# THE RECORD OF CRETACEOUS DINOSAURS IN ALASKA: AN OVERVIEW

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## ABSTRACT

All documented dinosaur remains from Alaska are found in late Albian to late Maastrichtian (100-68 Ma) age rocks. Except for one locality in southcentral Alaska, they are found between the 69th and 70th parallels. Dinosaur-bearing rocks cropout along several river courses that fall within the Arctic Foothills and Coastal Plains provinces. The vast majority of the remains are hadrosaurian, contained in organic-rich overbank deposits, or coarser channel-lag sediments. In addition to hadrosaurids, at least five other families are represented.

The great bulk of dinosaur-bearing strata are found within a 4-km stretch of the lower reaches of the Colville River near Ocean Point. In each of the last four years, additional sites have been found within this area. The middle section of the Colville has produced isolated and scattered finds but holds great potential for future discoveries from Sentinel Hill to Uluksrak, and from Ninuluk Creek to the Awuna. Farther to the north and west, the Kokolik, Utukok, Kaolak, and Ketik rivers are well worth future exploratory efforts. This area, which is between Pt. Lay and Pt. Belcher, has thus far produced dinosaur tracks and skin impressions. A promising structural and lithologic framework make this another prime target for prospecting.

Analysis thus far indicates that the majority of the fossils represent a typical late Campanian to Maastrichtian fauna with close affinities to faunas from Alberta, Canada, but with a definite transarctic character. These dinosaurs were living on floodplains and deltas in close proximity to the sea. Maritime climate influences and derived food sources must have been significant factors in their arctic lifestyle.

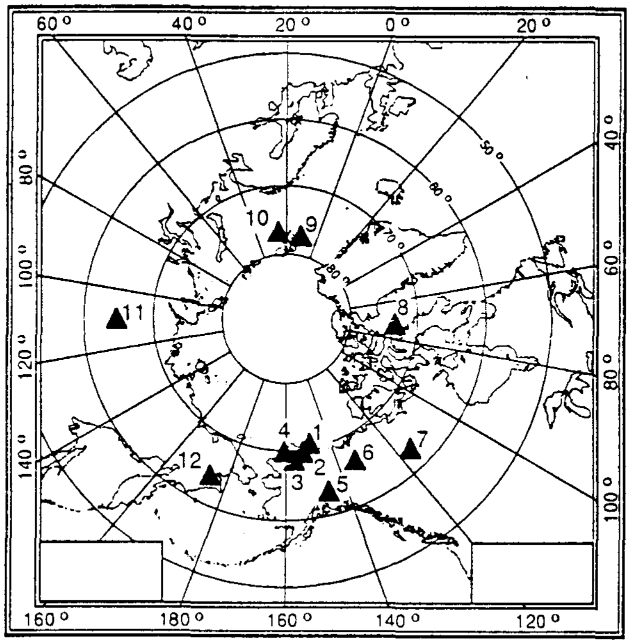


**Fig. 1. Cretaceous-age dinosaur sites (circumpolar region). Compiled from various sources, including Weishample et al. (1990).**
**1. Umiat to Ocean Point: Middle and lower portions of Colville River. A total of 12 sites with well-documented dinosaur remains, including bones, teeth, and an impression of a skin patch. Fauna includes ceratopsians, hadrosaurs, and theropods.**
**2. Ninuluk: Middle portion of Colville River, Tyrannosaurid tooth.**
**3. Awuna and Colville confluence: Ornithopod footprint.**
**4. Kokolik River and Avingak Creek: Upper portion of Kokolik River drainage, Northwestern. Ornithopod tracks, partial trackway, and hadrosaur skin patch.**
**5. Caribou Creek, Central Talkeetna Mountains: Partial cranium with two teeth of nodosaurid ankylosaur.**
**6. Peel River drainage, Yukon Territory, Canada: Hadrosaur vertebrae and partial hand.**
**7. East Little Bear River, Northwest Territories, Canada: Ceratopsian skull fragments and hadrosaur remains.**
**8. Bylot Island, District of Franklin, Canada: Lambeosaurine hadrosaur and theropod remains.**
**9.&10. Spitzbergen (Svalbard): Theropod and iguanodontid footprints.**
**11. Yakutia, Russia: Ankylosaurid remains.**
**12. Tributary of Kakunaut River, Magadan Region, Russia: Theropods and hadrosaur remains.**

