the offshore-loading scenario would be the same as for the proposal--NEGLIGIBLE.

(4) Effects on Subsistence-Use Patterns: Under the offshore-loading scenario, population figures remain the same as those used in the analysis of the oil-pipeline scenario, under the proposal, because resource levels are identical in both cases. Consequently, the effects on subsistence-use patterns from population increases at Unalaska and Cold Bay are the same as in the oil-pipeline scenario. Effects from oil-spill events near these communities also are the same as for the pipeline-transportation scenario. Oil-spill-contact probabilities are very similar for both transportation scenarios.

For the Bristol Bay region as a whole, effects on subsistence-use patterns under the offshore-loading scenario should be the same as for the pipeline-transportation scenario because of similar resource levels and subsequent similar OSRA results. A similar condition would prevail in the lower Alaska Peninsula subregion, although perhaps with somewhat reduced effects because of no oil-carrying tankers traversing between Unimak Pass and Balboa Bay. The existence of an LNG terminal at Balboa Bay poses a similar, although perhaps reduced, potential for effects on subsistence-use patterns in Sand Point from associated population increases. On the northern side of the Alaska Peninsula, the offshore-loading site near Port Moller produces a low conditional probability (11% probability of contact within 10 days) of oil contacting shore, thus confirming the relatively low risk to shoreline areas adjacent to the lease sale area. This also is shown in the OSRA results where there is a 5-percent final probability of contact for the Port Moller area (Land Segment 11) within 10 days and a 9-percent final probability of contact within 30 days.

CONCLUSION (Effects on Subsistence-Use Patterns):

Effects of the proposal on subsistence-use patterns under the offshore-loading scenario would be NEGLIGIBLE in Unalaska and Cold Bay, among the communities of the lower Alaska Peninsula subregion, and for the Bristol Bay region as a whole.

(5) Effects on Sociocultural Systems: The comparability of the population levels and effects on subsistence-use patterns of the offshore-loading scenario with the oil-pipeline scenario at Unalaska and Cold Bay are such that effects on sociocultural systems in these communities should be the same as under the oil-pipeline scenario. Within the Bristol Bay region as a whole, the effects of the offshore-loading scenario are the same as the oil-pipeline scenario, except that the oil-transshipment point has been moved from Balboa Bay to an offshore location on the northern side of the Alaska Peninsula. Consequently, effects on sociocultural systems within the Bristol Bay region would be the same under the offshore-loading scenario as under the pipeline-transportation scenario. With the absence of an oil terminal at Balboa Bay, there would be reduced effects at Sand Point; but the continuing presence of an LNG terminal under each scenario suggests that effects on sociocultural systems at Sand Point would remain at substantially the same level as under the pipeline-transportation scenario--MINOR.

CONCLUSION (Effects on Sociocultural Systems):

MINOR effects on sociocultural systems are possible in Sand Point. Effects on sociocultural systems would be NEGLIGIBLE in Unalaska, Cold Bay, elsewhere in the lower Alaska Peninsula subregion, and in the Bristol Bay region as a whole.

C. Alternative II - No Lease Sale

The cancellation of the proposed lease sale could reduce future OCS oil and gas production, perpetuate the need for imported oil, and add to a national need to develop alternative-energy sources. Appendix I identifies alternative-energy sources and describes their environmental risks and current and projected uses. Table IV-17 shows the amount of energy needed from other sources to replace anticipated oil and gas production from the proposal. The effects on biological resources and social and economic systems as described in the proposal (Alternative I) would not occur and are indicated below.

1. Effects on Biological Resources:

a. Effects on Fisheries Resources: If the lease sale were not held, any probability of adverse effect on fisheries from oil and gas development would not occur. The fisheries resources would continue to be used by man and would continue as the principal component of this ecosystem. Refer to Section IV.B.1.a.(1) for a discussion of cumulative factors that might affect fisheries resources.

b. Effects on Marine and Coastal Birds: There would be no adverse effects in the North Aleutian Basin or associated coastal areas as a result of this alternative. Refer to Section IV.B.1.a.(2) for a discussion of cumulative factors that might affect marine and coastal birds.

c. Effects on Pinnipeds and Sea Otters: There would be no adverse effects in the North Aleutian Basin or associated coastal areas as a result of this alternative. Refer to Section IV.B.1.a.(3) for a discussion of cumulative factors that might affect marine mammals.

d. Effects on Endangered and Threatened Species and Nonendangered Cetaceans: There would be no adverse effects on endangered and threatened species and nonendangered cetaceans as a result of this alternative. Refer to Sections IV.B.1.a.(4) and (5) for a discussion of cumulative factors that might affect endangered and threatened species and endangered cetaceans.

2. Effects on Social and Economic Systems:

a. Effects on Commercial Fishing Industry: Without oil and gas development in the North Aleutian Basin, domestic- and foreign-fishing operations would continue without the conflicts that could arise between these two industries. Benefits to the commercial fishing industry--such as increased safety and improved harbor facilities, navigation, and transportation systems--would not occur if there were no sale. Refer to Section IV.B.1.b.(1) for a discussion of cumulative factors that might affect the commercial fishing industry.

b. Effects on Local Economy: The effects on the general economy described in Section IV.B.1.b.(2) would not occur. Consequently, employment projections would be those presented in Section III.C.2. Refer to Section IV.B.1.b.(2) for a discussion of cumulative factors that might affect the local economy of the region.

Table IV-17

Energy Needed from Other Sources to Replace Anticipated Oil Production from the Proposed North Aleutian Basin (Sale 92)

Total Crude Oil Production (bbls)	3.64×10^{8}
Total Natural Gas Production (cf)	2.62×10^{8}
Crude Oil BTU Equivalent @ 5.6×10^{6} BTU/bbl.(BTU)	2.04×10^{15}
Natural Gas BTU Equivalent @ 1,031 BTU/cu. ft. (BTU)	2.70×10^{15}
Total Oil and Gas BTU Equivalent (BTU)	4.74×10^{15}

Alternative Energy-Source Equivalents:

Alternative Source	Amount of Resource
Oil	8.46×10^{8} (bbls)
Gas 1/	4.60×10^{12} (cu ft)
Coal	
Anthracite 2/	1.87×10^{8} (Tons)
Bituminous 3/	1.18×10^{8} (Tons)
Subbituminous 4/	2.49×10^{8} (Tons)
Lignite 5/	3.54×10^{8} (Tons)
Oil Shale 6/	1.21×10^{9} (Tons)
Tar Sands 7/	1.13×10^{9} (Tons)
Nuclear (Uranium Ore)	
Light Water Reactor 8/	7.90×10^{6} (Tons)
Breeder Reactor 9/	5.65×10^{9} (Tons)

Source: USDOI, MMS, 1984.

1/ 1031 BTU/cu. ft.
2/ 25.4×10^{6} BTU/ton (Williams and Meyers, 1976).
3/ 26.2×10^{6} BTU/ton (Ibid).
4/ 19.0×10^{6} BTU/ton (Ibid).
5/ 13.4×10^{6} BTU/ton (Ibid).
6/ .7 bbls/ton (Science and Public Policy Program, 1975).
7/ 4.2×10^{6} BTU/ton (Ibid).
8/ 100,000 tons of ore = 3 million tons of coal at 10,000 BTU/lb (Science and Public Policy Program, 1975).
9/ Use U238 isotope, constituting 99.29 percent of naturally occurring uranium. LWR uses U235 isotope, constituting .71 percent of naturally occurring uranium.

Note: Crude oil BTU equivalent @ 5.6×10^{6} BTU/bbl.

c. Effects on Community Infrastructure: Without OCS development, the potential expansion of the groundfish industry in the Aleutian Islands region is likely to create the greatest effect on community infrastructure. The groundfish industry in the Aleutian Islands region is expected to be totally controlled by domestic fishermen and processors by the beginning of the 21st Century. Forecasts of future local employment predict increases in employment and in the transient labor force for the Aleutian Islands. Refer to Section IV.B.1.b.(3) for a discussion of cumulative factors that might affect Cold Bay and Unalaska's community infrastructures.

Since infrastructure effects are directly tied to population levels, extreme growth-management problems could be expected in conjunction with the population increase. Direct effects associated with groundfishing are analyzed in Section IV.B.1.b.(1).

d. Effects on Subsistence-Use Patterns: This alternative would result in no adverse effects on subsistence-use patterns among the categories of places considered in this EIS. See Section III.C.4. for a discussion of the subsistence-use patterns and Section IV.B.1.b.(4) for an evaluation of potential cumulative effects from other projects anticipated to occur in the region.

e. Effects on Sociocultural Systems: This alternative would result in no adverse effects on sociocultural systems among the categories of places considered in this EIS. See Section III.C.5. for a discussion of potential future effects on sociocultural systems from the rapid development of the groundfish industry, and Section IV.B.1.b.(5) for an evaluation of potential cumulative effects from other projects anticipated to occur in the region.

D. Alternative III - Delay the Sale

Under this alternative, the proposed lease sale (Alternative I) would be delayed for a period of 5 years. The 5-year delay would allow time for additional studies pertinent to the North Aleutian Basin area to be completed. Table IV-18 identifies potential studies that could be conducted during the 5-year delay, based on the 1986 and 1987 proposed studies list for the Alaska Regional Studies Program. Additional studies could be proposed for the years 1988, 1989, and 1990. The following sections assess the effects of such a delay.

1. Effects on Biological Resources:

a. Effects on Fisheries Resources: Alternative III would defer effects identified and discussed in Sections IV.B.1.a. and IV.B.2.a., and some adverse effects could possibly be lessened because of the additional time for fisheries studies and improved technology for reducing oil pollution and oil-spill cleanup. Additionally, information of value from oil and gas development occurring elsewhere during this delay period--and the interaction of such development with fisheries--might prove applicable toward a further reduction of the already assessed effects on fisheries resources.

CONCLUSION (Effects on Fisheries Resources):

Alternative III could result in a slight reduction of already MINOR effects on fisheries. The additional time provided by this alternative could allow for improved technology for reducing oil pollution and oil-spill-cleanup technology.

CUMULATIVE EFFECTS (Effects on Fisheries Resources):

Delay would reduce the cumulative effects by postponing the effects of the proposal. Other cumulative effects would occur as expected.

b. Effects on Marine and Coastal Birds: Alternative III would delay the effects described in the proposal for 5 years. This delay could allow:

(1) Additional time to complete baseline studies that could clarify distributional patterns, species interactions, and population trends in this ecosystem; but it would not reduce the risk to seabird populations below that of the proposal unless techniques of oil-spill prevention, containment, cleanup, and avoidance of aircraft disturbance were improved in the interim.

(2) Time to undertake studies of adverse effects and means of mitigation or prevention, as well as time to establish a program for monitoring local- and regional-population trends.

CONCLUSION (Effects on Marine and Coastal Birds):

Alternative III would delay the effects of the proposal for 5 years. Throughout most of the lease sale area or associated potentially affected areas, the

Table IV-18

Studies Pertinent to the
North Aleutian Basin Area Which
May be Conducted during a 5-Year
Delay of Sale

Year	Study Title
1986-87	Effects of Petroleum Contaminated Waterways on Spawning Migrations of Adult Pacific Salmon
1986	Damage Function Application to Salmon in Bristol Bay
1986-87	Unimak Pass Migration Corridor Study
1986	Monitoring Effects of Oil and Gas Development in the Bering Sea
1986-87	Marine Meteorology Update
1987	Nearshore Fish and Shellfish Populations of the Alaska Peninsula
1986-87	Circulation Model and Oil-Spill-Risk Analysis
1987	Quantification of the Relative Magnitude of Noise Associated with Oil and Gas Exploration and Development Compared with Other Sources of Potential Acoustic Disturbance to Marine Mammal Habitats in Alaska
1986-87	Monitoring Seabird Populations Near Offshore Activity
1987	Sublethal Effects on Waterfowl Reproduction and Flight Activity
1987	Literature Analysis of the Probable Effects of Oil and Gas Exploration and Development on Major Haulout Concentrations of Bering Sea Pinnipeds
1987	Preliminary Analysis on the Probable Responses of Right Whales to Noise Associated with Oil and Gas Exploration and Development
1987	Laboratory Investigations of the Adherence of Oil to the Skin of Bowhead Whales
1987	Normal Behavior of Davis Strait Bowhead Whales: A Control Group for the Western Arctic Stock
1987	Aerial Surveys of Endangered Whales in the Bering, Chukchi, and Beaufort Seas
1987	Responses of Individual Humpback Whales to Repeated Exposure to Noise Associated with Oil and Gas Exploration and Development
1987	Mapping the Distribution of Endangered Whale Species in Alaska Waters
1987	Application of Satellite-Linked Methods of Large Cetacean Tagging and Tracking Capabilities in Offshore Lease Areas
1987	Background Air Quality Levels in Probable Alaska OCS Oil and Gas Production Areas
1987	Aleutian Transportation Systems Update and Monitoring
1987	Enclave Model Application for Select Communities in the Bering Sea
1987	Commercial Fishing Harvest and Employment Forecast
1986	Fur Seal Model
1985-87	Coastline and Surf Zone Smear Model
1986-87	Quality Assurance
1984-86	Alaska Peninsula Coastal Ecosystem Study
1987	Past, Present, and Predicted Petroleum Discharge in Alaskan Waters
1986-87	Meteorological and Oceanographic Data Management
1986	Summary of the Abundance and Distribution of Beluga Whales

Table IV-18

Studies Pertinent to the
North Aleutian Basin Area Which
May be Conducted during a 5-Year
Delay of Sale (continued)

Year	Study Title
1986	Simulation Modeling of the Effects of Oil Spills on the Population Dynamics of Key Marine Mammal Species
1986-87	Ice Freezeup and Breakup
1986-87	Remote Sensing Data Acquisition

effect of this lease sale on regional populations of marine and coastal birds is expected to be MODERATE.

CUMULATIVE EFFECTS (Effects on Marine and Coastal Birds):

Delay of this sale would postpone some of the cumulative effects discussed for the proposal. Most notably, oil-spill risk in coastal waters (migrating birds, shearwaters); lagoons (waterfowl); and offshore areas (shearwaters, overwintering birds) of the Alaska Peninsula's northern side would be reduced to MINOR during this interval, as would risk to colonial and overwintering birds in the Shumagin Islands and vicinity. Disturbance of waterfowl populations using Izembek (and potentially Nelson) Lagoons would decline to MINOR. Cumulative risk following the delay interval would be as described for the proposal, or somewhat reduced if the delay allowed improvement of spill-prevention, containment, and cleanup techniques, and implementation of mitigative measures.

c. Effects on Pinnipeds and Sea Otters: The effects of Alternative III on fur seals, sea otters, and other pinnipeds would be similar to those described for marine and coastal birds.

CONCLUSION (Effects on Pinnipeds and Sea Otters):

Alternative III would delay the effects of the proposal for 5 years. The combined effects of oil spills, disturbance, and habitat changes on sea otter populations associated with the proposal are likely to be MODERATE. Alternative III would have MODERATE effects on fur seals and MINOR effects on other pinnipeds.

CUMULATIVE EFFECTS (Effects on Pinnipeds and Sea Otters):

Delaying the sale would postpone the cumulative effects described for the proposal. The combined effects of oil spills, disturbance, and related adverse habitat changes associated with the cumulative activities are likely to result in MODERATE cumulative effects on sea otters and northern fur seals. Cumulative effects on walrus, Steller sea lions, harbor seals, and other pinnipeds are likely to be no more than MINOR. MAJOR cumulative effects on sea otters or northern fur seals are possible if several thousand sea otters were killed--probably as the result of more than 1 spill, or if several fur seal rookeries were heavily contaminated during the pupping season. Either of these events is very unlikely.

d. Effects on Endangered Species and Nonendangered Cetaceans: Effects associated with Alternative III would be essentially the same, at least qualitatively, as those discussed for the proposal (Sec. IV.B.1.a.(4)). The magnitude of effects could vary, depending on the population status of affected species at the time the delay would terminate or when undesirable effects would occur. Delay of the lease sale would provide additional time for ongoing research to gain additional data useful in improving the accuracy and precision of effects prediction.

CONCLUSION (Effects on Endangered Species and Nonendangered Cetaceans):

Alternative III could delay the effects of the proposal for 5 years. Effects on gray, right, fin, and humpback whales would be MINOR, while the effects on bowhead, blue, sei, and sperm whales would be NEGLIGIBLE. Potential effects on all nonendangered cetaceans would be MINOR.

CUMULATIVE EFFECTS (Effects on Endangered Species and Nonendangered Cetaceans):

Delaying the sale would postpone the cumulative effects discussed for the proposal. Effects on the bowhead, gray, fin, humpback, and sperm whales would be MINOR, while the effects on blue and sei whales would be NEGLIGIBLE. Effects on gray whales would be MODERATE. Potential effects on all nonendangered cetaceans would be no greater than MODERATE.

2. Effects on Social and Economic Systems:

a. Effects on Commercial Fishing Industry: A lease sale delay could affect commercial fishing. Expansion of the fishing industry during the delay period, principally through development of fisheries for domestic-groundfish or other species, such as herring or salmon, could increase the level of fishing activity in the area and thus increase the potential for industry conflicts if oil and gas activities occurred after the delay. Some present effects on the commercial fishing operation could be reduced, i.e., improvements in navigation would reduce gear loss and vessel collisions.

CONCLUSION (Effects on Commercial Fishing Industry):

Although some effects on the fishing industry could be reduced, possible expansion of the fishing industry during the delay could increase eventual conflicts between the fishing and oil industries.

CUMULATIVE EFFECTS (Effects on Commercial Fishing Industry):

Delaying this lease sale could result in better definition of cumulative effects and related mitigating measures, thereby reducing effects on commercial fishing.

b. Effects on Local Economy: The effects on the general economy would be the same as those described for the proposed in Section IV.B.1.b.(2), except for the delay of 5 years.

CONCLUSION (Effects on Local Economy):

Effects on the local economy would be the same as for the proposal (MINOR), only delayed 5 years.

CUMULATIVE EFFECTS (Effects on Local Economy):

The cumulative effects on local economy would be the same as described for the proposal, except for a postponement of effects resulting from the proposal.

c. Effects on Community Infrastructure: Delaying the lease sale 5 years would delay the effects described in Section IV.B.1.b.(3). However, the delay could provide the potentially affected communities with additional time to plan and prepare for the effects described in Alternative I. If the sale were delayed, the cost of housing, residential land, labor, and building materials could increase due to inflation.

CONCLUSION (Effects on Community Infrastructure):

Delaying the lease sale would provide additional time for communities to plan and prepare for possible effects. The effects would most likely be the same as those described for the proposal, only delayed 5 years.

CUMULATIVE EFFECTS (Effects on Community Infrastructure):

The effects from the cumulative projects described in Section IV.A.6.a. would be the same as those described for the proposal in Section IV.B.1.b.(3), except for a postponement of effects resulting from the proposal.

d. Effects on Subsistence-Use Patterns: The effects of Alternative III on subsistence-use patterns would be the same as those described for the proposal, only delayed (refer to Sec. IV.B.1.b.(4)). Delaying the sale could provide improved technology on oil-spill containment and cleanup and could reduce effects imposed by oil spills on these resources.

CONCLUSION (Effects on Subsistence-Use Patterns):

Effects on subsistence-use patterns would be the same as for the proposal, only delayed.

CUMULATIVE EFFECTS (Effects on Subsistence-Use Patterns):

The cumulative effects on subsistence-use patterns would be the same as for the proposal, except for a postponement of effects resulting from the proposal.

e. Effects on Sociocultural Systems: Refer to the discussion of effects on sociocultural systems for the proposal in Section IV.B.1.b.(5). The effects of Alternative III on sociocultural systems would be the same as for the proposal, only delayed.

CONCLUSION (Effects on Sociocultural Systems):

The effects on sociocultural systems would be the same as for the proposal, only delayed.

CUMULATIVE EFFECTS (Effects on Sociocultural Systems):

The cumulative effects on sociocultural systems would be the same as for the proposal, except for a postponement of effects resulting from the proposal.

E. Alternative IV - Alaska Peninsula Deferral

The total area offered with this alternative would be 1.96 million hectares (853 blocks). This alternative would defer leasing on 312,397 hectares (137 blocks) in the area identified for the proposal (Fig. II-3) which are within 40 kilometers of the Alaska Peninsula. The conditional-mean-resource estimates used for Alternative IV are 331 MMbbls of oil and 2.20 TCF of gas (Table II-1). The marginal probability for hydrocarbons is estimated to be 0.14 for Alternative IV.

The development assumptions for this alternative assume a pipeline-transportation scenario similar to that identified for Alternative I (Sec. IV.A.1.). Assumptions concerning geophysical activity, exploration, and development and production infrastructure would generally be the same as those identified for Alternative I (Sec. IV.A.1.). Estimates of drilling muds, cuttings, and formation waters for Alternative IV would be slightly less than those estimated for Alternative I because only 18 production wells (20 wells for the proposal) would be necessary to produce the estimated resource. Table IV-19 provides a schedule of development and production for Alternative IV.

1. Effects on Biological Resources:

a. Effects on Fisheries Resources: The Alaska Peninsula Deferral alternative would defer leasing of 137 blocks within 40 kilometers of the Alaska Peninsula. A localized reduction of effects of seismic and discharge activities and a reduced risk of oil-spill contact with the Port Moller area are expected as discussed below.

The elimination of seismic surveys in all areas within 40 kilometers as a result of the deferral could result in localized reductions of effects on lifestages of salmon, forage fish, groundfish, red king crab, and other invertebrates, which are concentrated in nearshore waters; however, with the limited radius of mortality (.6 to 1.5 meters), these reductions should not be significant. Seismic effects on regional fisheries populations would remain the same as for the proposal (negligible).

Under this alternative, the deferral of blocks also could result in localized reductions of effects of drilling and production discharges. Although the number of drilling and production wells remains the same as for the proposal, discharges would occur a minimum of 40 kilometers from land (rather than 18 km for the proposal) into waters a minimum of approximately 40 meters deep (rather than 30 m). This could result in more rapid dilution of toxic components and suspended-sediment levels. There would be no reduction in discharge amounts or frequencies from those expected from the proposal. Overall, the effects of drilling and production discharges on regional populations of fisheries resources are expected to remain the same as for the proposal (minor).

Port Moller is the only nearshore area that would benefit significantly from a reduction of oil-spill risk resulting from the alternative. The conditional probability of oil-spill contact within 3 or 10 days would be reduced from greater than 99.5 to 35 percent, and from 99.5 to 49 percent, respectively. Final oil-spill-risk probabilities are not, however, reduced significantly from the proposal--from 17 to 14 percent, from 20 to 17 percent, and from 24

Table IV-19
Estimated Schedule of Development and Production
(Alternative IV)

Year	Exploration Wells	Delineation Wells Oil	Delineation Wells Gas	Platforms Oil	Platforms Gas	Production and Service Wells Oil	Production and Service Wells Gas	Trunk Pipeline (Kilometers) Oil	Trunk Pipeline (Kilometers) Gas	Production Oil (MMbbls)	Production Gas (TCF)
1985											
1986	1										
1987	1										
1988	1	1									
1989	1	1	1								
1990	1	1		1		4					
1991			1			10		162			
1992					1	4	3	48	162		
1993							7		48	5	
1994										28	.084
1995										28	.106
1996										28	.106
1997										28	.106
1998										28	.106
1999										28	.106
2000										24	.106
2001										22	.106
2002										19	.106
2003										16	.106
2004										14	.106
2005										12	.106
2006										11	.106
2007										10	.106
2008										9	.106
2009										8	.106
2010										7	.106
2011										6	.106
2012											.106
2013											.086
2014											.064
2015											.042
2016											.016
2017											
Total	5	3	2	1	1	18	10	210	210	331	2.20

Source: USDOI, MMS, 1985.

to 20 percent for a 1,000-barrel oil spill over periods of 3, 10, and 30 days, respectively. In particular, the vulnerable lifestages of herring, salmon, red king crab, and several groundfish species concentrated in Port Moller would be less at risk to oil-spill contact and its consequent potential for moderate or major effects. Although the risk of oil-spill effects on the localized population in the Port Moller area would be reduced, the overall effects on regional populations would remain the same as for the proposal. Port Moller is the only important fisheries area that would experience a significant reduction in oil-spill probabilities. Unimak Pass would experience a small oil-spill-contact reduction of less than 0.5 percent for both 3- and 10-day trajectories. Other areas have conditional probabilities, for 3 and 10 days, of less than 0.5 percent for the proposal and would not experience a reduction from the deferral. Because the exploration, development, and production assumptions are similar to those for the proposal, overall oil-spill effects of the alternative on regional populations are expected to closely approximate those for the proposal. The effects on salmon, forage fish, groundfish, and other invertebrates would thus be minor, while major effects on red king crab would be anticipated.

CONCLUSION (Effects on Fisheries Resources):

The aggregate effects of seismic activities, drilling and production discharges, and oil spills on localized groups of fisheries resources are expected to be MINOR for salmon, forage fish, groundfish, and other invertebrates. Effects on red king crab are expected to be MAJOR.

b. Effects on Marine and Coastal Birds: If recoverable oil resources exist within 40 kilometers of the northern coast of the Alaska Peninsula, deferral of these lease blocks would remove potential platform oil-spill sites from the immediate vicinity of coastal foraging areas, migration corridors, and lagoon entrances, thereby allowing increased time for an oil spill originating at the remaining platform sites farther offshore to weather before entering critical areas, and for containment/cleanup procedures to be implemented. This alternative would not change the potential location of spills of pipeline or tanker origin.

The risk is greatest during spring and fall migration periods, when large numbers of waterfowl could be adversely affected by oil spills. Summer spills could result in substantial losses in large shearwater flocks foraging near or within the 50-meter depth contour. Although the probability of spill occurrence and contact does not differ substantially from the proposal, conditional contact probabilities (which assume oil has been released at a particular spill point) may be used to assess the potential effect of this deferral. This is accomplished through comparison of contact probabilities associated with spill points in the deferred area, which are eliminated from the proposal by this deferral (F1, B1, B2, D1), with those remaining near the lease sale area boundary under the alternative (F2, F3, F5, B3; see Appendix G, Tables G-2, G-5, G-8, G-9, Graphic 5; and Fig. IV-13 in Sec. IV.E.1.c). These comparisons reveal a reduced probability of spill contact with specific target areas under the deferral provisions of Alternative IV, where lease blocks within 40 kilometers of the peninsula have been eliminated (Table IV-20).

Table IV-20
Comparison of Conditional Contact Probabilities (percent) for Hypothetical Spill Points[1] in the Proposed Sale Area with Those Eliminated by the Alaska Peninsula Deferral (Alternative IV)[2]

Spill Trajectory Interval	Leasing Alternative	Nelson Lagoon (Land Segment 11)	Izembek Lagoon (Sea Target 4)	Port Moller/ Nelson Lagoon (Resource Area 7)	Offshore (Sea Target 23)
10-Day	Proposal	19(D1)	9(B1)	99+(D1)	99+(D1)
	Alternative IV (deferral)	11(B3)	5(F5)	49(B3)	32(B3)
30-Day	Proposal	19(B1)	5(F1)	25(B1)	13(B1)
	Alternative IV (deferral)	3(F5)	3(F2)	5(F5)	2(F5)

Source: MMS, 1985.

1/ Hypothetical spill points are in parentheses.
2/ Spill points from which contact probability within 10 days is small or negligible are compared under the 30-day trajectory interval.

The magnitude of apparent risk (of target contact) reduction exhibited by 10-day spill trajectories (period within which oil retains substantial toxicity) is approximately 50 percent. These values should be viewed as relative indicators of potential reduction with Alternative IV rather than the absolute magnitude of reduction expected since the compared spill points lie at different distances from the nearshore boundary of their respective areas (proposal or deferral). Similar reductions in risk to offshore targets (i.e., large shearwater flocks concentrated near the 50-m depth contour) would be realized with this Alternative (Table IV-20). Thirty-day spill-trajectory values are more variable as a result of more variable distances from target areas and alternative boundaries, and the influence of environmental factors over greater time and distance.

Although the range of apparent risk reduction provided by this alternative varies considerably, depending upon the potential spill points and target areas considered, the relative magnitude of risk reduction (approximately 50%) is quite similar among several of the different combinations considered above. This is not to suggest that the alternative would decrease to one-half the potential risks of the proposal, but there is a definite indication of reduction in risk to habitats on the northern side of the Alaska Peninsula. When the probability of an oil spill both occurring and contacting specific targets is considered, a somewhat lesser reduction in risk is realized. For example, the probability of a spill occurring and contacting the Port Moller/Nelson Lagoon inshore area declines from 20 (proposal) to 17 percent under this alternative (23 to 20% with the offshore-loading scenario). The probability of contacting the shoreline at Nelson and Izembek Lagoons remains unchanged at

5 and 3 percent, respectively. Risk to populations utilizing coastal habitats is expected to decline (and in fact does), since increased dispersion and weathering of a spill travelling a greater distance from the point of origin should result in lower mortality and thus decrease the time required by an affected population to recover. The effect of such a reduction would be most important during spring and fall migration periods (especially the latter, when spill trajectories trend toward or along the peninsula), when large numbers of waterfowl and shorebirds are at risk in coastal habitats. During the summer, large flocks of shearwaters in the inshore zone also would benefit from a reduction in risk.

The elimination of potential spill sites nearest the peninsula substantially reduces the expected probability of oil-spill contact with targets in this area, making it considerably less likely that effects discussed for the proposal (minor to major) would occur over the 26-year life of the field. In addition, the toxicity of spilled oil may decline somewhat through weathering processes as it travels over the greater distances between the lease sale area and the potential targets involved in this alternative; as a consequence, the severity of effects, as well as overall mortality, may be reduced somewhat (under certain circumstances weathering may not substantially reduce toxicity until several weeks have elapsed; Lewis and Malechi, 1984). Dilution of spilled oil as it disperses over a greater area and water depth also may reduce its toxicity, although conceivably more individuals could be contacted under these circumstances.

