OCS Study
BOEM 2014-003

Pacific Continental Shelf Environmental Assessment (PaCSEA)

Aerial Seabird and Marine Mammal Surveys off Northern California, Oregon, and Washington, 2011-2012

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Data Summary

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This study was funded, in part, by the US Department of the Interior, Bureau of Ocean Energy Management, Environmental Studies Program, Washington, DC, through Inter-Agency Agreement Number M10PG00081 with the U.S. Geological Survey. This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. This report has been technically reviewed by BOEM and was approved for publication. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government may be held liable for any damages resulting from the authorized or unauthorized use of this information. Mention of trade names or commercial products does not constitute endorsement or recommendation for use. This product has been peer reviewed and approved for publication consistent with USGS Fundamental Science Practices (http://pubs.usgs.gov/circ/1367/).

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ABOUT THE COVER

Cover photo: Feeding blue whale (*Balaenoptera musculus*) sighted offshore of Coos Bay, OR, in September 2012. Courtesy of Jonathan Felis (USGS).

ABSTRACT

Marine birds and mammals comprise an important community of meso- and upper-trophic-level predators within the northern California Current System (NCCS). The NCCS is located within one of the world's four major eastern boundary currents and is characterized by an abundant and diverse marine ecosystem fuelled seasonally by wind-driven upwelling which supplies nutrient-rich water to abundant phytoplankton inhabiting the surface euphotic zone. The oceanographic conditions throughout the NCCS fluctuate according to well-described seasonal, inter-annual, and decadal cycles. Such oceanographic variability can influence patterns in the distribution, abundance, and habitat use among marine birds and mammals. Although there are an increasing number of studies documenting distributions and abundances among birds and mammals in various portions of the NCCS, there have been no comprehensive, large-scale, multi-seasonal surveys completed throughout this region since the early 1980s (off northern California; Briggs et al. 1987) and early 1990s (off Oregon and Washington; Bonnell et al. 1992, Briggs et al. 1992, Green et al. 1992). During 2011 and 2012, we completed the Pacific Continental Shelf Environmental Assessment (PaCSEA) which included replicated surveys over the continental shelfslope from shore to the 2000-meter (m) isobath along 32 broad-scale transects from Fort Bragg, California (39° N) through Grays Harbor, Washington (47° N). Additionally, surveys at a finer scale were conducted over the continental shelf within six designated Focal Areas: Fort Bragg, CA; Eureka, CA; Siltcoos Bank, OR; Newport, OR; Nehalem Bank, OR; and Grays Harbor, WA. We completed a total of 26,752 km of standardized, low-elevation aerial survey effort across three bathymetric domains: inner-shelf waters (<100-m depth), outer shelf waters (100 – 200-m depth) and continental slope waters (200 – 2000-m depth). Survey effort was similar among seasons (winter, summer, and fall) and between years and varied according to the three bathymetric domains: 47% (12,646 km) covered the continental slope, 33% (8887 km) covered the inner-shelf (0 – 100-m depth), and 20% (5,219 km) covered the outer-shelf.

Overall, we recorded 15,403 sightings of 59,466 individual marine birds (12 families, 54 species). During winter, seven species groupings comprised >90% of the total number of birds counted (19,033) with Common Murres (*Uria aalge*) representing the majority of individuals counted (70.4% of total). The remaining six most abundant taxa included: Surf/White-winged Scoters (*Melanitta perspicillata/M. fusca*; 4.8% of total), Herring/Thayer's Gulls (*Larus argentatus/L. thayeri*; 3.8% of total), Cassin's Auklets (*Ptychoramphus aleuticus*; 3.8% of total), Glaucous-winged Gulls (*Larus glaucescens*; 3.7% of total), Black-legged Kittiwakes (*Rissa tridactyla*; 2.0% of total), and Western Gulls (*Larus occidentalis*; 1.9% of total). During summer, five species comprised >95% of the total number of birds counted (17,063) with the majority comprised of Common Murres (54.1% of total) and Sooty Shearwaters (*Puffinus griseus*; 34.4% of total). The remaining most abundant three taxa included: Fork-tailed Storm-Petrels (*Oceanodroma furcata*; 3.3% of total), Western Gulls (2.1% of total), and Leach's Storm-Petrels (*Oceanodroma leucorhoa*; 1.1% of total). During fall, nine species comprised >85% of the total number of birds counted (23,376) with the majority comprised of Common Murres (50.0% of total) and Sooty Shearwaters (10.5% of total). The remaining seven taxa included Cassin's Auklets (5.2% of total), Surf/White-winged Scoters (5.1% of total), Fork-tailed Storm-Petrels (3.8% of total), Red/Red-necked Phalaropes (*Phalaropus fulicarius/P. lobatus*; 3.2% of total), California Gulls (*Larus californicus*; 3.1% of total), Northern Fulmars (*Fulmarus glacialis*; 2.7% of total), and Sabine's Gulls (*Xema sabini*; 2.2% of

total). Throughout the entire PaCSEA survey area, average densities (± SE) at sea for all marine birds combined were similar between fall (23.7 ± 1.9 birds km^{-2}) and winter (24.0 ± 1.9 birds km^{-2}) and least during summer (16.3 ± 2.2 birds km^{-2}). Marine bird densities at sea varied according to bathymetric domain and season. Throughout the entire PaCSEA study area average densities (± SE) for all marine birds combined were greatest over the inner-shelf domain (<100-m depth) during fall (49.4 ± 5.0 birds km^{-2}) and similar during winter (37.4 ± 4.6 birds km^{-2}) and summer (37.5 ± 6.4 birds km^{-2}). Within the outer-shelf domain (100 – 200-m depth), average densities for all marine birds combined were greatest during winter (34.6 ± 4.2 birds km^{-2}), lesser during fall (16.2 ± 1.7 birds km^{-2}), and least during summer (6.9 ± 1.1 birds km^{-2}). Within the farthest offshore waters over the continental slope domain (200 – 2000-m depth) average densities for all marine birds combined were greatest during fall (10.0 ± 2.2 birds km^{-2}) and winter (9.3 ± 1.5 birds km^{-2}), and lesser during summer (6.2 ± 1.4 birds km^{-2}).

We observed 16 cetacean species and five pinniped species. Among the Mysticeti (baleen whales), humpback whales (*Megaptera novaeangliae*) were most frequently observed (114 sightings of 264 individuals) during summer and fall mostly over the outer-shelf and slope waters, however, individuals were also seen within the Siltcoos, Nehalem, Fort Bragg, and Eureka Focal Areas. We recorded 11 Odontoceti (toothed whale) species. Harbor porpoises (*Phocoena phocoena*) were the most frequently sighted (164 sightings of 270 individuals). Harbor porpoises were present year-round and most frequently sighted within the inner-shelf domain throughout the entire study area in all seasons. Harbor porpoises occurred in all six Focal Areas, with noteworthy aggregations within the Eureka, Siltcoos, and Grays Harbor Focal Areas.

We recorded 246 sightings of 375 individual pinnipeds (5 species). California sea lions (*Zalophus californianus*) were the most frequently sighted and were present year-round with slightly more sightings recorded during the fall. California sea lions showed a decreasing frequency of sightings and relative abundance with distance from shore across the bathymetric domains surveyed, being most frequently observed over the inner-shelf. Northern elephant seals (*Mirounga angustirostris*), harbor seals (*Phoca vitulina*), and northern fur seals (*Callorhinus ursinus*) were observed occasionally during all seasons with harbor seals occurring nearshore (usually within 10 km of the coast) and northern fur seals almost exclusively beyond the shelf break (> 200-m depth), especially during winter off Oregon and Washington. Northern (Steller's) sea lions (*Eumetopias jubatus*) were uncommonly sighted during winter and fall.

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Abbreviations and Acronyms

Bureau of Ocean Energy Management	BOEM
Chlorophyl-a	Chl-a
Degrees Celsius	°C
Global Positioning System	GPS
Hour	h
HyrdoRad3	HR3
Kilometers	km
Meters	m
National Oceanic and Atmospheric Administration	NOAA
Nautical Miles	nm
Northern California Current System	NCCS
Outer Continental Shelf	OCS
Pacific Continental Shelf Environmental Assessment	PaCSEA
Sea Surface Temperature	SST
Second	s
U.S. Geological Survey – Western Ecological Research Center	USGS WERC

1.0 INTRODUCTION

Recent interest has increased related to developing alternative sources of renewable energy to reduce dependence on oil. Some of those sources will include power generation infrastructure and support activities located within continental shelf waters, and potentially within deeper waters off the US Pacific coast and beyond state waters (i.e., outside three nautical miles [nm]). Currently, the Bureau of Ocean Energy Management (BOEM) is considering renewable energy proposals off the coast of Oregon. The 2011-2012 Pacific Continental Shelf Environmental Assessment (PaCSEA) project is intended to provide up-to-date information on species composition, distribution, abundance, seasonal variation, and habitat utilization among marine mammals and seabirds within the outer continental shelf (OCS) of the northern California Current System (NCCS). The NCCS supports abundant populations of seabirds and marine mammals, but comprehensive aerial surveys have not been conducted at all during certain months (i.e., winter) or were conducted two to four decades ago. Briggs et al. (1987) conducted extensive low-elevation surveys for marine birds and mammals off central and northern California during February 1980 through January 1983, and Bonnell et al. (1992), Briggs et al. (1992), and Green et al. (1992) conducted similar extensive aerial surveys from April 1989 to September 1990 off Oregon and Washington. Suryan et al. (2012) provided a review of surveys conducted off Oregon and a similar effort also has been initiated to summarize existing data off Washington (C. Menza, National Oceanic and Atmospheric Administration [NOAA] *in prep*).

Our three primary objectives were to (1) conduct aerial at-sea surveys of seabirds and marine mammals in shelf and slope waters off northern California, Oregon, and Washington and summarize species and seasonal at-sea densities, (2) conduct a comparison with existing similar surveys in northern California, Oregon, and Washington, and (3) validate and enhance aerial survey data for numerically abundant indicator species and certain resident breeding and non-resident migratory seabird species. Data generated are intended to inform resource managers concerned with evaluation of proposed renewable energy sites and environmental review of specific project proposals received by BOEM. In addition, new data regarding seabird density distributions will enhance incipient efforts to apply predictive modeling for species distributions (Nur et al. 2011) and future, applied vulnerability evaluations among seabirds in the NCCS.

Here, the U.S. Geological Survey – Western Ecological Research Center (USGS WERC) reports results from the first of our three primary objectives of the 2011-2012 PaCSEA project. This project objective entailed mapping species-specific density calculations from seasonal, low-elevation aerial seabird and marine mammal surveys off northern California, Oregon, and Washington coasts during 2011 and 2012. These data contribute to a growing amount of similar at-sea, transect-based survey data and provide more recent information regarding the variability in the distribution, abundance, and habitats among the diverse seabird and marine mammal community that exists in the northern California Current System. The remaining two objectives described below (historical comparisons and evaluation/augmentation of transect survey data for select species), currently are underway as part of a PaCSEA project timeline extension.

Historical comparisons—We have obtained aerial survey data from Briggs et al. (1992) for Oregon and Washington and from Briggs et al. (1987) from northern California. In a follow-up analysis, data from our PaCSEA surveys will be re-scaled to match previous survey data (densities calculated at segment lengths equivalent to 5-min longitude). Gridded bin densities will be assigned to sub-areas based on latitude and longitude and environmental parameters (e.g., bathymetry, sea surface temperature, and surface chlorophyll concentration). New survey data will be compared according to season with data from Briggs et al. (1987, 1992). We will compare at-sea densities using either generalized linear mixed-models (GLMM) or generalized linear models (GLM), depending on presence of random effects, to test differences in average density (weighted by survey effort per bin) between the historic and current survey periods among post-stratified sub-areas (region and bathymetric domain). Factors will include month, and Wald's Z-test will be used to examine the differences in densities of species in time and space.

Comparison of aerial transects with species-specific telemetry— Broad-scale strip- or line-transect surveys conducted either by ship or plane can be used to determine "snapshots" of species community composition, species abundances, and broad-scale habitat associations. Whereas transect surveys are beneficial for describing community and regional-scale patterns in occurrence for all species within a system, they require consideration of inherently short time-scales and are subject to high inter-survey variability (in both species distributions and oceanographic conditions). Transect surveys also have limited capacity for repeatability and are subject to biases resulting from pre-selected track-lines and sighting ability among species that is species or weather dependent. Telemetry offers a supplemental method for independently measuring spatio- and temporally-explicit movements and residency among marine birds and mammals (i.e, breeding or wintering periods or migration) independent of weather and diurnal periods. To increase resolution for describing at-sea space use among certain species, we are evaluating patterns in our transect data using telemetry applied to numerically dominant Common Murre (*Uria aalge*), Sooty Shearwater (*Puffinus griseus*), and the Pink-footed Shearwater (*Puffinus creatopus*), a species of international conservation concern. In 2012 and 2013, we evaluated Common Murre use of the Columbia River Plume and adjacent NCCS waters. From 2004 – 2009, together with collaborators, we evaluated Sooty Shearwater movements and distribution at sea throughout the NCCS. During 2006, 2009, 2011, and 2012, together with collaborators, we evaluated at-sea movements and distribution at sea among Pink-footed Shearwaters within and beyond the NCCS. We have initiated analyses to augment aerial transect survey data with high-resolution Common Murre and shearwater tracking data to assess spatiotemporal variability in hotspots that may or may not be detected effectively in the aerial transect data. We will examine the relationship of survey-derived measures of distribution at sea with movements and spatial utilization for these numerically dominant seabirds within the PaCSEA survey area to better define their use of shelf habitats and ocean features.

2.0 METHODS

2.1 Aerial Surveys

USGS-WERC conducted low-elevation aerial at-sea surveys to provide information on the distribution and abundance of marine birds and mammals as requested by BOEM, Pacific OCS Region. The primary survey area extended from Fort Bragg, California (39.3°N) to Grays Harbor, Washington (47°N) and focused on federal waters outside of the 3-mile state boundaries (Figure 1). We structured our at-sea surveys such that they would be comparable with historic transect lines off northern California (Briggs et al. 1987) and off Oregon and Washington (Briggs et al. 1992).

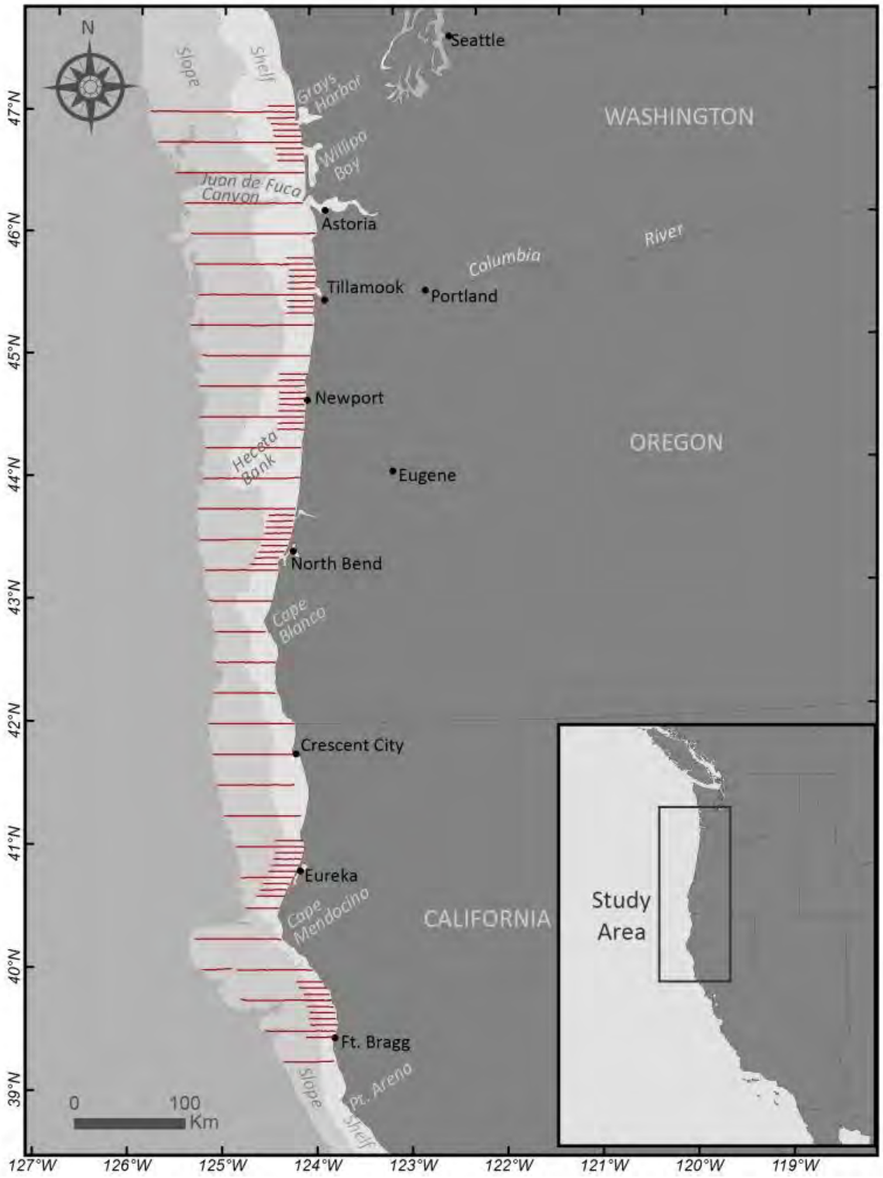

Figure 1. Pacific Continental Shelf Environmental Assessment (PaCSEA) study area showing 32 broad transects, six focal-area transect zones, and geographic place names referenced in text.

To ensure comparable spatial and temporal coverage with these similar historic datasets, we flew 32 east-west-oriented uniform transects (spaced at 15′ latitude [27.8-km] intervals) when possible to the 2000-m isobath (includes shelf, slope, and rise waters). At the request of BOEM, we included six focal-area surveys nested within the overall broad transect survey area (Figure 1). Each focal-area survey consisted of ten 25-km, parallel transect lines targeting shelf waters and spaced at 6-km intervals. This pattern (broad survey lines and Focal Area survey lines) was surveyed during each oceanographic season: summer (June-July), fall (September-October), and winter (January-February) during 2011 and 2012. Aerial survey methods follow Mason et al. (2007) with slight modifications. Specifically, we recorded all sightings of marine animals, vessels, and floating objects from twin-engine, high wing aircraft (Partenavia P-68, Aspen Helicopters, Oxnard, CA, or Commander AC-500, GoldAero, Arlington, WA; Figure 2) along pre-determined 150-m (75 m per side) strip transects at 60-m above sea level. Surveys were flown at 160 km h^{-1}, and we used a Global Positioning System (GPS) unit linked to a laptop computer that allowed us to simultaneously collect coordinates (WGS-84 map datum), sea surface temperature (SST, degrees Celcius [°C]) determined via a belly-mounted pyrometer, and ocean color data via an onboard radiometer (see Remote sensing methods).

Figure 2. Survey aircraft used during the PaCSEA program. Partenavia P-68 Observer (left; Aspen Helicopters, Oxnard, CA) and Commander AC-500 (right; GoldAero, Arlington, WA). Photo by J. Felis, USGS.

2.2 Environmental remote sensing

Sea-surface temperature (SST) was determined using an aircraft-mounted digital infrared radiation pyrometer (Heitronics™ KT19.85; measurement interval = 1s, response time = 3ms, emissivity = 0.99). SST values were appended to GPS flight data based on date and time. Ocean color was determined using an aircraft-mounted hyperspectral radiometer (HydroRad3 by HOBI Labs, Inc.). The HydroRad3 (HR3) provides simultaneous measurements of downwelling radiance (L_d), upwelling radiance (L_u; Figure 3), and downwelling irradiance (E_d) over the usable wavelength range of 440-780 nm. The sensor detecting the upwelled radiance has a 15° field of view and radiometric data are acquired every 2-3 s. The HR3 and pyrometer sensors were flown onboard at an altitude of 60-m above sea level at 160 km h^{-1}. In addition to pyrometer and radiometer measurements, we collected additional environmental data including Beaufort Sea State, cloud cover, and visual observations of oceanographic frontal boundaries. Raw HR3 data were first calibrated and then processed to full engineering units (RadSoft Version 1.1, HOBI Labs, Inc.). These data were imported into Matlab (Version 2011a Student; MathWorks, Natick, MA) and attributed with GPS flight data (geographic location) based on date and time. Full hyperspectral data were then reduced to 5-nanometer intervals using linear interpolation in Matlab.

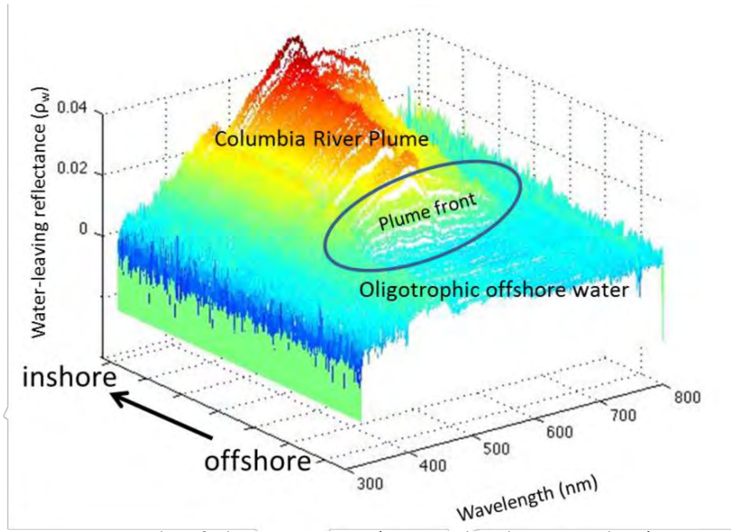

Figure 3. Example of along-transect (#29, Columbia River line) spectrograph of water-leaving reflectance (ρ_w) collected from aircraft-mounted radiometer during survey of the Columbia River. Plume water is easily detectable and contrasts markedly with offshore oligotrophic waters of the inner California Current. Spectrograph provided by J. Broughton, UCSC & USGS.

2.3 Species observations

We maintained the same two trained observers (J. W. Mason and J. N. Davis) throughout the study. During individual surveys, observers frequently verified strip widths using hand-held clinometers. Observations generally were discontinued when glare exceeded >25% of the field-of-view or if sea state exceeded Beaufort 5 (29-38 km h^{-1} wind speed). Observations were recorded into hand-held digital audio recorders. The third (non-dedicated) observer assisted the pilot with navigation, monitored sensor data, and maintained the onboard computer. The third observer also recorded incidental observations of marine mammals outside transects (i.e., non-standardized effort sightings). The effort for incidental marine mammal observations is not always consistent because the third observer was sometimes required to be engaged in other activities. Observations of species or individuals identified to nearest taxon included number of individuals, time, pre-coded behaviors, flight direction, and interspecies or vessel associations. Digital recordings of observations were archived and used by observers after surveys to enter data into a customized Graphical User Interface in ACCESS (Microsoft). Observation data were proofed after transcription to ensure accuracy or to resolve inconsistencies. Species observations were linked with GPS-based tracklines generated at 1 to 3 s intervals. Based on variations in the lag-time between sightings and recordings, we estimate that observations have a nominal along-trackline spatial accuracy of 222 m, based on a five-second lag at 160 km hr^{-1} survey speed.

2.4 Density estimation and mapping

Tracklines and associated observations were mapped and analyzed using ArcMap (ESRI, Redlands, CA). GPS data were recorded in WGS-84 map datum and projected to an USGS Albers Equal Area Conic map projection for presentation and subsequent density analyses. Concatenated GPS and observation data were then used to generate point and line coverages in ArcMap (ESRI, Redlands, CA). We designed a custom analytic tool using ArcMap Model Builder that allows for the construction and export of user-specified and effort-adjusted spatial binning of species observations along continuous trackines. For the purposes of this report, we calculated density estimates along continuous 3-km trackline segments (i.e., 3-km bins). Therefore, marine bird densities are based on a composite strip area ranging from 0.225 km^2 (one observer) to 0.450 km^2 (two observers). We made no effort to adjust densities such that they would be proportional to variations in the area of buffered transect (i.e., weighted offset variable).

Species accounts and density maps for marine birds are provided only if we observed a species ≥10 times (sightings, not individuals) during one of the two survey periods in at least one season. For marine mammals, we present maps for all sightings observed inside and outside survey strips and do not calculate densities. See Section 7.0 for more information on map layouts.

2.5 Additional observations and associations

We recorded additional information along with species identifications that included behaviors and associations. Observers also recorded oceanographic features (i.e., fronts) and the presence of floating debris, vessels, and fishing gear. A summary of the behavioral attributes and non-animal observations recorded during surveys is presented in Table 1 and Table 2, respectively.

Table 1. Numerical observation codes used for marine bird behaviors/associations during PaCSEA survey transects.

Behavior	Code	Association	Code
On/in water	1	Associated with krill	30
Flying (direction not specified)	2	Associated with fish shoal	32
Flying N	3	Associated with cetaceans	33
Flying NE	4	Associated with seabirds	35
Flying E	5	Associated with front	36
Flying SE	6	Sitting on or near floating wood	37
Flying S	7	Associated with floating litter	38
Flying SW	8	Associated with slick	39
Flying W	9	Associated with floating seaweed	40
Flying NW	10	Associated with kelp	41
Feeding	13	Associated with vessel	42
Grouped in “chorus line” (Murres)	24	Associated with or on buoy	43
		Multi-species flock association: participant	50

Table 2. Numerical observation codes used for non-animal observations during PaCSEA survey transects.

Feature Type	Description	Code	Feature Type	Description	Code
Oceanographic frontal features and transitions	blue to green	100	Floating features	seaweed	130
	green to blue	101		log	131
	blue to brown	102		wood, other	132
	brown to blue	103		buoy	133
	green to brown	104		fishing gear, float	134
	brown to green	105		fishing gear, line	135
	blue to red	106		fishing gear, other	136
	red to blue	107		litter, balloon	137
	green to red	108		litter, other	138
	red to green	109	Vessels	fishing vessel	140
	brown to red	110		non-fishing vessel	141
	red to brown	111	Oil	light (trace to 20%)	120
	foamy/scummy	112		medium (21 to 50%)	121
	Turbulent	113		heavy (>50%)	122
	Slick	114		sheen, silver	123
	broken, discontinuous	115		sheen, rainbow	124
	Strong	116		mousse	125
	Weak	117		pancake	126
	Wide	118		tarball	127
	Narrow	119			

Figure 4. Example of a mixed-species flock of gulls and pelicans associated with a fishing vessel (e.g., Codes 50 and 42; see Table 1). Photo by J. Felis, USGS.

3.0 RESULTS

3.1 Aerial Survey Effort

We conducted replicated surveys off northern California, Oregon and southern Washington on 14-26 January 2011, 23-30 June 2011, 7-19 October 2011, 17-27 February 2012, 1-5 July 2012, and 19-24 September 2012 (Table 3). Inclement weather occasionally interfered with survey effort. For example, we were not able to complete Focal Area surveys during February 2012 within the Nehalem and Grays Harbor target zones, although we were able to complete surveys along several broad lines that overlapped these areas. Also, U.S. Department of the Interior aviation flight restrictions for extended overwater operations constrained our maximum offshore extent to 50-nm during February, July, and September 2012 surveys. This restriction only affected survey coverage of the far offshore slope waters (>200-m depth) off northern Oregon and southern Washington, where there occurs a region of broad continental shelf. We completed a total 26,752 km of standardized survey effort (not including coastal and offshore deadhead segments between transect lines; Table 3). Effort allocated according to bathymetric domain (i.e., depth strata) was approximately proportional to areas occupied by the bathymetric domains of the shelf-slope region with additional effort targeting regions of the continental shelf (mostly <200-m depth) within Focal Area surveys identified as a priority by BOEM. Effort was similar among seasons (winter, summer, and fall) and between years. With respect to depth strata, 47% (12,646 km) covered the slope domain (200 – 2000-m depth), 33% (8887 km) covered the inner-shelf (0 – 100-m depth), and 20% (5219 km) covered the outer-shelf (Table 3).

Table 3. Summary of low-elevation aerial survey effort (km transects flown) during PaCSEA surveys off northern California, Oregon, and southern Washington.

			Depth Stratum			
Year	**Month**	**Survey Dates**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	January 14 – 26	1780	991	2285	**5056**
	June	June 23 – 30	1572	874	2382	**4828**
	October	October 7 – 19	1487	893	2277	**4657**
2012	February	February 17 – 27	1114	752	1626	**3492**
	July	July 1 – 5	1451	846	2055	**4352**
	September	September 19 – 24	1483	863	2021	**4367**
All Surveys			**8887**	**5219**	**12,646**	**26,752**

3.2 Remote Sensing

The physical oceanography and marine food-web structure of the northern California Current region varies seasonally and inter-annually (Checkley and Barth 2009, Ruzicka et al. 2012) and this variability can influence the distribution and abundance patterns among marine birds and mammals (Briggs et al. 1992, Ainley et al. 2005). In order to evaluate seasonal and inter-annual variability in ocean conditions and conduct future analyses of species-specific distributions, we collected fine-scale, remotely-sensed sea surface temperature data (using an aircraft-mounted pyrometer) and present monthly composite averages of chlorophyll-*a* concentrations determined using National Aeronautics and Space

Administration (NASA) Moderate Resolution Imaging Spectroradiometer (MODIS). Fine-scale (<100 m), remotely-sensed ocean color data collected via our aircraft-mounted hyperspectral radiometer is currently being analyzed and is intended for future reporting.

Winter surveys revealed the least amount of variability in SST (Figure 5). In January 2011, coolest temperatures (5-6° C) were confined to the relatively small region nearshore off the Columbia River, Willapa Bay, and Grays Harbor (Figure 5). The region of coolest water was more extensive in February 2012 and reached beyond the shelf domain (<200 m depth) and farther south off northern OR (Figure 5). The onset of regional upwelling during spring and summer caused increased heterogeneity in the SST of the PaCSEA region. In June 2011, relatively warmer waters (16-18°C) emanating from the Columbia River appeared to be transported toward the southwest and extended at least to the slope domain (>200 m depth) off central Oregon (Figure 5). Closer to shore, coolest waters (11-12°C) during June 2011 occurred off south-central Oregon north of Cape Blanco (Figure 5). A relatively more extensive recurrent region of cool water occurred off northern California, just south from Cape Mendocino and extending across the shelf and slope domains in June 2011 and July 2012 (Figure 5). Surveys during October 2011 and September 2012 revealed SST distributions associated with regional fall relaxation events yet also some signature of sustained coastal upwelling, especially during September 2012 off central-southern Oregon (Figure 5). October 2011 surveys revealed incursions of warmer waters north of Cape Blanco, OR, and south of Cape Mendocino, CA, with small pockets of cooler waters near Cape Mendocino (Figure 5). In September 2012, the signal from warmer offshore waters was evident over the slope domain north of Cape Blanco, Oregon outside a thin band of cooler waters adjacent to the coast (Figure 5).

Consistent with increased mixing during the winter, surveys during January 2011 and February 2012 revealed the least amount of variability and the least concentrations overall in regional surface chlorophyll-*a* (chl-*a*) throughout the NCCS (Figure 6). Summer conditions reflect greatest concentrations of chl-*a* over the inner-shelf with some discrete hotspot regions. During June 2011, greatest concentrations (>12.6 mg chl-*a* m^{-3}) were associated with the Cape Blanco/Heceta Bank region and the Cape Mendocino region of northern California (Figure 6). Chlorophyll-*a* during July 2012 displayed a similar pattern, but areas of relatively greater concentration extended farther north through central Oregon and were lacking south of Cape Mendocino (Figure 6). Fall surveys during October 2011, revealed greatest surface chl-*a* concentrations near the shelf break off Grays Harbor, WA, in the vicinity of the Columbia River Plume, near the California/Oregon border, and south of Cape Mendocino, CA (Figure 6). During September 2012, greatest chl-*a* concentrations were observed off south-central Oregon near Heceta Bank and over the inner-shelf from Cape Blanco, OR south to Cape Mendocino, CA (Figure 6).

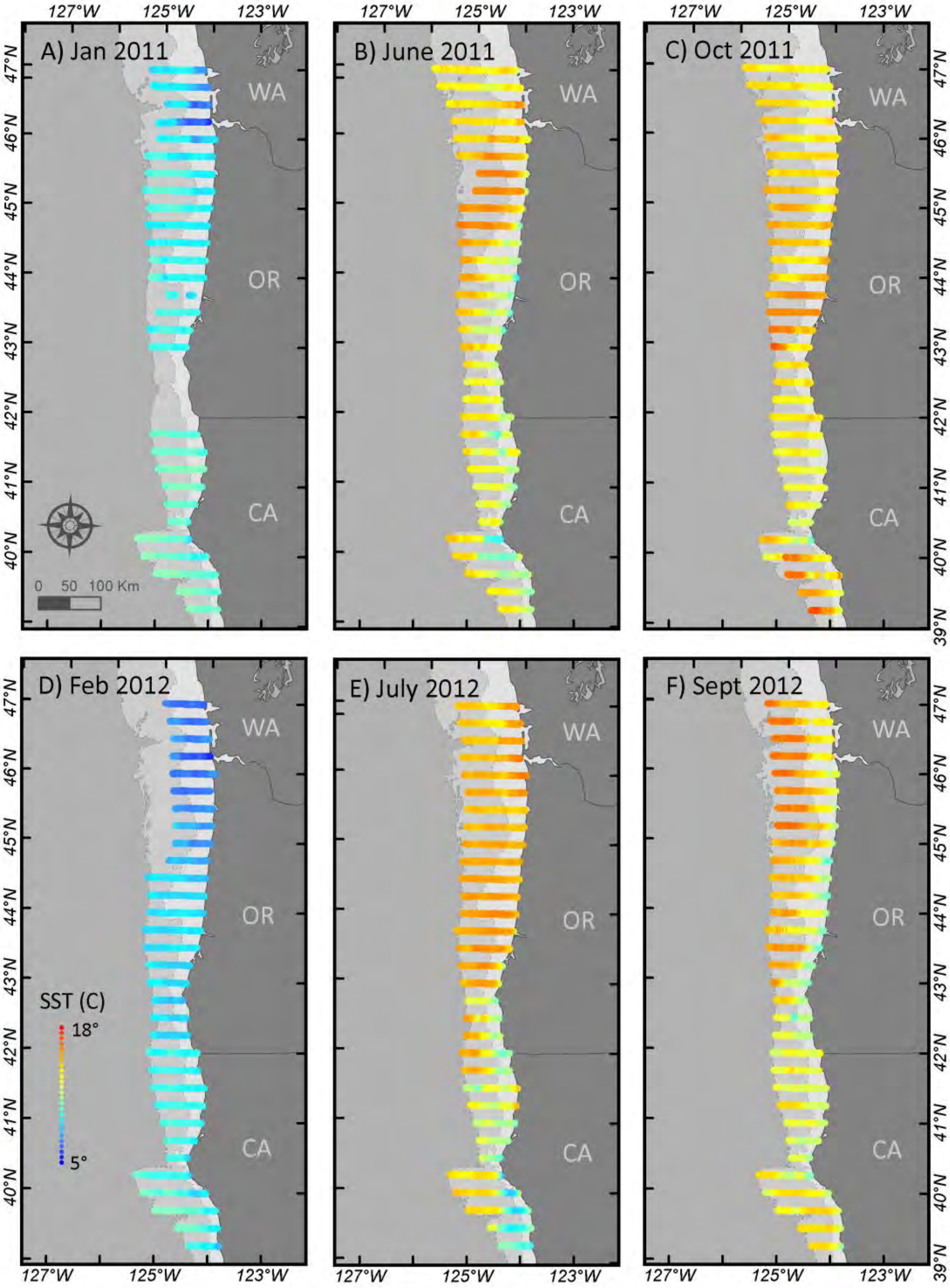

Figure 5. Sea surface temperature (SST, °C) from aircraft-mounted infrared pyrometer collected along replicated, broad transect surveys during winter (A, D), summer (B, E), and fall (C, F). Gaps in (A) off southern Oregon represent missing temperature data only and do not reflect patterns in continuous survey trackline effort.

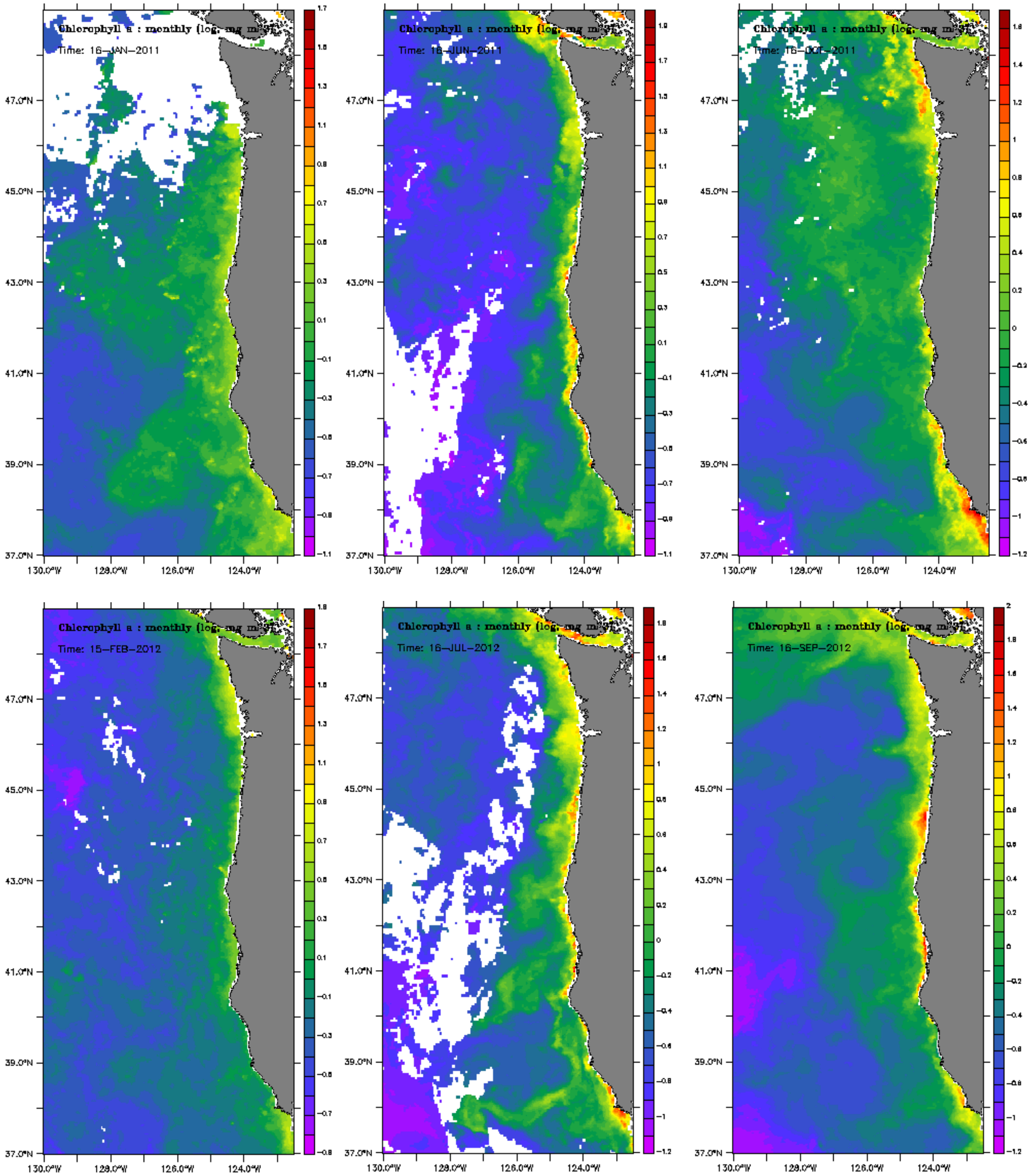

Figure 6. Monthly composite Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery (NASA Aqua MODIS Chlorophyll-*a,* log mg Chl-*a* m^{-3}) for the northern California Current Region during each of the six PaCSEA survey windows. NOAA CoastWatch distributes chlorophyll-a concentration data from NASA's Aqua Spacecraft. Available via http://coastwatch.pfel.noaa.gov (accessed 25 June 2013).

3.3 Marine Birds

Overall, we recorded 15,403 sightings of 59,466 individual marine birds (12 families, 54 species) while on effort (broad-scale surveys and Focal Area surveys). Land birds (e.g., Peregrine Falcon [*Falco peregrinus*], N=1) and non-*Phalaropus* shorebirds (e.g., Sanderling [*Calidris alba*], N=4 and Whimbrel [*Numenius phaeopus*], N=1) were rarely seen during offshore surveys and are not included within summary totals for marine birds. Less than 9% of all individuals were not identified to species, with the majority of these identified to the following nearest species parings: Common/Arctic Tern (*Sterna hirundo/S. paradisaea*), Herring/Thayer's Gull (*Larus argentatus/L. thayeri*), Pacific/Red-throated Loon (*Gavia pacifica/G. stellata*), Parasitic/Long-tailed Jaeger (*Stercorarius parasiticus/S. longicaudus*), cormorants (*Phalacrocorax* spp.), Red/Red-necked Phalarope (*Phalaropus fulicaria/P. lobatus*), Surf/White-winged Scoter (*Melanitta perspicillata/M. fusca*), and Western/Clark's Grebe (*Aechmophorous occidentalis/A. clarkia*).

During winter, seven species groupings comprised >90% of the total number of birds counted (19,033) with Common Murres representing the majority of individuals counted (70.4% of total). The remaining 6 most abundant taxa included: Surf/White-winged Scoters (4.8% of total), Herring/Thayer's Gulls (3.8% of total), Cassin's Auklets (*Ptychoramphus aleuticus*; 3.8% of total), Glaucous-winged Gulls (*Larus glaucescens*; 3.7% of total), Black-legged Kittiwakes (*Rissa tridactyla*; 2.0% of total), and Western Gulls (*Larus occidentalis*; 1.9% of total). During summer, five species comprised >95% of the total number of birds counted (17,063) with the majority being Common Murres (54.1% of total) and Sooty Shearwaters (34.4% of total). The remaining most abundant taxa included: Fork-tailed Storm-Petrels (*Oceanodroma furcata*; 3.3% of total), Western Gulls (2.1% of total), and Leach's Storm-Petrels (*Oceanodroma leucorhoa*; 1.1% of total). During fall, 9 species comprised >85% of the total number of birds counted (23,376) with the majority being Common Murres (50.0% of total) and Sooty Shearwaters (10.5% of total). The remaining 7 taxa included Cassin's Auklets (5.2% of total), Surf/White-winged Scoters (5.1% of total), Fork-tailed Storm-Petrels (3.8% of total), Red/Red-necked Phalaropes (3.2% of total), California Gulls (*Larus californicus*; 3.1% of total), Northern Fulmars (*Fulmarus glacialis*; 2.7% of total), and Sabine's Gulls (*Xema sabini*; 2.2% of total).

Throughout the PaCSEA survey area, average densities (± SE) at sea for all marine birds combined were similar between fall (23.7 ± 1.9 birds km^{-2}) and winter (24.0 ± 1.9 birds km^{-2}) and least during summer (16.3 ± 2.2 birds km^{-2}). Among taxa, maximum estimated densities at sea ranged from 0 (e.g., Pink-footed Shearwaters in winter) to 3733.3 birds km^{-2} (Sooty Shearwaters in summer). Four taxa achieved densities >1000 birds km^{-2}: Sooty Shearwaters (summer and fall), Common Murres (winter, summer, fall), Surf/White-winged Scoters (fall), and Fork-tailed Storm-Petrels (fall). Twelve taxa achieved maximum observed densities 100 – 1000 birds km^{-2}: Sabine's Gulls (fall), Red/Red-necked Phalaropes (fall), Herring/Thayer's Gulls (fall and winter), California Gulls (fall), Pigeon Guillemots (*Cepphus columba*; winter), Northern Fulmars (fall and winter), Pacific/Red-throated Loons (winter), Black-legged Kittiwakes (winter), Western/Clark's Grebes (winter), Cassin's Auklets (fall), Glaucous-winged Gulls (winter), and Western Gulls (summer).

Marine bird densities at sea varied according to bathymetric domain and season (see Marine Bird Species Accounts, Section 4.0). Throughout the PaCSEA study area, average densities (± SE) for all marine birds combined were greatest over the inner-shelf domain (< 100-m depth) during fall (49.4 ± 5.0 birds km^{-2}) and similar during winter (37.4 ± 4.6 birds km^{-2}) and summer (37.5 ± 6.4 birds km^{-2}). Within the outer-shelf domain (100 – 200-m depth), average densities for all marine birds combined were greatest during winter (34.6 ± 4.2 birds km^{-2}), lesser during fall (16.2 ± 1.7 birds km^{-2}), and least during summer (6.9 ± 1.1 birds km^{-2}). Within the farthest offshore waters over the continental slope domain (200 – 2000-m depth), average densities for all marine birds combined were greatest during fall (10.0 ± 2.2 birds km^{-2}) and winter (9.3 ± 1.5 birds km^{-2}), and lesser during summer (6.2 ± 1.4 birds km^{-2}).

Table 4. Summary of all marine bird species sighted during PaCSEA surveys. Total counts of individuals and average densities (birds km^{-2} (SE)) are reported for all surveys combined and each season combined. Densities were calculated using 3-km transect-segments and average values include segments with zero densities.

	ALL SURVEYS		Winter		Summer		Fall	
***Group*/Species**	**Count**	**Density**	**Count**	**Density**	**Count**	**Density**	**Count**	**Density**
Sea Ducks								
Brant	33	0.02 (0.01)	33	0.05 (0.03)	-	-	-	-
Black Scoter	35	0.01 (0.01)	35	0.03 (0.03)	-	-	-	-
Surf/White-winged Scoter	2190	0.74 (0.25)	918	0.96 (0.22)	84	0.07 (0.06)	1188	1.21 (0.71)
Common Merganser	1	<0.01 (<0.01)	-	-	-	-	1	<0.01 (<0.01)
Red-breasted Merganser	2	<0.01 (<0.01)	2	<0.01 (<0.01)	-	-	-	-
Loons								
Pacific/Red-throated Loon	248	0.11 (0.04)	171	0.25 (0.11)	16	0.01 (0.01)	61	0.07 (0.02)
Common Loon	79	0.03 (<0.01)	29	0.04 (0.01)	10	0.01 (<0.01)	40	0.05 (0.01)
Grebes								
Western/Clark's Grebe	609	0.27 (0.05)	237	0.30 (0.09)	5	<0.01 (<0.01)	367	0.52 (0.14)
Albatrosses								
Black-footed Albatross	149	0.05 (0.01)	4	<0.01 (<0.01)	106	0.10 (0.02)	39	0.04 (0.01)
Laysan Albatross	2	<0.01 (<0.01)	-	-	-	-	2	<0.01 (<0.01)
Shearwaters & Fulmars								
Northern Fulmar	857	0.32 (0.05)	189	0.23 (0.05)	26	0.02 (0.01)	642	0.70 (0.13)
Pink-footed Shearwater	423	0.14 (0.02)	-	-	33	0.03 (0.01)	390	0.39 (0.07)
Flesh-footed Shearwater	3	<0.01 (<0.01)	-	-	-	-	3	<0.01 (<0.01)
Buller's Shearwater	79	0.03 (0.01)	-	-	1	<0.01 (<0.01)	78	0.09 (0.02)
Sooty Shearwater	11679	4.02 (0.72)	1	<0.01 (<0.01)	9225	9.12 (1.97)	2453	2.43 (0.59)
Short-tailed Shearwater	9	<0.01 (<0.01)	4	<0.01 (<0.01)	-	-	5	0.01 (<0.01)
Manx Shearwater	1	<0.01 (<0.01)	-	-	-	-	1	<0.01 (<0.01)
Storm-Petrels								
Fork-tailed Storm-Petrel	1466	0.47 (0.17)	3	<0.01 (<0.01)	569	0.53 (0.20)	894	0.82 (0.44)
Leach's Storm-Petrel	208	0.07 (0.01)	3	<0.01 (<0.01)	181	0.17 (0.04)	24	0.02 (0.01)
Cormorants								
Cormorant spp.	265	0.09 (0.02)	126	0.16 (0.05)	94	0.09 (0.03)	45	0.04 (0.01)
Pelicans								
Brown Pelican	170	0.06 (0.01)	1	<0.01 (<0.01)	44	0.04 (0.02)	125	0.12 (0.04)
Phalaropes								
Red/Red-necked Phalarope	752	0.27 (0.08)	1	<0.01 (<0.01)	-	-	751	0.78 (0.23)

	ALL SURVEYS		Winter		Summer		Fall	
***Group*/Species**	**Count**	**Density**	**Count**	**Density**	**Count**	**Density**	**Count**	**Density**
Jaegers & Skuas								
South Polar Skua	21	0.01 (<0.01)	-	-	6	0.01 (<0.01)	15	0.01 (<0.01)
Pomarine Jaeger	44	0.02 (<0.01)	2	<0.01 (<0.01)	2	<0.01 (<0.01)	40	0.04 (0.01)
Parasitic/Long-tailed Jaeger	16	0.01 (<0.01)	-	-	-	-	16	0.01 (<0.01)
Alcids								
Common Murre	30983	11.13 (0.76)	13418	17.14 (1.76)	5874	5.34 (0.87)	11691	11.66 (1.28)
Pigeon Guillemot	174	0.05 (0.04)	160	0.16 (0.12)	4	<0.01 (<0.01)	10	0.01 (0.01)
Marbled Murrelet	95	0.04 (0.01)	19	0.02 (0.01)	2	<0.01 (<0.01)	74	0.09 (0.04)
Scripps's/Guadalupe Murrelet	9	<0.01 (<0.01)	-	-	-	-	9	0.01 (<0.01)
Ancient Murrelet	223	0.08 (0.01)	213	0.24 (0.05)	-	-	10	0.02 (0.01)
Cassin's Auklet	2053	0.71 (0.06)	722	0.91 (0.09)	102	0.10 (0.02)	1229	1.14 (0.17)
Rhinoceros Auklet	420	0.15 (0.02)	161	0.21 (0.04)	21	0.02 (0.01)	238	0.24 (0.04)
Gulls								
Black-legged Kittiwake	387	0.16 (0.04)	374	0.51 (0.14)	-	-	13	0.02 (0.01)
Sabine's Gull	530	0.25 (0.11)	-	-	12	0.01 (<0.01)	518	0.71 (0.31)
Bonaparte's Gull	2	<0.01 (<0.01)	-	-	-	-	2	<0.01 (<0.01)
Heermann's Gull	44	0.02 (<0.01)	14	0.01 (<0.01)	15	0.02 (0.01)	15	0.02 (0.01)
Mew Gull	17	0.01 (<0.01)	11	0.01 (<0.01)	-	-	6	0.01 (<0.01)
Western Gull	1184	0.44 (0.04)	364	0.46 (0.06)	362	0.40 (0.07)	458	0.45 (0.05)
California Gull	1165	0.41 (0.05)	316	0.35 (0.04)	118	0.11 (0.02)	731	0.78 (0.15)
Herring/Thayer's Gull	1115	0.41 (0.07)	730	0.95 (0.16)	-	-	385	0.36 (0.16)
Glaucous-winged Gull	1144	0.45 (0.05)	695	0.92 (0.13)	77	0.08 (0.01)	372	0.41 (0.06)
Terns								
Least Tern	1	<0.01 (<0.01)	-	-	1	<0.01 (<0.01)	-	-
Caspian Tern	66	0.02 (0.01)	-	-	66	0.06 (0.02)	-	-
Common/Arctic Tern	5	<0.01 (<0.01)	-	-	2	<0.01 (<0.01)	3	<0.01 (<0.01)

4.0 MARINE BIRD SPECIES ACCOUNTS

Surf/White-winged Scoter (*Melanitta perspicillata/M. fusca*)

When sitting on the water, these two sea-ducks can be hard to distinguish from the air; after introductions of each species, both Surf and White-winged Scoters will be treated together. Surf Scoters breed in scattered, isolated freshwater ecosystems across boreal and sub-arctic Canada and Alaska; non-breeders summer along the Pacific coast. During fall-spring, breeders that winter in the Pacific are found in coastal waters from southeast Alaska through northern Baja California, Mexico, and within the northern reaches of the Gulf of California, Mexico. The fall migration tends to be separated by sex and life-stage; off Oregon, birds arrive in early September and numbers peak in October and November (Briggs et al. 1992). During spring migration, birds start leaving wintering grounds during March (Savard et al. 1998) traveling in loose flocks at altitudes from sea-level to near 100 m (J. Adams, pers. obs.). Coastal migration past a single line of latitude can reach from 100s to 1000s of birds per hour during April (Savard et al. 1998). Migratory flights overland are known to take place at night, but there is little information about migratory movements over the ocean (Savard et al. 1998).

White-winged Scoters nest in freshwater ecosystems within the northwestern interior of North America (Brown et al. 1997). Outside of summer, White-winged Scoters often are associated with the more numerous Surf Scoters off Washington, Oregon, and California, with numbers of White-winged Scoters decreasing from north to south (Briggs et al. 1987). Details surrounding White-winged Scoter migration are not well known, but timing and flight behaviors likely are similar to Surf Scoters. Both species occur in greatest numbers within a few km of shore and generally are more abundant over sandy substrates in the lee of coastal promontories (Briggs et al. 1987); Briggs et al. (1992) noted that scoter distribution at sea extended to the mid-shelf off Washington.

Table 5. Mean density (birds km^{-2} [SE]) of Surf/White-winged Scoters (*Melanitta perspicillata/M. fusca*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	2.08 (0.49)	-	<0.01 (<0.01)	0.67 (0.16)
	June	0.35 (0.34)	-	-	0.11 (0.11)
	October	7.35 (4.45)	-	-	2.26 (1.37)
2012	February	4.21 (1.41)	0.02 (0.02)	-	1.30 (0.44)
	July	0.10 (0.08)	-	-	0.03 (0.03)
	September	0.28 (0.20)	-	-	0.09 (0.06)
All Surveys		**2.32 (0.80)**	**<0.01 (<0.01)**	**<0.01 (<0.01)**	**0.74 (0.25)**

Surf/White-winged Scoter densities were greatest in fall (1188 individuals; 1.21 ± 0.71 birds km^{-2}) and winter (918 individuals; 0.96 ± 0.22 birds km^{-2}) with much lower densities occurring in summer (0.07 ± 0.06 birds km^{-2}; Table 4). In all seasons, Surf/White-winged Scoters were found nearshore, predominantly over the inner-shelf (Table 5). In winter, Surf/White-winged Scoters mostly occurred off of northern California and southern Washington at low to high densities in both January 2011 and February 2012 (Figure 54). Similarly, Surf/White-winged Scoters were common at moderate to high densities in winter in the Eureka and Grays Harbor Focal Areas and were sporadically encountered at low densities in the remaining Focal Areas (Figure 56). In fall, most Surf/White-winged Scoters were observed during October 2011 off central and northern Oregon and southern Washington (Figure 55). Isolated concentrations of moderate to high densities were also observed in the Eureka and Nehalem Focal Areas in both fall surveys; sporadic sightings of low to moderate densities were observed in the remaining Focal Areas only in October 2011 (Figure 57).

Pacific/Red-throated Loon (*Gavia pacifica/G. stellata*)

Pacific Loons nest throughout the northwestern arctic and sub-arctic tundra and taiga regions of Canada and Alaska. The species undergoes a somewhat asynchronous migration along the Pacific coast during spring and fall, with a primary wintering destination among breeders occurring off the west coast of Baja California, Mexico (Russell 2002). The first southward fall migrants reach the Washington and Oregon coasts in August, with peaks generally in late October to early November (Russell 2002). Migration rates off northern California during fall have been estimated at 600-800 individuals h^{-1} (Palmer 1962). This species has been observed during the winter off California in large flocks which can influence regional density estimates at sea. Off California and Oregon, spring migration starts during late March, peaks in mid-April, and tapers off through June, with peak passage rates of 2500 – 3000 birds h^{-1} off Oregon and Washington (Crowell and Nehls 1976). During migration, the majority of birds occur within a few km of the coastline, generally flying diurnally at altitudes <100 m and usually <10 m (Russell 2002).

Red-throated Loons share much of the breeding range of Pacific Loons, however their nesting habitat is more restricted to coastal areas (Barr et al. 2000). Whereas breeders in northern Alaska winter in southeast Asia, Red-throated Loons nesting elsewhere in Alaska winter off the west coast of North America, as far south as Baja California, Mexico (Schmutz et al. 2009). Red-throated Loons wintering off western North America follow a similar migration timing and pattern as Pacific Loons, although they prefer waters very near the coast (Briggs et al 1987, Briggs et al. 1992).

Table 6. Mean density (birds km^{-2} [SE]) of Pacific/Red-throated Loons (*Gavia pacifica/G. stellata*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at 3-km scale.

		Depth Stratum			
Year	**Month**	**0 - 100m**	**100 - 200m**	**200 - 2000m**	**All Depths**
2011	January	1.22 (0.64)	0.08 (0.04)	-	0.41 (0.21)
	June	-	-	-	-
	October	0.36 (0.09)	-	-	0.11 (0.03)
2012	February	0.20 (0.07)	-	-	0.06 (0.02)
	July	0.09 (0.04)	-	-	0.03 (0.01)
	September	0.09 (0.04)	-	-	0.03 (0.01)
All Surveys		**0.33 (0.11)**	**0.01 (<0.01)**	**-**	**0.11 (0.04)**

While both of these loon species occur off the California, Oregon, and Washington coasts, Pacific Loons dominate numerically in this region (Briggs et al. 1987; Briggs et al. 1992). Distinguishing between these two species in their winter plumage during aerial surveys can be difficult and, hereafter, both species are treated together.

Pacific/Red-throated Loons were most abundant during winter (171 individuals; 0.25 ± 0.11 birds km^{-2}) and were relatively rare in summer (16 individuals; 0.01 ± 0.01 birds km^{-2}) and fall (61 individuals; 0.07 ± 0.02 birds km^{-2}; Table 4). In winter, sightings were concentrated over the inner-shelf, especially in January 2011 (1.22 ± 0.64 birds km^{-2}; Table 6); sightings were concentrated off southern Washington and were more sporadic throughout the rest of the study area (Figure 18). A similar pattern existed in October 2011 when Pacific/Red-throated Loons were observed at moderate densities over the shelf off southern Washington but were mostly absent across the rest of the study area; very few Pacific/Red-throated Loons were seen in September 2012 (Figure 19). Among the Focal Areas, Grays Harbor had the greatest densities of this species group in both fall and winter (Figure 20 and Figure 21).

Common Loon (*Gavia immer*)

One of five loon species worldwide, the Common Loon is abundant with widespread breeding throughout boreal and sub-arctic Canada (94% of the total breeding population of ca. 260,000 pairs; Evers et al. 2010). Approximately 30% of the total world population (those nesting in western Canada through British Columbia, and Southeast Alaska) disperses westward and southward during the fall post-breeding period when an estimated 220,000 individuals (including juveniles) over-winter off the Pacific Coast of North America (Evers et al. 2010). Spring and fall migration together with wintering ecology are relatively poorly known. Ocean migrants employ a stepping-stone migration with movements interspersed with staging areas characterized by nearshore areas with relatively clear water and abundant prey (Evers et al. 2010). Peak migrations off California occur in late April to early May and during late November, and early May and November off Oregon (Briggs et al. 1992). During the non-breeding season, Common Loons in marine ecosystems are most frequently located within a few km of shore as they pursue benthic prey occurring in relatively shallow waters. Individuals are rarely observed outside inner-shelf waters (less than 100-m depth; Briggs et al. 1992, Evers et al. 2010).

Table 7. Mean density (birds km^{-2} [SE]) of Common Loons (*Gavia immer*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at 3-km scale.

		Depth Stratum			
Year	**Month**	**0 - 100m**	**100 - 200m**	**200 - 2000m**	**All Depths**
2011	January	0.09 (0.03)	0.02 (0.02)	-	0.04 (0.01)
	June	0.01 (<0.01)	-	<0.01 (<0.01)	<0.01 (<0.01)
	October	0.15 (0.04)	-	-	0.05 (0.01)
2012	February	0.14 (0.05)	-	-	0.04 (0.01)
	July	0.03 (0.02)	-	-	0.01 (<0.01)
	September	0.13 (0.04)	-	<0.01 (<0.01)	0.04 (0.01)
All Surveys		**0.09 (0.01)**	**<0.01 (<0.01)**	**<0.01 (<0.01)**	**0.03 (<0.01)**

We observed few Common Loons, but most sightings occurred in fall (40 individuals; 0.05 ± 0.01 birds km^{-2}) and winter (29 individuals; 0.04 ± 0.01 birds km^{-2}; Table 4). In both seasons, almost all birds were found over inner-shelf waters at low densities (0.09 – 0.15 birds km^{-2}; Table 7). The species was most regularly found in the Grays Harbor Focal Area (Figure 16 and Figure 17).

Western/Clark's Grebe (*Aechmophorus occidentalis/A. clarkii*)

These two species are very similar in appearance and behavior and often co-occur in the marine waters of our study area; therefore, we consider their distribution together and refer collectively to these as Western Grebes (Clark's Grebes represent ~8 – 13% of the total population of these two species; LaPorte et al. 2013). Western Grebes breed inland throughout the western U.S. and central-southwestern Canada. Western Grebes achieve greatest numbers within coastal waters of the NCCS during October through May within a narrow coastal band, usually <0.5 km from the coast (Briggs et al. 1987, Mason et al. 2007). During winter and spring, Western Grebes are among the most numerous species observed immediately adjacent to the coast (e.g., local densities in Monterey Bay, CA: *ca*. 200-400 birds km^{-2}; Henkel 2004). Migratory movements occur primarily at night, but are poorly documented (LaPorte et al. 2013). Western Grebes migrate to post-breeding molt sites where many birds undergo wing molt before continuing on to wintering sites (LaPorte et al. 2013). During winter months, flocks are often found in sheltered waters (e.g. in the lee of coastal promontories) and are associated with shallow, sandy-bottom habitats (Briggs et al. 1987, LaPorte et al. 2013).

Western Grebes occurred during all seasons with greatest densities in fall (367 individuals; 0.52 ± 0.14 birds km^{-2}) and winter (237 individuals; 0.30 ±0.09 birds km^{-2}; Table 4). Western Grebes were encountered almost exclusively near shore in waters <100-m depth (Table 8). In winter, these birds were observed in 2011 and 2012 off of Cape Mendocino and Grays Harbor and just south of the Columbia River (Figure 22). In February 2012, a large concentration of Western Grebes occurred off the Columbia River in waters >200-m deep (Figure 22). During the fall of 2011 and 2012, Western Grebes were consistently observed off the Columbia River, Willapa Bay, and Grays Harbor, WA (Figure 23). In fall and winter, Western Grebes were common in the Grays Harbor Focal Area and infrequently occurred at moderate to high densities in the Fort Bragg and Eureka Focal Areas; the species was rarely seen in the Siltcoos Bank and Nehalem Focal Areas (Figure 24 and Figure 25).