## INTRODUCTION

The last 9 years has been an extraordinary period of discovery of Cretaceous terrestrial vertebrates throughout the arctic margins, with new finds occurring each year. Arctic dinosaurs of Cretaceous age previously were known only from tracks at two sites on Spitzbergen or Svalbard (Lapparent, 1962; Edwards et al., 1978). They now are represented by abundant skeletal remains from a total of 12 widely separated locations (Fig.1). Documented dinosaur remains and evidences are found in late Albian to Maastrichtian (100-68 Ma) rocks. H.W. Roehler and G.D. Stricker (1984) are credited with the earliest published description of Cretaceous dinosaur fossils from Alaska. An earlier collection of dinosaur remains from Alaska was not recognized as such until 1983, some 22 years after they were found near Ocean Point on the Arctic Coastal Plain (Wahrhaftig, 1969) of northern Alaska by the late Shell Oil Company geologist R.L. Liscomb. The Liscomb collection led, in 1984 and 1985, to the discovery of the richest dinosaur-bearing deposits thus far documented for the circumarctic region. Except for a single locality in the Talkeetna Mountain area of southcentral Alaska at nearly 62 degrees north (Gangloff, 1990), Alaska dinosaur remains presently are found between 69 and 70 degrees north latitude. Several lines of evidence (Smith et al., 1981; Ziegler et al., 1983; Witte et al., 1987) strongly suggest higher paleolatitudes during the Late Cretaceous than at present. All of the dinosaurs from northern Alaska have been found in rocks assigned to either the Nanushuk or Colville Group.

## GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION

Northwestern Alaska, from the Colville River to the upper reaches of the Kokolik River (Fig.2), encompasses the greatest number of sites as well as the largest volume of recovered remains. The bulk of skeletal fossils and productive horizons are found along the Colville River from Umiat to Ocean Point. The most productive dinosaur-bearing rocks are found along the lower Colville River and are organic-rich crevasse-splay, pond, and channel-lag deposits assignable to the Kogosukruk Tongue of the Prince Creek Formation (Fig.3). A 10-km stretch of high bluffs near Ocean Point includes seven highly fossiliferous lenses and several less productive ones. Changing river levels, landslides, and talus accumulation make consistent identification of fossiliferous horizons difficult. Despite these difficulties, each of the last 4 years has witnessed the discovery of new sites along this portion of the Colville. One micro-vertebrate site has produced the only evidence of hypsilophodont dinosaurs. A variety of mammals, including an early marsupial, are associated with these dinosaur remains. A recently discovered channel-lag deposit has been found to contain the largest examples of common hadrosaurs, or duckbills, as well as a small, previously unknown dromaeosaur, *Saurornitholestes* (see Table 1 for descriptions of these forms).

The middle section of the Colville River, from Umiat upstream to just beyond the intersection with the Awuna, contains three documented dinosaur localities. One, at the southern end of the Ninuluk bluffs, has produced a moderate-size theropod tooth (a tyrannosaurid?) found in conglomerates of the Chandler Formation. The other locality is just southeast of the Colville and Awuna confluence (Parrish et al., 1987). The presence of an ornithopod footprint in fine sandstone of the Chandler Formation marks the earliest Cretaceous (late Albian) evidence of dinosaurs on the North Slope (Witte et al., 1987). In addition to dinosaurs, this section of the river has produced remains of Cenomanian turtles and teleost fish. On the western