These changes in oil-spill toxicity and distribution principally are expected to reduce effects in areas/seasons where moderate effects are projected under the proposal (medium to high bird densities in coastal areas). Potential effects in offshore areas where densities are low and oceanographic conditions more variable (proposal=minor), and in peninsula lagoons where oil may be trapped (proposal=major), are not expected to change substantially under this alternative.

CONCLUSION (Marine and Coastal Birds):

Under this alternative, the elimination of potential spill sites nearest the Alaska Peninsula substantially (50+%) reduces the probability of spilled oil contacting birds in important coastal habitats; however, the probability of spills both occurring and contacting the important Port Moller area is reduced only from 20 to 17 percent. Nevertheless, effects discussed under the proposal are considered less likely to occur under this alternative. Also, the severity of effects on individuals and populations may be reduced as a result of oil weathering and dispersal. The principal consequence of these changes in oil distribution and toxicity is expected to be a reduction of effects in areas/ seasons where moderate effects are projected under the proposal. In sum, adverse effects under this alternative are expected to be MINOR. Effects in offshore areas (proposal=minor) and peninsula lagoons (proposal=major) are expected to remain unchanged under this alternative.

c. Effects on Pinnipeds and Sea Otters: This alternative would defer leasing of 137 blocks within 40 kilometers north of the Alaska Peninsula and Unimak Island (Figure II-3). If an oil spill occurred in the eastern portion of the deferral area offshore of Port Moller (represented by Launch Points B-2 and D-1, Fig. IV-13), there is a comparatively high (17% to

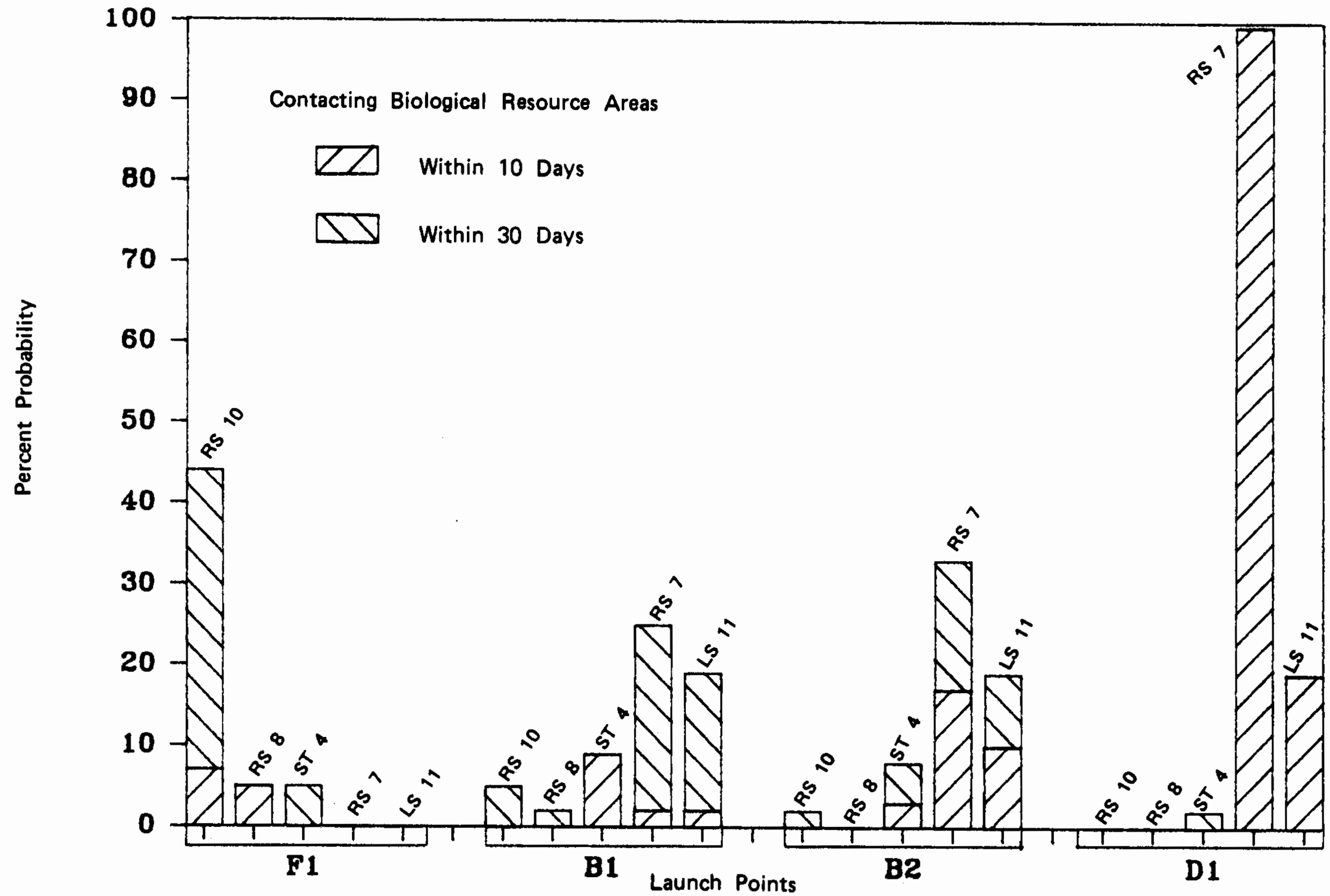


FIGURE IV–13

PERCENTAGE PROBABILITY THAT AN OIL SPILL STARTING AT PARTICULAR LOCATIONS (Launch Points F1, B1, B2, and D1, see Graphic 5) LOCATED WITHIN ALTERNATIVE IV DEFERRAL AREA WILL CONTACT CERTAIN BIOLOGICAL RESOURCE AREAS

Legend

RS 10 = Biological Resource Area 10 (Shelf Break North of Unimak Pass)
RS 8 = Biological Resource Area 8 (Unimak Pass)
ST 4 = Sea Target 4 (Izembek Lagoon)
RS 7 = Biological Resource Area 7 (Port Moller)
LS 11 = Land Segment 11 (Nelson Lagoon)

19%) chance that a spill would contact the Port Moller (Biological Resource Area 7) or Nelson Lagoon (Land Segment 11) coastal-habitat areas of sea otters and harbor seals within 10 days, respectively (Fig. IV-13). Risk to the Port Moller area from Launch Point B-2 increases to 33 percent within 30 days. (The probability of Launch Point D-1 contacting the Port Moller area is 99.5 percent in Fig. IV-13 because this launch point is located within Biological Resource Area 7). If an oil spill occurred in the center of the deferral area (Launch Point B-1) or in the western portion of the deferral area (Launch Point F-1), there is a 9- and 7-percent chance (respectively) of the spill contacting the Izembek Lagoon area (Sea Target 4), and the shelf break north of Unimak Pass within 10 days (Biological Resource Area 10) (Fig. IV-13). These areas are important habitats of sea otters and northern fur seals. If an oil spill occurred in the western or central portion of the deferral area (Launch Points F-1 and B-1), contact probabilities for sea otter concentration areas (see Graphic 3) would be greater than those shown in Figure IV-13 because important sea otter habitat extends along the coast from Unimak Island to Port Moller. Consequently, deferring oil activities in the area could reduce spill risks and oil effects on 18,000 to 20,000 sea otters and could reduce, to a slight extent, the spill risks and effects on northern fur seals in the St. George Basin. However, spill-contact risks to sea otter and pinniped habitats in the Port Moller area are comparatively high for a launch point (B-3, Graphic 5) north of Port Moller within blocks that are not included in the deferral area (Appendix G, Table G-2, Biological Resource Area 7). However, potential spills from other launch points in the rest of the lease area outside the deferral are at very low risk of contacting coastal habitats. The combined probabilities indicate that this alternative could slightly reduce oil-spill risks to several thousand sea otters, harbor seals, and walrus occurring in the Port Moller area (Appendix G, Table G-16, Biological Resource Area 7).

Potential noise and disturbance effects on pinnipeds and sea otters are likely to be similar under this alternative to the proposal because the same number of drill platforms and the same level of air and vessel-support traffic would occur under this alternative.

In summary, this alternative could reduce oil-spill effects on sea otters and, to a slight extent, effects on northern fur seals and other pinnipeds. Assuming oil and gas exploration and development were to take place in this deferral area under the proposal, this alternative could potentially reduce the oil-spill effects on sea otters from moderate to minor, assuming that substantially lower estimates of sea otters (for example, less than 100 individuals) would die from an oil spill under this alternative than under the proposal, wherein a much greater estimated number of sea otters (for example, 400 to 700 individuals) could be killed.

CONCLUSION (Effects on Pinnipeds and Sea Otters):

The effect of this alternative on sea otters could be MINOR, versus MODERATE under the proposal, while the effects on fur seals could still be MODERATE, with MINOR effects on other pinniped species (the same as under the proposal). Cumulative effects would be essentially the same as for the proposal.

d. Effects on Endangered and Threatened Species:

(1) Effects on Endangered Cetaceans: The area encompassed by this alternative is adjacent to the area used by 70 to 80 percent of the gray whale population during its spring and fall migrations. A portion of the population (approximately 10%) spends the summer feeding in the lagoons and coastal waters along the northern shore of the Alaska Peninsula. Areas of importance include the Nelson Lagoon/Port Moller and Ugashik Bay areas. Other endangered whales that may be present in the sale area during the summer feeding period include the fin, humpback, and right whales. The bowhead whale may be in this area on occasion during the winter and early spring months. This alternative has combined probabilities that are similar to the proposal with a pipeline transportation option (see Sec. IV.B.1.a.(4) for analysis of the proposal). Overall risks and associated effects on endangered cetaceans and their habitats would be somewhat reduced by the removal of the 4 spill points which present high risks to some whale use areas. However, final probabilities do not change substantially by deferral of this area. The total number of expected spills of 1,000 barrels or greater would be 0.86; and the probability of 1 or more of these spills occurring would be 58 percent. A localized reduction of effects from noise and disturbance to endangered species may result from this alternative.

CONCLUSION (Effects on Endangered Cetaceans):

This alternative would result in NEGLIGIBLE effects on bowhead, sei, blue, and sperm whales. Effects on gray, right, fin, and humpback whales would be MINOR.

(2) Effects on Endangered and Threatened Birds: Due to their low use of this area, potential effects on endangered and threatened birds would be essentially the same as for the proposal (both transportation scenarios).

CONCLUSION (Effects on Endangered and Threatened Birds):

Effects on endangered and threatened birds resulting from this alternative are expected to be NEGLIGIBLE.

e. Effects on Nonendangered Cetaceans: The area encompassed by this alternative is frequently used by killer and minke whales and Dall's porpoise. Several other nonendangered cetaceans pass through the area, either as infrequent visitors or on migrations to and from summer feeding areas. Cetaceans spend the summer feeding in the lagoons and coastal waters; the Nelson Lagoon/Port Moller area is frequented by beluga whales feeding on salmon and herring. This alternative would have combined probabilities that are similar to the proposal (see Sec. IV.B.1.a.(5))

Overall risks and associated effects on nonendangered cetaceans and their habitats would be the same as for the proposal. A localized reduction of effects from noise and disturbance on nonendangered species may result from this alternative.

CONCLUSION (Effects on Nonendangered Cetaceans):

This alternative would result in a reduction of oil-spill risks and effects of noise and disturbance on nonendangered cetaceans and their habitats. Effects resulting from this alternative are expected to be NEGLIGIBLE, as compared to MINOR for the proposal.

2. Effects on Social and Economic Systems:

a. Effects on Commercial Fishing Industry:

Space and Catch Loss: The deferral of blocks within 40 kilometers of the Alaska Peninsula would essentially eliminate the potential for foreclosure of any areas for crab or groundfish fishing in these deferred blocks due to installment of platforms. However, the level of oil development would remain the same outside the deferral area. With the exception of *C. bairdi* (tanner crab) and yellowfin sole, the area being deferred does not appear to be a highly concentrated fishing area based on catch information for recent years. Even for *C. bairdi* and yellowfin sole, other areas outside the deferral area have more highly concentrated populations of these species. Therefore, this deferral is not expected to alter catch-loss estimates from those of the proposal to any significant degree.

Gear Conflicts: The Alaska Peninsula Deferral alternative would delete a number of blocks in which fishing is significant, but would delete none of the blocks where fishing is most highly concentrated. Furthermore, the location of the deferral is out of the path of seismic vessels and supply boats that would be travelling between Unalaska and the proposal area. Therefore, the Alaska Peninsula Deferral would not reduce gear conflicts by any appreciable amount.

Effects of Oil Spills: The Alaska Peninsula Deferral would reduce the potential effects of oil spills on salmon and herring fishing operations, especially in the area of Port Moller, where risk is the highest. If a spill occurred (conditional probabilities), the chances of it hitting the shore west of Port Moller (Nelson Lagoon to Pavlof Bay, Land Segment 11) would be reduced from 19 to 3 percent for a 3-day trajectory and from 19 to 11 percent for 10 days. The lower part of the Alaska Peninsula, from False Pass to and including Unimak Island, would be as likely to be hit by an oil spill with the Alaska Peninsula Deferral as without it, at a maximum chance of 5 percent within 10 days if an oil spill occurred. However, the probability of an oil spill contacting other land segments along the peninsula drops from a maximum of 2 to 4 percent to less than .5 percent with the adoption of the Alaska Peninsula Deferral. The chance of a spill occurring and contacting each of these areas is less than .5 percent, the same as for the proposal.

The Alaska Peninsula Deferral would have very little effect on the likelihood of oil spills occurring and contacting crab and/or groundfish fisheries. The likelihood of an oil spill contacting the area northwest of Port Moller (Sea Target 23), where oil-spill risk to crab fisheries is highest, is not reduced with adoption of the Alaska Peninsula Deferral. Neither is the likelihood for hitting any of the other sea targets in concentrated fishing areas, except Sea Target 3, about 40 miles north of Unimak Pass. The conditional probability of a spill hitting this tanner crab area would be reduced from 23 to 5 percent within 3 days, but would remain at 23 percent within 10 days. Final probabilities do not change significantly from the proposal with this alternative.

In summary, the Alaska Peninsula Deferral would reduce the conditional probability of an oil spill contacting salmon and herring fisheries, especially west of Port Moller. The deferral would reduce only slightly the likelihood of contact with crab fisheries, and would not reduce the likelihood of contact with groundfish fisheries.

Other Effects: Since the level of exploration and development would generally be the same as for the proposal, effects from competition for service support and labor, and the likelihood for collisions between fishing and oil industry vessels, would be the same as discussed for the proposal.

CONCLUSION (Effects on Commercial Fishing Industry):

The Alaska Peninsula Deferral would reduce the likelihood of oil spills contacting salmon and herring fisheries. The deferral would not appreciably reduce other oil-spill risks to fisheries. The effects on commercial salmon, herring, and groundfish fisheries would be MINOR. Effects on the red king crab fishery would be MAJOR.

b. Effects on Local Economy: This alternative generally encompasses the same development scenario as the proposal, thus producing comparable levels of population growth and development activity. Because of this, effects on the local economy at Unalaska and Cold Bay would be the same as for the proposal.

CONCLUSION (Effects on Local Economy):

The local economic effects would be approximately the same as described for the proposal, MINOR.

c. Effects on Community Infrastructure: This alternative generally encompasses the same development scenario as the proposal, thus producing comparable levels of population growth and development activity. Because of this, effects on community infrastructure at Unalaska and Cold Bay should be the same as for the proposal.

CONCLUSION (Effects on Community Infrastructure: The effects on the community infrastructure of Cold Bay and Unalaska, as a result of the Alaska Peninsula Deferral, would be the same as for the proposal, NEGLIGIBLE.

d. Effects on Subsistence-Use Patterns: This alternative generally encompasses the same development scenario as the proposal, thus producing comparable levels of population growth and development activity. Because of this, effects on subsistence-use patterns at Unalaska and Cold Bay and in the Bristol Bay region generally should be the same as for the proposal. Placement of lease sale blocks farther offshore of the Alaska Peninsula (by deferring certain nearshore blocks) offers the potential for reducing the risk to nearshore subsistence resources and habitats. Use of conditional probabilities (using Table G-8, Appendix G, for 10-day land-contact probabilities if oil were spilled in the deferred area) shows that deferral of the nearshore blocks deletes a considerable amount of risk to shoreline areas. This is confirmed by the final probabilities. The OSRA shows a similar pattern and level of risk to land segments in the alternative as in the proposal. However, the aggregate risk from oil-spill contacts already is relatively low, thus reducing the significance of the reduction obtained by deferring nearshore blocks.

CONCLUSION (Effects on Subsistence-Use Patterns:

Effects on subsistence-use patterns would be the same as for the proposal, NEGLIGIBLE.

e. Effects on Sociocultural Systems: The levels of population growth and industrial activity in Alternative IV are comparable with the proposal, since the development-scenario assumptions are generally the same as for the proposal. The removal of blocks farther offshore of the Alaska Peninsula makes no substantial reduction in potential effects on subsistence-use patterns (as shown in Sec. IV.B.1.b.(4)), and therefore should do little to reduce social, cultural, or political effects generated by reduced effects on subsistence resources. The removal of blocks, however, should reduce the fear of potential effects on sociocultural systems generally embraced by residents of the Bristol Bay region. Political effects on regional community associations such as the Bristol Bay Native Association, the Aleutian-Pribilof Islands Association, and the several coastal resource service areas also may be reduced somewhat with the removal of these blocks; but any reduction may be marginal in terms of involvement required.

CONCLUSION (Effects on Sociocultural Systems):

Effects on sociocultural systems are generally the same as for the proposal. MINOR effects on sociocultural systems are possible in Sand Point. In Unalaska, Cold Bay, and the Bristol Bay region as a whole, the effects on sociocultural systems would be NEGLIGIBLE.

F. Effects on Other Issues

1. Water Quality:

a. Effects of the Proposal (Alternative I):

Pipeline-Transportation Scenario: Under normal offshore operations, varying degrees of water-quality degradation will occur as a result of oil and gas exploration and development in the Bering Sea. Potential water-quality degradation resulting from increased OCS oil and gas operations is derived from the resuspension of bottom sediments through exploration and development activities and pipeline construction, the discharge of sanitary and domestic wastes, the discharge of formation waters, the discharge of drilling fluids and muds, and the accidental hydrocarbon discharges due to spills, blowouts, and chronic small-volume spills.

Sediment Resuspension: Ten exploration/delineation wells, thirty-two production wells, and two production platforms are estimated to be required as a result of the proposed action. Sediment resuspension is likely to occur as a result of setting anchors for semisubmersible exploratory rigs and driving piles for production platforms. The amount of sediment resuspended from these activities will be negligible and restricted to the area immediately around the specific activity, and will likely be reduced to background levels within several hundred meters downcurrent from the activity.

The OCS construction operations resulting in sediment resuspension in receiving waters of the North Aleutian Basin are minor in volume and import compared to the natural processes that occur there. Storm surges and oceanographic conditions in the Bering Sea result in natural bottom disturbances that exceed the effects from pipeline construction and platform siting; therefore, effects due to sediment resuspension are deemed negligible.

Discharges from Platforms: The OCS exploratory vessels and production platforms would discharge drilling fluids in bulk quantities, along with lower-level releases of petroleum hydrocarbons and sanitary wastes from wastewater-discharge sources. The OCS production platforms also will discharge bulk quantities of petroleum-formation waters. Discharges of drilling muds and drill cuttings in the North Aleutian Basin lease sale area are projected from the development scenarios in Section II.B. Under the mean-resource-case scenario, an estimated 3.64 to 327.5 MMbbls of formation waters; 4,844 to 8,344 tons of drilling-mud solids; 48,900 to 69,900 tons of drill cuttings; and an average of 11,000 gallons/day of treated sanitary and domestic wastes from platforms are expected to be discharged.

Discharges from platforms in the Bering Sea will be regulated through a general National Pollution Discharge Elimination System Permit (NPDES) from the EPA. General NPDES permits elsewhere in Alaska expressly prohibit discharges of halogenated phenol compounds, trisodium nitrilotriacetic acid, sodium chromate, sodium dichromate, oil-based drilling muds, and diesel-oil additives. These restrictions will likely be retained in the Bering Sea NPDES permit, as may others that specify maximum-bulk-discharge rates, predilution requirements, and minimum-effluent-discharge depths (see Table IV-3).

Effects on water quality are to be expected only in the immediate vicinity of discharges. Drilling fluids typically form two plumes when discharged in the water column. Within minutes of discharge, the heavier materials settle to the seafloor, usually within a few hundred meters of the discharge point. Lighter, suspended particles and dissolved materials remain in the water column for several hours. These materials will eventually settle out adjacent to and downcurrent from the discharge point. Solids dilutions of up to 10,000:1 at 100 meters from the discharge point have been measured in OCS field studies.

Assuming a 200-meter-radius mixing zone around a drilling rig, up to .13 square kilometers of the lease sale area would have impaired water quality during some part of the year while exploration and delineation activities are ongoing. This impairment would exist during periods of actual discharge, but would rapidly dissipate afterward. During production, with two platforms operational, .26 square kilometers of the lease area would have impaired water quality. Discharges at production locations, however, would continue over several years.

Total production of formation waters is estimated to range from 3.64 to 327.5 MMbbls, with proportionately more waters being produced during the later stages of field life. The discharge of these formation waters will be regulated by EPA permit so that water-quality criteria for areas outside of an established mixing zone are not exceeded. The mixing zone would likely be of the same magnitude as that for drilling-mud discharges, affecting only a few tenths of a square kilometer over the entire proposed lease sale area. Most of the formation water--that produced in later years as the field declines--would likely be reinjected into the formation to preserve pressures.

Thus, water quality on the order of less than a square kilometer will be affected by deliberate discharges of drilling fluids from exploration or production platforms. Deliberate discharges, other than drilling fluids and formation waters, are expected to have a negligible effect on water quality because of their small volumes and the area's dilution potential. Degradation of water quality would persist less than a year at exploration platforms, but would continue intermittently as wells were drilled through the years at production platforms. Thus, water-quality effects from discharges would be minor.

Oil Spills: In addition to permitted and planned discharges, accidental oil spills are likely to occur. Based on experiences in other OCS areas, a most likely number of 1 oil spill of 1,000 barrels or greater is projected if oil is produced from the proposed lease sale.

Based on the studies of Ixtoc and Bravo blowouts (Grahl-Nielson, 1978; Mackie et al., 1978; Fiest and Boehm, 1980), expected total hydrocarbon concentrations within the upwelling plume of a blowout should be on the order of 10 parts per million (most of the plume is seawater). Concentrations outside of the plume and just outside of the edges of a surface slick should reach 0.3 parts per million. In the water column near a slick, dissolved hydrocarbons will generally constitute about 10 percent of total (dispersed plus dissolved) oil, the bulk of the oil being present as discrete oil droplets (see Fig. IV-3). However, the ratio of dissolved to total oil in concentrations derived from a subsurface plume may be higher. The rising plume of small oil droplets allows some increase in dissolution of oil, but the rapid rise of most of the oil to the surface suggests that the increase in dissolution must be fairly small.

By the third day after spillage, the water-soluble, toxic components of the oil would be depleted from the oil slick, mostly by either dissolution during rising of a subsurface plume or by evaporation, relatively little is dissolved from the oil once it forms a slick.

In the early hours of a spill, water concentrations of hydrocarbons would decrease rapidly with distance from the slick (Manen and Pelto, 1984). Within a few hundred meters, concentrations of hydrocarbons will decrease tenfold, to approximately 0.03 parts per million. For a spill in the open sea, with both slick and water column moving under different influences and in different directions, higher concentrations of hydrocarbons would not be expected to accumulate with time.

According to Cline's (1981) Bristol Bay hydrocarbon model, the 0.3-parts-per-million (ppm) concentration at the edge of a subsurface plume would decrease tenfold to 0.03 ppm within 12 kilometers of the spill, and hundred-fold to 0.003 ppm within 80 kilometers of the spill. Pollutant concentrations equivalent to background (0.001 ppm) might be detectable for 200 to 300 kilometers.

In addition to the infrequent occurrence of large spills, more chronic spillage of smaller volumes also is expected. Oil spills of 50 barrels or less are thought to constitute a quarter of the total spillage from the offshore oil industry (National Academy of Sciences, 1975). The oil-spill record for all-size industry spills in Cook Inlet demonstrates improvement in more recent years, a trend which parallels that for major OCS spills nationwide. Since 1971, the Cook Inlet oil industry has had 141 spills under 1,000 barrels each, for a rate of 265 spills per billion barrels produced. The average reported spill size since 1971 has been 4.4 barrels. If we extrapolate this rate to the proposed lease sale, we project 119 small spills over the production years, totaling 525 barrels over the life of the field.

Because of unavoidable chronic and accidental discharges of oil, measurable degradation of existing pristine water quality is very likely to occur in the area. Plumes of dissolved hydrocarbons from a major spill (100,000 barrels or more) could be detectable over the low background levels for perhaps 200 to 300 kilometers. Occasional tar balls or mousse (water in oil emulsions) would be expected. Likely increases in dissolved hydrocarbon concentrations, however, should appreciably degrade water quality only in limited areas and for short periods.

Decomposition and weathering processes for oil are slowed appreciably in colder waters. Prudhoe Bay crude remained toxic to zooplankton in coastal tundra ponds for 7 years after an experimental spill (Barsdate et al., 1980), demonstrating persistence of (toxic) oil fractions or their weathering and decomposition products. In Bering Sea waters, biodegradation would be slow because of cold temperatures and because of the pristine nature of the Bering Sea. To date, oil spillage in the Bering Sea has been too little to promote development of a healthy population of those microorganisms that like to feed on hydrocarbons (Haines and Atlas, 1982). In marine waters, advection and dispersion generally reduce the effects of release of toxic-oil fractions or daughter products, except possibly to isolated waters of embayments with limited circulation. Regional long-term degradation of water quality below state and federal standards because of hydrocarbon contamination is very unlikely. Thus, water-quality effects from hydrocarbon releases should be minor.

Port Moller/Balboa Bay Pipeline: If oil is found, two 210-kilometer pipelines could be emplaced to transport oil and gas from production platforms across the Port Moller/Balboa Bay transportation corridor to a transshipment terminal at Balboa Bay. Offshore-pipeline-construction activities would result in the resuspension of sediments along the route of the pipeline; however, these sediments would rapidly settle following the completion of activities in a specific area. If entrenchment of the pipeline occurred, up to 1.41 million cubic yards of sediment could be displaced along the pipeline route over the 3-year construction period. Pipeline burial from the mouth of Port Moller to the head of Portage River Valley (Fig. II-2) could require dredging and displacement of 64,000 cubic yards of material. Turbidity levels in Port Moller and Herendeen Bay would increase during dredging and back-filling operations as a result of sediment dispersion (BBRMP, 1985).

Degradation of water quality in Foster Creek and the Portage River could result from pipeline development. Land clearing, material site development and dredging operations along the pipeline right-of-way could increase erosion, and alteration of surface water and groundwater patterns. Construction activities close to the river channel result in changes in stream depth and velocity. Wetland dredging and filling near Portage River valley and in the vicinity of Pyramid Mountain and Cathedral Peak may cause ponding and disrupt natural groundwater flow (BBRMP, 1985).

Terminal-site construction at Balboa Bay could require extensive grading and leveling. These operations would require wetland filling and could cause increased sedimentation in Foster Creek. Shipping-channel dredging at a terminal facility at Balboa Bay would result in increased suspended solids and turbidity in the embayment (BBRMP, 1985).

Pipeline and access-road construction would have a temporary adverse effect on surface and groundwater quality within the pipeline corridor. Local effects could be severe but would be short-term. Long-term effects could occur if continual maintenance dredging of Balboa Bay is necessary (BBRMP, 1985).

Offshore-Loading-Transportation Scenario: Under the offshore-loading scenario, the effects on water quality would generally be the same as under the pipeline-transportation scenario (minor) because sediment resuspension discharges from platforms and effects from oil spills would be the same. This scenario would not require an offshore or onshore oil pipeline. As a result, local and short-term effects on surface and groundwater associated with emplacement of an oil pipeline along the Port Moller/Balboa transportation corridor would not occur. However, emplacement of a gas pipeline along the corridor would continue to have short-term, local water-quality effects.

SUMMARY (Effects on Water Quality):

Anchoring of exploration or production drilling rigs and entrenchment of pipeline(s) under the pipeline-transportation and offshore-loading-transportation scenarios would increase turbidity only temporarily over a limited area. Platform discharges of drilling fluids during exploration and production would contaminate less than 1 square kilometer. Production, but not exploration, discharges would continue intermittently over several years. The 1 projected oil spill of 1,000 barrels or greater could significantly, but temporarily, increase water-column-hydrocarbon concentrations over several hundred kilometers.

CONCLUSION (Effects on Water Quality):

Effects on water quality from the proposal would be MINOR under either transportation scenario.

CUMULATIVE EFFECTS (Effects on Water Quality):

Cumulative effects include those from the proposal plus those arising from prior and future lease sales. These include Sales 57 and 100 (oil tankered from Norton Sound), Sales 70 and 89 (St. George Basin lease sales), Sales 83 and 107 (oil tankered from the Navarin Basin), and potential tankering of Canadian crude through the modeled area. The cumulative risk of oil spills in the OSRA is projected at a most-likely number of 24 spills of 1,000 barrels or greater in the modeled area. No spills of 100,000 barrels or more are projected. As in the proposal, these spills would significantly, but temporarily, degrade water quality in the area. Overall, oil pollution would be increased from that for the proposal alone, but no other effects on water quality would be greater than for the proposal, due to the timing of the particular sales, their production/construction schedules, and the duration of anticipated effects. Significant long-term effects on regional water quality would still be very unlikely.

Conclusion (Effects on Water Quality): MINOR water-quality effects would occur through short- and long-term local degradation.

b. Effects of Alternatives II, III, and IV:

Alternative II (No Sale): If the lease sale were not held, any adverse effects from the proposal (Alternative I) would not occur; however, effects on water quality from existing OCS oil and gas operations (Norton Sound [Sales 57 and 100], St. George Basin [Sales 70 and 89], Navarin Basin [Sale 83 and 107], and potential Canadian tankering, etc.) would still be expected.