Table 8. Mean density (birds km^{-2} [SE]) of Western/Clark's Grebes (*Aechmophorus occidentalis/A. clarkii)* for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 - 100m**	**100 - 200m**	**200 - 2000m**	**All Depths**
2011	January	0.72 (0.29)	-	-	0.23 (0.10)
	June	0.03 (0.01)	-	-	<0.01 (<0.01)
	October	2.67 (0.82)	0.02 (0.02)	-	0.83 (0.25)
2012	February	1.12 (0.52)	0.04 (0.04)	0.05 (0.05)	0.38 (0.16)
	July	-	-	-	-
	September	0.59 (0.23)	-	-	0.19 (0.07)
All Surveys		**0.84 (0.17)**	**<0.01 (<0.01)**	**<0.01 (<0.01)**	**0.27 (0.05)**

Black-footed Albatross (*Phoebastria nigripes*)

The Black-footed Albatross is one of three northern-hemisphere-breeding albatross species. Greater than 95% (ca. 55,000 breeding pairs in 2005) of the total world population nests in the northwestern Hawaiian Islands, with a smaller sub-population nesting in the Bonin and Izu island groups off Japan (Awkerman et al. 2008). The species is listed as "Endangered" under IUCN, "Endangered" by Japan, "Threatened" by Mexico (Awkerman et al. 2008), and as a "Species of Special Concern" by Canada (COSEWIC 2013). Black-footed Albatrosses are extremely far-ranging and can occur within the CCS year-round, but have maximal abundances from summer to early fall during their non-breeding dispersal period. Black-footed Albatrosses are avid scavengers and past documented aggregations within our study area have been associated with fishing vessels (Briggs et al. 1992).

A total of 149 Black-footed Albatrosses were counted during our surveys, primarily during summer (106 individuals; 0.10 ± 0.02 birds km^{-2}) and fall (39 individuals; 0.04 ± 0.01 birds km^{-2}; Table 4). The species was observed sporadically throughout the entire survey area over outer-shelf and slope waters (Table 9), but was almost always associated with the shelf-break (200-m isobath) in all seasons (Figure 26 and Figure 27). In the summer, aggregations of Black-footed Albatrosses consistently were found between Cape Mendocino and the California-Oregon border with isolated concentrations in June 2011 off Grays Harbor and in the Ft. Bragg Focal Area (Figure 26 and Figure 28). Patchy aggregations were observed in both fall surveys between Cape Blanco and north-central Oregon (Figure 27).

Table 9. Mean density (birds km-2 [SE]) of Black-footed Albatrosses (*Phoebastria nigripes*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 - 100m	100 - 200m	200 - 2000m	All Depths
2011	January	-	-	0.01 (0.01)	<0.01 (<0.01)
	June	<0.01 (<0.01)	0.29 (0.09)	0.11 (0.03)	0.12 (0.02)
	October	-	0.02 (0.02)	0.05 (0.02)	0.03 (<0.01)
2012	February	-	-	<0.01 (<0.01)	<0.01 (<0.01)
	July	0.06 (0.05)	0.09 (0.06)	0.09 (0.03)	0.08 (0.02)
	September	-	0.06 (0.03)	0.08 (0.02)	0.05 (0.01)
All Surveys		**0.01 (<0.01)**	**0.08 (0.02)**	**0.06 (<0.01)**	**0.05 (<0.01)**

Northern Fulmar (*Fulmarus glacialis*)

Northern Fulmars are abundant throughout the boreal and sub-arctic north Pacific and are especially widespread during winter. Approximately 99% of the northeastern Pacific Ocean and Bering Sea population (ca. 2 million individuals) nests at four colonies: Semidi Islands (Gulf of Alaska), Chagulak Island (Aleutians), Pribalof Islands (Bering Sea), and St. Matthew/ Hall Islands (Bering Sea; Mallory et al. 2012). Birds from the Semidi Islands population migrate seasonally to overwinter in the CCS (Mallory et al. 2012). First arrivals off central California occur in late September, with a peak in abundance during November (Briggs et al. 1987); breeders first arrive at northern boreal/arctic colonies in late April to May. The species exhibits dramatic plumage polymorphism ranging from solid dark grey to all white. At sea, Northern Fulmars are known to be aggressive scavengers and their distribution at local scales can be influenced by certain fishing activities, especially offal discharge from industrial trawling operations (Mallory et al. 2012).

In 2011 and 2012, Northern Fulmars were most common in fall (642 individuals; 0.70 ± 0.13 birds km^{-2}) followed by winter surveys (189 individuals; 0.23 ± 0.05 birds km^{-2}); the species was rarely encountered in summer months (26 individuals; 0.02 ± 0.01 birds km^{-2}; Table 4). In January 2011 and February 2012, Northern Fulmars mostly were found over slope waters (0.30 ± 0.05 and 0.65 ± 0.23 birds km^{-2} respectively; Table 10) and were consistently encountered at moderate to low densities near Heceta Bank, OR, and throughout northern California; the species was infrequently observed north of Newport, OR (Figure 31). This species was rarely observed in summer and, when encountered, birds were typically found at low densities near the shelf-break off northern California (Figure 32). In October 2011, Northern Fulmars were found over outer-shelf (1.82 ± 0.88 birds km^{-2}) and slope waters (1.64 ± 0.34 birds km^{-2}; Table 10) and were seen on every survey line with greatest concentrations off central Oregon and northern California (Figure 33). In October 2011, Northern Fulmars were present at moderate densities near the shelf-break in the Fort Bragg and Eureka Focal Areas and throughout the Siltcoos Bank Focal Area; fewer birds were located in the three northern Focal Areas (Figure 34). Northern Fulmars were uncommon in September 2012 and were observed at low to moderate densities over slope waters near Heceta Bank and between the California-Oregon border and Cape Mendocino (Figure 33).

Table 10. Mean density (birds km^{-2} [SE]) of Northern Fulmars (*Fulmarus glacialis*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	<0.01 (<0.01)	0.07 (0.03)	0.30 (0.05)	0.15 (0.02)
	June	<0.01 (<0.01)	<0.01 (<0.01)	0.04 (0.02)	0.02 (<0.01)
	October	0.33 (0.11)	1.82 (0.88)	1.64 (0.34)	1.28 (0.26)
2012	February	0.02 (0.01)	0.06 (0.02)	0.65 (0.23)	0.31 (0.10)
	July	0.02 (0.01)	0.03 (0.02)	0.03 (0.02)	0.03 (<0.01)
	September	0.02 (0.01)	0.05 (0.02)	0.16 (0.05)	0.09 (0.02)
All Surveys		**0.07 (0.02)**	**0.36 (0.16)**	**0.47 (0.07)**	**0.32 (0.05)**

Pink-footed Shearwater (*Puffinus creatopus*)

The Pink-footed Shearwater is a Chilean endemic breeder of which a portion of the adult breeding population (ca. 28,000 breeding pairs, Muñoz & Hodum, *unpubl. data*) undergoes a seasonal, trans-equatorial migration to occupy shelf and slope waters of the CCS from March through October, with maximal abundance during July through September (Briggs et al. 1987). Owing to habitat loss and predation by introduced mammals, combined with limited number of colonies off Chile, the species is recognized as “Vulnerable” by IUCN, “Threatened” by Canada, and “Endangered” by Chile. Pink-footed Shearwaters are similarly-sized compared with the much more abundant Sooty Shearwater, and during summer months the two species often co-occur off California, Oregon, and Washington (Briggs et al. 1987, 1992). Pink-footed Shearwaters also co-occur with California Gulls off Oregon and Washington (Briggs et al. 1992). Seasonal abundance off Oregon and Washington can be highly variable, presumably associated with inter-annual oceanographic conditions and forage fish abundances (Phillips et al. 2010).

Pink-footed Shearwater abundance was greatest in fall surveys (390 individuals; 0.39 ± 0.07 birds km^{-2}), whereas fewer birds were seen in summer (33 individuals; 0.03 ± 0.01 birds km^{-2}) and none were observed in winter (Table 4). In the summer surveys (June 2011 and July 2012), the species was infrequently encountered across the entire study area at low densities (0.02 ± <0.01 and 0.04 ± 0.01 birds km^{-2}, respectively), usually occurring over outer continental shelf and slope waters (Table 11; Figure 35). Pink-footed Shearwaters were relatively common in fall surveys, with average densities of 0.24 ± 0.08 birds km^{-2} in October 2011 and 0.54 ± 0.11 birds km^{-2} in September 2012 (Table 11). Birds were patchily distributed in October 2011, primarily over outer continental shelf and continental slope waters offshore of Oregon between Tillamook and Newport and from Heceta Bank south to the California-Oregon border; additional observations were recorded over the Juan de Fuca Canyon in Washington and south of Cape Mendocino in California (Figure 36). In September 2012, the species was observed at greater densities and on almost every transect north of Cape Mendocino, with the greatest densities observed between Cape Blanco and North Bend, OR (Figure 36). Additionally, average density over the inner-shelf was greater in September 2012 (0.29 ± 0.06 birds km^{-2}) than in October 2011 (0.03 ± 0.02 birds km^{-2}; Table 11), owing to a greater abundance of Pink-footed Shearwaters on Focal Area transects (particularly Newport, Nehalem, and Grays Harbor Focal Areas; Figure 37).

Table 11. Mean density (birds km^{-2} [SE]) of Pink-footed Shearwaters (*Puffinus creatopus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	-	-	-	-
	June	0.01 (<0.01)	0.02 (0.01)	0.03 (0.01)	0.02 (<0.01)
	October	0.03 (0.02)	0.46 (0.29)	0.27 (0.10)	0.24 (0.08)
2012	February	-	-	-	-
	July	<0.01 (<0.01)	0.10 (0.04)	0.03 (0.01)	0.04 (0.01)
	September	0.29 (0.06)	0.65 (0.25)	0.65 (0.19)	0.54 (0.11)
All Surveys		**0.06 (0.01)**	**0.21 (0.07)**	**0.17 (0.04)**	**0.14 (0.02)**

Buller's Shearwater (*Puffinus bulleri*)

The Buller's Shearwater is a transequatorial migrant that breeds in the southwestern Pacific Ocean, primarily on two of the Poor Knights Islands (Aorangi and Tawhiti Rahi) off northern New Zealand. The global population (*ca*. 2.5 million, but probably less; BirdLife International 2013) is highly vulnerable to the introduction of mammalian predators because of its restricted breeding range, as was witnessed at Aorangi Island when the removal of introduced domestic pigs in 1936 allowed a severely reduced breeding population to increase from *ca*. 200 to *ca*. 200,000 pairs by 1981 (BirdLife International 2013). In their non-breeding season, Buller's Shearwaters migrate to the north Pacific from Japan and then to North America and are present off California, Oregon, and Washington during the boreal summer and early fall. Peak numbers are typically found in July and November off Washington and Oregon (Briggs et al. 1992) and in August and September off northern California (Briggs et al. 1987).

We encountered 79 individual Buller's Shearwaters in our survey program; all but one sighting (in July 2012) occurred during fall surveys (0.09 ± 0.02 birds km^{-2}; Table 4). Almost all sightings were of one or two individuals. In October 2011, most Buller's Shearwaters were located sporadically over outer continental shelf and slope waters at low densities (0.05 – 0.06 birds km^{-2}; Table 12); almost all were sighted north of Cape Mendocino (Figure 29). In September 2012, this species was more widespread across the entire study area and at greater average densities, particularly over the slope (0.14 ± 0.07 birds km^{-2}) and inner-shelf (0.19 ± 0.11 birds km^{-2}; Table 12). However, while a similar pattern of sporadic sightings of one to two individuals persisted over the slope in September 2012, several small groups of up to twelve individuals (33% of all individuals sighted) were observed on one transect over the inner-shelf in central Oregon near Newport, contributing to the relatively greater average density in this depth stratum (Figure 30).

Table 12. Mean density (birds km-2 [SE]) of Buller's Shearwaters (*Puffinus bulleri*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	-	-	-	-
	June	-	-	-	-
	October	0.03 (0.02)	0.05 (0.02)	0.06 (0.02)	0.05 (0.01)
2012	February	-	-	-	-
	July	-	-	<0.01 (<0.01)	<0.01 (<0.01)
	September	0.19 (0.11)	0.02 (0.01)	0.14 (0.07)	0.13 (0.05)
All Surveys		**0.04 (0.02)**	**0.01 (<0.01)**	**0.03 (0.01)**	**0.03 (<0.01)**

Sooty Shearwater (*Puffinus griseus*)

The Sooty Shearwater is one of the world's most abundant seabirds (>20 million birds; Heather and Robertson 1997). In the Pacific, it nests in the southern hemisphere on islands off Chile and New Zealand. After chick-rearing, adults perform a trans-equatorial migration and a proportion of the population arrives to reside within the CCS during April through October. Off California, Sooty Shearwaters dominate the marine avian biomass in summer (Briggs & Chu 1986). Briggs et al. (1987) reported a latitudinal trend in the timing of maximum densities, with greatest densities off northern California during July through September, and slightly earlier south from Cape Mendocino, CA. Migrating shearwaters are unconstrained by the need to attend colonies, and therefore can rapidly redistribute to profitable foraging areas throughout the CCS (Adams et al. 2012). The species can achieve impressive densities at sea, and single foraging flocks can extend for several kilometers and number in the hundreds of thousands of individuals (Briggs et al. 1987). Individuals tend to aggregate in the lee of coastal promontories, downstream from active upwelling cells (Briggs and Chu 1986). Recent satellite tracking studies reveal inter-annual variability in offshore extent of habitat use and important aggregation areas associated with the Columbia River Plume and the Cape Blanco to Heceta Bank region of the shelf off Oregon (Adams et al. 2012).

Sooty Shearwaters were the most abundant bird in summer surveys (9225 individuals; 9.12 ± 1.97 birds km^{-2}) and second most abundant in fall (2453 individuals; 2.43 ± 0.59 birds km^{-2}); only one individual was observed in winter (Table 4). In June 2011, this species was most abundant over inner-shelf (36.01 ± 11.15 birds km^{-2}) and slope (7.71 ± 2.54 birds km^{-2}; Table 13) waters; most birds were observed over shelf waters off Washington and over slope waters off northern Oregon (Figure 38). Sooty Shearwaters in June 2011 were widespread at much lower densities south of central Oregon throughout the rest of the study area, although some denser aggregations were observed south of Cape Mendocino near the shelf break (Figure 38). Far fewer Sooty Shearwaters were observed in July 2012 (1061 individuals, compared with 8470 in June 2011) and average densities were less (Table 13). Sooty Shearwaters remained most abundant over the continental shelf off southern Washington and were locally abundant south of Cape Mendocino; sightings across the rest of the study area were patchily distributed (Figure 38). In summer, Sooty Shearwaters were consistently present at moderate to high densities in the Grays Harbor and Fort Bragg Focal Areas and were sporadically present in all others (Figure 40).

Average densities of Sooty Shearwaters across the entire study area were similar in October 2011 (2.19 ± 1.08 birds km^{-2}) and September 2012 (2.67 ± 0.41 birds km^{-2}; Table 13). In October 2011, most birds were seen over the continental shelf off southern Washington and over slope waters off northern Oregon (Figure 39). Additional aggregations were observed over outer-shelf and slope waters south of Heceta Bank to Cape Blanco; very few Sooty Shearwaters were observed off California, mostly near the California-Oregon border (Figure 39). This pattern was mirrored in Focal Areas, with moderate to high densities present in the Grays Harbor and Siltcoos Bank Focal Areas and few shearwaters seen elsewhere (Figure 41). In September 2012, the species was more widespread across the study area and more often found over inner-shelf waters compared with October 2011 (Table 13); greatest densities were off southern Washington, near Newport, OR, and off northern California between Eureka and the California-Oregon border (Figure 39). Sooty Shearwaters were widespread at low to high densities in all Focal Areas except Ft. Bragg and Eureka during October 2011 (Figure 41).

Table 13. Mean density (birds km-2 [SE]) of Sooty Shearwaters (*Puffinus griseus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	-	-	<0.01 (<0.01)	<0.01 (<0.01)
	June	36.01 (11.15)	2.89 (1.15)	7.71 (2.54)	15.62 (3.75)
	October	1.68 (0.76)	0.82 (0.24)	3.20 (2.26)	2.19 (1.08)
2012	February	-	-	-	-
	July	5.29 (2.25)	1.98 (1.06)	0.19 (0.03)	2.22 (0.76)
	September	7.30 (1.25)	0.83 (0.28)	0.34 (0.08)	2.67 (0.41)
All Surveys		**8.91 (2.07)**	**1.12 (0.27)**	**2.08 (0.62)**	**4.02 (0.72)**

Fork-tailed Storm-Petrel (*Oceanodroma furcata*)

This small, pelagic denizen of the north Pacific is one of the most abundant breeding seabirds throughout the Gulf of Alaska and Aleutian Islands (*ca*. 5 – 10 million individuals; Boersma and Silva 2001). Scattered, smaller Fork-tailed Storm-Petrel colonies (100s to 2000 individuals) exist on isolated offshore islets in Washington, Oregon, and northern California. Generally they are thought to range 75 to 150 km from colonies during the breeding season and are associated with the waters of the continental slope (Boersma and Silva 2001). Dispersal during winter is widespread within the north Pacific above 40° N. They are generally thought to occupy waters father offshore from the shelf-slope during winter, but stormy weather can result in nearshore occurrences (Boersma and Silva 2001). Briggs et al. (1992) noted that Fork-tailed Storm-Petrels were among several species with strong negative correlations with Sooty Shearwaters off Oregon and Washington. In the Gulf of Alaska, the species is attracted to fishing vessels which can modify local-scale abundance and aggregation (Gould et al. 1982).

Fork-tailed storm-petrels were common in fall (894 individuals; 0.82 ± 0.44 birds km^{-2}) and summer (569 individuals; 0.53 ± 0.20 birds km^{-2}; Table 4) surveys and mostly absent in winter. The species was widespread over slope and, to a lesser extent, outer-shelf waters during summer months (Table 14; Figure 42). Greatest densities occurred over Heceta Bank, near the shelf break in southern Washington, and between Cape Mendocino and the California-Oregon border in June 2011. During July 2012, the species was relatively less common with local concentrations off the California-Oregon border (Figure 42).

Fork-tailed Storm-Petrels were more abundant, but less widespread, in the fall surveys compared to the summer (Table 4; Figure 43). In both October 2011 and September 2012, moderate to high densities were located over outer-shelf and slope waters off southern Washington and over Heceta Bank, with isolated, large flocks off Cape Blanco; the species was rarely encountered off northern California (Figure 43). Birds were sometimes concentrated in large flocks of up to 450 individuals. Sightings of Fork-tailed Storm-Petrels were sporadic in Focal Areas during summer and fall, and occurred predominantly over the outer-shelf and near the shelf break (Figure 44). In September 2012, moderate densities were located over the inner-shelf in the Siltcoos Focal Area in association with large concentrations of foraging Common Murres, Cassin's Auklets, and humpback and blue whales.

Table 14. Mean density (birds km^{-2} [SE]) of Fork-tailed Storm-Petrels (*Oceanodroma furcata*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	-	-	-	-
	June	0.04 (0.02)	0.30 (0.10)	1.55 (0.83)	0.80 (0.39)
	October	0.03 (0.02)	0.11 (0.04)	1.90 (1.64)	0.92 (0.76)
2012	February	-	0.02 (0.02)	<0.01 (<0.01)	<0.01 (<0.01)
	July	0.04 (0.03)	0.11 (0.04)	0.44 (0.10)	0.24 (0.05)
	September	0.27 (0.14)	0.22 (0.13)	1.27 (0.88)	0.71 (0.41)
All Surveys		**0.07 (0.02)**	**0.13 (0.03)**	**0.91 (0.36)**	**0.47 (0.17)**

Leach's Storm-Petrel (*Oceanodroma leucorhoa*)

The Leach's Storm-Petrel is an abundant pelagic seabird and recognized as the most widespread procellariiform breeding in the northern hemisphere. There are *ca.* 36,000 breeders on isolated islets off northern Washington (Speich and Wahl 1989) and an estimated 482,000 breeders off Oregon (37% of the total Oregon breeding seabird population), making it the second-most abundant locally breeding seabird species after Common Murres (Naughton et al. 2007). During the summer breeding season, breeding Leach's Storm-Petrels are thought to forage within 200 km of their colonies, but can range farther (Huntington et al. 1996). Winter dispersal is thought to be primarily to the central and eastern tropical Pacific, but birds are seen year-round within the CCS (Briggs et al. 1987, 1992).

Leach's Storm-Petrels were observed primarily in summer (181 individuals; 0.17 ± 0.04 birds km^{-2}) and, to a lesser extent, fall surveys (24 individuals; 0.02 ± 0.01 birds km^{-2}; Table 4). Most birds were observed over slope waters in summer and the species was more abundant in June 2011 (0.52 ± 0.14 birds km^{-2}) than in July 2012 (0.18 ± 0.05 birds km^{-2}; Table 15). In both summer surveys, Leach's Storm-Petrels were primarily found at greatest densities between Cape Blanco and Cape Mendocino, in the general vicinity of most breeding colonies for this species within the study area; across the rest of the region, sightings were patchily distributed at low densities (Figure 45). Leach's Storm-Petrels were encountered at low densities in the fall, primarily in October 2011 over slope waters off northern Oregon and southern Washington; very few birds were seen off the California-Oregon border in September 2012 (Figure 46). This species rarely occurred in Focal Areas.

Table 15. Mean density (birds km^{-2} [SE]) of Leach's Storm-Petrels (*Oceanodroma leucorhoa*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	-	-	-	-
	June	0.01 (0.01)	0.02 (0.02)	0.52 (0.14)	0.25 (0.07)
	October	-	0.07 (0.03)	0.04 (0.01)	0.03 (<0.01)
2012	February	-	<0.01 (<0.01)	<0.01 (<0.01)	<0.01 (<0.01)
	July	-	-	0.18 (0.05)	0.08 (0.02)
	September	0.02 (0.02)	-	0.02 (<0.01)	0.01 (<0.01)
All Surveys		**<0.01 (<0.01)**	**0.02 (<0.01)**	**0.14 (0.03)**	**0.07 (0.01)**

Cormorants (*Phalacrocorax penicillatus, P. auritus,* and *P. pelagicus*)

Herein, we treat the three resident cormorant species together because they can be difficult to differentiate during aerial surveys and generally they occupy similar habitats at sea, mostly over the inner-shelf and usually within 25 km of land (Briggs et al. 1987). Cormorants are obligated to roost daily because they lack waterproof feathers. In Washington during the late 1980s, breeding Pelagic Cormorants outnumbered breeding Double-crested Cormorants and Brandt's Cormorants combined (4866, 3296, and 554 individuals, respectively; Speich and Wahl 1989). Oregon supports an order of magnitude more breeders than Washington of each species with Double-crested Cormorants in greater abundance than Brandt's Cormorants and Pelagic Cormorants (30,400, 21,200, and 10,100 individuals, respectively). Off northern California in 1989, there were an estimated 15,500 breeding Brandt's Cormorants, 3252 Double-crested Cormorants, and 8400 Pelagic Cormorants (Carter et al. 1992). More recently, there have been dramatic increases in the population of Double-crested Cormorants breeding at the mouth of the Columbia River (Anderson et al. 2004). Distribution at sea (in all seasons) generally follows the distribution of colonies along the coast, many of which are used during the non-breeding season as roosting sites (Briggs et al. 1992).

Cormorants were observed in all seasons, primarily in winter (126 individuals; 0.16 ± 0.05 birds km^{-2}) and summer (94 individuals; 0.09 ± 0.03 birds km^{-2}; Table 4); birds were almost always found over inner-shelf waters (Table 16). Sightings were sporadic with greatest densities occurring south of Crescent City, CA, and off of the Columbia River in July 2012 and off Cape Mendocino and south of North Bend, OR, in January 2011 (Figure 48, Figure 49, Figure 50). They occurred in almost every Focal Area during summer, fall, and winter; greatest densities occurred off Ft. Bragg and Eureka in winter, Fort Bragg and Newport in summer, and Fort Bragg, Nehalem, and Grays Harbor in fall (Figure 51, Figure 52, Figure 53).

Table 16. Mean density (birds km^{-2} [SE]) of cormorants (*Phalacrocorax penicillatus, P. auritus,* and *P. pelagicus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	0.69 (0.29)	0.03 (0.02)	-	0.23 (0.10)
	June	0.19 (0.04)	0.02 (0.01)	-	0.06 (0.01)
	October	0.10 (0.03)	-	-	0.03 (0.01)
2012	February	0.24 (0.07)	-	-	0.07 (0.02)
	July	0.32 (0.16)	0.06 (0.06)	-	0.12 (0.05)
	September	0.16 (0.05)	-	-	0.05 (0.01)
All Surveys		**0.28 (0.06)**	**0.02 (0.01)**	**-**	**0.09 (0.02)**

Brown Pelican (*Pelecanus occidentalis*)

In the Pacific off North America, the Brown Pelican nests from southern California through Mexico and throughout the Gulf of California, Mexico. Wintertime non-breeding range among California and Mexican populations appears to fluctuate with latitude according to an inter-annual and inter-decadal periodicity associated with changes in forage fish distribution and abundance and regional sea-surface temperature. During cold-water periods, most non-breeding Brown Pelicans tend to remain south of Oregon, but during warm-water conditions and since 1985, thousands have dispersed annually to reach waters off the coasts of Oregon and Washington (Jaques 1994, Sheilds 2002). Numbers in the central and northern CCS tend to peak during September and October, and then decrease as adults return to breeding colonies by December. Offshore extent during migration is within 10 km of the coast (Briggs et al. 1983).

Brown Pelicans were most abundant in fall (125 individuals; 0.12 ± 0.04 birds km^{-2}) and summer (44 individuals; 0.04 ± 0.02 birds km^{-2}) with only one pelican observed during winter (Table 4). This species predominantly occurred in waters over the inner-shelf (Table 17). In summer, the few Brown Pelicans that were observed on standardized transects (i.e., not including coastal deadheads) occurred at low densities off southern Washington in the Grays Harbor Focal Area and at the mouth of the Columbia

River. In fall, Brown Pelicans were observed off the mouth of the Columbia River and in all Focal Areas at low to moderate densities in October 2011 over shelf waters (0.42 - 0.43 birds km^{-2}; Table 17); the species was mostly absent in September 2012 when most were found in the Grays Harbor Focal Area (Figure 47).

Table 17. Mean density (birds km^{-2} [SE]) of Brown Pelicans (*Pelecanus occidentalis*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	<0.01 (<0.01)	-	-	<0.01 (<0.01)
	June	0.03 (0.02)	0.02 (0.02)	-	0.01 (<0.01)
	October	0.43 (0.13)	0.42 (0.27)	<0.01 (<0.01)	0.23 (0.07)
2012	February	-	-	-	-
	July	0.19 (0.10)	-	-	0.06 (0.03)
	September	0.04 (0.02)	-	-	0.01 (<0.01)
All Surveys		**0.12 (0.03)**	**0.08 (0.05)**	**<0.01 (<0.01)**	**0.06 (0.01)**

Red/Red-necked Phalarope (*Phalaropus fulicarius/P. lobatus*)

These two marine “shorebird” members of the scolopacid family are difficult to separate accurately at sea during aerial surveys and, herein, we consider them together. Both species nest in the arctic and winter throughout the Peru and Humboldt Currents off South America (Rubega et al. 2000, Tracy et al. 2002). Red Phalaropes are considered the most marine of the three phalarope species. Based on boat surveys off California, Briggs et al. (1987) noted that Red Phalaropes occurred >50 km offshore, whereas Red-necked Phalaropes occurred consistently closer to shore, but the two species often co-occurred at sea. Red Phalarope numbers peaked approximately one month later than Red-necked Phalaropes during spring and fall migrations off California (Briggs et al. 1987). Peak fall densities off northern California, Oregon, and Washington were observed between July and October, and peaks in spring migration were much less protracted and occurred during April and May (Briggs et al. 1987, 1992).

Table 18. Mean density (birds km^{-2} [SE]) of Red/Red-necked Phalaropes (*Phalaropus fulicarius/P. lobatus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	-	-	<0.01 (<0.01)	<0.01 (<0.01)
	June	-	-	-	-
	October	0.24 (0.11)	1.05 (0.45)	1.94 (0.91)	1.21 (0.44)
2012	February	-	-	-	-
	July	-	-	-	-
	September	0.26 (0.25)	0.30 (0.13)	0.35 (0.18)	0.31 (0.12)
All Surveys		**0.09 (0.05)**	**0.24 (0.08)**	**0.41 (0.17)**	**0.27 (0.08)**

Phalaropes were present almost exclusively during fall surveys in 2011 and 2012 (751 individuals; 0.78 ± 0.23 birds km^{-2}; Table 4). Birds were observed in all depth strata but greatest average densities were observed over slope waters, especially in October 2011 (1.94 ± 0.91 birds km^{-2}); phalaropes were more evenly distributed with depth during September 2012 (0.26 - 0.35 birds km^{-2}; Table 18). During October 2011, phalaropes were encountered at low to high densities primarily between Heceta Bank and Cape Blanco off south-central Oregon and south of Cape Mendocino off northern California; low densities were also observed off northernmost Oregon (Figure 108). Fewer phalaropes were observed during September 2012 (Table 18); similar areas off Oregon were utilized, whereas off California most birds were encountered just north of Cape Mendocino (Figure 108). Low to high densities were observed in the Fort Bragg, Eureka, and Siltcoos Bank Focal Areas, particularly during October 2011; sightings were rare in Focal Areas farther north (Figure 109).

Pomarine Jaeger (*Stercorarius pomarinus*)

The Pomarine Jaeger is the largest and most numerous of the three jaegers that frequent the NCCS during the spring and fall migration when birds move between arctic breeding sites and the subtropical-tropical Pacific. Off Washington, this species occurs from mid-July through October with peak abundance off California during late September and October (Briggs et al. 1987, 1992). Sightings are rare the rest of the year, and it is thought that the spring migration of this species occurs further offshore than in the late summer and fall (Briggs et al. 1987). At sea in the NCCS, Pomarine Jaegers tend to occur as scattered individuals and in small flocks associated mostly with the continental slope waters where they often co-occur with gulls, and occasionally with fishing vessels (Briggs et al. 1992). During migration, individuals may settle on the water during high winds or achieve heights of 30-50 m above sea level but frequently occur >10 m above sea level during mild weather (Wiley and Lee 2000).

Almost all Pomarine Jaegers were observed in fall surveys (40 individuals; 0.04 ± 0.01 birds km^{-2}; Table 4); birds were present at similar average densities over the slope and outer-shelf in both fall surveys (0.03 – 0.06 birds km^{-2}; Table 19). Sightings were rare during October 2011 with low to moderate densities found near Heceta Bank and offshore of the California-Oregon border (Figure 88). Birds were more widespread during September 2012 when low densities were observed between Cape Blanco and Cape Mendocino; the species was rarely encountered further north (Figure 88).

Table 19. Mean density (birds km^{-2} [SE]) of Pomarine Jaegers (*Stercorarius pomarinus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	-	-	-	-
	June	<0.01 (<0.01)	-	<0.01 (<0.01)	<0.01 (<0.01)
	October	0.02 (0.01)	0.03 (0.03)	0.05 (0.02)	0.03 (0.01)
2012	February	-	-	0.01 (0.01)	<0.01 (<0.01)
	July	-	-	-	-
	September	0.02 (<0.01)	0.05 (0.02)	0.06 (0.02)	0.04 (<0.01)
All Surveys		**<0.01 (<0.01)**	**0.01 (<0.01)**	**0.02 (<0.01)**	**0.02 (<0.01)**

Parasitic/Long-tailed Jaeger (*Stercorarius parasiticus/S. longicaudus*)

The smaller two of the three North American jaeger species, Parasitic and Long-tailed Jaegers are particularly hard to distinguish at sea, especially among juveniles and during the non-breeding season when migrants from northern breeding sites occur within the NCCS. Parasitic Jaegers nest throughout the arctic in North America and along the west coast of Alaska into the Gulf of Alaska; the species winters in the temperate southern Pacific (Wiley and Lee 1999). Parasitic Jaegers peak in abundance in the NCCS during fall and spring, where they are occasionally observed close to the coastline chasing gulls and terns while engaged in bouts of kleptoparasitism (Briggs et al. 1987, Briggs et al. 1992, Wiley and Lee 1999). Long-tailed Jaegers nest in the Arctic and also winter in the southern temperate Pacific. Their migratory movements generally occur far from shore over and beyond the continental shelf domain southward during July – October and northward during April – June (Wiley and Lee 1998). During migration, this species can fly up to 250 m above sea-level in calm conditions, but flies much nearer the surface during headwinds; it may bank and soar in high-wind conditions (Wiley and Lee 1998). Although an order of magnitude less common than Pomarine Jaegers (*S. pomarinus*), Briggs et al. (1987, 1992) did record a few Parasitic/Long-tailed jaegers over the continental shelf and slope off California – Washington during the fall.

Only 16 individual Parasitic/Long-tailed jaegers were observed during our survey program (Table 4); almost all sightings were during September 2012 over slope waters (0.04 ± 0.01 birds km^{-2}; Table 20). When present over the shelf, jaegers were typically found close to the shelf break (Figure 87). Sightings were rare and sporadic at low densities across the study area south of central Oregon (Figure 87).

Table 20. Mean density (birds km^{-2} [SE]) of Parasitic/Long-tailed Jaegers (*Stercorarius parasiticus/S. longicaudus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	-	-	-	-
	June	-	-	-	-
	October	0.01 (0.01)	-	-	<0.01 (<0.01)
2012	February	-	-	-	-
	July	-	-	-	-
	September	0.01 (<0.01)	0.02 (0.01)	0.04 (0.01)	0.03 (<0.01)
All Surveys		**<0.01 (<0.01)**	**<0.01 (<0.01)**	**<0.01 (<0.01)**	**<0.01 (<0.01)**

Common Murre (*Uria aalge*)

With the exception of the Sooty Shearwater during summer, the Common Murre dominates year-round in both number and biomass within the marine avian community from northern California through Washington. Carter et al. (2001) summarized recent knowledge of the population trends throughout the west coast of North America, excluding Alaska. Off northern California in 1989, 11 colonies supported 261,400 breeding birds (24% of the *U. a. californica* population). The largest single colony complex in California is located on Castle Rock, 20-km south of the California – Oregon border (142,400 birds in 1982); the majority of the sub-species' population resides off the coast of Oregon, where by 1988, approximately 711,900 breeding birds occurred at 66 colonies (66% of the total population). Colonies off Oregon are distributed according to available steep rocky cliffs and offshore rocky habitat which occurs predominantly in the north and south of the state (Naughton et al. 2007). Numbers of breeding Common Murres off Washington are less, on the order of 5900 – 9600 individuals in 1994 and 1995, respectively (Carter et al. 2001). At sea off Oregon, Briggs et al. (1992) reported greatest densities over mid-shelf waters. Local densities during the nesting season can exceed 100 birds km^{-2} as rafts of birds aggregate near breeding colonies (Figure 7); there appeared to be a trend for Common Murres to be more aggregated farther offshore during the winter when densities increased in association with the shelf-break (Briggs et al. 1992). Common Murres undergo a flightless molt period at sea in late summer/fall (Carter et al. 2001)

Common Murres were the most abundant birds in the study area in all surveys combined (30,983 total individuals) and in all seasons except summer when the species was second only to Sooty Shearwaters (Table 4). Common Murres were widespread and ubiquitous across the latitudinal extent of the study area in all surveys (Figure 96, Figure 97, Figure 98).

Figure 7. Common Murres (1000+ individuals; *Uria aalge*) rafted below cliff-side nesting colony at Cape Lookout, Oregon, in June 2011.

In winter months, Common Murres were found at moderate to high densities over inner-shelf (39.22 ± 7.30 and 8.29 ± 1.78 birds km^{-2}) and outer-shelf waters (33.71 ± 5.33 and 25.56 ± 6.19 birds km^{-2} during January 2011 and February 2012, respectively; Table 21). Average density was least over the slope

(Table 21); birds observed over the slope typically were not far seaward of the shelf-break (Figure 96). Fewer Common Murres were seen during February 2012 compared with January 2011 at all depths; however, this difference was greatest over the inner-shelf (Table 21). The species was present at moderate to high densities in all Focal Areas but was relatively less prevalent in the Siltcoos Bank and Newport Focal Areas (Figure 99).

In summer months, Common Murres were most abundant over the inner-shelf and the average density at all depths exhibited less inter-annual variation than in winter (Table 21). Average density in summer (5.34 ± 0.87 birds km^{-2}) was less than in winter (17.14 ± 1.76 birds km^{-2}; Table 4), likely due in part to the absence of many birds from the water as they attended breeding colonies in the study area (Figure 7). Moderate to high densities were found throughout the region with greatest concentrations located between Cape Blanco and Cape Mendocino, where most of the larger breeding colonies are located (Figure 97). During June 2011, low densities of Common Murres were observed over the slope off northern Oregon, whereas the species was mostly absent from slope waters during July 2012 (Figure 97). Common Murres were widespread at moderate to high densities in the Fort Bragg, Eureka, and Nehalem Focal Areas and more patchily distributed at low to high densities in the Siltcoos Bank, Newport, and Grays Harbor Focal Areas; abundance was lower in most Focal Areas during July 2012 compared with June 2011 (Figure 100).

Common Murres were most abundant over shelf waters in fall surveys and, similar to summer, predominantly over the inner-shelf (Table 21). Birds were widespread at moderate to high densities in both fall surveys over the shelf (Figure 98). In October 2011, isolated concentrations of birds were observed over slope waters at moderate densities near the Juan de Fuca Canyon, Heceta Bank, and Cape Blanco (Figure Fall Broad). Moderate to high densities of Common Murres were widespread over inner-shelf waters in all Focal Areas in both fall surveys (Figure 101).

Table 21. Mean density (birds km^{-2} [SE]) of Common Murres (*Uria aalge*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	39.22 (7.30)	33.71 (5.33)	5.87 (2.42)	22.86 (2.89)
	June	13.47 (4.13)	4.07 (0.77)	0.50 (0.10)	5.38 (1.33)
	October	23.99 (4.21)	9.39 (1.69)	0.94 (0.24)	9.95 (1.38)
2012	February	8.29 (1.78)	25.56 (6.19)	3.37 (1.00)	10.28 (1.68)
	July	15.36 (3.42)	1.59 (0.36)	0.05 (0.02)	5.31 (1.12)
	September	36.67 (6.51)	6.66 (1.99)	0.57 (0.47)	13.46 (2.18)
All Surveys		**23.26 (2.08)**	**13.13 (1.39)**	**1.79 (0.43)**	**11.13 (0.76)**

Marbled Murrelet (*Brachyramphus marmoratus*)

This small, federally Threatened alcid is found throughout coastal Washington, Oregon, and northern California in association with old-growth forests where it nests inland on the large limbs of coniferous trees. Marbled Murrelets have a restricted nearshore distribution; they are rarely encountered at sea

>5-km from shore and very often are found in shallow waters 0.1 – 2-km from shore. Given this distribution at sea, our survey design, which relied on relatively broadly spaced, regional cross-shelf surveys, was not appropriate for accurately depicting the true distribution of this species. The most recent 5-year Status Review reported an estimated 12,940 Marbled Murrelets off outer Washington through northern California (Cape Flattery through Cape Mendocino), with about half of these off Oregon north of Cape Blanco (USFWS 2009).

We observed 95 individual Marbled Murrelets during the PaCSEA survey program; almost all were sighted during October 2011 (74 individuals; Table 4), although individuals were observed as far as 60 km from shore (Figure 102). Most murrelets were located over inner- (0.26 ± 0.24 birds km^{-2}) and outer-shelf waters (0.42 ± 0.15 birds km^{-2}; Table 22) in the Fort Bragg Focal Area in that month (Figure 102, Figure 103). Few sightings occurred in winter surveys (19 total individuals) between Heceta Bank and Crescent City, California, and only two Marbled Murrelets were observed in summer (July 2012; Table 4 and Table 22).

Table 22. Mean density (birds km^{-2} [SE]) of Marbled Murrelets (*Brachyramphus marmoratus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	0.04 (0.04)	-	-	0.01 (0.01)
	June	-	-	-	-
	October	0.26 (0.24)	0.42 (0.15)	<0.01 (<0.01)	0.18 (0.08)
2012	February	0.06 (0.03)	0.03 (0.03)	-	0.02 (0.01)
	July	0.01 (0.01)	-	-	<0.01 (<0.01)
	September	-	-	-	-
All Surveys		**0.06 (0.04)**	**0.08 (0.03)**	**<0.01 (<0.01)**	**0.04 (0.01)**

Ancient Murrelet (*Synthliboramphus antiquus*)

The Ancient Murrelet is a small (ca. 200 g), diving alcid that nests in scattered colonies throughout the boreal Alaska Current from British Columbia, Canada westward throughout the Alaska Peninsula and Aleutian Archipelago, and extending southward through Russia, Japan, and into the Yellow Sea off China. Approximately a quarter to half of the world's population (*ca*. 500,000 birds) breeds in the Haida Gwaii Archipelago, British Columbia, Canada (Gaston and Shoji 2010). The species is listed as one of "Special Concern" by the Canadian Committee on the Status of Endangered Wildlife due to historically dramatic population reduction caused by introduced mammalian predators on breeding islands (COSEWIC 2013). Post-breeding dispersal and wintering ecology at sea in the California Current are poorly known, but southward movements from British Columbia and extending to the central California Current occur during August – October (Gaston and Shoji 2010). Previous survey efforts at sea described very infrequent sightings (a total of 11 individuals) of Ancient Murrelets off northern Washington and Oregon during winter and spring (Briggs et al. 1992) and occasional sightings beyond the shelf-break off northern California during February – April, south of Point Arena (Briggs et al. 1987).

A total 223 Ancient Murrelets were detected on surveys during winter and fall (Table 4). The species was most abundant during January 2011, when aggregations of up to 15 individuals were observed off southern Washington and northern Oregon, mostly affiliated with offshore waters over the continental slope (0.65 ± 0.16 birds km^{-2}; Table 23, Figure 89). Few birds were observed during February 2012, however weather did not permit extensive surveying of waters over the slope where most birds were found the previous winter. The species was not detected during the summer period and only 10 individuals were observed on one fall survey (October 2011; Table 4). Ancient Murrelets were rarely observed over inner-shelf waters (Figure 89).

Table 23. Mean density (birds km^{-2} [SE]) of Ancient Murrelets (*Synthliboramphus antiquus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	0.13 (0.11)	0.24 (0.11)	0.65 (0.16)	0.39 (0.09)
	June	-	-	-	-
	October	-	-	0.07 (0.04)	0.03 (0.02)
2012	February	0.03 (0.01)	0.08 (0.04)	0.08 (0.04)	0.06 (0.02)
	July	-	-	-	-
	September	-	-	-	-
All Surveys		**0.03 (0.02)**	**0.05 (0.02)**	**0.13 (0.03)**	**0.08 (0.01)**

Cassin's Auklet (*Ptychoramphus aleuticus*)

The Cassin's Auklet is a small (*ca*. 160 g), diving alcid that breeds in colonies from Mexico through Alaska. In terms of breeding abundance, the center of the breeding distribution occurs in the Scott Island group, British Columbia, Canada, where *ca*. 2 million individuals resided in the 1980s (Ainley et al. 2011). Off central to northern Washington, north of our study area, seven colonies accounted for *ca*. 88,000 birds during the 1980s (Speich and Wahl 1989). A small portion of the estimated total breeding population nests within our NCCS study area with small colonies located in Oregon (*ca*. 400 breeding birds; e.g. Haystack Rock [hundreds], and off Cape Blanco [hundreds]; Naughton et al. 2007) and at Castle Rock National Wildlife Refuge, California (705 breeding pairs in 2007; Cunha 2011). During the spring – summer nesting season, breeding adults forage within approximately 30 km of their colonies (Adams et al. 2005). Post-breeding dispersal from British Columbia colonies is thought to be southward extending into California (Briggs et al. 1987), with some indication that southern breeders may move northward into the NCCS during the post-breeding period (late summer – fall; Adams et al. 2004)

Overall, Cassin's Auklet was the fourth-most abundant seabird encountered on surveys (2053 individuals; Table 4). Greatest densities occurred during winter (722 individuals; 0.91 ± 0.09 birds km^{-2}) and fall (1229 individuals; 1.14 ± 0.17 birds km^{-2}; Table 4), with relatively few birds encountered during summer off northern California and southern Oregon in the vicinity of known breeding colonies in the study area (Figure 91, Figure 94). Auklets displayed seasonal variability in offshore distribution (Table 24). During winter, they were more widespread and concentrated over outer-shelf and slope waters with greatest abundances near Heceta Bank in both years and south of Cape Mendocino in 2012 (Figure

90). Cassin's Auklets displayed relatively consistent inter-annual patterns in distribution during winter within the three southernmost Focal Areas, and were most abundant within the Ft. Bragg Focal Area (Figure 93). The species was more patchily distributed during both fall surveys when large, isolated concentrations of birds were observed off southern Washington and off Oregon between Tillamook and Newport, primarily over the outer-shelf and slope (Figure 92). Relatively few birds were observed south of central Oregon during October 2011, however, the species was very abundant during September 2012 over shelf waters from North Bend, OR, south to Cape Mendocino (Figure 92, Figure 95). There was greater inter-annual variability during fall within the Focal Areas, with greatest abundance observed during September 2012 within the Siltcoos Bank Focal Area (Figure 95) where auklets were associated with large concentrations of foraging Common Murres, Fork-tailed Storm-Petrels, and humpback (*Megaptera novaeangliae*) and blue whales (*Balaenoptera musculus*).

Table 24. Mean density (birds km^{-2} [SE]) of Cassin's Auklets (*Ptychoramphus aleuticus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	0.29 (0.14)	0.95 (0.25)	0.96 (0.20)	0.74 (0.12)
	June	-	0.08 (0.08)	0.10 (0.07)	0.06 (0.04)
	October	0.10 (0.04)	0.49 (0.14)	0.66 (0.13)	0.45 (0.07)
2012	February	0.18 (0.07)	2.02 (0.37)	1.27 (0.21)	1.11 (0.13)
	July	0.12 (0.06)	0.25 (0.07)	0.11 (0.04)	0.14 (0.03)
	September	2.37 (0.68)	4.40 (1.11)	0.26 (0.06)	1.87 (0.33)
All Surveys		**0.52 (0.12)**	**1.34 (0.21)**	**0.53 (0.05)**	**0.71 (0.06)**

Rhinoceros Auklet (*Cerorhinca monocerata*)

The Rhinoceros Auklet is a medium-sized alcid closely related to the other puffins. In the northeastern Pacific, the species' breeding range extends from the Gulf of Alaska to southern California (Gaston and Deshesne 1996). In 1988, there were an estimated 60,814 breeders nesting in Washington, mostly at Protection Island (34,216) and Destruction Island (23,600) to the north of our study area (Gaston and Deshesne 1996). Off Oregon, approximately 475 breeding birds (94% of state's breeding population) occur along the southern coastline (Naughton et al. 2007). In 1988, Carter et al. (1992) estimated 1,032 breeding birds nested at Castle Rock National Wildlife Refuge off northern California. Rhinoceros Auklets are much more numerous in British Columbia, Canada (*ca*. 333,000 breeders; Rodway 1991), and are unique among the puffins in the northeastern Pacific in that they are strictly nocturnal at their colonies. Post-breeding dispersal from large colonies to the north of the PaCSEA study area are southward with an influx of birds occurring off Oregon and California during fall and winter (Gaston and Dechesne 1996). Briggs et al. (1987) noted increased abundances off northern California by late October, and a decline here as birds moved south to waters off central and southern California during winter.

Rhinoceros Auklets were most abundant in fall (238 individuals; 0.24 ± 0.04 birds km^{-2}) and winter surveys (161 individuals; 0.21 ± 0.04 birds km^{-2}; Table 4); only 21 individuals were seen during summer months. In both winter and fall, densities were fairly consistent over outer-shelf and slope waters (0.13

– 0.33 birds km^{-2}), whereas abundance over the inner-shelf exhibited more inter-annual variation in those seasons (Table 25). In summer months, Rhinoceros Auklets were found primarily over the inner-shelf (Table 25).

Rhinoceros Auklets were regularly encountered at low to moderate densities off Oregon and California in both winter surveys, although their distribution was somewhat patchy (Figure 104). Concentrations of moderate to high densities were encountered off southern Washington during January 2011 but not February 2012 (Figure 104; Figure 106). The species was rarely encountered in summer, primarily off Oregon in the Nehalem, Newport, and Siltcoos Bank Focal Areas in both years. In both fall surveys, auklets were encountered at low to moderate densities off north-central Oregon and south of Cape Mendocino, and at moderate to high densities from Heceta Bank south to Cape Blanco; low to moderate densities were encountered between Cape Mendocino and the California-Oregon border during September 2012 (Figure 105; Figure 107).

Table 25. Mean density (birds km^{-2} [SE]) of Rhinoceros Auklets (*Cerorhinca monocerata*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	0.50 (0.22)	0.19 (0.07)	0.14 (0.03)	0.27 (0.08)
	June	0.06 (0.03)	0.04 (0.02)	-	0.03 (0.01)
	October	0.10 (0.04)	0.33 (0.15)	0.26 (0.09)	0.23 (0.06)
2012	February	0.10 (0.04)	0.13 (0.05)	0.20 (0.06)	0.15 (0.03)
	July	0.04 (0.02)	<0.01 (<0.01)	-	0.02 (<0.01)
	September	0.39 (0.13)	0.26 (0.08)	0.14 (0.04)	0.25 (0.05)
All Surveys		**0.20 (0.05)**	**0.16 (0.03)**	**0.12 (0.02)**	**0.15 (0.02)**

Black-legged Kittiwake (*Rissa tridactyla*)

The Black-legged Kittiwake is a small, abundant, well-studied (breeding season) pelagic gull that, in the Pacific, nests throughout the Gulf of Alaska and Aleutian Archipelago; they also breed in the Bering and Chukchi Seas (Hatch et al. 2009). Black-legged Kittiwakes move into the NCCS during November to January with peak numbers off California in January to March; they depart by May to return to northern colonies (Briggs et al. 1987).Black-legged Kittiwake distribution during the winter off California, Oregon, and Washington shows no clear pattern or trends associated either with distance to shore or other environmental factors such as sea surface temperature and upwelling index (Briggs et al. 1987, 1992, Ainley and Hyrenbach 2010).

Black-legged Kittiwakes were commonly observed in winter (374 individuals; 0.51 ± 0.14 birds km^{-2}), rarely in fall (13 individuals; 0.02 ± 0.01 birds km^{-2}; Table 4), and were not observed in summer. In January 2011, the species was present at similar average densities over outer-shelf (0.38 ± 0.20 birds km^{-2}) and slope waters (0.46 ± 0.14 birds km^{-2}; Table 26). Birds were patchily concentrated at low to high densities from central Oregon to central Washington and near Cape Mendocino (Figure 58). Greatest Black-legged Kittiwake densities occurred in February 2012; densities were greater over slope waters

(1.25 ± 0.58 birds km^{-2}) than over the outer-shelf (0.72 ± 0.48 birds km^{-2}; Table 26). Black-legged Kittiwakes were infrequently observed in Focal Areas; greatest densities were found along the shelf-break in the Fort Bragg Focal Area in January 2011 (Figure 59).

Table 26. Mean density (birds km^{-2} [SE]) of Black-legged Kittiwakes (*Rissa tridactyla*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	0.04 (0.03)	0.38 (0.20)	0.46 (0.14)	0.30 (0.08)
	June	-	-	-	-
	October	-	0.02 (0.02)	-	<0.01 (<0.01)
2012	February	0.08 (0.04)	0.72 (0.48)	1.25 (0.58)	0.76 (0.29)
	July	-	-	-	-
	September	<0.01 (<0.01)	<0.01 (<0.01)	0.05 (0.03)	0.03 (0.02)
All Surveys		**0.02 (<0.01)**	**0.18 (0.08)**	**0.25 (0.08)**	**0.16 (0.04)**

Sabine's Gull (*Xema sabini*)

The Sabine's Gull is a small, conspicuous, Holarctic gull of pelagic nature that favors southern hemisphere coastal upwelling ecosystems during its annual non-breeding season. Unknown proportions of individuals over-winter in the Humboldt (off Peru) and Benguela Currents (off South Africa). Fall migration abundances off the western U.S. tend to be more protracted with individuals being less-concentrated at sea (Briggs et al. 1987, Day et al. 2001), and seasonal timing likely reflects inter-annual variability in departure related to breeding success (Davis et al. 2012). Off California, spring migration numbers increase from late-April to reach a peak during mid-May (estimated at 50,000 individuals; Briggs et al. 1987); the spring migration peak occurs slightly later off Oregon and Washington (Briggs et al. 1987, 1992). In the fall, numbers off Washington and Oregon peak during August – September and slightly later (September – October) off California (Briggs et al. 1987, 1992). Limited observations of birds flying during migration revealed low elevation of flight over the sea-surface (5 – 15 m; Day et al. 2001).

Table 27. Mean density (birds km^{-2} [SE]) of Sabine's Gulls (*Xema sabini*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	-	-	-	-
	June	<0.01 (<0.01)	0.02 (0.02)	0.03 (0.01)	0.02 (<0.01)
	October	-	0.04 (0.02)	2.73 (1.29)	1.28 (0.60)
2012	February	-	-	-	-
	July	-	-	-	-
	September	-	0.08 (0.05)	0.21 (0.07)	0.11 (0.03)
All Surveys		**<0.01 (<0.01)**	**0.02 (<0.01)**	**0.53 (0.23)**	**0.25 (0.11)**

We observed 530 individual Sabine's Gulls, primarily in fall surveys over slope waters (518 individuals; 0.71 ± 0.31 birds km^{-2}; Table 4; Table 27). The species was most abundant during October 2011, when very large concentrations of birds were located over the slope near Heceta Bank (2.73 ± 1.29 birds km^{-2}; Table 27; Figure 78). Occasional sightings of moderate to low densities occurred south of Cape Blanco, and the species was mostly absent off northern Oregon and southern Washington (Figure 78). During September 2012, Sabine's Gulls were widespread at moderate to low densities north of Cape Blanco off Oregon and Washington, whereas they were absent off California and southernmost Oregon (Figure 78).

Heermann's Gull (*Larus heermanni*)

The medium-sized Heermann's Gull is unique among the suite of gulls that inhabit the NCCS. It is the only all-dark gull present off North America. There are an estimated 300,000 breeders of which approximately 90% of the global population nest on Isla Raza, in the Gulf of California, Mexico (Islam 2002). It also is unique because it is the only North American gull to migrate northward along the Pacific Coast during fall and winter, reaching, in low numbers, as far as southern British Columbia, Canada (Islam 2002). Abundance peaks off northern California in late June and off Oregon in late July; most breeding adults depart for southern colonies by mid-March (Briggs et al. 1987, 1992). Heermann's Gulls have a mixed diet during the non-breeding period and individuals often are seen intermingling with shorebirds in pursuit of decapod crustaceans in surf-washed, sandy-beach habitats along the exposed outer coast (Islam 2002). Individuals often associate also with feeding brown pelicans and occasionally southern sea otters (J. Adams pers. obs.).

Heermann's Gulls were rarely observed during 2011 and 2012; only 44 individuals were counted (Table 4). When present in any given survey, almost all observations were of low densities and typically found in one isolated patch over shelf waters or over the slope very close to the shelf break (Table 4). In the winter, Heermann's Gulls were only found during February 2012 in the Eureka Focal Area (Figure 72), whereas in the summer, most birds were found in the Fort Bragg Focal Area during July 2012 (Figure 73). In fall surveys, this species was encountered primarily in the Grays Harbor and Nehalem Focal Areas during October 2011 (Figure 71).

Table 28. Mean density (birds km^{-2} [SE]) of Heerman's Gulls (*Larus heermanni*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	-	-	-	-
	June	0.01 (<0.01)	-	-	<0.01 (<0.01)
	October	0.08 (0.03)	-	-	0.03 (<0.01)
2012	February	0.05 (0.02)	0.05 (0.03)	<0.01 (<0.01)	0.03 (0.01)
	July	0.03 (0.02)	0.06 (0.02)	0.01 (<0.01)	0.03 (0.01)
	September	0.04 (0.02)	-	-	0.01 (<0.01)
All Surveys		**0.04 (<0.01)**	**0.02 (<0.01)**	**<0.01 (<0.01)**	**0.02 (<0.01)**

Western Gull (*Larus occidentalis*)

The Western Gull is among the least abundant North American gull species with a global population estimated at about 40,000 breeding pairs (Pierotti et al. 1995). In our study area, Western Gulls readily hybridize with Glaucous-winged Gulls, and the two species together with the hybrids are treated as one in breeding population estimates within Washington (36,923 breeding individuals; Speich and Wahl 1989) and Oregon (32,300 breeding individuals; Naughton et al. 2007). Post-breeding dispersal is limited in this species with some birds moving north and some south during fall and winter (Pierotti et al. 1995). Breeding birds generally occupy similar areas during winter as during the breeding season, but can be more far-ranging during the non-breeding season (Pierotti et al. 1995). Most breeding pairs begin to occupy nesting territories by March (Penniman et al. 1990). At sea off Washington, Western Gulls (together with Glaucous-winged Gulls and hybrids) tend to associate with large multi-species flocks, especially nearshore where these large gulls serve as "catalysts" or initiators of flock-foraging events (Hoffman et al. 1981). Briggs et al. (1992) found that Western Gulls were negatively associated with Sooty Shearwaters within mixed-species flocks. Briggs et al. (1987) found Western Gulls to be most evenly distributed during winter, with relatively high numbers present within 25-km of shore between Point Arena and the Oregon border.

Western Gulls were the sixth most abundant marine bird species observed across all surveys (1184 total individuals) and their average density was seasonally consistent (0.40 – 0.46 birds km^{-2}; Table 4). For all surveys, birds were most abundant over inner-shelf (0.94 ± 0.09 birds km^{-2}) and outer-shelf waters (0.38 ± 0.09 birds km^{-2}; Table 29); of the few birds observed over the slope, most were located near the shelf break (Figure 79, Figure 80, Figure 81). This species was relatively more abundant over the inner-shelf compared with the outer-shelf in winter and fall surveys, whereas densities were similar over inner- and outer-shelf waters in the summer (Table 29). Regionally, Western Gulls were widespread and common at low to moderate densities across the entire study area during all seasons (Figure 79, Figure 80, Figure 81, Figure 82, Figure 83, Figure 84).

Table 29. Mean density (birds km^{-2} [SE]) of Western Gulls (*Larus occidentalis*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	Month	0 – 100 m	100 – 200 m	200 – 2000 m	All Depths
2011	January	1.16 (0.32)	0.20 (0.05)	0.08 (0.02)	0.46 (0.10)
	June	0.63 (0.13)	0.57 (0.10)	0.19 (0.09)	0.41 (0.06)
	October	1.48 (0.29)	0.27 (0.06)	0.03 (0.01)	0.53 (0.09)
2012	February	1.00 (0.20)	0.26 (0.08)	0.20 (0.04)	0.46 (0.07)
	July	0.66 (0.15)	0.67 (0.49)	0.07 (0.03)	0.39 (0.12)
	September	0.71 (0.11)	0.34 (0.07)	0.15 (0.04)	0.37 (0.04)
All Surveys		**0.94 (0.09)**	**0.38 (0.09)**	**0.12 (0.02)**	**0.44 (0.04)**

California Gull (*Larus californicus*)

This medium-sized gull has historically nested in the semi-arid interior of northwestern North America, with the largest breeding colonies (>20,000 individuals) in California, Idaho, and Utah (Winkler 1996).

However, recent establishment of breeding colonies in San Francisco Bay, CA, and, to a lesser extent, the Columbia River mouth, has expanded the summertime range of this species to the Pacific coast (Ackerman et al. 2006). California Gulls undergo a seasonal migration between interior breeding grounds and the Pacific coast where they range from southern British Columbia, Canada, to central Mexico. Breeders from the Canadian prairies are thought to follow the Columbia River basin (Winkler 1996) and reach peak abundance in coastal waters off Oregon and Washington during September and again during the spring in March (Briggs et al. 1992). Arrival of post-breeding adults at the coasts off Oregon and Washington begins in July (Briggs et al. 1992), but non-breeders and juvenile birds may reside in coastal waters year round (Winkler 1996). Local abundances at sea, often in large flocks from fall to spring, can be greatly influenced by associations with fishing vessels (Wahl and Heinemann 1979). Coastal distributions also are likely associated with proximity to municipal landfill sites (Winkler 1996).

California Gulls were most abundant in fall (731 individuals; 0.78 ± 0.15 birds km^{-2}) and winter (316 individuals; 0.35 ± 0.04 birds km^{-2}), but were also present in summer (118 individuals, 0.11 ± 0.02 birds km^{-2}; Table 4). For all surveys, this species was most common over the inner-shelf (1.02 ± 0.17 birds km^{-2}) and, to a lesser extent, the outer-shelf (0.26 ± 0.05 birds km^{-2}); few were seen over slope waters (Table 30). This species was widespread at low to moderate densities off northern California in both winter surveys and off southern Washington in January 2011 (Figure 60); average densities at all depths were similar during both winter surveys (0.38 birds km^{-2} in January 2011 and 0.32 birds km^{-2} in February 2012; Table 30). Distribution and abundance in Focal Areas in winter mirrored broad transect observations, with additional sightings of low densities found off Oregon in the Siltcoos Bank, Newport, and Nehalem Focal Areas (Figure 63).

Table 30. Mean density (birds km^{-2} [SE]) of California Gulls (*Larus californicus*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	0.78 (0.14)	0.22 (0.08)	0.16 (0.05)	0.38 (0.05)
	June	0.06 (0.02)	<0.01 (<0.01)	0.01 (<0.01)	0.03 (<0.01)
	October	3.65 (0.92)	0.90 (0.25)	0.16 (0.04)	1.40 (0.29)
2012	February	0.89 (0.18)	0.06 (0.03)	0.06 (0.03)	0.32 (0.06)
	July	0.42 (0.09)	0.22 (0.10)	0.02 (<0.01)	0.19 (0.04)
	September	0.27 (0.05)	0.10 (0.04)	0.03 (0.01)	0.12 (0.02)
All Surveys		**1.02 (0.17)**	**0.26 (0.05)**	**0.07 (0.01)**	**0.41 (0.05)**

Most summer sightings of California Gulls occurred during July 2012 when low densities were observed near the California-Oregon border and near the Oregon-Washington border; few were seen elsewhere (Figure 61). Similarly, presence in Focal Areas was mostly limited to the Eureka and Siltcoos Bank Focal Areas in the south and the Nehalem and Grays Harbor Focal Areas in the north (Figure 64). In the fall, California Gulls were widespread and common at low to high densities everywhere north of Cape Blanco during October 2011; however, the species was relatively rare at low densities in this same region during September 2012 (Figure 62). South of Cape Blanco, birds were fairly widespread but infrequent at low densities during both fall surveys (Figure 62). A similar fall pattern was observed in Focal Areas (Figure 65).