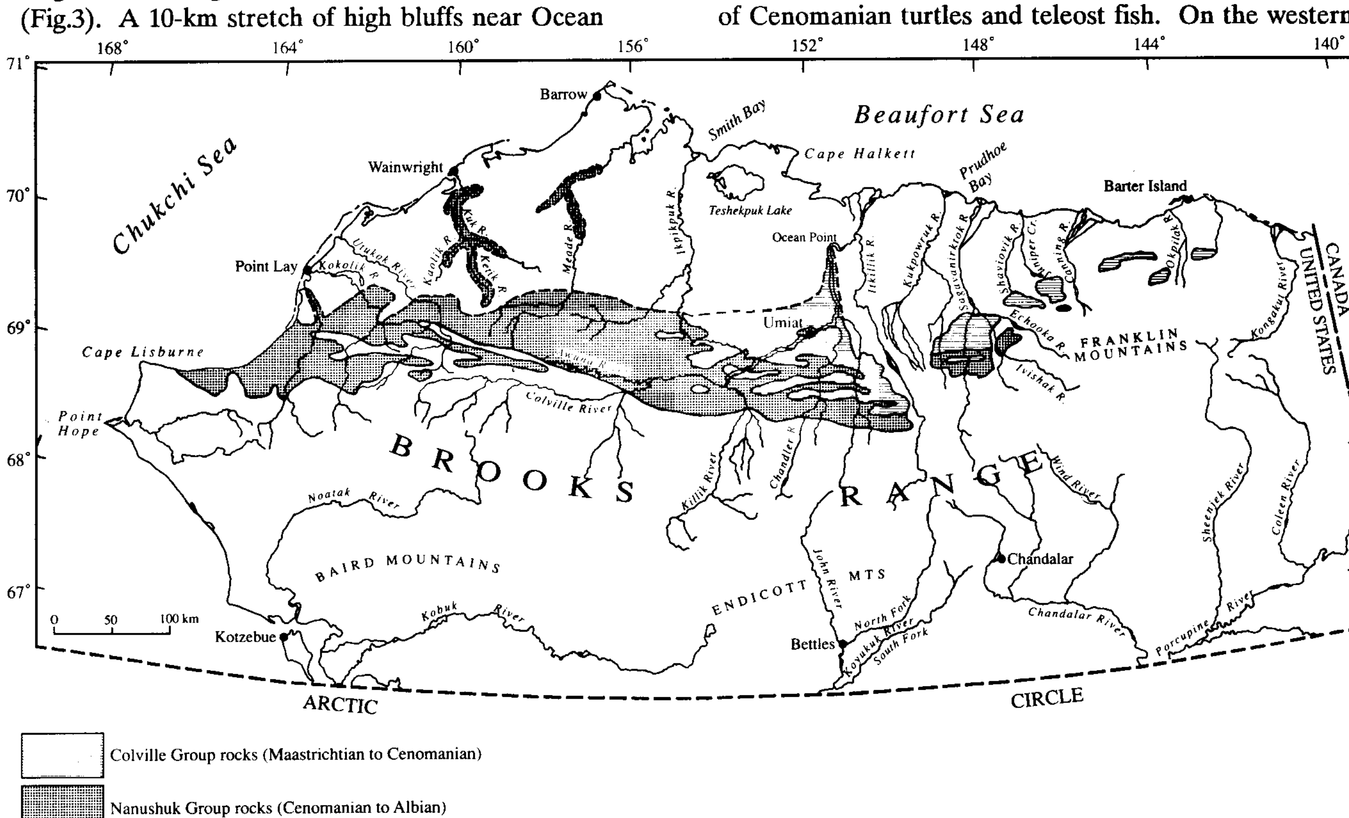


**Fig. 2. Geographic trend of the autochthonous Cretaceous rocks that contain evidence of dinosaurs, or offer the best possibilities for future finds, northern Alaska. Modified from Huffman, Jr. (1985).**