Alternative III (Delay the Sale): If the sale were delayed, the effects would be the same as for the proposal, only delayed for 5 years. The effects of the proposal (Alternative I) on water quality would be minor. In the cumulative case, minor water-quality effects would occur through short- and long-term local degradation. These effects would be delayed for 5 years.

Alternatives IV (Alaska Peninsula Deferral): Because the resource level for this alternative is similar to the proposal, 1 spill of 1,000 barrels or more is anticipated. Thus, the block-deferral alternative may change the location but not the nature of water-quality effects. The effects of the deferral alternative could be minor, the same as for the proposal. In the cumulative case, minor water-quality effects would occur through short- and long-term local degradation.

2. Effects on Air Quality:

a. Effects of the Proposal (Alternative I):

Pipeline-Transportation Scenario: Effects on air quality from activities under the proposal are not expected to be a problem. No violations of national or state air-quality standards or Prevention-of-Significant-Deterioration (PSD) requirements should occur.

Normal Offshore Operations: The proposal includes a total of five exploration wells, five delineation wells (three oil and two gas), two production platforms (one oil and one gas) and thirty-two production wells (twenty oil and twelve gas). Peak exploration (three wells) is projected for 1989, peak-production drilling (thirteen wells) in 1991, and peak joint oil and gas production would occur during 1995 through 1999. If all oil and gas exploration and development were to occur in a small area 18 kilometers (11.18 miles) offshore, air-quality-analysis exemption limitations (30 CFR 250.57) would be exceeded only for nitrogen oxides and only during peak drilling of production wells (Table IV-21). The main source of nitrogen oxides is diesel-engine emissions from drilling vessels. In reality, it is unlikely that the exemption limitations for nitrous oxides would be exceeded because drilling sites would be located more than 18 kilometers offshore and would be subject to emission controls.

Nitrogen-oxide and nonmethane volatile-organic-compound emissions may exceed exemption limitations during average and peak production of oil and gas, also if all operations are concentrated 18 kilometers (11.18 miles) offshore. In the unlikely event that exploration or production plans demonstrate that air-quality-exemption levels might be exceeded, additional air-quality analysis would be required prior to issuance of national or state air-quality permits. In addition, emissions could be reduced by use of alternate well locations in combination with slant or directional drilling and by use of available pollution-control technologies (Table IV-22).

The onshore emission sources in this relatively remote area can be expected to be no greater than existing ambient concentrations in the Kenai/Nikiski area, where petroleum production, refining, gas liquefaction, and marine loading occur. The Kenai/Nikiski area meets Class II-PSD standards. Onshore emission in the Balboa Bay area should meet Class II-PSD standards. Emissions from oil-storage and shipment facilities and a liquid-natural-gas-processing and shipment plant at the Balboa Bay will be subject to review and air-quality modeling necessary to assure attainment of federal and state air-quality standards and Class II-PSD limitations. The primary pollutant emitted from the oil-storage and shipment facilities would be nonmethane volatile-organic compounds (Table IV-23). Quantities of other pollutants emitted during oil storage and shipment are considered negligible (Stephens et al., 1977). The major pollutant emitted from natural gas liquefaction and shipment would be nitrogen oxides (Table IV-24).

Table IV-21

Estimated Uncontrolled Emissions from Offshore Platforms for Alternative I (Proposal) and Alternative IV (metric tons per year)

	Pollutant 1/				
	CO	NO_x	TSP	SO_2	VOC
Peak-Exploration Drilling 2/	20.24	57.6	3.89	8.87	14.64
Peak Development plus Development and Production Drilling 3/	68.06	421.96	19.96	28.13	14.52
Mean-Production Years 4/	297.32	1100.26	41.49	61.0	3568.41
Peak-Production Years 4/	353.03	1306.77	49.52	62.92	4318.49
Exemption Limitations at 18 Kilometers Offshore 5/	15427.4	337.8	337.8	337.8	337.8
Exemption Limitations at 40 Kilometers Offshore 5/ (Alternative IV)	26379.0	755.0	755.0	755.0	755.0

Source: USDOI, MMS, 1984.

1/ CO=carbon monoxide, NO_x=nitrogen oxide, TSP=total suspended particulates, SO_2=sulfur dioxide, VOC=volatile organic compounds (less nonreactive compounds such as methane and ethane).

2/ Based upon 3 wells per year, 1.5 wells drilled to 2,286 meters average depth, 88 days average drilling time (Hooks, McCloskey and Associates, 1984). Assumes gas flared from test wells.

3/ Based on construction of 1 platform and drilling of 13 wells in 1991 to an average depth of 2,286 meters. Platform-construction emissions based on Table IV.D.3-1 of Final Supplement to the Final Environmental Impact Statement, Proposed 5-Year OCS Oil and Gas Lease Sale Schedule (USDOI, MMS, 1982).

4/ Based on Stephens et al. (1977); data from Gulf of Mexico.

5/ Exemption levels 5 kilometers from shore, based on 30CPR 250.57.

Table IV-22
Control Measures for Major Offshore Oil and Gas Emission Sources

Emission Source	Location[1/]	Major Pollutant	Control Measure	Possible Emission Reductions	Measure In Use	Other Controls
Diesel Engines	Drilling vessel Marine tanker	NO_x	Injection-timing retard	10-20%	No	Exhaust gas recirculation.
			Intake-air cooling	30%	Some engines	
		SO_x	Low-sulfur fuel	Variable		
Gas Turbines	Platform OS&T	NO_x	Water injection	70-80%	Yes[2/]	Fuel-injection retard SCR on exhaust gas.
		All	Waste-heat recovery[3/]	26%	Yes[4/]	
Flares	Drilling vessel Platform OS&T	VOC	Vapor recovery	95%	No	
Valves, Flanges, Compressor Seals, Pumps	Platform OS&T	VOC	Inspection and maintenance	50-75%	No	Double mechanical seals on compressors and pumps; Connect compressor pumps to vapor-recovery system.
Storage Tanks	Platform	VOC	Use of floating roofs or vapor recovery on fixed roofs	75-95%	Yes[5/]	
Tanker Loading	Platform OS&T	VOC	Vapor recovery	95%	Yes[4/]	
Gas Processing	Platform	SO_x	Tail-gas treatment (e.g., Stretford); Sulfur-recovery unit (e.g., Claus)	95-99%	Yes[6/]	

Source: Form and Substance, Inc., 1983.

Table IV-22
Control Measures for Major Offshore Oil and Gas Emission Sources
(Continued)

1/ OS&T = Offshore separation and treatment.

2/ Used on Esson Platform Hondo, Texaco Platform Habitat. Some problems noted.

3/ Can eliminate need for external combustion process heaters.

4/ Exxon Platform Hondo.

5/ Onshore facilities.

6/ Exxon Platform Hondo, Chevron Platform Grace, Union Platform Gilda (if H_2S is encountered).

Table IV-23
Estimated Peak Emissions for Balboa Bay Oil Terminal 1/

	Volatile Organic Compounds (metric tons per year)
Hydrocarbon Emissions From Oil Storage Tanks 2/	6.75
Hydrocarbon Emissions from Loading Tankers 3/	17.65

Source: USDOI, MMS, 1984.

1/ Emissions of pollutants other than volatile organic compounds (VOC) would be negligible. Figures given exclude methane, which is assumed to be 90 percent of VOC emissions. Emissions from vehicles, aircraft, heating, etc., would be small.

2/ Based on a nonmethane evaporative loss rate of .24 grams per barrel of storage capacity and a storage capacity of 850,000 barrels (10 days at peak production) (Mellinger et al., 1979.).

3/ Based on nonmethane evaporative loss rates for an 80,000-DWT tanker filling each 6 days. Figures based on Mellinger et al. (1979).

Table IV-24
Estimated Peak Emissions for Balboa Bay
Liquid Natural Gas Terminal 1/
(metric tons per year)

Pollutants 2/				
CO	NO_x	TSP	SO_2	VOC
493.58	4725.61	124.51	272.35	34.98

Source: MMS, 1984.

1/ Emissions per throughput assumed identical to those estimated for a liquid natural gas plant at Nikiski, Alaska, by Pacific Alaska LNG Associates (1979).

2/ Pollutants are as identified in Table IV-21.

Emissions from support activities at oil- and gas-storage and shipment facilities also are considered to be negligible. The PSD review is initiated for potential major emission sources (greater than 227 metric tons of an undivided pollutant each year). Consequently, review would be required for carbon monoxide, nitrogen oxides, and sulfur dioxide at the liquid-natural-gas plant.

Accidental Emissions: Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. Large emissions, however, are rare and are unlikely to occur as a result of the proposal.

The number of blowouts in the OCS--almost entirely gas and/or water--has averaged 3.3 per 1,000 wells drilled since 1956 (Fleury, 1983). The data do not show a statistical trend of decreasing rate of occurrence. The blowout rate has actually averaged somewhat higher since 1974, at 4.3 per 1,000 wells drilled; but the difference between the post-1974 period and the longer 1956-to-1982 record is statistically insignificant.

A gas blowout could release 20 metric tons per day of gaseous hydrocarbons, of which about 2 metric tons per day would be nonmethane hydrocarbons and thus classified as volatile organic compounds (Stephens et al., 1977). Since 1974, 60 percent of the blowouts have lasted 1 day or less; only 10 percent have lasted more than 7 days. Based on the assumption of Poisson distribution, the probability of experiencing 1 or more blowouts in drilling the 42 wells projected for the proposal would be about 17 percent. In the unlikely event that a gas blowout occurred, it would be very unlikely to persist more than 1 day and it would very probably release less than 2 metric tons of volatile organic compounds (nonmethane).

Oil spills are a second accidental source of gaseous emissions. The logarithmic-mean size of 1,000-barrel-or-greater spills is 8,000 barrels for platform spills, 7,500 barrels for pipeline spills, and 20,000 barrels for tanker spills (Lanfear and Amstutz, 1983). Over the life of an oil slick, evaporation accounts for from one-third to two-thirds of the slick mass. If a 20,000-barrel spill occurred in the proposed sale area, 6,700 to 13,333 barrels of oil or 900 to 1,800 metric tons of gaseous hydrocarbons or 90 to 180 metric tons of volatile organic compounds could be lost to the atmosphere, mostly within the first few days of a spill. The movement of the slick during this time would result in lower concentrations and dispersal of emissions over an area several times larger than the slick itself. The OSRA for the proposal projects a 61-percent chance of 1 or more spills of 1,000 barrels within the Bering Sea.

Gas or oil blowouts may catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of spilled oil. For catastrophic oil blowouts, in situ burning may be the only effective technique for spill control.

Burning affects air quality in two major ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and very slightly increase emissions (relative to quantities in other oil and gas industry emissions) of other pollutants (Table IV-25).

If an oil spill is ignited immediately after spillage, the burn can combust the 33 to 67 percent of crude oil or higher amount of fuel oil that otherwise

Table IV-25
Emissions from Burning 20 Metric Tons per Day
of Natural Gas during a Blowout

	Duration of Blowout		
	1 Day	4 Days	7 Days
Total Suspended Particulates	0.0090	0.040	0.060
Sulfur Dioxide	0.0003	0.001	0.002
Volatile Organic Compounds	0.0040	0.020	0.030
Carbon Monoxide	0.0090	0.040	0.070
Nitrogen Oxides	0.0400	0.150	0.260

Source: Calculated from Emission Factors in Frazier et al., 1977.

Table IV-26
Emissions from Burning of Crude Oil
(metric tons)

	Size of Burn		
	1,000 barrels	20,000 barrels	100,000 barrels
Total Suspended Particulate 1/	0.50	9.0	50.0
Sulfur Dioxide 2/ 3/	8.60	170.0	860.0
Volatile Organic Compounds 2/	0.05	0.9	5.0
Carbon Monoxide 2/	0.40	8.3	41.0
Nitrogen Oxides 2/	1.10	23.0	110.0

Source: USDOI, MMS, Alaska OCS Region. 1984.

1/ Estimated as 5 percent of the total burn. See text.

2/ Burning assumed to be the same as residual-oil firing in industrial burners. Emissions calculated from factors in Frazier et al., 1977.

3/ Assumes a sulfur content of 2.9 percent.

would evaporate. On the other hand, incomplete combustion injects oily soot and minor quantities of other pollutants into the air (Table IV-26). For a major oil blowout, setting fire to the wellhead could burn 95 percent of the oil with 5 percent escaping unburned as droplets in the smoke plume. Clouds of black smoke from a 360,000-barrel tanker fire 75 kilometers off the coast of South Africa deposited oil residue in a rain on animals and crops 50 to 80 kilometers inland. Clean rain later the same day washed away most of the residue, allaying fears of permanent damage (Oil Spill Intelligence Report, 1983).

Burns that are two or three orders of magnitude smaller do not appear to cause noticeable fallout problems. Along the Trans-Alaska Pipeline, 500 barrels of a spill were burned over a 2-hour period "apparently with no long-lasting adverse effect" (Schulze et al., 1982). The smaller-volume Tier II burns at Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group, 1983).

Coating portions of the ecosystem with oily residue is the major but not the only potential air-quality risk. Oily residue in smoke plumes from crude oil is mutagenic, but not highly so (Sheppard and Georghiou, 1981). The Expert Committee of the World Health Organization considers daily average smoke concentrations of more than 250 micrograms per cubic meter to be a health hazard for bronchitis (Craxford, 1983). National Ambient Air Quality Standards in the U.S. have primary and secondary 24-hour maximum limits of 260 and 150 micrograms per cubic meter of total suspended particulates, respectively, not to be exceeded more than once per year.

For the proposal, there is a 61-percent chance of 1 or more spills of at least 1,000 barrels. Only burns of spills of about 20,000 barrels or greater magnitude are likely to noticeably contaminate land that would be a minimum of 18 kilometers from the proposed lease sale area. Spills of 20,000 barrels or greater from inshore pipelines would have to be in the nature of a slow, undetected leak over a couple of months. Only a fraction of the volume of such a spill would be burnable when detected. Over the 31 years of oil exploration and production, perhaps 1 spill could potentially burn and locally contaminate coastal or inland areas. Such an occurrence also would require onshore winds. Sea breezes may not be an important consideration because large fires create their own breezes. Any contamination also could be washed away by subsequent rain and therefore would be temporary. In addition, air-quality criteria allow particulate limits to be exceeded once a year. Thus, air-quality standards at any specific location would be very unlikely to be exceeded.

Offshore-Loading-Transportation Scenario: Effects on air quality under this scenario would be the same as under the pipeline-transportation scenario, with the exception that effects of a transshipment terminal on air quality would not occur because a terminal would not be required.

SUMMARY (Effects on Air Quality):

Effects on air quality from the proposal (pipeline-transportation or offshore-loading scenario) are expected to be minor, based upon projected emissions of offshore exploration and production activities and potential onshore facilities in an area of pristine air quality. Projected peak emissions would not exceed state or federal air-quality limitations unless concentrated nearshore. In that event, existing control technology would ensure attainment of standards, although air quality would not be absolutely pristine near facilities. Air-quality effects for the proposal are expected to be analogous to those identified for Lease Sales 46 (USDOI, BLM [Sale 46 FEIS], 1980; USDOI, BLM [Sale 60 FEIS], 1981a). Onshore emissions would also be subject to federal PSD review and modeling.

CONCLUSION (Effects on Air Quality):

Direct effects on air quality from activities of the proposal under either transportation option would be MINOR. Additional air-quality analyses may be required by permitting agencies prior to any production activities.

CUMULATIVE EFFECTS (Effects on Air Quality):

Sale 92 is the only lease sale currently scheduled for the North Aleutian Basin. Pending any additional proposals, air-quality effects would remain minor.

Conclusion (Effects on Air Quality): Cumulative effects of the proposal on air quality would be MINOR.

b. Effects of Alternatives II, III and IV:

Alternative II - No Sale: No air-quality effects would result from this alternative.

Alternative III - Delay the Sale: A 5-year delay in the sale, with all development activities otherwise the same as for Alternative I, would result in the same effects as for the proposal, minor. The cumulative effects on air quality would be the same as for the proposal (minor) only delayed 5 years.

Alternative IV - Alaska Peninsula Deferral: Alternative IV limits exploration and production activities to at least 40 kilometers offshore. Consequently, exemption limitations are increased such that they could not be exceeded by exploration activities even if all occurred in a limited area. In the unlikely event that production, which would be reduced from that of the proposal, were concentrated in one area 40 kilometers offshore, exemption levels for nitrogen oxides and volatile organic compounds (nonmethane) could be exceeded. The amount of exceedence would be smaller than under the proposal. The overall effect upon air quality would remain minor. The cumulative effects on air quality would be the same as for the proposal, minor.

3. Effects on Cultural Resources:

a. Effects of the Proposal (Alternative I):

Pipeline-Transportation Scenario: Based on the mean-resource estimate (364 MMbbls), the pipeline-transportation scenario, and the transshipment terminal projected at Balboa Bay under the proposal, it is likely that both offshore and onshore cultural resources of the North Aleutian Basin lease sale area could be adversely affected to a minor degree.

Offshore oil and gas exploration and development activities (drilling-platform emplacement and pipeline trenching between production platforms, feeder pipelines, and a landfall) could affect historic-shipwreck sites located in nearshore and offshore areas. Ships wrecked near Port Moller include the Leffie (1902), the Excelsior (1906), the John Currier (1907), and the Jessie-Minor (1911). In addition, there are seven other ships wrecked among the islands near Balboa Bay (Table III-45).

Although there are numerous shipwrecks that could be affected (see Table IV-27 and Figs. IV-14 and IV-15), it is improbable that offshore prehistoric habitation sites would be found in the lease area (Dixon, Sharma, and Stoker, 1983; MMS Archeologic Analysis, Appendix J); therefore, the proposal would have no effect on offshore prehistoric sites (the probability of nearshore prehistoric sites in state waters has not been examined).

Onshore, cultural resources (Sec. III.D.3.) may be affected by oil spills as well as by installation of two 20-kilometer pipelines across the Alaska Peninsula (Fig. II-2), oil and gas development facilities, and an attendant local population increase. Construction of airports and/or oil and gas pipelines over or adjacent to archeological sites would directly affect cultural resources. Oil spills would indirectly affect cultural resources should cleanup equipment (bulldozers, trucks, or other heavy equipment) be moved overland from an air facility to the beach. If such transportation occurred, cultural sites on the beach or nearshore could be damaged when roads were constructed and/or all-terrain vehicles were driven over them; however, existing laws protect cultural sites (Table IV-28), and it is expected that the adverse effects would be minor.

The probability of 1 or more spills of 1,000 barrels or greater occurring from a tanker spill between Balboa Bay and a receiving facility is 0.28 and 0.07 for spills of 100,000 barrels or greater (Table IV-10). Oil-spill-cleanup activities resulting from such spills could adversely affect cultural resources on the southern shore of the peninsula and along Balboa Bay. Such activities also could affect areas between the shore and airports, if cleanup equipment is brought by airplane and transported to the spill area by vehicle; such vehicles might require new roads. It is expected that, if existing laws and regulations protecting cultural resources are adhered to before and during oil-spill-cleanup activities, the effects would be minor.

Areas of cultural significance that may be affected by oil-spill-cleanup activities include Nunivak Island (see Graphic 5: Segments 31-33), Cape Newenham (Segments 23-24), Walrus Island (21-22), Port Heiden (14-15), Port Moller (11-12), Bogoslof Island, Inner Bristol Bay (16-20), and the lower Alaska Peninsula and Unalaska and Unimak Islands (1-10). Segments 3 through 7 and 9 are most likely to be prehistoric human-habitation sites; these areas are likely habitats for food sources--prehistoric birds and mammals. The probability of oil contacting these segments within 10 days of a spill is less than 10 percent, and it is expected that existing laws would protect cultural resources from more than minor disturbance.

Offshore-Loading-Transportation Scenario: The effects of this transportation option would generally be the same as under the pipeline-transportation scenario. The principal exception would involve effects associated with oil-pipeline emplacement and development of an oil terminal at Balboa Bay.

Table IV-27

Summary of Effects on Shipwrecks and Cultural Sites by OSRA Land Segment

OSRA Land Segment 1/	No. of Ship-wrecks 2/	No. of Cultural Sites 2/	30-Day OSRA % Prob. Proposal 3/	30-Day OSRA % Prob. Cumulative 3/	Approximate Location of Segment	Effect on Land Segment 4/
Type I Segments 5/						
4	4	42	n	n	Unalaska-Dutch Harbor	Moderate
6	7	16	n	6	Unimak Pass	Moderate
8	2	14	1	1	Cold Bay	Minor
9	1	37	1	1	NE of Cold Bay	Minor
16	5	20	n	n	Ugashik	Minor
18	5	20	n	n	Kvichak Bay	Minor
19	2	26	n	n	Nushugak Bay, Constantine	Minor
35	1	12	n	n	Nunivak Is., North Side	Minor
Type II Segments 6/						
2	0	25	n	n	Umnak Island	Minor
5	0	25	n	2	SW of Unimak Pass	Moderate
7	0	41	1	7	Unimak Island	Moderate
11	4	3	9	9	SW of Port Moller	Moderate
20	1	1	n	n	Cape Constantine	Minor
21	0	15	n	n	Kulukak Bay	Minor
23	0	17	n	n	Point off Round Island	Minor
24	0	16	n	n	Summit Island	Minor
27	0	16	n	n	Togiak Bay	Minor
32	0	15	n	n	S of Nunivak Island	Minor
146	4	4	n	28	St. Paul	Moderate
Type III Segments						
1	0	2	n	n	See Graphic 5 for location	Minor
3	0	11	n	2		Minor
10	0	1	3	3		Minor
12	0	5	3	3		Minor
13	0	4	7	7		Minor
14	0	5	2	2		Minor
15	0	1	n	n		Minor
17	0	1	n	n		Minor
22	0	11	n	n		Minor
25	0	5	n	n		Minor
26	0	10	n	n		Minor
28	0	3	n	n		Minor
29	0	5	n	n		Minor
30	0	6	n	n		Minor
31	0	10	n	n		Minor
33	0	5	n	n		Minor
34	0	6	n	n		Minor
36	0	3	n	n		Minor
37	0	5	n	n		Minor
38	0	4	n	n		Minor
147	0	3	1	35		Minor
Mean	1	12				

Source: MMS, Alaska OCS Region.

1/ For cultural resources these segments include some distance inland. See Graphic 5 for land-segment locations.

2/ Type I: Above the mean on both number of shipwrecks and of cultural sites. Type II: Above the mean on either number of shipwrecks or cultural sites. Type III: Below the mean on both shipwrecks and cultural sites.

3/ Probability of 1 or more spills of 1,000 barrels or greater occurring and contacting land segments within 30 days.

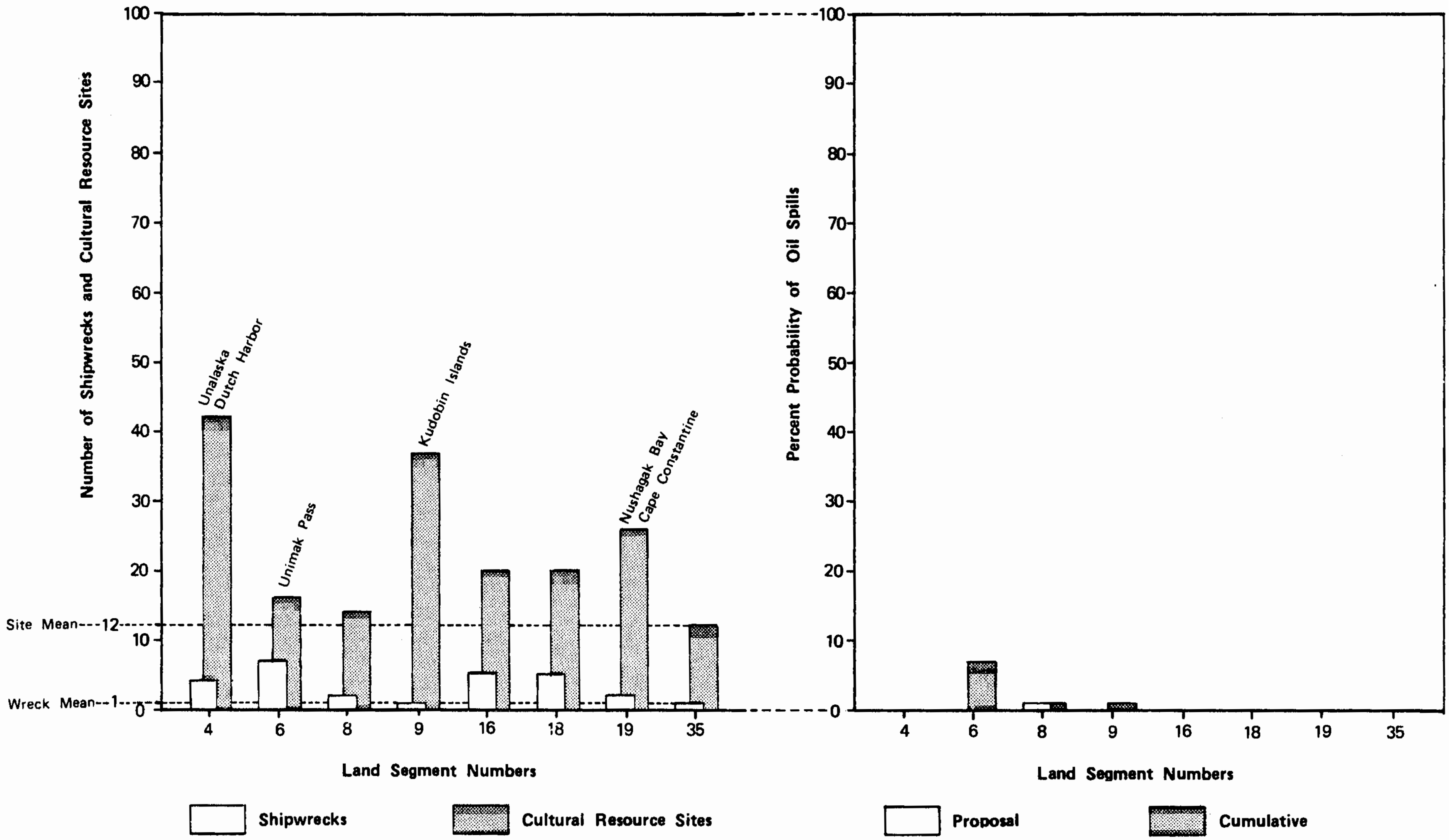
4/ Effects given are due to activities of OCS population and oil-spill cleanup given a spill. See discussion in text and Figures IV-14 and 15.

5/ See bar chart Figure IV-14.

6/ See bar chart Figure IV-15.

FIGURE IV-14

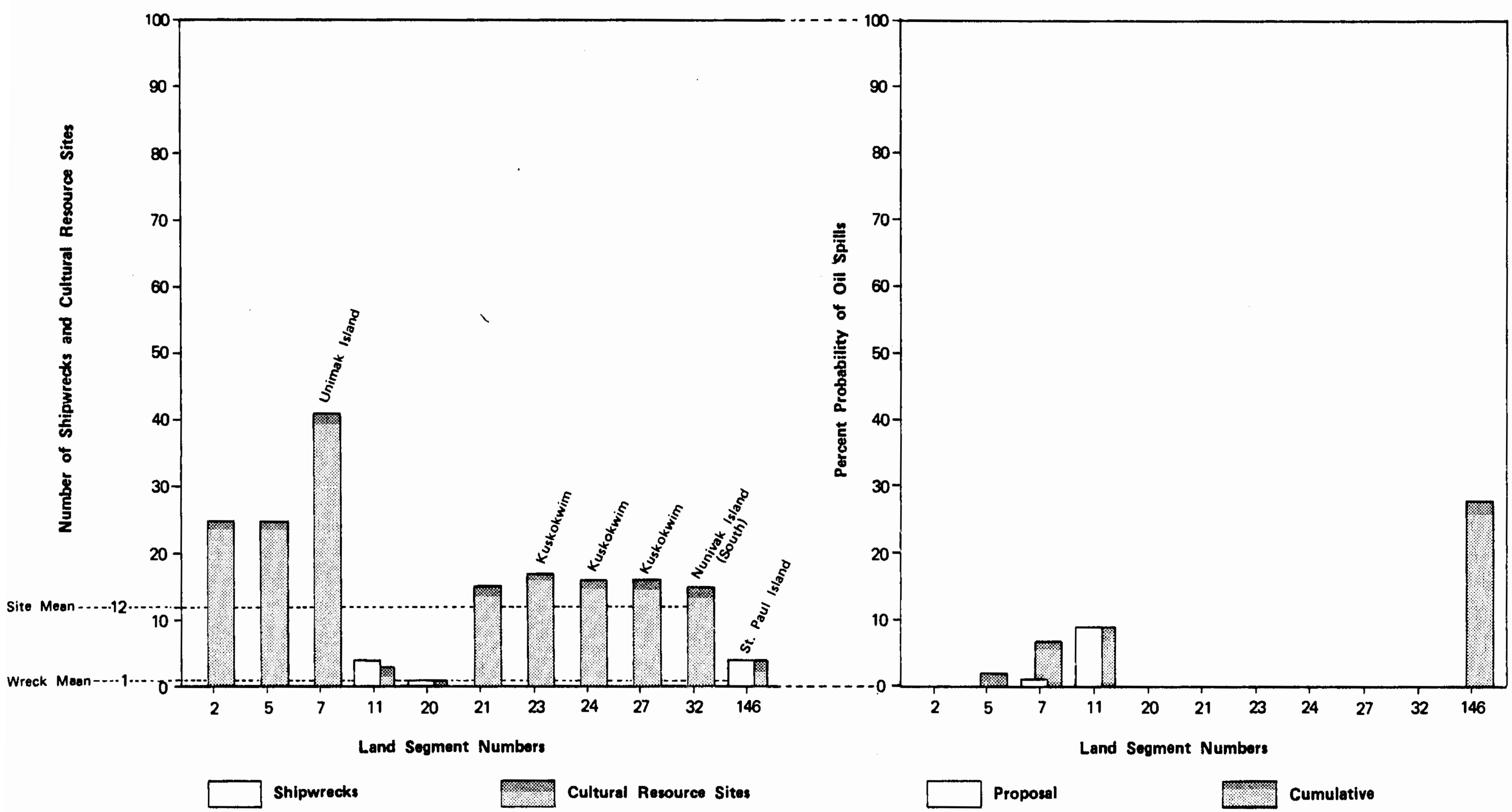
NUMBER OF SHIPWRECKS AND CULTURAL RESOURCE SITES (BOTH ABOVE THE MEAN) PER LAND SEGMENT AND THEIR PROBABILITY OF OIL SPILL CONTACT (WITHIN 30 DAYS)



SOURCES: Tornfelt, 1985.
USDI, MMS, 1982.
State of Alaska, Dept. of Natural Resources, Alaska Heritage Survey File and Computor List, 1985.