Herring/Thayer's Gull (*Larus argentatus/L. thayeri*)

Because of near complete plumage intergradation, the darkest Thayer's Gull is virtually inseparable from a Herring Gull (Snell 2002), therefore the two species are considered herein together. The Herring Gull is an abundant, well studied circumboreal/sub-arctic breeder with one recognized subspecies, *L. a. smithsonianus*, nesting in North America (Pierotti and Good 1994). Herring Gulls hybridize with Glaucous-winged Gulls where breeding distributions overlap (Pierotti 1987). Herring Gulls generally arrive in the NCCS during fall, with peak abundances recorded from December to February (Briggs et al. 1987). Thayer's Gulls nest in the central-eastern Canadian Arctic, and following post-breeding dispersal, can be relatively abundant and common over shelf waters off Washington and Oregon, with offshore distribution potentially linked to fishing activities (Morgan et al. 1991, Snell 2002). Details surrounding the migration of this species are lacking compared with those of Herring Gulls.

These gulls were commonly encountered in winter (730 individuals; 0.95 ± 0.16 birds km^{-2}) and fall (385 individuals; 0.36 ± 0.16 birds km^{-2}) surveys; none were seen in summer (Table 4). During winter surveys, abundances in all depth strata were similar; abundance was greater at all depths during January 2011 (1.29 ± 0.29 birds km^{-2}) compared with February 2012 (0.53 ± 0.07 birds km^{-2}; Table 31). Birds were widespread and common at low to moderate densities in both winter surveys; high densities were observed near Heceta Bank and south of Cape Mendocino during January 2011 and north of Cape Mendocino off northern California during February 2012 (Figure 74). Herring/Thayer's gulls were commonly observed at low to high densities near the shelf break in the Ft. Bragg and Eureka Focal Areas and, to a lesser extent, over the shelf in the Nehalem and Grays Harbor Focal Areas in winter; they were less common and at low densities in the Siltcoos and Newport Focal Areas (Figure 76).

Table 31. Mean density (birds km^{-2} [SE]) of Herring/Thayer's Gulls (*Larus argentatus/L. glaucoides thayeri*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	1.41 (0.68)	1.38 (0.57)	1.17 (0.30)	1.29 (0.29)
	June	-	-	-	-
	October	0.56 (0.17)	0.60 (0.29)	0.79 (0.64)	0.68 (0.31)
2012	February	0.48 (0.14)	0.57 (0.12)	0.55 (0.09)	0.53 (0.07)
	July	-	-	-	-
	September	0.04 (0.02)	0.03 (0.02)	<0.01 (<0.01)	0.02 (<0.01)
All Surveys		**0.41 (0.12)**	**0.43 (0.11)**	**0.41 (0.13)**	**0.41 (0.07)**

In the fall, almost all Herring/Thayer's Gulls were observed during October 2011; very few birds were seen during September 2012 (Table 31; Figure 75), likely because this survey occurred before the seasonal migration of these birds into the study area. During October 2011, they were relatively widespread from Heceta Bank north to southern Washington at low to high densities; average densities were similar across all depth strata (0.68 ± 0.31 birds km^{-2}; Table 31; Figure 75). An isolated concentration of birds was observed at low densities south of Cape Mendocino (Figure 75). Herring/Thayer's Gulls were relatively common within Focal Areas (except Eureka) during October 2011 with aggregations observed throughout the inner shelf off Oregon and Washington Focal Areas and affiliated with the shelf break within the Ft Bragg Focal Area (Figure 77).

Glaucous-winged Gull (*Larus glaucescens*)

The large-bodied Glaucous-winged Gull nests from Oregon through the Gulf of Alaska and around the perimeter of the North Pacific to Japan. This species can be difficult to identify at sea because it hybridizes with Western Gulls in northern Oregon and Washington, and with Herring Gulls and Glaucous Gulls in Alaska. Glaucous-winged Gulls nest throughout coastal Washington with an estimated 36,923 breeding birds (107 colonies) statewide during the late 1980s (Speich and Wahl 1989). Fewer gulls nest within Oregon, but hybridization with Western Gulls in this region prevented accurate numerical species-specific estimation; there was a combined estimate for the two species (and hybrids) of 32,300 statewide (Naughton et al. 2007). Post-breeding dispersal both to the north and south takes place from late August through October and birds generally leave southern wintering areas in May (Hayward and Verbeek 2008). Migration is variable as understood through band recovery data. Birds nesting in Washington on Protection Island rarely were resighted farther than 200 km from their colony. Young birds (<25 mo.) rarely were sighted farther than 322 km from natal colonies. In contrast, birds banded in British Columbia, Canada tended to move farther to the south into the NCCS (summarized in Hayward and Verbeek [2008]). Glaucous-winged Gulls are considered among the most widely distributed gulls throughout the north Pacific and can be seen from shore to 100s of kilometers offshore (Briggs et al. 1992). Briggs et al. (1992) found this species widely distributed off northern Washington, but much less frequently encountered south of the Columbia River. This species maintains an opportunistic diet and flocks often associate with fishing vessels and offal at sea.

Glaucous-winged Gulls were most abundant in winter (695 individuals; 0.92 ± 0.13 birds km^{-2}) and fall (372 individuals; 0.41 ± 0.06 birds km^{-2}) with lesser densities in summer (77 individuals; 0.08 ± 0.01 birds km^{-2}; Table 4). In all seasons, birds occurred predominantly over inner-shelf waters (Table 32). This species was aggregated at moderate to high densities off southern Washington and northern Oregon during January 2011 and more widespread and patchy and at lower densities throughout the rest of the study area. This gull also was patchy and occurred in relatively low densities across the entire region during February 2012 (Figure 66) with some areas of greater concentration off northern California in the Ft. Bragg and Eureka Focal Areas (Figure 69). At all depths, this species was relatively more abundant during January 2011 (1.47 ± 0.23 birds km^{-2}) than during February 2012 (0.26 ± 0.05 birds km^{-2}; Table 32).

Most Glaucous-winged Gulls in summer were sighted during June 2011 (Table 32), when low to moderate densities were found off southern Washington in and around the Grays Harbor Focal Area and, to a lesser extent, off northern California in and around the Eureka Focal Area (Figure 67 and Figure 70). Very few were seen during July 2012. In the fall, Glaucous-winged Gulls were more abundant at all depths during October 2011 (0.71 ± 0.12 birds km^{-2}) than during September 2012 (0.09 ± 0.02 birds km^{-2};

Table 32). In both surveys, birds were common at low to moderate densities off southern Washington and northern Oregon and, to a lesser extent, near Cape Blanco (Figure 68). During October 2011, the species also was widespread at low densities throughout central Oregon and occurred in and around the Ft. Bragg Focal Area (Figure 68 and Figure 71).

Table 32. Mean density (birds km^{-2} [SE]) of Glaucous-winged Gulls (*Larus glaucescens*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	3.36 (0.69)	0.90 (0.16)	0.41 (0.08)	1.47 (0.23)
	June	0.32 (0.06)	0.11 (0.06)	0.01 (<0.01)	0.13 (0.03)
	October	1.88 (0.37)	0.40 (0.12)	0.09 (0.02)	0.71 (0.12)
2012	February	0.49 (0.13)	0.13 (0.04)	0.18 (0.04)	0.26 (0.05)
	July	0.02 (0.01)	0.02 (0.02)	0.01 (<0.01)	0.01 (<0.01)
	September	0.21 (0.05)	0.10 (0.03)	0.01 (<0.01)	0.09 (0.02)
All Surveys		**1.06 (0.14)**	**0.28 (0.04)**	**0.11 (0.02)**	**0.45 (0.05)**

Caspian Tern (*Hydroprogne caspia*)

The Caspian Tern population of the Pacific coast region of North America has more than doubled (to 12,900 breeding pairs) during the period from 1981 – 2000 (Suryan et al. 2004). Coincident with this rapid population growth has been a significant shift in the distribution of breeding birds with 69% of breeders in 2000 (*vs*. 7% in the late 1970s) concentrated in Oregon, mostly within the Columbia River estuary, where the species has capitalized on artificial nesting islands generated by river dredge spoils (Suryan et al. 2004). Breeders, together with young, depart colonies in the Pacific Northwest during late summer through early fall. Pacific coast breeders generally winter along the west coast of Mexico and into Guatemala (Cuthbert et al. 1999).

Table 33. Mean density (birds km^{-2} [SE]) of Caspian Terns (*Hydroprogne caspia*) for each survey month within inner continental shelf (0 – 100 m), outer continental shelf (100 – 200 m), and continental slope (200 – 2000 m) depth strata. Densities are analyzed at a 3-km scale.

		Depth Stratum			
Year	**Month**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
2011	January	-	-	-	-
	June	0.11 (0.03)	0.02 (0.02)	0.01 (<0.01)	0.04 (0.01)
	October	-	-	-	-
2012	February	-	-	-	-
	July	0.22 (0.11)	<0.01 (<0.01)	-	0.07 (0.04)
	September	-	-	-	-
All Surveys		**0.06 (0.02)**	**<0.01 (<0.01)**	**<0.01 (<0.01)**	**0.02 (<0.01)**

Caspian Terns were locally abundant over inner-shelf waters in summer surveys (66 total individuals; 0.11 ± 0.03 and 0.22 ± 0.11 birds km^{-2} in June 2011 and July 2012, respectively) and were absent in fall and winter (Table 4; Table 33). Almost all sightings were located off southern Washington and at the mouth of the Columbia River, in close proximity to the only significant breeding colony of this species in the study area (East Sand Island; Figure 85, Figure 86). Few sightings were located off northern Oregon (Nehalem Focal Area) and off northern California (Eureka Focal Area, June 2011 only; Figure 86).

5.0 Marine Mammals

The PaCSEA survey was designed to maximize accuracy of seabird species identification and density estimation; therefore, the low elevation (60 m) precluded density estimation via preferred line transect methods employed for marine mammals using aircraft flown at greater survey altitude (162 - 198 m; Forney et al. 1991, Green et al. 1992, Carretta and Forney 2004). Furthermore, according to a Memorandum of Understanding between USGS-WERC and NOAA Protected Species Division, pilots were instructed to alter survey tracklines to avoid direct over-flights for all marine mammals. Pilots also maintained a 1.5-km buffer around colonies and pinniped haulout areas to avoid over-flights and potential disturbance to breeding and resting animals. Herein, we present monthly and bathymetric summaries of the number of mammal sightings and individuals encountered during PaCSEA surveys. Although these numbers are not standardized to effort, the relative number of sightings and their locations provides useful information for evaluating relative abundance, habitat associations, and shifts in species' distributions according to season and bathymetry.

Overall, we observed 16 cetacean species and five pinniped species. Among the Mysticeti (baleen whales), humpback whales (*Megaptera novaeangliae*) were most frequently observed (114 sightings of 264 individuals) during summer and fall (Table 34). Although humpback whales were observed mostly over the outer-shelf and slope waters (Table 35), individuals were seen within the Siltcoos (January 2011, September 2012), Nehalem (June 2011, July 2012), Fort Bragg (July 2012, September 2012), and Eureka (October 2011, September 2012) Focal Areas (Figure 113, Figure 114, Figure 115). Surveys within the Siltcoos Focal Area during September 2012 revealed an unusually high number of humpback whale sightings associated with relatively high-density aggregations of Cassin's Auklets, Common Murres, and several sightings of blue whales (*Balaenoptera musculus*, Figure 115). We recorded 10 sightings of 16 blue whales with all but one sighting of two individuals (over the continental slope in February 2012) occurring during fall (Table 34, Figure 115). All blue whales were observed off Oregon, with a noteworthy aggregation of sightings associated with abundant humpback whales within the Siltcoos Bank Focal Area (Figure 115). We recorded six sightings of 13 fin whales (*Balaenoptera physalus*) during winter and summer 2012 only in offshore waters over the continental slope (Table 34 and Table 35; Figure 113 and Figure 114). Minke whales (*Balaenoptera acutorostrata*) were relatively infrequently observed (6 sightings of 7 individuals) during summer and fall over Oregon shelf waters and within the Siltcoos and Newport Focal Areas during fall (Figure 114, Figure 115). We recorded 26 sightings of 40 gray whales (*Eschrichtius robustus*) during all seasons. All but two sightings (recorded during June 2011 over the continental slope) were within 25 km of the coast (Figure 113, Figure 114, and Figure 115). Gray whales were observed within the Nehalem Focal Area in summer and fall (Figure 114 and Figure 115). We recorded an additional 47 sightings of 75 unknown large baleen whales during 2011 and 2012 (Figure 113, Figure 114, and Figure 115).

The waters of the NCCS provide habitat for a diverse assemblage of Odontoceti (toothed whales; Green et al. 1992, Appler et al. 2004, Forney 2007). During PaCSEA surveys, we recorded 11 odontocete species. Harbor porpoises (*Phocoena phocoena*) were the most frequently sighted (164 sightings of 270 individuals; Table 34). Harbor porpoises were present year-round and most frequently sighted within the inner-shelf domain throughout the entire study area in all seasons (Table 35). Harbor porpoises occurred in all six Focal Areas, with noteworthy aggregations within several Focal Areas: Eureka (winter and fall), Siltcoos (January 2011), and Grays Harbor (June 2011; Figure 119, Figure 120, and Figure 121).

Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) were the second most frequently sighted species and the most numerically abundant (38 sightings of 2237 individuals; Table 34). Pacific white-sided dolphins were present in all seasons, but were more frequently observed in 2011. This species has the tendency to occur in large herds and two sightings in February 2012 (955 individuals) represented 43% of the individuals observed. Although this delphinid was most frequently observed over the continental slope domain (Table 35), it also occurred within the Fort Bragg Focal Area (February 2012) and within the nearshore area of the Nehalem Focal Area (June 2011). Northern right whale dolphins (*Lissodelphis borealis*) were nearly as frequently observed and in similar numerical abundance (27 sightings of 2140 individuals) as Pacific white-sided dolphins. Northern right whale dolphins also were more frequently sighted in greater abundance during 2011 (Table 34). Northern right whale dolphins were far more abundant over the continental slope domain (Table 35). This delphinid occurred only twice in the outer portion of two Focal Areas: Grays Harbor (June 2011) and Fort Bragg (October 2011; Figure 120 and Figure 121). Dall's porpoises (*Phocoenoides dalli*) were seen infrequently and were the fifth-most abundant odontocete (36 sightings totaling 81 individuals; Table 34). These porpoises were seen on every survey in low numbers, most frequently in offshore waters over the slope domain (Table 35) and often in association with humpback whales. Dall's porpoises occurred within the Grays Harbor (June 2011) and Siltcoos (September 2012) Focal Areas (Figure 120 and Figure 121). Risso's dolphins (*Grampus griseus*) were less-frequently sighted than Dall's porpoises, but tended to occur in larger groups year-round (15 sightings totaling 459 individuals; Table 34)and mostly within outer-shelf and slope domains (Table 35; Figure 116, Figure 117, and Figure 118). The remaining six odontocetes and animals classified as "unidentified small cetacean" were observed infrequently and included sperm whales (*Physeter macrocephalus*), killer whales (*Orcinus orca*), Baird's beaked whales (*Berardius bairdii*), short-finned pilot whales (*Globicephala macrorhynchus*), common bottlenose dolphins (*Tursiops truncatus*), and short-beaked common dolphins (*Delphinus delphis*; Table 34, Table 35, and Figure 116-121).

The coastline and associated coastal islands of northern California, Oregon, and Washington support breeding rookeries and important haul-out refugia for several pinnipeds including northern elephant seals (*Mirounga angustirostris*), Pacific harbor seals (*Phoca vitulina richardsii*), California sea lions (*Zalophus californianus*), and northern (Steller) sea lions (*Eumatopias jubatus*). In addition, waters beyond the shelf break are frequented in the winter by migratory northern fur seals (*Callorhinus ursinus*) that breed annually in the Bering Sea. During the PaCSEA surveys, we recorded 246 sightings of 375 individual pinnipeds (five species). California sea lions were the most frequently sighted and were present year round with slightly more sightings recorded during the fall (Table 34). California sea lions showed a decreasing frequency of sightings and relative abundance with distance from shore across the bathymetric domains surveyed, being most frequently observed over the inner-shelf (Table 35). Northern elephant seals, harbor seals, and northern fur seals were observed occasionally during all seasons with harbor seals occurring nearshore (usually within 10 km of the coast) and northern fur seals almost exclusively beyond the shelf break, especially during winter off Oregon and Washington (Table 34 and 35, Figure 122-124). Northern sea lions were uncommonly sighted during winter and fall (Table 34).

Table 34. Summary of monthly marine mammal sightings (number of individuals) recorded during PaCSEA surveys off northern California, Oregon, and southern Washington. Marine mammals were sighted opportunistically and numbers are unadjusted to survey effort (see Methods).

	2011			**2012**			**Total**
***GROUP*/Species**	**January**	**June**	**October**	**February**	**July**	**September**	
MYSTICETES							
Blue Whale	-	-	2 (3)	1 (2)	-	7 (11)	**10 (16)**
Fin Whale	-	-	-	2 (7)	4 (6)	-	**6 (13)**
Minke Whale	-	-	2 (2)	-	2 (2)	2 (3)	**6 (7)**
Humpback Whale	3 (4)	19 (40)	21 (48)	4 (5)	17 (39)	49 (127)	**113 (263)**
Gray Whale	6 (11)	3 (5)	1 (1)	4 (9)	3 (4)	6 (6)	**23 (36)**
Unknown large whale	15 (26)	5 (6)	8 (10)	-	7 (14)	12 (19)	**47 (75)**
ODONTOCETES – large							
Sperm Whale	-	1 (2)	1 (1)	-	-	-	**2 (3)**
Killer Whale	-	-	-	-	1 (10)	1 (2)	**2 (12)**
Baird's Beaked Whale	-	1 (10)	-	-	-	-	**1 (10)**
Short-finned Pilot Whale	1 (8)	-	-	-	-	-	**1 (8)**
Risso's Dolphin	1 (8)	4 (31)	1 (1)	3 (276)	2 (26)	3 (17)	**14 (359)**
Unknown small cetacean	3 (4)	3 (10)	2 (22)	-	1 (1)	2 (6)	**11 (43)**
ODONTOCETES – small							
Common Bottlenose Dolphin	1 (2)	-	-	3 (4)	1 (2)	1 (4)	**6 (12)**
Short-beaked Common Dolphin	-	-	1 (1)	-	-	-	**1 (1)**
Northern Right Whale Dolphin	2 (415)	4 (351)	8 (821)	4 (57)	4 (401)	5 (95)	**27 (2140)**
Pacific White-sided Dolphin	7 (432)	12 (453)	12 (277)	2 (955)	2 (10)	3 (110)	**38 (2237)**
Dall's Porpoise	6 (14)	4 (8)	1 (2)	4 (8)	4 (6)	15 (40)	**34 (78)**
Harbor Porpoise	39 (73)	30 (52)	18 (39)	19 (22)	22 (32)	31 (46)	**159 (264)**
PINNIPEDS							
California Sea Lion	18 (33)	20 (21)	23 (36)	9 (16)	17 (21)	39 (86)	**126 (213)**
Northern (Steller) Sea Lion	1 (1)	-	1 (1)	-	-	2 (8)	**4 (10)**
Northern Elephant Seal	7 (8)	6 (6)	4 (4)	5 (5)	3 (3)	6 (7)	**31 (33)**
Northern Fur Seal	14 (21)	2 (2)	3 (3)	5 (5)	-	11 (16)	**35 (47)**
Pacific Harbor Seal	13 (27)	2 (2)	8 (10)	8 (8)	7 (7)	2 (2)	**40 (56)**
Unknown pinniped	3 (4)	-	-	-	-	1 (1)	**4 (5)**
TOTAL ALL SPECIES	**140 (1091)**	**116 (997)**	**117 (1282)**	**73 (1379)**	**97 (584)**	**198 (606)**	**741 (5939)**

Table 35. Summary of marine mammal sightings (number of individuals) according to bathymetric domain recorded during PaCSEA surveys off northern California, Oregon, and southern Washington. Marine mammals were sighted opportunistically and numbers are unadjusted to survey effort (see Methods).

	Depth Stratum			
***GROUP*/Species**	**0 – 100 m**	**100 – 200 m**	**200 – 2000 m**	**All Depths**
MYSTICETES				
Blue Whale	6 (9)	3 (5)	1 (2)	**10 (16)**
Fin Whale	-	-	6 (13)	**6 (13)**
Minke Whale	1 (1)	4 (4)	1 (2)	**6 (7)**
Humpback Whale	10 (30)	49 (113)	54 (120)	**113 (263)**
Grey Whale	17 (26)	4 (7)	2 (3)	**23 (36)**
Unknown large whale	10 (15)	15 (23)	22 (37)	**47 (75)**
ODONTOCETES – large				
Sperm Whale	-	-	2 (3)	**2 (3)**
Killer Whale	-	1 (2)	1 (10)	**2 (12)**
Baird's Beaked Whale	-	-	1 (10)	**1 (10)**
Short-finned Pilot Whale	-	-	1 (8)	**1 (8)**
Risso's Dolphin	1 (2)	3 (271)	10 (86)	**14 (359)**
Unknown small cetacean	5 (28)	2 (7)	4 (8)	**11 (43)**
ODONTOCETES – small				
Common Bottlenose Dolphin	4 (9)	1 (1)	1 (2)	**6 (12)**
Short-beaked Common Dolphin	1 (1)	-	-	**1 (1)**
Northern Right Whale Dolphin	1 (6)	1 (10)	25 (2124)	**27 (2140)**
Pacific White-sided Dolphin	3 (16)	3 (101)	32 (2120)	**38 (2237)**
Dall's Porpoise	1 (1)	7 (16)	26 (61)	**34 (78)**
Harbor Porpoise	149 (246)	9 (17)	1 (1)	**159 (264)**
PINNIPEDS				
California Sea Lion	76 (157)	29 (34)	21 (22)	**126 (213)**
Northern (Steller) Sea Lion	3 (3)	1 (7)	-	**4 (10)**
Northern Elephant Seal	15 (16)	6 (6)	10 (11)	**31 (33)**
Northern Fur Seal	3 (4)	3 (3)	29 (40)	**35 (47)**
Pacific Harbor Seal	37 (53)	3 (3)	-	**40 (56)**
Unknown pinniped	2 (2)	1 (1)	1 (2)	**4 (5)**
TOTAL ALL SPECIES	**345 (625)**	**145 (631)**	**251 (4683)**	**741 (5939)**

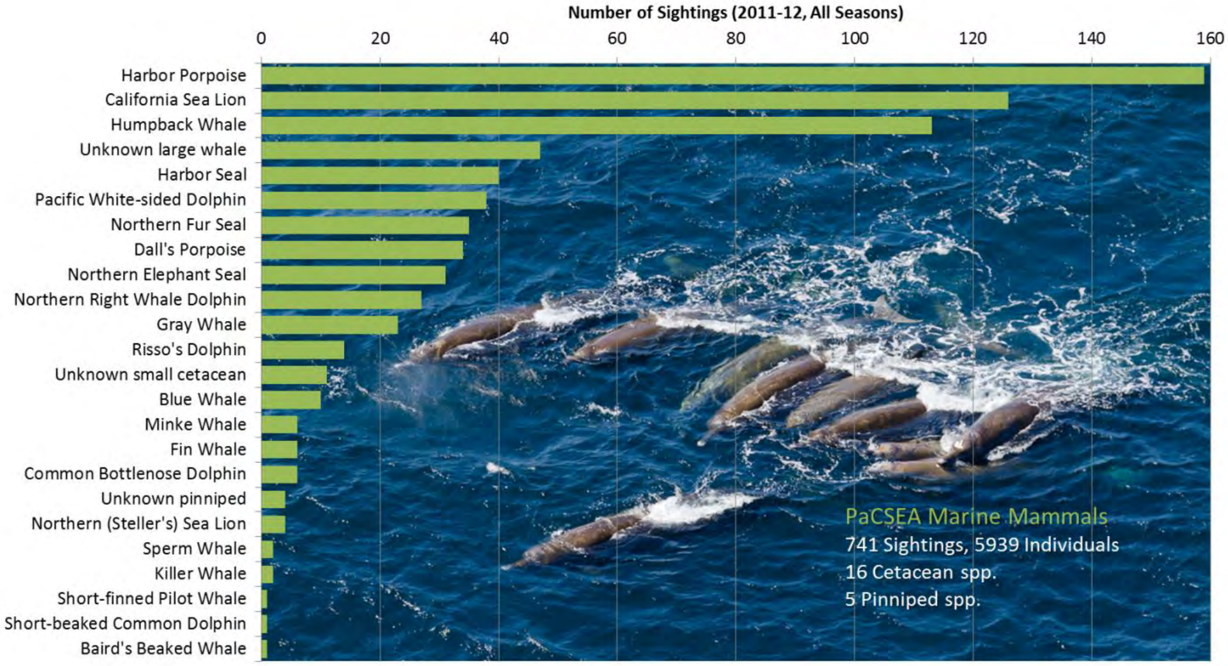

Figure 8. Total number of marine mammal sightings (non-standardized effort) by species during the PaCSEA surveys 2011 – 2012 (all seasons combined). Photo of Baird's beaked whale (*Berardias bairdii*). Photo by J. Felis, USGS.

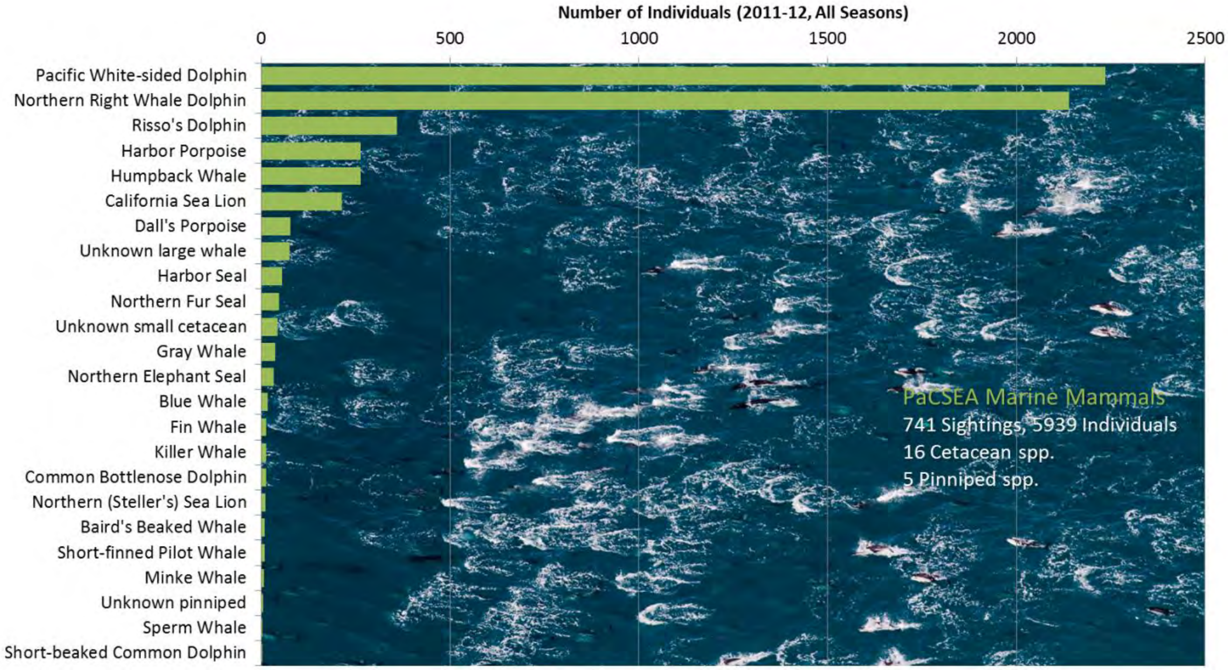

Figure 9. Total number of individual marine mammals (non-standardized effort) by species during the PaCSEA surveys 2011 – 2012 (all seasons combined). Photo of mixed Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) and northern right whale dolphin (*Lissodelphis borealis*) herd. Photo by J. Felis, USGS.

6.0 Literature Cited

Ackerman, J. T., J. Y. Takekawa, C. Strong, N. Athearn, and A. Rex. 2006. California Gull distribution, abundance, and predation on waterbird eggs and chicks in south San Francisco Bay. Unpublished final report, U.S. Geological Survey, Western Ecological Research Center, Davis and Vallejo, CA.[Available at: Western Ecological Research Center, U.S. Geological Survey, 3020 State University Dr. East, Modoc Hall, 3rd Floor, Room 3006, Sacramento, CA 95819].

Adams, J., C. MacLeod, R.M. Suryan, K.D. Hyrenbach, and J.T. Harvey. 2012. Summer-time use of west coast U.S. National Marine Sanctuaries by migrating sooty shearwaters (*Puffinus griseus*). Biological Conservation 156:105-116..

Adams, J., J.Y. Takekawa, and H.R. Carter. 2004. Foraging distance and home range of Cassin's Auklets nesting at two colonies in the California Channel Islands. Condor 106:618–637.

Ainley, D.G., D.A. Manuwal, J. Adams and A.C. Thoresen. 2011. Cassin's Auklet (*Ptychoramphus aleuticus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/050

Ainley, D.G., and K.D. Hyrenbach. 2010. Top-down and bottom-up factors affecting seabird population trends in the California current system (1985–2006). Progress in Oceanography 84:242–254.

Ainley, D.G., L.B. Spear, C.T. Tynan, J.A. Barth, S.D. Pierce, R.G. Ford, and T. J. Cowles. 2005. Physical and biological variables affecting seabird distributions during the upwelling season of the northern California Current. Deep-Sea Research II 52:123–143.

Anderson, C.D., D.D. Roby and K. Collis. 2004. Conservation implications of the large colony of Double-crested Cormorants on East Sand Island, Columbia River Estuary, Oregon, U.S.A. Waterbirds 27(2):155-160.

Appler, J., J. Barlow, and S. Rankin. 2004. Marine mammal data collected during the Oregon, California, and Washington Line-transect expedition (ORCAWHALE) conducted aboard the NOAA SHIPS McArthur and David Starr Jordan, July – December 2001. NOAA Tech Memo NOAA-TM-NMFS-SWFSC-359.

Awkerman, J.A., D.J. Anderson, and G. C. Whittow. 2008. Black-footed Albatross (*Phoebastria nigripes*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/065

Barr, J. F., C. Eberl and J. W. Mcintyre. 2000. Red-throated Loon (*Gavia stellata*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/513

BirdLife International. 2013. Species factsheet: *Puffinus bulleri*. Retrieved from http://www.birdlife.org

Boersma, P.D and M. C. Silva. 2001. Fork-tailed Storm-Petrel (*Oceanodroma furcata*), The Birds of North

America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/569

Bonnel, M.L., C.E. Bowlby, and G.A. Green. 1992. Chapter 2: Pinniped Distribution and Abundance off Oregon and Washington, 1989 – 1990. *In*: J.J. Brueggeman (Ed.) Oregon and Washington Marine Mammal and Seabirds Surveys. Final Report, OCS Study MMS 91-0093, Pacific OCS Region, Minerals Management Service, US Department of the Interior, Los Angeles, CA.

Briggs, K. T., W. B. Tyler, D. B. Lewis, P. R. Kelly, and D. A. Croll. 1983. Brown Pelicans in central and northern California. Journal of Field Ornithology 54:353-373.

Briggs, K.T., Chu, E.W., 1986. Sooty shearwaters off California: distribution, abundance, and habitat use. Condor 88: 355–364.

Briggs, K.T., W.M. Breck Tyler, D.B. Lewis, and D.R. Carlson. 1987. Bird Communities at Sea Off California 1975 to 1983. Studies in Avian Biology No. 11. The Cooper Ornithological Society. 74 pp.

Briggs, K.T., D.H. Varoujean, W.W. Williams, R.G. Ford, M.L. Bonnel, and J.L. Casey. 1992, Chapter 3: Seabirds of the Oregon and Washington OCS, 1989 – 1990. *In*: J.J. Brueggeman (Ed.) Oregon and Washington Marine Mammal and Seabirds Surveys. Final Report, OCS Study MMS 91-0093, Pacific OCS Region, Minerals Management Service, US Department of the Interior, Los Angeles, CA.

Brown, P.W. and L.H. Fredrickson. 1997. White-winged Scoter (*Melanitta fusca*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/274

Camphuysen, K., J. Shamoun-Baranesb, W. Boutenb, and S. Garthe. 2012. Identifying ecologically important marine areas for seabirds using behavioural information in combination with distribution patterns. Biological Conservation 156:22–29.

Carretta, J.V. and K.A. Forney. 2004. Preliminary estimates of harbor porpoise abundance in California from 1999 and 2002 aerial surveys. Administrative Report LJ-04-01, available from Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037. 13 pp.

Carter, H.R., McChesney, G.J., Jaques, D.L., Strong, C.S., Parker, M.W., Takekawa, J.E., Jory, D.L., and Whitworth, D.L. 1992. Breeding populations of seabirds in California, 1989 – 1991, Vol. I – Population Estimates. Unpublished draft report, U.S. Fish & Wildlife Service, Northern Prairie Wildlife Research Center, 6924 Tremont Rd., Dixon, CA 95620.

Carter, H.R., U.W. Wilson, R.W. Lowe, M.S. Rodway, D.A. Manuwal, J.E. Takekawa, and J.L. Yee. 2001. Population trends of the Common Murre (*Uria aalge californica*). Pages 33–133 in D. A. Manuwal, H. R. Carter, T. S. Zimmerman, and D. L. Orthmeyer, editors. Biology and conservation of the Common Murre in California, Oregon, Washington, and British Columbia. Volume 1: Natural history and population trends. U.S. Geological Survey, Information and Technology

Report USGS/BRD/ITR-2000-0012, Washington, DC.

Checkley Jr., D.M., and Barth, J.A. 2009. Patterns and processes in the California current system. Progress in Oceanography 83:49–64.

COSEWIC. 2013. Committee on the Status of Endangered Wildlife in Canada. Retrieved from http://www.cosewic.gc.ca/eng/sct5/index_e.cfm

Crowell, Jr., J.B. and H.B. Nehls. 1976. Northern Pacific Coast region. American Birds 30:878–882.

Cunha, M.J. 2011. Breeding status of Cassin's auklet (*Ptychoramphus aleuticus*) and Rhinoceros auklet (*Cerorhinca monocerata*) on Castle Rock National Wildlife Refuge, Del Norte County, California. Unpublished Master's Thesis. Humboldt State University. 81pp.

Cuthbert, F.J. and L.R. Wires. 1999. Caspian Tern (*Hydroprogne caspia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/403

Davis, S.E., M. Maftei, I.L. Jones, and M.L. Mallory. 2012. Trans-equatorial migration of Sabine's Gulls (*Xema sabini*) from a breeding site in the central Canadian High Arctic. Unpublished Abstract. Pacific Seabird Group Annual Meeting 2012.

Day, R.H., I.J. Stenhouse and H.G. Gilchrist. 2001. Sabine's Gull (*Xema sabini*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/593.

Evers, D.C., J.D. Paruk, J.W. Mcintyre and J.F. Barr. 2010. Common Loon (*Gavia immer*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/313

Forney, K.A., D.A. Hanan, and J. Barlow. 1991. Detecting trends in harbor porpoise abundance from aerial surveys using analysis of covariance. Fishery Bulletin 89:367–377.

Gaston, A.J. and A. Shoji. 2010. Ancient Murrelet (*Synthliboramphus antiquus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/132

Gaston, A.J. and S.B. Dechesne. 1996. Rhinoceros Auklet (*Cerorhinca monocerata*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/212

Gould, P.J., D.J. Forsell, and C.J. Lensink. 1982. Pelagic distribution and abundance of seabirds in the Gulf of Alaska and eastern Bering Sea. U.S. Fish and Wildlife Service, FWS/OBS-82/48.

Green, G.A., J.J. Brueggeman, R.A. Grotefendt, and C.E. Bowlby. 1992, Chapter 1: Cetacean Distribution and Abundance off Oregon and Washington, 1989 – 1990. *In*: J.J. Brueggeman (Ed.) Oregon and

Washington Marine Mammal and Seabirds Surveys. Final Report, OCS Study MMS 91-0093, Pacific OCS Region, Minerals Management Service, US Department of the Interior, Los Angeles, CA.

Hatch, S.A., G.J. Robertson and P.H Baird. 2009. Black-legged Kittiwake (*Rissa tridactyla*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/092

Hayward, J.L. and N.A. Verbeek. 2008. Glaucous-winged Gull (*Larus glaucescens*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/059

Heather, B.D. and H.A. Robertson. 1997. The field guide to the birds of New Zealand. Oxford University Press, Oxford, UK.

Henkel, L.A. 2004. Seasonal abundance of marine birds in nearshore waters of Monterey Bay, California, Western Birds 35(3):126–146.

Hoffman, W., D. Heinemann, and J.A. Wiens. 1981. The ecology of seabird feeding flocks in Alaska. Auk 98:437–456.

Huntington, C.E., R.G. Butler and R.A. Mauck. 1996. Leach's Storm-Petrel (*Oceanodroma leucorhoa*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/233

Islam, K. 2002. Heermann's Gull (*Larus heermanni*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/643

Jaques, D.L. 1994. Range expansion and roosting ecology of non-breeding California Brown Pelicans. Master's Thesis. University of California, Davis.

LaPorte, N., R.W. Storer and G.L. Nuechterlein. 2013. Western Grebe (*Aechmophorus occidentalis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/026a

Mallory, M.L., S.A. Hatch and D.N. Nettleship. 2012. Northern Fulmar (*Fulmarus glacialis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/361.

Mason, J.W., G.J. McChesney, W.R. McIver, H.R. Carter, J.Y. Takekawa, R.T. Golightly, J.T. Ackerman, D.L. Orthmeyer, W.M. Perry, J.L. Yee, M.O. Pierson, and M.D. McCrary. 2007. At-sea distribution and abundance of seabirds off southern California: a 20-year comparison. Studies in Avian Biology, No. 33. 95 pp.

Morgan, K.H., K. Vermeer, and R.W. McKelvey. 1991. Atlas of pelagic birds of western Canada. Canadian

Wildlife Service Occasional Paper 72:1-72.

Naughton, M.B., D.S. Pitkin, R.W. Lowe, K.J. So, and C.S. Strong. 2007. Catalog of Oregon Seabird Colonies, US Fish and Wildlife Service, Washington D.C. Biological Technical Publication, BTP-R1009-2007. 481 pp.

Nur, N., J. Jahncke, M.P. Herzog, J. Howar, K.D. Hyrenbach, J.E. Zamon, D.G. Ainley, J.A. Wiens, K. Morgan, L.T. Ballance, and D. Stralberg. 2011. Where the wild things are: predicting hotspots of seabird aggregations in the California Current System. Ecological Applications 21:2241–2257.

Palmer, R.S. 1962. Handbook of North American birds, vol. 1. Loons through flamingos. Yale Univ. Press, New Haven, CT.

Penniman, T. M., M.C. Coulter, L.B. Spear, and R. J. Boekelheide. 1990. Western Gull. Pages 218–244 in Seabirds of the Farallon Islands: ecology, dynamics, and structure of an upwelling system community. (Ainley, D. G. and R. J. Boelkelheide, Eds.) Stanford Univ. Press, Palo Alto, CA.

Phillips, E., J. Zamon, J. Adams, K.D. Hyrenbach, P. Hodum, and L. Reinalda. 2010. Anomalous Pink-footed Shearwater abundances in Oregon and Washington coastal waters: an ecosystem indicator in the northern California Current. First World Seabird Conference. Victoria, B.C., Canada Sept. 7–11 2010.

Pierotti, R.J. and C.A. Annett. 1995. Western Gull (*Larus occidentalis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/174

Pierotti, R. 1987. Isolating mechanisms in seabirds. Evolution 41:559-570.

Pierotti, R.J. and T.P. Good. 1994. Herring Gull (*Larus argentatus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/124

Rodway, M.S. 1991. Status and conservation of breeding seabirds in British Columbia. Pages 43–102 in Supplement to the Status and Conservation of the World's Seabirds. (Croxall, J. P., Ed.) International Council for Bird Preservation Tech. Publ. No. 11, Cambridge, U.K.

Rubega, M.A., D. Schamel and D.M. Tracy. 2000. Red-necked Phalarope (*Phalaropus lobatus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/538

Russell, R.W. 2002. Pacific Loon (*Gavia pacifica*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/657a

Ruzicka, J.J., R.D. Brodeur, R.L. Emmett, J.H. Steele, J.E. Zamon, C.A. Morgan, A.C. Thomas, and T.C. Wainwright. 2012. Inter-annual variability in the Northern California Current food web structure:

Changes in energy flow pathways and the role of forage fish, euphausiids, and jellyfish. Progress in Oceanography 102:19–41.

Savard, Jean-Pierre L., D. Bordage and A. Reed. 1998. Surf Scoter (*Melanitta perspicillata*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/363

Schmutz, J. A., K. A. Trust, and A. C. Matz. 2009. Red-throated Loons (*Gavia stellata*) breeding in Alaska, USA, are exposed to PCBs while on their Asian wintering grounds. Environmental Pollution 157:2386-2393.

Shields, M. 2002. Brown Pelican (*Pelecanus occidentalis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/609

Snell, R.R. 2002. Thayer's Gull (*Larus thayeri*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/699b

Speich, S.M., and T.R. Wahl. 1989. Catalog of Washington Seabird Colonies. U.S. Fish & Wildlife Service. Biological Report 88(6). 510 pp.

Suryan, R.M., E.M. Phillips, K.J. So, J.E. Zamon, R.W. Lowe, and S.W. Stephensen. 2012. Marine bird colony and at-sea distributions along the Oregon coast: Implications for marine spatial planning and information gap analysis. Northwest National Marine Renewable Energy Center Report no. 2. Corvallis: NNMREC. 26 pp.

Suryan, R.M., D. P. Craig, D.D. Roby, N.D. Chelgren, K. Collis, W.D. Shouford, and D.E. Lyons. 2004. Redistribution and growth of the Caspian Tern population in the Pacific coast region of North America, 1981-2000. The Condor 106(4):777–790.

Tracy, D.M., D. Schamel and J. Dale. 2002. Red Phalarope (*Phalaropus fulicarius*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/698

USFWS. 2009. Marbled Murrelet (*Brachyramphus marmoratus*): 5-year Review. 2009. US Fish & Wildlife Service, Washington Fish and Wildlife Office, Lacey, WA, June 12, 2009. 85pp. + Appendicies. Retrieved from http://ecos.fws.gov/docs/five_year_review/doc2417.pdf

Wahl, T.R., and D. Heinemann. 1979. Seabirds and fishing vessels: co-occurrence and attraction. The Condor 81:390-396.

Wiley, R.H. and D.S. Lee. 2000. Pomarine Jaeger (*Stercorarius pomarinus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/483

Wiley, R.H. and David S. Lee. 1999. Parasitic Jaeger (*Stercorarius parasiticus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/445

Wiley, R.H. and David S. Lee. 1998. Long-tailed Jaeger (*Stercorarius longicaudus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/365

Winkler, D.W. 1996. California Gull (*Larus californicus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/259

7.0 Species Distribution Maps

Given the large latitudinal extent of the PaCSEA survey area, broad-scale maps were divided into north and south sub-scenes at 43° 20′ N (i.e., just north of Cape Arago, OR). Maps for the two surveys completed in each season (winter, summer, and fall) are presented on opposing pages such that the northern portion is on the left-hand side and the southern portion is on the right. In this layout, the reader can compare inter-annual and monthly differences in the density distributions among numerically abundant species. Focal area maps for a given season are all presented on the same page. All marine bird densities are set to a common scale so that visual comparisons can be made across seasons and species.

For the purposes of displaying large amounts of data in this report, seasonal broad- and focal-scale maps are only produced for marine birds if we observed a species ≥10 times (sightings) during one of the two survey periods in a given season. For example, if we only observed one flock (sighting) of 23 Pigeon Guillemots in in the focal areas in January 2011 and saw none in February 2012, we chose not to map winter focal areas for that species.

We present maps for all marine mammal sightings observed inside and outside survey strips. Marine mammal maps are arranged similarly to broad-scale marine bird maps, however the focal areas are also included at this scale and are not mapped separately.

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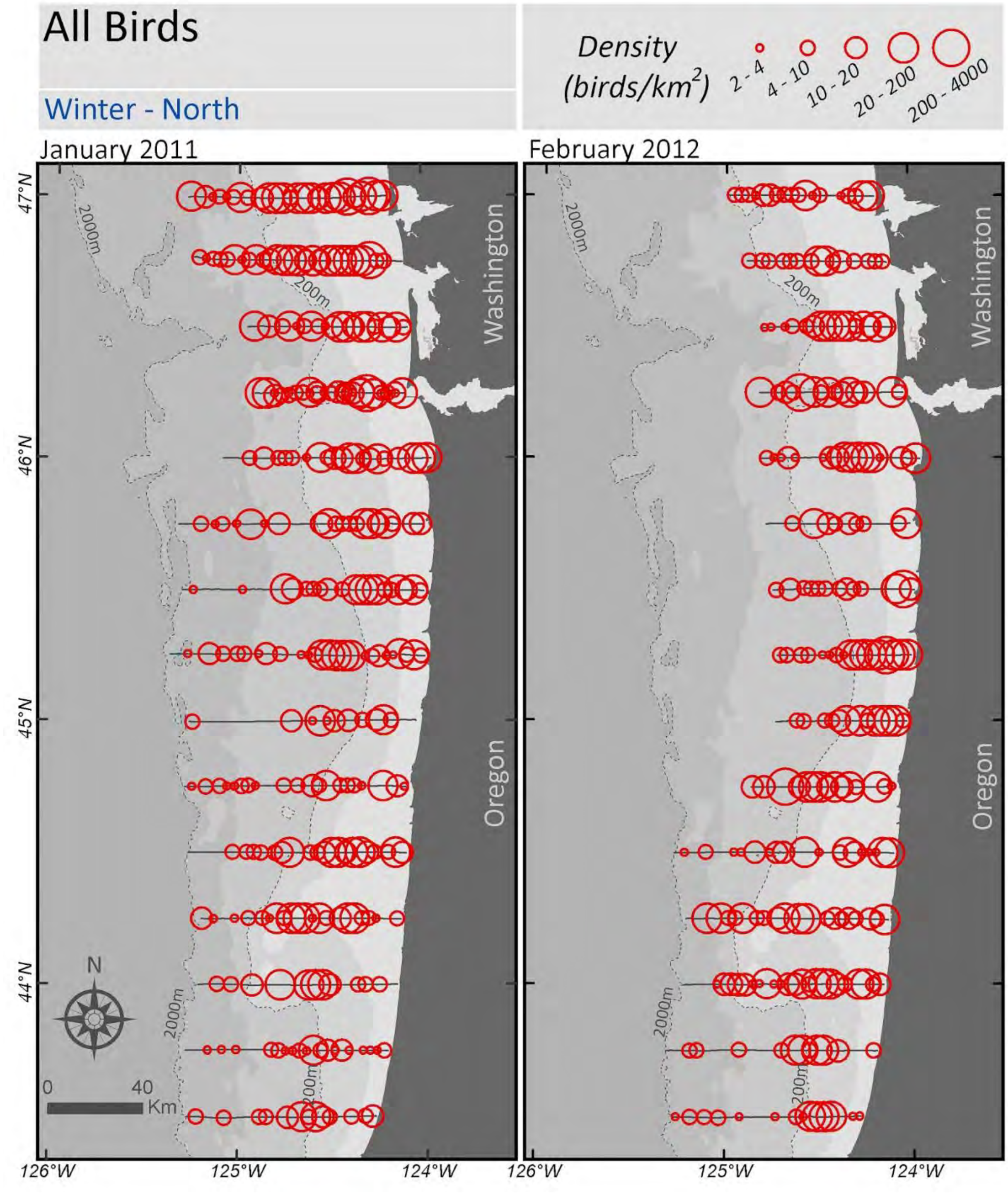
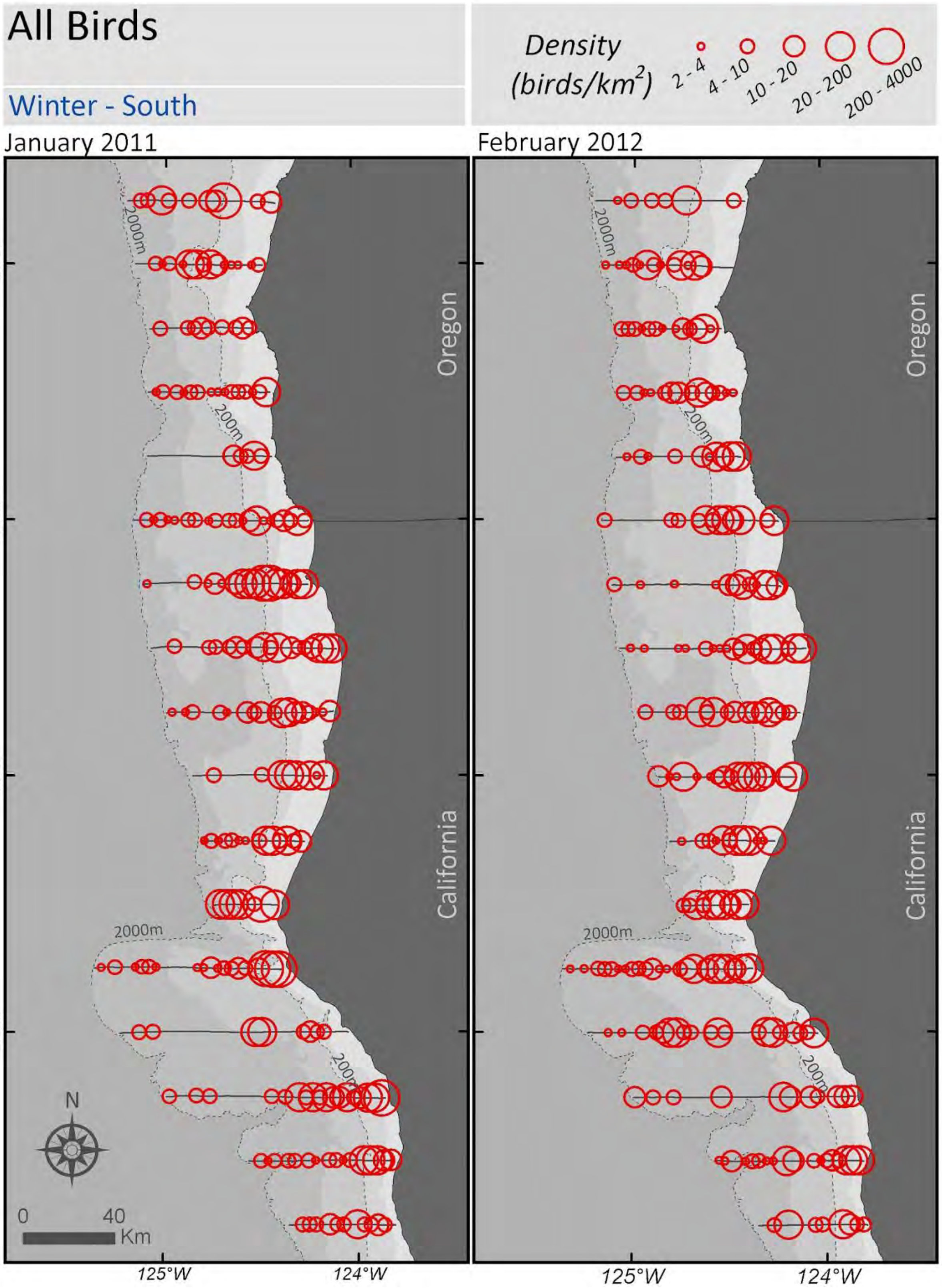


Figure 10. Mean density (birds km^{-2}) of all bird species in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


All Birds
Winter - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
January 2011
February 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

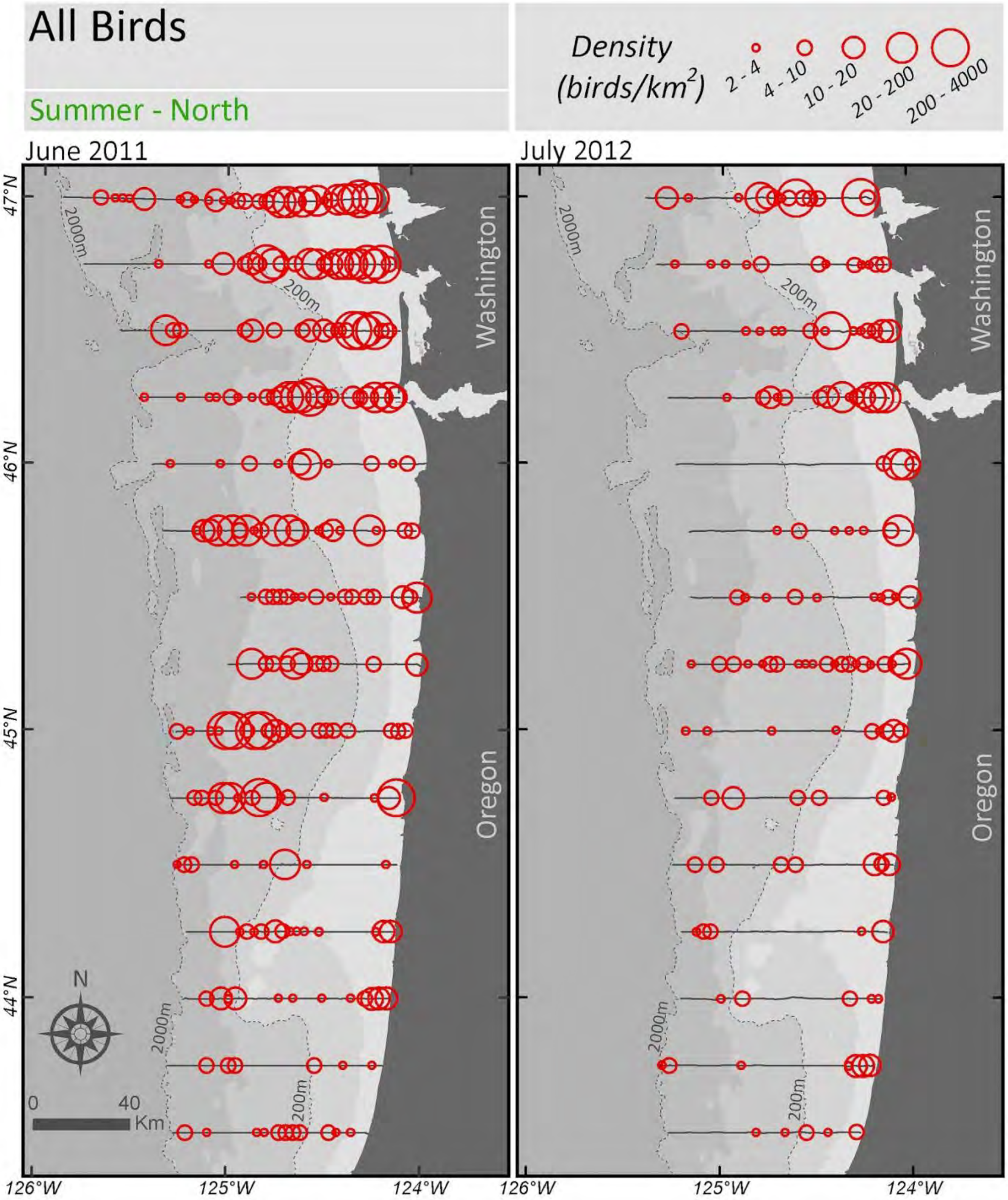
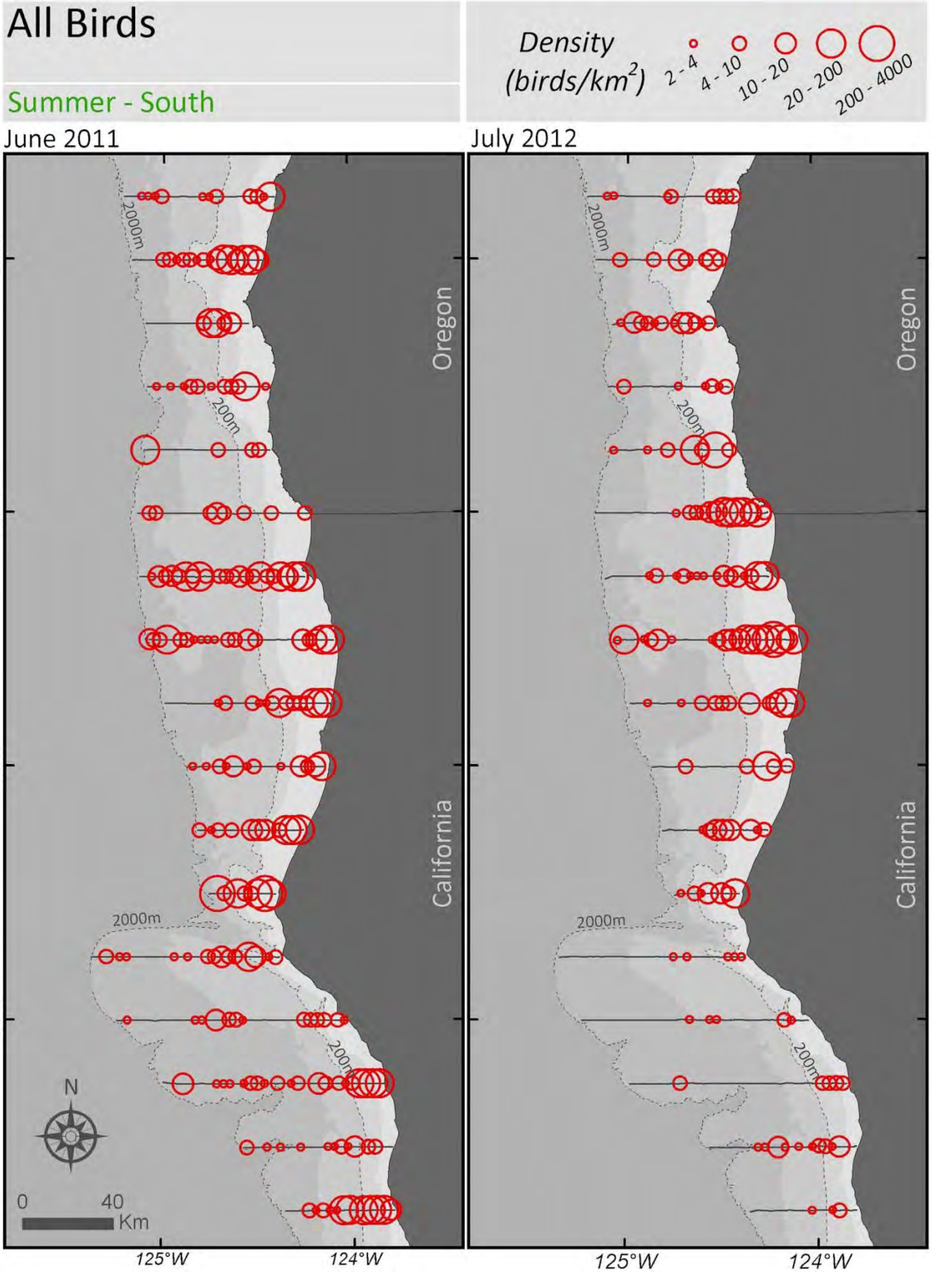


Figure 11. Mean density (birds km^{-2}) of all bird species in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


All Birds
Summer - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
43°N
42°N
41°N
40°N
125°W
124°W
2000m
200m
Oregon
California
N
0
40
Km