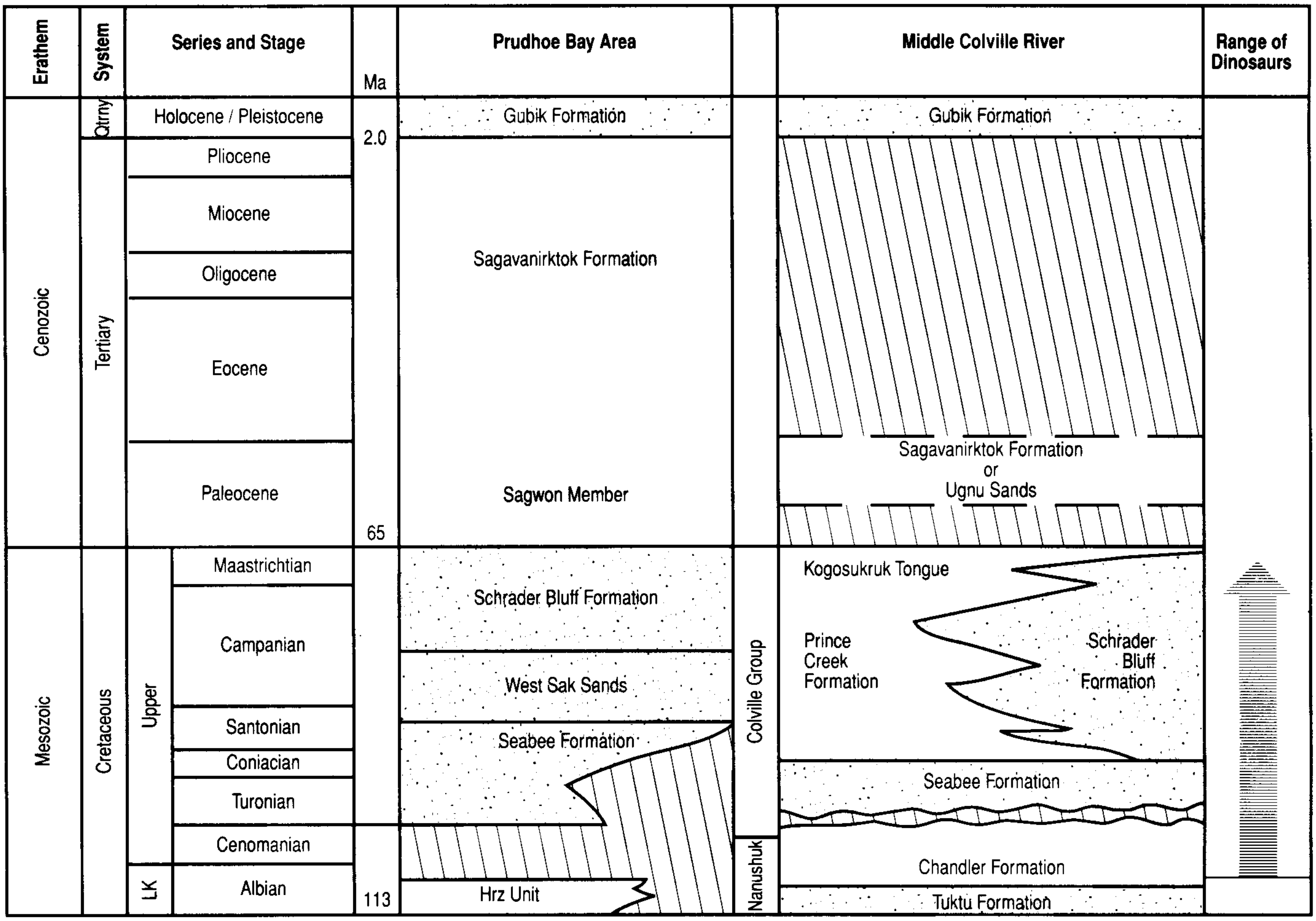


**Fig.3. Stratigraphic distribution of dinosaurs and succession of rock units for northwestern part of North Slope. Compiled from R.A. Spicer et al. (1987) and *COSUNA* Project, F.A. Lindberg (Editor) (1987). Stippling of units represents marine rocks.**