FIGURE IV-15

NUMBER OF SHIPWRECKS AND CULTURAL RESOURCE SITES (EITHER ONE BELOW THE MEAN) PER LAND SEGMENT AND THEIR PROBABILITY OF OIL SPILL CONTACT (WITHIN 30 DAYS)



SOURCES: Tornfelt, 1985.
USDI, MMS, 1982.
State of Alaska, Dept. of Natural Resources, Alaska Heritage Survey File and Computor List, 1985.

Table IV-28
Cultural Resource Laws and
Regulations Applicable to the
North Aleutian Basin

Antiquities Act of 1906 (Public Law 59-209; 34 Stat. 225; 16 U.S.C. 432, 433)

Uniform Rules and Regulations (43 CFR Part 3 and DM Part 310. 7.6)

Recreation and Public Purposes Act of 1926 (Public Law 69-386; 44 Stat. 741; 43 U.S.C. 869)

Historic Sites Act of 1935 (Public Law 74-292; 49 Stat. 666; 16 U.S.C. 461 et seq.)

Outer Continental Shelf Act of 1953 (Public Law 83-212; 67 Stat. 462; 43 U.S.C. 1331)

Reservoir Salvage Act of 1960 (Public Law 86-523; 74 Stat. 220,221; 16 U.S.C. 469) as amended by the Archeological and Historic Preservation Act of 1974 (Public Law 93-291; 88 Stat. 174; 16 U.S.C. 469)

The Department of Transportation Act of 1966 (Public Law 89-670; 80 Stat. 931; 49 U.S.C. 1653)

National Historic Preservation Act of 1966 (Public Law 89-665; 80 Stat. 915; 16 U.S.C. 470) as amended (Public Law 94-422; 90 Stat. 1313; and Public Law 94-458; 90 Stat. 1939)

National Environmental Policy Act of 1969 (Public Law 91-190; 83 Stat. 852; 42 U.S.C. 4321)

Council of Environmental Quality Guidelines (40 CFR Part 1500)

Executive Order 11593 ("Protection and Enhancement of the Cultural Environment," 36 F.R. 8921, May 13, 1971)

Procedures of the Advisory Council on Historic Preservation (36 CFR Part 800)

Marine Protection, Research, and Sanctuaries Act of 1974 (Public Law 92-532; 86 Stat. 1052)

Archeological Resource Protection Act of 1979 (Public Law 96-95)

Effects on cultural resources resulting from development of this infrastructure would not occur under this transportation scenario.

CONCLUSION (Effects on Cultural Resources):

Effects of the proposal (pipeline-transportation or offshore-loading-transportation scenario) on offshore and onshore cultural resources would be MINOR.

CUMULATIVE EFFECTS (Effects on Cultural Resources):

The major actions affecting cultural resources are: (1) the federal and state oil and gas lease sales; (2) the Apollo and Sitka mines on Unga Island; and (3) the proposed airport expansion at Unalaska. Cultural resources would be affected by OCS populations and activities in the Sales 70, 83, and 89 areas. The discussion of cultural resources in the Final EIS's for Sales 70 and 83 are incorporated herein by reference (USDOI, MMS, 1982; USDOI, MMS, 1983e).

Anticipated exploration and production infrastructure in the Navarin and St. George Basins (Table IV-12) could affect cultural resources in these areas. The combined effects of Sales 70, 83, 89, and 100 would increase population and would therefore affect cultural resources. For example, exploration and development personnel whose families live in Anchorage may want to seek hunting and fishing experiences in the northern Aleutian coastal area while recreating with their families. Such visits would increase the probability of interaction with cultural resources. Tankering of hydrocarbons from other Bering Sea lease sales through Unimak Pass would not have an effect on cultural resources in the Balboa Bay area. The volume of oil tankered out of Balboa Bay will be oil from the proposal.

If the Apollo and Sitka mines went into production, the increased population could affect the cultural resources around Balboa Bay and possibly the Port Moller area. Visits and hunting and fishing excursions would be likely sources for effects on cultural resources.

Conclusion (Effects on Cultural Resources): The cumulative effect of all potential actions in the lower Alaska Peninsula on cultural resources would be MINOR.

b. Effects of Alternative II, III, and IV:

Alternative II (No Sale): If the lease sale were not held, no adverse effects resulting from the proposal (Alternative I) would occur.

Alternative III (Delay the Sale): If the sale were delayed, the effects would be the same as for the proposal (minor), only delayed 5 years. The cumulative effects on cultural resources would be minor.

Alternative IV (Alaska Peninsula Deferral): This alternative would not reduce offshore effects appreciably because the lease blocks lie in an area of low probability of human habitation. Onshore, effects would not be reduced, although vulnerable resource areas (target land segments) affected by the proposal would be removed by this deferral. Beach resources and upland resources are protected by existing laws (Table IV-28); therefore, Alternative IV would have minor effects on cultural resources. The cumulative effect on cultural resources would be the same as for the proposal, minor.

4. Effects on Transportation Systems:

a. Effects of the Proposal (Alternative I):

Pipeline-Transportation Scenario: This section analyzes the effects of the proposed action on the following areas--Unalaska, Cold Bay, Unimak Pass, and the corridor of the transpeninsula pipeline. The analysis includes consideration of the infrastructure emplaced for exploration activities related to St. George Basin Lease Sales 70 and 89 (Sale 70 preceded both Sales 89 and 92 by nearly 3 years).

Cold Bay (Effects on Air Facilities): The air facility at Cold Bay is expected to serve the direct support needs of drilling and construction activities generated by the proposal. The airfield will support all exploration- and development-drilling efforts, as well as pipelaying activities and terminal construction.

During the exploration period, helicopter operations should average one to two trips per day per platform. In the development phase, helicopter operations should increase to two or more trips per day. During the production phase, helicopter-support traffic should decrease to one flight a day or every other day on an as-needed basis. Average annual enplanements during the peak of construction activities may reach 11,500 passengers, a figure representing a 30- to 40-percent increase over Cold Bay's present passenger level. Existing facilities at Cold Bay are inadequate to handle this level of increase. In the production phase, passenger levels would be expected to fall to 4,500 per year. New facilities, particularly dormitory and warehouse facilities, would need to be constructed.

Cold Bay also would provide air support for construction activities occurring at the terminal site (Balboa Bay) and along the pipeline construction corridor. Workers arriving in jets would be transferred to smaller rotary or fixed-wing aircraft for delivery to the construction sites. During the 1992 and 1993 construction seasons, these secondary flights could amount to 30 aircraft operations per month. Total aircraft operations for the peak development period could range between 650 and 700 operations per month, an activity level seven times greater than the present level. During the production phase, aircraft operations are expected to decline to 260 to 280 trips per month.

Unalaska (Effects on the Marine System): The principal focus of marine-supply activities would be the City of Unalaska and its harbors. A 16-hectare marine-support facility is currently located at Unalaska. It is unknown how many additional support facilities will exist in Unalaska by the end of the Sales 89 and 92 exploratory periods; however, the City of Unalaska is projected to become the regional support center for all oil activities. This event could trigger competition between the fisheries and petroleum industries for space to build dock and warehouse facilities.

During the exploratory period, Unalaska is expected to serve a maximum of two drilling rigs in a drilling season. At least two support vessels would be assigned to each platform and would visit the drill site every day or every other day. Existing facilities, or facilities remaining from Sale 70 exploratory activity (assuming Sale 70 exploratory activity is unsuccessful), should be able to accommodate the approximately 60 support-vessel trips per month.

During the development phase, Unalaska's support facilities would serve platform installation and initial production activities, as well as marine-pipeline-laying operations. Support-boat/tug operations serving the platform installations would depend on the types of platforms emplaced. If a large gravity based platform were used, much of the deck equipment could be in place when the structure is towed into the Bering Sea. If this were the case, support operations could be expected to last a month per structure, with approximately one trip per day to the installation site. If a steel-jacket platform structure were installed, deck-equipment-emplacement operations could take several additional months, depending on the weather. In this case, support-boat trips would average at least one per day, with extensive resupply operations necessary should poor weather delay equipment installation. Workboat trips to the platforms would average between one every day and one every 2 days.

Pipelaying activities are expected to occur during the spring and summer; approximately 80 kilometers of concrete-coated pipe could be laid during a season. Given the climatic instability of the Bering Sea, it may be necessary to employ a second pipelaying barge during one season to meet the scenario assumption--210 kilometers of oil pipeline emplaced during 1992 and 1993. Each pipelaying barge would require an attendant pipe-trenching and burial barge. The number of workboat trips to these vessels could reach approximately 100 during the spring/summer operation period.

Tubular goods, as well as dry-bulk-drilling materials, are expected to be unloaded and stored in Unalaska for later transport to offshore sites. During the peak of drilling activity, barge traffic (6,000 short tons) devoted to these materials should not exceed three arrivals per year. In regard to other peak-period barge traffic, four fuel barges of the 7,000-short-ton class would be required for each year between 1990 and 1993. During the pipelaying years (1992-1993), at least four barges (6,000-short-ton class) may be required. Unlike the fuel, which is expected to be stored in and shuttled between Unalaska and the operations sites, the pipe sections are expected to travel directly to site.

The maximum number of support-boat trips in the exploration/development period should reach a peak of 120 trips per month during the 1992 spring/summer drilling season.

During the production phase (1994-on), all forms of marine transport are expected to decline to a plateau of modest activity. Support-boat activity is expected to decline to one trip every 2 days or as needed. Platform-fuel requirements, if not met by the use of formation gas, would be provided by scheduled barge service.

Unalaska (Effects on Air Facilities): Unalaska is not expected to provide direct support for offshore activities. Air activities would be related to the transfer of marine-support personnel and the emergency delivery of drilling supplies. During 1993, the year of peak air activity, at least 420 additional enplanements related to oil and gas activities are expected on a monthly basis. During the production phase, monthly enplanements related to the proposal are expected to decline to 150 to 200 per month. In the next few years, Unalaska will expand its air facility to allow use by jets of the 727 and 737 class. Such an expansion would facilitate the transfer of OCS-related personnel and would minimize the effects their passage would place on the local air system.

Unimak Pass: The principal effects of the proposal on the Unimak Pass area would occur during the development phase, with the passage of six to seven barges per year carrying dry-bulk-drilling materials, tubular goods, and fuel. Unimak Pass also would be the access route for platforms being towed to the proposed lease area. Vessels carrying platform-deck equipment, crane barges that handle the deck equipment, pipelaying and pipe-burial barges, and the necessary support/tug vessels also would use the pass. Compared to the number of vessels currently using the pass, anticipated shipping related to the proposal could be considered negligible.

Balboa Bay and the Transpeninsula Pipeline Corridor: Assuming the discovery of commercially recoverable quantities of hydrocarbons, the initial effect of the proposed action on the subject area would occur with the establishment of a construction camp near the proposed terminal facility site. Between 1991 and 1993, an oil and gas pipeline and attendant service road would be constructed from Herendeen Bay to Balboa Bay. In the same period, a 25- to 30-hectare oil terminal/processing facility and an 80-hectare LNG facility would be constructed in Albatross Anchorage, a subembayment of Balboa Bay. The route selected follows the alignment of a route which, early in the century, was surveyed for a coal railroad. The topography of the hypothesized pipeline corridor is relatively low compared to the adjacent transpeninsula routes. This would aid rapid construction of the route; however, the approach from Herendeen Bay is very swampy and would require extensive quantities of gravel to create a permanent roadbed and pipeline pad.

The terminal facility would be essentially self-contained and would provide oil storage for up to 10 days. Oil tankers of the 80,000-DWT class would visit the facility every 5 to 7 days. LNG tankers of the 125,000-cubic-meter class would visit the LNG facility every 5 to 7 days.

Offshore-Loading-Transportation Scenario: Under the offshore-loading scenario, the effect on the transportation systems of Cold Bay and Unalaska would be the same as described for the pipeline transportation scenario. Vessel traffic effects on Unimak Pass would be minor if an offshore-loading scenario were utilized to develop the resources of the proposed action. The offshore-loading scenario, which is analyzed as a transportation option under the proposal, would result in an additional 60 tanker transits through Unimak Pass during the peak years of production (1995-2000). During the late 1990's, it is estimated that large-vessel traffic transiting Unimak Pass would be in excess of 1,000 trips per year. It is doubtful that traffic generated by the proposal would constitute more than 5 percent of that total. The effects of this level of tanker transportation is considered minor. The effects on Balboa Bay and the pipeline corridor would be reduced because an oil pipeline and transshipment facility would not be required. However, the effects resulting from a gas pipeline, LNG facility, and LNG tankering out of Balboa Bay would continue to be major.

SUMMARY (Effects on Transportation Systems):

The effects of the proposed action are focused on the air facility at Cold Bay, the transpeninsula pipeline corridor, and the transshipment terminal and LNG facilities at Balboa Bay. The effects of the proposed action would be major in these areas, particularly during the construction/development period. The pipeline corridor and terminal would be constructed in an area previously without any type of transport infrastructure, and large-vessel traffic would be introduced into an area with no large-vessel operations. In regard to the Cold Bay airfield, the influx of personnel during the construction/development period would significantly increase airport operations and passenger enplanements above present levels. The lessees may have to construct warehouse, dormitory, and very possibly hangar facilities to maintain their supply capabilities; however, many of these needed structures might already be constructed as part of exploratory activities for previous Bering Sea lease sales (70 and 89).

The effects of the proposed sale on the Unimak Pass are expected to be minor due to the low traffic volumes generated by the proposal. Effects of the proposed sale on Unalaska are expected to be moderate. The City of Unalaska already hosts one dedicated oil-support base, with additional facilities to be established in the near future. Competition for land between the fishing and oil industries could develop if both industries concurrently entered a maximum-growth period.

CONCLUSION (Effects on Transportation Systems):

The proposal (pipeline-transportation- and offshore-loading-transportation scenarios) would have a MAJOR effect on transportation systems at Cold Bay, Balboa Bay, and on the pipeline corridor, while the effects on Unalaska would be MODERATE. Effects on Unimak Pass vessel traffic would be MINOR.

CUMULATIVE EFFECTS (Effects on Transportation Systems):

The overall cumulative effect of this action, incremental to all other proposed Bering Sea development strategies, is expected to be minor. Cumulative transportation effects for proposed Bering Sea sales are expected to focus into five or six locations; the use of the sixth location, St. Matthew Island, ultimately will be contingent on the outcome of current litigation. Of the remaining five locations: St. Paul, Unalaska, Cold Bay, Unimak Pass, and Balboa Bay, only three would be affected significantly enough to warrant an analysis of cumulative effects. Unalaska, which would bear the burden of Sale 92 marine-support activities, also is postulated to serve as a support base for activities related to the development of leases sold in Sales 70 and 89 as well as a regional marine-supply center for all Bering Sea operations. Infrastructure, created for Sale 70 lease-development activities, including storage yards, chemical tanks, docks, etc., could easily serve Sale 92 operations. This would be the case should the same series of bidders prove successful in all three southern Bering Sea sales. It should be remembered that the development of Sale 70 leases would largely be finished by the time Sales 89 and 92 leases require development. The Cold Bay airfield is expected to serve air-support functions for drilling, pipelaying, and construction activities related to possible petroleum-related developments in the southern Bering Sea. Aircraft operations, passenger enplanements and related improvements in facilities required or generated by Sales 89 and 92 could easily be accommodated in the shadow of Sale 70 development activities. In regard to Balboa Bay, according to the revised scenario for the cumulative case, only production from Sale 92 leases will be piped to that embayment for storage and transshipment. In a cumulative sense, the establishment of a transshipment facility at Balboa Bay would represent a major effect in that the southern coast of the Alaska Peninsula is without any type of port infrastructure that could handle large ocean-going vessels. It would also mean the introduction of large ocean-going ships into an area that is infrequently visited by such vessels. The intensity of effects from such a facility would tend to telescope to the point of origin: effects on Balboa Bay and the surrounding waters could be major. However, given the current density of the region's shipping traffic and general isolation, the cumulative regional effects of a Balboa Bay terminal could be considered minor.

The marine- and air-support facilities at St. Paul Island are not expected to have a support function in regard to Bristol Bay activities. It is believed that the support facilities at St. Paul will be used primarily for offshore operations in the northern Bering Sea, specifically the Navarin Basin. The traffic levels through Unimak Pass will be insignificantly affected by Sale 92 activities. Vessel transits related to the proposed action are expected to be comprised of supply and material barges as well as traffic related to platform installation. Apart from a minor flurry of activity, during the field development phase, long-term traffic effects could be considered minor.

Conclusion (Effects on Transportation Systems): In the cumulative case, the effects of the proposed action can be considered to be MINOR.

b. Effects of Alternatives II, III, and IV:

Alternative II (No Sale): If the lease sale were not held, the effects resulting from the proposal would not occur.

Alternative III (Delay the Sale): If the sale were delayed, the effects of the sale would be essentially the same as for the proposal, only delayed for a period of 5 years. The cumulative effects on transportation systems would be the same as for the proposal--major in the Balboa Bay area and minor in other areas.

Alternative IV (Alaska Peninsula Deferral): The effects of the deferral alternative would be the same as for the proposal. The cumulative effects on transportation systems would be the same as for the proposal--major in the Balboa Bay area and minor in other areas.

5. Effects on Land-Use Plans and Coastal Management:

a. Land-Use Plans:

(1) Effects of the Proposal (Alternative I):

Pipeline-Transportation Scenario: The effects on land uses and existing plans are primarily associated with the following types of activities: (1) siting of onshore developments serving OCS leases (air- and marine-support facilities and marine terminals); and (2) land demands resulting from increased residential populations.

Land-use conflicts between OCS activities and existing land uses and plans in the Bristol Bay region, other than at sites proposed for exploration and development infrastructure, would generally not occur. Unalaska and Cold Bay are proposed as support-base sites, while a pipeline would be developed across the Alaska Peninsula following the proposed Port Moller/Balboa Bay transportation corridor. A marine terminal also would be constructed in the Balboa Bay area.

Cold Bay: Cold Bay has been indicated as a potential air-support site due to its superior airfield facilities. A small support-base facility could be constructed near the airport. Such a facility could include a hanger/warehouse complex, offices, and a helipad. ARCO has developed a small facility, adjacent to Cold Bay's dock facilities, on land leased from the Thirteenth Regional Native Corporation. The facility provides living quarters for ARCO employees.

OCS-generated population increases would require about 2 hectares (4 acres) of land for residential purposes. Although little land is available for development, land necessary for residential needs should pose few problems. Reduced operations by several major companies and agencies and resultant population reductions would create an oversupply of housing that could be used by OCS-generated populations. Also, current negotiations between the city, the federal government, and the State of Alaska are expected to result in the city acquiring at least 405 hectares (1,000 acres) of land by the turn of the century.

Unalaska: The development strategy for the North Aleutian Basin uses Unalaska as a marine-service base because of its strategic location near Unimak Pass, its good natural anchorage, and its existing marine infrastructure. The Offshore Systems, Inc., marine-support facility at Captain's Bay should be adequate to support exploratory drilling activities. This facility, designed to oil industry specifications, was established in 1982 to support Bering Sea COST wells. Development and production activities could require facility expansion to provide additional dockside space, warehousing, and open-air storage. Actual use would depend on the amount of production activity. Because only two production platforms are projected to be used, the existing facility should be adequate. Thus, facility-related land-use effects are expected to be minor.

The Unalaska Community Development Plan has allocated 516 hectares (1,276 acres) of land for residential purposes in four categories according to density of dwellings and character of development. About 4 hectares (9 acres) of residential land would be necessary to accommodate the housing needs of the OCS-generated resident population. Based on the comprehensive plan, enough developable land exists to accommodate residential demands of OCS and groundfish-industry activities. Although developable lands exist, land may be difficult to obtain, since the Ounalashka Corporation is the city's major landholder and it has no short-term plans for land sales. The oil industry may have to lease land from the corporation to provide residential areas for its employees.

Port Moller/Balboa Bay Transportation Corridor: The pipelines between Port Moller and Balboa Bay on the Alaska Peninsula could be from 55 to 69 kilometers (34 to 43 miles) long, depending on the port site chosen in Balboa Bay. The pipelines are assumed to be underwater for 8 to 13 kilometers (5 to 8 miles) in the Port Moller/Herendeen Bay area. The overland portion of the route, south of Herendeen Bay, would pass through Portage Valley and would require air, ground, and marine support, which could include helicopters, other aircraft, bulldozers, all-terrain vehicles (ATV's), barges, and ships.

Oil- and gas-pipeline development, scheduled for the years 1991 and 1993, could have a major effect on wilderness values along the proposed route, primarily due to construction and maintenance activities and to the physical presence of pipeline and support facilities. Construction and maintenance vehicles would impair the area's naturalness through alterations to soils and vegetation and the possible disturbance of wildlife, resulting in an unnatural community. Approximately 500 acres of land could be visually impaired due to the above activities. Due to the area's mountainous terrain, visual disruptions would be evident from land about 5 to 8 kilometers (3 to 5 miles) on each side of the pipeline. During the life of the pipeline, noise and the visibility of support facilities and maintenance vehicles also would impair wilderness values (BBRMP, 1985). The development of a 25- to 30-hectare oil terminal and 80 hectare LNG plant at Balboa Bay also could impair wilderness values.

The development of pipelines and a service road following the above route would pass through the Alaska Peninsula National Wildlife Refuge and conform with the preferred transportation-corridor routes identified in the Draft Bristol Bay Cooperative Management Plan (BBRMP, 1985). Development of a pipeline between Port Moller and Balboa Bay in the Alaska Peninsula NWR would not conflict with the preferred alternative identified in the Draft Refuge Comprehensive Conservation Plan (USDOI, FWS, 1984). Pipeline development would be subject to the provisions of Title XI of ANILCA and to FWS requirements concerning rights-of-way. An environmental assessment or an EIS would have to be prepared and a special USC permit would have to be granted by the FWS before pipeline construction on the refuge could begin. The marine terminal, LNG plant, and most of the pipeline corridor would be outside the refuge on land selected or conveyed to the Native corporations. As a result, the decision to build these facilities would be largely up to the Native landowners (USDOI, FWS, 1984).

Offshore-Loading-Transportation Scenario: This scenario would have minor effects on Cold Bay and Unalaska which are the same as the pipeline transportation scenario. An offshore-loading scenario would reduce the effects on wilderness values between Port Moller and Balboa Bay because an oil pipeline and terminal would not be required. However, the effects on wilderness values would continue to be major as a result of the gas pipeline and LNG facility at Balboa Bay.

CONCLUSION (Effects on Land-Use Plans):

The effects on Unalaska and Cold Bay as a result of industrial and residential land-use demands would be MINOR under both transportation scenarios. The development of an oil and gas pipeline on the Alaska Peninsula between Port Moller and Balboa Bay would conform with the preferred transportation corridors identified in the BBRMP (1985) and Draft Refuge Comprehensive Plan (1984). However, an oil or gas pipeline, oil terminal, or LNG facility would have a MAJOR effect on the area's wilderness values.

CUMULATIVE EFFECTS (Effects on Land-Use Plans):

Additional facilities could be required in Unalaska and Cold Bay to support exploration and development in the Navarin, St. George, and North Aleutian Basins. This is particularly true for Unalaska, which, in addition to providing OCS facilities, is expected to emerge as a major port for the burgeoning groundfish industry. If possible, the Offshore Systems, Inc., marine-support facility at Captain's Bay which was established to support Bering Sea COST wells would be used to support exploration, and development and production activities in the Bering Sea. Additional facility requirements beyond those that could be supplied by the Offshore Systems, Inc., facility could increase competition for limited docking facilities. The three commercial port facilities--the City dock, the Chevron dock, and the Captain's Bay dock--could be used to support exploration and development. The latter commercial port facilities are in the community development plan's general industrial land-use classification, which is intended to accommodate industrial uses not directly related to the seafood-processing industry. The major land-use constraint associated with these port facilities (except the Captain's Bay dock) is the lack of adjacent developable land to serve as a supply yard. The Captain's Bay dock facility contains about 28 hectares (70 acres) of developable land adjacent to the facility. This land should be capable of handling most service and supply functions. However, this facility is generally not available for commercial operations. If the city or Chevron docks are deemed suitable, or the Captain's Bay dock becomes available, the major effect could be congestion of the harbor during peak shipping seasons. Peak seasons are associated with the transshipment of fish from the Bristol Bay fishery (May and June), the transshipment of goods to northern and western Alaska (July), and an October peak caused by the crab fishery. If existing port facilities are not suitable or are unavailable, industry may choose to construct additional piers and warehouse complexes in the Unalaska area. In the cumulative case, the effects on land use along the route selected for pipeline development would be the same as those identified for the proposal, since OCS activities in the North Aleutian Basin would provide the only impetus for change in this area.

Conclusion (Effects on Land-Use Plans): The cumulative effect of development activities on land uses in Unalaska would be MODERATE, as compared to MINOR for the proposal (Alternative I). The cumulative effects on land use along the Port Moller/Balboa Bay pipeline route would be the same as for the proposal.

(2) Effects of Alternatives II, III, and IV:

Alternative II (No Sale): The expansion of the groundfish industry in the Bering Sea would provide the impetus for change in Unalaska in the absence of the lease sale (Alternative II). In Unalaska, the groundfish industry's demand for boat harbors, warehouses, and housing would increase industrial development on waterfront sites. Land uses in Cold Bay and along the pipeline route would remain unchanged, since no major actions are anticipated in these areas in the absence of the lease sale.

Alternative III (Delay the Sale): This alternative would not change the effects attributed to the proposal, except to delay them for a period of 5 years. Cumulative effects on land use would be the same as for the proposal.

Alternative IV (Alaska Peninsula Deferral): The level of industrial activity and projected population growth for Alternative IV would generally be the same as for the proposal. Because of these assumptions, the effects on land uses in Unalaska and Cold Bay, and along the proposed pipeline route, would be substantially identical to the proposal; the proposal would have a negligible effect on land uses in Unalaska and Cold Bay and a major effect on wilderness values along the Port Moller/Balboa Bay transportation corridor. The cumulative effect of development activities on land uses in Unalaska and along the Port Moller/Balboa Bay pipeline route would be major.

b. Coastal Management:

(1) Effects of the Proposal (Alternative I):

Pipeline-Transportation Scenario: Effects of this proposal may occur in the lease sale area, in areas used as support bases and facility sites, and along transportation routes. The effects described throughout Section IV are related in this section to Alaska's coastal management policies, including: coastal habitats; air, land, and water quality; historic, prehistoric, and archeological resources; coastal development; geophysical hazards; energy facilities; transportation and utilities; and subsistence. Most of the effects noted in this section are related to oil spills. Therefore, the potential conflicts with coastal policies are based on an unlikely event which, in many cases, would be mitigated as a result of OCS operating orders and various stipulations.

The following analysis focuses on state policies contained in AAC Chapter 80, Standards of the Alaska Coastal Management Program (ACMP). Although the Yukon/Kuskokwim CRSA (Cenaliuriit) and Bristol Bay CRSA have coastal programs adopted by the Alaska Coastal Policy Council, no onshore activities are hypothesized near or within their boundaries, and oil-spill trajectories lead oil away from the inner Bay and northern coast. Some potential fishery effects are identified in the Bristol Bay CRSA, particularly around Port Heiden. In those instances, the Bristol Bay CRSA policies are discussed in conjunction with the state guidelines. Other effects occur either outside organized coastal districts or in areas where a program is still being developed. Once the coastal program of the Aleutians East CRSA is approved, its policies may be relevant because many of the effects noted in Section IV occur within that coastal district.

Draft policies of the Aleutians East CRSA Board provide insight into the probable final policies of the region. Given the board goal that oil and gas activities should be maintained in a manner favorable to the region, it is likely that activities will not be prohibited but rather curtailed to protect fisheries resources and to prevent interference with commercial and subsistence fishing. The draft policies provide more stringent, but more specific, guidance to industry. These explicit regulations will make decisionmaking less subjective, and this should help to ameliorate potential conflicts caused by oil and gas activities. Alternatively, industry could be much more limited by these detailed policies, depending upon how the state interpreted the more general existing policies. The one standard used in the Aleutians East policies is the facility-siting standard that development must occur in previously developed areas. Although the policy preference is to use existing facilities, the placement of new facilities is guided by habitat considerations rather than existing infrastructure.

Coastal Development: Regulations in the ACMP give the highest priority to water-dependent uses of the shoreline, followed by water-related uses and uses for which there are no feasible or prudent alternatives (6 AAC 80.040a). This priorty was retained in the Bristol Bay CRSA policies that replaced this state standard (Bristol Bay CRSA Coastal Management Program, Sec's 1.2 to 1.6.) Activities and uses hypothesized in this EIS usually are water-dependent or water-related and, therefore, receive priority for siting along a shoreline. Housing is the primary element that is neither water-dependent nor water-related. At this point in time, however, it is not possible to determine the sites that would be used for housing.

A second requirement is that the placement of structures, dredges, and fill must comply--at a minimum--with Corps of Engineers permit regulations (6 AAC 80.040[b]). Networking between the Corps' permit process and that of the state coastal-management process works to ensure that this requirement is met.