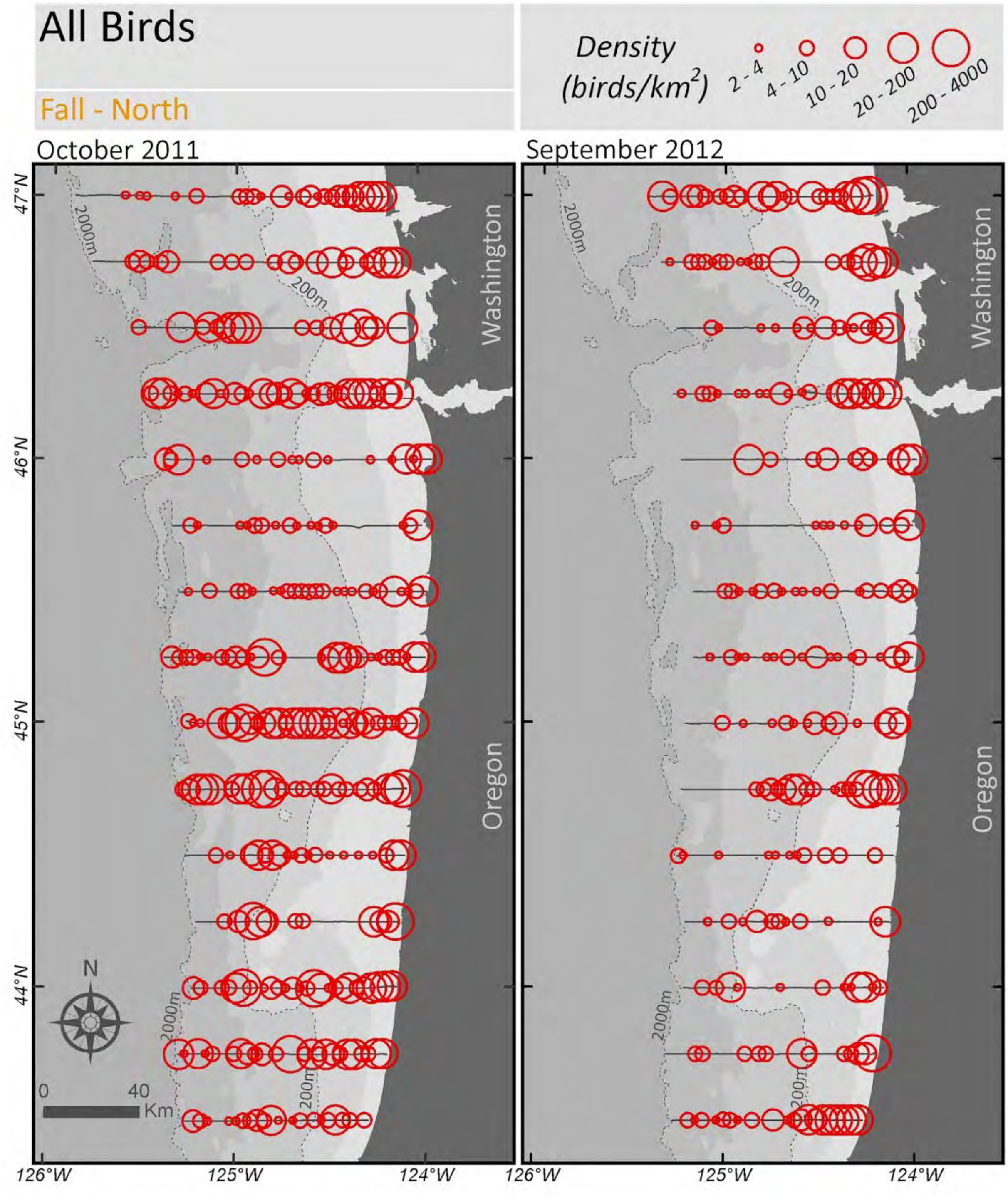
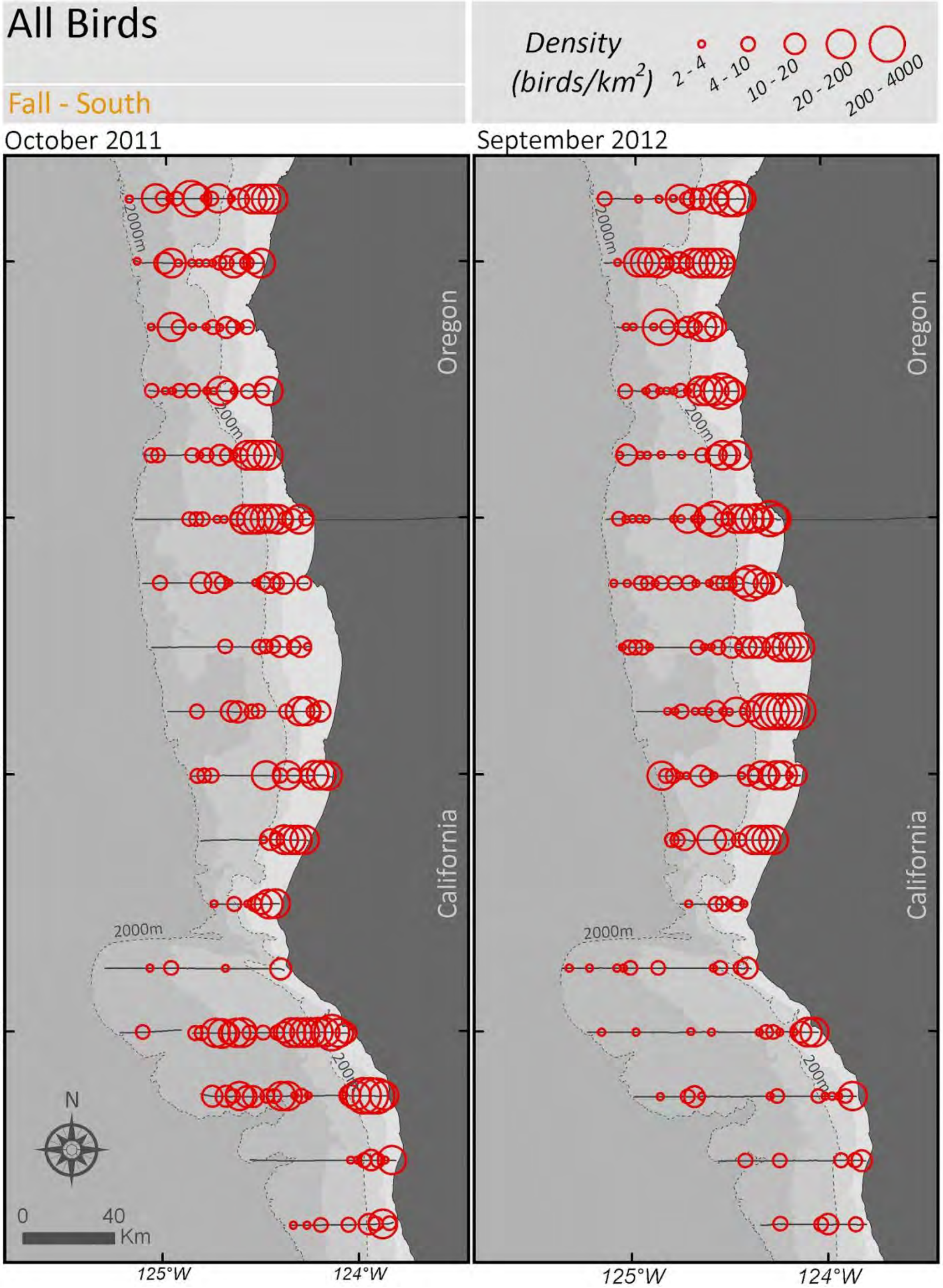


Figure 12. Mean density (birds km^{-2}) of all bird species in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

All Birds

Fall - South



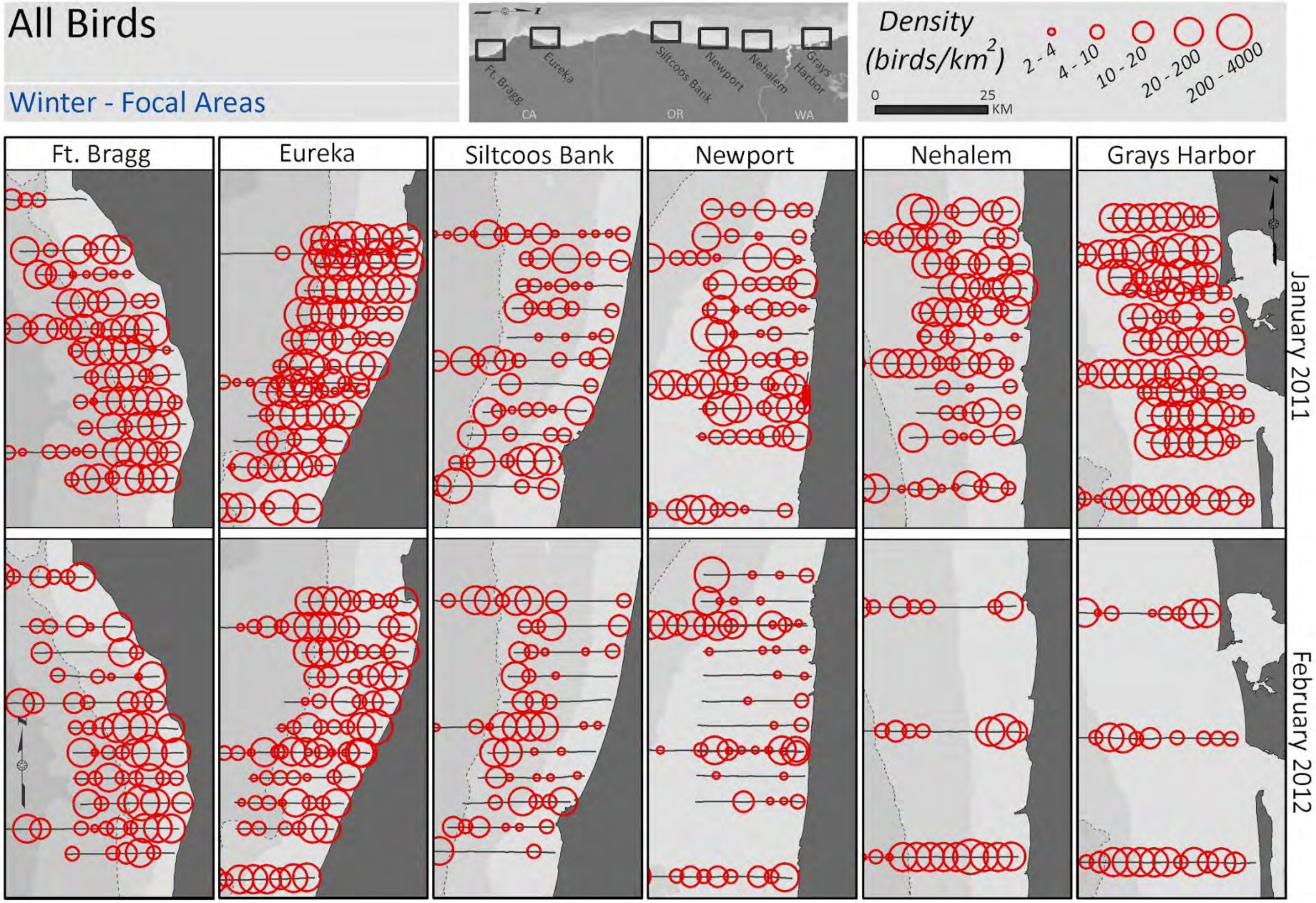


Figure 13. Mean density (birds km^{-2}) of all bird species in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

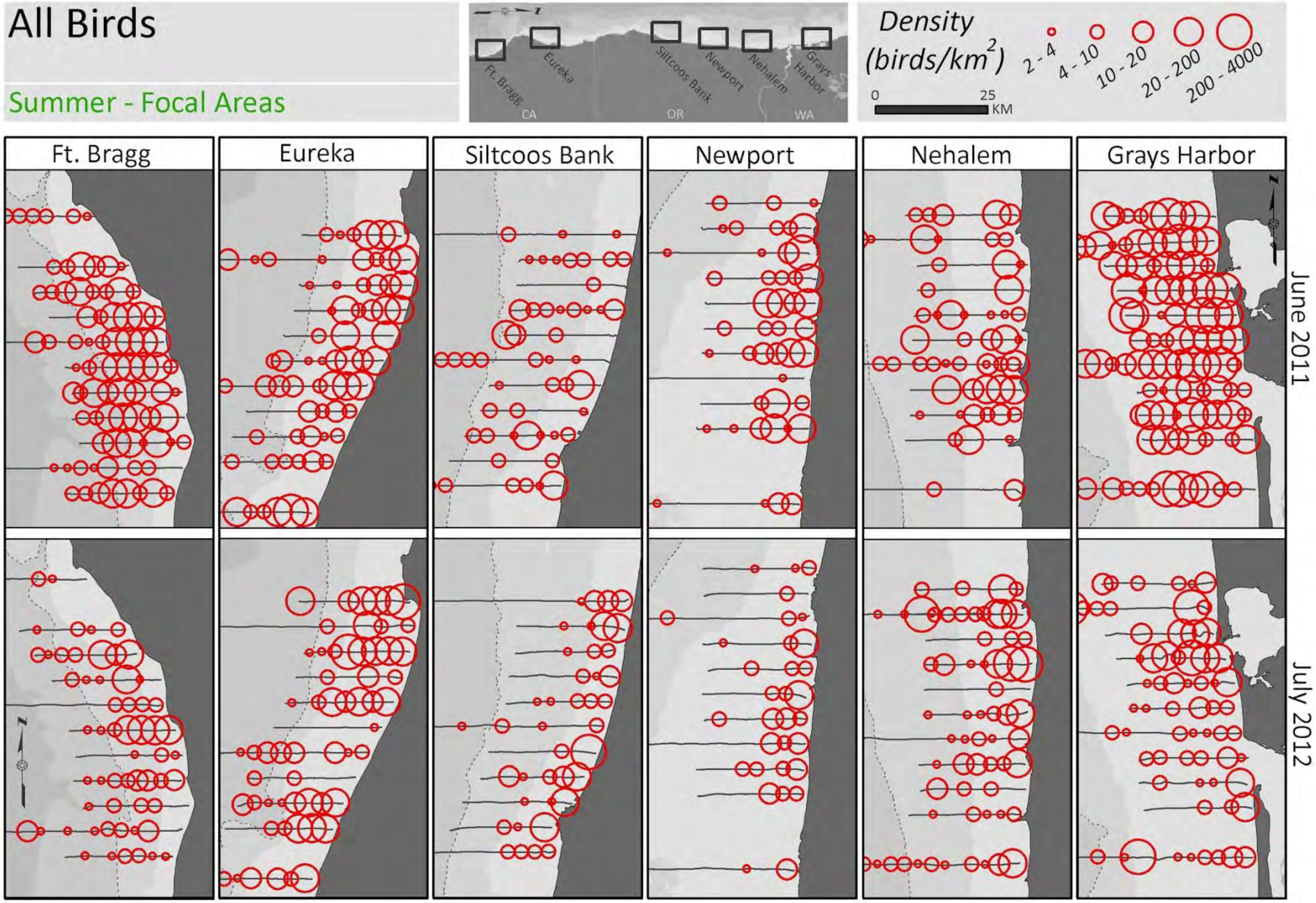


Figure 14. Mean density (birds km^{-2}) of all bird species in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

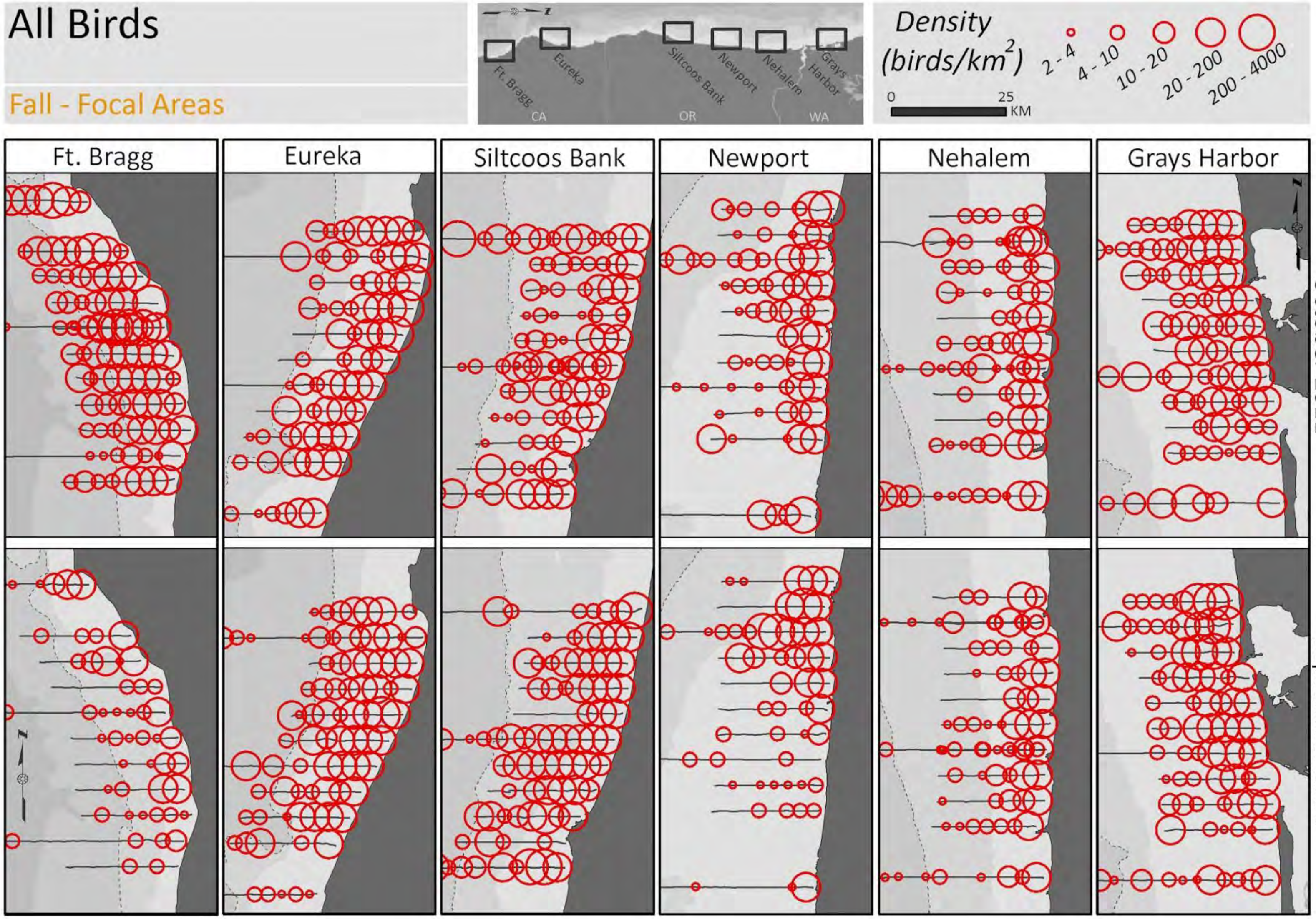


Figure 15. Mean density (birds km^{-2}) of all bird species in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

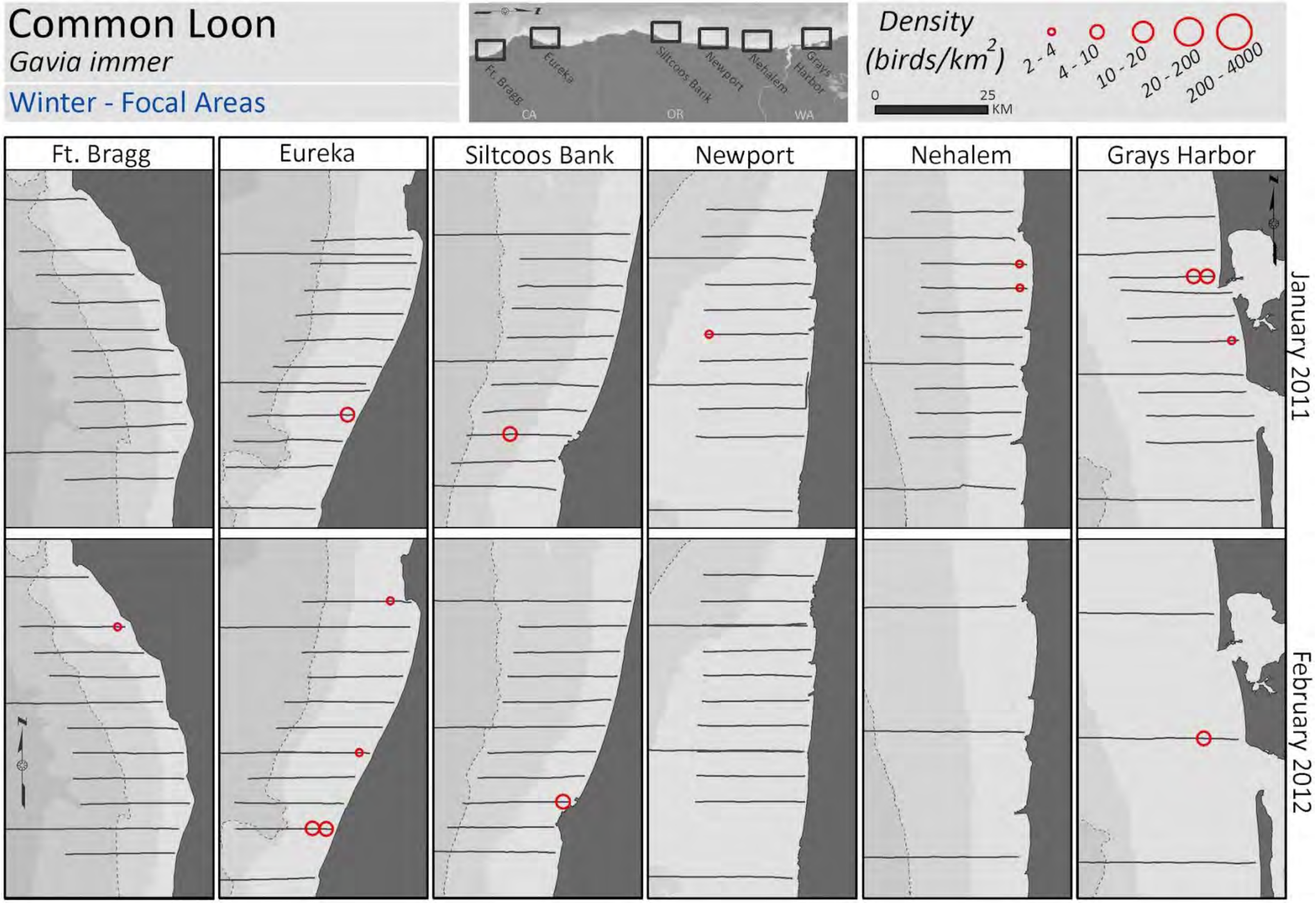


Figure 16. Mean density (birds km^{-2}) of Common Loons (*Gavia immer*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

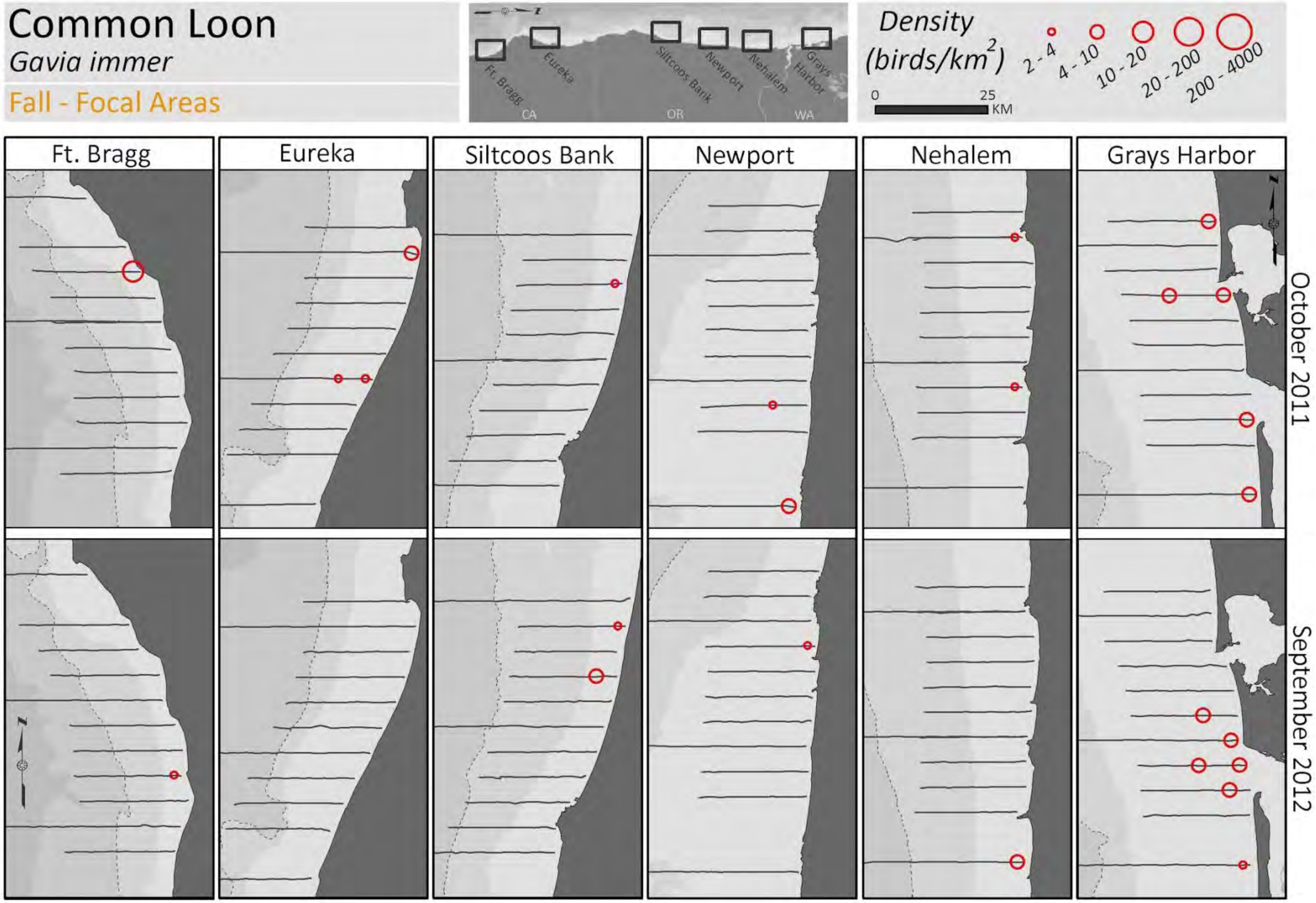


Figure 17. Mean density (birds km^{-2}) of Common Loons (*Gavia immer*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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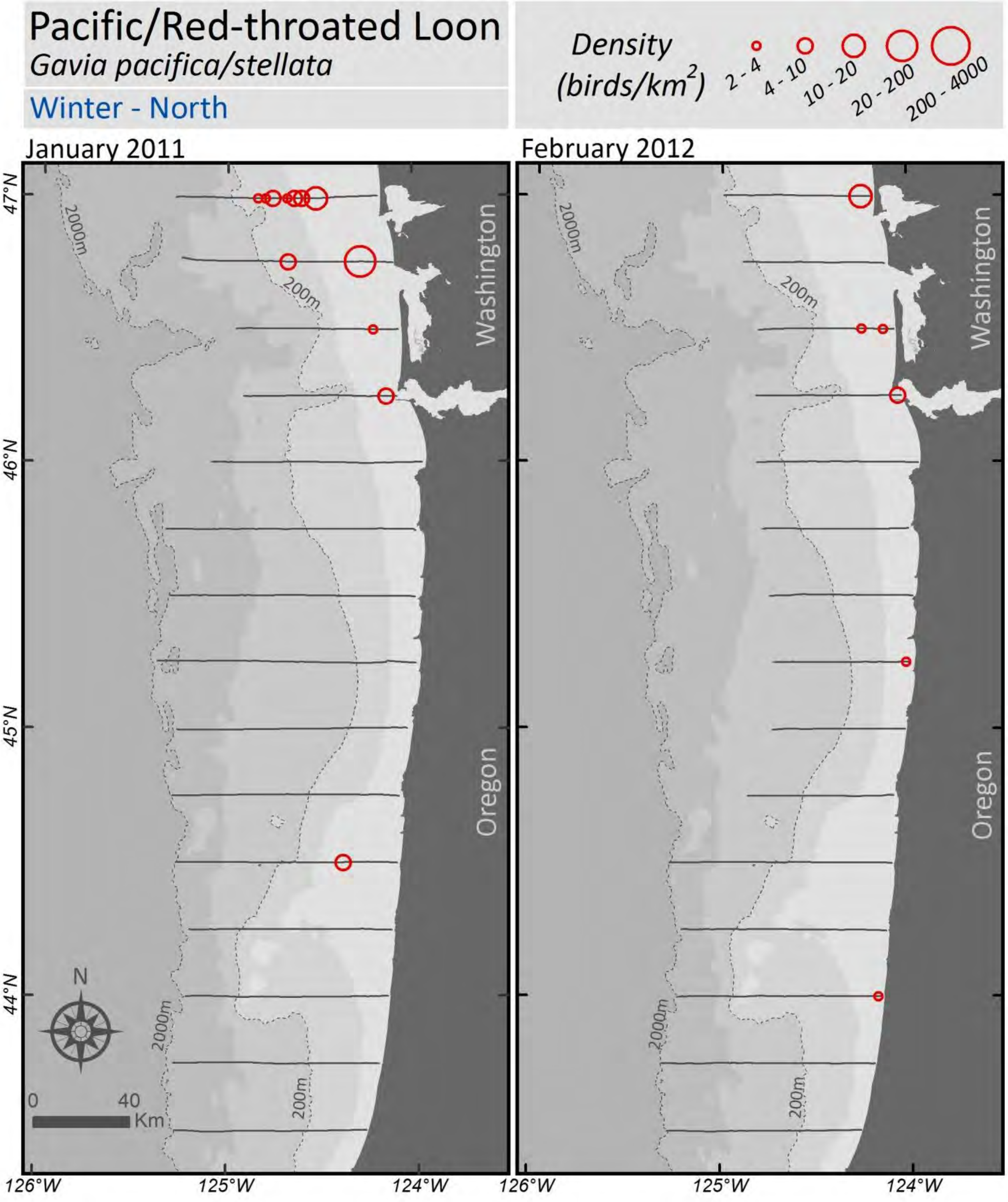
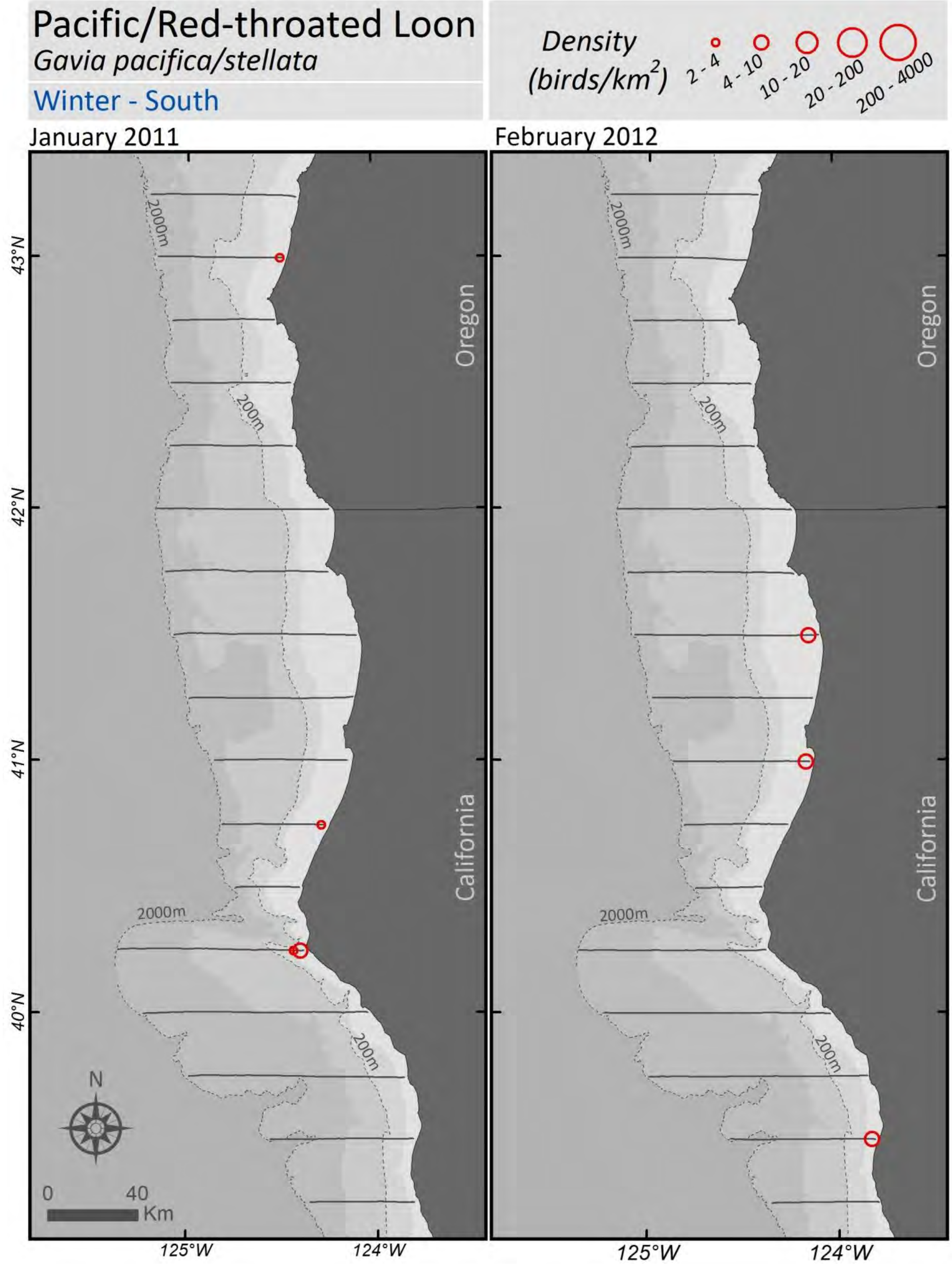


Figure 18. Mean density (birds km^{-2}) of Pacific/Red-throated loons (*Gavia pacifica/stellata*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Pacific/Red-throated Loon

Gavia pacifica/stellata

Winter - South



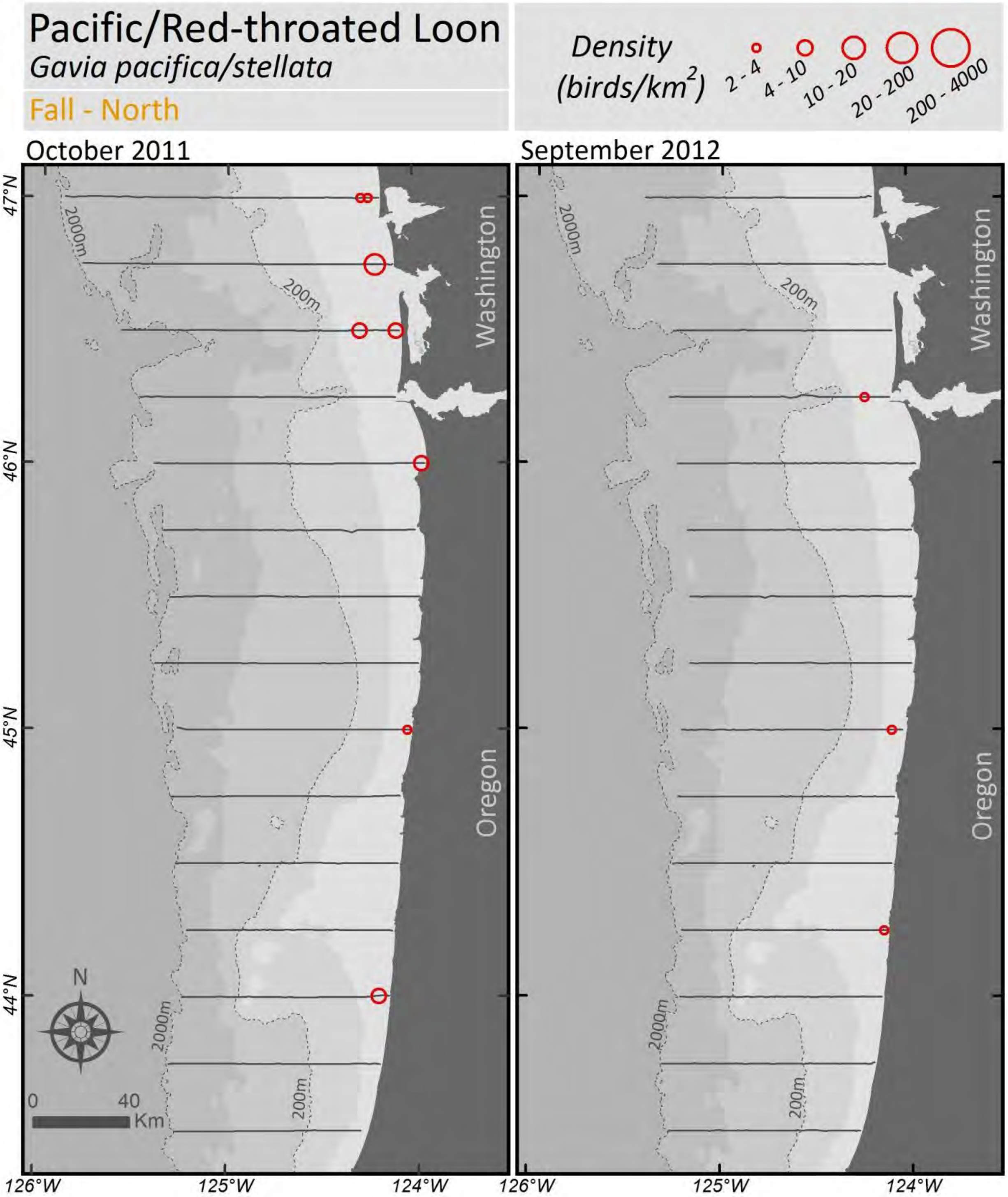
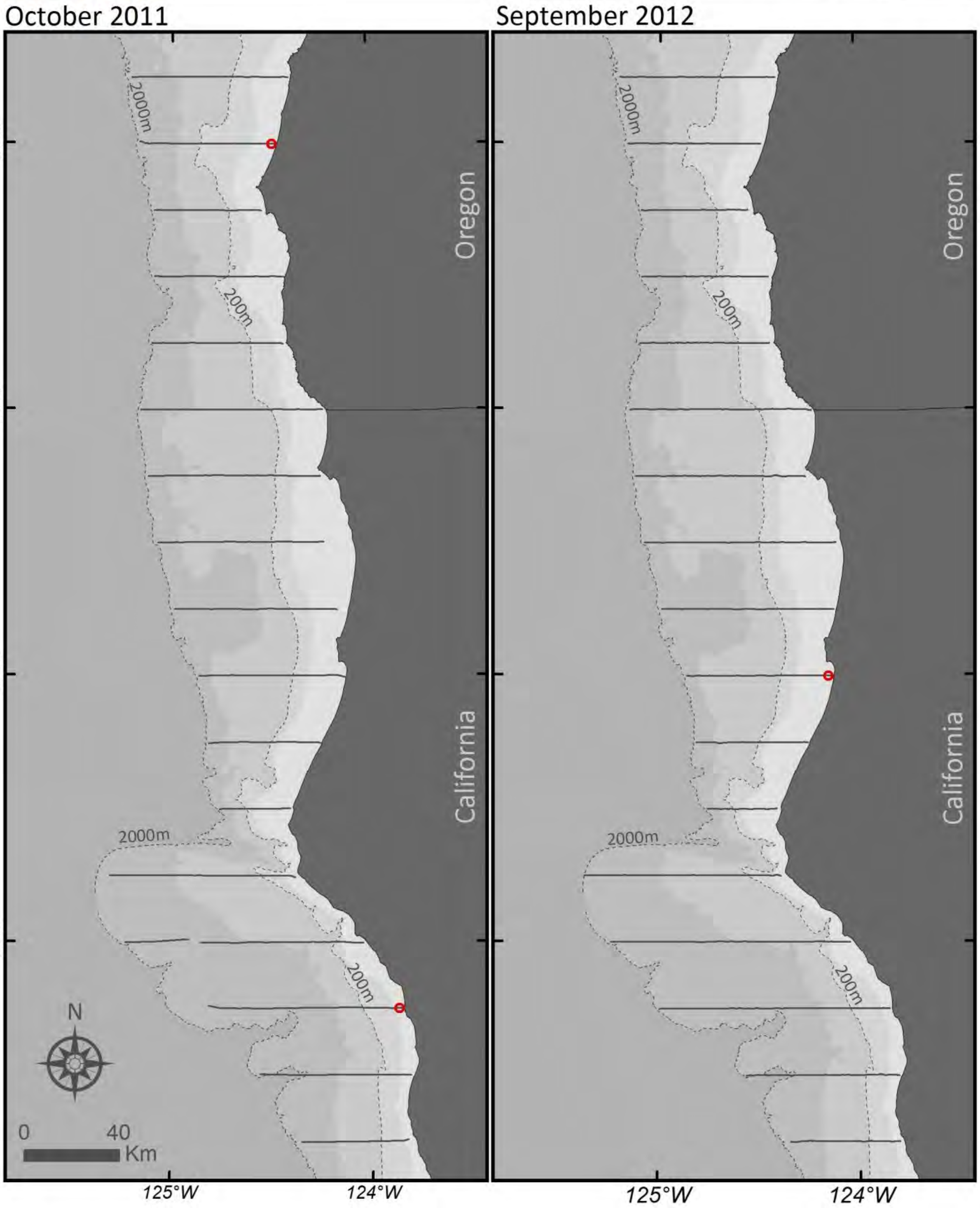


Figure 19. Mean density (birds km^{-2}) of Pacific/Red-throated loons (*Gavia pacifica/stellata*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Pacific/Red-throated Loon

Gavia pacifica/stellata

Fall - South



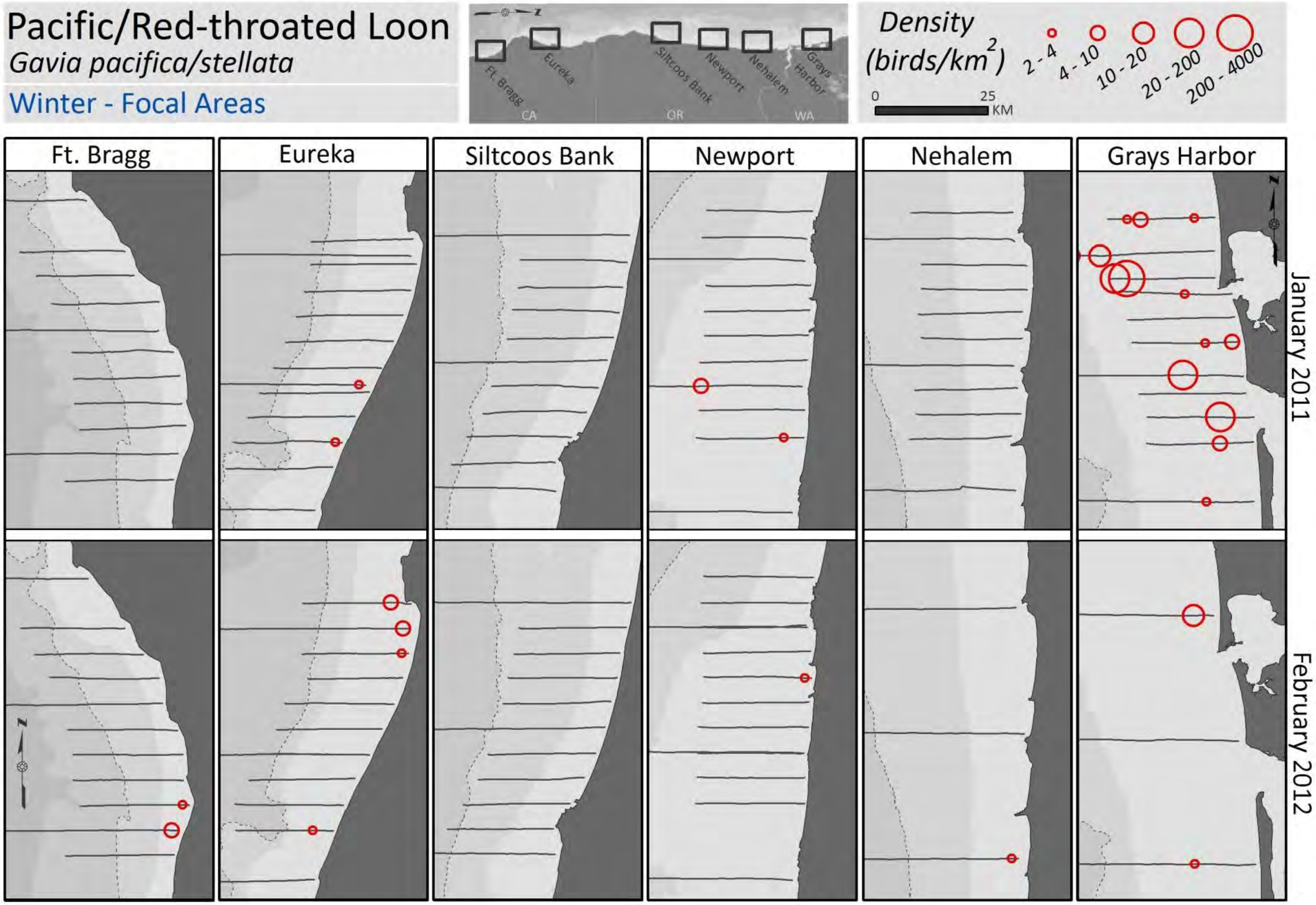


Figure 20. Mean density (birds km^{-2}) of Pacific/Red-throated loons (*Gavia pacifica/stellata*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

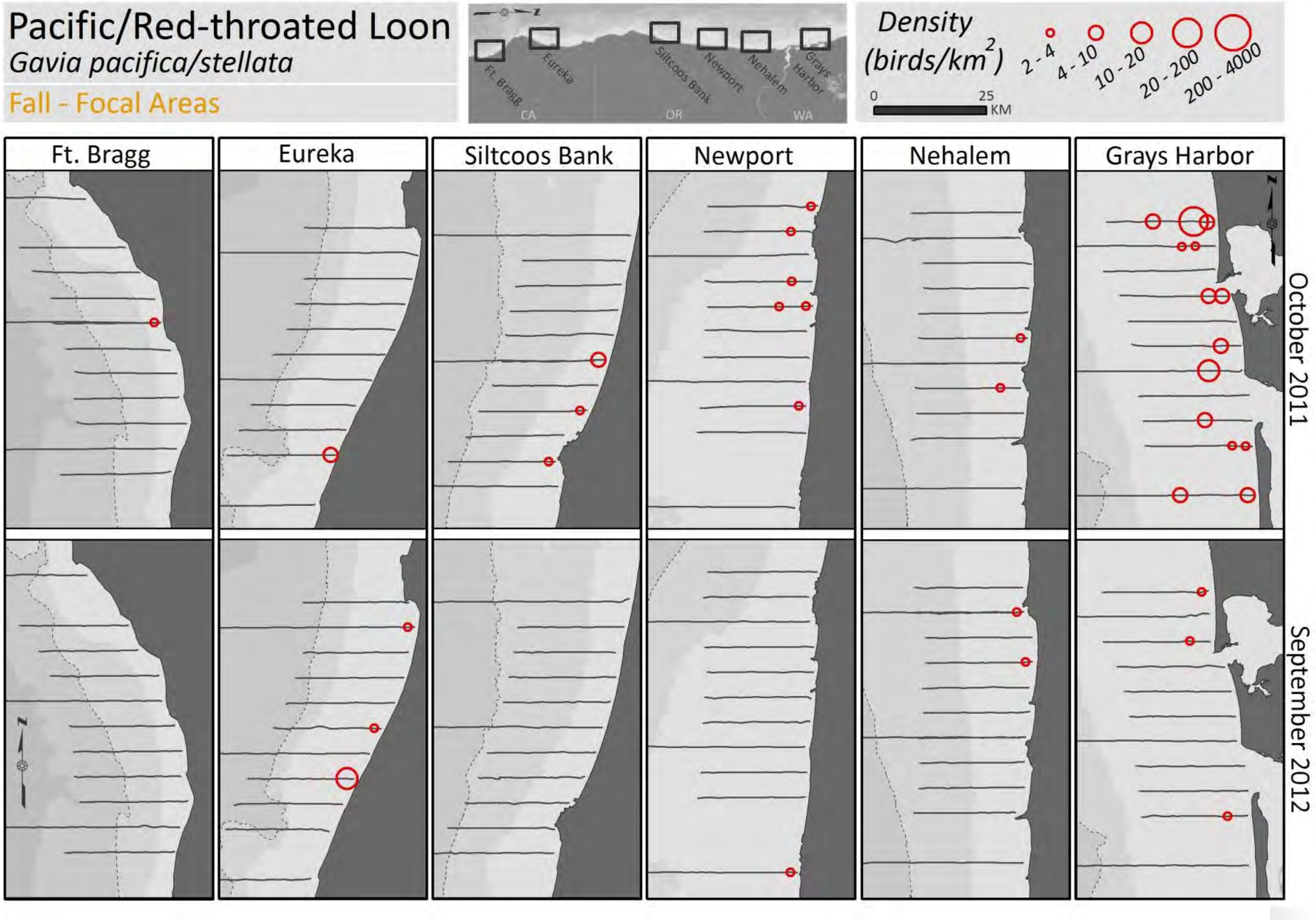


Figure 21. Mean density (birds km^{-2}) of Pacific/Red-throated loons (*Gavia pacifica/stellata*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

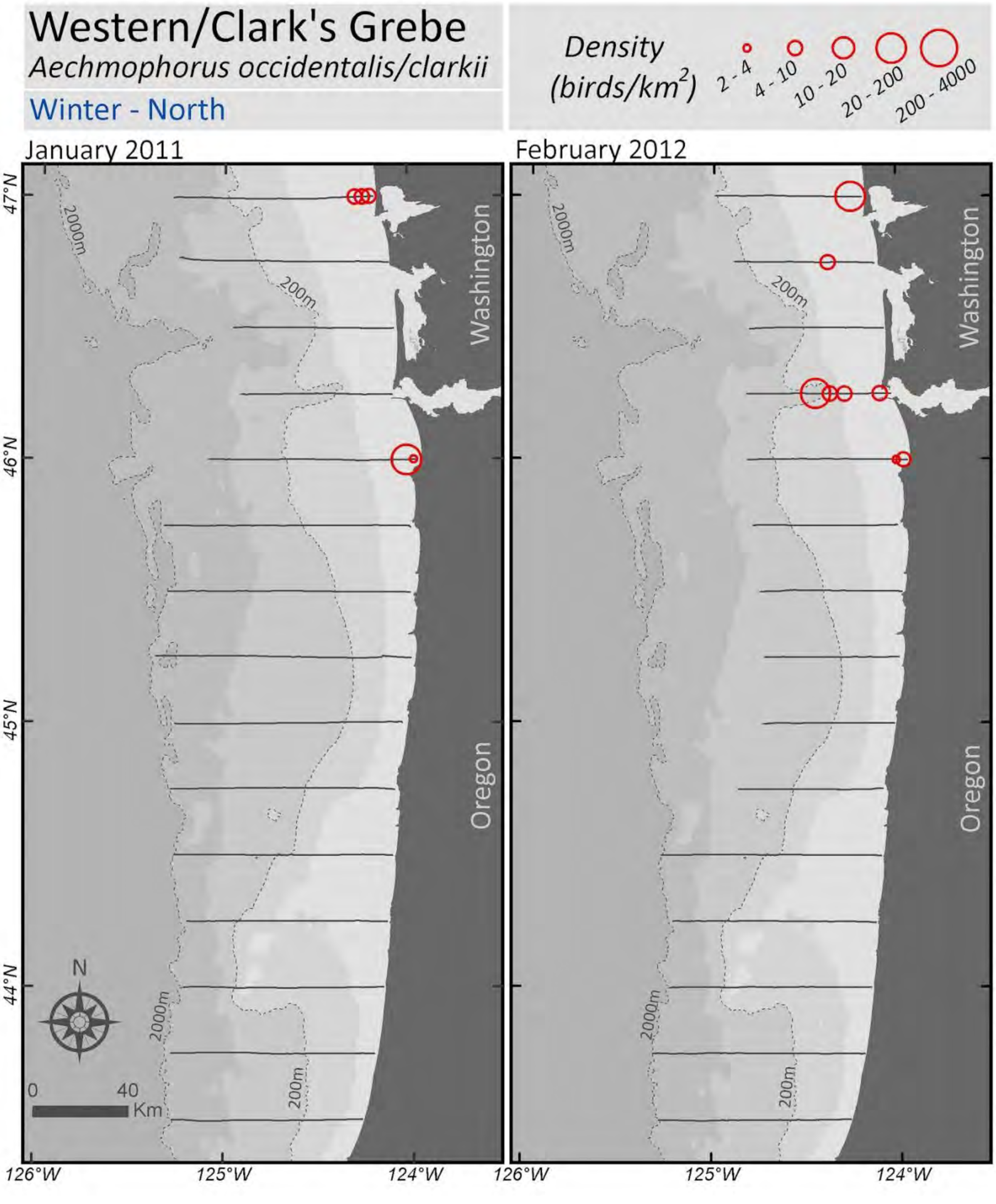
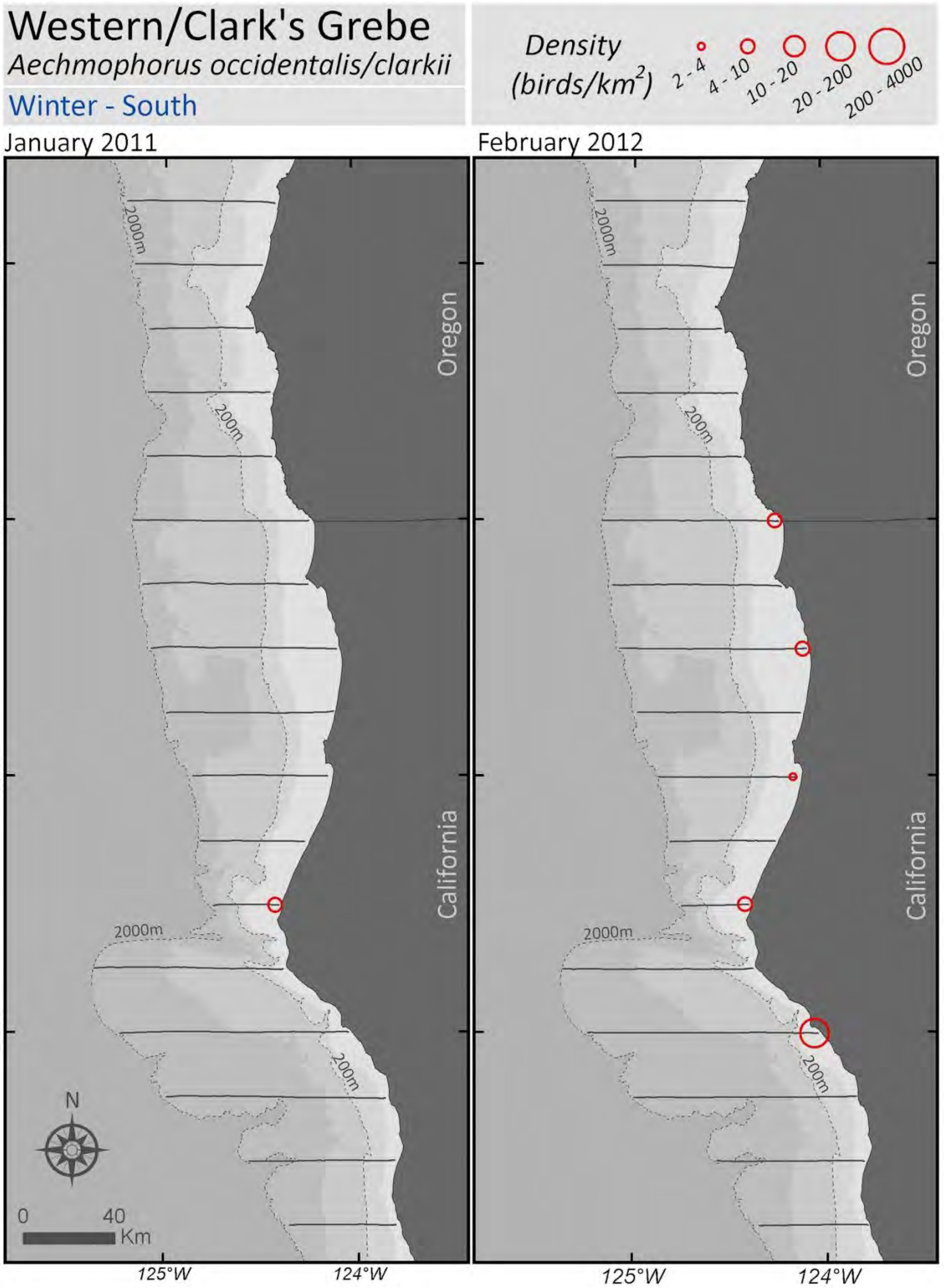


Figure 22. Mean density (birds km^{-2}) of Western/Clark's Grebes (*Aechmophorus occidentalis/clarkii*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Western/Clark's Grebe

Aechmophorus occidentalis/clarkii

Winter - South



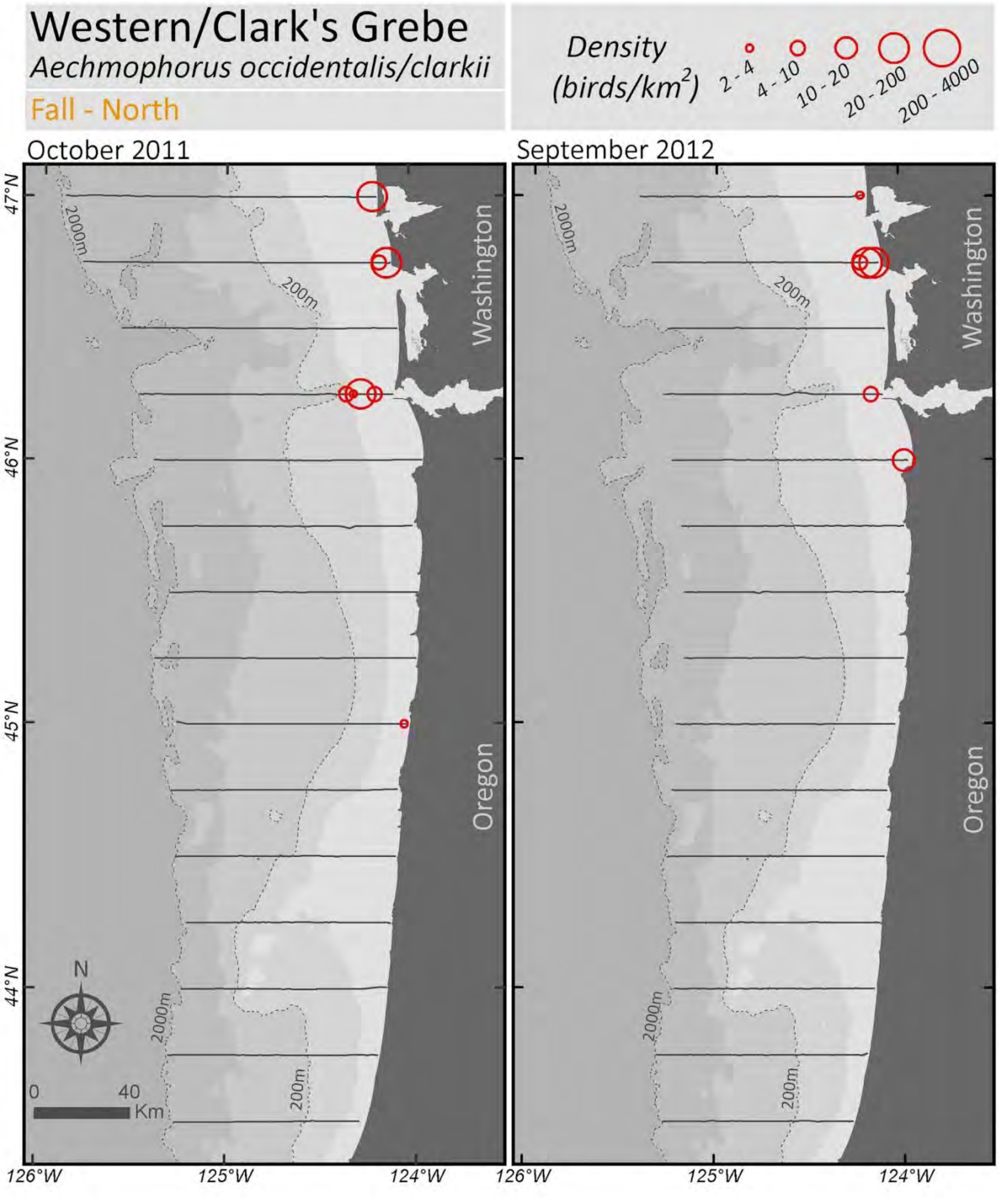
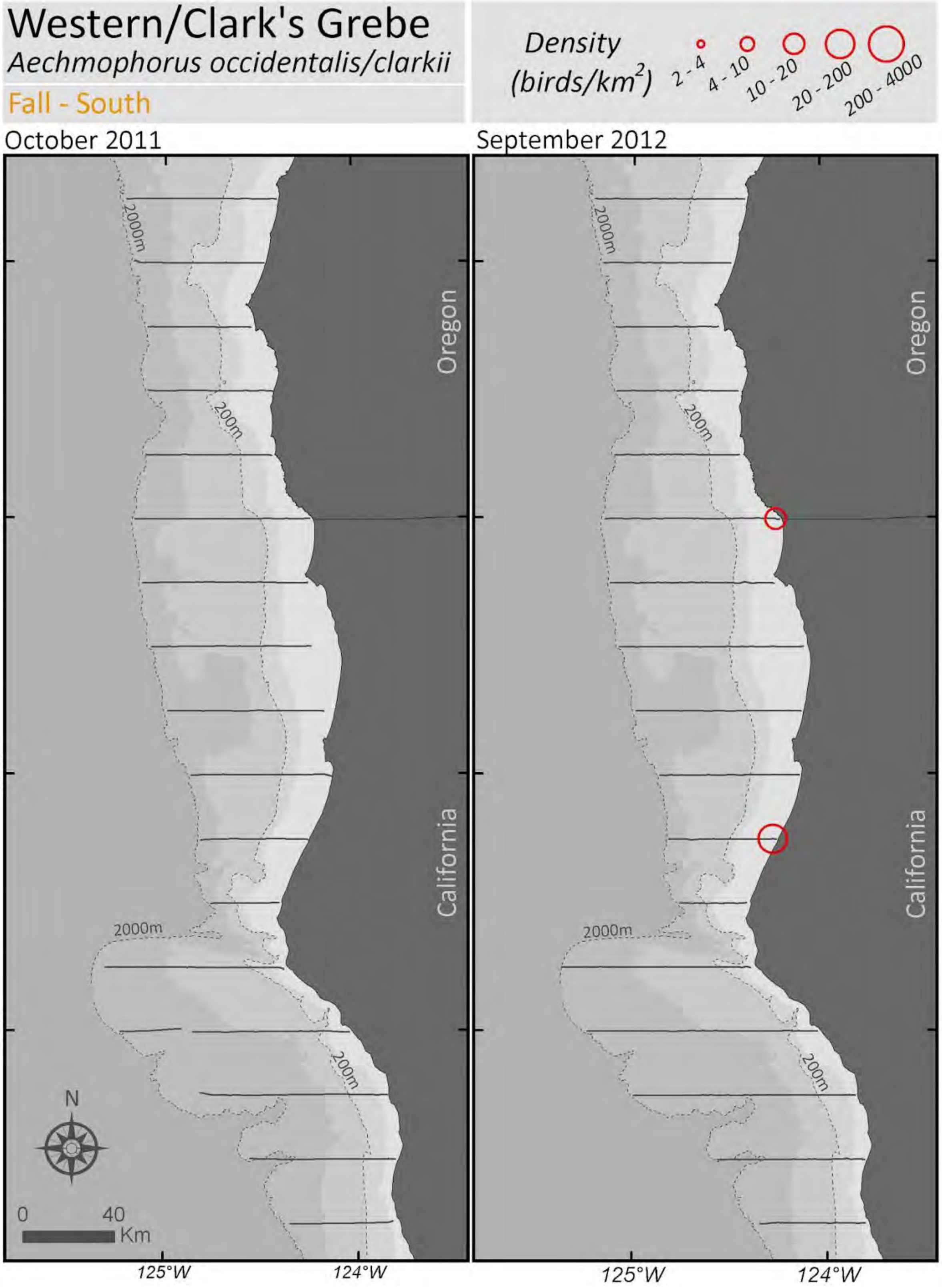


Figure 23. Mean density (birds km^{-2}) of Western/Clark's Grebes (*Aechmophorus occidentalis/clarkii*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Western/Clark's Grebe