arctic slope, the middle section of the Kokolik River, including a tributary called Avingak Creek, contains tracks and skin impressions of ornithopod dinosaurs but no skeletal remains (Roehler & Stricker, 1984; Witte et al., 1987). Abundant fossil plant remains are found in direct association with the dinosaur evidence. These fossils are part of coal-bearing delta-plain deposits and are preserved in fine sandstones and silts interpreted as crevasse-splay deposits of the upper part of the Corwin Formation. This part of the Corwin Formation is most likely late Albian to Cenomanian. These discoveries were secondary results of work that stressed the systematic mapping of coal-bearing deposits and the collection of associated plant fossils. The last 14 years of geologic investigations have outlined a region that offers great potential for future dinosaur finds. Very little primary effort has been made to prospect for dinosaurs in this large area. The upper drainages of the Kokolik, Utukok, Ketik, Meade, and Ikpikpuk rivers hold the most promise for new discoveries when previous history, rock types, regional relief, and structural trends are all taken into account (Fig.2).

No dinosaur remains are reported from east of the Colville River. Partial remains of a large teleost fish have been collected on the Ivishak River. The marine loon-like diving bird *Hesperornis* (Bryant, 1983) is reported from the Echooka River. Both come from outcrops of Late Cretaceous rocks assignable to the Colville Group. The upper Shaviovik River and Juniper Creek offer promise of future dinosaur finds. Another promising area lies just upstream of the confluences of the Ivishak and Echooka as they near the Sagavanirktok River. This area offers relatively easy access. Near the abandoned camp of Sagwon, the Dalton Highway transects exposures of the Prince Creek Formation. Less than 1 km to the east, the west bank of the Sagavanirktok River provides even better exposures of these rocks.

**Table 1. Late Cretaceous dinosaur and associated vertebrate and megafloral record in Alaska.**

I. **DINOSAURS**
Dominated by a noncrested hadrosaur (duckbill) and a variety of ceratopsians
- A. HADROSAURS
  *Edmontosaurus saskatchewanensis*, most common duckbill, noncrested, up to 15 m long, small juveniles to large adults.
  *Kritosaurus* sp., large (10 m) noncrested duckbill, teeth only.
- B. CERATOPSIANS
  *Pachyrhinosaurus* sp., *Anchiceratops*-like form.
- C. HYPSILOPHODONTID
  *Thescelosaurus* sp., small bipedal herbivore, teeth and toe bone.
- D. THEROPODS
  1. Tyrannosaurid
     *Albertosaurus* sp., moderate to large bipedal carnivorous form, teeth and bones.
  2. Troodontid
     *Troodon* sp., small, lightly built bipedal carnivore, teeth and skull.
  3 Dromaeosaurid
     *Sauronitholestes* sp., small, lightly built, large-brained, bipedal carnivore, teeth only.
- E. ANKYLOSAUR
  Nodosaurid type, of moderate size, heavily armored, skull and teeth, Talkeetna Mtns. only.

II. **OTHER VERTEBRATES**
Most represented by teeth or few skeleton elements
- A. BIRD
  *Hesperonis* sp.
- B. FISH
  Sturgeon and several teleosts.
- C. TURTLE
  Pond turtle, earliest turtle known from above Arctic Circle.
- D. MAMMALS
  Three taxa, including a marsupial, teeth only.
- E CROCODILIANS AND AMPHIBIANS CONSPICUOUSLY ABSENT

III. **PLANTS**
Forest consisted of coniferous trees with low-diversity angiosperm understory and ground cover. Ground cover of horsetails, ferns, and some aquatic plants--coastal high latitude, mixed coniferous forest of North America.
- A. WOOD
  Six taxa, *Xenoxylem latiporosum*, conifer.
- B. DECIDUOUS CONIFER
  *Paratoxodium wigginsi*, needles and fronds.
- C. RUSHES
  *Equisetites* sp.
- D. ANGIOSPERM
  *Hollickia quercifolia.*

## SUMMARY OF DINOSAUR FINDS

### *Talkeetna Mountains*

A partial cranium and two complete teeth of a nodosaurid ankylosaur have been reported from the central Talkeetna Mountains some 130 km northeast of Anchorage (Gangloff, 1990). These remains were weathered out of a calcareous nodule that was contained in the upper part of the Matanuska Formation. The Matanuska Formation is primarily deep-water marine but does include shallow-water lagoonal and deltaic/estuarine facies.