Geologic Hazards: Development in areas identified as being geologic-hazard areas "may not be approved by the appropriate state or local authority until siting, design, and construction measures for minimizing property damage and protecting against loss of life have been provided" (6 AAC 80.050.[b]). The Bristol Bay CRSA geophysical hazard policy (CMP, Sec. 2.1), which replaced that of the state, includes the significant loss of fish and wildlife habitats and populations as features to be protected. No hazard areas have been identified officially in this lease sale area. However, potential hazards from earthquakes and volcanoes are high in the area noted as a potential facility site for produced oil. Indeed, the Shumagin Islands, situated in the vicinity of a seismic gap, occupy a likely area for a major earthquake. Volcanoes along the Alaska Peninsula and Aleutian Islands are very active and can be highly explosive. Onshore development would need to be designed with these hazards taken into consideration.

Offshore development would be subject to similar hazards. In addition, those drilling offshore could encounter unstable sediments, surface and subsurface faults (many of which could be active), and gas-charged sediments. Each of these potential hazards can be mitigated through procedures in the OCS operating orders for Alaska.

Standards for Facility Siting: Sixteen policies guide the siting of energy facilities. Although the exact locations of the potential facilities are not known at this time, no direct activity or induced growth is anticipated within the boundaries of the Yukon/Kuskokwim or Bristol Bay CRSA. General areas for locating support activities and a transshipment terminal hypothesized in this EIS include Unalaska, Cold Bay, and a pipeline route between Herendeen Bay and Balboa Bay. The attributes of these locations and the effects noted in other portions of this EIS form the basis for the analysis of this policy.

The siting of facilities in an area and in such a way as to minimize effects on the environment is considered in several of the policies. Included in these policies are stipulations requiring that adverse environmental effects be minimized (6 AAC 80.070[b][1]); only minimal site clearing, dredging, and construction occur in productive habitats (6 AAC 80.070[b][10]); facilities be located so that spills along the transportation route would not affect biologically productive or valuable habitats (6 AAC 80.070[b][11]); free passage and movement of fish and wildlife be maintained (6 AAC 80.070[b][12]); facilities be located in areas of least biological value and vulnerability where effluents and spills may be contained (6 AAC 80.070[b][13]); and facilities be located in areas where winds and air currents can disperse airborne emissions which cannot be captured before they escape into the atmosphere (6 AAC 80. 070[b][14]).

Sites identified in this EIS as potential support areas conform, in varying degrees, with these policies. Shore-based facilities in Cold Bay and Unalaska probably could comply with the environmental policies. Development in these two communities probably would be adjacent to or would use existing infrastructure. One dock facility to support OCS operations already has been constructed in Unalaska; more than likely, additions would be consistent with CMP policies. However, site-specific designs would be needed to ensure that policies concerning the free passage of fish and wildlife and limits on dredge and fill activities are followed. Airborne emissions should not be a problem; but again, site-specific analyses would be necessary to confirm this conclusion. Oil spills in either community would not be related to oil produced from the sale, but rather to incoming products or to exports to the platforms.

Placing a transshipment terminal at Balboa Bay and a pipeline across the Alaska Peninsula would require extra mitigation measures to ensure that adverse environmental effects would be minimized. Although no major dredging should be required in Balboa Bay, major modification of the uplands would be required for the terminal, and major filling would be required for the road which parallels the northern onshore segment of the pipelines. Nearshore spills along the pipeline route would have the potential for major effects on birds in Nelson Lagoon and moderate effects on sea otters. Cleanup in this environment could be difficult due to the marshy nature of the estuary.

Alternatively, the tanker route from Balboa Bay provides an opportunity to control spills, if one should occur within the bay. Should an oil spill occur outside the bay or not be contained during the peak of the fur seal migration, the potential exists for moderate effects on the regional fur seal population. If a spill occurred during the summer months, major effects on the seabird population in the Shumagin Islands also are possible. Throughout the remainder of the year, an oil spill could have moderate effects on the bird populations. Air currents in Balboa Bay are expected to be adequate to disperse those emissions which escape into the atmosphere.

Onshore, the pipelines between Herendeen Bay and Balboa Bay should conform with the environmental policies for facility siting. Located along one of the routes identified by the Bristol Bay State Plan, the pipelines are north of the major caribou-migration path and calving area of the southern subherd. Therefore, effects of the pipelines on caribou likely would be quite localized and of minor importance both locally and regionally. Brown bear also would experience only minor local and regional effects.

Social and economic concerns associated with facility siting center on the compatibility of the proposed facilities with existing and subsequent adjacent uses (6 AAC 80.070[b][2]); the degree to which activities are consolidated (6 AAC 80.070[b][3]); the concurrent uses of the facilities (6 AAC 80.070[b][4]); the potential to expand facilities at the selected site (6 AAC 80.070[b][6]); the ability of the existing infrastructure, including roads, docks, and airstrips, to satisfy industry needs (6 AAC 80.070[b][7]); the minimizing of traffic through population centers (6 AAC 80.070[b][15]); and the protection of areas of particular scenic, recreational, environmental, or cultural value (6 AAC 80.070[b][12]).

Support bases hypothesized for Unalaska and Cold Bay should conform with all the social and economic policies noted above. The sites were selected because of the compatibility of the anticipated uses with the existing uses and proximity to the lease sale area. These communities also are anticipated to be the shore bases for other lease areas in the Bering Sea. The continued use of Cold Bay and Unalaska as shore bases serves to consolidate OCS-related activities, and expansion to accommodate Sale 92 should not be a problem. Existing infrastructure in Cold Bay would be adequate in almost all instances; in fact, OCS uses are expected to take over buildings and services which may be abandoned in the near future. Only storage and housing facilities that might be needed during the construction of the onshore pipeline and oil terminal are potential additions to the local infrastructure. OCS-related activity in Unalaska is expected to be minimal when compared to the growth associated with the fishing industry. With the exception of the developments in Cold Bay, noted above and in Section IV.F.4. (Transportation Systems), effects on infrastructure in the two communities are expected to be negligible.

Although the pipeline crosses the Alaska Peninsula in the location consistent with a transportation corridor identified in the Bristol Bay State Plan, the hypothetical pipeline's oil terminal and LNG facility are located in areas containing Alaska Peninsula wilderness values rather than adjacent to compatible-use areas where the existing infrastructure is adequate, and thus fail to conform with the social and economic facility-siting policies that promote such locations.

Unless an official wilderness designation precluded the use of the area as a pipeline corridor, construction of these facilities still could occur there if no other feasible and prudent alternative were found to be preferable.

Three transportation issues are included in the facility-siting policies. First, routes and harbors should have the least exposure to reefs, shoals, drift ice, and other obstructions (6 AAC 80.070[b][8]). Balboa Bay is generally deeper than 21 meters; however, the dimensions of the bay require that tankers be accompanied by tugs well out into the bay. In addition, extreme caution would be needed while navigating past the Shumagin Islands. However, reefs, shoals, and drift ice should not pose hazards.

Second, the use of vessel-traffic control is encouraged (6 AAC 80.070[b][9]). Traffic through Unimak Pass was studied by the U.S. Coast Guard to determine if a vessel-traffic-control system is needed now or in the near future (Federal Register, 1984, Vol. 49:39:7180). Conclusions indicated no controls are necessary; the need for such control will be re-examined in several years (Federal Register, 1985, Vol. 50: 52: 10877).

Third, shore-based facilities should not result in overcrowded harbors or interfere with fishing operations and equipment (6 AAC 80.070[b][16]). Unalaska is assumed to be the marine base for OCS activities. Docking facilities for the fishing and oil industries are separate, so there should be no overcrowding in the harbor. Probably no port site located along the Alaska Peninsula could be totally out of the range of fishing operations; however, the oil and fishing industries are cooperating to prevent interference by OCS-associated activities with fishing activities (Hanley, 1984). Other than during development, interference should be negligible to minor; during development, moderate effects on crab-fishing operations could occur. Operations on the southern side of the Alaska Peninsula should not interfere with either fishing operations or equipment.

Finally, the cooperation of developers with landowners and federal agencies is required (6 AAC 80.070[b][5]). Although the degree of cooperation between these parties cannot be determined at this point, it is likely that industry will comply with this standard.

Transportation and Utilities: The standard for transportation and utility routes and facilities is that they "must be sited inland from beaches and shorelines unless the route or facility is water-dependent or no feasible and prudent inland alternative exists to meet the public need for the route or facility" (6 ACC 80.080[b]). Once district programs have been adopted in the area, transportation and utility routes and facilities must be compatible with those standards (6 AAC 80.080[a]). Conformance with this standard should be possible for both the road and the pipelines between Herendeen Bay and Balboa Bay and for local roads constructed within the communities to connect various onshore-support activities. The road and pipelines to Balboa Bay would need to cross a segment of the shoreline, since the route would originate offshore.

The remainder of the route would run through Portage Valley rather than paralleling the beaches. In neither community should local roads constructed for support activities need to be located in coastal areas unless they are associated with water-dependent activities.

Subsistence: Although no areas have been designated as areas in which subsistence is the dominant use of coastal resources, district and state agencies must recognize and assure opportunities for subsistence usage of coastal areas and resources (6 AAC 80.120[a]). The effects of this lease sale on subsistence are noted as negligible in most cases. The most serious potential effects would occur if an oil spill reduced fish stocks or closed a fishery important to local fishermen. Such a loss could have repercussions for other subsistence resources and for the local systems for sharing subsistence resources; in particular, this could affect marginally successful fishermen residing in the larger communities, such as King Cove and Sand Point.

Coastal Habitats: Effects have been identified in five of the coastal habitats included in the ACMP--offshore, barrier islands and lagoons, estuaries, rocky islands and seacliffs, and upland habitats. Most habitats are guided by two standards, an overall standard for all habitats and one standard unique to each. The overall habitat standard states that coastal areas must be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources (6 AAC 80.130.[b]). This overall standard and the specific standard for the habitat are applied to the analysis of each of the following habitats.

Offshore habitat must be managed to maintain or enhance the state's sport, commercial, and subsistence fishery (6 AAC 80.130.[c][1]). Most spills hypothesized in this EIS have an offshore origin. Although effects of oil spills in the offshore habitat tend to be negligible or minor, the red king crab population of the region could experience serious losses leading to major effects. In nearshore areas, several resources could experience moderate overall effects (i.e., fur seals and sea otters). If an oil spill should contact nearshore areas, particularly near Port Moller, while fishes and invertebrates are concentrated for spawning and early stages of development, most would experience moderate effects. Again, red king crab are an exception; red king crab would experience major effects. Effects on birds also increase to moderate if oil contacts coastal waters during a season when birds are concentrated in pelagic areas. Resources in inner Bristol Bay (generally Port Heiden to Cape Newenham) experience few effects because oil-spill trajectories indicate that if oil ever reaches these shores, it already is weathered and, therefore, not lethal. Negligible effects on fishing harvests would result from the loss of fishing areas as a result of space limitations from production platforms and pipelines. Gear damage also would be negligible. The greater areal extent of the fishing grounds for groundfish and crab fisheries, and longer fishing seasons for groundfish, increase the chance that the commercial fisheries could be affected from offshore oil spills; however, these factors also make potential effects negligible.

The standards for barrier islands and lagoons require that the configuration of these bodies be maintained and that activities that would decrease the use of barrier islands by coastal species be discouraged (6 AAC 80.130.[c][5]). Bird populations in Izembek and Nelson Lagoons have been identified as particularly susceptible to effects from this lease sale. Birds in Nelson Lagoon could experience moderate effects either from a spring or fall oil spill or disturbance from production activities in Port Moller. Brant geese in Izembek Lagoon could experience moderate effects as a result of disturbance from aircraft; other geese and Steller's eider could experience minor effects. Major effects on brant, cackling Canada, and white-fronted geese could follow if a spill were to enter Izembek Lagoon in spring or fall. In the event that an oil spill occurred during the spring or fall, bird populations in both lagoons could experience major effects. Because the populations in the lagoons dwindle during the summer, only minor effects would occur in the lagoons during that season.

The Aleutians East CRSA Board designated its entire shoreline area as estuarine in the draft CMP. ACMP standards require that estuarine areas be managed "to assure adequate water flow, natural circulation patterns, nutrients, and oxygen levels, and avoid the discharge of toxic wastes, silt, and destruction of productive habitats" (6 AAC 80.130.[c][2]). In general, oil spilled in Port Moller could have a moderate effect on most birds if the spill occurred in spring or fall; however effects on Aleutian terns could be major. Major effects also could result if a spill in Port Moller coincided with salmon and/or herring fishing seasons. Because of the short duration of these fisheries, it is improbable that a spill would occur during the fishing season; however, it is this short duration of the season that aggravates the effects if oil should spill during that period. A spill in Port Moller also could have a major effect on the herring population; salmon could experience moderate effects. The other estuarine area that would be subject to major change is Balboa Bay. Siting the terminal in Balboa Bay need not alter the natural characteristics of the water. Although an oil spill would temporarily affect the area, no long-term effects should be experienced. Given the steep topography of the shoreline, construction would have a greater effect on uplands than on estuarine areas. These effects are assessed with respect to standards for facility siting.

Rocky islands and seacliffs must be managed "to avoid harassing wildlife, destroying important habitat, and introducing competing or destructive species or predators" (6 AAC 80.130[c][4]). The Shumagin Islands were assigned to this habitat by the Aleutians East CRSA Board in the draft habitat maps. Because of the proximity of the islands to the transportation route for produced oil, the Shumagin Islands could be affected by oil spills since there is a 51-percent probability that a transport-related spill of 1,000 barrels or greater would occur. During summer, when large seabird colonies are present, major effects could follow a spill. Moderate effects could occur during all other seasons because substantial numbers of birds are present year-round.

Upland habitat is managed according to the overall habitat only. Primary effects on the uplands would be caused by the hypothetical pipeline and Balboa Bay terminal. Effects of this construction are discussed in detail in the section on standards for facility siting. In general, effects on terrestrial mammals would be minor.

Potential effects on habitats range from neglible to major, depending upon a variety of factors including the location of the spill, spill trajectories, season of the spill, and species. Red king crab are the only resource at risk throughout the year from an oil spill. Fur seals, sea otters, and brant geese are the resources most at risk from disturbance. Port Moller, Izembek Lagoon, and the Shumagin Islands are the areas most frequently sited in the resource evaluation. These potential negative effects conflict with the protection of living resources and their habitat--the management concept inherent in the habitat standards. However, uses and activities in the coastal area which will not conform with the habitat standards may be allowed if: (1) there is a significant public need for the proposed activity, (2) there is no feasible or prudent alternative to meet the public need which would conform, and (3) all feasible and prudent steps are taken to maximize conformance (6AAC 80, 130[d]).

Bristol Bay CRSA policies emphasize the importance of maintaining and enhancing fisheries. Policies often relate to development parameters for streams and coastal areas within the CRSA boundaries. Because no development is expected to occur upon the Bristol Bay CRSA, these policies are not applicable. A broad policy of the district relates to the need for water quality of fish-bearing waters to be maintained at a level that will ensure the continued health and propagation of fish populations. The value of such areas around Bristol Bay and the potential effects of oil in them are discussed in Chapter IV.B.1. Given the wind and current regime, only negligible effects would occur within the Bristol Bay CRSA boundaries, even in Port Heiden--the area at greatest risk.

Air, Land, and Water Quality: State standards for air, land, and water quality incorporate the regulations and procedures of the Alaska Department of Environmental Conservation (6 AAC 80.140). Air quality usually is enforced at the time an application is received. Assuming that the legally required procedures are followed, only minor effects are anticipated. The Bristol Bay CRSA policy for water quality, which supplements this state policy, is discussed above in the habitat analysis.

Historic, Prehistoric, and Archeological Resources: Coastal districts and appropriate state agencies are required "to identify areas which are important to the study, understanding, or illustration of national, state, or local history or prehistory" (6 AAC 80.150). Some shipwrecks already have been identified in the lease area. Onshore, construction may lead to the discovery of additional archeological finds, especially in Port Moller and the lower portion of the Alaska Peninsula. Once district programs are completed, specific areas of concern may be identified.

Offshore-Loading-Transportation Scenario: Under this transportation alternative, negative effects are eliminated for the rocky island and seacliff habitat of the Shumagin Islands and are reduced for Port Moller. This would alleviate some of the potential effects on birds, sea otters, and pinnipeds. These reductions were not sufficient to reduce the potential overall levels of effects for these resources. Effects analyzed in other policies are not reduced to the point where conclusions are modified. As a result, conflicts with coastal-zone-management policies would be comparable for both methods of hydrocarbon transportation.

SUMMARY (Effects on Coastal Management):

Potential negative effects in offshore, estuarine, and lagoon habitats which could follow an oil spill, or disturbance by aircraft, conflict with the coastal-management standards developed by the state for these habitats. Construction of the pipeline(s) between Herendeen Bay and Balboa Bay through wilderness areas and wetlands and the potential effects from oil spilled along the pipeline route conflict with the coastal-management standards for siting energy-related facilities developed by the state. Although such conflicts with these coastal policies are permissible under extenuating circumstances, guaranteeing conformance with the criteria for exemptions is not possible at this time.

CONCLUSION (Effects on Coastal Management):

Pipeline and terminal development, transportation of produced oil, and potential oil spills could lead to MODERATE conflicts with coastal management policies for habitats and facility siting.

CUMULATIVE EFFECTS (Effects on Coastal Management):

Crabs and invertebrates, several whale species, endangered birds, commercial fisheries, subsistence in Cold Bay and Bristol Bay, air quality, and water quality would remain at the same level of effect in the cumulative case. All other factors considered in the EIS exhibit some increase in effect level. Because of this, the general level of potential conflict with CZM policies is increased.

The greatest level of increase is in the infrastructure in Unalaska. This is followed by infrastructure effects in Cold Bay, effects on local economy, and effects on sociocultural systems in Unalaska and the rest of the Alaska Peninsula, and land use. Increased effects in the local economy would not conflict with the state's coastal program because they relate primarily to projected increases in employment in the domestic-groundfish industry. In Unalaska, infrastructure effects are related to residential and industrial growth. No hypothetical scenarios are available to determine specific siting of these activities; however, the CZM program may be useful for guiding this growth. Increases in effects in sociocultural systems are related to duration and degree of disruption and to unmet subsistence needs of a segment of the Aleut populations. Only this latter aspect is associated with coastal management policies (habitat, facility siting, and subsistence). Cumulative effects on land use would remain major for the pipeline route and increase to moderate in Unalaska. Lack of suitable back-up space for shipping is the primary reason for that increase. These effects accentuate the potential conflict noted in the base case with respect to facility siting and habitats.

Conclusion (Effects on Coastal Management): Because the development discussed in the cumulative analysis will occur sequentially, rather than precipitously, cumulative effects with respect to coastal management policies would remain MODERATE.

(2) Effects of Alternatives II, III, and IV:

Alternative II (No Sale): If no sale were held, the effects noted in other sections would not occur. As a result, potential conflicts with CMP's noted for the proposal would not occur. Cumulative effects would be moderate, the same as for the proposal, because the infrastructure still would be needed for other lease sales and the fishing industry, although the exact siting might shift.

Alternative III (Delay the Sale): Although the Aleutians East CRSA Board has not completed its coastal program at this point, the program should be completed prior to November 1985. Delay of the sale for 5 years would permit the City of Akutan, which is located in proximity to Unalaska, to complete its CMP. Akutan should not experience direct effects from the lease sale, but rather may be affected if the fishing industry needs additional moorage. Cumulative effects would be moderate, the same as for the proposal.

Alternative IV (Alaska Peninsula Deferral): Deferral of blocks along the Alaska Peninsula would reduce the conflicts with the policies for lagoon and estuarine habitats noted for the proposal. Potential effects on marine and coastal birds would be reduced to moderate in lagoon areas and to minor in nearshore areas. Effects on sea otters and nonendangered cetaceans would be less than for the proposal. The potential effects on fish and commercial fisheries in the estuarine habitat of Port Moller also could be reduced with this alternative, although the level of effects noted is not reduced. Effects associated with the offshore habitat would not be reduced appreciably. Effects associated with the construction and operation of the transpeninsula pipeline and transshipment terminal would not change with this alternative. Therefore, potential conflicts with the energy-facility-siting policy noted for the proposal would not be lessened. Because effects in the estuarine and lagoon habitats would be reduced considerably, potential conflict with coastal management policies would be reduced to MINOR with this alternative. Cumulative effects would be MODERATE, the same as for the proposal.

6. Effects on Terrestrial Mammals (Brown Bear and Caribou:

a. Effects of the Proposal (Alternative I):

Pipeline-Transportation Scenario:

Brown Bear: Principal effects of OCS oil and gas development on the brown bear are likely to result from onshore-support activities on the Alaska Peninsula, and from a transpeninsula pipeline corridor. Disturbance, habitat degradation, and elevated bear mortality are the principal types of adverse effects that could be expected from construction, maintenance, and support activities. Disturbance may result from increased numbers of aircraft overflights from Cold Bay (2 to 3 flights per day during development activities) in support of offshore or onshore activities, from construction activity, or from increased access and human presence in important bear habitats on the peninsula. Habitat degradation may result from construction of a 20-kilometer overland pipeline and service road or other facilities that would increase levels of disturbance in the environment, and from spillage of oil or other hazardous substances into stream drainages. As road access is extended into remote bear habitat, mortality in the bear population may increase as a result of elevated hunting pressure and increased incidence of bear destruction in defense of life and property. This may require imposing local regulations more restrictive than elsewhere in the region.

A pipeline corridor between Port Moller on the northern coast and Balboa Bay on the southern coast of the Alaska Peninsula probably would alter important bear habitat and could result in bears abandoning important feeding and denning sites and traditional routes of movement between these and other high-use support areas along the 20-kilometer overland pipeline. Construction of a pipeline facility at the head of Herendeen Bay could cause some den sites in Deer Valley to be abandoned; however, denning probably would recur following the construction phase. Construction and maintenance of a transpeninsula pipeline could disrupt local bear movements between denning and spring-use areas, especially if construction activities were not seasonally restricted. On the southern side of the peninsula, bears could be displaced from Kagayan Flats and other essential spring-use habitat by construction of port and terminal facilities and increased marine traffic in the Balboa Bay area. When body condition is poor, bears displaced from foraging areas essential to optimal survival in the spring post-emergence period (especially sows with cubs), could experience serious adverse effects, including higher cub mortality. Later in the year, disturbance could result in avoidance of some important feeding areas (i.e., salmon streams), thereby increasing competition at other such areas. Increased air traffic and other activity at Cold Bay in support of OCS oil and gas operations could have similar types of effects in the Izembek National Wildlife Refuge. Most of these activities could have the effect of rendering localized habitat areas unavailable, at least temporarily. In particular, if critical spring-foraging areas, for which few alternative sites exist, were to become unavailable, local effects could be moderate. However, most bear habitats exist in abundance on the peninsula; thus, regional effects are likely to be minor.

Bears could ingest some oil or experience some molting of fur as a result of feeding on oiled carcasses of any fish, birds, or mammals washed onto beaches following an oil spill. However, since only 1 spill of 1,000 barrels or greater is expected to occur, and the chance of a spill occurring and contacting the beach is less than 7 percent, it is not likely that a significant proportion of the regional bear population would be affected; thus, effects are not expected to exceed minor.

Barren-Ground Caribou: General types of factors that may cause adverse effects on caribou are similar to those discussed for brown bears. Caribou are most sensitive to adverse effects of disturbance during the calving period. Construction activities or other sources of disturbance and habitat degradation that occur within or near calving areas could affect behavior and use patterns and, ultimately, herd productivity and distribution. Caribou could be disturbed by construction activity and increased aircraft overflights in the vicinity of Port Moller during winter; however, since animals are not likely to be concentrated in this area during winter, effects probably would be minor. There are few caribou for most of the year in the Port Moller region. Post-calving aggregations of 700 to 1,200 animals occur in late June in the King Salmon River valley between Bear Lake and Port Moller; however, the pipeline would not displace these animals from traditional post-calving habitat because this area is about 25 miles to the northeast of the pipeline corridor. Since the main calving area for the southern subherd is south of Port Moller, interruption of migration or calving is likely to be minimal.

Offshore-Loading-Transportation Scenario: An offshore-loading scenario would reduce some potential sources of disturbance to brown bear and barren-ground caribou between Port Moller and Balboa Bay because an oil pipeline and terminal would not be necessary. This scenario would continue to have minor effects on terrestrial mammals because a gas pipeline and LNG terminal would still be necessary under this scenario.

SUMMARY (Effects on Terrestrial Mammals):

Neither brown bear nor caribou are likely to be affected substantially by offshore OCS activities, although any spilled oil reaching beaches could affect animals foraging there. Disturbance, habitat degradation, and elevated mortality are the principal types of adverse effects of onshore activities that could cause terrestrial mammal populations to decline in abundance and distribution as a result of both transportation scenarios. Interruption of movements between critical seasonal-use areas, and disturbance while animals are occupying such areas, are the most likely causes of adverse effects. However, due to the distribution of brown bears and caribou, and to the seasonal-use areas and projected development, effects are likely to be quite localized and of MINOR importance both locally and regionally.

CONCLUSION (Effects on Terrestrial Mammals):

Both local and regional effects of onshore development on brown bear and caribou are likely to be MINOR.

CUMULATIVE EFFECTS (Effects on Terrestrial Mammals):

Activities that may produce cumulative effects on terrestrial mammals include federal and state ongoing and proposed petroleum developments, energy development, mining, other transportation corridors, and subsistence harvests.

Federal sales in this region (St. George Basin, Navarin Basin) could increase the level of support activity at Cold Bay and the amount of oil transshipped across the peninsula. Oil spills associated with tankering from these and other lease areas could result in beach fouling that could have some effect on foraging animals. Proposed state oil and gas sales (Bristol Bay Uplands Sale 41, Alaska Peninsula Sale 56) would affect mainly the northern peninsula area.

The potential effects of other proposed transpeninsula-transportation corridors (i.e., Port Heiden to Kululik Bay and Pilot Point to Wide Bay) to the north and the King Cove/Cold Bay road are discussed in the Bristol Bay Coastal Management Plan (1984). The potentially most serious of these is the proposed King Cove/Cold Bay road which, together with the other activities noted above, could greatly increase disturbance and access to critical habitat areas, with the result that effects could increase to a moderate level.

Conclusion (Effects on Terrestrial Mammals): Terrestrial mammal populations could experience MODERATE cumulative effects from development activities in this region.

b. Effects of Alternatives II, III, and IV:

Alternative II (No Sale): If the lease sale were not held, the effects resulting from the proposal would not occur.

Alternative III (Delay the Sale): If the sale were delayed, the effects of the sale would essentially be the same as for the proposal, minor. Terrestrial mammal populations could experience moderate cumulative effects from development activities in this region. Specific effects attributed to Sale 92 would be delayed 5 years.

Alternative IV (Alaska Peninsula Deferral): The transportation scenario for Alternative IV revolves around the onshore-support activities and the transpeninsula-pipeline corridor (the same as those identified for Alternative 1). Because of this, the effects of this alternative on terrestrial mammal populations would be the same as for the proposal, minor. The cumulative effects on terrestrial mammals would be the same as for the proposal, moderate.

G. Unavoidable Adverse Effects

1. Biological Resources:

a. Fisheries Resources: Some mortality of fisheries resources in the immediate vicinity of seismic activities, drilling and production discharges, or in an area contacted by an oil spill is considered unavoidable. If oil-spill-contingency plans are carried out effectively and cleanup techniques are successful, unavoidable oil-spill effects could be reduced substantially. A spill that contacted nearshore areas and beaches, however, might not be cleaned up completely and might continue to affect fisheries resources in these areas as hydrocarbons are released from beach or bottom sediments over time. Some long-term, sublethal effects of exposure to discharges and oil-spill effects also would be unavoidable but are not quantifiable at this time. Overall, unavoidable adverse effects are expected to be localized and MINOR.

b. Marine and Coastal Birds: Some mortality of marine birds in the immediate vicinity of an oil spill in open water is considered unavoidable. If an oil spill entered one of the lagoons on the northern side of the Alaska Peninsula during spring- or fall-migration periods, moderate to major effects on certain waterfowl populations would be unavoidable. In the event that the oil spill could not be cleaned up completely, even if spill entry occurred outside these migration periods, oil still could contact birds concentrated there during migration. If oil-spill-contingency plans were carried out effectively and cleanup efforts were successful, unavoidable oil-spill effects could be reduced substantially. Overall, unavoidable adverse effects are likely to be localized, short-term, and, for the most part, MINOR in open-water situations and MODERATE in lagoons during specified seasons. Some aircraft disturbance of waterfowl in the Izembek National Wildlife Refuge during migration periods is considered unavoidable. Adherence of aircraft, especially helicopters, to flight paths recommended by refuge personnel could reduce such disturbance to MINOR levels.

c. Pinnipeds and Sea Otters: Oil-spill effects on pinnipeds and sea otters in the immediate vicinity of an oil spill in open water or in leads during the ice season are considered unavoidable. If oil-spill-contingency plans were carried out effectively and cleanup techniques were successful, unavoidable oil-spill effects could be reduced somewhat. However, a spill that occurred during unfavorable weather conditions would not be likely to be cleaned up effectively and, thus, would be likely to contact marine mammals and result in some adverse effects and some sea otter mortalities. Some effects from disturbance in the vicinity of a tanker terminal at Balboa Bay would be unavoidable. Overall unavoidable effects on sea otters and fur seals are considered MODERATE, while unavoidable effects on other pinnipeds are considered MINOR.

d. Endangered and Threatened Species: In the event of production, the probability of an oil spill occurring in certain areas indicates that summer feeding areas may be subject to at least localized risk. Uncontrolled noise and other forms of disturbance associated with the proposal (i.e., noise due to vessel activity or aircraft overflight, tanker traffic, or related geophysical activities) may cause temporary behavioral responses.

These responses are not expected to preclude migrations or to disrupt feeding activities. Such disturbance-related effects would be most likely to occur on gray whales during summer feeding periods or when they are migrating nearshore (March-December) in the North Aleutian Basin lease sale area. Other endangered cetaceans that frequent the shelf-break areas adjacent to the North Aleutian Shelf during the summer feeding period (such as fin and humpback whales) also could be affected by the aforementioned activities. Present knowledge of petroleum-related activity and its unavoidably adverse effects on cetacean fitness is under review, and relationships between development and effects will be refined. A number of mitigating measures are available to reduce possible adverse effects. It is estimated that unavoidable adverse effects would not exceed MINOR.