Aechmophorus occidentalis/clarkii

Fall - South



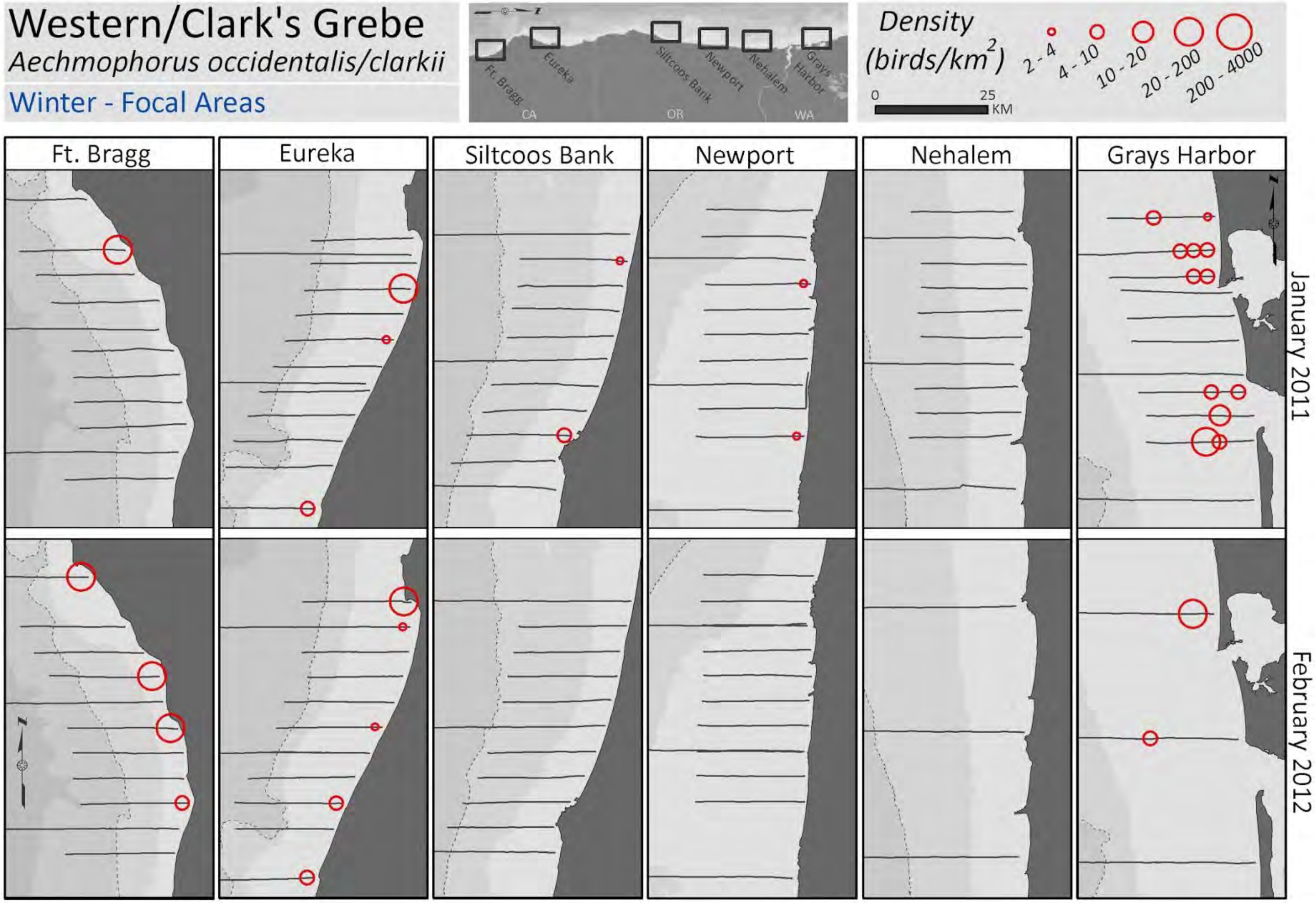


Figure 24. Mean density (birds km^{-2}) of Western/Clark's Grebes (*Aechmophorus occidentalis/clarkii*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

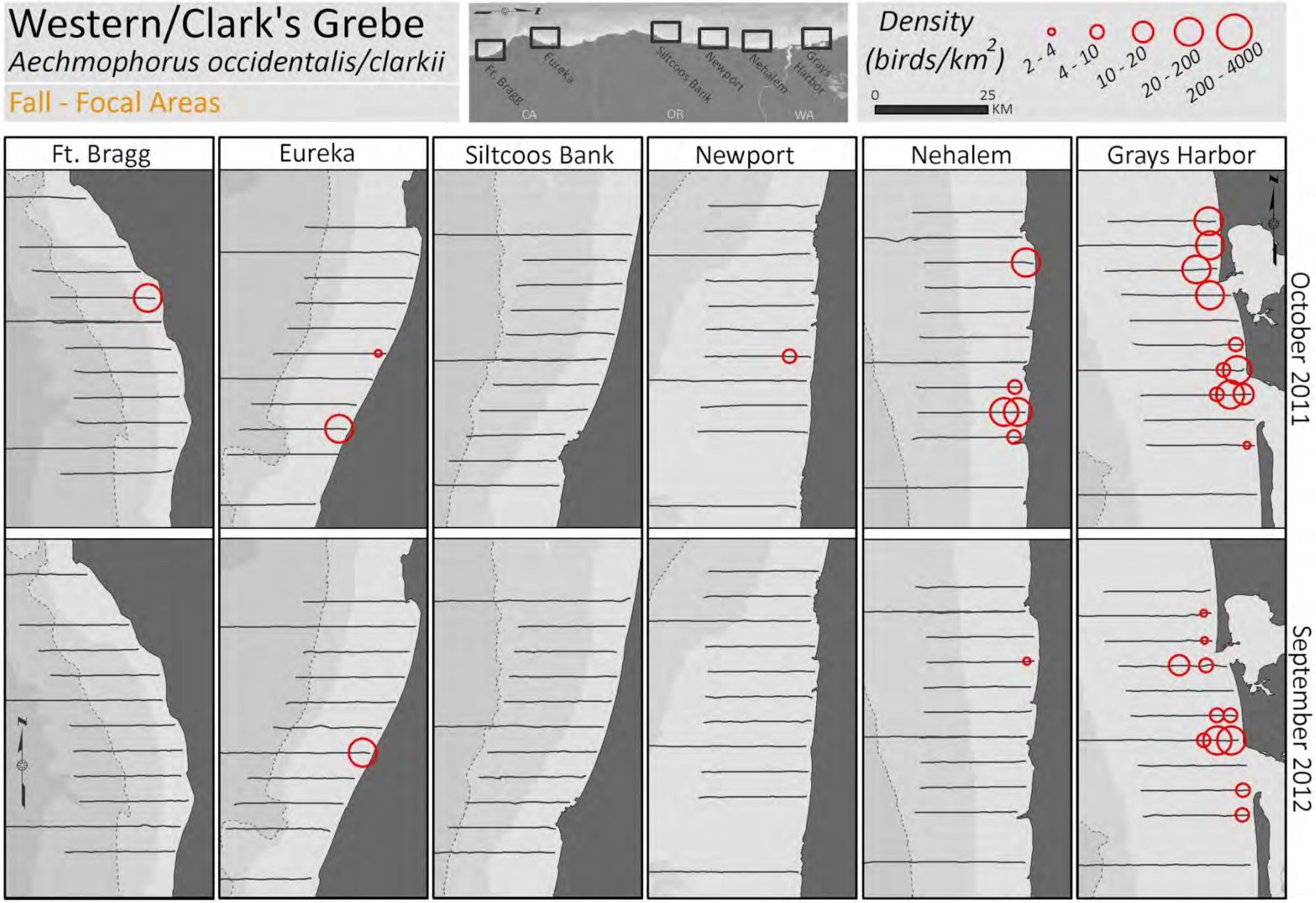


Figure 25. Mean density (birds km^{-2}) of Western/Clark's Grebes (*Aechmophorus occidentalis/clarkii*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

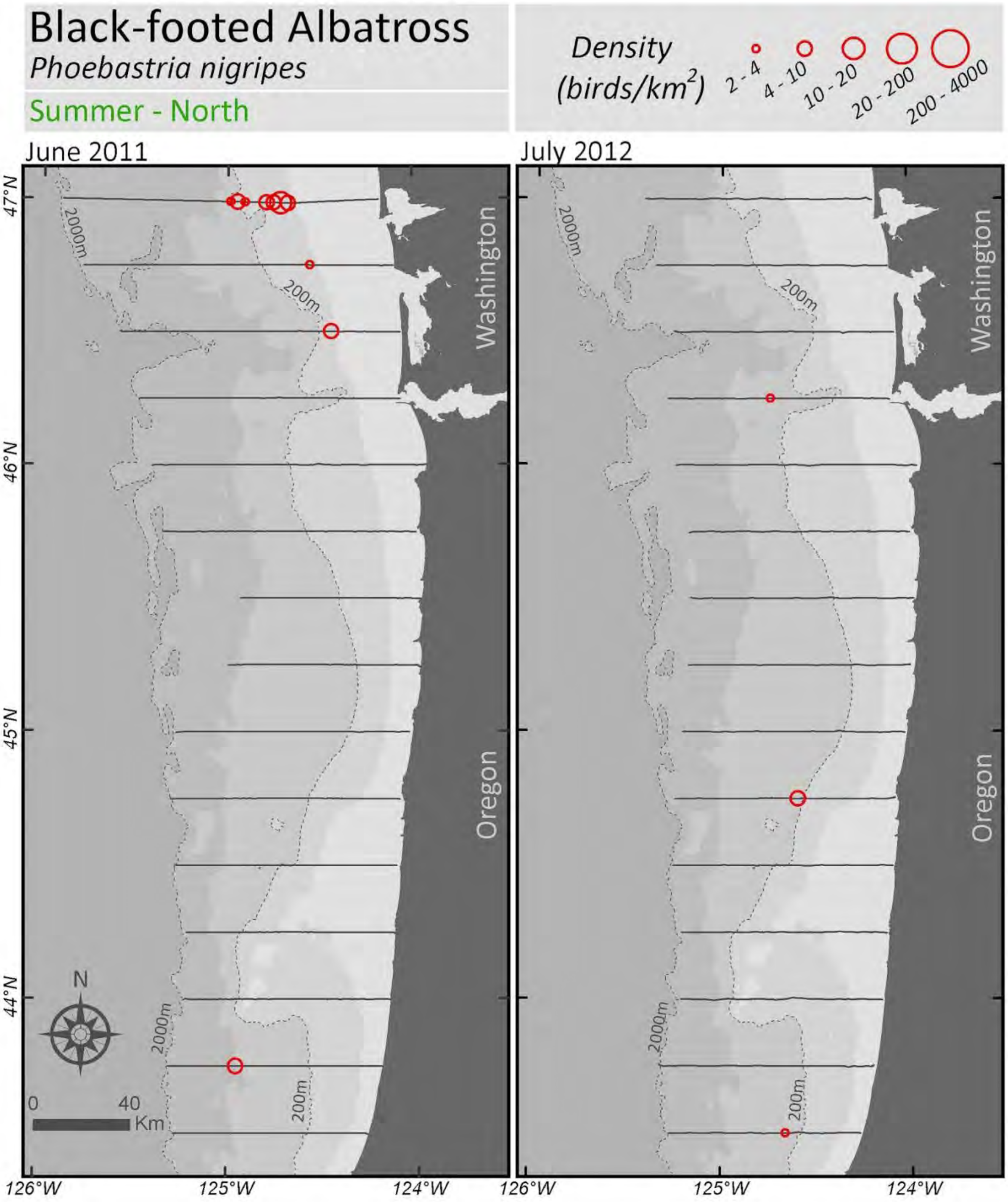
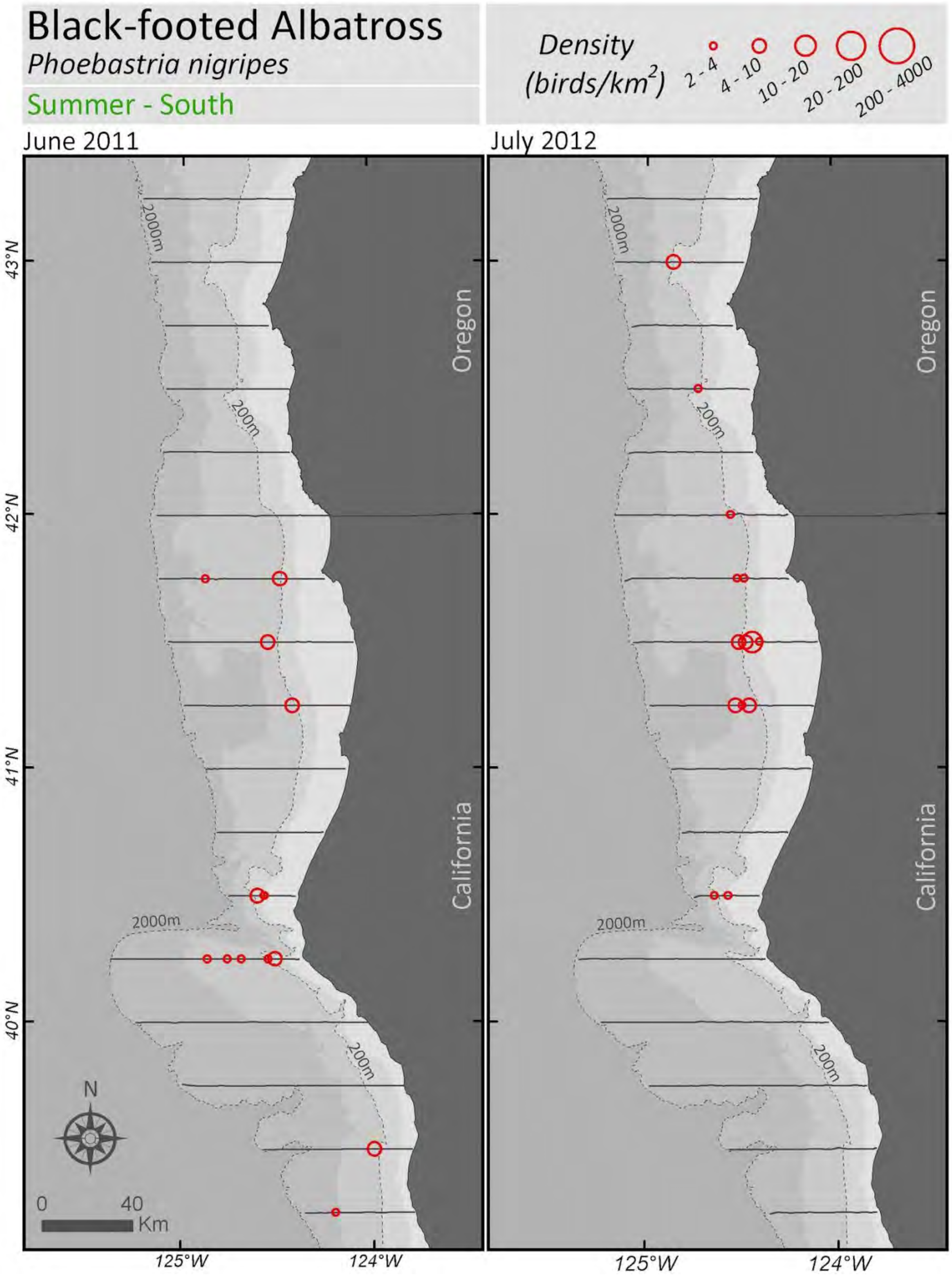


Figure 26. Mean density (birds km^{-2}) of Black-footed Albatrosses (*Phoebastria nigripes*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Black-footed Albatross
Phoebastria nigripes
Summer - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
43°N
42°N
41°N
40°N
125°W
124°W
2000m
200m
Oregon
California
N
0
40
Km

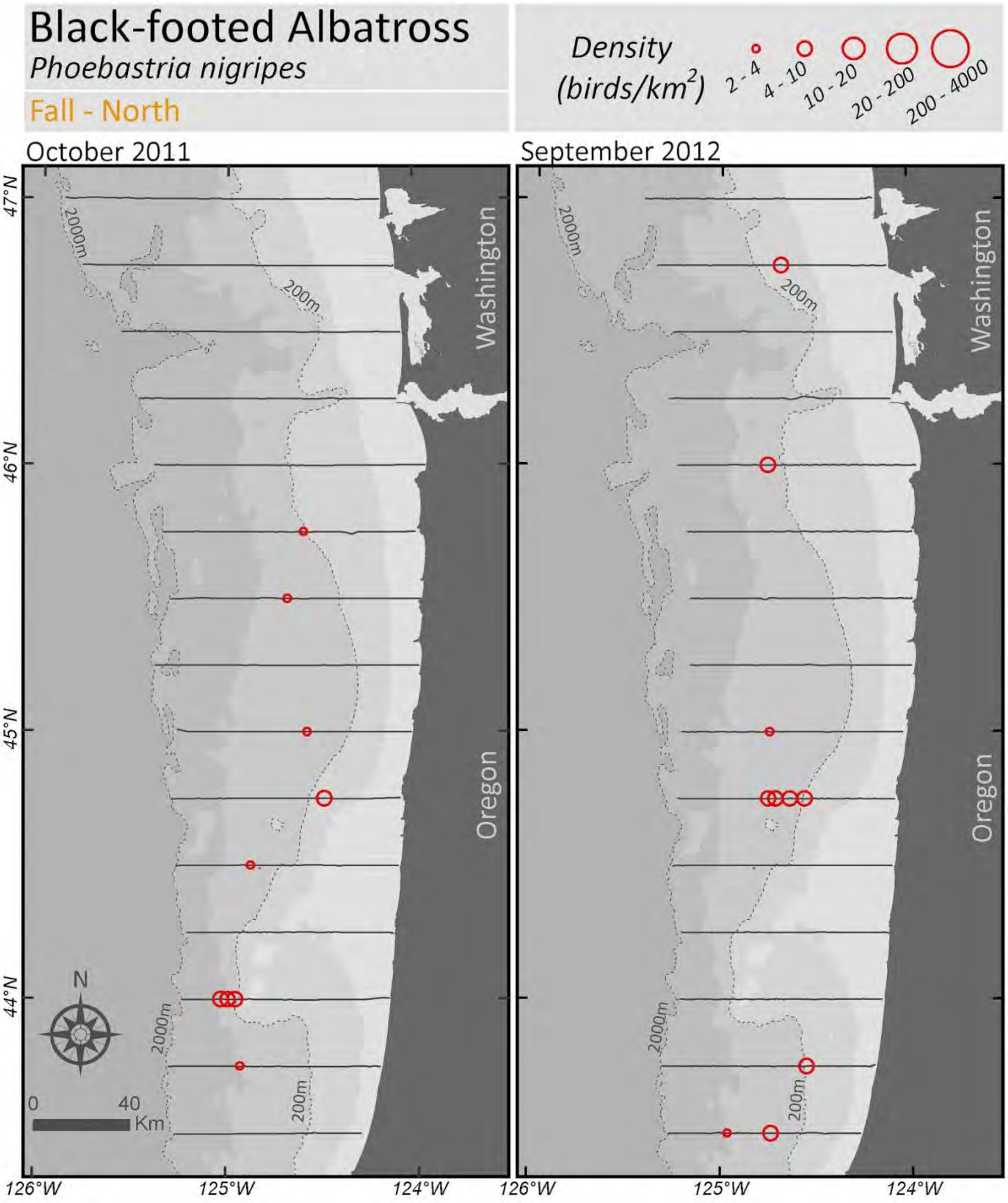
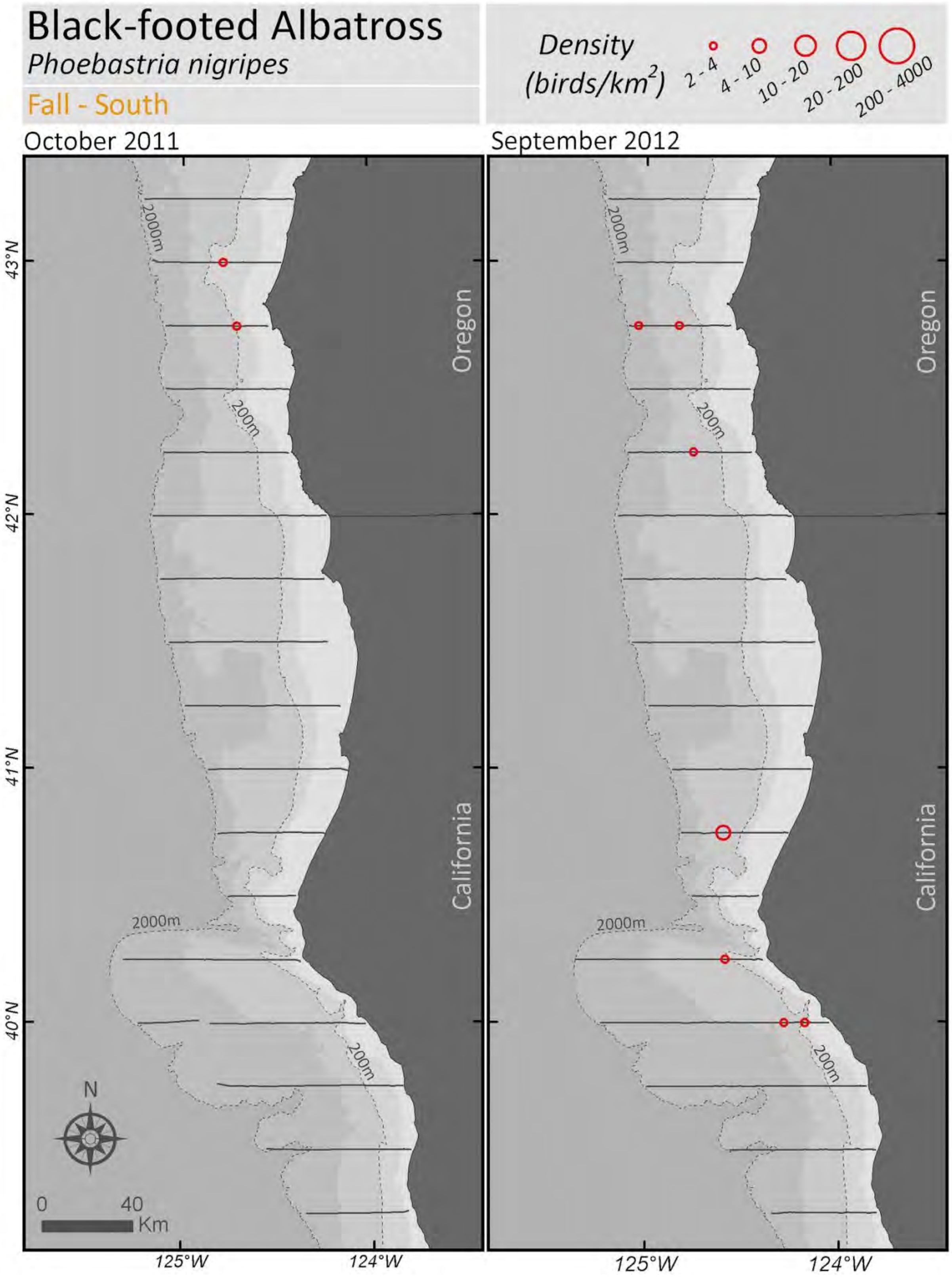


Figure 27. Mean density (birds km^{-2}) of Black-footed Albatrosses (*Phoebastria nigripes*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Black-footed Albatross
Phoebastria nigripes
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

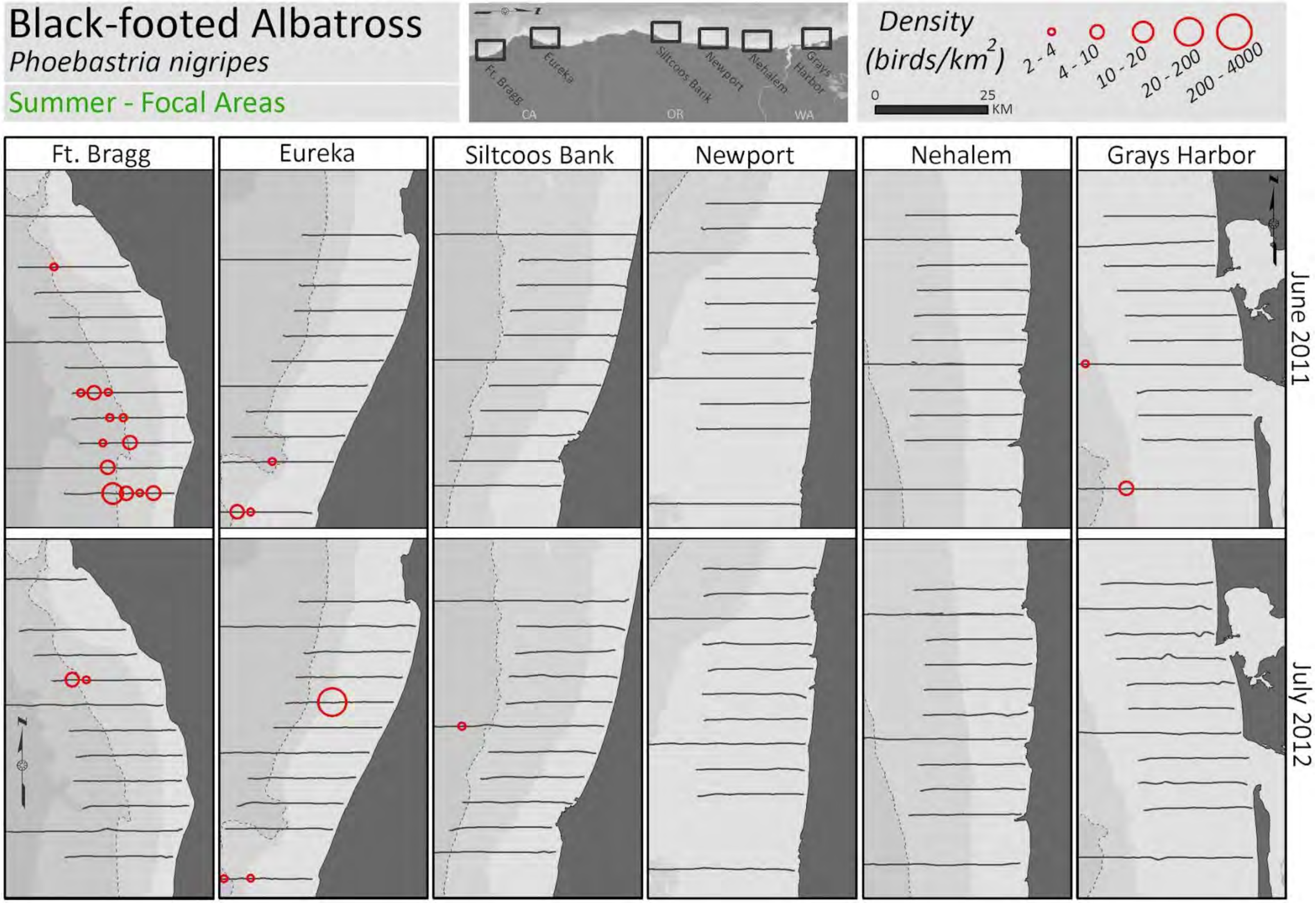


Figure 28. Mean density (birds km^{-2}) of Black-footed Albatrosses (*Phoebastria nigripes*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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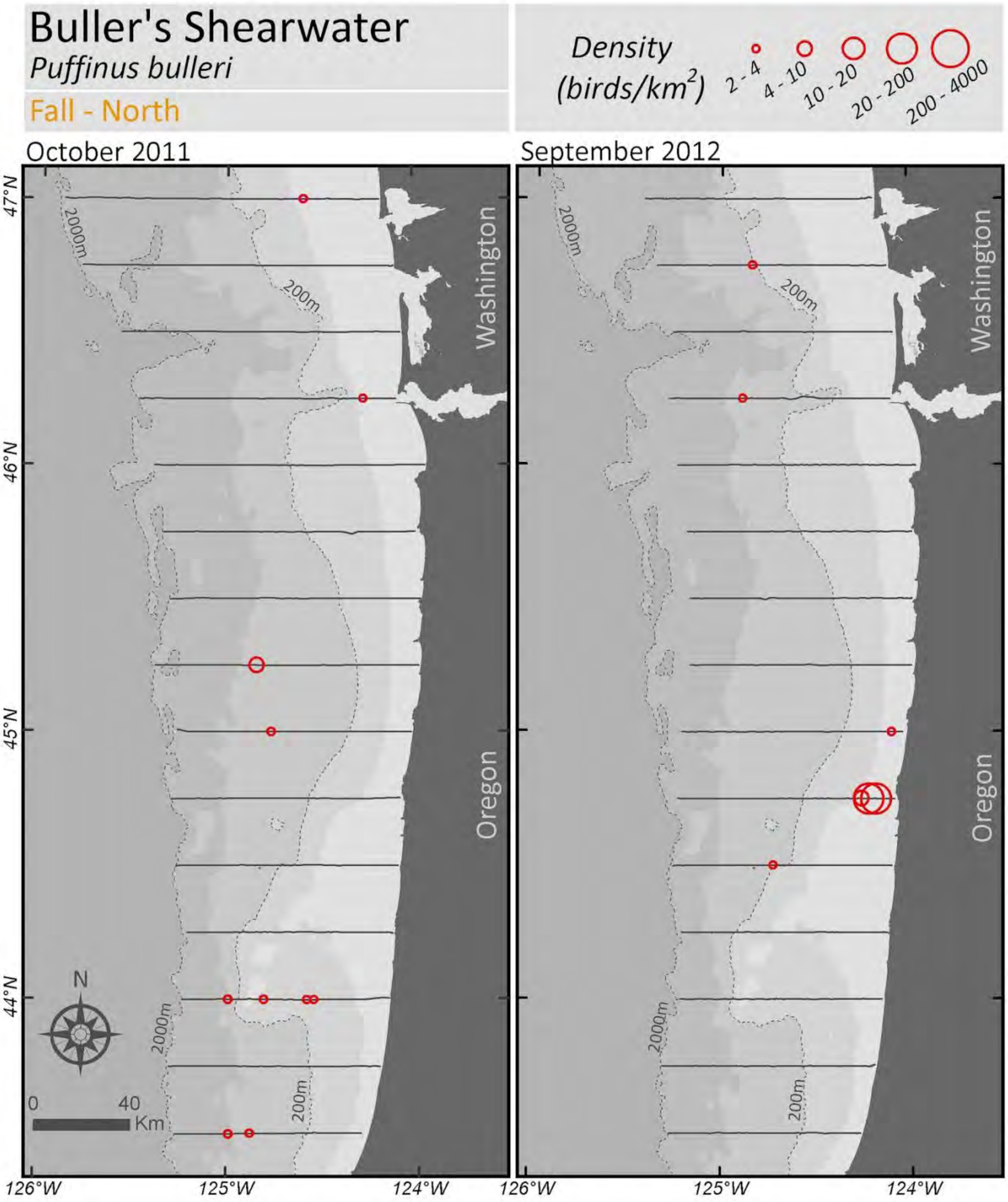
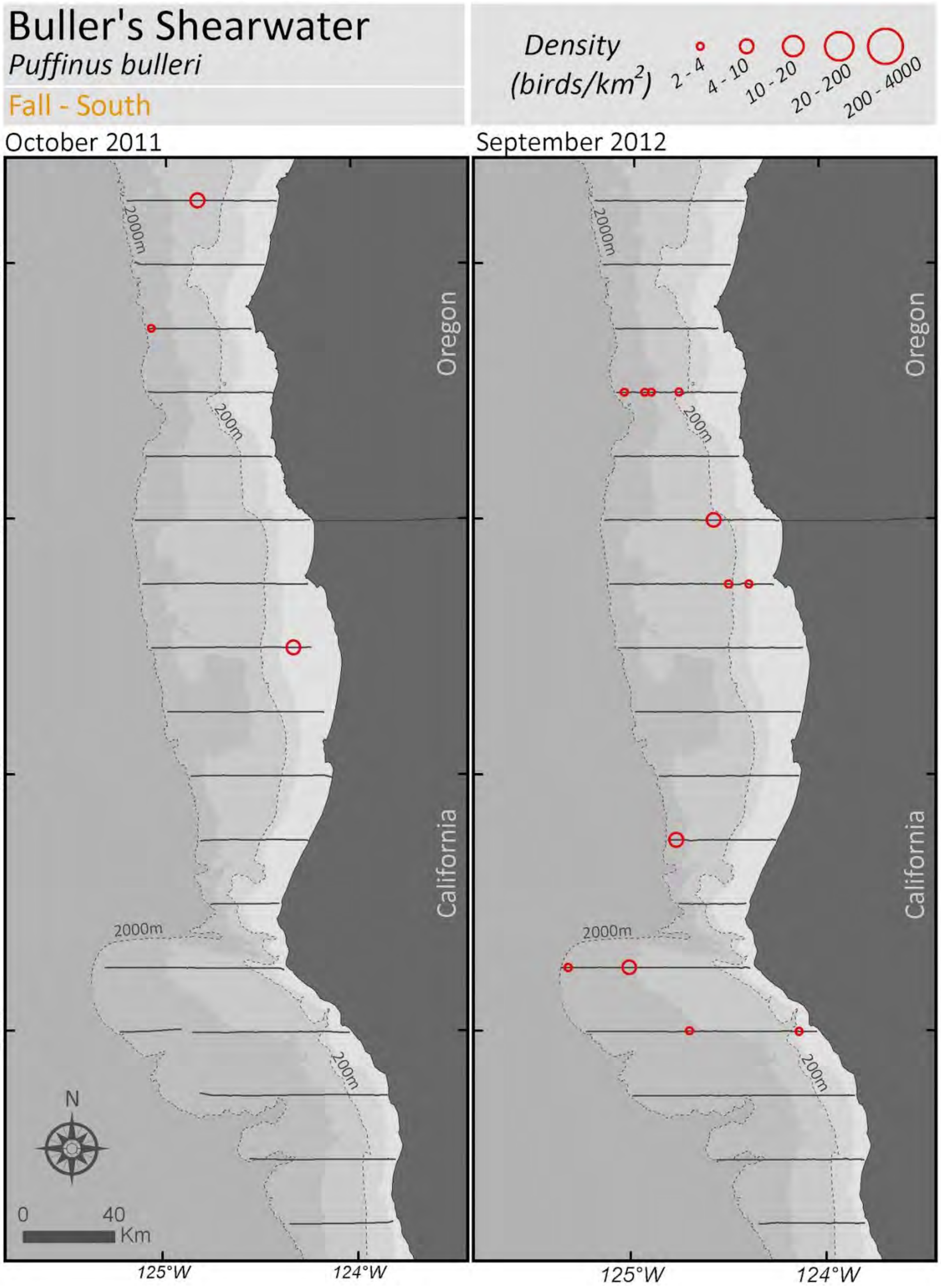


Figure 29. Mean density (birds km^{-2}) of Buller's Shearwaters (*Puffinus bulleri*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Buller's Shearwater
Puffinus bulleri
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

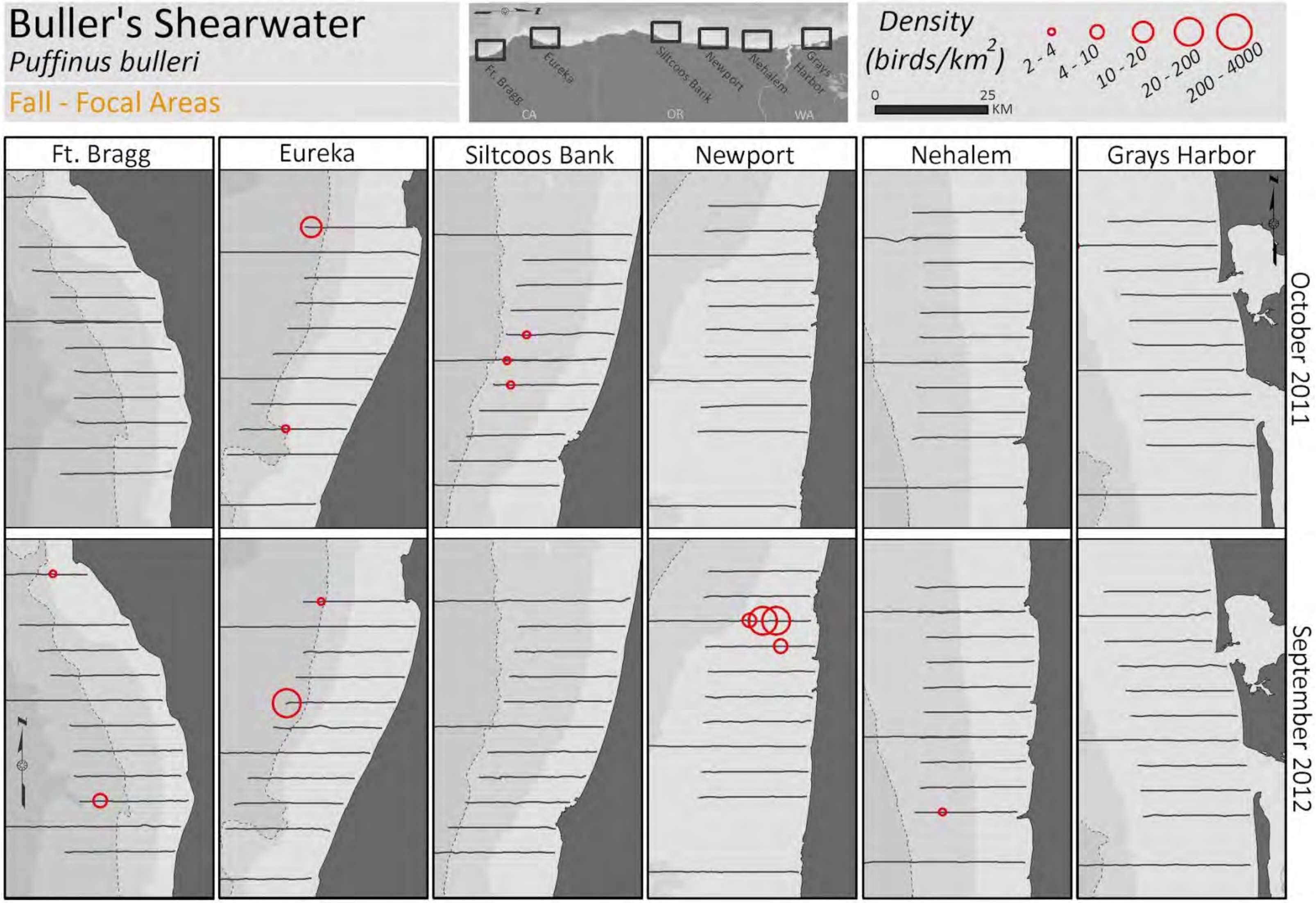


Figure 30. Mean density (birds km^{-2}) of Buller's Shearwaters (*Puffinus bulleri*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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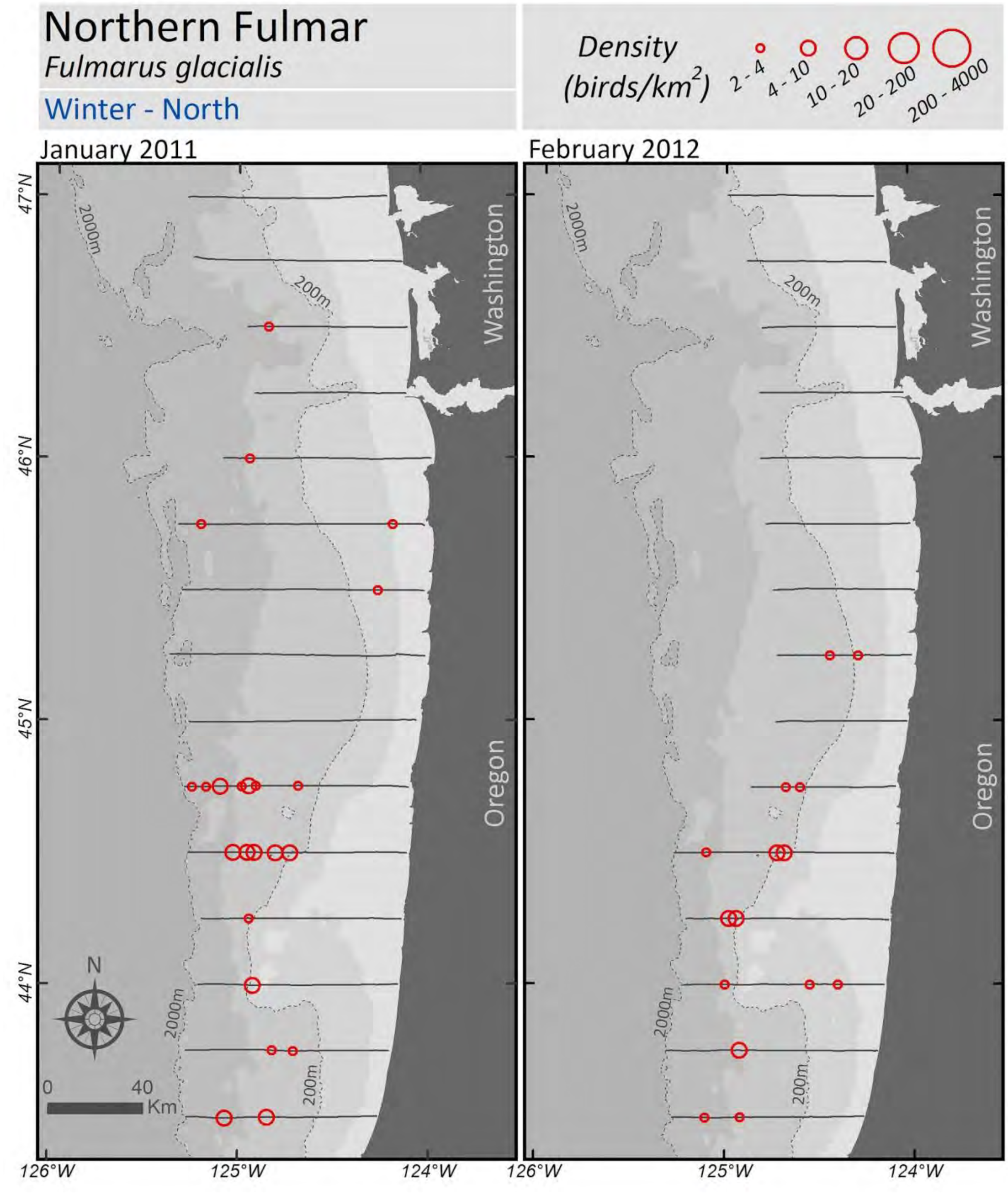
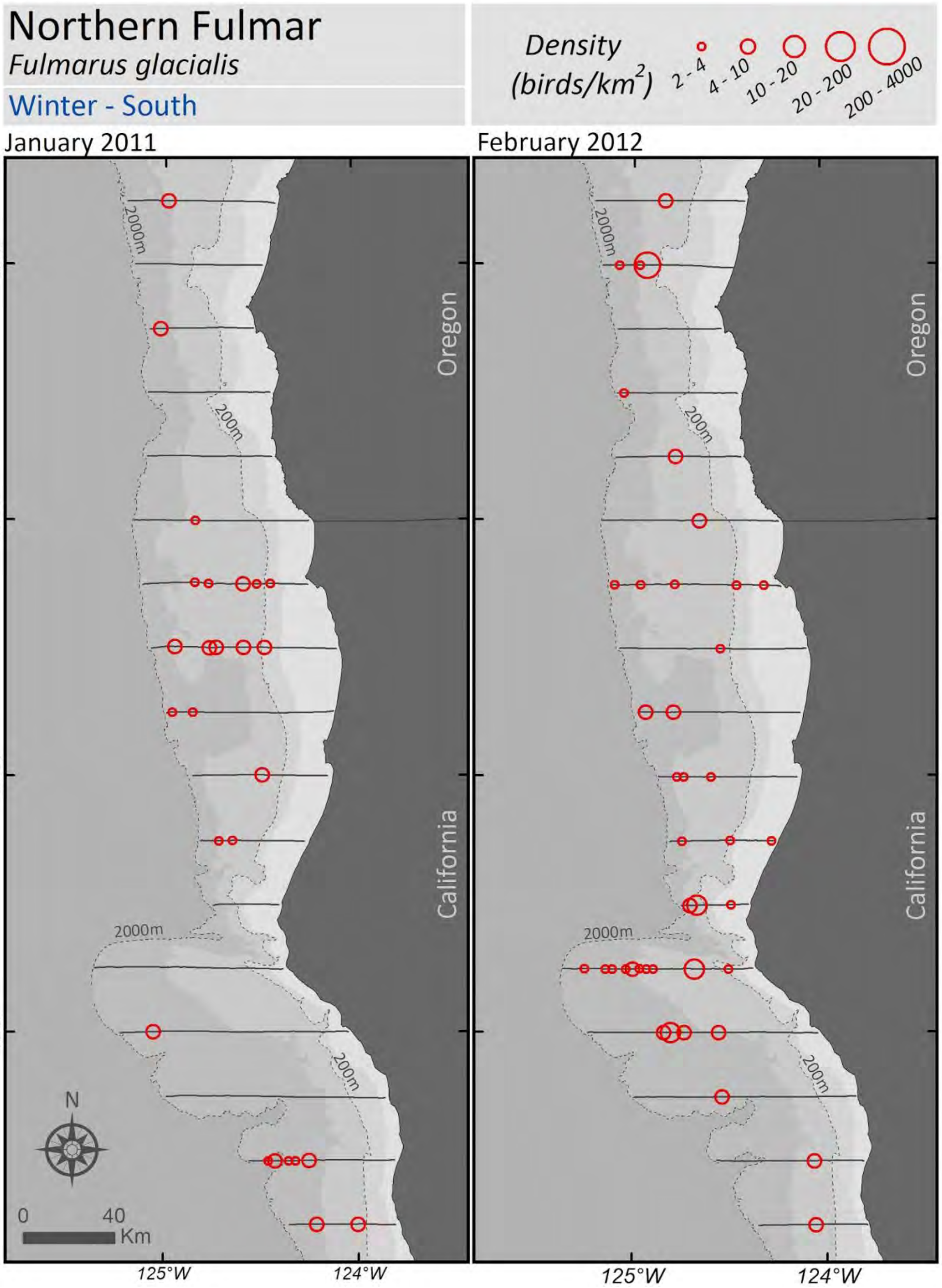


Figure 31. Mean density (birds km^{-2}) of Northern Fulmars (*Fulmarus glacialis*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Northern Fulmar
Fulmarus glacialis
Winter - South
Density (birds/km^2)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
January 2011
February 2012
43°N
42°N
41°N
40°N
Oregon
California
2000m
200m
N
0
40
Km
125°W
124°W

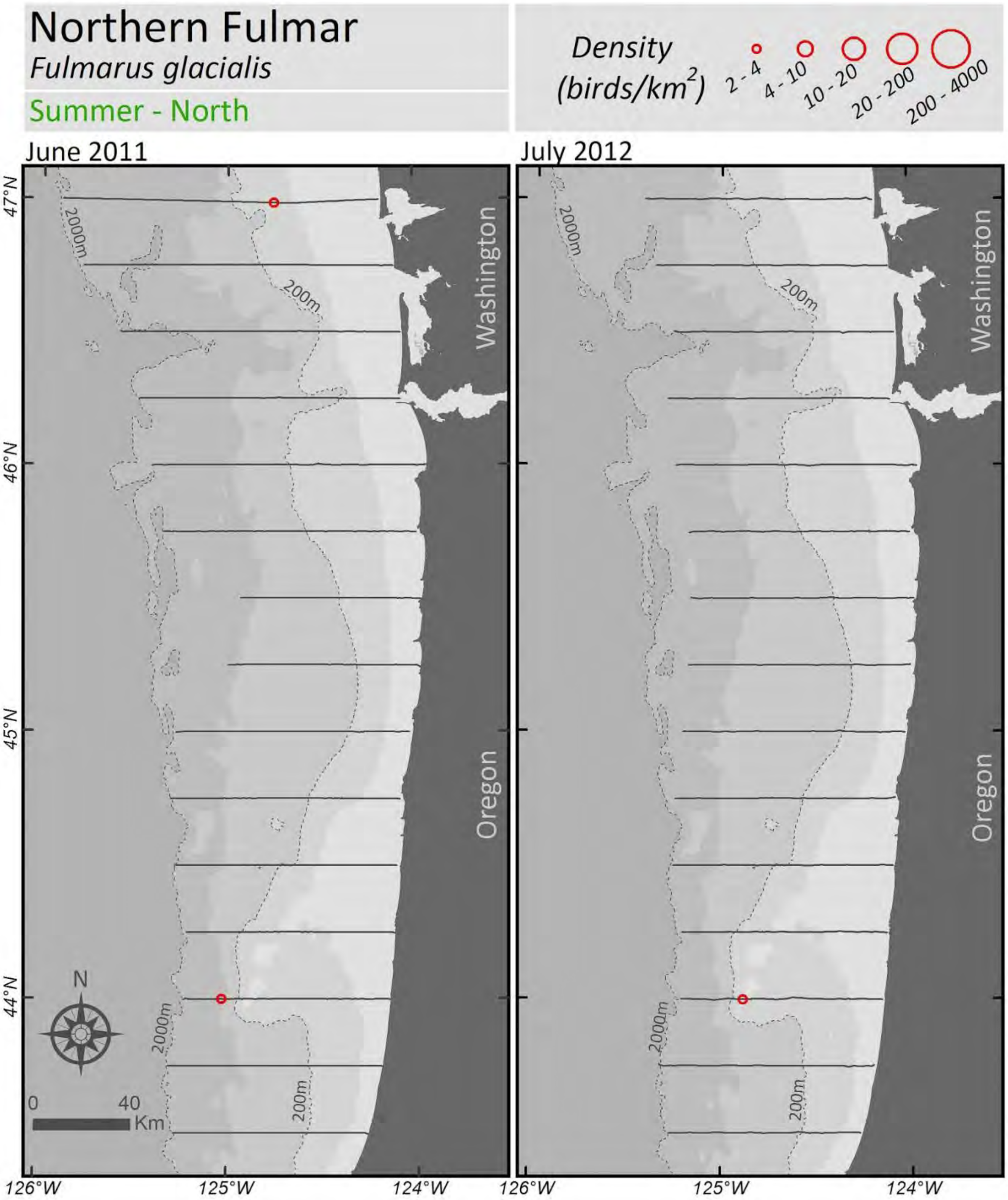
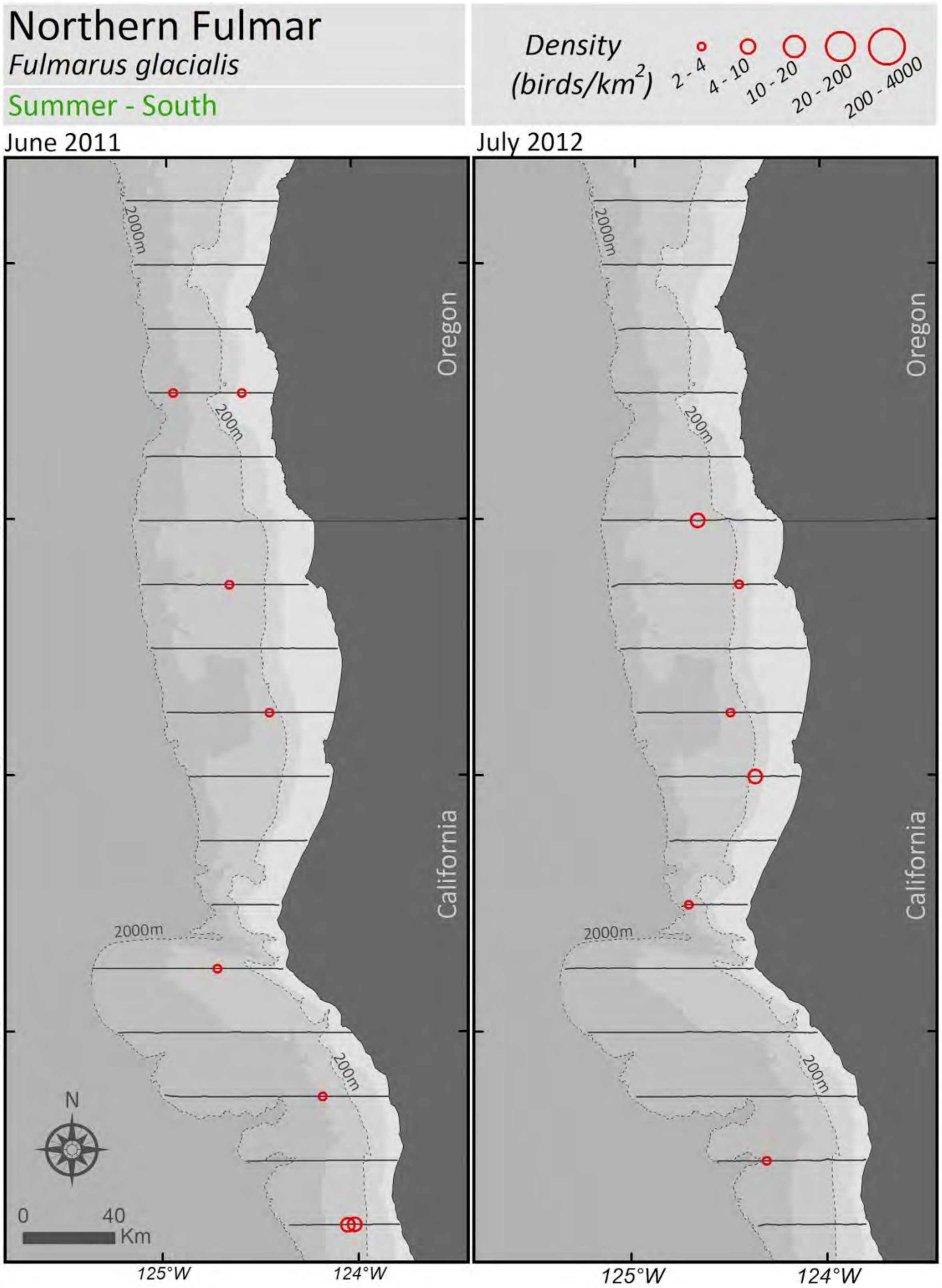


Figure 32. Mean density (birds km^{-2}) of Northern Fulmars (*Fulmarus glacialis*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Northern Fulmar

Fulmarus glacialis

Summer - South



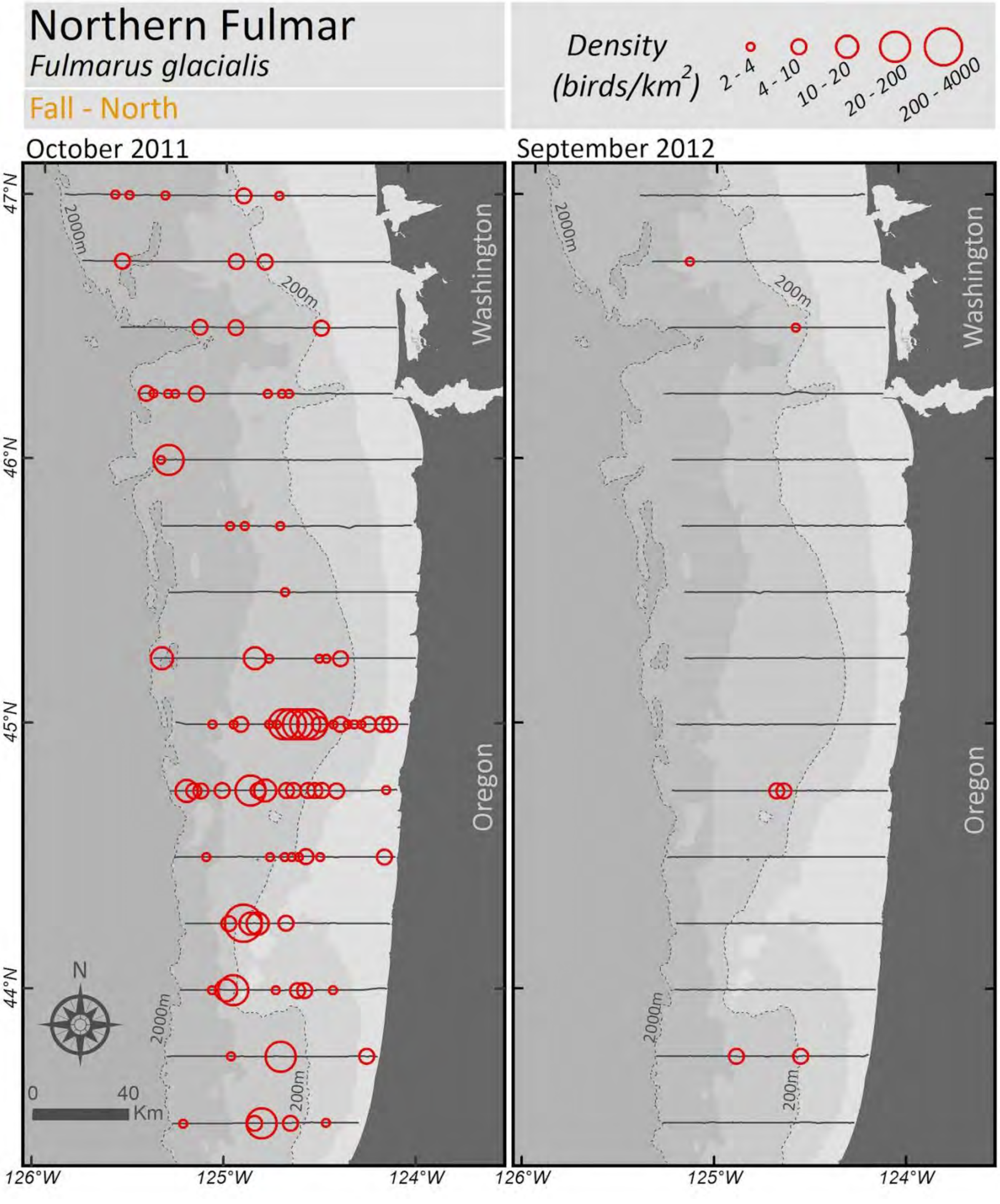
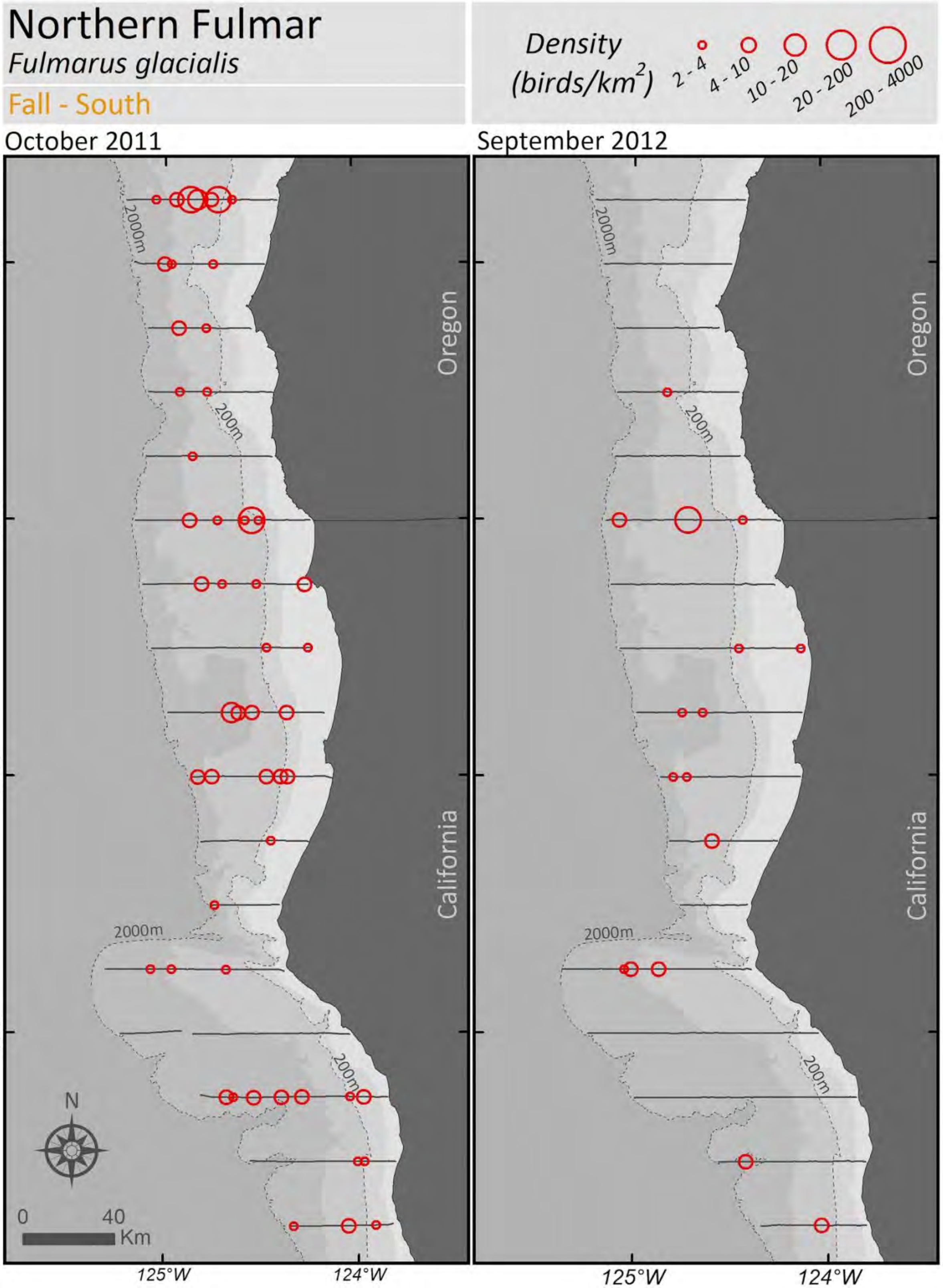


Figure 33. Mean density (birds km^{-2}) of Northern Fulmars (*Fulmarus glacialis*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Northern Fulmar
Fulmarus glacialis
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
43°N
42°N
41°N
40°N
2000m
200m
Oregon
California
N
0
40
Km
125°W
124°W