The ankylosaur partial cranium was collected from the upper part of Member 3 of Jones (1963). This places it in Jones' Pacydiscus kameshakensis faunal zone and is equivalent to an interval that spans the late Campanian to early Maastrichtian stages of the Late Cretaceous.

### *Colville River: Ocean Point to Awuna River*

Over 4,000 individual skeletal elements--including teeth, ossified tendons, and bones--have been mapped or cataloged from the Ocean Point area. Caudal vertebrae, dentaries, pelvic elements, humeri, and phalanges are the most common skeletal elements collected. Most fossils have been collected from organic-rich structureless mud and siltstones interpreted as crevasse-splay or overbank and pond deposits (Phillips, 1989). Younger and older dinosaur fossils have been screened from clay-rich, conglomeratic sandstones that represent distributary channel-lag deposits. These highly friable deposits are also assigned to the Kogosukruk Tongue of the Prince Creek Formation.

The most common taxon is the noncrested hadrosaur, *Edmontosaurus* (Nelms, 1989). Juveniles and adults are represented. Most adults are atypically small. *Kritosaurus* or a gryposaur may be represented by teeth. Ceratopsians are the next most abundantly represented group. *Pachyrhinosaurus* is represented by a cranium that is 75 percent complete. Other centrosaurs such as *Brachyceratops* and *Styracosaurus* may be represented by fragmentary cranial and postcranial material. The chasmosaurine *Anchiceratops* also may be present (Parrish et al., 1987). At least three different theropods are represented by teeth and some fragmentary cranial and appendicular elements. *Troodon*, *Albertosaurus*, and *Sauromitholestes* have been identified. A hysilophodontid is known from teeth and a single ungual. Although the hadrosaurs are represented by the great bulk of skeletal and ichnofossils, the theropods are represented by the greatest diversity, with three families: Troodontidae, Tyrannosauridae, and Dromaeosauridae (see Table 1).

The bulk of the fossils are found in highly organic, fine-grained paludal and crevasse-splay deposits that form almost monospecial bone beds. These bone beds reach a maximum thickness of 1 m, exhibit graded bone distributions, have no paleosols or diastems, and only occasionally contain partially articulated skeletal elements. They therefore represent single episodes of relatively rapid deposition.

Smaller collections of hadrosaur and tyrannosaurid skeletal elements have been made from deposits assignable to the late Albian to Cenomanian age Chandler Formation in the middle section of the Colville River.

## AGE AND AFFINITIES OF COLVILLE RIVER FAUNA

The fauna from the Ocean Point area of the Colville River is undoubtedly late Campanian to late Maastrichtian in age. This age assignment is justified on two grounds: (1) A series of K-Ar and 40Ar/39Ar age determinations (Conrad et al., 1989) applied to tuffs located throughout the most fossiliferous part of the stratigraphic sequence indicate a chronometric age of 66-68 Ma to 70-71 Ma, and (2) a comparison to standard stratigraphic ranges for North American dinosaurs indicates a late Campanian to late Maastrichtian age with a skewing towards Maastrichtian. It must be noted that there is still a significant amount of disagreement as to the chronometric date for the Campanian and Maastrichtian boundary. An acceptance of the most commonly used Campanian-Maastrichtian boundaries would place all of the Ocean Point material within the Maastrichtian Stage of the Late Cretaceous. John Obradovich (pers. commun.) would place the Campanian-Maastrichtian boundary at 71.3 ± 0.5 Ma and would place the Ocean Point area fauna within the late Campanian to early Maastrichtian interval. This age assignment is based on preliminary age determinations of sanidine in tuffs studied earlier by Conrad et al. (1989).