Unavoidable adverse effects on the Aleutian Canada goose, short-tailed albatross, and peregrine falcon as a result of this proposed lease sale are likely to be NEGLIGIBLE.

e. Nonendangered Cetaceans: In the event of production, the probability of an oil spill occurring in certain areas indicates that summer feeding areas may be subject to at least localized risk. Uncontrolled noise and other forms of disturbance associated with the proposal (i.e., noise due to vessel activity or aircraft overflights, tanker traffic, or related geophysical activities) may cause temporary behavioral responses. These responses are not expected to preclude migrations or disrupt feeding activities. Such disturbance-related effects would be most likely to occur to minke and killer whales during summer feeding periods or when they are migrating nearshore (March-December) in the North Aleutian Basin lease sale area. Other nonendangered cetaceans that frequent the shelf-break areas of the North Aleutian Shelf during the summer feeding periods also could be affected by the aforementioned activities. However, petroleum-related activity and its unavoidably adverse effects on cetacean fitness is under review, and relationships between development and effects will be refined. It is estimated that unavoidable adverse effects probably would not exceed MINOR.

2. Social and Economic Systems:

a. Commercial Fishing Industry: Some preemption or loss of fishing area and subsequent loss of harvest through emplacement of oil industry facilities (platforms, pipelines, and subsea completions) is considered unavoidable. Oil spills could cause unavoidable fouling of gear (mostly crab buoys), temporary preemption or foreclosure of fishing grounds, and tainting or perceived tainting, all of which could cause an unavoidable MINOR loss in catch and/or income to fishermen.

b. Local Economy: No unavoidable adverse effects are anticipated.

c. Community Infrastructure: Unalaska may experience some difficulty in financing public-service demands resulting from the proposal; however, due to the minimal increases in demand created by the proposal, this seems unlikely. Unavoidable adverse effects in Unalaska would be NEGLIGIBLE. There would be no unavoidable adverse effects on Cold Bay's infrastructure.

d. Subsistence-Use Patterns: Oil-spill incidents could result in unavoidable direct loss of subsistence resources. Other potentially unavoidable adverse effects on subsistence-use patterns could include: (1) a further erosion of values underlying subsistence-based living as a result of increased regulation of resources to reduce pressures thereon; (2) increased resident dependency on transfer payments or other forms of cash substitution to compensate for unmet subsistence needs; and (3) increased levels of instability in subsistence-based systems of organization in response to perceived or actual threats to biological systems. It is estimated that unavoidable adverse effects would be NEGLIGIBLE.

e. Sociocultural Systems: The social consequences of Unalaska's Aleuts becoming more of a minority in the community are unavoidable, although such effects generally are expected to be attributable to fisheries-oriented development. In the Bristol Bay region, the perceived or actual threat to subsistence resources, or the indirect or induced consequences derived therefrom, could produce unavoidable increased levels of anxiety over the relative stability and reliability of sociocultural systems that are based on subsistence practices, values, and orientation. A comparable unavoidable response also could be realized if commercial salmon fishing were actually, or thought to be, endangered, not only because of the economic consequences but also because of the effects on occupational identity and sociocultural systems, which are based on commercial fishing as the primary resource of the subsistence-based economy. Unavoidable adverse effects are not anticipated to exceed MINOR.

3. Other Issues: No significant unavoidable adverse effects are expected on coastal management programs as a consequence of the proposal.

a. Water Quality: The only unavoidable adverse effect on water quality anticipated from the proposed action is input of large quantities of hydrocarbons through accidental spillage. Although it would be an obvious impairment of the lease area's pristine water quality, spillage would have a MINOR long-term effect on water quality.

b. Air Quality: Offshore oil and gas development and the development of an LNG plant at Balboa Bay would cause slight increases in onshore concentrations of NO_x, SO_x, TSP, CO and O_3. Emission controls or appropriate emission offsets may be necessary to insure compliance with ambient-air-quality standards. Unavoidable adverse effects would be NEGLIGIBLE.

c. Cultural Resources: Any disturbance to a cultural site could cause dislocation of artifacts, with attendant loss of information or complete destruction of the site. Construction of pipelines and development facilities in the Balboa Bay area could result in adverse effects on cultural resources. Archeological sites along shorelines could be adversely affected by cleanup activities if an oil spill should contact a shoreline. However, most beach sites discovered to date have already been altered by swells, waves, or ice. Unavoidable adverse effects are expected to be MINOR.

d. Transportation Systems: The use of the transportation scenario for the proposal (Alternative I) would have the effect of introducing a significant level of infrastructure into a relatively primitive area. The use of a pipeline and road system by the public may extend hunting activities to areas presently unaffected by such activities. However, the unavoidable adverse effects are expected to be MINOR.

e. Land-Use Plans: Land-use effects in Cold Bay and Unalaska resulting from the proposal would be avoidable rather than unavoidable. Land-use effects could be mitigated by site-planning and land-use regulations.

Development of a pipeline between Port Moller and Balboa Bay and a terminal at Balboa Bay would have a major effect on the area's wilderness values. Construction and maintenance activities would impair the area's natural characteristics through alterations of soils and vegetation. Due to the area's mountainous terrain, visual disruptions would be perceptible from land from 3 to 5 miles on either side of the pipeline. During the life of the facilities, noise and visible support facilities also would impair wilderness values. Facility development in these areas would have a MAJOR unavoidable adverse effect on the area's wilderness values. Although careful planning could lessen the overall effect, developments of this nature are contrary to wilderness principles.

f. Terrestrial Mammals (Brown Bear and Caribou): Degradation and the loss of some brown bear and caribou habitats and populations would be unavoidable. Construction and maintenance of facilities, roads, airstrips, and pipelines would require some level of activity during periods when bear and caribou are present and could potentially disrupt parts of the animals' annual cycle. If a minimum-approach distance to wildlife were maintained, unavoidable adverse effects could be reduced substantially. Overall, unavoidable adverse effects are likely to be localized during the construction period and MINOR in a regional sense.

H. Relationship between Local Short-Term Uses and Maintenance and Enhancement of Long-Term Productivity

In this section, the short-term effects and uses of various components of the environment of the North Aleutian Basin lease area are related to long-term effects and the maintenance and enhancement of long-term productivity. The effects of the proposed action would vary in kind, intensity, and duration, beginning with preparatory activities (seismic-data collection and exploration drilling) of oil and gas development and ending when natural environmental balances might be restored.

In general, "short term" refers to the useful lifetime of the proposal, but some even shorter-term uses and effects are considered. "Long term" refers to that time beyond the lifetime of the proposal. The oil-producing life of the field in the North Aleutian Basin lease sale area is estimated to be about 26 years. In other words, short term refers to the total duration of oil exploration and production, whereas long term refers to an indefinite period beyond the termination of oil production. This indefinite period will vary from one environmental component to another.

Many of the effects discussed in Section IV are considered to be short-term (being greatest during the construction, exploration, and early production phases) and could be further reduced by the mitigating measures discussed in Section II.C.1.a. Additional measures could be initiated by state and local communities to significantly reduce economic inflation and social effects (see Sec's. IV.B.1.b. and IV.B.2.b.).

In the short term, biological productivity would be lost on all onshore lands used for support activities of the proposed project. With proper management, these areas could be returned to productivity in the long term. Although restoration may not be entirely feasible, the overall loss would result in a minor adverse effect. The direct land requirements, as shown in the hypothetical development scenario, would show in both the short term and the long term because of disturbance. Construction of a pipeline between Port Moller and Balboa Bay and a terminal facility at Balboa Bay would cause definite short- and long-term changes. Some biological species may have difficulty repopulating and could be displaced. Similar effects also would occur at other locations hypothesized as terminal sites.

Short-term oil pollution and the possibility of long-term cumulative-oil-pollution effects could cause serious adverse effects on all components of the marine ecosystem, including fisheries. While restoration would allow fisheries production to regain original levels, any reduced annual harvests during the life of the project would be irretrievably lost.

Fresh-water pollution from onshore activities is a short-term effect. Any degradation of water quality is expected to be short-term and localized, with no long-term degradation anticipated.

The biota would be threatened by potential short-term oil pollution. Direct mortality could be significant through the combined effects of human harassment and the increased frequency and volume of noise from vessel traffic or overflying aircraft. Such disturbances could alter behavior patterns and drive fauna away from traditional feeding and breeding grounds or to other critical areas within their range, thereby reducing species populations over a long period of time.

The redistribution or reduction of species populations in the short term could affect regional subsistence-use patterns. Such regional patterns also could be affected in the short term if commercial fishing, as a means of identity and livelihood, were affected. Such short-term effects on subsistence-use patterns from the proposal would not be expected to have long-term consequences, except as one of numerous sources of social disruption, or unless chronically imposed on the resource base of the region. In the short term, increased human population and industrial activity within the lower Alaska Peninsula subregion could change the culture of the area in the long term to more fully incorporate an urban perspective toward individual and social relations and household modes of income production.

Improved accessibility to primitive areas as a result of support-facility construction is a short-term result of this proposal. Overall coastal wilderness values may decrease from increased land use, particularly along the proposed pipeline route.

Archeologic and historic values discovered during development would enhance long-term knowledge. Overall, discoveries could lead to location of additional sites, but destruction of artifacts would represent a long-term loss.

Consumption of offshore oil would be a long-term use of nonrenewable resources. Economic, political, and social benefits could accrue from the availability of oil. Consumption would decrease the nation's current dependency on oil imports and create short-term benefits. If additional petroleum resources were discovered and developed in the lease sale area, the proposed production system would enhance future extraction.

Oil production in the North Aleutian Basin lease sale area would provide a short-term, critically needed energy source and perhaps provide time either for the development of long-term alternative-energy sources or substitutes for petroleum feedstocks. Petroleum development in this area also could mean the irretrievable loss of some fisheries production. Maintenance and enhancement of long-term fisheries productivity would depend on efforts to control water-quality levels. Regional planning could aid in controlling changing economics and populations and, thus, in moderating adverse effects.

I. Irreversible and Irretrievable Commitment of Resources

1. Minerals Resources: The mean resource estimate for the proposed action is 364 MMbbls of oil. Should these resources be discovered and produced, they would be consumed.

2. Biological Resources: Even if a small area were involved in relation to the total lease sale area, platform emplacement and pipeline construction could cause an irreversible loss of benthic habitat to various shellfish and mollusk groups. If pipelines remained in place beyond the production years of the area, this same benthic habitat could be irretrievably altered, although the alteration probably would not be detrimental to benthic shellfish and mollusk populations.

Should an oil spill occur in the lease sale area, fish and invertebrates, marine and coastal birds, pinnipeds and sea otters, and nonendangered cetaceans contacted could be lost. Construction of onshore facilities at Balboa Bay and Port Moller could result in degradation of nesting habitat and displacment of seabirds from important nesting areas. Displacement could become irretrievable if permanent alterations of the environment were maintained by such activities.

Increased air and ship traffic and onshore activities, as well as potential habitat degradation or reduction in available food resulting from oil and gas industry operations, could displace birds and mammals, pinnipeds and sea otters, and nonendangered cetaceans into less favorable environments--with population-level reductions possible. Displacement could become irretrievable if permanent alterations of the environment were maintained by such activities.

Endangered Species: Under the proposal, it is possible that endangered species could be subjected to irreversible effects from oil spills, disturbance ance due to noise associated with oil and gas activities, and/or loss and alteration of habitats due to facility development. Such effects may lead to long-term loss of individual members of endangered species, but overall-population effects would be minor.

3. Social Systems: Village subsistence practices could be irreversibly affected by the displacement of subsistence resources from customary locally used habitat or by the reduction of resources through the modification of favorable habitat. The displacement could be irretrievable if the effects were maintained over time. The proposal could contribute to irreversible changes in cultural values and orientations.

4. Economic Resources: The loss of commercial fishing harvests would have an irreversible and irretrievable effect on the economy. If uncompensated, any loss of fishing gear attributed to the proposal would be irretrievable and irreversible. In addition, possible destruction of fish, marine mammals, birds, or other subsistence resources, although slight, would be an irretrievable and irreversible loss.

5. Cultural Resources: The destruction of cultural-resource sites possibly could result in an irreversible and irretrievable loss of information about prehistoric human occupancy of the area; however, this appears unlikely.

J. Worst-Case Analyses: Worst-case analyses have been performed for the gray and right whales. The worst-case analysis for the gray and right whales addresses scenarios drawn from scientific study results and worst-case effects from a major oil spill and from seismic and noise disturbance. Because the major variable factors in cause and effect involve different degrees of uncertain and unknown conditions, it is necessary to assume some specific level or condition to perform realistic analysis. This information is presented below.

1. Worst-Case Analysis for the Gray Whale:

	Assumptions	Estimated Probability of Assumption
1.	Seismic testing and other noise disturbance will occur during the whale's high-use period (April-December).	Medium to High
2.	Noise disturbances will interfere with communication or displace feeding whales.	Medium
3.	Migrating gray whales will be feeding in nearshore waters (within 5 km).	Medium to High
4.	A maximum of five drilling structures will be distributed in the area during the high use period.	Low
5.	Whales will contact the one expected hydrocarbon spill during the life of the field (26 years).	Low
6.	Hydrocarbon pollution will kill prey items.	Medium to High
7.	Oil-contaminated baleen will interfere with feeding.	Medium to Low
8.	Oil will remain on the skin long enough to cause damage.	Low

Scenario: The following is a speculative assessment of a possible worst case for a large-volume, continuous spill and for noise associated with OCS activities that could interact with gray whales during the high-use period (April-December). The platform-spill rate for spills of 100,000 barrels or greater is 0.03 spills/billion barrels produced.

The scenario is as follows:

1. A blowout of a production well will occur, exit the casing at the seafloor, and create a plume in the water column at a rate of 1,000 barrels/day for 100 days (total spill volume of 100,000 bbls).

2. The blowout will be located in the northeast portion of the lease sale area (between Spill Points B1, B2, B3, and D1; Graphic 5), and the well will not be ignited, so all released oil will remain in the marine environment.

3. Cleanup and recovery techniques will be inadequate to remove most of the spilled oil on a daily basis for the duration of the spill, at which time a rig will complete the shutdown process (natural bridging will not occur).

4. Spilled oil will be found in broken ice and open-water conditions.

5. Gray whales will be in the area from April through December (highest abundance during the spring and fall migrations), and they generally will not avoid or detect the 1 probable oil spill (greater than or equal to 1,000 barrels) over the 26-year life of the field.

6. Oil will affect the whales' health due to ingestion or absorption through the skin, ultimately causing chronic long-term effects on the whales.

7. Stress also will occur due to acoustical disturbance, which displaces whales from traditional feeding grounds and/or disrupts migration routes and/or timing.

Assuming that an oil-spill/whale interaction occurs during the life of the field, effects that could be expected include: increased susceptibility to disease, increased concentrations of hydrocarbons in whale tissues, avoidance of preferred feeding habitats, masking of communication signals due to acoustical disturbance, and a loss of habitat due to rig placement. Spilled oil may force females to travel away from calf-rearing areas, placing calves under additional stress, which may result in a weakened year-class.

It is assumed that a large (100,000-barrel), continuous (100-day) oil spill will occur just before most of the spring migrants enter the North Aleutian Basin lease sale area (spill persists from early April to mid-July). Approximately 80 percent of the gray whale population uses the nearshore migratory route along the northern shore of the Alaska Peninsula and will therefore potentially pass through an area contaminated by the blowout (similar to the Santa Barbara spill). Approximately 10 percent of those whales will remain in the Bristol Bay area to feed in estuaries and other nearshore areas during the summer.

Although it has not been documented that gray whales can detect or will avoid an oil spill, neither has it been documented that the whales will remain in an area contaminated by oil. Some gray whales are known to pass through natural oil seeps off California with no apparent physical harm, but some modifications in swimming speed, direction, and respiration patterns were observed (Geraci and St. Aubin, 1982). Kent et al. (1983) observed that most gray whales passing natural oil seeps off California generally showed apparent indifference to its presence. Other times the whales radically changed their migration direction. The migration route appears to be displaced offshore in the oiled areas, possibly indicating an adaptive avoidance response to long-term exposure to the oil. However, it is clear that gray whales do travel through these areas without apparent harm. If the changes in swimming speed and direction are interpreted as an avoidance reaction, then it is possible that some gray whales may not pass through contaminated waters in the lease sale area. These whales would be deflected offshore and would be unable to feed in the estuaries, where some summer feeding occurs. Consequently, they would arrive at the preferred more northern feeding areas with lower blubber reserves than if they had been able to feed along the northern shore of the Alaska Peninsula. By not being able to feed in the Port Moller/Nelson Lagoon area, migrating gray whales could either arrive at their primary northern feeding grounds with depleted blubber stores and spend a longer time feeding in other Alaska Peninsula estuaries, thus decreasing the amount of time available to assimilate nutrients in preferred feeding habitats.

Any oil released in the northeast portion of the lease sale area is likely to contact the Port Moller/Nelson Lagoon area (Resource Area 7) within 3 days, but is unlikely to contact areas farther east even after 30 days. The whales that normally summer in the Port Moller/Nelson Lagoon area would be the most severely affected. A continuous 100-day spill would deplete the prey in that area and force the whales into less desirable habitats. Contamination of sediments may lead to slow recovery of amphipod populations in affected areas; thus, amphipod populations could be depressed for 1 to several years. Whales subjected to lowered prey densities may result in the deposition of thin blubber layers, abortion of fetuses by pregnant females, inadequate milk production by lactating females and therefore an increased calf mortality, and generally poor condition, decreased disease resistance, and survival. This could result in a decrease in the strength and health of the whales, and a loss of a portion of the very old and very young age-classes could occur. This would affect a small portion of the gray whale population (less than 10%); effects on a regional basis could take years to be expressed.

Since whales are known to feed in the Port Moller/Nelson Lagoon area, it is possible for them to foul their baleen with oil. The fouling would decrease feeding efficiencies and increase potential gastric problems. Geraci and St. Aubin (1982) found that gray whale baleen fouled with Bunker C (a heavy oil) restricted water flow for up to 15 minutes. Therefore, although the baleen plates were still noticeably fouled, normal flow patterns were restored. The longest period during which Geraci and St. Aubin found persistent oil on gray whale baleen was 20 hours. Assuming that whales migrate at 5 kilometers/hour (Leatherwood et al., 1983), gray whales could pass through the spill area and begin feeding in Port Heiden and Ugashik Bay within 24 and 48 hours, respectively. These other habitats (along the Alaska Peninsula) may already have reached their carrying capacities and may not be able to adequately support additional whales.

Other potential effects could result if oil adheres to the skin and is transported into the bloodstream. Those whales passing through or feeding near the oil slick may bioaccumulate hydrocarbons in their tissues. Hydrocarbons that may accumulate in the blubber would be released as the blubber is metabolized. The blubber would be metabolized at times of increased demand upon the body, such as during the winter period of reduced feeding, during migration, or during lactation. Petroleum hydrocarbons released from the blubber may have adverse effects or be passed through the milk to the offspring, where toxic effects could result in poor survival of the calf. Whales passing through the oil slick would probably show no more physical harm than when they pass through the natural oil seeps off California. Massive acute reactions are thereby unlikely to occur, but chronic problems are more likely to have long-term effects. Chronic effects may be expressed as a lower fecundity rate, which would reverse the current increasing population trend.

It is possible that seismic testing will be ongoing during the fall migration. The detailed discussion of seismic effects on gray whales from the Sale 70 Supplemental FEIS is incorporated by reference (USDOI, MMS, 1983). Most gray whales also follow the spring-migration route during the fall migration, only somewhat farther offshore. A portion of the population migrates directly offshore across Bristol Bay toward Unimak Pass. The migrating whales also will be exposed to acoustical disturbances from support aircraft and vessel traffic. Malme et al. (1983), testing responses of migrating gray whales off central California with noises from playback experiments, reported changes in migrating behaviors at 2.5 kilometers for drilling platforms, 1.5 kilometers for semisubmersibles, and 2.0 kilometers for helicopters. Observable behavioral changes in migrating gray whales subjected to an airgun array began when the whales were at least 5 kilometers from the sound source. These responses to acoustical disturbances suggest that migrating gray whales in Bristol Bay also will deflect their migratory routes in response to OCS activities in the lease sale area. The whales may not be in optimal condition due to stress from passing through or around an earlier oil spill (their blubber stores may not have been completely restored). These somewhat weakened whales returning to Bristol Bay during the fall migration will be exposed to acoustical disturbances, which could cause enough stress to begin depleting the nutrient reserves earlier than would occur in a nonstressful situation. Responses to acoustical disturbances include milling, course deflection, and confused swimming. It also is possible that communications could be masked, resulting in cow/calf separations. If the whales' response to the acoustical disturbance is strong enough to cause a delay in the migration, there will be less time available for calving in the Baja California lagoons. The continuous exposure to extra stress could result in a decrease in the strength and health of the whales.

In conclusion, a combination of acoustical disturbances and oil-spill events could affect a significant portion of the gray whale population that uses the lease sale area between April and December. In the event that all negative effects occurred, the summer feeding areas could be abandoned, and/or new migratory pathways might be utilized and ultimately be expressed as a reversal of the currently increasing population trend.

CONCLUSION (Effects on the Gray Whale):

Effects of a major oil spill on the gray whale are expected to be MAJOR.

2. Worst-Case Analysis for the Right Whale:

Assumptions	Estimated Probability of Assumption
1. Seismic testing and other noise disturbance will occur during the high-use period (May-September).	Medium to High

Assumptions	Estimated Probability of Assumption
2. Noise disturbances will interfere with communication, displace feeding, or prevent breeding.	Medium to Low
3. Right whales will be feeding in the lease sale area during the summer.	Medium
4. A maximum of five drilling structures will be distributed in the area during the high-use period.	Low
5. Whales will contact the 1 expected hydrocarbon spill during the life of the field (26 years).	Low
6. Hydrocarbon pollution will kill prey items.	Medium to High
7. Oil-contaminated baleen will interfere with feeding.	Medium to Low
8. Oil will remain on the skin long enough to cause damage.	Low

Scenario: The following is a speculative assessment of a possible worst case for a large-volume, continuous spill and for noise associated with OCS activities which could interact with right whales during the high use period (May-September).

1. A blowout of a production well will occur, exit the casing at the seafloor, and create a plume in the water column at a rate of 1,000 barrels/day for 100 days (total spill volume of 100,000 bbls).

2. The blowout will be located in the northern portion of the lease sale area (between Spill Points A2 and A3; Graphic 5), and the well will not be ignited, so all released oil will remain in the marine environment.

3. Cleanup and recovery techniques will be inadequate to remove most of the spilled oil on a daily basis for the duration of the spill, at which time a rig will complete the shutdown process (natural bridging will not occur).

4. Spilled oil will be found in open-water conditions.

5. Right whales will be in the area from May through September. They generally will not avoid or detect the 1 probable oil spill (greater than or equal to 1,000 bbls) over the 26-year life of the field.

6. Oil will affect the whales' health due to ingestion or absorption through the skin, ultimately causing chronic long-term effects on the whales.

7. Stress also will occur due to acoustical disturbance, which displaces whales from traditional feeding grounds and/or disrupts migration routes and/or timing.

Assuming that an oil-spill/whale interaction occurs during the life of the field, effects that could be expected include: increased susceptibility to disease, increased concentrations of hydrocarbons in whale tissues, avoidance of preferred feeding habitats, masking of communication signals due to acoustical disturbance, and a loss of habitat due to rig placement. Spilled oil may force females to travel away from calf-rearing areas, placing calves under additional stress which may result in a weakened year class.

It is assumed that a large (100,000-barrel), continuous (100-day) oil spill occurs just before most of the right whales enter the North Aleutian Basin lease sale area (spill persists from June to late September). Historic whaling records indicate that right whales were taken in the lease sale area mostly in August and September. The current population is so depressed that it would be unusual for more than one-third of the population to be in the entire Bering Sea (total population estimated at 200 whales in the North Pacific). In a very rare occurrence, one-ninth of the population (22 whales) may be summering in the lease sale area.

Although it has not been documented that right whales can detect or will avoid an oil spill, neither has it been documented that the whales will remain in an area contaminated by oil. A spill lasting for most of the summer feeding period (highly unlikely) and remaining in the area (assuming inadequate cleanup occurs) could adversely affect right whales. Massive acute reactions are unlikely, but chronic problems are more likely to have long-term effects. The primary factor affecting right whales during a continuous oil spill would be the loss of their primary prey species (copepods). Secondary effects could occur from oil possibly adhering to the skin and becoming transported into the bloodstream, or from coating of the baleen, which would decrease feeding efficiencies and increase potential gastric problems. Since the whales' primary prey source would no longer be abundant in the spill location, right whales would be forced to move to another feeding area.

If, in another suitable feeding area, seismic surveys began which ensonified an area 60 kilometers in diameter (see Sale 70 Supplemental FEIS) from the seismic vessel, adverse reactions could occur to right whales. Reactions are expected to be short-term, although whales may be forced to leave the area if surveys are continuous (every day, for up to 20 hours per day) over a long timeframe (several weeks). Seismic surveys could mask communication signals, increasing the difficulty of whales locating one another for feeding, socialization, or other activities. Other acoustical disturbances, such as drilling noise or aircraft and vessel traffic, may mask communication signals. If ambient-noise levels are low, ensonification of an area surrounding the sound source may deter right whales from using a particularly preferred habitat and cause them to select a less desirable habitat with lower noise levels. The continuous interruption of feeding activities and movement to other areas will decrease the amount of time available to assimilate necessary nutrients, which are stored for use during the remainder of the year. This could result in a decrease in the strength and health of the whales, which ultimately may be expressed as a decrease in the already low right whale population (lower reproductive urge, pregnancy rate, or average mortality age).

In conclusion, a combination of noise disturbance and oil-spill events could affect a significant portion of the North Pacific right whale population that was concentrated in the lease-sale-area portion of their summer feeding range. In the event that all negative effects occurred, the outcome could be the abandonment of the historic summer feeding areas on the North Aleutian Shelf. Being planktonic feeders, right whales could find other suitable habitats, but the results of the aforementioned scenarios may hasten the decline of the North Pacific right whale.

CONCLUSION (Effects on the Right Whale):

Effects of a major oil spill on the right whale could be MAJOR.

3. Effects of a Worst-Case Oil Spill:

Section 1502.22 of the CEQ Regulations does not require agencies to analyze a worst-case scenario for each species or resource. Therefore, the MMS has prepared a detailed worst-case scenario in which the species or the resources of concern are analyzed. The possible effects are analyzed for each resource of concern for a catastrophic spill of 100,000 barrels. Where information is incomplete, reasonable assumptions are made. The analysis addresses the effects of a worst-case oil spill occurring 55 kilometers north of Port Moller during May and June. The assumption for the worst-case scenario assumes a long-duration (60-day) oil spill from Spill Point B3. Because of the distance from the spill point to nearshore habitats, the water-soluble toxic components would be largely depleted by the time the spill contacted nearshore areas. For this reason, the effects on fisheries resources and some endangered cetaceans under the worst-case scenario would be slightly lower than the effects of the proposal, which assumes that a 100,000-barrel oil spill contacts important nearshore habitats in higher hydrocarbon concentrations. The conclusions for the worst-case analyses for the gray (Sec. J.1.) and right (Sec. J.2.) whales differ from the conclusions for these endangered cetaceans under the worst-case-oil-spill analysis (Sec. J.3.), because the assumptions, which are the basis for analysis, vary with each worst case.

1. On May 1, a subsurface oil blowout occurs at a production platform in the vicinity of Launch Point B3 (see Graphic 5), in the portion of the proposed lease sale area farthest into Bristol Bay. The location is about 55 kilometers north of Port Moller, in water that is 70 meters deep. The blowout initially releases 2,000 barrels of crude a day, linearly decreasing to 1,350 barrels a day by Day 60, when a relief well is completed, stopping the blowout. Total amount of oil spilled is 100,500 barrels over 60 days.

2. For the purposes of this analysis, the possibility of spill mitigation through at-sea response measures is ignored.

3. Note that this blowout is unusual in that it is necessary to drill a relief well. In OCS waters, 72 percent of past blowouts have naturally bridged (Exxon Company USA, 1984); that is, the wellbore collapsed and/or

well pressure was depleted. Since 1974, 60 percent of OCS blowouts have lasted 1 day or less, and only 10 percent have continued for more than 7 days (Sec. IV.F.2).

4. According to Brower et al. (1977), average windspeed at the spill site is 12 knots in May and about 10 knots in June. Sea-surface temperatures are 3°C in May and 5°C in June. Note that wind-speeds in excess of 0.6 knots cause slicks to break into streaks or windrows (Fingas et al., 1979).

5. According to Brower et al. (1977), winds from the northeast, north, or northwest near Port Moller have speeds of 17 knots or greater less than 1 percent of the time in May and June; and winds of such speed are not persistent, seldom lasting as long as 20 hours (less than 1% of the time).

6. Ocean currents and tidal excursions in the vicinity of Launch Point B3 are parallel to the coast (Sec. III.A.3.).

7. Because of the last two items above, it would be extremely unlikely for a spill at Launch Point B3 to reach shore until about the third day after spillage. A spill will only move at about 3.5 percent of the windspeed.

8. In a subsea blowout, most of the oil would surface in a relatively small area. With a water depth of 70 meters, the oil would surface in the center of a convective cell with about a 50-meter radius (the convective cell is caused by the rising oil and gas plume.) The 50-meter radius marks a convergence: within this radius, surface currents would be outward, and outside this radius currents would be directed inward. The net effect is to trap, at least temporarily, some of the oil at the surface within the radius. Droplets less than 50 microns in size, including about 1 percent of blowout volume (14-20 bbls/day), would escape the main plume and be carried several kilometers downcurrent before reaching the water surface (Buist et al., 1981; ESL Environmental Sciences Limited, 1982).