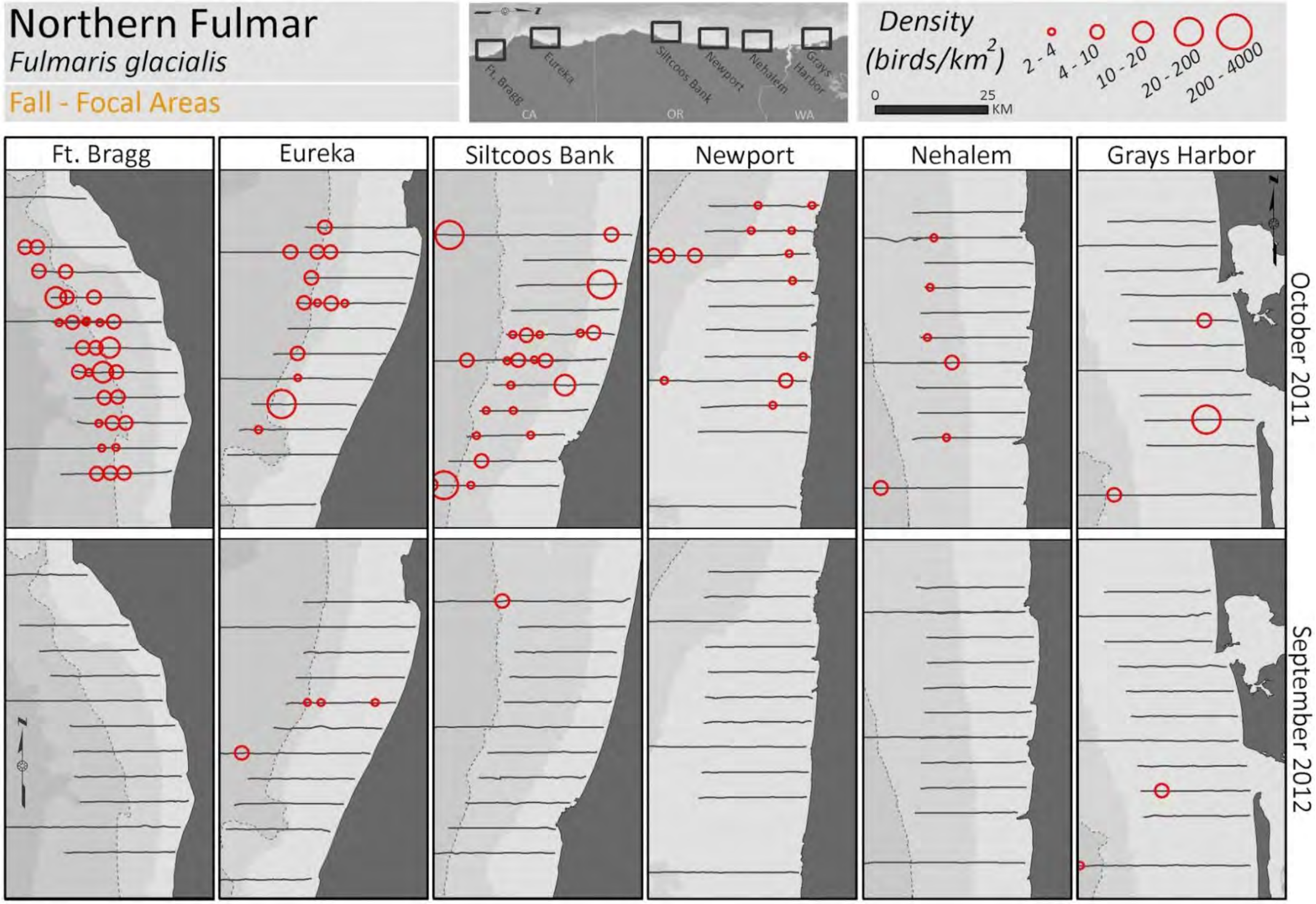


Figure 34. **Mean density (birds km^{-2}) of Northern Fulmars (*Fulmarus glacialis*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.**

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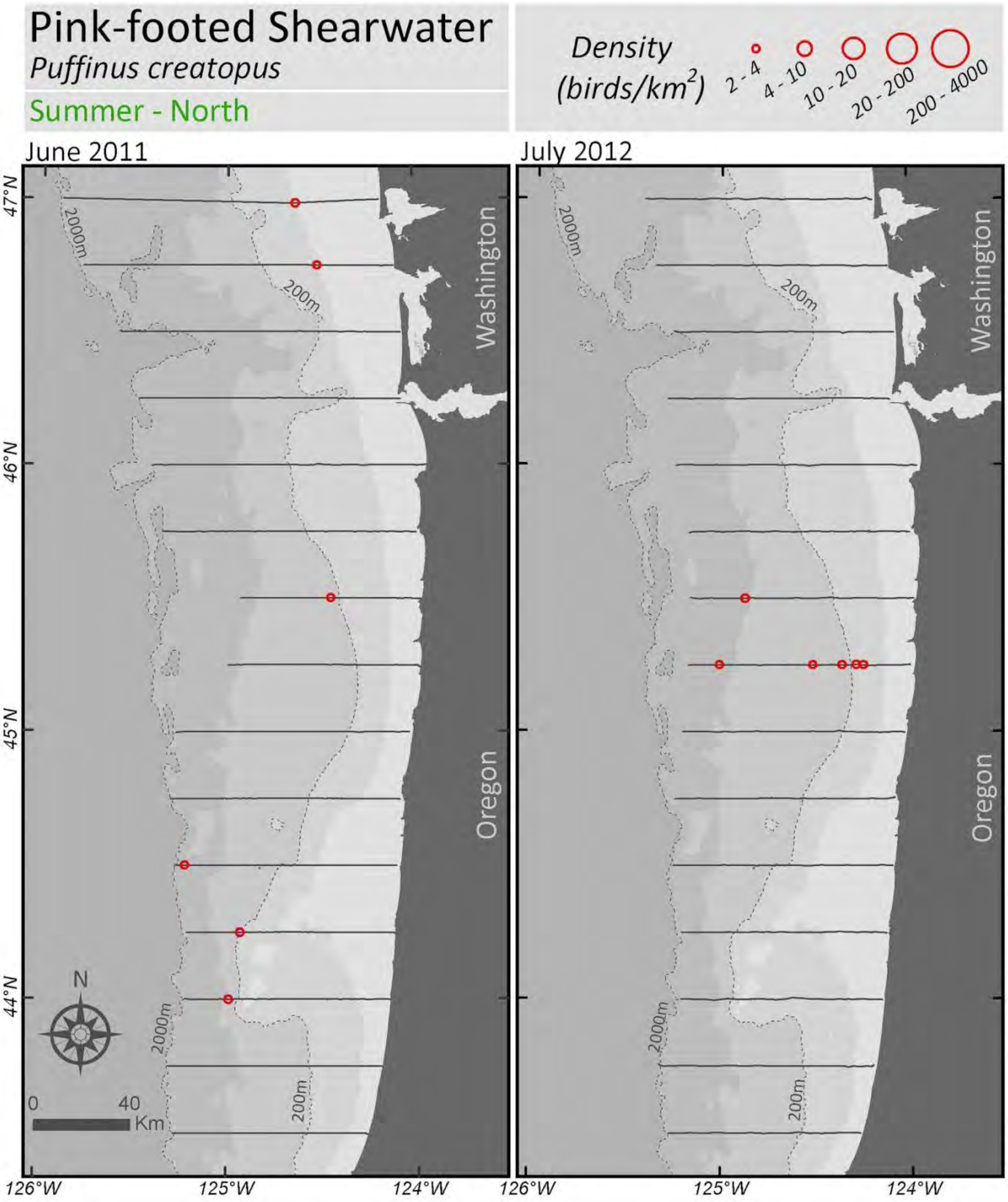
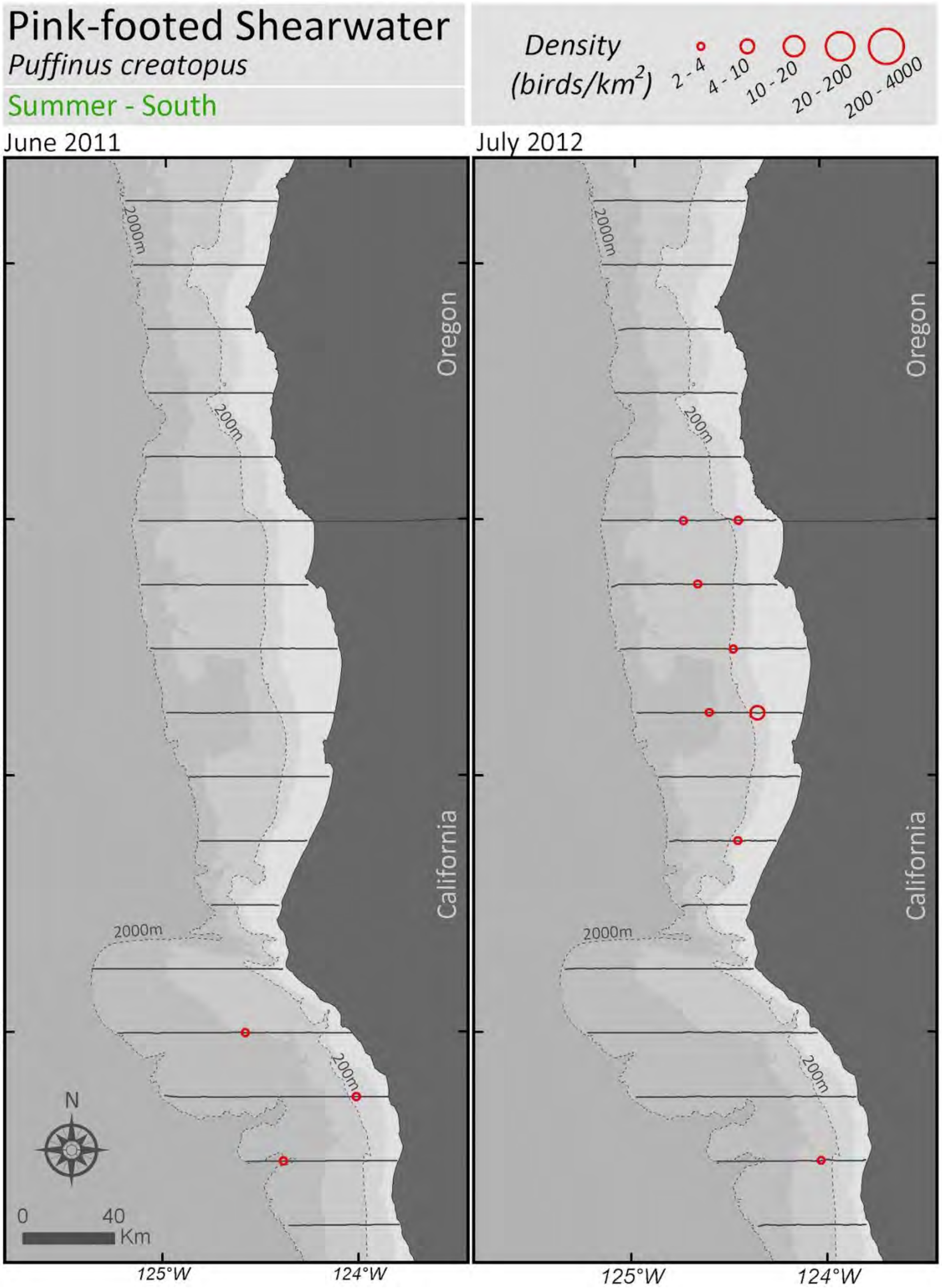


Figure 35. Mean density (birds km^{-2}) of Pink-footed Shearwaters (*Puffinus creatopus*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Pink-footed Shearwater

Puffinus creatopus

Summer - South



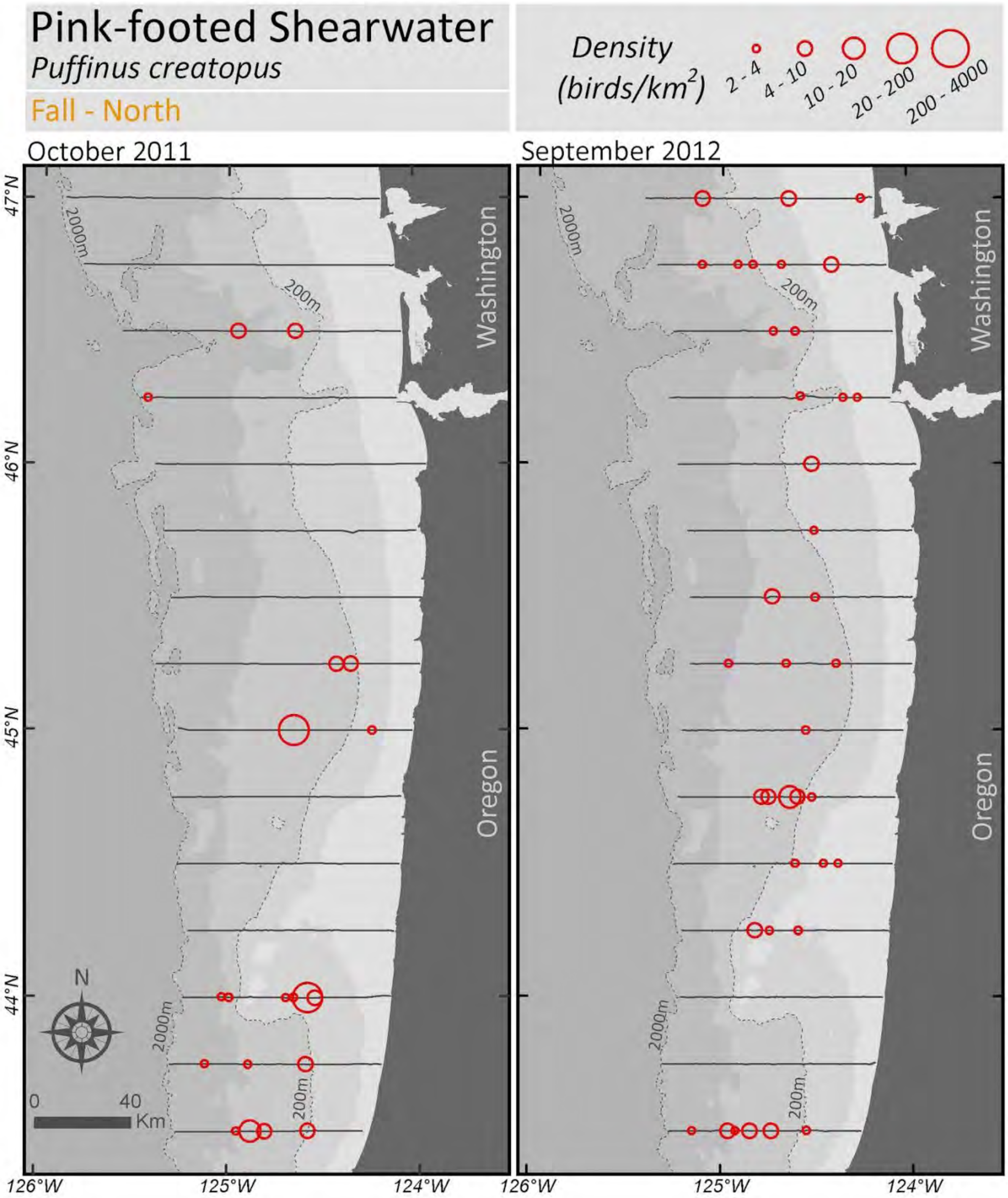
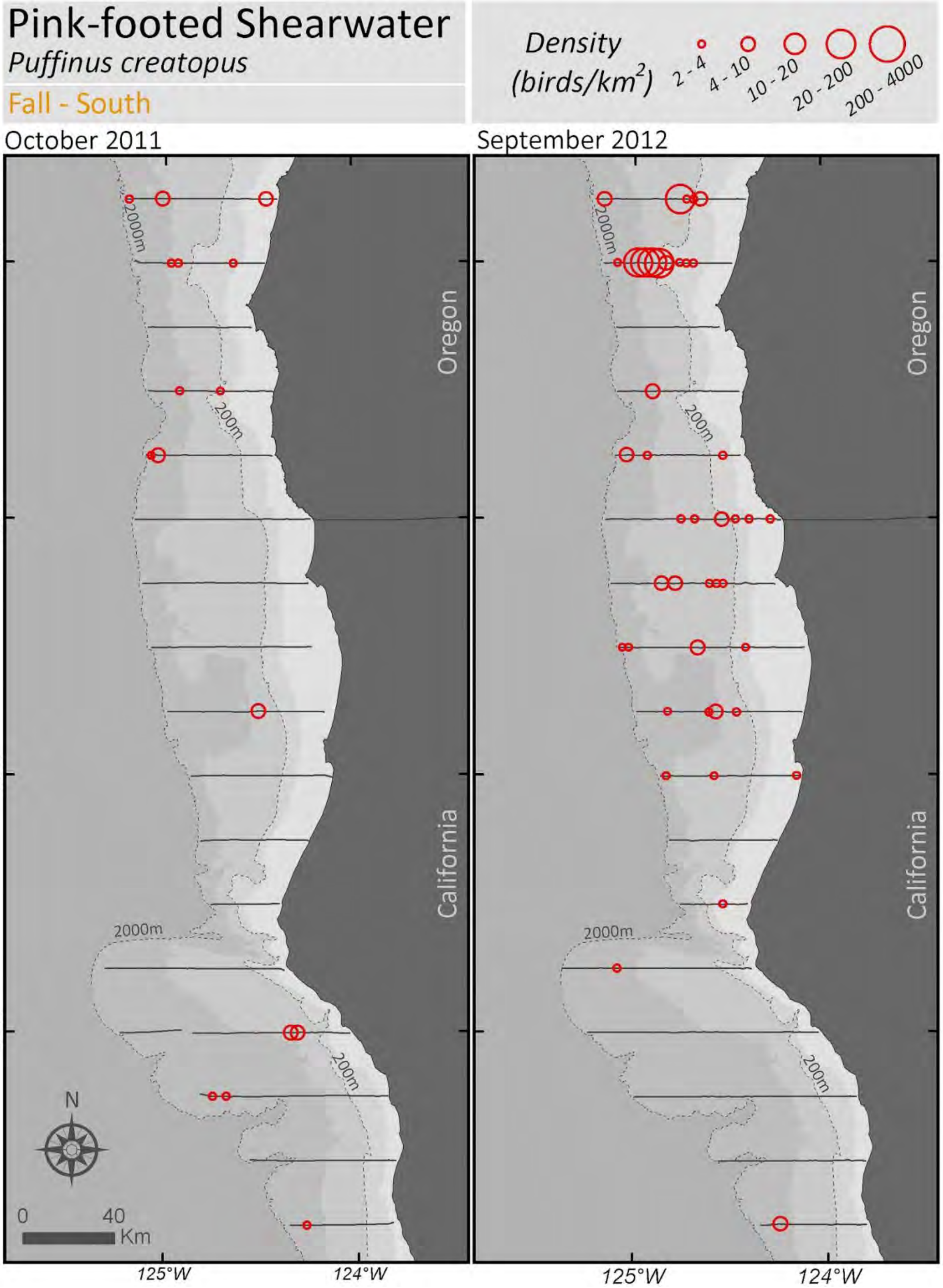


Figure 36. Mean density (birds km^{-2}) of Pink-footed Shearwaters (*Puffinus creatopus*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Pink-footed Shearwater

Puffinus creatopus

Fall - South



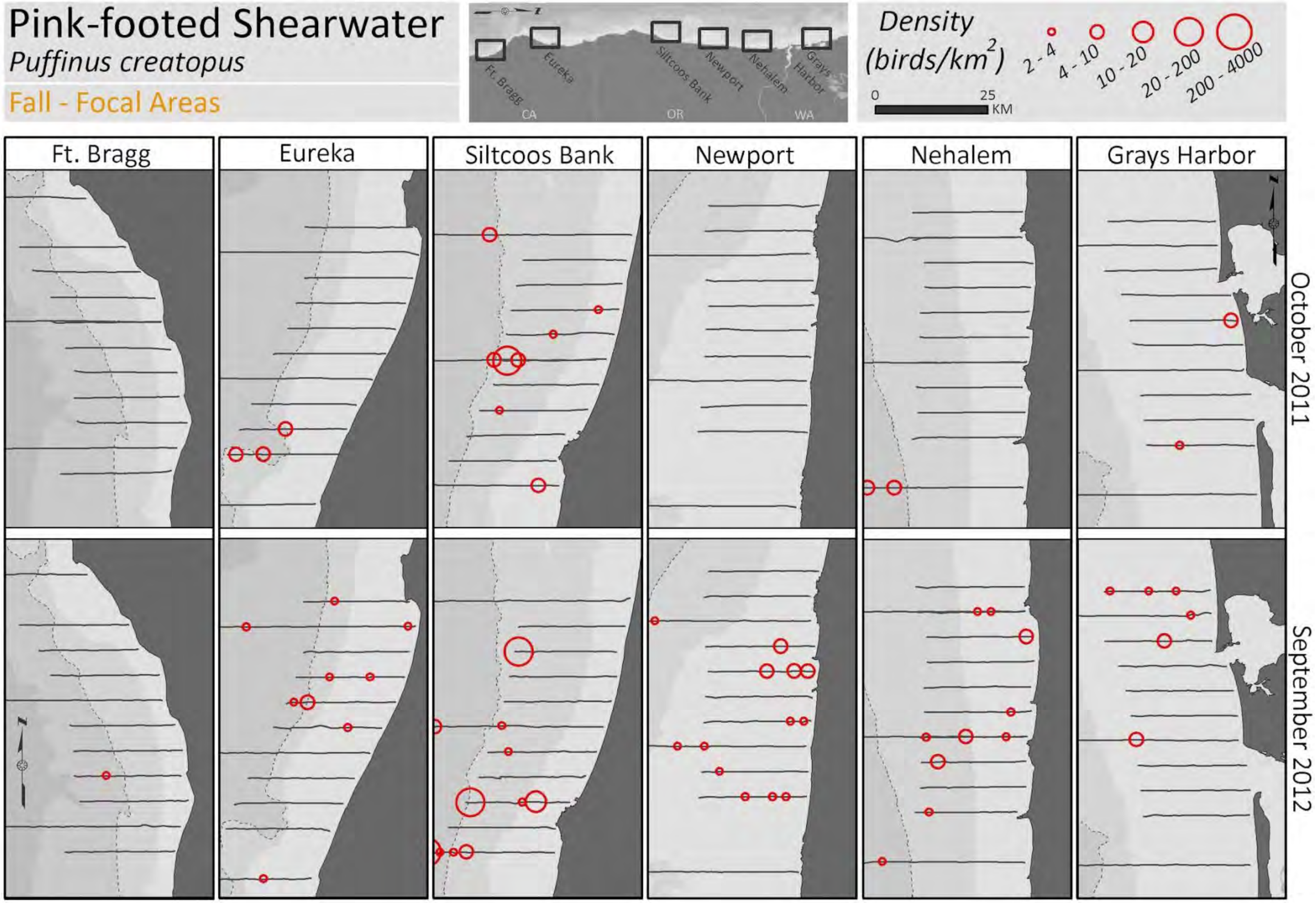


Figure 37. Mean density (birds km^{-2}) of Pink-footed Shearwaters (*Puffinus creatopus*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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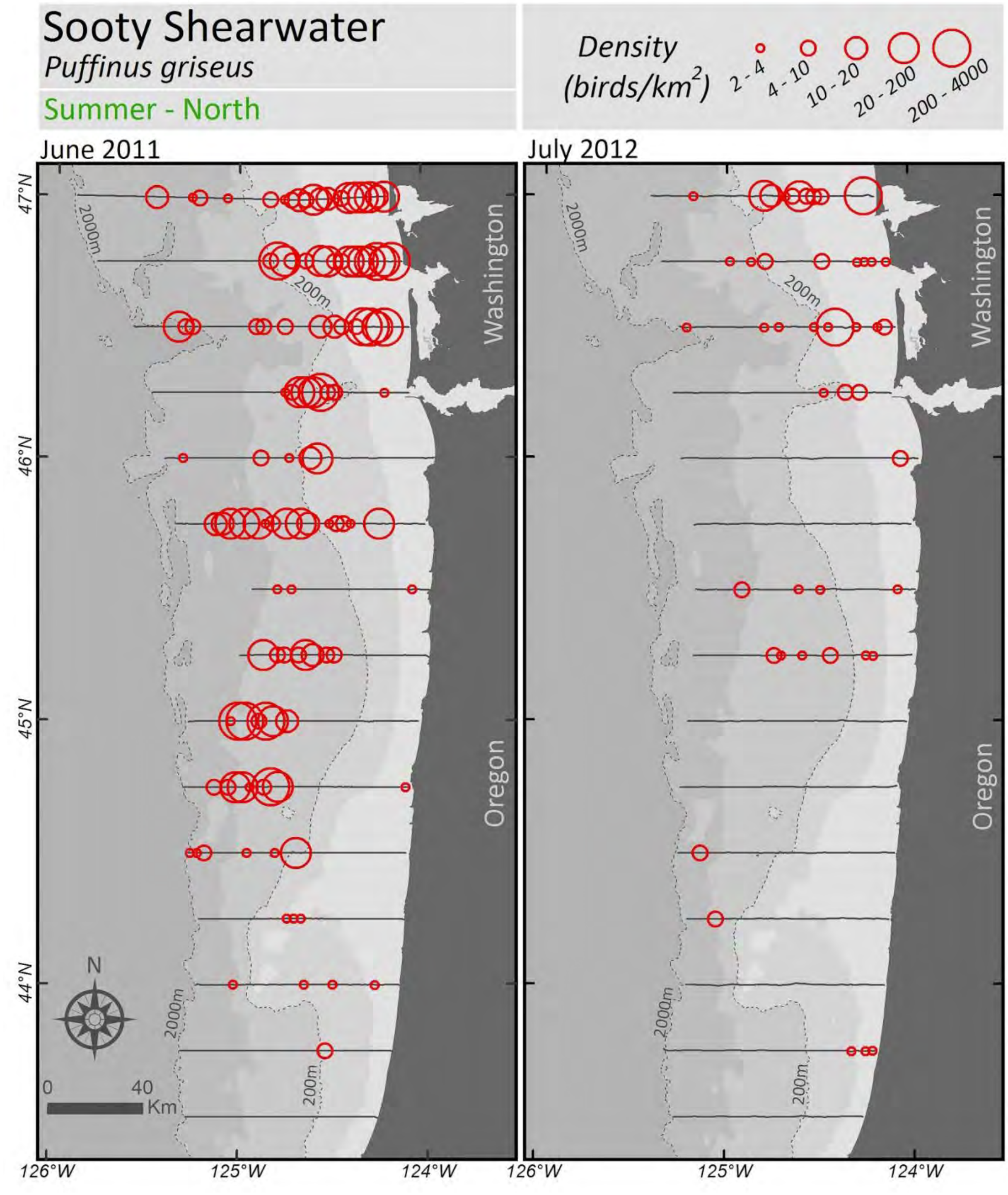
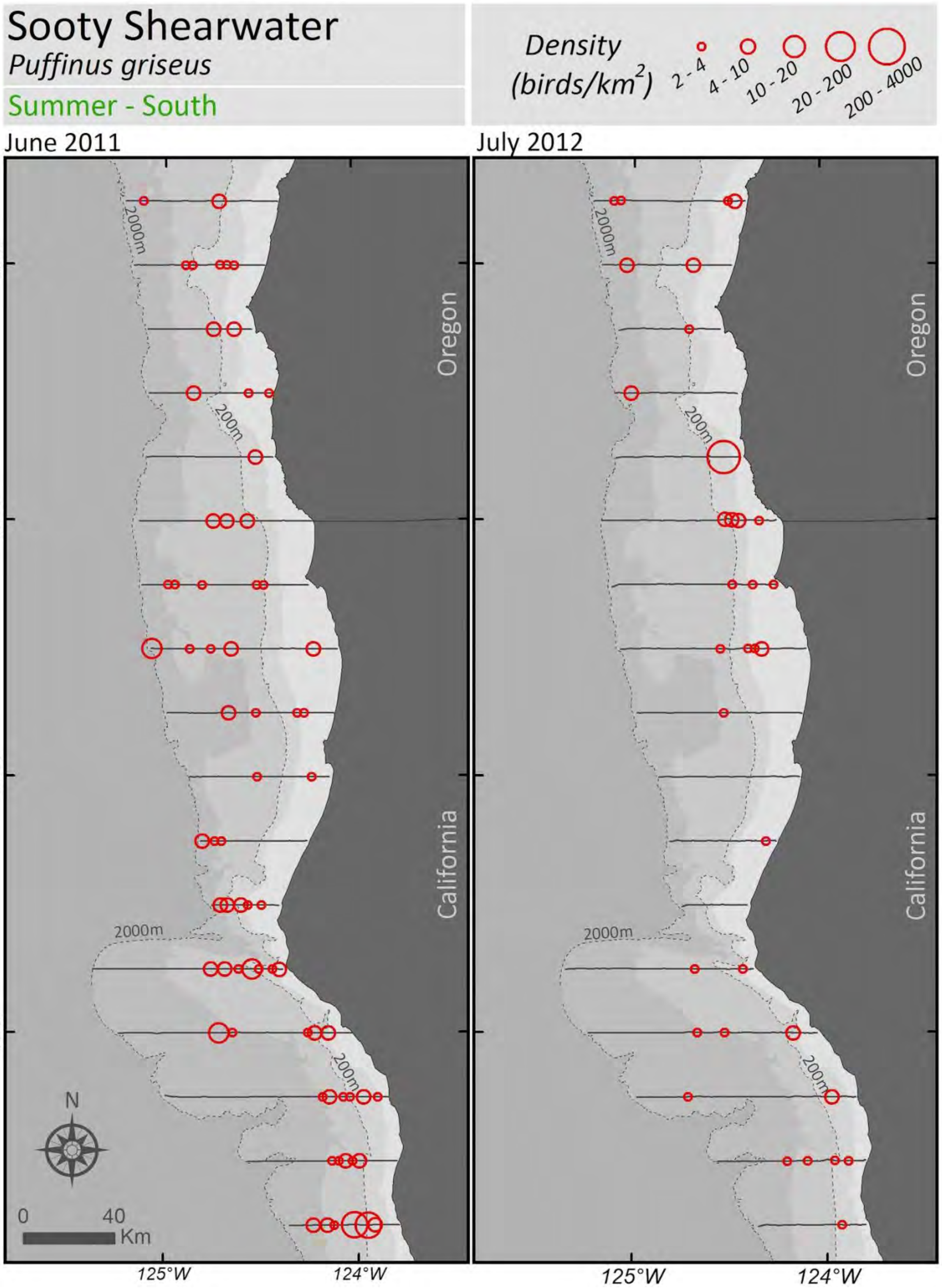


Figure 38. Mean density (birds km^{-2}) of Sooty Shearwaters (*Puffinus griseus*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Sooty Shearwater
Puffinus griseus
Summer - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
43°N
42°N
41°N
40°N
2000m
200m
Oregon
California
N
0
40
Km
125°W
124°W

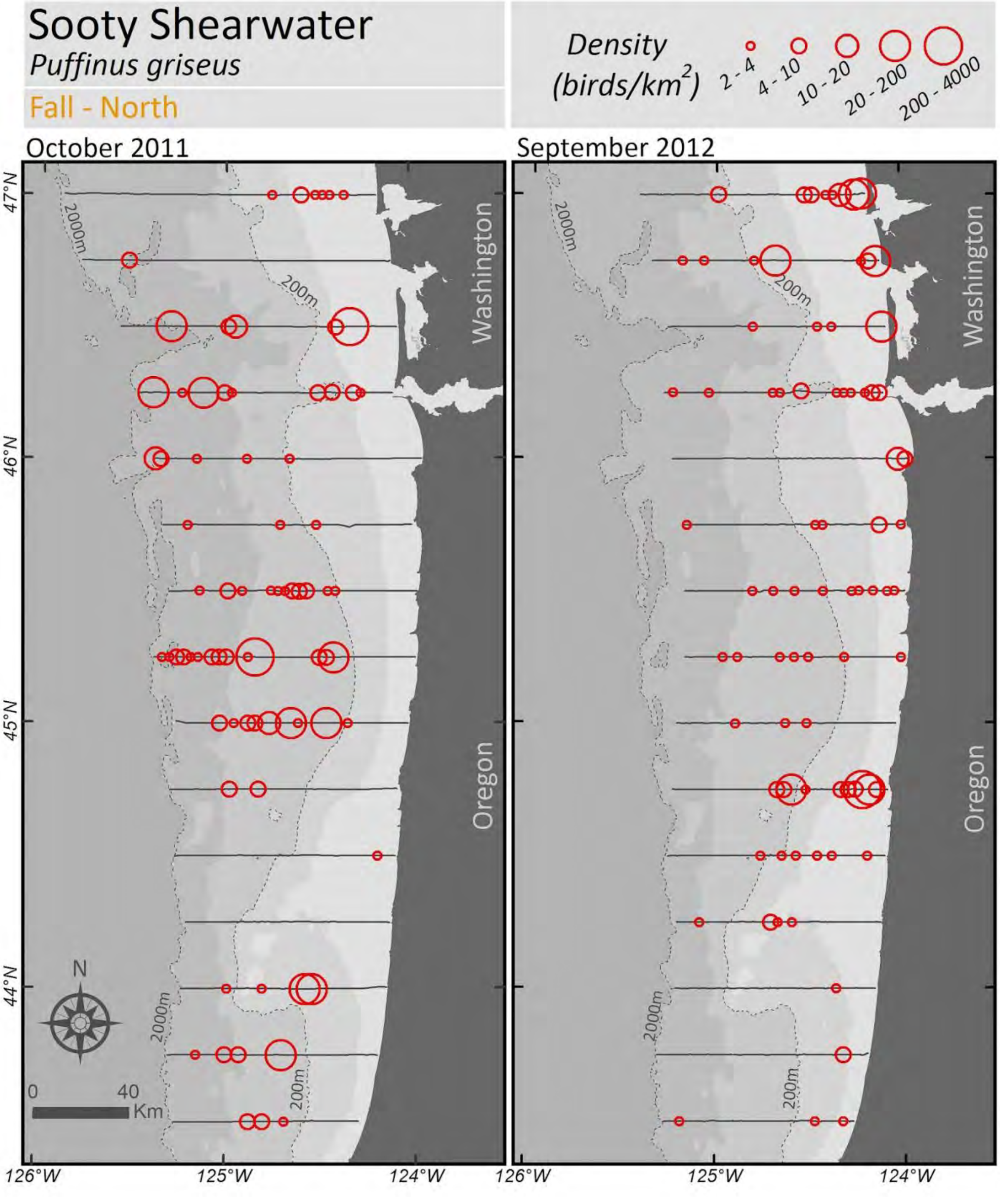
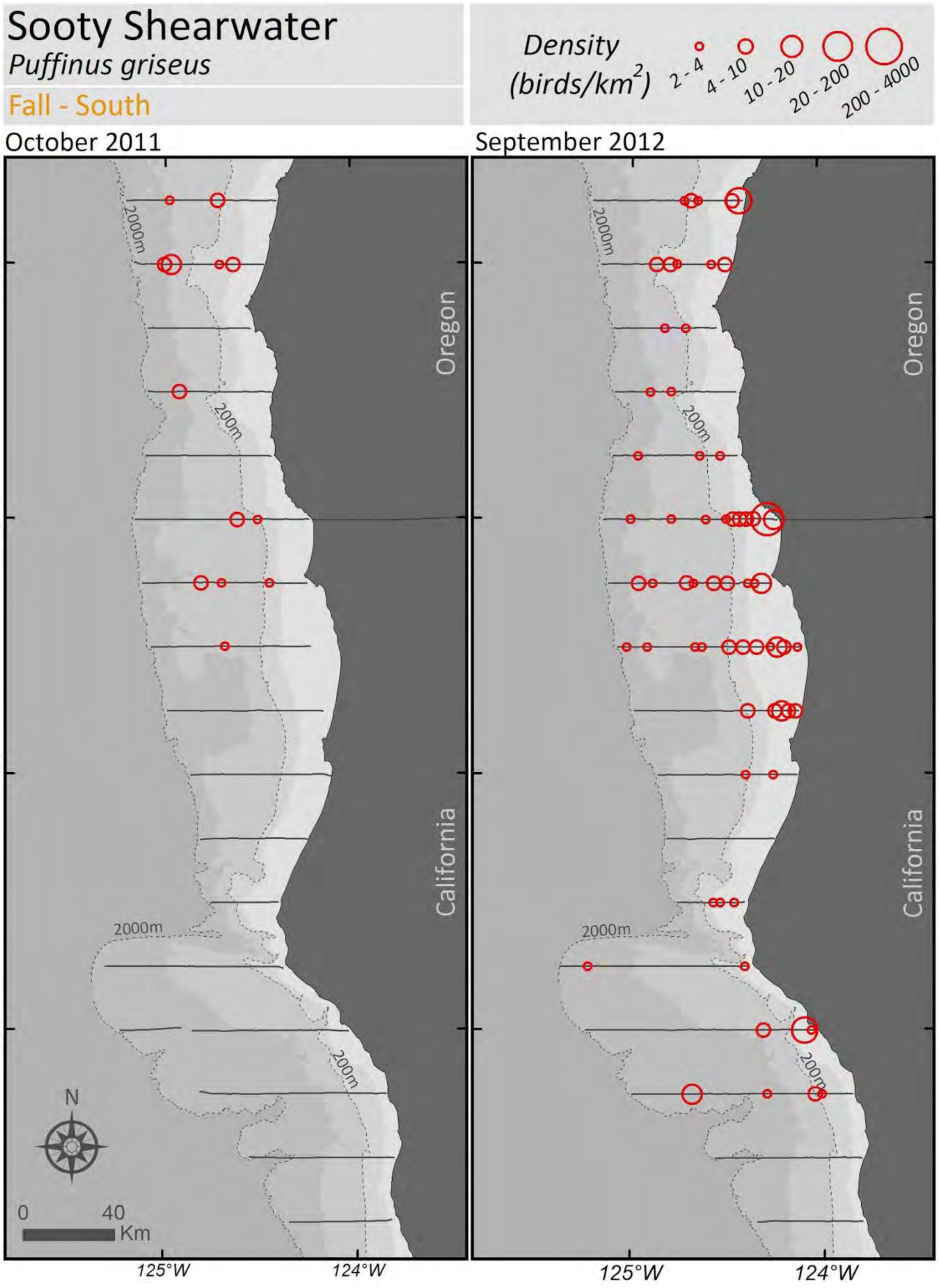


Figure 39. Mean density (birds km^{-2}) of Sooty Shearwaters (*Puffinus griseus*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Sooty Shearwater

Puffinus griseus

Fall - South



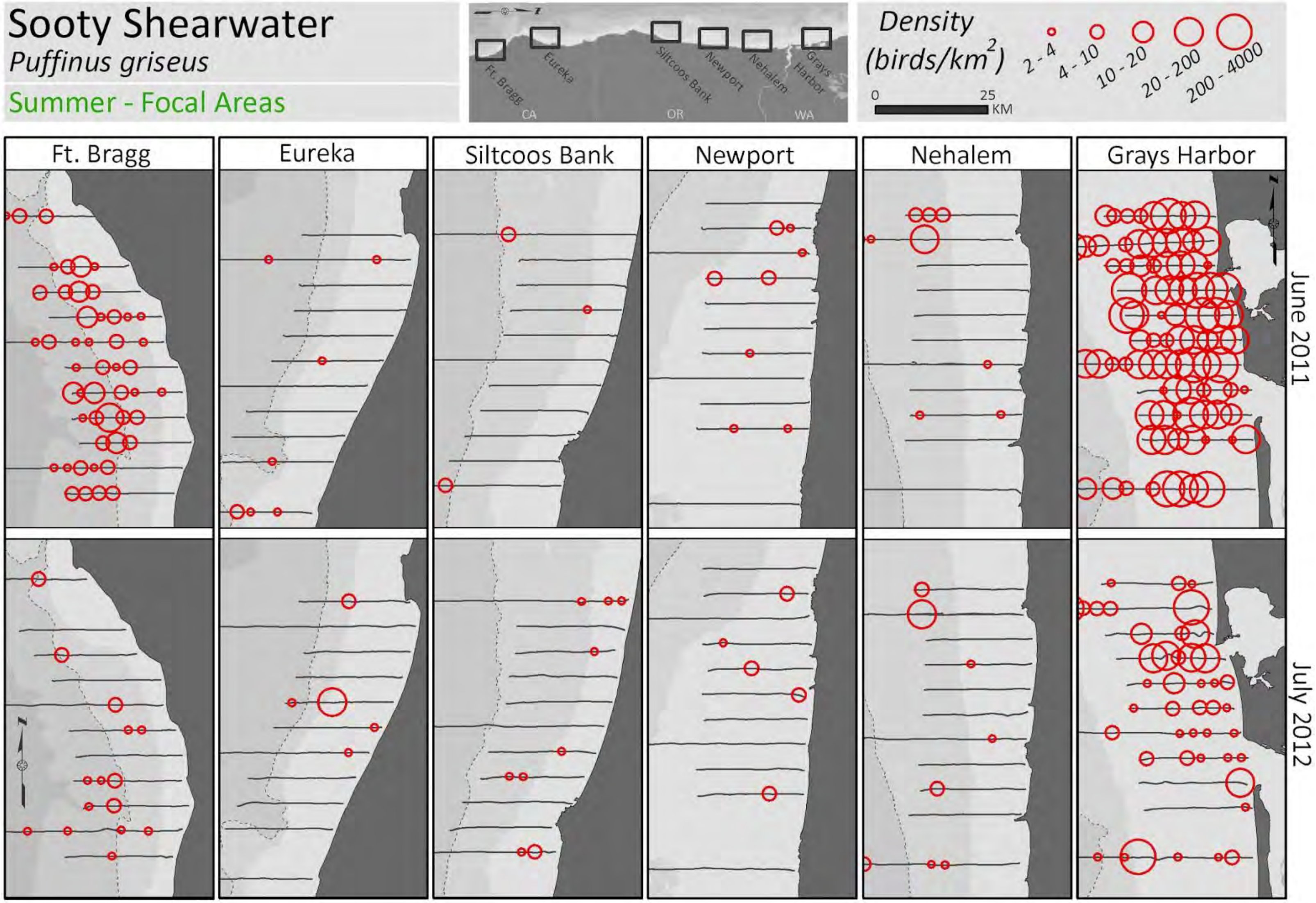


Figure 40. Mean density (birds km^{-2}) of Sooty Shearwaters (*Puffinus griseus*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

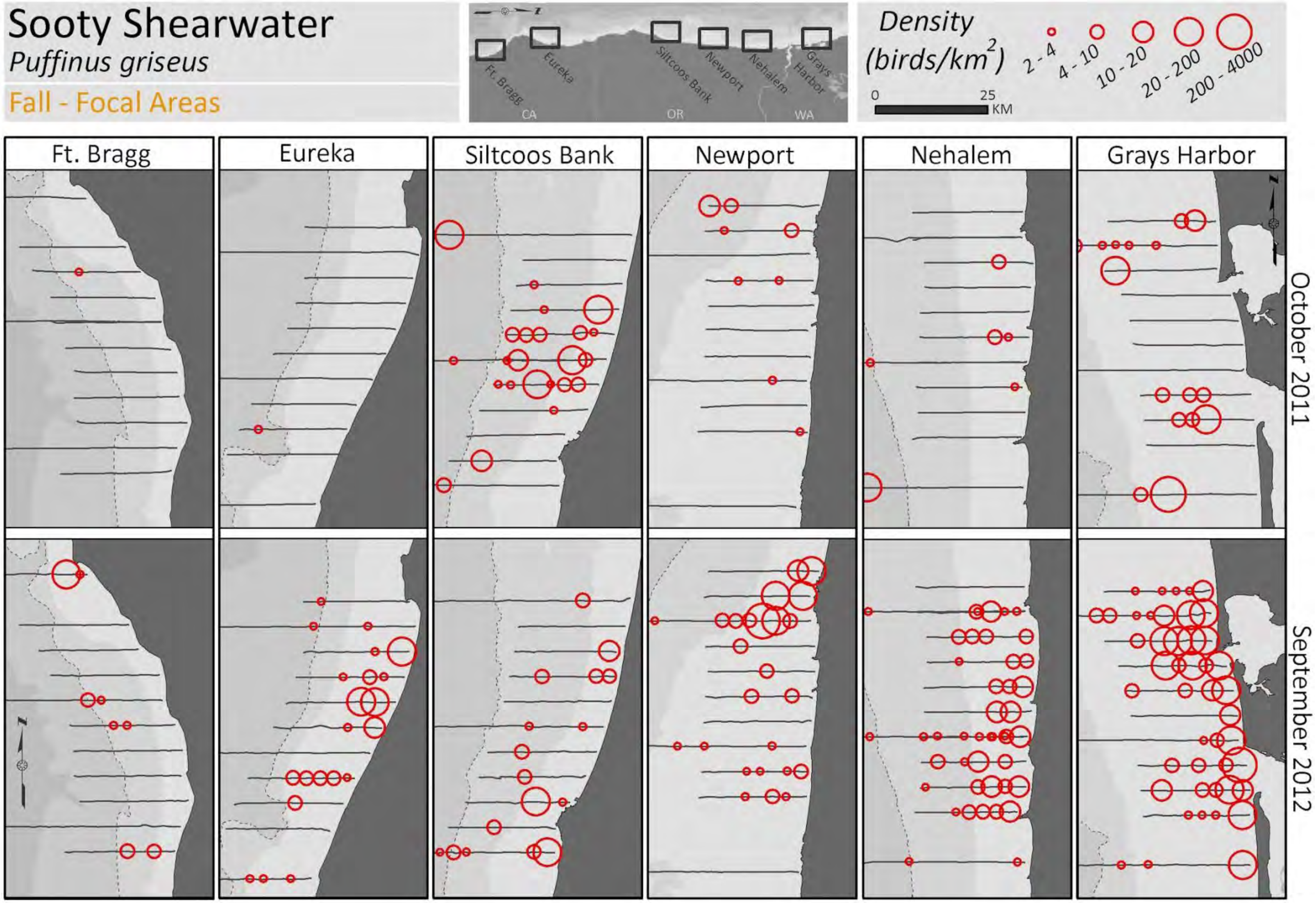


Figure 41. Mean density (birds km^{-2}) of Sooty Shearwaters (*Puffinus griseus*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

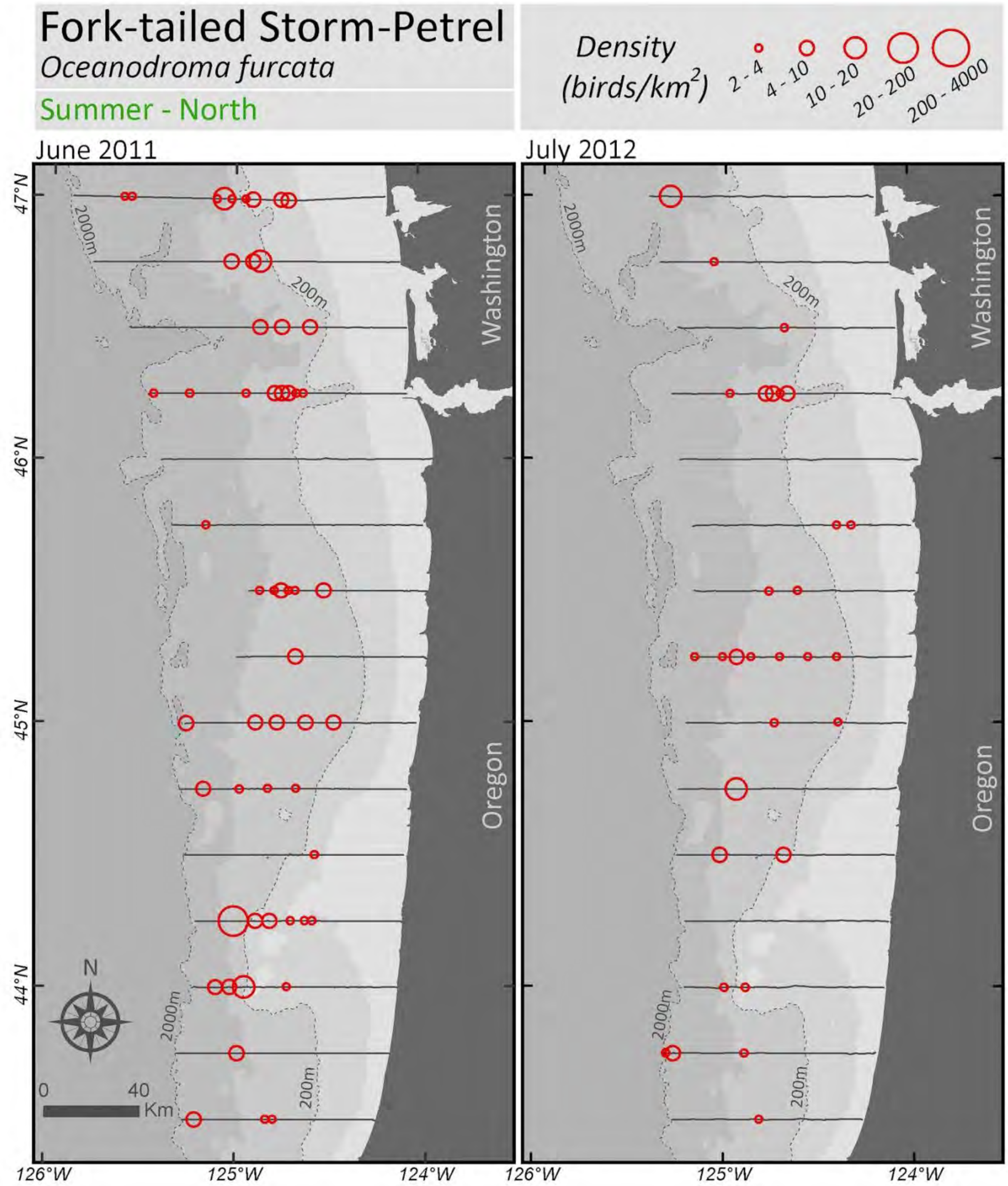
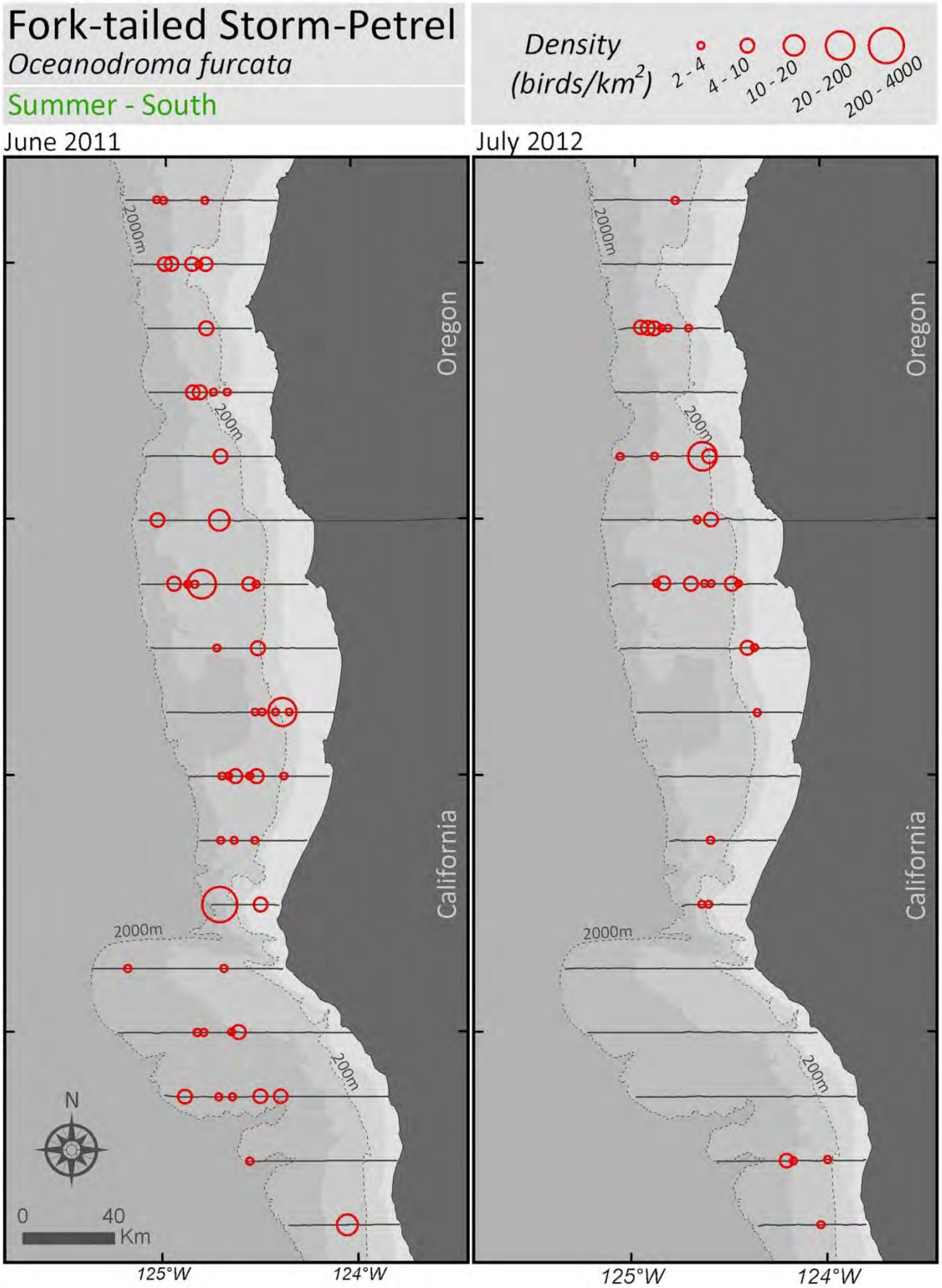


Figure 42. Mean density (birds km^{-2}) of Fork-tailed Storm-Petrels (*Oceanodroma furcata*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Fork-tailed Storm-Petrel
Oceanodroma furcata
Summer - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
43°N
42°N
41°N
40°N
2000m
200m
Oregon
California
N
0
40
Km
125°W
124°W

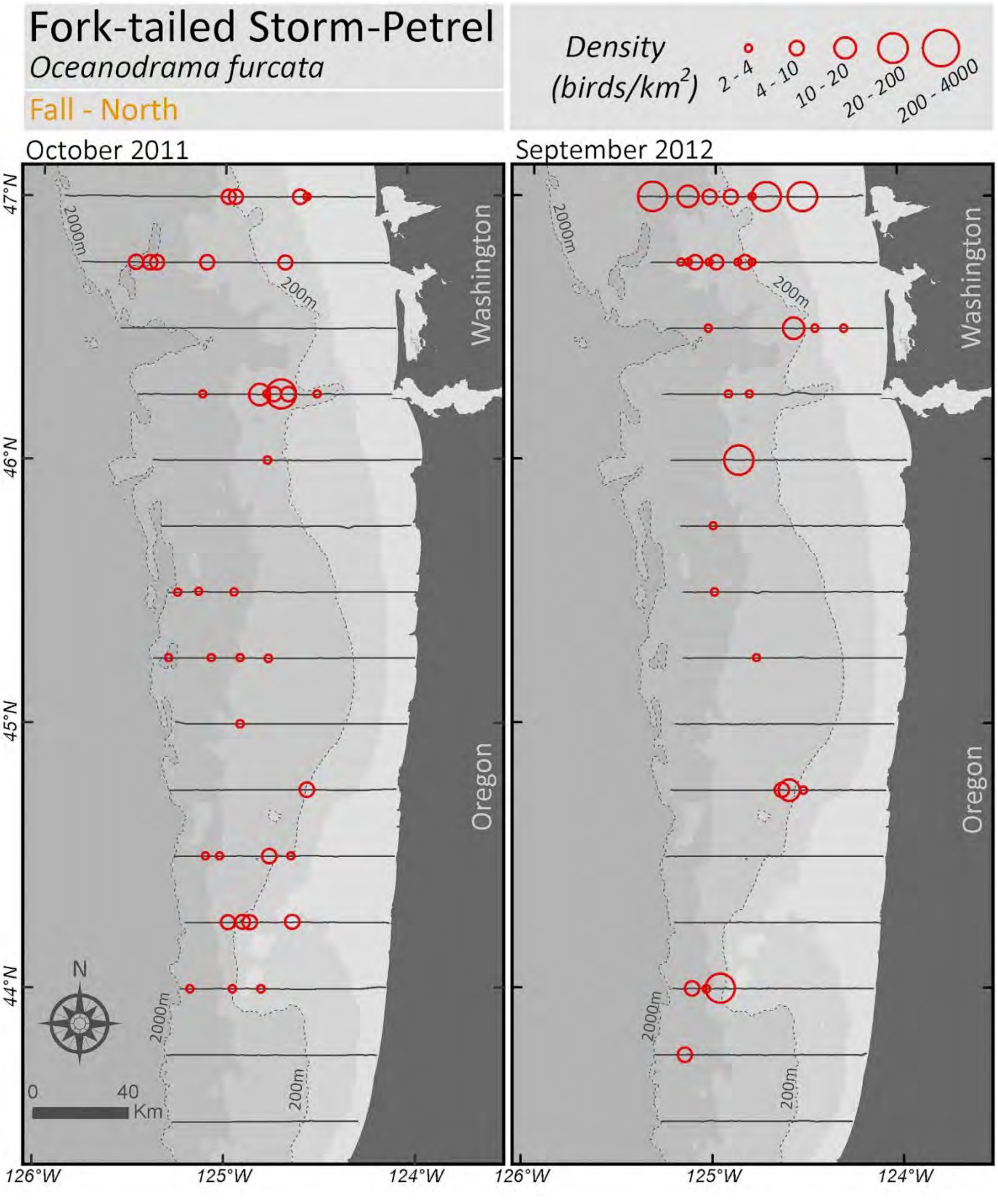
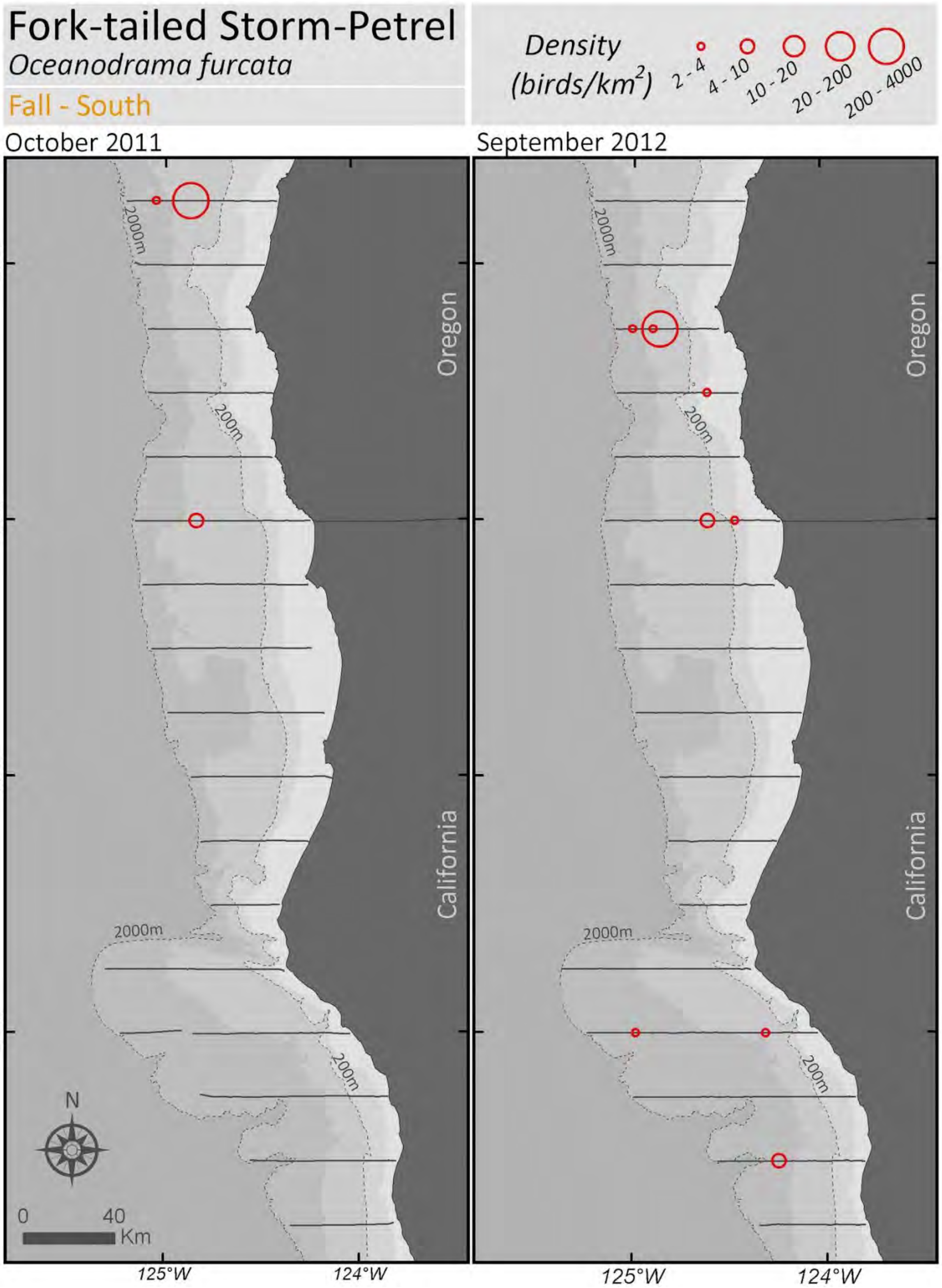


Figure 43. Mean density (birds km^{-2}) of Fork-tailed Storm-Petrels (*Oceanodroma furcata*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Fork-tailed Storm-Petrel
Oceanodrama furcata
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
43°N
42°N
41°N
40°N
125°W
124°W
2000m
200m
Oregon
California
N
0
40
Km