The Colville dinosaur assemblage shows the greatest similarity to an assemblage reported from the Horseshoe Canyon Formation near Drumheller, Alberta, Canada; the assemblages were compared at the generic level. The close similarity is most striking in the hadrosaurids, ceratopsids, and theropods. Likewise, a younger assemblage from the Scollard Formation of Alberta appears to have much in common with the Colville assemblage. Important differences can be noted in the ceratopsians and theropods. The Scollard contains a typical Lancian *Triceratops* fauna characterized by its ceratopsian namesake and the theropod *Tyrannosaurus rex.* Faunal differences noted in a comparison between the Colville, Horseshoe, and Scollard probably are not attributable to paleoenvironmental differences because all three represent nearshore flood-plain and deltaic settings (Lehman, 1987). It is possible that the typical *Triceratops* fauna is a southern or biogeographic variant. The Horseshoe Canyon assemblage may represent a northern faunal variant that is only partially correlatable with the Lancian as well as the late Maastrichtian.

Comparisons with assemblages reported from the arctic margins are difficult. Most arctic finds are either highly fragmentary, or are nondefinitive. One exception is found near Pekulneyskoje Lake in northeasternmost Eurasia, where I. A. Nessov has reported the presence of middle Maastrichtian hadrosaurine dinosaurs and a variety of theropods including *Troodon* (Nessov, 1992). Nessov concludes that this assemblage of dinosaurs represents a coastal resident population that was strongly influenced by proximity to maritime climate factors.

## FOSSIL REPOSITORIES

Most of the fossil collections described above reside at the University of Alaska Museum, Fairbanks, or at the University of California, Berkeley's Museum of Paleontology. Additional collections or specimens are kept at the Dorothy Page Museum, Wasilla, Alaska, and the United States National Museum of Natural History, Washington, D.C. Detailed locality data is on file at all of these institutions.

## SUMMARY

The Colville River from Umiat to Ocean Point in Alaska has been documented as the most productive Late Cretaceous dinosaur-bearing area in the circumarctic. Most of this documentation has been carried out over the past 8 years. A very small part of the massive mapping and exploration effort that has been expended in Alaska and the circumarctic since World War II has been directed towards prospecting for dinosaurs and associated fossil vertebrates. Certainly, much remains to be discovered, mapped, and analyzed in this vast region. The last 8 years have allowed us to just begin to appreciate the richness of the dinosaurian record of the arctic margins.

If all of the present evidence is taken into account, the following conclusions are either justified or at least strongly suggested:

1. Dinosaurs were widespread, abundant, and relatively diverse throughout the arctic margins during the Late Cretaceous.
2. Arctic dinosaur assemblages are typical of late Campanian to late Maastrichtian assemblages found farther to the south but appear to exhibit a transarctic character. This character is exemplified by the dominance of diminutive individuals of *Edmontosarus,* the presence of a possible northern variant or subspecies of the centrosaur *Pachyrhinosaurus,* and a distinctive theropod assemblage. The theropods are characterized by a small tyrannosaurid and forms such as the lightly built troodontids and dromaeosaurids.
3. Resident populations of hadrosaurines and theropods dominated. This is exemplified by the scarcity or absence of typically large adults and the abundance of juveniles and diminutive individuals. Although eggs and nests have not been reported, a possible hadrosaur hatchling bone has been found (G. Nelms, pers. commun., 1992).
4. Residents and migrants alike must have been ecologically influenced by the more equitable climate found contiguous to the long coastlines of the Late Cretaceous. The hadrosaurs, in particular, may have

adapted to nearshore or strand-line food sources that concentrated along these shorelines.

5. Most migrant dinosaurs, whether engaging in long-distance or shorter displacement movements, must have taken advantage of coastal routes. These routes would have been close at hand, offered greater ease of movement, and contained a greater variety of food sources. In addition, the proximity to the ocean would have moderated the climate and delayed the onset of some winter conditions.

6. At least one major route for terrestrial faunal interchange was well established by the Late Cretaceous. This route joined northeastern Eurasia and northwesternmost North America. Another route may have linked northwestern Eurasia, Greenland, Spitzbergen, and northeastern North America.

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