9. In some cases, blowouts enhance the formation of mousse, a water-in-oil emulsion. Mousse formation would slow the weathering processes, including dissolution.

10. Based on the studies of Ixtoc and Bravo blowouts (Grahl-Nielson, 1978; Mackie et al., 1978; Fiest and Boehm, 1980), expected total hydrocarbon concentrations within the upwelling plume should be on the order of 10 parts per million (ppm) (most of the plume is sea- water). Concentration outside of the plume and just outside the edges of the resulting slick should reach 0.3 ppm. In the water column near a slick, dissolved hydrocarbons will generally constitute about 10 percent of total (dispersed plus dissolved) oil; the bulk of the oil being present as discrete oil droplets (Fig. IV-3). However, the ratio of dissolved oil to total oil (in concentrations derived from the subsurface plume) may be higher. The rising plume of small oil droplets allows some increase in dissolution of oil, but the rapid rise of most of the oil to the surface suggests that the increase in dissolution must be fairly small.

11. By the third day after spillage, the water-soluble, toxic components of the oil have been depleted from the oil slick mostly by either dissolution during rising of the subsurface plume or by evaporation. Relatively little is dissolved from the oil once it forms a slick.

12. In the early hours of a spill, water concentrations of hydrocarbons will decrease rapidly with distance from the slick (Manen and Pelto, 1984). Within a few hundred meters, concentration of hydrocarbons will decrease tenfold; in this case to 0.03 ppm. Because the spill is in the open sea, with both slick and water column moving under different influences and in different directions, higher concentrations of hydrocarbons would not be expected to accumulate with time through the 60-day spill.

13. According to Cline's (1981) Bristol Bay hydrocarbon model, the 0.3-parts-per-million concentration at the edge of the subsurface plume would decrease tenfold to 0.03 ppm within 12 kilometers of the spill, and hundredfold to 0.003 ppm within 80 kilometers of the spill. Pollutant concentrations equivalent to background (0.001 ppm) might be detectable for 200 to 300 kilometers.

14. For long-duration spills, conditional probabilities given for Launch Point B3 in Tables G1 through G9 (Appendix G) can be used to represent the amounts of oil that reach various resources rather than the probabilities of contact (see example in Sec. IV.A.3.d.). For the spill in question, each percentage point is equivalent to initial spillage of about 1,000 barrels.

15. Weather types in the southern Bering Sea generally last about 3 days, a period covering spillage of 4,000 to 6,000 barrels of oil in this scenario. Thus, any conditional probabilities greater than about 5 percent represent at least two occasions of resource contact; probabilities over 10 percent represent at least three contacts, etc. Each occasion of contact would be with a slick of initially about 5,000 barrels prior to weathering.

16. Disregarding weathering, a spill of 100,000 barrels would cover no more than 20 square kilometers of sea surface (Sec. IV.A.3.d.). One day's spillage of 1,350 to 2,000 barrels would cover only 0.3 to 0.4 square kilometer. Because winds are great enough to break the slick into streaks (Assumption No. 4), the slick would spread dis- continuously over a larger, perhaps tenfold-larger area, but with 90 percent of the slick area not actually covered by oil.

17. Weathering would not change the area of discontinuous slick, but would decrease the proportion of oiled surface within the slick.

18. High benthic concentrations of oil will occur only in the vicinity of the blowout and in the nearshore following landfalls of oil. About 1 percent of the spilled oil (1,000 barrels) is adsorbed into coarser sediments resuspended by the blowout and is deposited within a few kilometers of the drill site, mostly in the first few days of the blowout. Half of this deposition is assumed to occur within 1 kilometer and the remainder within 10 kilometers. Resulting deposition is 90 grams of oil per square meter over 0.8 square kilometer. Associated with the coarser sediments,

this oil is resistant to resuspension but is subject to slow biological decomposition at a rate of a few percent per year.

19. Maximum residence time for any oil sedimenting with the finer solids normally present in the water column would be less than 1 year because of the high sediment resuspension rates in Bristol Bay (Thorsteinson, 1984). Discrete slicks can very seldom be tracked for more than about 10 days before the slick becomes too dispersed to locate or identify (USDOI, MMS, 1983). The 30,670 barrels of crude still at sea 30 days after spillage would remain as well-weathered crude, individual tar balls, and patches of mousse. Some of this oil would continue to come ashore (Table IV-29). Oil remaining at sea would eventually form tar balls, disperse widely, slowly weather, and probably sink to the bottom within 1 or 2 years (Payne, 1982).

20. The amount of shoreline oiling is summarized in Table IV-30. Land segments with conditional probabilities less than 0.5 percent are not shown.

21. Most of the coastline from Land Segment 9 (Cape Glazenap) to Land Segment 14 (Port Heiden) has high to very high oil-retention capability (Michel et al., 1982; Sec. IV.A.3.d.). Much of the coastline is fronted with coarse-sand or mixed-sand-and-gravel beaches. Neighboring the beaches are coastal lagoons and behind the beaches are backshore marshes. Most, but not all, initial oiling would occur to the sand or sand-and-gravel beaches. Nelson Lagoon, Port Moller, and Port Heiden would be oiled to some extent.

22. Some oil reaching the beaches would be worked into the beach sediment; most would be washed off the beaches by surf and storm action within months to a year. Oil, either washed off the beaches into backshore marshes or lagoons or deposited there directly, could persist for several years. Oil washed off the beaches into the foreshore would have enough sand pounded into the oil by the surf to move just off the beach face, sink, and be deposited just offshore as tar logs and reefs. Weathering of such nearshore deposits would be very slow, less than a few percent per year.

b. Effects on Biological Resources:

(1) Effects on Fisheries Resources:

Effects on Salmonids: Adult salmon migrating to natal streams to spawn and outmigrants enroute to ocean rearing areas may pass through areas affected by a spill from Launch Point B3. Shallow, nearshore areas that are contacted may be inhabited by juveniles prior to moving seaward.

Adult salmon having LC_{50} values of 1 to 3 ppm (Thorsteinson and Thorsteinson, 1982) could be killed following exposure to hydrocarbon concentrations of 10 ppm within a 50-meter radius of the blowout. Other adult salmon encountering concentrations in excess of 3.2 ppm may avoid such concentrations. The number of salmon affected, however, would be minimal within the 50-meter radius of the plume. Concentrations of 0.3 ppm at the edge of the plume, decreasing to 0.03 ppm within 12 kilometers of the plume, would not cause many additional

Table IV-29
Mass Balance in Terms of Days after Spillage
Integrated over the Life of the Spill
(Total Spillage Equals 100,500 Barrels)

Phase	Days After Spillage					
	3 Days		10 Days		30 Days	
	Barrels	Percent	Barrels	Percent	Barrels	Percent
Slick	73,840	(74)	47,960	(47)	30,870	(30)
Vapor	12,340	(12)	16,910	(17)	16,910	(17)
Dispersed	9,130	(9)	25,820	(26)	25,820	(26)
Dissolved	1,000	(1)	900	(1)	900	(1)
Sedimented	300	(0)	1,100	(1)	1,100	(1)
Onshore	3,890	(4)	7,810	(8)	25,100	(25)

Source: Calculated from Figure IV-3 (Sec. IV.A.3.) and above discussion (USDOI, MMS, [Sale 92 FEIS], 1985).

Table IV-30
Shoreline Oiling Resulting from Spill Scenario
(In Barrels)

Land Segment	Fresh Crude (0-3 days after spillage)	Weathered Crude (4-10 days after spillage)	Dispersed Weathered Crude (11-30 days after spillage)	Total Crude (0-30 days after spillage)
9	0	0	1,100	1,100
10	0	0	1,700	1,700
11	2,300	3,500	0	5,800
12	1,600	400	0	2,000
13	0	0	10,600	10,600
14	0	0	4,500	4,500

Source: Calculated from Tables G-1 through G-9 (Appendix G), Table IV-29, (above) and above discussion (USDOI, MMS, [Sale 92 FEIS], 1985).

mortalities, but could result in sublethal effects on prespawning adults through the area. A small portion of the regional population of salmon could be affected within the limited areal influence of the spill.

Contact of nearshore areas from Port Heiden to Port Moller also may affect some salmon. Outmigrants that migrate along the coastline (i.e., sockeye to 48 km offshore) and juveniles that inhabit nearshore and estuarine areas prior to moving offshore may contact hydrocarbons as a result of this oil spill. With the spill occurring 55 kilometers offshore, a few juveniles (LC_{50} 1-3 ppm; Thorsteinson and Thorsteinson, 1982) may encounter lethal concentrations and others may be exposed to sublethal levels that may affect their ability to survive, develop, or reproduce. Salmon migrating within 12 kilometers of the plume would be exposed to concentrations of 0.03 ppm or greater and could experience sublethal effects. Those in nearshore areas would encounter lower concentrations and experience less effects. Only a small portion of the outmigrants would be killed compared to the regional population spawning along the northern side of the Alaska Peninsula and in Bristol Bay, resulting in a minor effect.

CONCLUSION (Effects on Salmonids):

Although a small number of adults enroute to spawning grounds, juveniles using nearshore areas, and juveniles outmigrating along the Alaska Peninsula may be killed and others may experience sublethal effects, a small portion of the regional salmon populations would be affected by this oil spill, resulting in a MINOR effect.

Effects on Forage Fishes: Adult forage fish traversing the lease sale area between their offshore overwintering areas and shallow, coastal areas or streams where they spawn could be affected by an oil spill from Launch Point B3. Reproductive stages concentrated in nearshore areas also may experience limited effects.

Adult forage fish that encounter the immediate area of the spill may experience lethal or sublethal effects. For example, herring, having an LC_{50} value of 1.22 ppm (Rice et al., 1979), would be killed by contact with hydrocarbon concentrations of 10 ppm within the 50-meter radius of the blowout. Additional mortalities and sublethal effects on forage fish could occur on those that traverse the area of the spill and are exposed to concentrations of 0.3 ppm at the edge of the plume, decreasing to 0.03 ppm 12 kilometers from the plume. Adults traversing the area enroute to spawning at Port Moller or Port Heiden thus could be killed or experience sublethal effects. For example, exposure of female herring to a few parts per billion just before spawning resulted in decreased survival of eggs, embryos, and larvae. The number of forage fish contacted within the areal influence of the spill, however, would be small compared to the regional populations of these species.

Reproductive stages of forage fish in the nearshore area between Port Heiden and Port Moller also could be affected by this spill. Concentrations would decrease from 0.03 ppm within 12 kilometers of the plume (43 km offshore) to 0.003 ppm within 80 kilometers, so concentrations contacting nearshore lifestages would be very low. Although lethal effects probably would not occur on herring embryos, which have been shown to die following exposure to 0.1 ppm (Hameedi, 1982), sublethal effects may occur, as documented on herring larvae following exposure to 25 ppb (Hameedi, 1982). Capelin eggs on gravel substrates along the shore may be affected similarly. Anadromous boreal smelt and eulachon would not experience effects on eggs; and Pacific sand lance eggs are widely distributed, so minimal effects are expected. Larvae of these species in the nearshore area may be affected. Effects on lifestages in the nearshore areas, however, are expected to be limited because of the low concentrations of hydrocarbons reaching these areas. In addition, forage-fish species are widely distributed in the eastern Bering Sea, and effects of this oil spill of limited areal influence are expected to affect only a small portion of the regional populations, resulting in a moderate effect.

CONCLUSION (Effects on Forage Fish):

Although a small number of adults enroute to nearshore or stream-spawning areas and reproductive lifestages in the nearshore zone may be affected adversely by this oil spill, the numbers affected are expected to be small because of the low hydrocarbon concentrations and the limited areal influence of the spill, consequently resulting in MODERATE effects, at worst, on herring, and MINOR effects on other forage-fish species.

Effects on Groundfish: A variety of groundfish inhabit, spawn, and rear in the vicinity of Launch Point B3 and in areas that may be contacted by this oil spill. Although adult groundfish generally inhabit deeper offshore waters, many of the species use shallow, surficial, or nearshore waters during their earlier lifestages.

Adult benthic fish having LC_{50} values of 5.34 (Thorsteinson and Thorsteinson, 1982) may be killed following exposure to hydrocarbon concentrations of 10 ppm within the upwelling plume of the blowout. Mortalities, however, would be limited to fish within a 50-meter radius of the blowout. Exposure to concentrations of 0.3 ppm at the edge of the plume, decreasing to 0.03 within 12 kilometers of the blowout, could result in some sublethal effects on adult groundfish in that area. Most adult groundfish inhabit depths of 70 to 750 meters, and consequently, few are expected to be affected by the blowout at the 70-meter depth. Contact with hydrocarbons in benthic sediments also may result in mortalities or sublethal effects within a 10-kilometer radius of the blowout. Any adult groundfish affected in the offshore environment would be a small portion of the regional populations of species inhabiting the eastern Bering Sea.

More serious effects would be expected for planktonic egg and larval stages, which are concentrated in surfical waters or in shallow, nearshore waters between the blowout and the coast between Port Moller and Port Heiden. Groundfish eggs and larvae, which have LC_{50} values of 0.1 to 1.0 (Thorsteinson and Thorsteinson, 1982), may be killed as a result of contacting hydrocarbon concentrations of 10 ppm within the plume and lower concentrations that decrease to 0.03 ppm within 12 kilometers of the plume. Sublethal effects may occur following exposure to concentrations greater than 25 ppb, which could occur between 12 kilometers (0.03 ppm) and 80 kilometers (0.003 ppm) from the plume. Although mortalities and sublethal effects may occur, the number of individuals affected would be only a portion of the egg and larval drift populations for groundfish of the eastern Bering Sea.

Contact of nearshore areas from Port Heiden to Port Moller also may affect some lifestages of groundfish using these areas. Because oil would not contact these nearshore areas for 3 days, by which time the water-soluble toxic components would be largely depleted, concentrations are expected to be low and cause minimal numbers of mortalities and some sublethal effects on egg or larval lifestages concentrated in the nearshore area. Juveniles rearing in the nearshore area contacted by the oil spill could be affected sublethally by the water-soluble fraction, and more seriously, by oil that is resuspended for months to a year after being incorporated into sand or sand and gravel beaches. These effects, however, would be limited to the lifestages using the nearshore area between Port Heiden and Port Moller that is contacted by the oil spill. Only a portion of the regional populations of groundfish could be affected by this oil spill, resulting in a moderate effect.

CONCLUSION (Effects on Groundfish):

Offshore benthic adult groundfish, planktonic eggs and larvae, and juveniles in the nearshore area contacted by oil may be affected by this spill, but because of the limited area with lethal concentrations and the extensive distributions of regional groundfish populations in the eastern Bering Sea, only a portion of these populations is expected to be affected, resulting in a MODERATE effect.

Effects on Red King Crab: Benthic and pelagic, nearshore lifestages of red king crab could be affected by an oil spill that occurred at Launch Point B3 and contacted nearshore areas between Port Heiden and Port Moller.

Adult benthic crabs having LC_{50} values of 1 to 4 ppm (Thorsteinson and Thorsteinson, 1982) may be killed following exposure to hydrocarbon concentrations of 10 ppm within the upwelling plume of the blowout. Mortalities would be limited, however, to crabs within a 50-meter radius of the blowout. Exposure to hydrocarbon concentrations of 0.3 ppm at the edge of the plume, decreasing to 0.03 ppm within 12 kilometers of the blowout, could result in some sublethal effects on adult crabs. Contact with hydrocarbons in benthic sediments (which are estimated to persist less than a year in this environment) also may result in mortalities or sublethal effects within 10 kilometers of the blowout. Only a small portion of the adults of the regional population would be affected in this area.

Contact of nearshore areas between Port Heiden and Port Moller also may affect some lifestages of red king crab. Because oil would not contact these areas for 3 days, by which time the water-soluble toxic components would be largely depleted, concentrations are expected to be low (less than the 0.03 ppm expected within 12 km of the plume). These hydrocarbon concentrations could have some sublethal effects on developing red king crab eggs carried on females in the nearshore area, or on larvae that are in nearshore areas, which could affect their ability to develop, survive, or reproduce. Effects would be limited, however, because hydrocarbon concentrations would be so low by the time the spill contacted the nearshore area. Adult and juvenile red king crab in the nearshore environment would not be killed, and would probably experience only minimal sublethal effects from these concentrations. The number of organisms expected to be affected is small compared to the regional population of the southeastern Bering Sea.

CONCLUSION (Effects on Red King Crab):

Because vulnerable lifestages of red king crab are concentrated in nearshore areas that are expected to be contacted by such low hydrocarbon concentrations 3 days after the spill, minimal, if any, mortalities and limited sublethal effects are expected on red king crab. The number of organisms expected to be affected is only a small portion of the regional population, resulting in a MODERATE effect.

Effects on Other Invertebrates: Various invertebrate species could be affected by the worst-case oil spill including: tanner, dungeness, and Korean hair crabs, shrimp, and clams. Adult crabs inhabiting benthic areas; planktonic crab and shrimp larvae and egg and larval bivalves in the pelagic environment; and nearshore lifestages including spawning adults, eggs, larvae, and juvenile crabs, spawning and larval shrimp, and bivalves may all be affected by this oil spill, which orginates at Launch Point B3 and contacts the shore between Port Heiden and Port Moller.

Adult benthic crabs having LC_{50} values of 1 to 4 ppm (Thorsteinson and Thorsteinson, 1982) may be killed following exposure to hydrocarbon concentrations of 10 ppm within the upwelling plume of the blowout. Mortalities, however, would be limited to crabs within a 50-meter radius of the blowout. Exposure to hydrocarbon concentrations of 0.3 ppm at the edge of the plume, decreasing to 0.03 ppm within 12 kilometers of the blowout, could result in some sublethal effects on adult crabs. Contact with hydrocarbons in benthic sediments (which are estimated to persist less than a year) also may result in mortalities or sublethal effects within 10 kilometers of the blowout. Only a small portion of the adults of the regional populations of crab species would be affected in this area.

Planktonic invertebrate lifestages in the pelagic environment (i.e., crab and shrimp larvae, egg and larval bivalves) may experience mortalities or sublethal effects following the worst-case oil spill. For example, shrimp larvae have an LC_{50} value of 0.01 and crab larvae have LC_{50} values as low as 0.1 ppm, so some mortalities would be expected from the blowout to distances of 12 kilometers (0.03 ppm) or greater from the plume. Sublethal effects would occur at lower concentrations encountered at greater distances from the plume. The number of organisms affected, however, would be only a portion of the widespread egg and larval drift populations of invertebrates inhabiting the eastern Bering Sea.

Contact of nearshore areas between Port Heiden and Port Moller also may affect some lifestages of invertebrates inhabiting these areas. Because oil would not contact these areas for 3 days, by which time the water-soluble toxic components would be largely depleted, concentrations are expected to be low (less than the 0.03 ppm expected within 12 kms of the plume). Juvenile and adult shrimp and crabs have LC_{50} values ranging from 0.1 to 4 ppm (Thorsteinson and Thorsteinson, 1982) and are not expected to be killed, but some eggs and larvae (particularly of shrimp) may be killed. In addition, sublethal effects may occur for various lifestages exposed and may reduce the ability of these organisms to survive, develop, or reproduce. Oil incorporated into sand or sand and gravel beaches may be resuspended for months to a year, and may result in exposure of organisms beyond the 60-day spill length. Only organisms in the nearshore area from Port Heiden to Port Moller, however, would be contacted and affected by this spill. Because of the widespread distributions of these organisms in the eastern Bering Sea, the limited areal extent of the spill, and the hydrocarbon concentrations expected, only a small portion of the regional populations of these species is expected to be affected, resulting in a moderate effect.

CONCLUSION (Effects on Other Invertebrates):

Benthic adult crabs, planktonic crab and shrimp larvae, planktonic bivalve eggs and larvae, and planktonic or benthic lifestages of crabs, shrimp, and bivalves which inhabit the nearshore area contacted by this oil spill may be affected adversely. Because of the limited area with lethal hydrocarbon concentrations and the extensive distributions of regional invertebrate populations in the eastern Bering Sea, only a portion of these populations is expected to be affected, resulting in a MODERATE effect.

(2) Effects on Marine and Coastal Birds: Occurrence of a major oil release in the northeast section of the lease sale area in late spring is likely to result in substantial adverse effects on marine and coastal bird populations. Coastal migrants and nonbreeding shearwaters moving through inshore waters, and waterfowl and shorebirds staging in the Nelson Lagoon/Port Moller area would be at the greatest risk.

An estimated 5,800 barrels of oil is assumed to enter Nelson Lagoon (although an undetermined quantity would be washed ashore on barrier islands surrounding the entrances) where about 350 (Gill et al., 1981) to 849 (Arneson, 1980) birds/km^2 have been recorded during the spring-migration period. This volume of oil could cover 35 km^2, about 25 percent of the lagoon surface, if no containment/cleanup efforts were undertaken. Surface coverage this extensive could affect nearly 30,000 individuals if considered as the equivalent of a nearly instantaneous spill. This is equivalent to perhaps 50 percent of the birds present at any given time. However, under the stated scenario, smaller amounts of oil would arrive in the lagoon over a 60-day period, and since migrant birds are continually passing through the area during this period, it is possible that greater numbers would be affected over this longer interval. These values suggest that as much as 10 to 15 percent of certain waterfowl populations could be affected, a result that could make major effects a likely outcome, especially in the case of the emperor goose, one of several species currently experiencing a substantial population decline. Bird densities in the remainder of the Port Moller area, where the equivalent of 2,000 barrels of oil is projected to enter, are substantially lower (364 birds/km^2 or about 43% of densities in Nelson Lagoon), and thus it is not likely that effects would exceed moderate.

Although the oil-covered area near the spill site would be relatively small (20 km^2), as a portion of it disperses toward the peninsula, spreading of the slick could result in an overall extent of 200 km^2 between the spill site and Port Moller/Nelson Lagoon. The oil would disperse as a discontinuous slick, but, even if the birds did not initially land in the continuous portion of the slick, this might not result in substantially decreased mortality estimates, since it requires relatively light oiling, such as might be encountered in the fringes of the slick patches, to ultimately cause death. Bird densities in the inshore zone (to about the 50-m depth contour) are generally lower (86-227 birds/km^2) than within the peninsula's embayments. The most common species groups include shearwaters, eiders, and other seaducks, and gulls and terns. Given the nature of the slick as it disperses from the spill site, and the lower bird densities (possible mortality of 10,000-20,000 individuals), it is likely that during slack periods of migration effects would be minor, while during the peak migration period some seaduck species could experience moderate effects. Shearwaters are more abundant than all other species in the inshore zone, especially later in May and June. Passage rates of 175 to 300 birds per minute have been recorded for several hours in May (Gill et al., 1981). If such rates continued for 8 hours, for example, as many as 84,000 to 144,000 shearwaters could traverse the area. Large "gyres" of these birds (10,000+ individuals) have been observed frequently and, judging from observations in nearby areas, concentrations of 100,000 birds probably are not infrequent. Like most other abundant species utilizing this zone, shearwaters forage from the surface and so are vulnerable to oil contact. Despite their great abundance, if circumstances resulted in oil contacting a large proportion of one of these enormous flocks, minor to moderate effects could be expected. Further offshore from the spill site, most recorded bird densities are considerably lower and oil-spill effects are not likely to exceed minor.

CONCLUSION (Effects on Marine and Coastal Birds):

Coastal bird populations staging in Nelson Lagoon during a 100,000-barrel platform oil spill could experience MAJOR effects because of the substantial mortality that would result from oil contact with large concentrations of birds. Because of lower densities in the inshore zone, effects are likely to be less severe, ranging from MINOR during slack migration periods to MODERATE during peak migration. Offshore, effects are not likely to exceed MINOR as a result of low bird densities. Effects ultimately could be more severe, especially in certain goose species, if coincident with population declines caused by other factors.

(3) Effects on Pinnipeds and Sea Otters: A portion of the sea otter population occurring along the coast of the Alaska Peninsula and Port Moller area would be contacted by oil in this catastrophic oil-spill scenario. About 49 percent of the total 100,500 barrels of spilled oil (equaling about 49,000 barrels) would contact the Port Moller Resource Area (7), an important sea otter habitat (Appendix G, Table G-3, Spill Point B3, Resource Area 7). This oil spill is estimated to spread over a total area of about 98 km^2 as a discontinuous oil slick lasting for the 60-day spill period. Using Schneider's (1981) observed average high (6.5 sea otters/km^2), medium (0.3/km^2), and low (.06/km^2) densities of sea otters along the northern coast of the Alaska Peninsula, an estimated 6 to 637 sea otters may be present in the area discontinuously covered in the Port Moller Resource Area. If larger rafts of otters occur (perhaps a few hundred per raft), a few thousand sea otters may be present in the spill area. Assuming that all sea otters in the area covered by the discontinuous oil slicks (no more than 10% of the area actually covered by oil) come in contact with oil and are killed, an estimated 6 to 637 sea otters may be lost. If several large rafts of sea otters were contacted by oil, perhaps a few thousand animals might be lost. Thus, the overall range of sea otter mortality could be from zero to a few thousand. The worst-case loss of a few thousand sea otters from the Alaska Peninsula-Unimak Island population would take this regional population more than one generation to recover. At locations where course benthic sediments have been contaminated (for example an average of 50 ppm per top centimeter of sediment)

within 80 km^2 of the blowout, some benthic prey of sea otters may be affected by persistent oil contamination for several years. Although benthic prey and benthic habitat affected by the spill (within the 80-km^2 area) represent a small part of the available sea otter foraging habitat along the Alaska Peninsula coast, some loss of prey or reduction in the quality of sea otter prey may be lost for several years if benthic areas remain contaminated. However, this habitat degradation is not likely to significantly affect the regional sea otter population, which readily uses different local habitats and different prey organisms available along the coast, including bottomfish and a variety of invertebrates.

A catastrophic oil-spill blowout occurring offshore of Port Moller poses a very low oil-spill-contact risk to northern fur seals. There is a slight (2%) chance of the spill contacting St. George Island Resource Area 1 (Appendix G, Fig. G-2) within 30 days and zero percent within 10 days (Appendix G, Table G-3, Spill Point B3). A portion of an estimated 2,000 barrels (2% of 100,500 barrels total oil spilled) of highly weathered oil (more than 10 days and up to 30 days old) could reach marine waters within 50 kilometers of St. George Island. The portion of the spill reaching this fur seal habitat or other foraging habitat would be highly weathered patches of oil, tar balls, and patches of mousse. It is likely that no more than a few hundred fur seals would come in contact with oil from the spill. The loss of a few hundred fur seals would represent a minor effect on the northern fur seal population, with recruitment replacing lost individuals within one generation.

The other pinniped species populations, including several thousand walrus, harbor seals, and sea lions, are likely to be present in the lease sale area (excluding northern Bristol Bay) during May and June, at the time of the oil spill. Perhaps 1,500 to 2,000 male walrus may be hauled-out in the Port Moller-Cape Seniavin area at the time of the spill, when an estimated 2,000 to 5,800 barrels of fresh and also weathered oil would contact some portion of the coastline (Table IV-30). An estimated 6,000 harbor seals, including breeding adults and pups, may be present in the Port Moller area at the time of the spill. A few sea lions may be present in the spill area; however, most of the regional population would be in northern Bristol Bay or further west near Unimak and Amak Islands. Thus, a few thousand walrus and several thousand harbor seals could come in contact with oil at haulout sites or in nearshore waters in the Port Moller to Port Heiden coastal area. Even if many of these pinnipeds were oiled, experiments on the effects of oil on ringed seals from case histories of oil spills (such as the Santa Barbara spill), strongly suggest that the loss of adults and young due to oiling is not likely to be more significant than loss due to natural mortality. However, some highly stressed adults, weak from disease or injuries, may die as a result of oiling. Some harbor seal pups that become heavily oiled could also die directly or be abandoned as a result of the disturbance associated with oil-spill-cleanup efforts. The loss of walrus and harbor seals due to the oil spill is not likely to exceed a few to perhaps one hundred individuals. These losses would represent minor effects on regional walrus and harbor seal populations, with lost individuals likely to be replaced within one generation.

CONCLUSION (Effects on Pinnipeds and Sea Otters):

The effects of a catastrophic oil-spill event on sea otters are estimated to be MODERATE, while the effects on northern fur seals, sea lions, and harbor seals are estimated to be MINOR. Effects on the other pinnipeds that may be present in the planning area in low numbers are likely to be NEGLIGIBLE.

(4) Effects on Endangered and Threatened Species:

Effects on Endangered Cetaceans: The location of the blowout (Spill Point B3, Graphic 5) is not one frequently used by endangered cetaceans. The pelagic whales are more likely to be found west of the area, the gray and humpback whales in more nearshore waters. Spilled oil expected to contact shore within 3 days and over the life of the blowout could contact 200 kilometers of shoreline. Oil would be on the water for a minimum of 60 days, starting May 1. The peak of the gray whale migration generally has passed the affected area by the end of April, although up to 10 whales/hour have been observed during the first week of May (peak rate of 17 whales/hour). Assuming a gray whale migrates at 5 kilometers per hour, the whales could be exposed to oil for 40 hours as they migrate along the contaminated area. During the Santa Barbara oil spill, which lasted several months, the entire northbound gray whale migration passed through or near the area contaminated by the spill. There were no acute reactions from whales passing through the area from the oil. It can be assumed that effects from a 100,500-barrel spill would be no more than that of the Santa Barbara spill. Effects on gray whales would be negligible. It is unlikely that the other endangered whales would be in the spill location during its occurrence (see Graphic 4 and Sec. IV.B.1.a.(4)). Therefore, effects on gray, bowhead, right, blue, sei, fin, sperm, and humpback whales would be negligible.

Effects on Endangered and Threatened Birds: Only the endangered short-tailed albatross is likely to be in the spill area. It is extremely unlikely that the albatross would be landing on oil-contaminated water. The Aleutian Canada goose and the peregrine falcon would be in the area only rarely.

CONCLUSION (Effects on Endangered and Threatened Species):

Effects on endangered and threatened species would be NEGLIGIBLE.