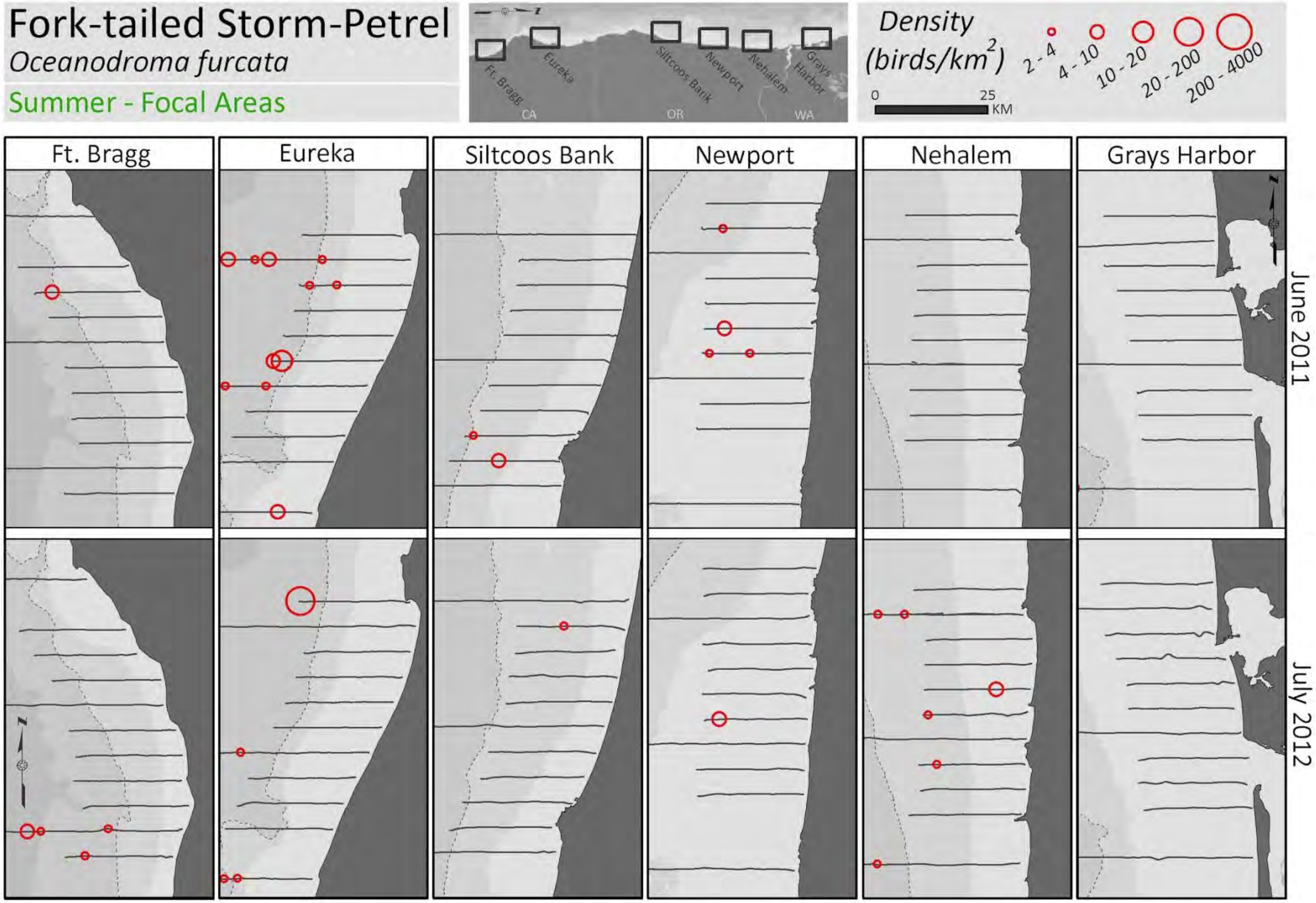


Figure 44. Mean density (birds km^{-2}) of Fork-tailed Storm-Petrels (*Oceanodroma furcata*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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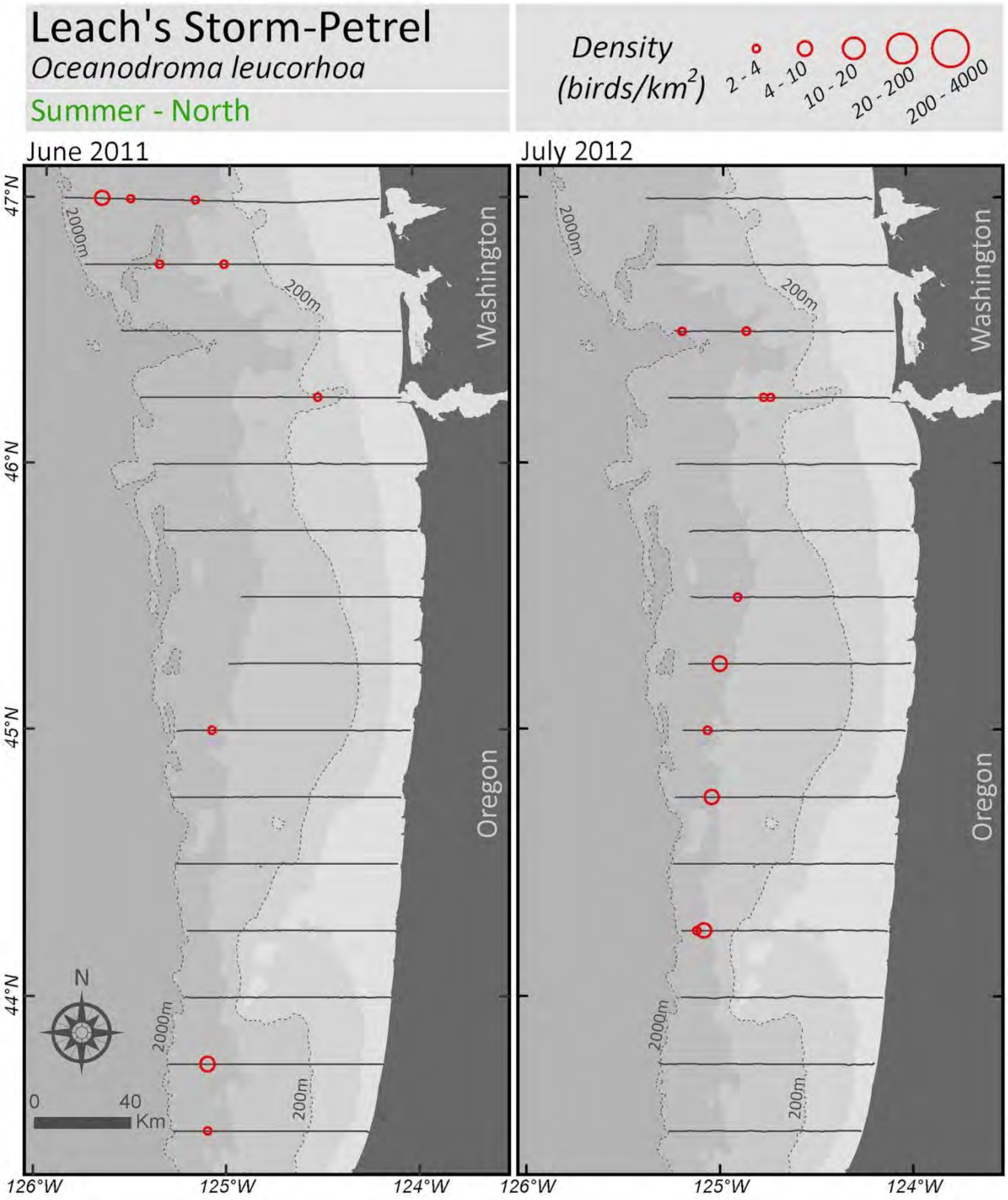
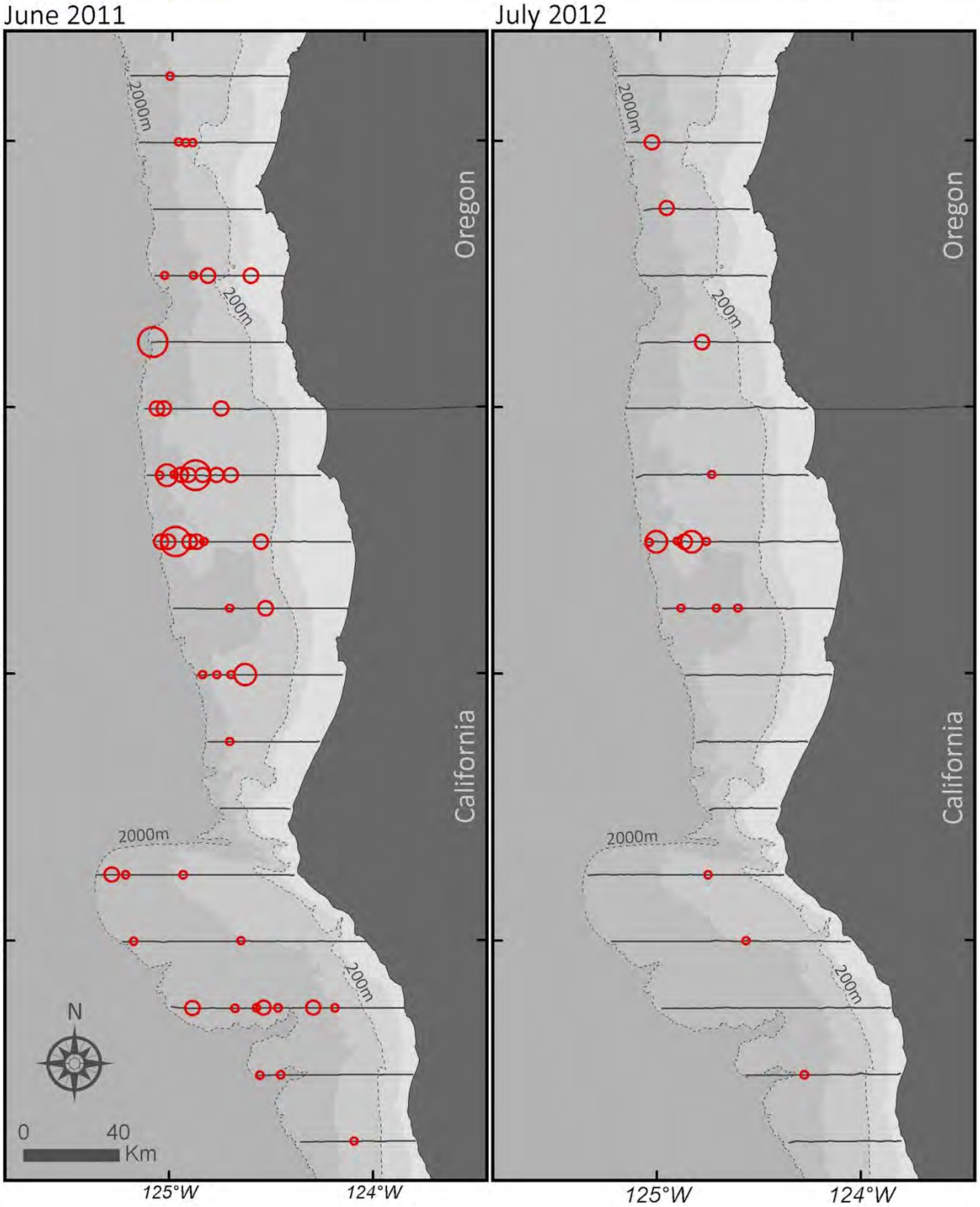


Figure 45. Mean density (birds km^{-2}) of Leach's Storm-Petrels (*Oceanodroma leucorhoa*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Leach's Storm-Petrel

Oceanodroma leucorhoa

Summer - South



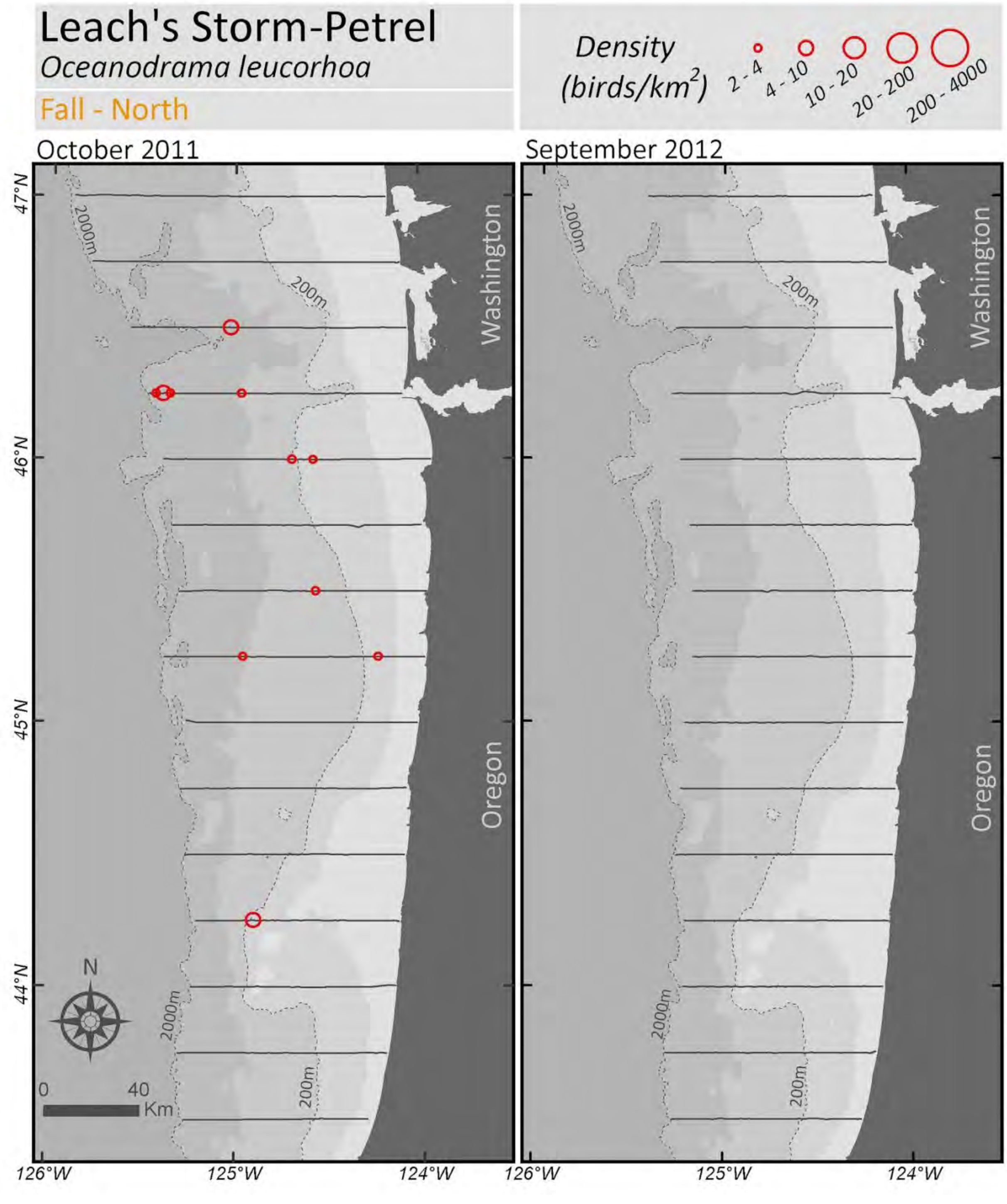
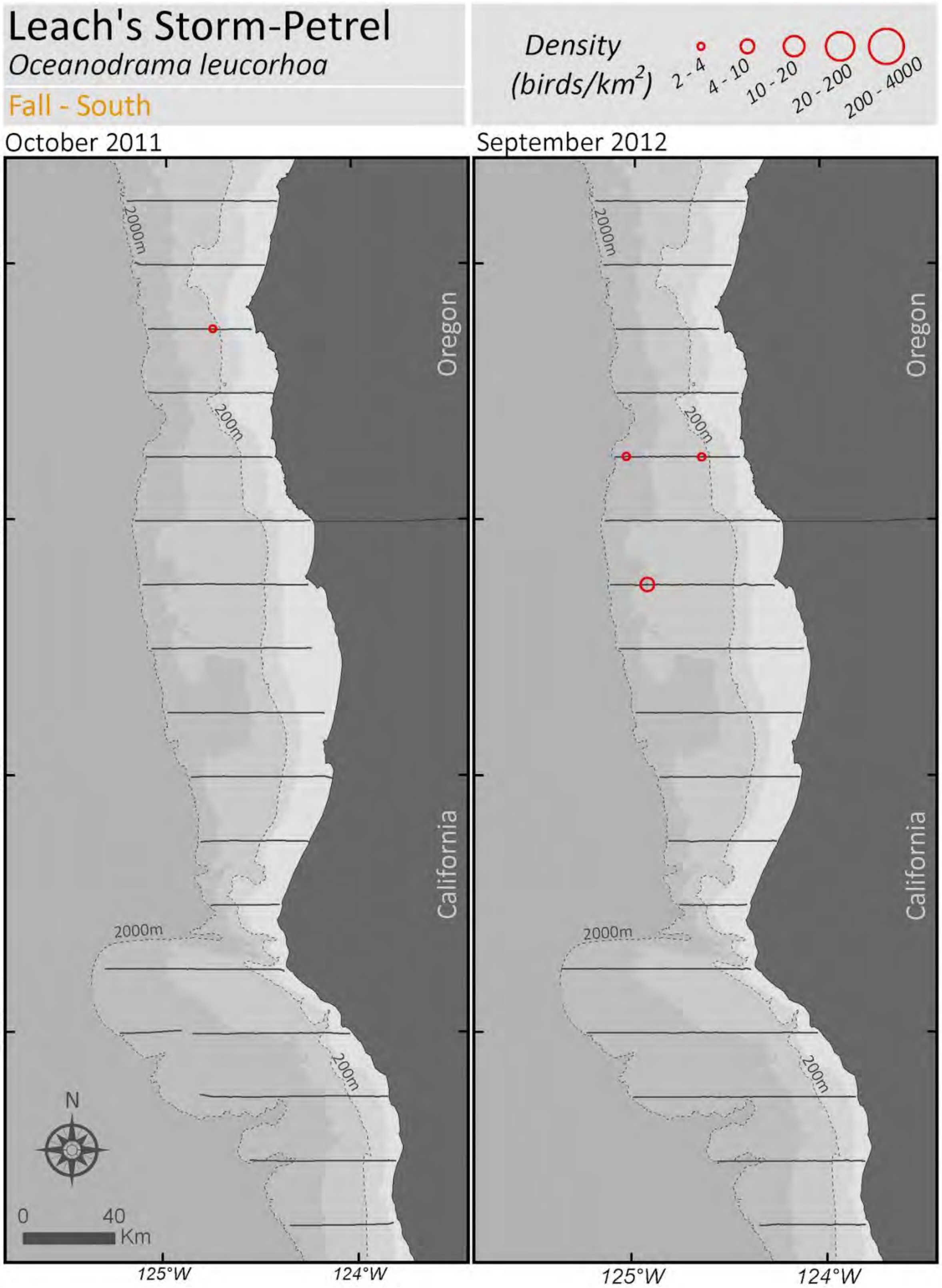


Figure 46. Mean density (birds km^{-2}) of Leach's Storm-Petrels (*Oceanodroma leucorhoa*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Leach's Storm-Petrel
Oceanodrama leucorhoa
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

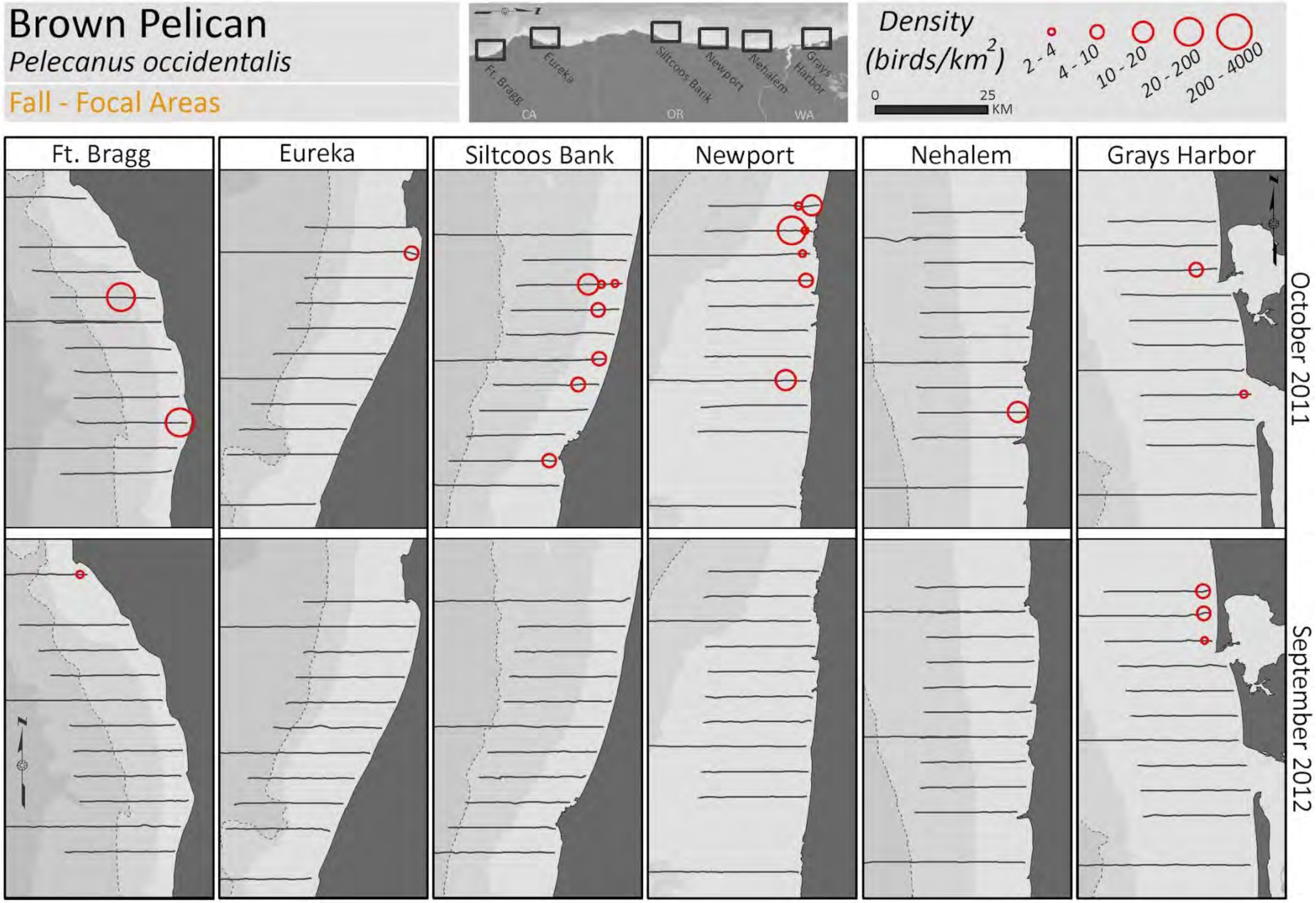


Figure 47. Mean density (birds km^{-2}) of Brown Pelicans (*Pelecanus occidentalis*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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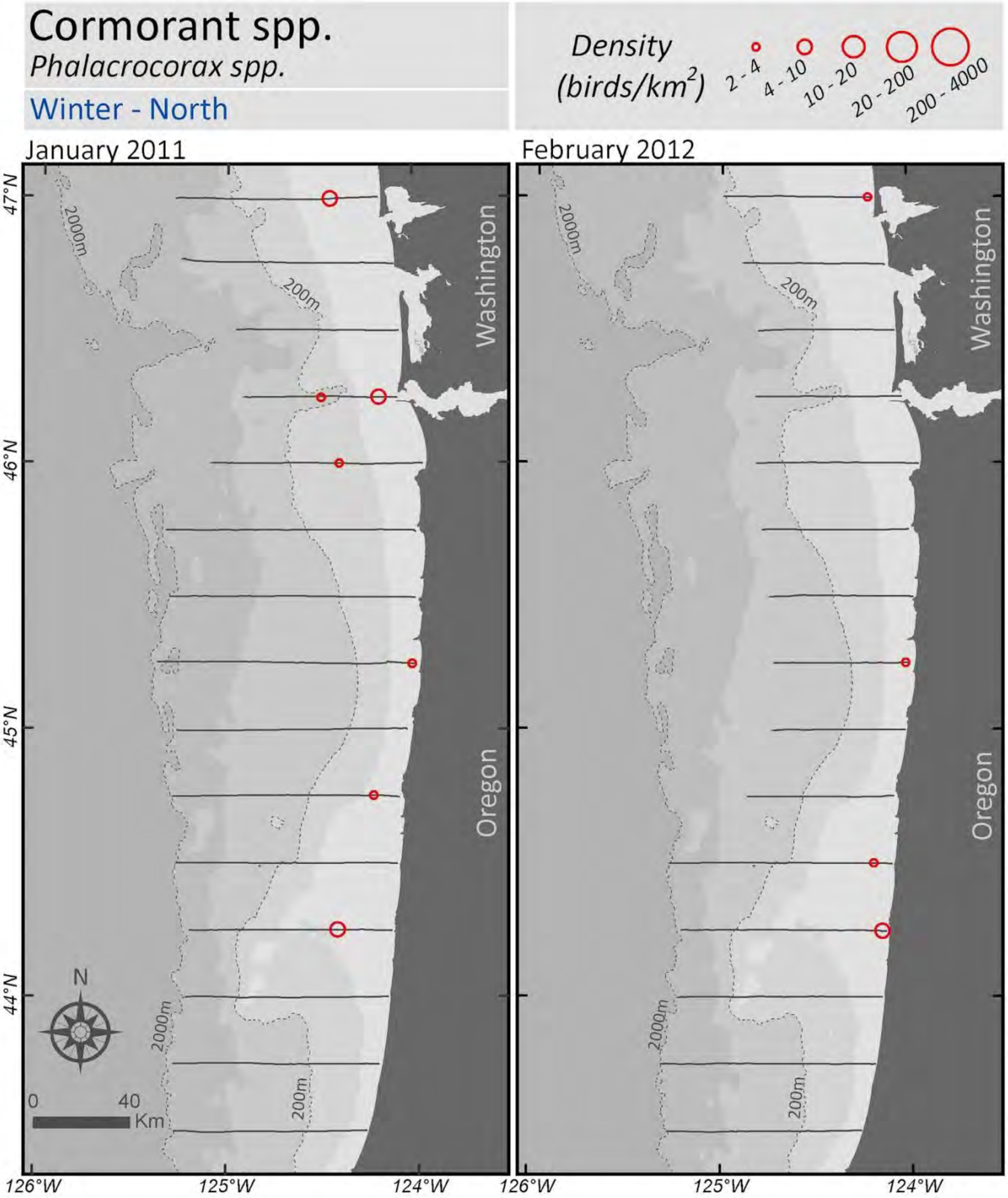
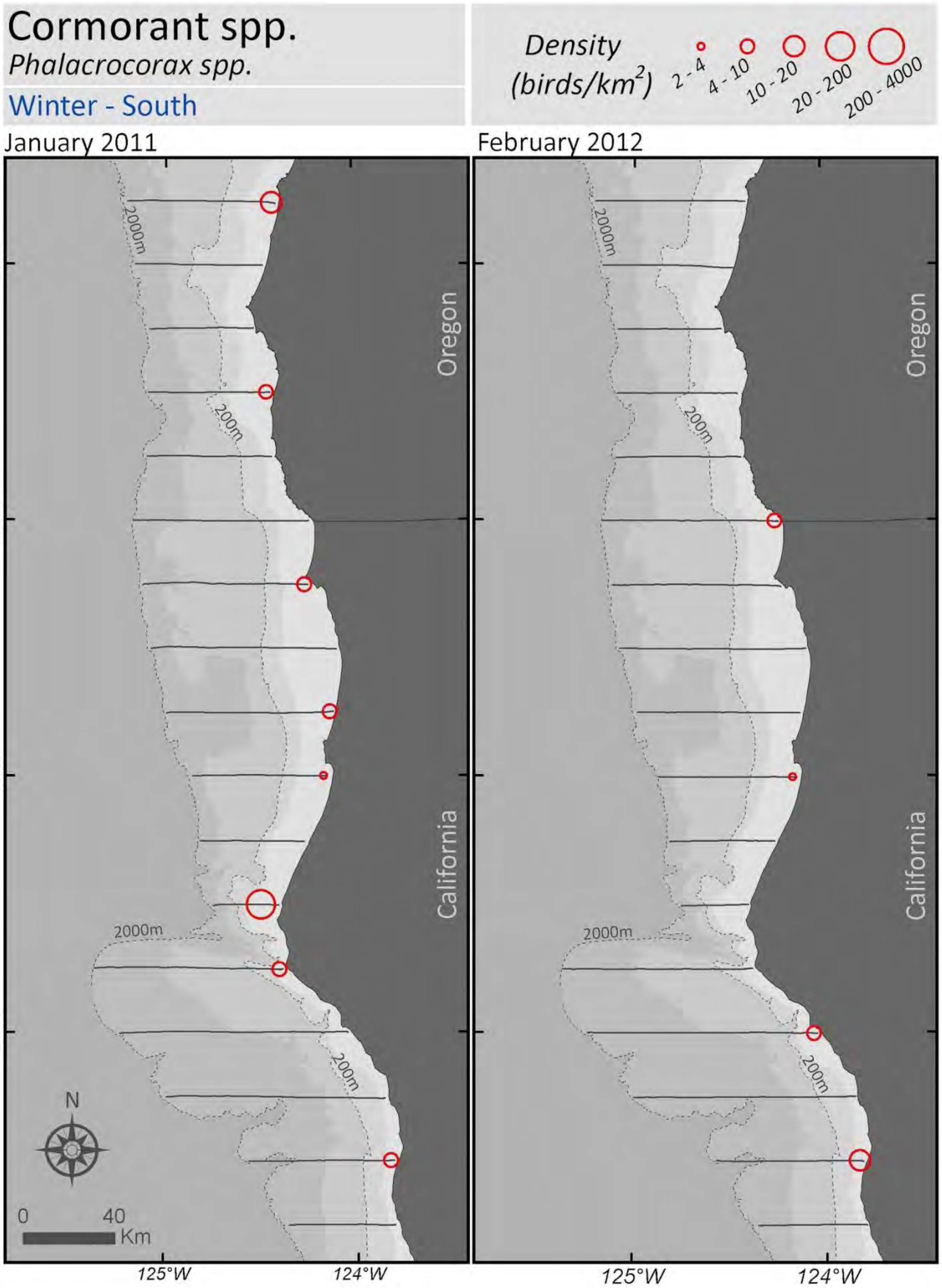


Figure 48. Mean density (birds km^{-2}) of cormorants (*Phalacrocorax spp.*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Cormorant spp.

Phalacrocorax spp.

Winter - South



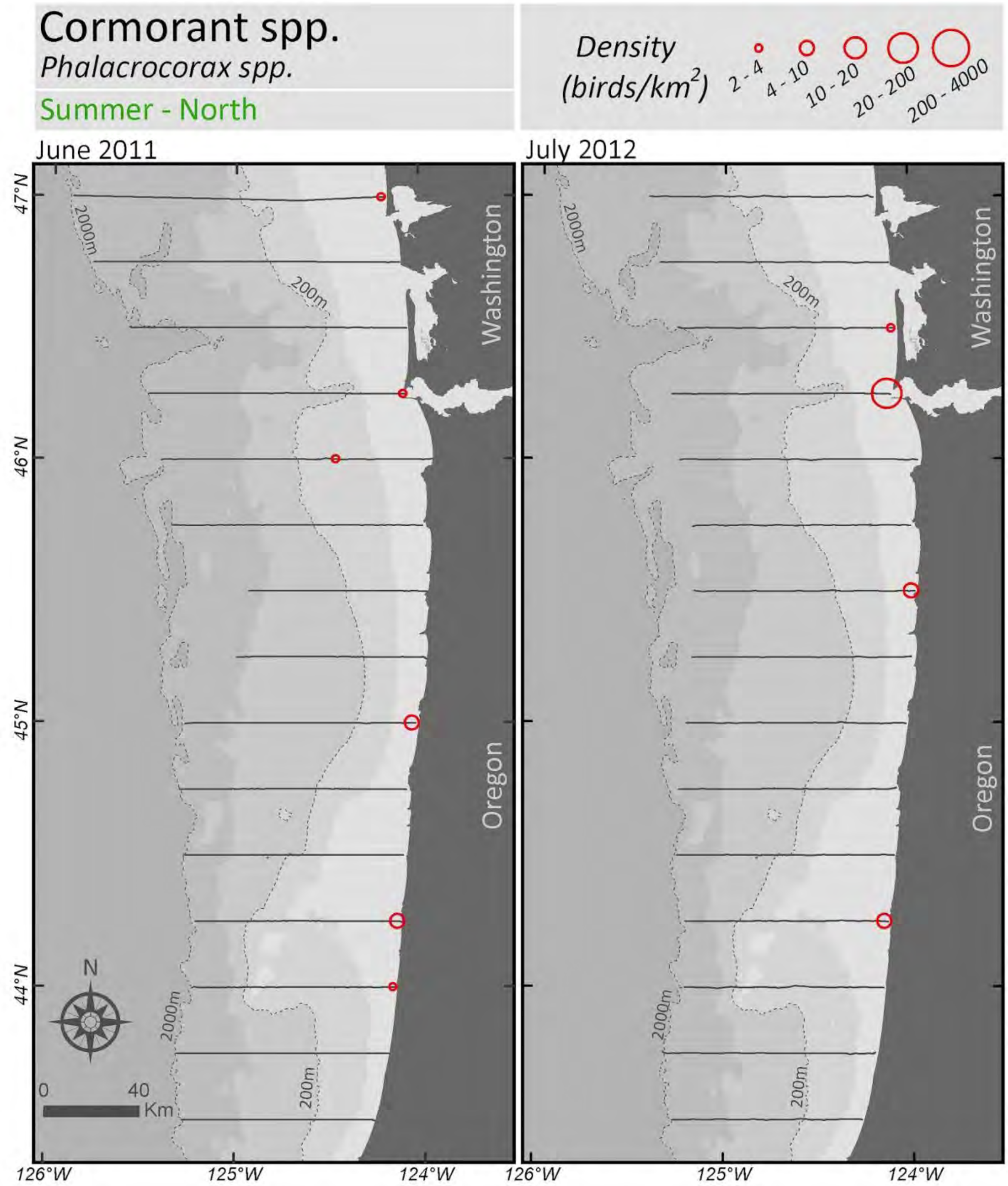
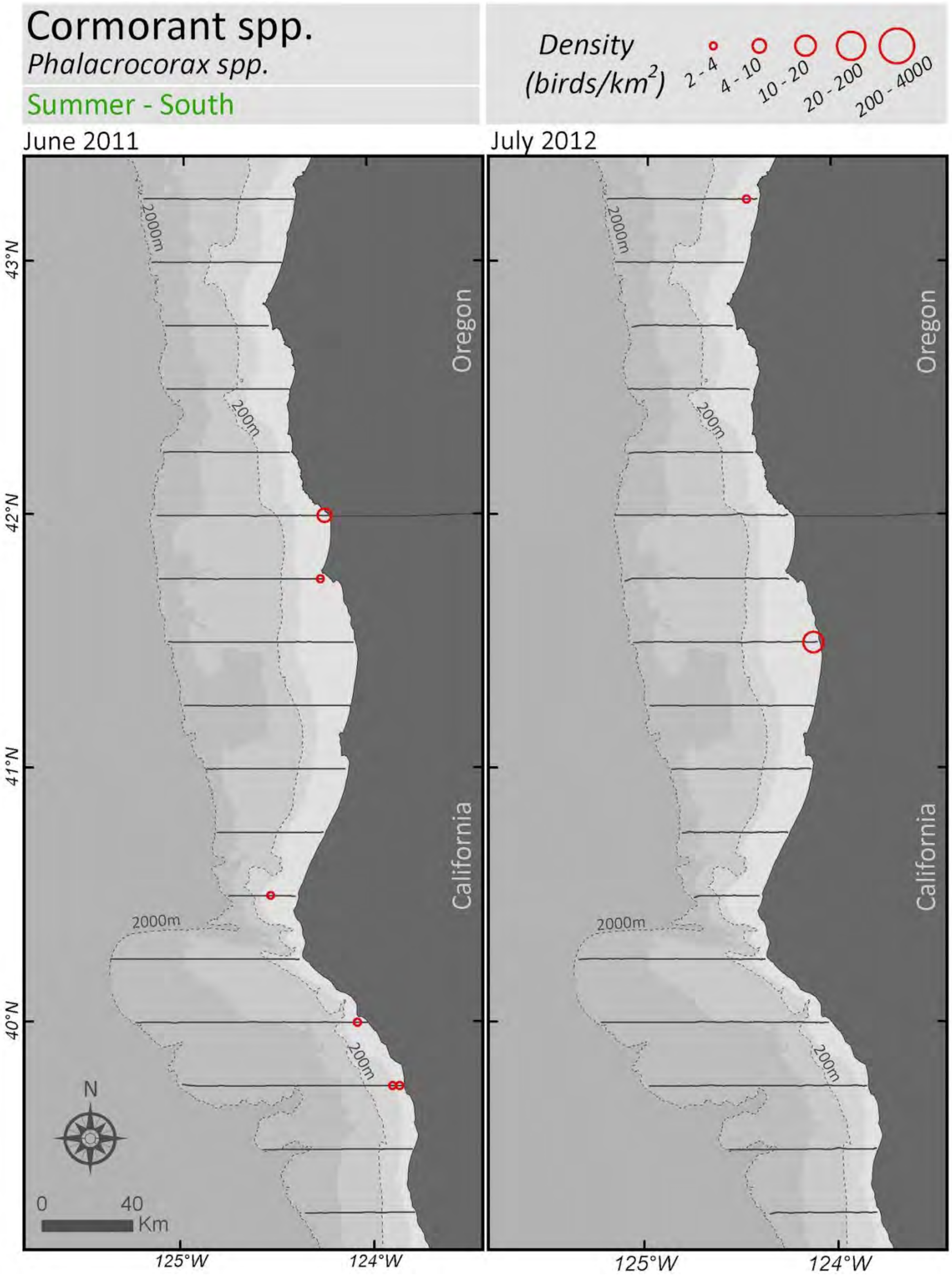


Figure 49. Mean density (birds km^{-2}) of cormorants (*Phalacrocorax spp.*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Cormorant spp.
Phalacrocorax spp.
Summer - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

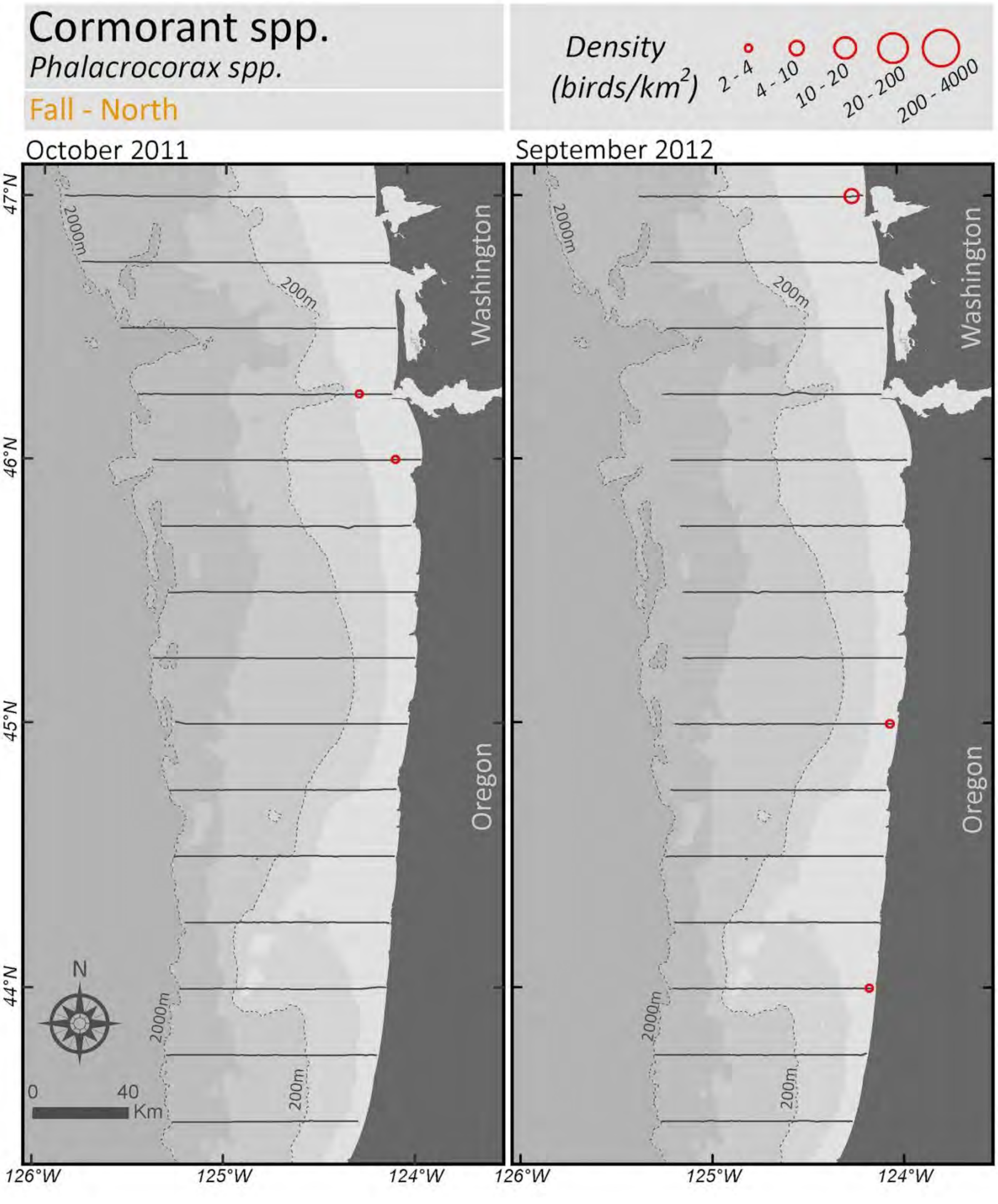
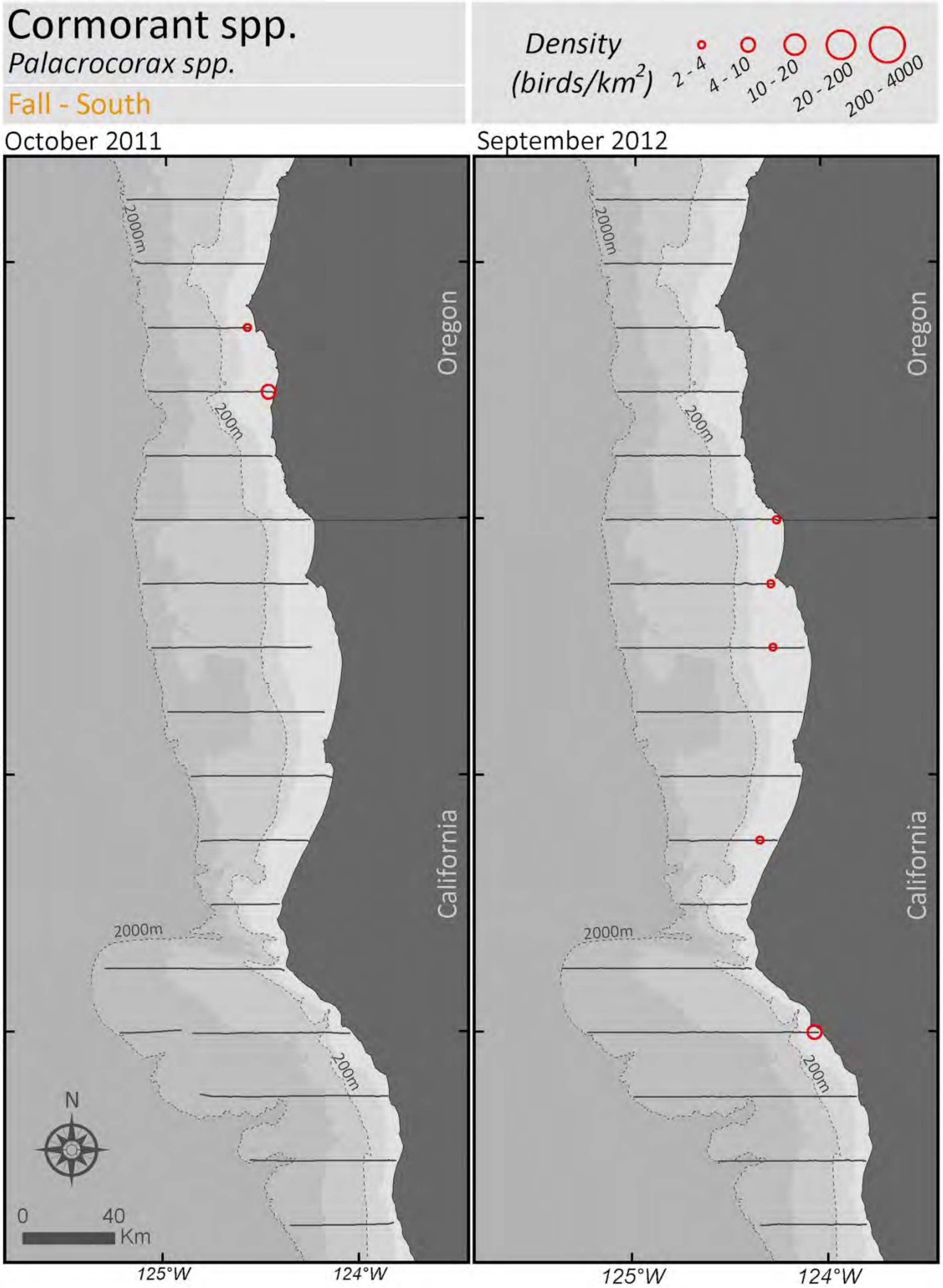


Figure 50. Mean density (birds km^{-2}) of cormorants (*Phalacrocorax spp.*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.



Cormorant spp.

Palacrocorax spp.

Fall - South

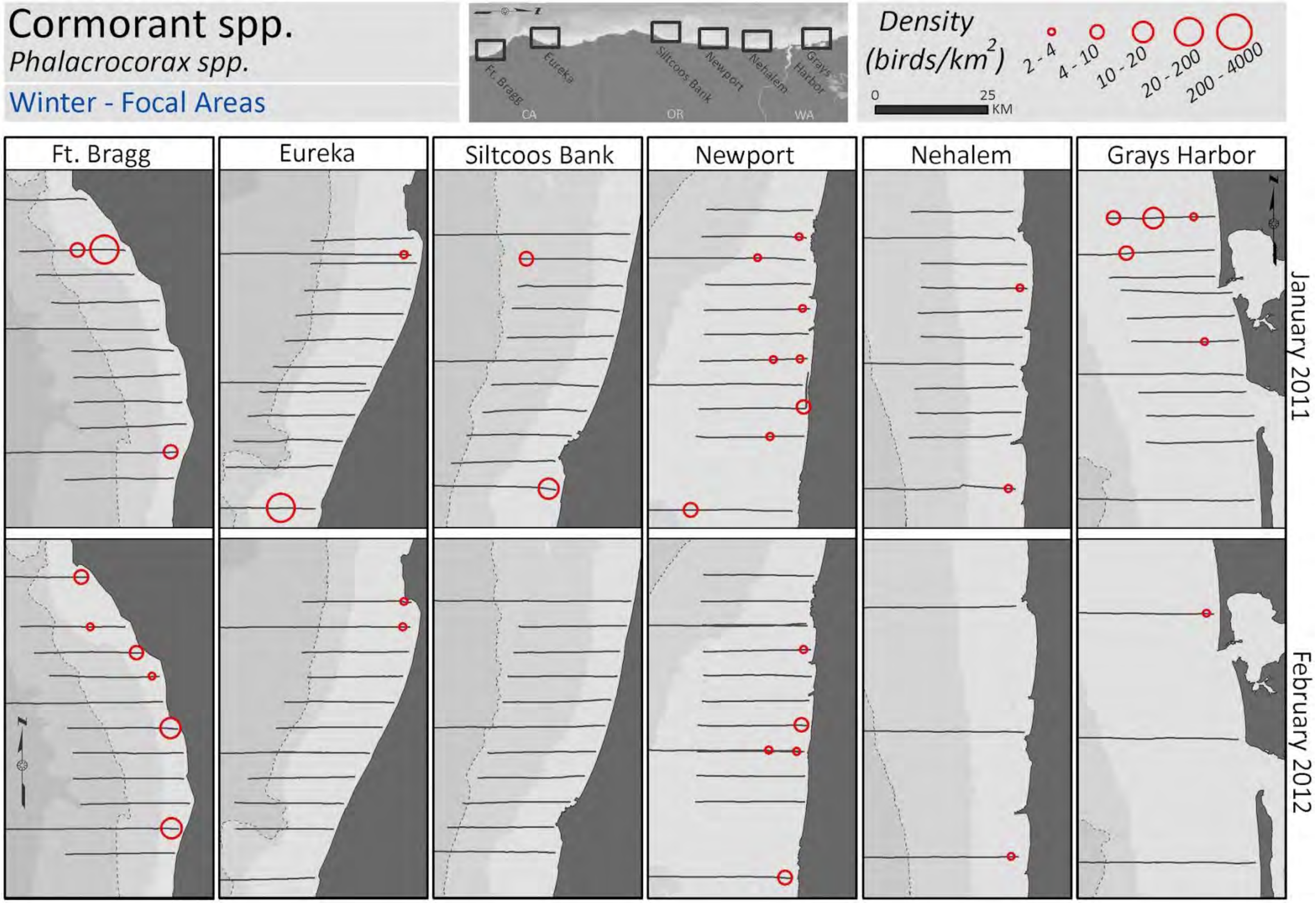


Figure 51. Mean density (birds km^{-2}) of cormorants (*Phalacrocorax spp.*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

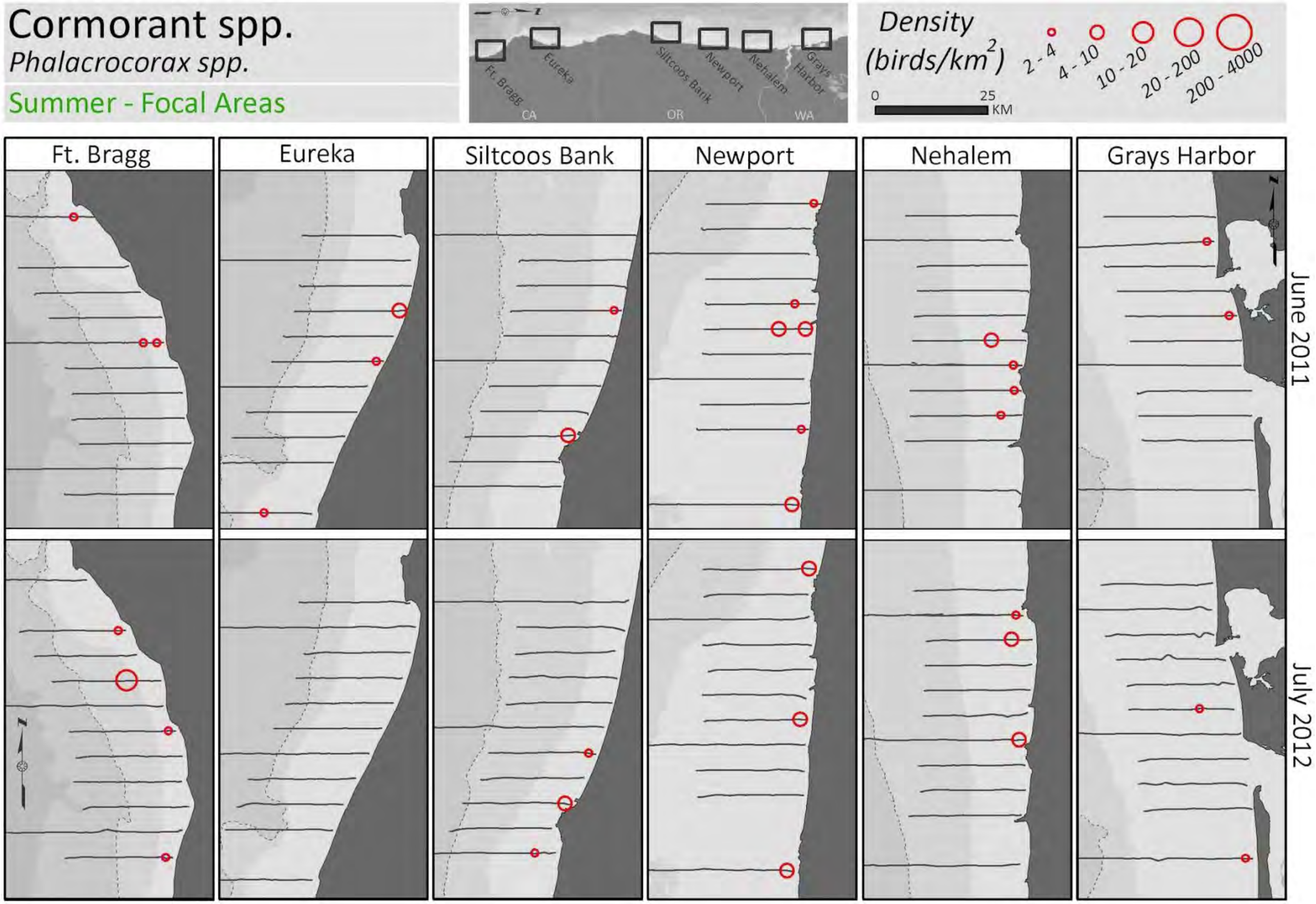


Figure 52. Mean density (birds km^{-2}) of cormorants (*Phalacrocorax spp.*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

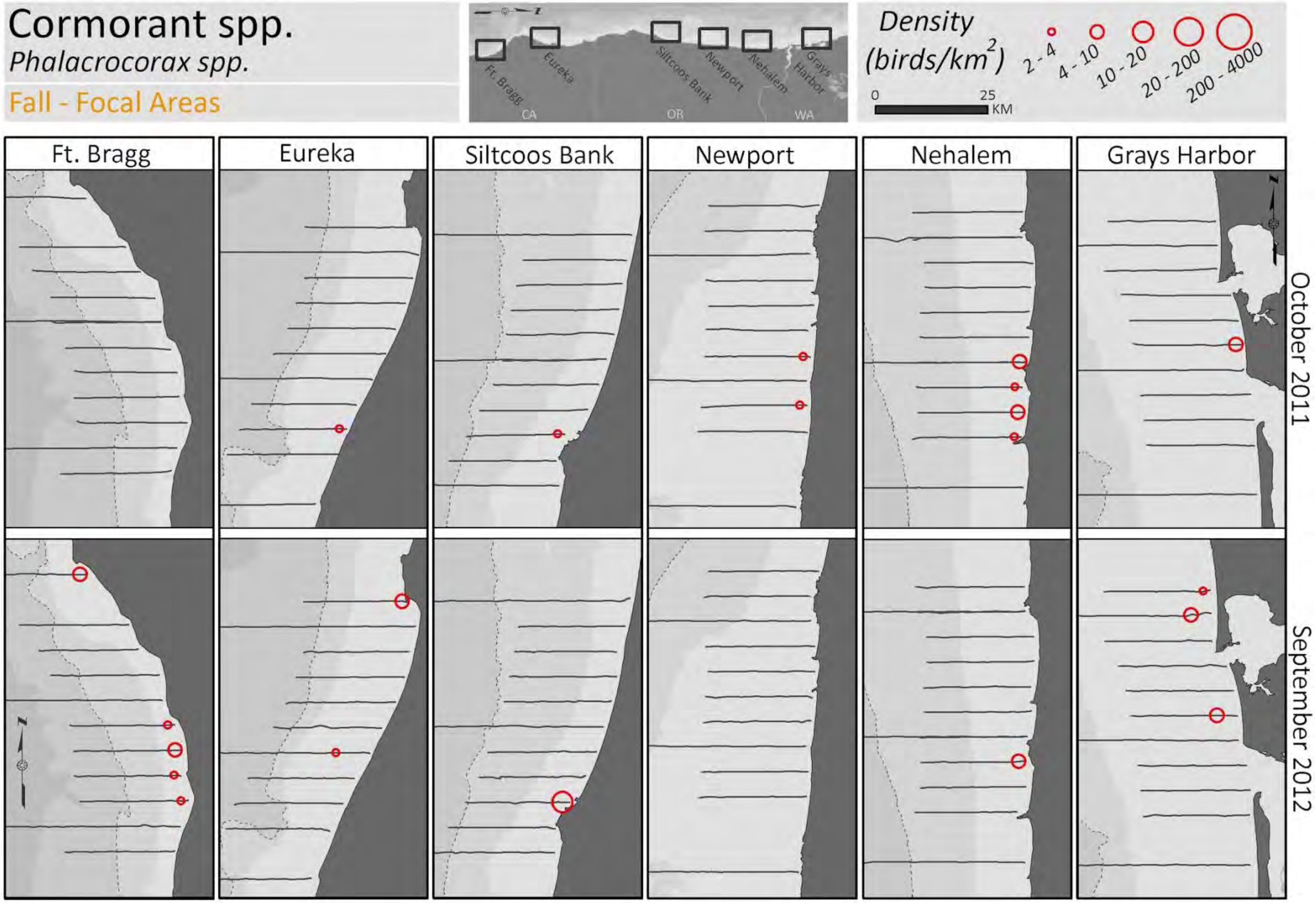


Figure 53. Mean density (birds km^{-2}) of cormorants (*Phalacrocorax spp.*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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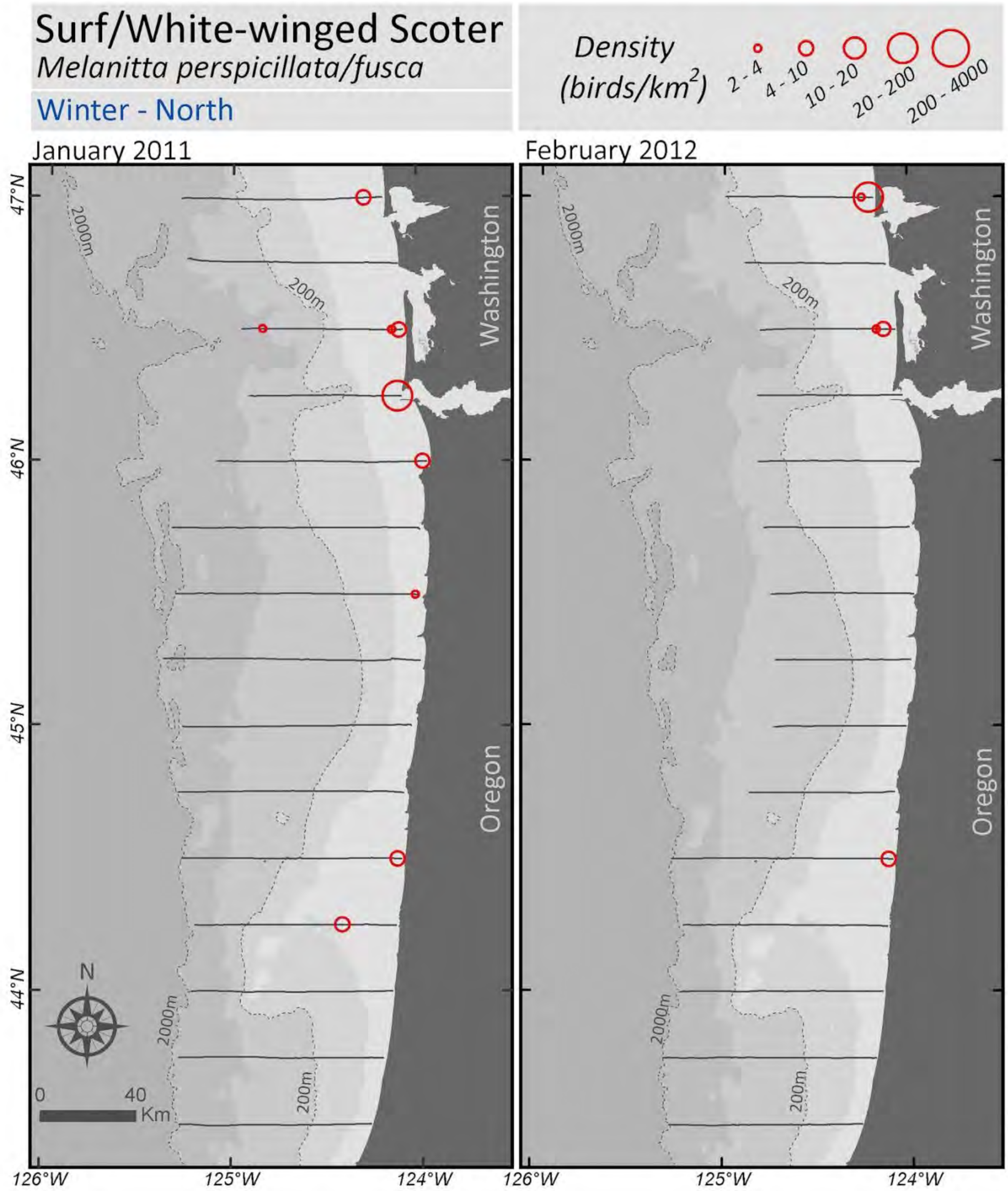
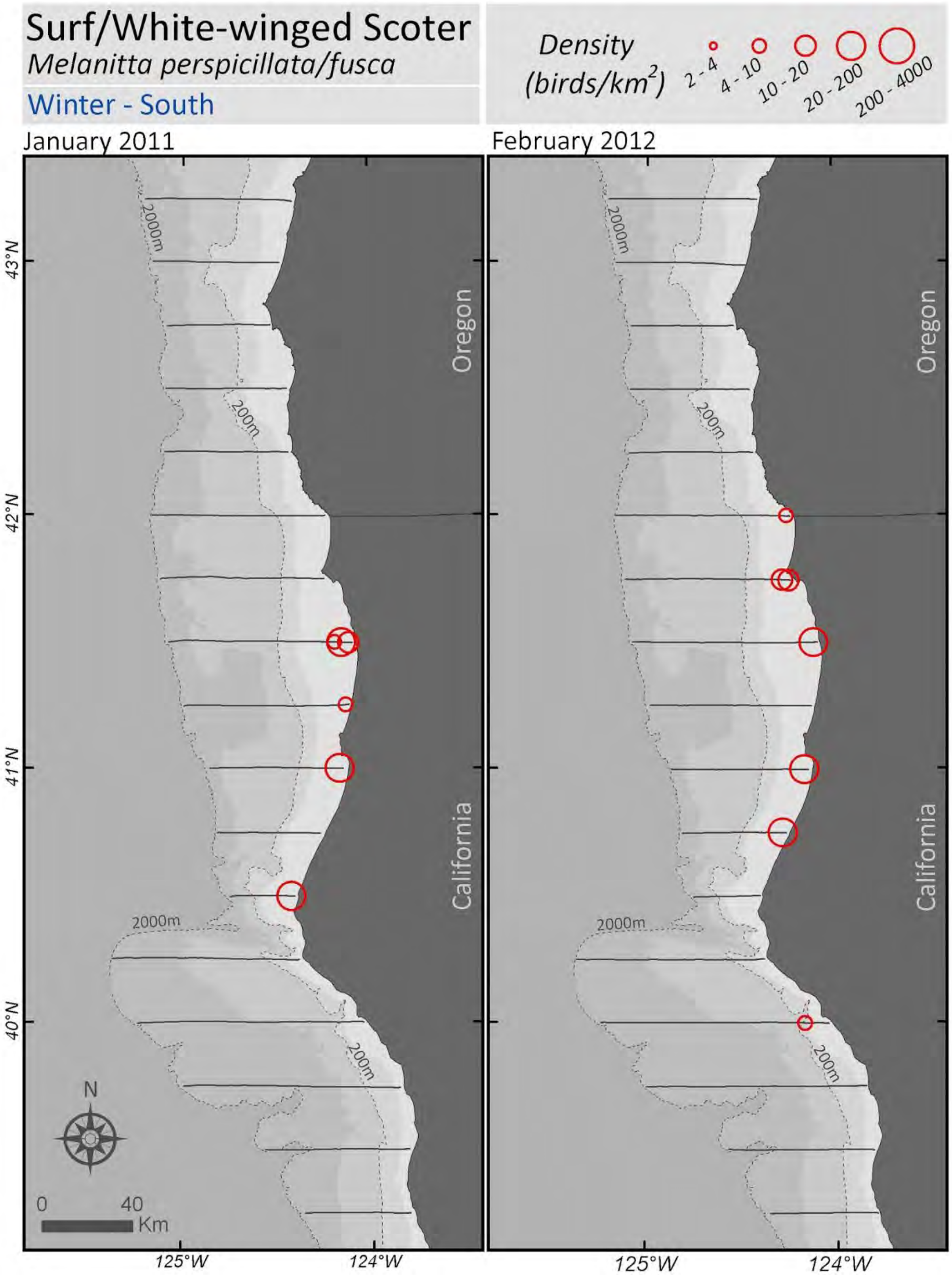