(5) Effects on Nonendangered Cetaceans: Effects on nonendangered cetaceans would be the same as described for endangered cetaceans. The toothed cetaceans average about 10 miles per hour and would be in the oil-contaminated area for only about 12 to 13 hours, assuming that they did not stay in the area.

CONCLUSION (Effects on Nonendangered Cetaceans):

Effects on nonendangered cetaceans would be NEGLIGIBLE.

b. Effects on Social and Economic Systems:

(1) Effects on Commercial Fisheries: A 100,500-barrel oil spill could affect eastern Bering Sea fishermen through closure of the area to commercial fishing, through oil contamination of fishing gear tainting

the catch and rendering it unfit for human consumption, and by the toxic effects of oil on fisheries resources (which could reduce the populations and subsequent harvests). These effects are discussed in detail in Section IV.B.1.a.(1).

Fisheries that could be affected by this spill scenario are the North Alaska Peninsula and Bristol Bay herring and salmon fisheries, and the large-scale groundfish fisheries on the continental shelf and slope.

Effects on Commercial Salmon and Herring Fisheries: North Alaska Peninsula-Bristol Bay commercial salmon fisheries begin annually during the latter half of May, the herring spawning timing dependent on water temperature, which determines herring inshore-spawning migrations. Both purse seines and gill-nets are employed in these fisheries. The herring fishery operates on a catch quota basis and is closed when the quota is reached; this usually requires less than a week. The salmon season, with exceptions for localized management areas, is from May 1 through September 30. Within this season, the fishery is regulated by open fishing periods; and emergency closures also are imposed when spawning escapements are inadequate. Rearing salmon also probably are present in these waters during this period.

Togiak is the major Bristol Bay herring sac-roe and roe-on-kelp fishery, but oil-spill-risk-analysis data does not show oil from a large 100,500-barrel oil spill reaching this distant area over a 60-day period. Herring also are fished off Port Moller and in Port Moller Bay. These areas would receive about 1,600 barrels of 3-day-old crude oil and a total of 2,000 barrels of 30-day-old crude from Spill Point B3. Initial contact would, however, be in very low concentrations, less than 0.03 ppm, with much of the water-soluble toxic components of the oil depleted from the slick either by dissolution or evaporation. The concentration of 0.03 ppm is well below the 0.1 ppm found lethal to herring eggs. However, there may be sublethal effects on herring eggs and larvae at this concentration. This concentration also is far less than the 1 ppm found lethal to adult herring. Thus, this large oil spill would have no perceptible adverse effect on the southeastern Bering Sea herring fisheries.

A 100,500-barrel oil spill that originates in the lease sale area, and persists over a 60-day period, would intercept all Bristol Bay salmon runs, beginning with chinook in mid-May and concluding with the early coho salmon run in early July. Outmigrants of all five species also would be present in these areas over this time. Based on field studies, where measured volumes of oil were added to one of two fish ladders, salmon tend to detect and avoid very small volumes of oil in water (Weber et al., 1981). Therefore, it appears likely that salmon would avoid the maximum 200 km^2 of the spill area without undue delay in their migrations.

Only the salmon-fishing areas off of the northern coast of the Alaska Peninsula (Port Moller area) would be in danger of being contacted by this large oil spill over a 60-day period. There is a 35-percent chance of contact within 3 days of the spill, increasing to a 49-percent chance after 10 and 30 days. These are assessed as moderate-to high-risk probabilities to the commercial salmon fishery.

The oil probably would cause migrating salmon to move away from these fishing areas and cause great loss to the fishermen, who would be prevented from fishing in an area where even a small volume of oil was present in the water column. Even if the catch were not affected by the oil, the perceived effects could go so far as to reduce marketability.

Over a 60-day period, this oil spill could have a major effect on the salmon fishery in this area.

Effects on Commercial Groundfish Fisheries: Trawl and longline fisheries operate year-round, mainly on the continental slope. A yellowfin sole trawl fishery also occurs in Bristol Bay, principally as a joint-venture fishery. Other groundfish also are caught. Much of the lease sale area is closed to trawling to protect juvenile halibut and the red king crab.

A catastrophic oil spill launched from Spill Point B3 (Graphic 5) has a 0.5-percent chance of being carried to continental-slope areas, where there is intensive trawling and longlining for groundfish. The principal effect on the commercial groundfish fisheries would be the closure of fishing areas to prevent gear and/or catch contamination. While a 100,500-barrel oil spill would encompass an area of no more than 20 km^2, its trajectory (sweep from Spill Point B3 to coastal areas) would preclude commercial fishing operations over a much larger area during this 60-day period. During this 60 days, however, much of the initial spillage would be dissipated through the natural processes of weathering and evaporation, thus making it undetectable.

Because only a relatively small area would be closed to commercial trawling and longlining over a short period of time, (about 20 km^2), as compared with the literally thousands of square kilometers where groundfish occur, the overall effect of this catastrophic oil spill on this fishery would be negligible.

Effects on Commercial Shellfish Fishery: Red king and tanner crab-pot fisheries would not be operative during the May-to-June spill period. Therefore, this event would not affect crab fishermen.

Capelin, smelt, and sandlance do not support a directed commercial effort at this time, although a capelin fishery may develop.

CONCLUSION (Effects on Commercial Fisheries):

An oil spill of this size and duration could have MAJOR effects on the salmon fisheries of Nelson Lagoon and Port Moller. This oil spill would have NEGLIGIBLE effects on commercial herring, groundfish, and crab fisheries.

(2) Effects on Subsistence-Use Patterns: Potential effects from a worst-case oil blowout off Port Moller would focus primarily on subsistence-resource-harvest patterns at the community level. Due to the location of the assumed spill event, no direct or indirect effects are expected at Unalaska. Direct or indirect effects also are not expected at Cold Bay because of the limited amount of subsistence-harvest practices carried out in Cold Bay and its distance from the spill event. Beyond these two communities, which are instrumental in supporting offshore oil and gas operations, potential effects on subsistence harvests at the community level could occur

among lower Alaska Peninsula communities and more generally among communities in the larger Bristol Bay region.

The community of Nelson Lagoon could be expected to be affected due to its location near the entrance to Port Moller and the fact that the event would occur during the startup of adult salmon migration. As shown previously on Tables III-37 and III-38, salmon are a primary subsistence resource for residents of Nelson Lagoon, Port Heiden, and other communities on the Alaska Peninsula. These communities additionally rely on localized, nearshore, intertidal, and backshore habitats for subsistence supplies of other marine organisms and vegetation throughout the year. Such locally available subsistence resources could be reduced in availability should such habitats near Nelson Lagoon or Port Heiden be fouled for several years by the residue from the spill, as postulated in the description of the spill event. A total of 15,600 barrels of combined fresh, weathered, and dispersed-weathered oil is forecast to contact Port Moller (Land Segments 11 and 12) over the 60-day life of the blowout. A total of 9,000 barrels of dispersed-weathered crude is forecast to contact the Port Heiden area (Land Segment 14) over the same period of time.

According to the fisheries analysis, migrating adult salmon are expected to avoid the spill (Sec. IV.B.1.a.(1)). The spill emanates from a blowout located some 55 kilometers offshore of Port Moller (Spill Point B3, Graphic 5) and produces a discontinuous slick to shore over this distance during the 60-day life of the spill. It is assumed that adult salmon will not altogether avoid the shores of the Alaska Peninsula, since some stocks of salmon spawn there. The result should be fewer salmon, an unknown portion of which have processed hydrocarbons through their systems. Although the flesh of such fish may be tainted, the fish are assumed to be edible. Accordingly, the blowout may affect salmon less from a subsistence standpoint than from the loss of commercial use of the resource. Port Heiden fishermen fish Bristol Bay commercially but set net locally for subsistence. Nelson Lagoon fishermen have a nearshore set-gillnet fishery, which produces commercial income as well as subsistence products. Beyond possibly reducing the quantity of fish caught commercially by Nelson Lagoon fishermen, the blowout may trigger a general tainting scare, as discussed for the proposal. Processors may refuse to purchase fish from fishermen for fear of having an unmarketable commodity. This effect could extend to all fishermen fishing western Alaska salmon stocks that migrate north of the Alaska Peninsula.

Biological effects on marine mammals and birds are discussed in Section IV.B.1.a.(2) and (3). Although not used extensively among Alaska Peninsula communities, harbor seals and walrus oiled by the slick could be unusable for subsistence purposes elsewhere in Bristol Bay, despite the relatively minor biological effect assessed for populations as a whole. Migratory ducks and geese could likewise be oiled or their food supplies affected along the Alaska Peninsula, but the effect is less than that from tainting, or from the making of pelts unusable or from direct mortality. The result of the latter on selected species is such that there should be relatively insignificant effects on subsistence use of these resources beyond those fluctuations in population sizes experienced in nature.

CONCLUSION (Effects on Subsistence-Use Patterns):

Effects on subsistence-use patterns would be MINOR.

K. Section 810 Evaluation

The Department of the Interior maintains that neither Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA) nor the subsistence evaluation procedures in Section 810 of the ANILCA apply to outer continental shelf (OCS) leasing activities. In light of the Ninth Circuit Court's decision, November 2, 1984, Gambell and Stebbins v. Clark, the Minerals Management Service (MMS) has prepared the following evaluation under Section 810 of ANILCA. This evaluates the effects of the proposed North Aleutian Basin Lease Sale 92 on subsistence uses and needs, the availability of other lands, and other alternatives that would reduce or eliminate the area of the lease sale that conflicts with subsistence needs.

Recent case law distinguishes the lease sale from other stages of OCS development, i.e., exploration, and development and production. Therefore, each of the three stages is examined separately. This division also will better identify the possible effects of each stage on subsistence uses. Future stages are evaluated to the extent possible at this time, consistent with other analyses in the EIS. The three stages examined are:

- Lease Sale
- Exploration
- Development and Production

Section 810 of the ANILCA (Public Law 96-487) provides that:

> (a) In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands under any provision of law authorizing such actions, the head of the federal agency having primary jurisdiction over such lands or his designee shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes. No such withdrawal, reservation, lease, permit, or other use, occupancy, or disposition of such lands which would significantly restrict subsistence uses shall be effected until the head of such federal agency:
>
> (1) gives notice to the appropriate state agency and the appropriate local committees and regional councils established pursuant to Section 805;
>
> (2) gives notice of, and holds, a hearing in the vicinity of the area involved; and
>
> (3) determines that (A) such a significant restriction of subsistence uses is necessary and consistent with sound management principles for the utilization of public lands, (B) the proposed activity will involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other disposition, and (C) reasonable steps will be taken to minimize adverse effects upon subsistence uses and resources resulting from such actions.

(b) If the Secretary is required to prepare an environmental impact statement pursuant to Section 102(2)(C) of the National Environmental Policy Act, he shall provide the notice and hearing and include the findings required by subsection (a) as part of such environmental impact statement.

(c) Nothing herein shall be construed to prohibit or impair the ability of the State or any Native Corporation to make land selections and receive land conveyances pursuant to the Statehood Act or the Alaska Native Claims Settlement Act.

(d) After compliance with the procedural requirements of this section and other applicable law, the head of the appropriate federal agency may manage or dispose of public lands under his primary jurisdiction for any of those uses or purposes authorized by this Act or other law.

To determine if a significant restriction of subsistence uses and needs is likely to result from the proposal, the following three factors have been considered:

- The likelihood of reducing the population of harvestable resources;
- The likelihood of reducing the availability of resources by alteration of their normal distribution patterns; and
- The likelihood of limitation of access to subsistence resources.

Restrictions, if any, on subsistence use would be significant if there were:

- A large reduction in the abundance of a harvestable resource;
- Major redistributions of those resources;
- Substantial interference with harvester access to active subsistence sites; or
- A major increase in nonsubsistence harvests by nonrural, nonresident OCS workers.

Restrictions, if any, on subsistence use would not be significant if there were:

- No, or a slight, reduction in the abundance of harvestable resources;
- No effect (or slight inconvenience) on the ability of harvesters to reach and use active subsistence-harvesting sites; and
- No substantial increase in competition for harvestable resources from nonsubsistence harvests by nonrural, nonresident OCS workers.

1. <u>The Proposal--Factors Affecting Subsistence Uses and Needs:</u> Uses of subsistence resources in the potentially affected area are discussed in Sections III.C.4. and IV.B.1.b.(4) of this EIS. Those discussions are

incorporated by reference in this Section 810 analysis. Subsistence uses noted include salmon, moose, caribou, waterfowl, crab, other salt-water fish, fresh-water fish, seal, walrus, reindeer, and beaver. Subsistence activities, although concentrated on land, along the coasts, and near shore, occur less throughout the entire lease sale area than in nearby selected communities.

In addition to the discussion of subsistence resources and uses, this EIS includes a forecast of future subsistence trends. According to this forecast, the communities selected for discussion are expected to exhibit a continued dependence on subsistence; per capita levels of dependence are expected to remain stable during the projected life of the oil field.

The Section 810 evaluation of the development and production stage of this proposal is based on the development and production scenario designed around oil and LNG terminals located at Balboa Bay, connected by pipelines to the offshore oil and gas fields. A variation of this scenario, which considers transporting oil directly to market from an offshore-loading point within the lease sale area, also is used in the EIS. The pipeline scenario is used in this 810 analysis because potential effects are the same as, or greater than, those derived from the offshore-loading scenario. The proposed pipeline scenario provides the hypotheses and assumptions necessary to make such a determination. Since no development and production plans exist at present, the proposed scenario assumes that oil and gas will be found in economically recoverable amounts; it further assumes that 1 or more oil spills of 1,000 barrels or greater will occur during the productive life of the field. Resource estimates indicate, however, that there is only a 20-percent chance of recoverable petroleum being present in the lease sale area. If oil is found, there is a 61-percent chance that 1 or more oil spills of 1,000 barrels or greater will occur somewhere within the basin (Sec. IV.A.3.b.).

Seismic surveying constitutes another possible source of effects on subsistence uses. Airgun devices are generally preferred for seismic work because they produce higher quality data and less damage to marine life than explosive devices. The small potential radius within which airgun effects may be experienced and the limited amount of such testing that may occur in the North Aleutian Basin suggest that effects on fish and marine invertebrates would be negligible, especially if explosive-energy devices are not used (see Sec. IV.B.1.a.(1) regarding seismic effects on fish and marine invertebrates).

To determine the potential significant restrictions on subsistence uses and needs, the following criteria were considered: (1) potential to reduce the population of harvestable resources, (2) potential to reduce availability of resources by alteration of their normal distribution patterns, and (3) limitation of access to subsistence resources. Within this framework, the discussion focuses on Unalaska, Cold Bay, the Bristol Bay region (including the northern shore of Bristol Bay), and the lower Alaska Peninsula subregion. Unalaska and Cold Bay are assumed to host petroleum industry operations in support of the proposed lease sale. Those nonhost communities (including Nelson Lagoon and Sand Point) that could be affected by an LNG and oil terminal at Balboa Bay also are considered. In these communities, potential changes in the patterns of subsistence-resource use during development and production, as a result of the lease sale, are assessed in relation to population increases and risks to resources posed by potential oil-spill incidents.

In each case, potential effects are assessed in relation to current trends brought about in each community in the absence of the lease sale.

a. Potential to Reduce the Population of Harvestable Resources: For the purpose of analyzing the significance of the effects of the proposal's three stages on subsistence uses for this Section 810 determination, the area of analysis has been divided into two basic categories: the communities that potentially could host support bases, namely Unalaska and Cold Bay, and the Bristol Bay region, with special attention given the lower Alaska Peninsula subregion, which is proximate to the lease sale area (see Sec's. III.C.4. and IV.B.1.b.(4)).

(1) Unalaska and Cold Bay: Exploration activities are expected to be based primarily out of support facilities located at Unalaska and Cold Bay. The limited scope and duration of such activities should produce no appreciable effects on subsistence in either community due to a reduction in the populations of harvestable resources. During development and production stages, the lease sale would contribute 4 to 7 percent of the resident or enclave population in Unalaska at any given time over the expected life of the project, as discussed in Section IV.A.1.d. The added harvest competition for locally available subsistence resources from this source would be insignificant in Unalaska, particularly compared to the population effects of fisheries-oriented industrial development in the community (as described in Sec. III.C.4.). Development and production in the lease sale area is expected to increase the resident population of Cold Bay by 25 to 30 percent, but effects on subsistence-use patterns would be minimal due to the limited extent of subsistence practices carried out there and to the relative abundance of fish and wildlife resources within reach of Cold Bay residents.

The potential loss of subsistence resources or habitat from offshore oil-spill events is more likely in Cold Bay than in Unalaska, due to the proximity of the offshore field (see Sec. IV.B.1.b.(4)). The probability of spilled oil reaching the coast near Cold Bay within 30 days is 1 percent. The combined agents of potential population increases and oil-spill events produce the highest potential for effects in Cold Bay, but the net result on Cold Bay subsistence-use patterns would be minimal due to the limited subsistence demand for resources (see Sec. III.C.4.) and the relative abundance of resources in the area. According to the biological analysis, most effects on the size of the populations of harvestable resources due to the proposal would come from oil spills. Oil spills are highly unlikely unless the development and production stage is reached. Should oil spills occur, their effects on salmon, other fish, and invertebrates are expected to be minor, although there could be major effects on the red king crab population (see Sec. IV.B.1.a.(1)). Effects on regional populations of marine and coastal birds are expected to be moderate. Minor effects are anticipated for seals and sea lions and for bear and caribou. Higher levels of localized effects could occur in each of these biological populations. In Unalaska, the combined effects would be marginal, especially compared to the effects brought about by the growth of the groundfish industry (see Sec. III.C.4.).

(2) Bristol Bay Region: The Cold Bay air facility is anticipated to be the only support base in the Bristol Bay region that is used in the exploration phase of lease sale activities, as noted in the previous

discussion. With the exception of this facility and the LNG and oil terminals at Balboa Bay, no other OCS-related facilities are expected to be established in the Bristol Bay region. The potential effects of the terminals constructed at Balboa Bay for the development and production stages of activity are discussed in the next section (Alaska Peninsula subregion). For the region as a whole, increased pressure on subsistence resources from increased OCS-associated population would be minimal and relatively inconsequential due to the general absence of such population in the region.

There is a relative absence of direct effects from oil-spill contacts with land segments and biological resource areas in the Bristol Bay region (see Fig. IV-11 and Sec. IV.B.1.b.(4)). The probability of contact is low (1%), except for the Port Moller area, which is discussed in the next section. Indirect effects from oil spills on subsistence-use patterns could accrue if subsistence resources or habitats were tainted by a spill or if a tainting scare were to cause a closure or curtailment of the commercial salmon fisheries along the Alaska Peninsula or in Bristol Bay. The latter case could cause increased pressures on marine- and terrestrial-subsistence resources as a short-term strategy for dealing with the income shortfall (see Sec. IV.B.1.b.(4) for details); however, these effects would be long-term and relatively insignificant for the population as a whole.

(3) Lower Alaska Peninsula Subregion: The lower Alaska Peninsula subregion could be more affected by development and production as a result of the proposed lease sale than other parts of the Bristol Bay region because of the proximity of the lease sale area, the extension of a pipeline from the lease sale area through Port Moller, and the designation of Balboa Bay as a potential site for major oil and gas terminals. The communities involved include False Pass, Nelson Lagoon, Port Heiden, King Cove, Sand Point, and Cold Bay. Nelson Lagoon could experience some temporary changes in subsistence-use patterns. For example, there could be an increased need for caribou if salmon were too tainted to be used for human consumption. These changes would be marginal (see Sec. IV.B.1.b.(4)). Additional service industries could be attracted to Sand Point if the Balboa Bay terminals were constructed. However, the level of effect from residential-population increases during the development and production stages would be marginal because of the relatively plentiful salmon and marine resources. Terrestrial wildlife would not be affected because these animals are hunted primarily on the mainland (air access to the lower peninsula is expensive). The terminal facilities and accompanying tanker traffic could pose a minimal level of risk to marine resources from oil-spill events and chronic discharges near Sand Point; however, subsistence-use patterns at Sand Point could be affected less by direct changes in subsistence-resource abundance or distribution than by indirect effects among segments of the population if the commercial salmon fishing industry were affected. Some indirect, short-term, minor effects on subsistence-use patterns could occur during development and production from tainted fish harvested in the commercial salmon-fishing industry. Marginal commercial fishermen would experience the most direct effects due to the tenuous relationship between cash- and subsistence-income production (see Sec. IV.B.1.b.(4)). The marginally successful fisherman of the lower Alaska Peninsula subregion is likely to be a resident of the larger communities, such as King Cove and Sand Point. The oil-spill-risk analysis shows a relative absence of direct oil-spill contacts with the shore of Bristol Bay or the lower Alaska Peninsula, with the exception of the Port Moller area. South of

the Alaska Peninsula, the oil transshipment terminal at Balboa Bay (and associated tanker traffic) contributes a 7-percent probability that an oil spill of equal to or greater than 1,000 barrels could occur. The most likely number of spills for the southern side of the Alaska Peninsula is zero (see Table IV-10 for oil-spill data for the terminal facility).

° Lease Sale: The leasing action and associated preliminary activities prior to exploration would have no effect on and would not significantly reduce the populations of harvestable resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Exploration: Exploration activities would not significantly reduce the populations of harvestable resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Development and Production: The development and production stages would not significantly reduce the populations of harvestable resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

b. Potential to Reduce the Availability of Resources by Alteration of Their Normal Distribution Patterns: The limited scope and duration of exploration activities carried out from Unalaska and Cold Bay are not expected to produce significant effects on subsistence through the alteration of normal resource-distribution patterns. Given the extensive distribution and volume of subsistence-fishery and marine mammal resources in the lease area, the ability of residents of the Bristol Bay region or the lower Alaska Peninsula subregion to harvest subsistence resources during the development and production stages would not be affected, and there would be no significant alteration of normal resource-distribution patterns (see Sec. IV.B.1.a.). The widespread distribution of salmon and other fisheries resources, for example, is discussed in Sec. IV.B.1.a.(1). Such should also be the case with the location of the support facilities, such as marine- and air-support facilities and the oil and gas transshipment terminals.

In Cold Bay and Unalaska, the offshore support facilities do not represent a new function at the site and thus would not alter the relative distribution of subsistence resources. New transshipment-terminal functions at Balboa Bay could be sited to avoid disturbance of normal subsistence-resource-distribution patterns. With terrestrial mammals, neither brown bears nor caribou are likely to be affected substantially by offshore OCS activities. Because of the distribution of brown bears and caribou, and because of seasonal-use areas and projected development, effects are likely to be quite localized and of minor importance both locally and regionally (see Sec. IV.F.6.a.).

° Lease Sale: The leasing action and associated preliminary activities prior to exploration would not alter normal subsistence-resource-distribution patterns in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Exploration: Exploration activities would not alter normal distribution patterns or significantly reduce the availability of subsistence resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Development and Production: The development and production stage would not change normal distribution patterns or significantly reduce the availability of subsistence resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

c. Limitation of Access to Subsistence Resources: Physical access to subsistence-resource-harvest sites is not likely to be limited by activities associated with the lease sale, exploration, or development and production for residents of the Bristol Bay region or the lower Alaska Peninsula subregion. Access to subsistence-fishery and marine mammal resources is either from the shore or via boat to harvest areas generally within state waters (within 3 miles of shore). The marine and air-support functions specified in the scenario at Unalaska and Cold Bay would not limit access to subsistence resources for residents of these communities beyond existing conditions, because these functions are consistent with the primary historic functions of these communities. There are no residents of Balboa Bay, where the scenario establishes oil and gas transshipment terminals. The pipeline to Balboa Bay is not likely to limit access to subsistence resources because it should represent only a minor obstacle to travel even if located at grade level.

° Lease Sale: The leasing action and associated preliminary activities prior to exploration would not limit access to subsistence resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Exploration: Exploration activities would not significantly limit access to subsistence resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Development and Production: Development and production phases would not significantly limit access to subsistence resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

2. Availability of Other Lands: Within the North Aleutian Basin lease sale area, there are no other lands that could be used for the proposed lease sale other than those discussed in the alternatives. The Secretary previously removed 83 percent of the initial proposed lease sale area from Sale 92, thus eliminating other available lands. This document has reviewed and evaluated all other reasonable options for leasing and development in the area. The North Aleutian Basin was expressly included in the July 1982 5-year program as an area to be considered for leasing.

3. Alternatives: This section on alternatives is concerned with an evaluation of alternative ways to accommodate the proposed action rather than an evaluation of other sites for the proposed action. Alternative IV provides a reduction in direct risk to locally available subsistence resources and habitats along the northern side of the Alaska Peninsula generally, and in the vicinity of Port Moller in particular. However, considering that the

level of such risk from the proposal is relatively low (assessed at a negligible level) to begin with, additional reduction of risk only marginally reduces potential effects on subsistence-use patterns on the Alaska Peninsula. Beyond block deferral alternatives, an alternative to an oil and gas lease sale would be consideration of alternative-energy sources. The feasibility of other national energy sources and of the no-sale alternative are discussed in Appendix I and Section IV, respectively (incorporated in this section by reference). A number of mitigating measures, however, could be adopted to provide greater protection for subsistence use. Relevant potential lease sale stipulations proposed with the sale include the orientation program, the measure on the protection of biological resources, and the requirements that deal with wellheads, pipelines, and the transportation of hydrocarbons. The orientation-program stipulation would make oil industry workers aware of the special environmental, social, and cultural values of the regional residents and the environment. The orientation program would help to promote an understanding and appreciation for local community, customs, and lifestyles of Alaskans. It also would provide necessary information to personnel which could reduce behavioral disturbance to wildlife. The stipulation on protection of biological resources provides for information gathering and the application of appropriate protective measures to biological populations or habitats affected by lease operations. The requirements regarding wellheads, pipelines, and hydrocarbon transportation are designed to minimize adverse biological effects and thus protect resources that may be used for subsistence purposes. Information to Lessees (ITL) includes a variety of topics that could additionally serve to mitigate adverse effects on subsistence resources and uses (see Sec. II.C.1.b.(2) for a discussion of ITL's).

4. Discussion:

° Lease Sale: The actual lease sale for North Aleutian Basin Sale 92 is an administrative action consisting of offers, bids, evaluations, and lease awards. The only oil- and gas-related activities that occur as a direct result of awarding leases are preliminary activities. As defined in 30 CFR 250.34, such activities do not result in any significant adverse effect on the natural resources of the outer continental shelf and would not have a significant effect on subsistence uses in any of the four areas of the sale analysis (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Exploration: Exploratory activities, including seismic investigations undertaken as a result of leases and exploratory drilling, could occur as a consequence of the lease sale, and their possible effects have been examined. These activities could result in effects from site-specific seismic investigations, exploratory drilling, accidental spills, discharge of formation waters and drilling muds, noise, traffic from boat- and aircraft-support activities, onshore support facilities, local population increases, and oil- and gas-related employment. The exploratory operations from other Bering Sea drilling (for Sales 57 and 83) have been considered in preparing this Section 810 analysis and have been found to have no significant effect on subsistence uses. Similarly, no significant restrictions are expected in any of the four areas of Sale 92 (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Development and Production: Development and production activities would be expected to occur if economically recoverable hydrocarbons are discovered. Finding economic quantities of recoverable oil and the development and production of that oil is given a 20-percent chance of happening. Development and production activities consist of the drilling of additional wells; the construction of pipelines and storage facilities, loading facilities, and shore bases; and tanker traffic and planned and accidental discharges. Of these activities, oil spills have the most potential to have unavoidable adverse effects on subsistence uses; other activities are of less concern.

This Section 810 evaluation assumes that, if the development and production stage occurs, 1 oil spill of 1,000 barrels or greater will occur during the productive life of the field. There is a 20-percent chance of discovering oil in commercial quantities, and a 61-percent chance of an oil-spill of 1,000 barrels or greater occurring if such quantities of oil were discovered.

Given these probabilities, it is extremely unlikely that an oil spill would occur and contact the nearshore populations of mammals, fish, and birds used for subsistence in Cold Bay, Unalaska, the Bristol Bay region, and the lower Alaska Peninsula subregion. The probability of such an event occurring is generally less than 1 percent, except in the Port Moller area. Significant changes in distributions of subsistence species or limitations to access are not expected to occur as a result of the proposal. For these reasons, this evaluation demonstrates that no significant restriction of subsistence uses in Cold Bay, Unalaska, the Bristol Bay region, and the lower Alaska Peninsula subregion is foreseeable as a result of the proposed lease sale.

Given the oil-spill-risk probabilities for Sale 92, it is not likely that a spill would cause a subsistence species to become unavailable to a community for more than 1 year, or that the spill would reduce the total amount of subsistence foods consumed by humans in the affected community. This Section 810 analysis demonstrates that significant changes in distributions of subsistence species or significant limitations of access to subsistence resources are not likely or expected to occur as a result of proposed Sale 92.

5. Findings:

° Lease Sale: The lease sale and associated preliminary activities that would occur prior to exploration for Sale 92 are unlikely to significantly restrict subsistence uses in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Exploration: Sale 92 exploratory activities are unlikely to significantly restrict subsistence use of marine and terrestrial resources in the lease sale area or in any of the onshore areas likely to be affected (Cold Bay, Unalaska, Bristol Bay region, lower Alaska Peninsula subregion).

° Development and Production: Included above is an analysis of the development and production stage of the proposal based on hypothetical development scenarios and a 21-percent possibility of finding economically recoverable oil. Based on this analysis, the development and production stage of the lease sale is unlikely to significantly restrict subsistence uses in Unalaska and Cold Bay or in the Bristol Bay region and lower Alaska Peninsula subregion. No activities that would restrict subsistence uses are currently proposed or anticipated. Although this finding is based upon reasonable and valid assumptions, there is a great deal of uncertainty about the precise location, timing, or level of intensity of either exploration or development and production. Therefore, if leases were sold and exploration plans were submitted to the MMS for review and approval, the possible effects on subsistence uses would be reanalyzed pursuant to Section 810 of the ANILCA before exploration plans were approved. If discoveries were made and development and production plans were submitted to the MMS, these plans also would be subjected to review under Section 810 prior to approval.

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