Figure 54. Mean density (birds km^{-2}) of Surf/White-winged Scoters (*Melanitta perspicillata/fusca*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Surf/White-winged Scoter
Melanitta perspicillata/fusca
Winter - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
January 2011
February 2012
43°N
42°N
41°N
40°N
125°W
124°W
2000m
200m
Oregon
California
N
0
40
Km

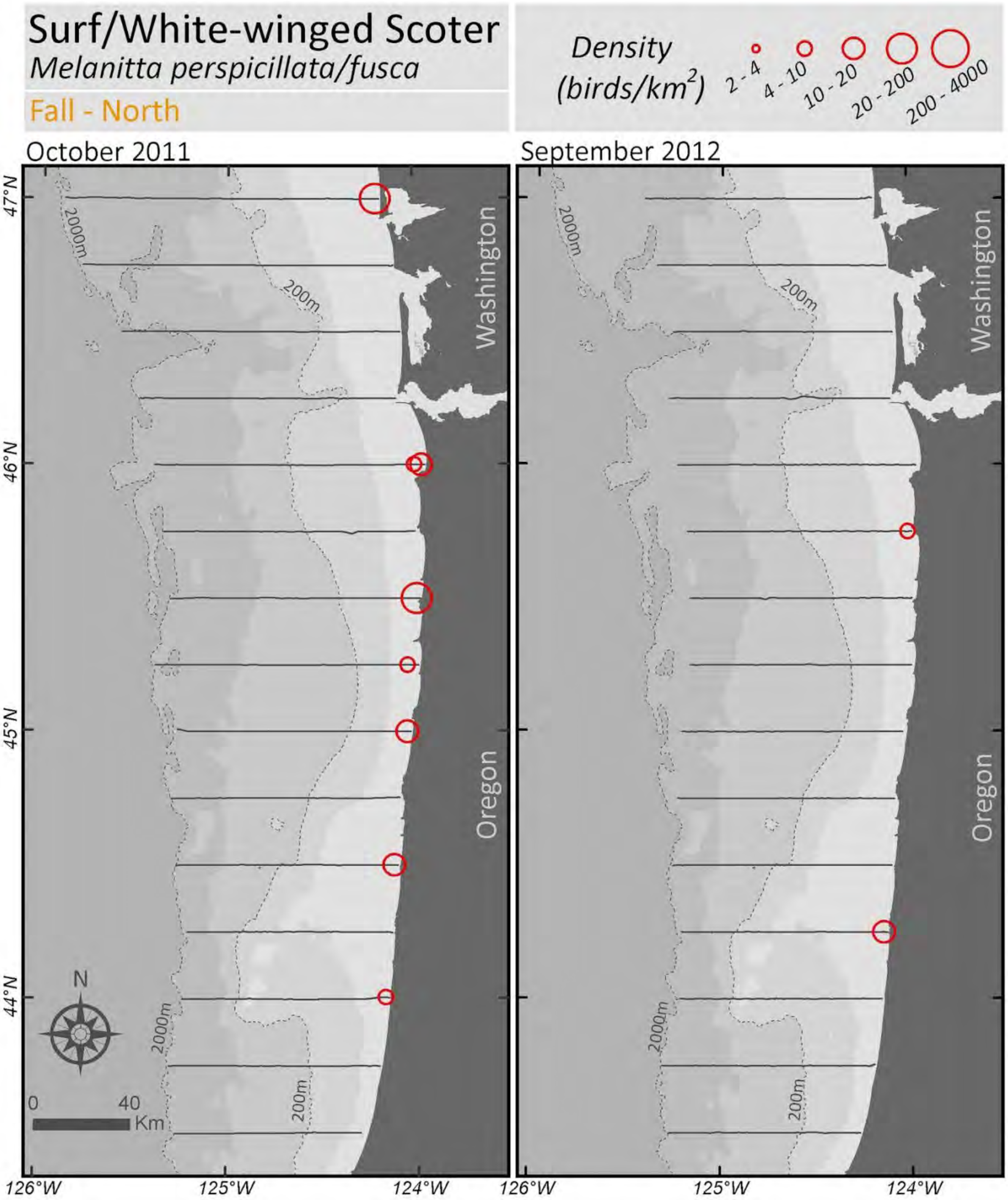
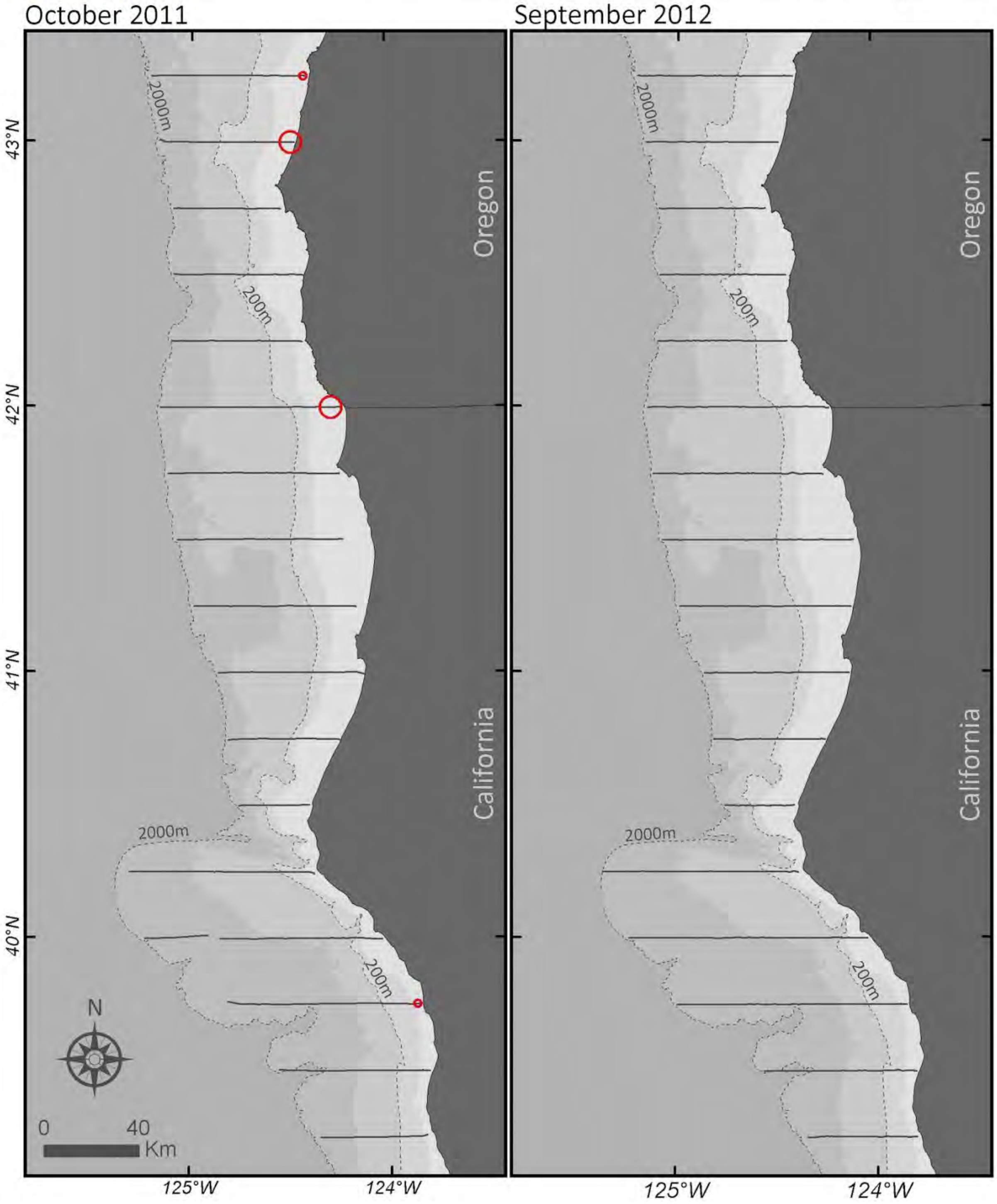


Figure 55. Mean density (birds km^{-2}) of Surf/White-winged Scoters (*Melanitta perspicillata/fusca*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Surf/White-winged Scoter

Melanitta perspicillata/fusca

Fall - South



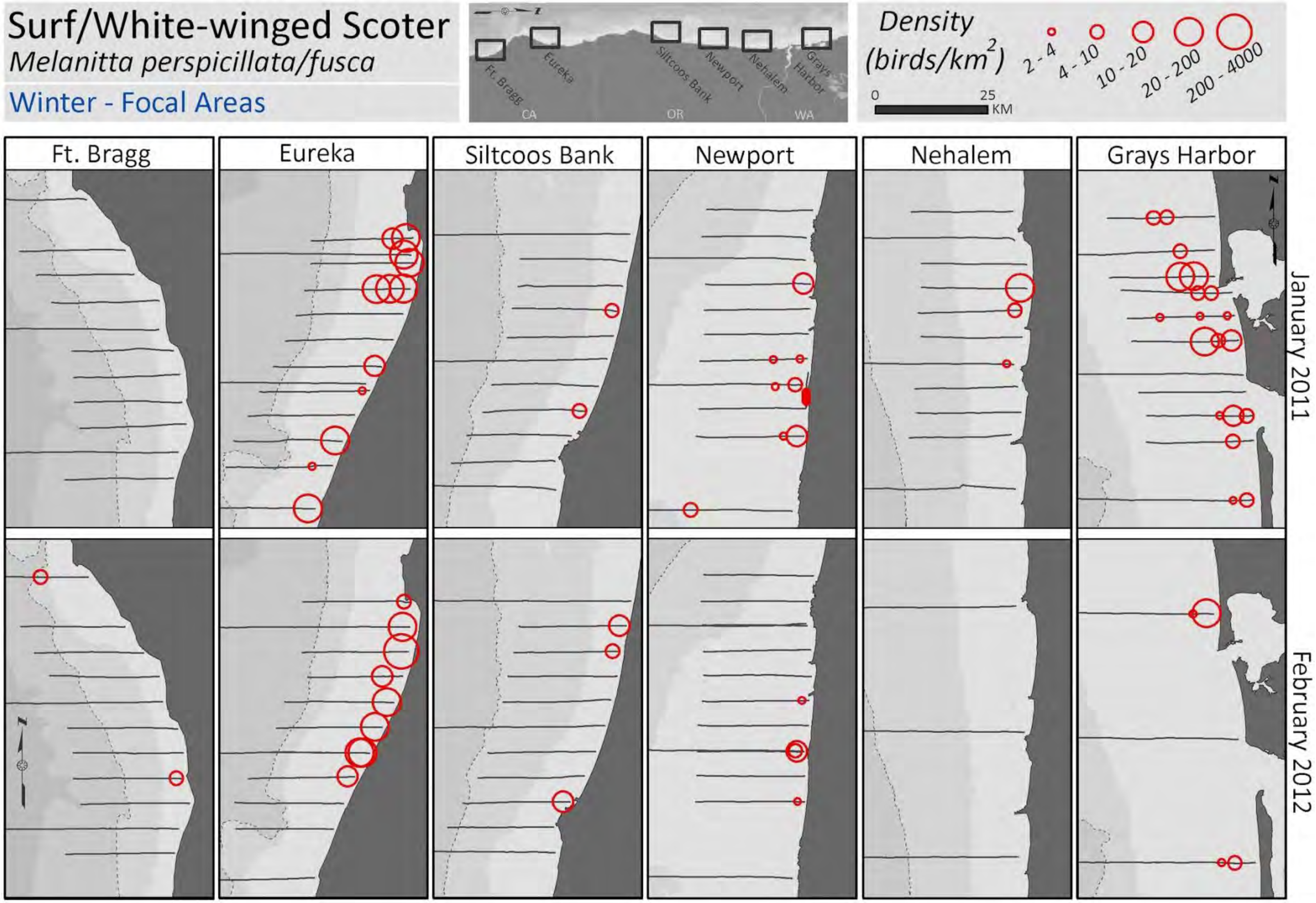


Figure 56. Mean density (birds km^{-2}) of Surf/White-winged Scoters (*Melanitta perspicillata/fusca*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

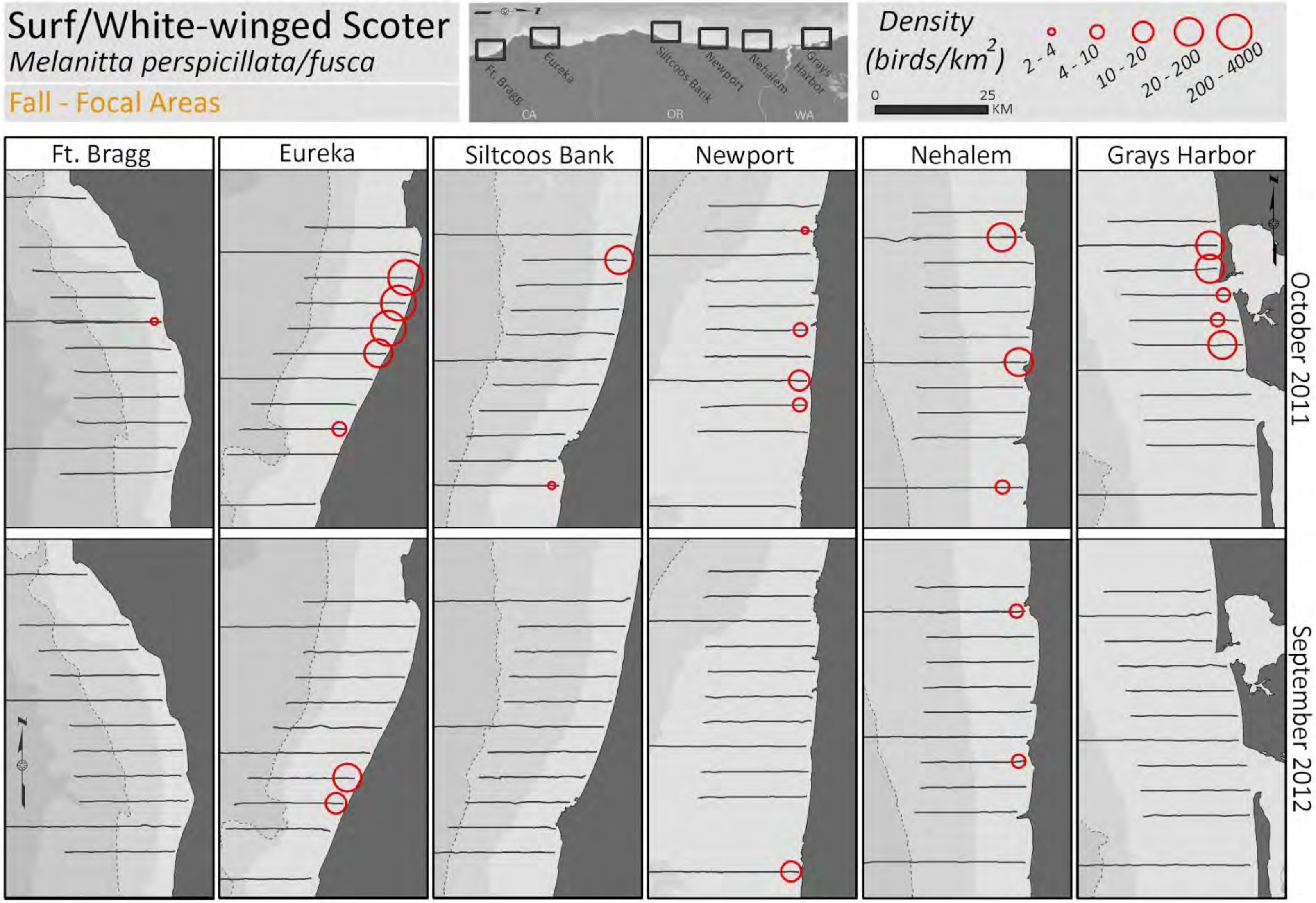


Figure 57. Mean density (birds km^{-2}) of Surf/White-winged Scoters (*Melanitta perspicillata/fusca*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

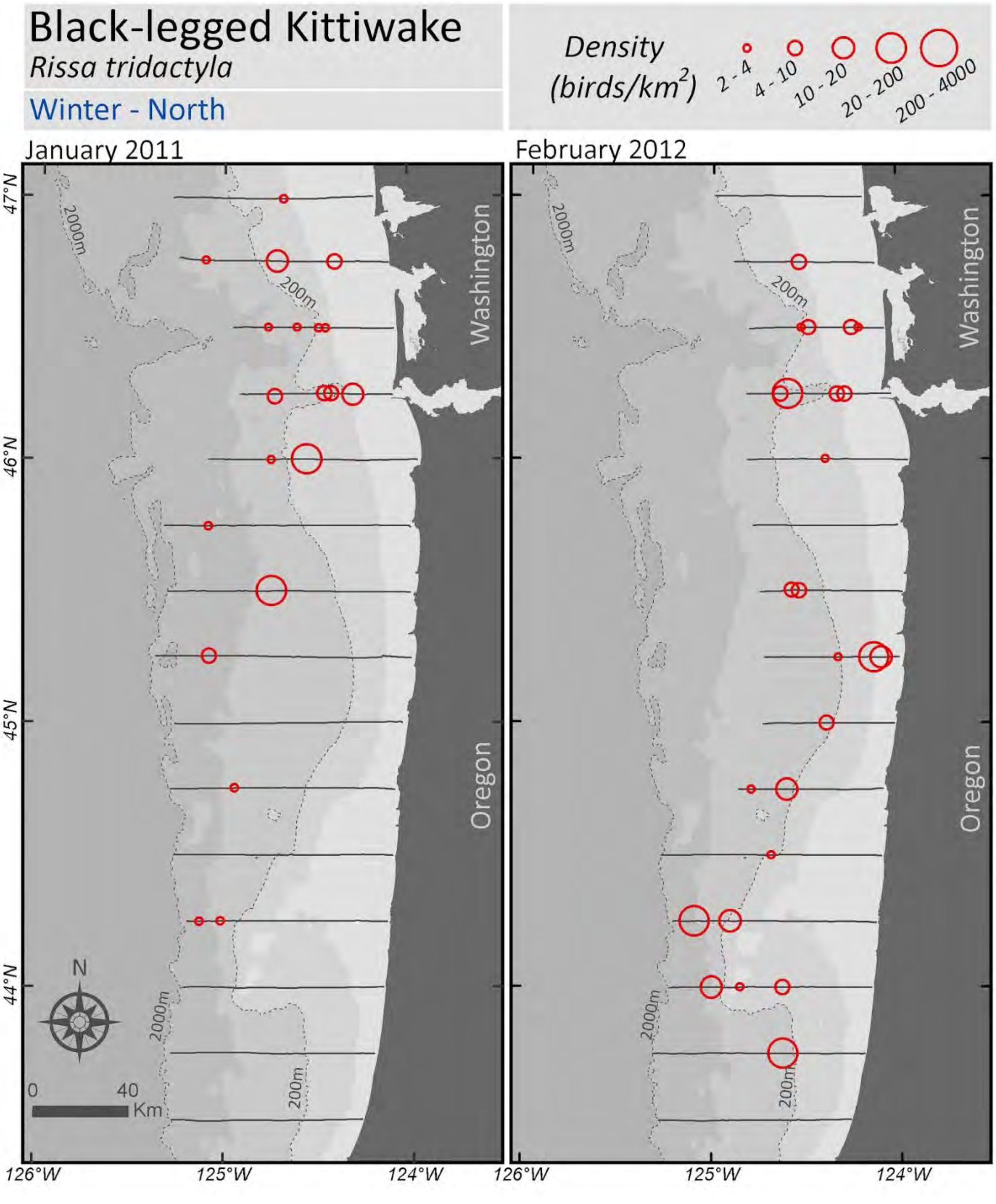
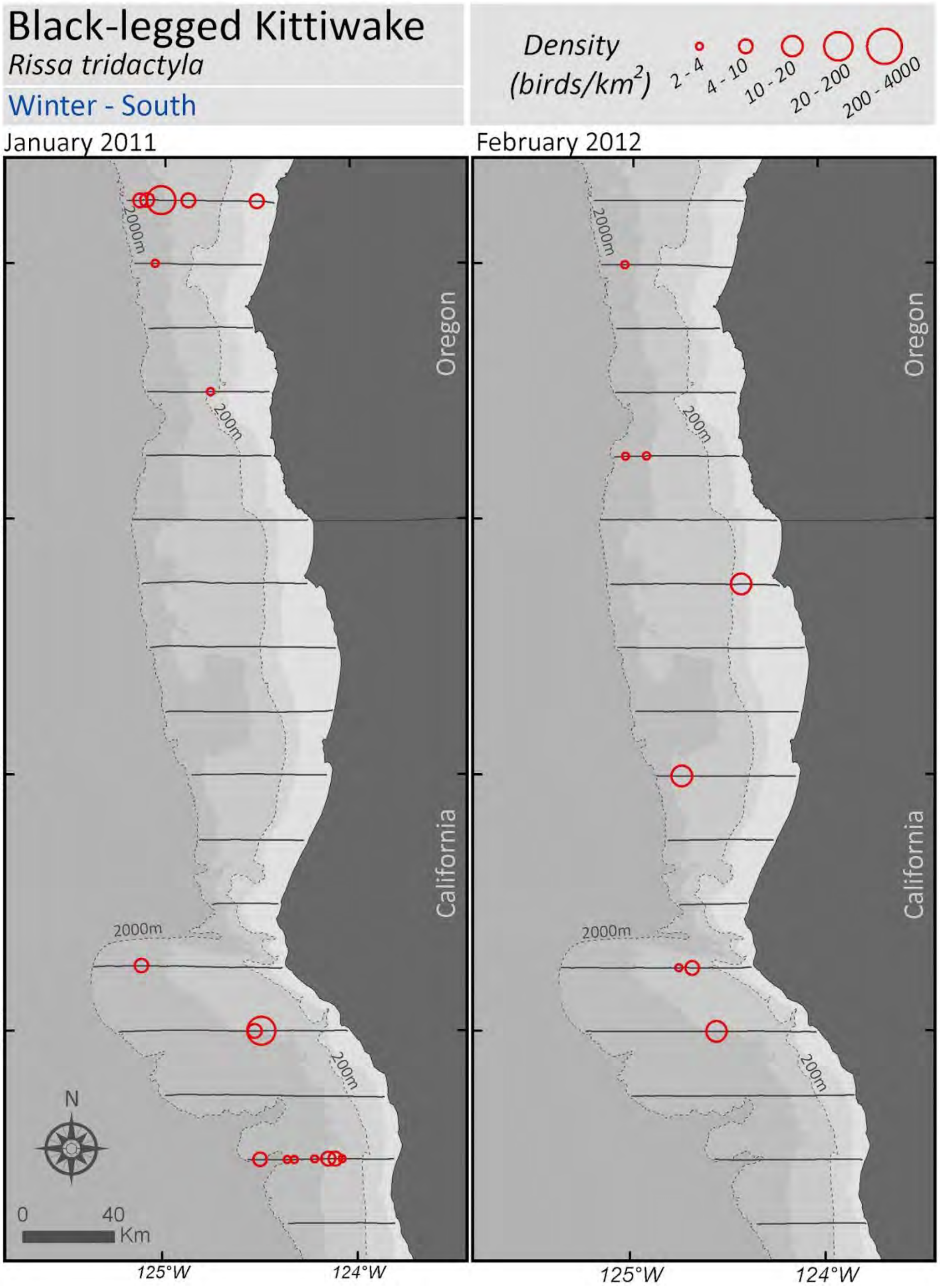


Figure 58. Mean density (birds km^{-2}) of Black-legged Kittiwakes (*Rissa tridactyla*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Black-legged Kittiwake

Rissa tridactyla

Winter - South



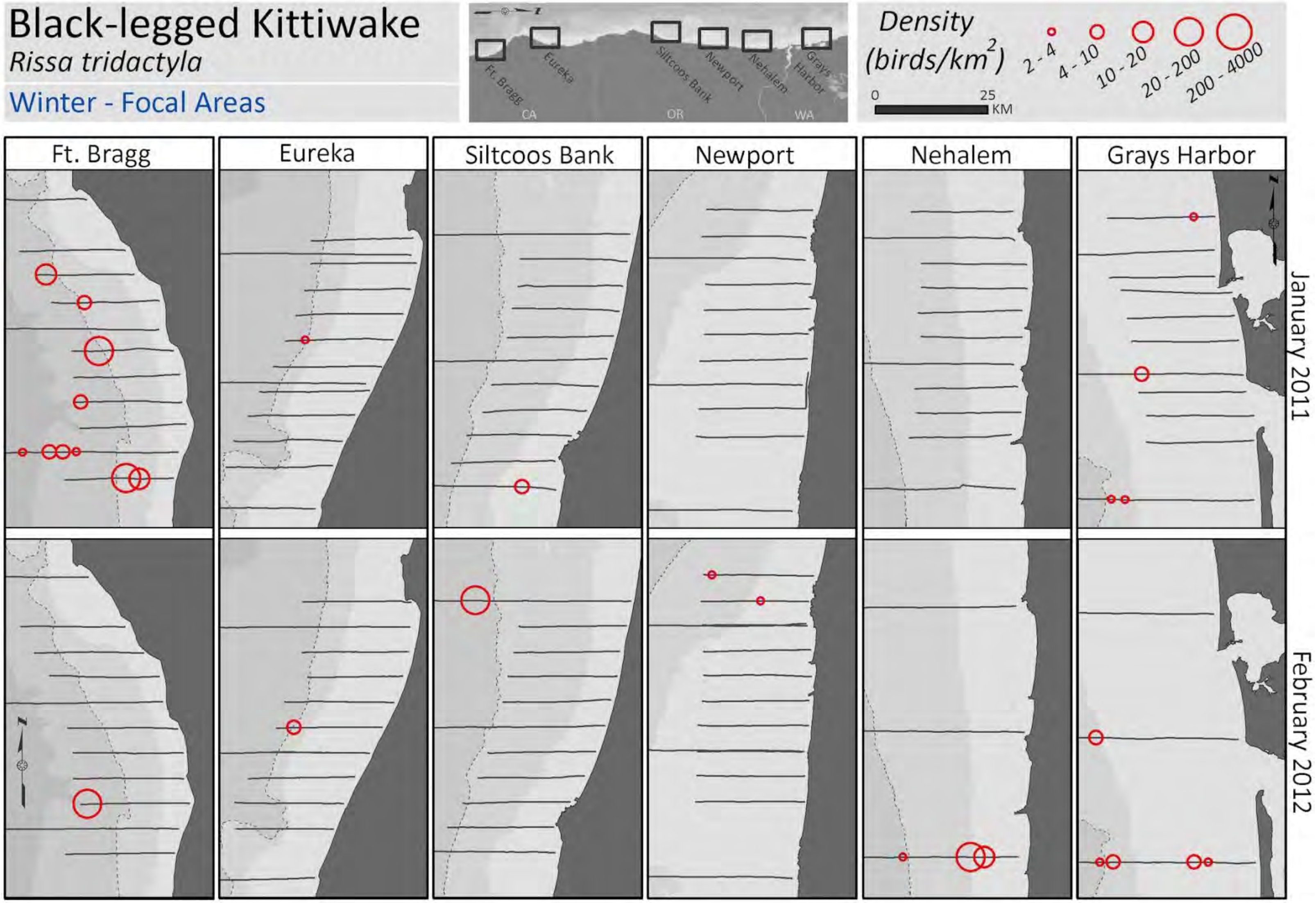


Figure 59. Mean density (birds km^{-2}) of Black-legged Kittiwakes (*Rissa tridactyla*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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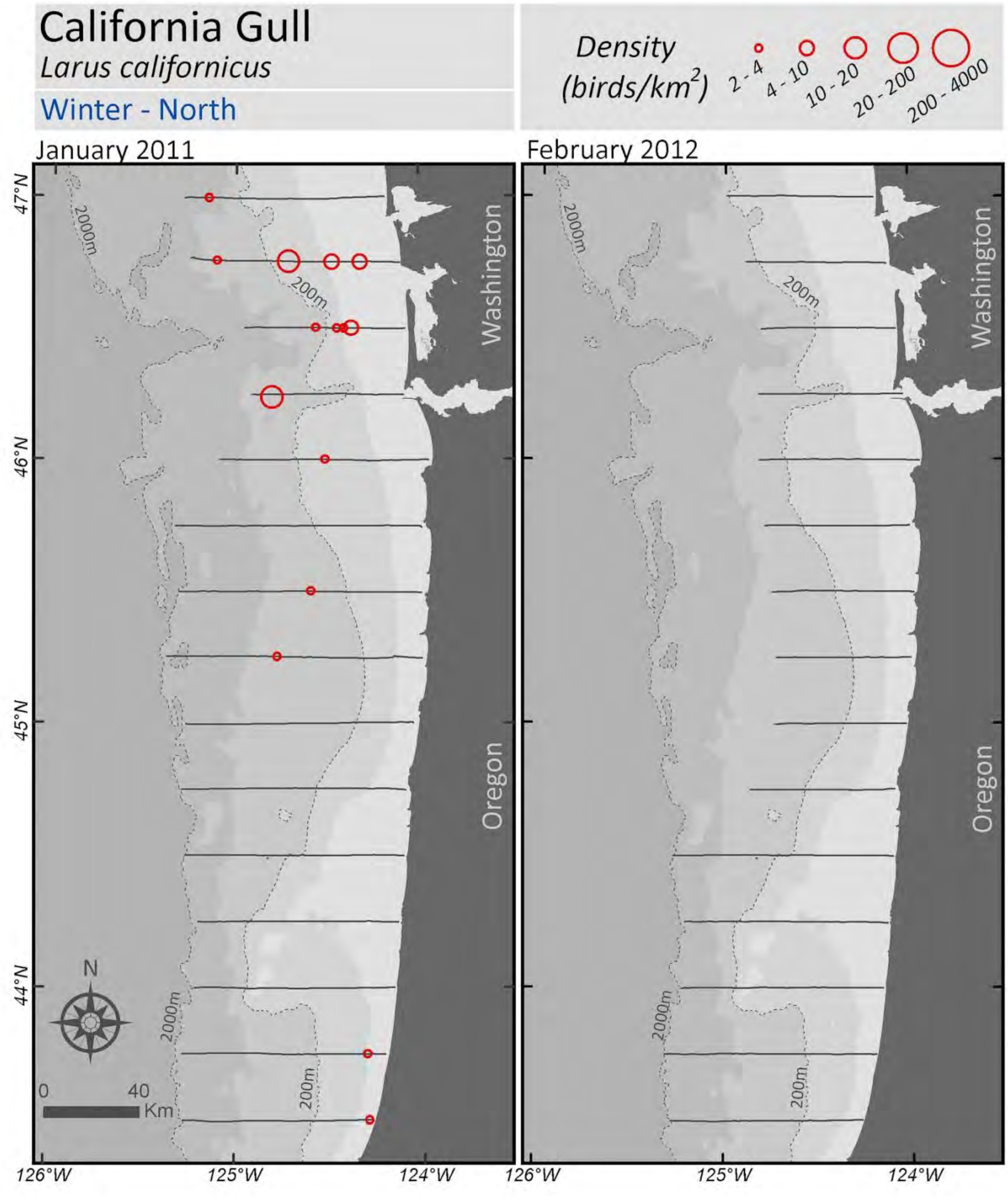
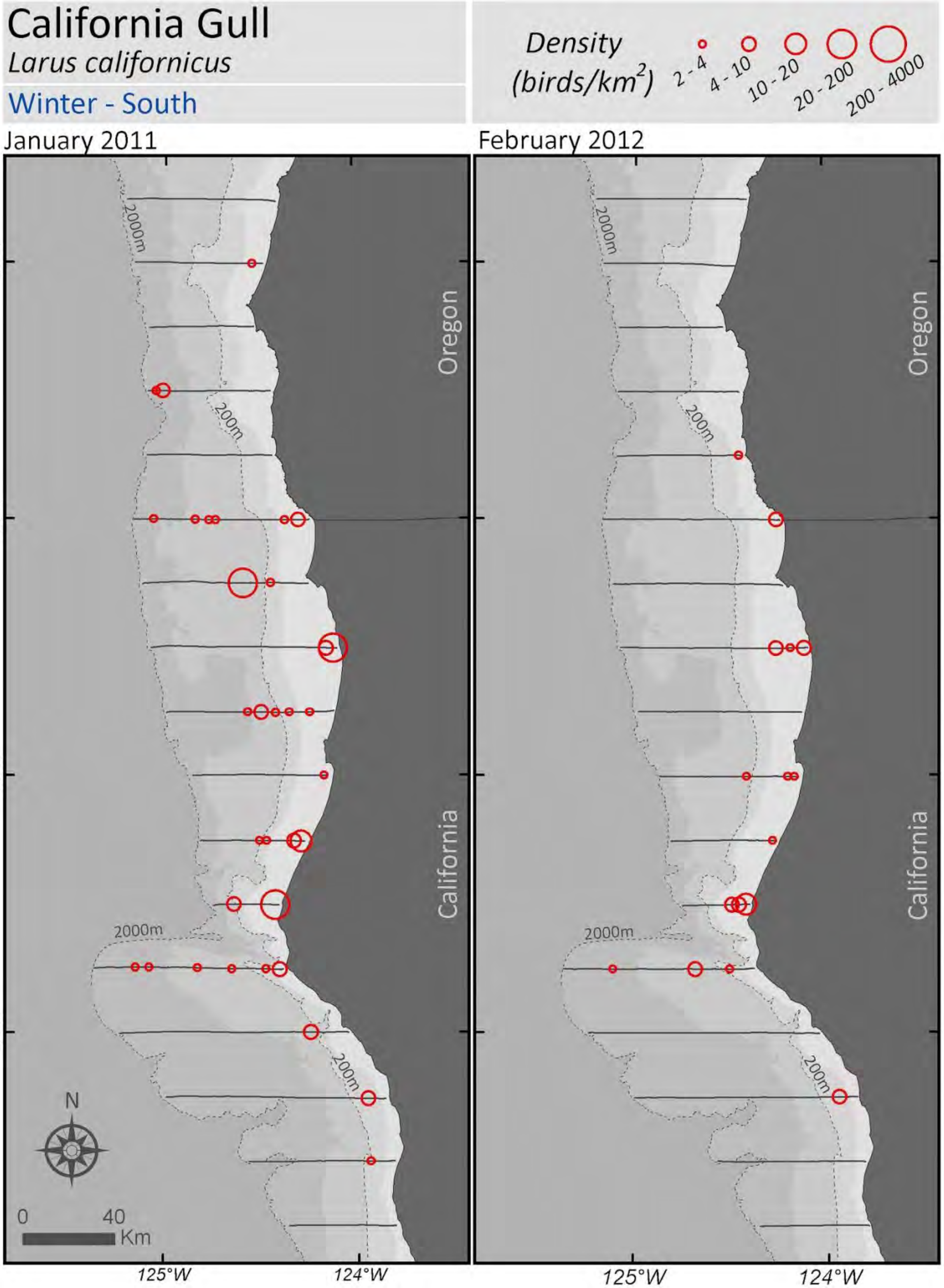


Figure 60. Mean density (birds km^{-2}) of California Gulls (*Larus californicus*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

California Gull

Larus californicus

Winter - South



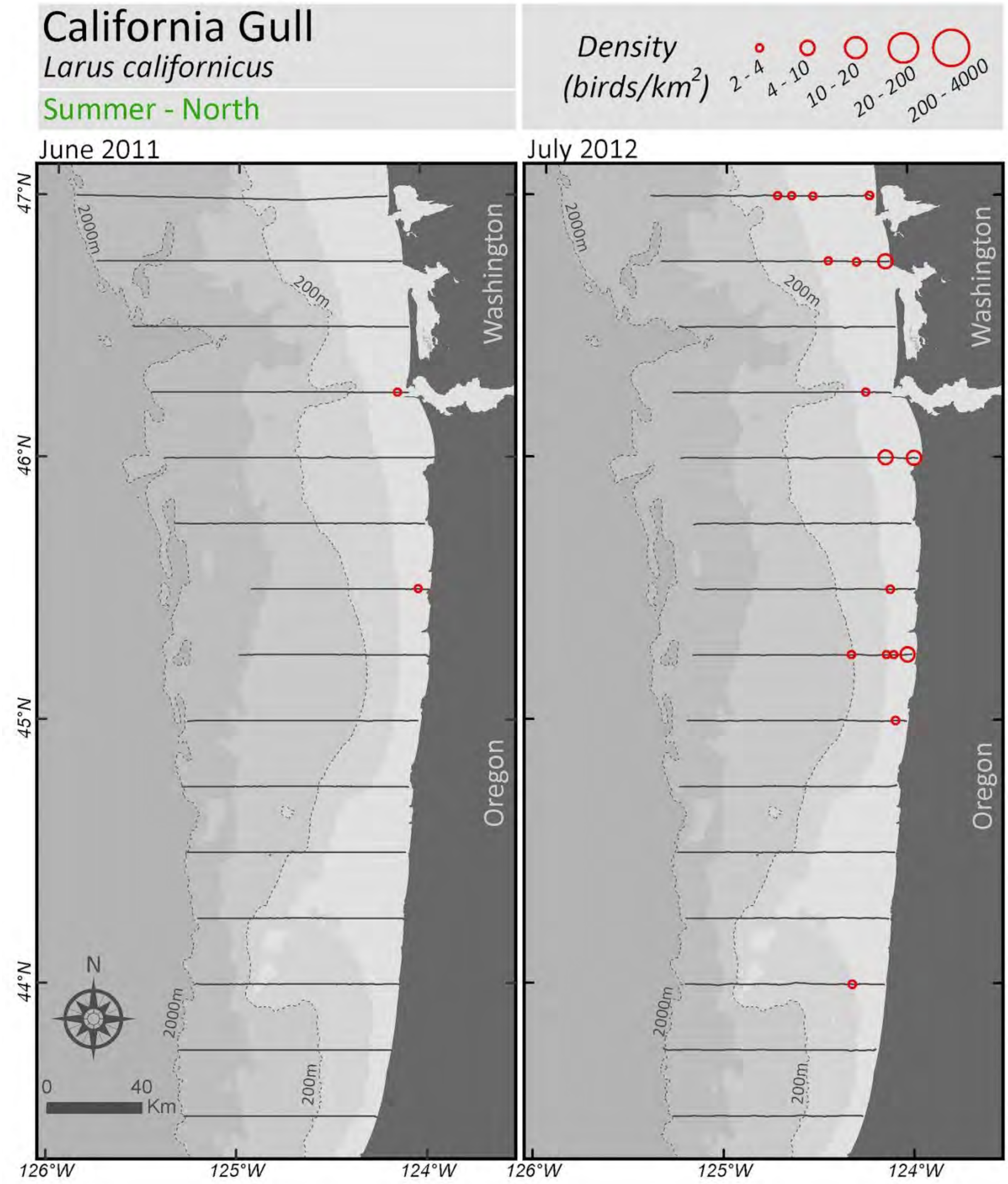
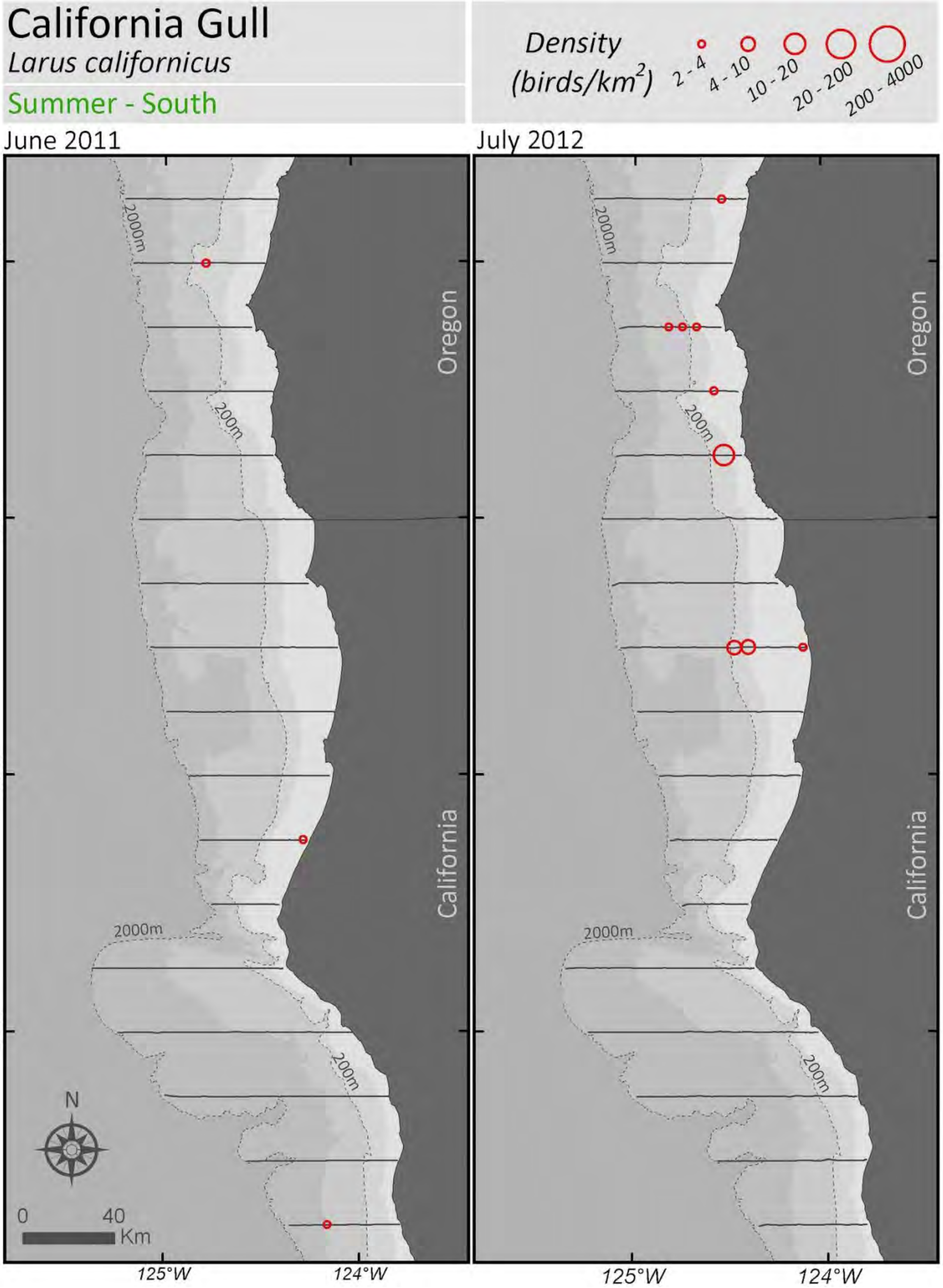


Figure 61. Mean density (birds km^{-2}) of California Gulls (*Larus californicus*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

California Gull

Larus californicus

Summer - South



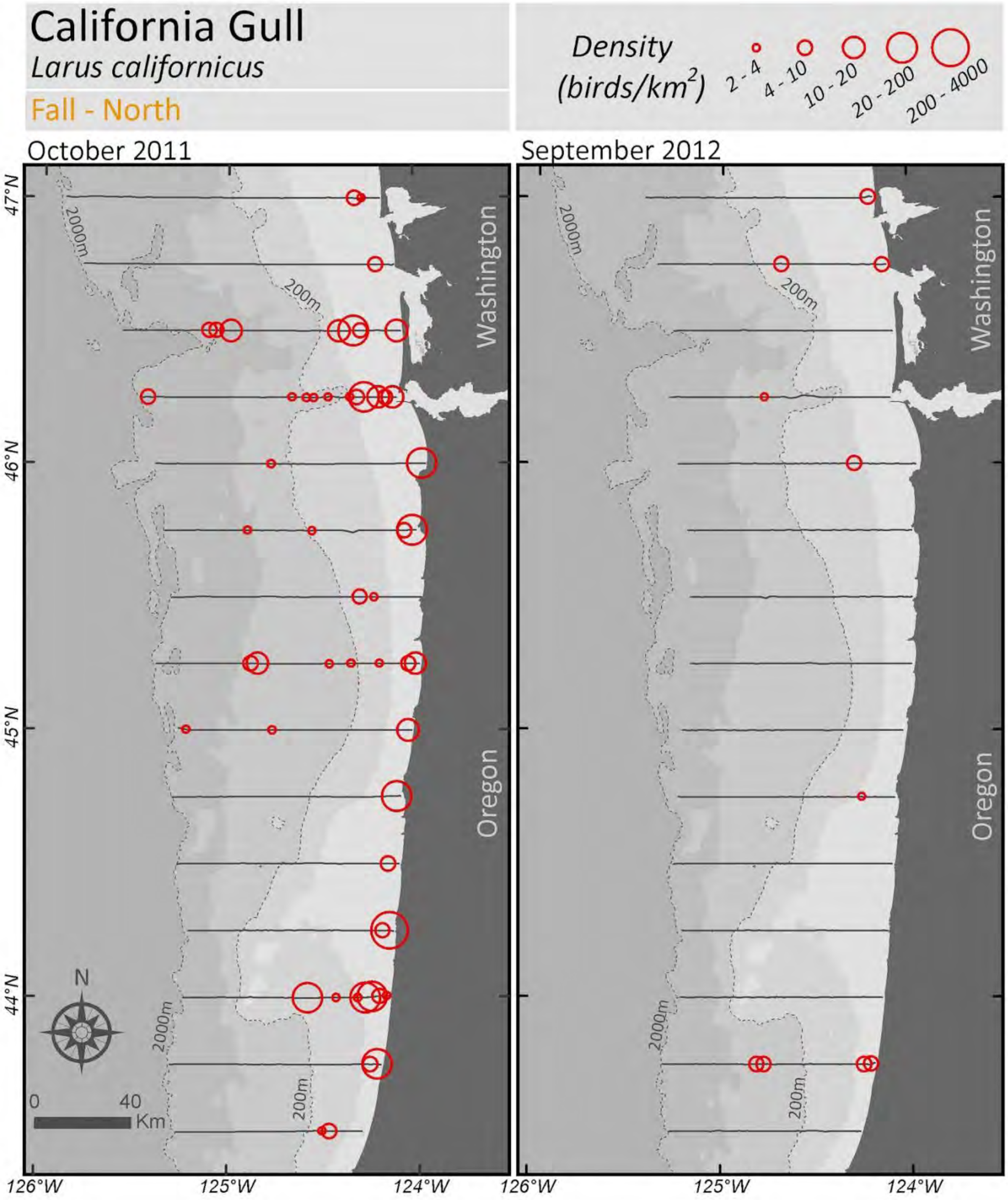
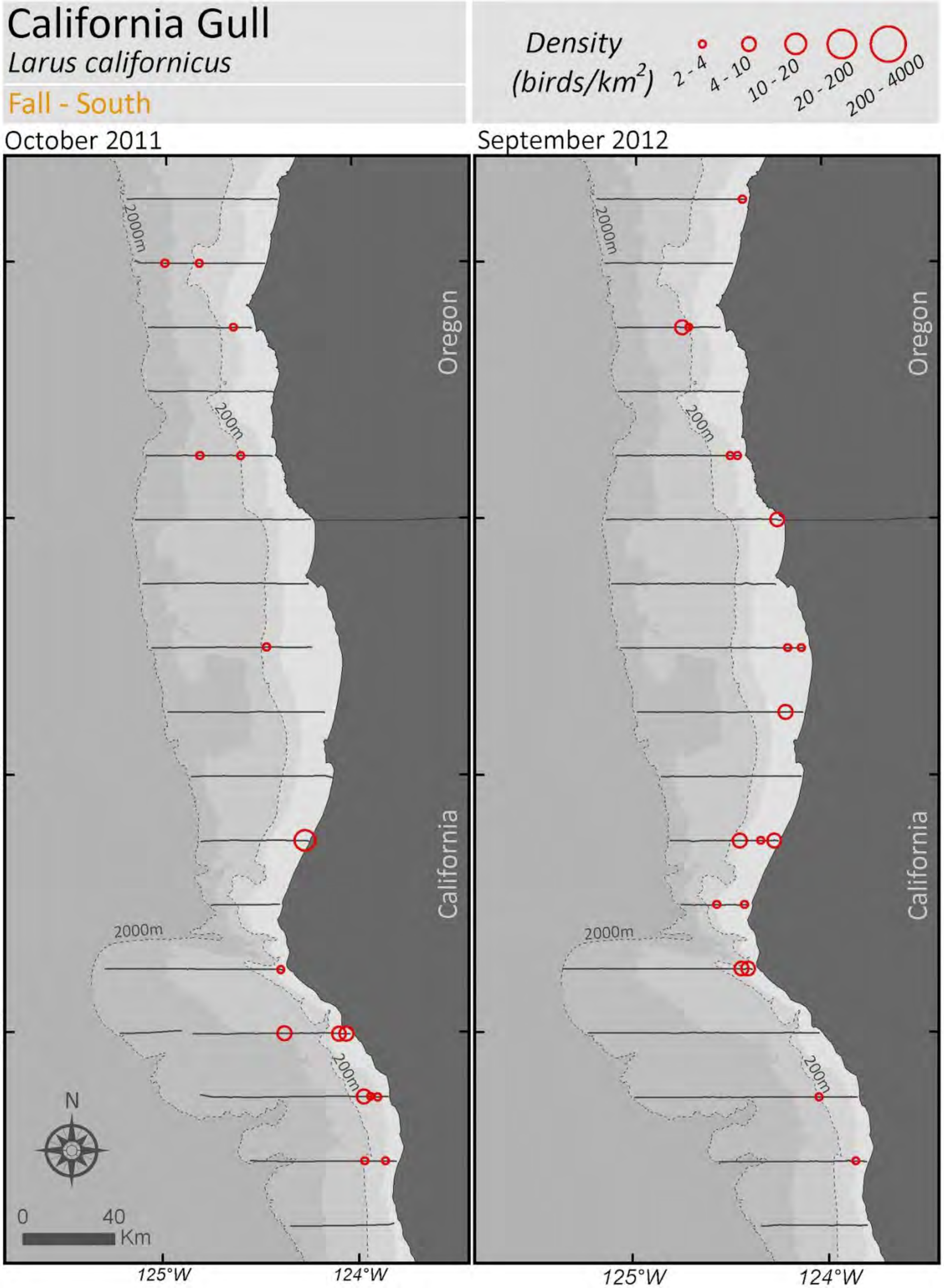


Figure 62. Mean density (birds km^{-2}) of California Gulls (*Larus californicus*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

California Gull

Larus californicus

Fall - South



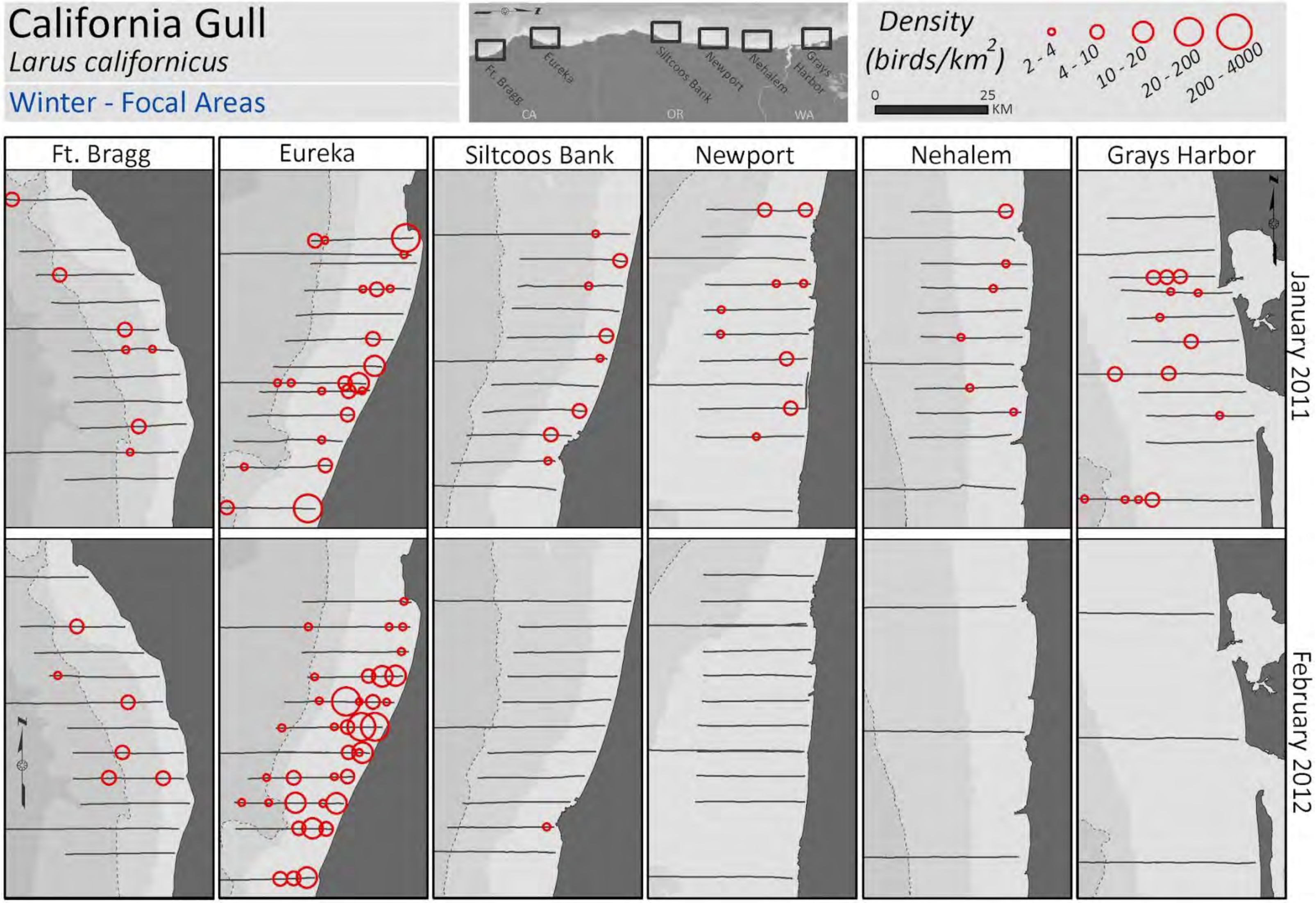


Figure 63. Mean density (birds km^{-2}) of California Gulls (*Larus californicus*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

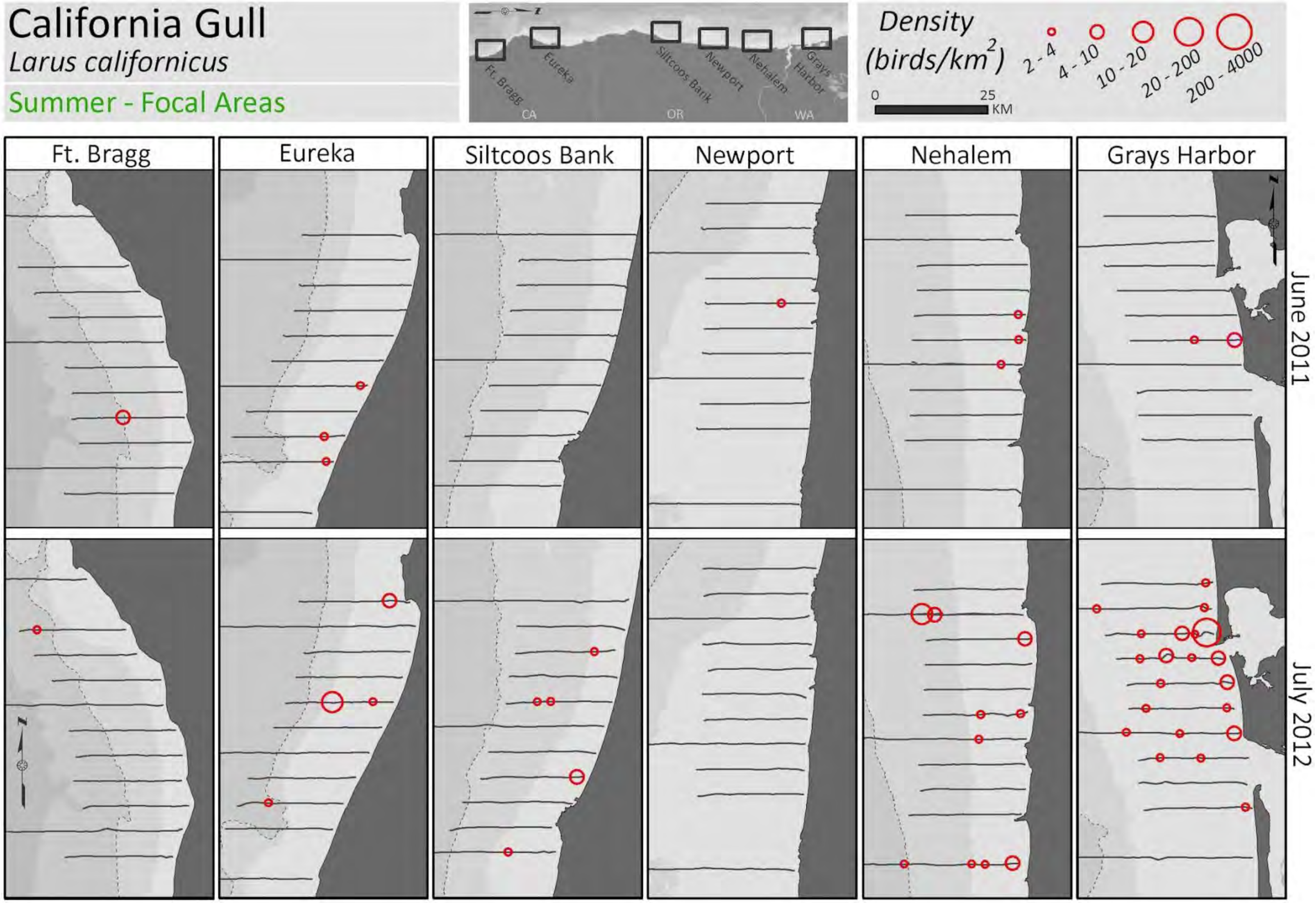


Figure 64. Mean density (birds km^{-2}) of California Gulls (*Larus californicus*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

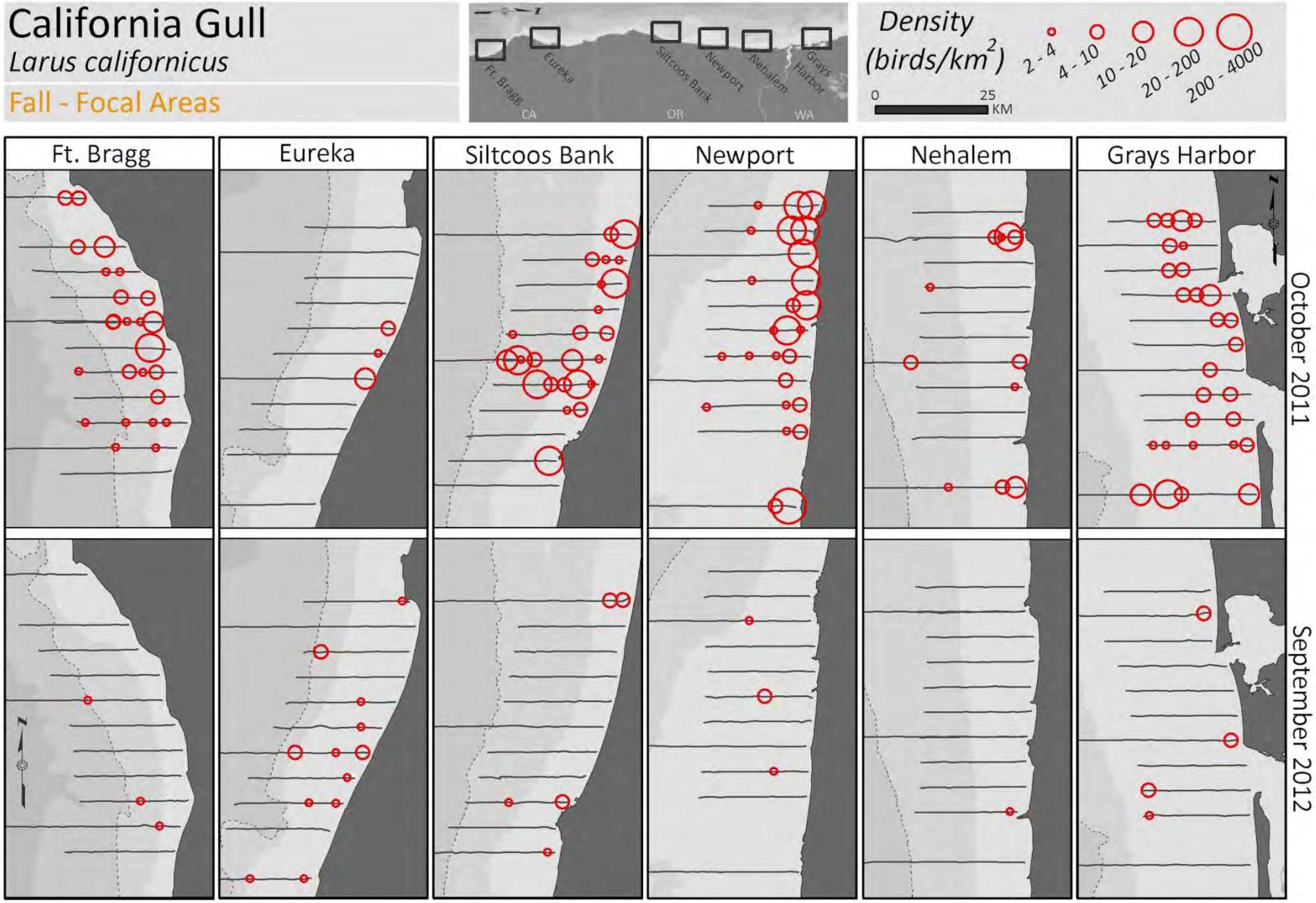


Figure 65. Mean density (birds km^{-2}) of California Gulls (*Larus californicus*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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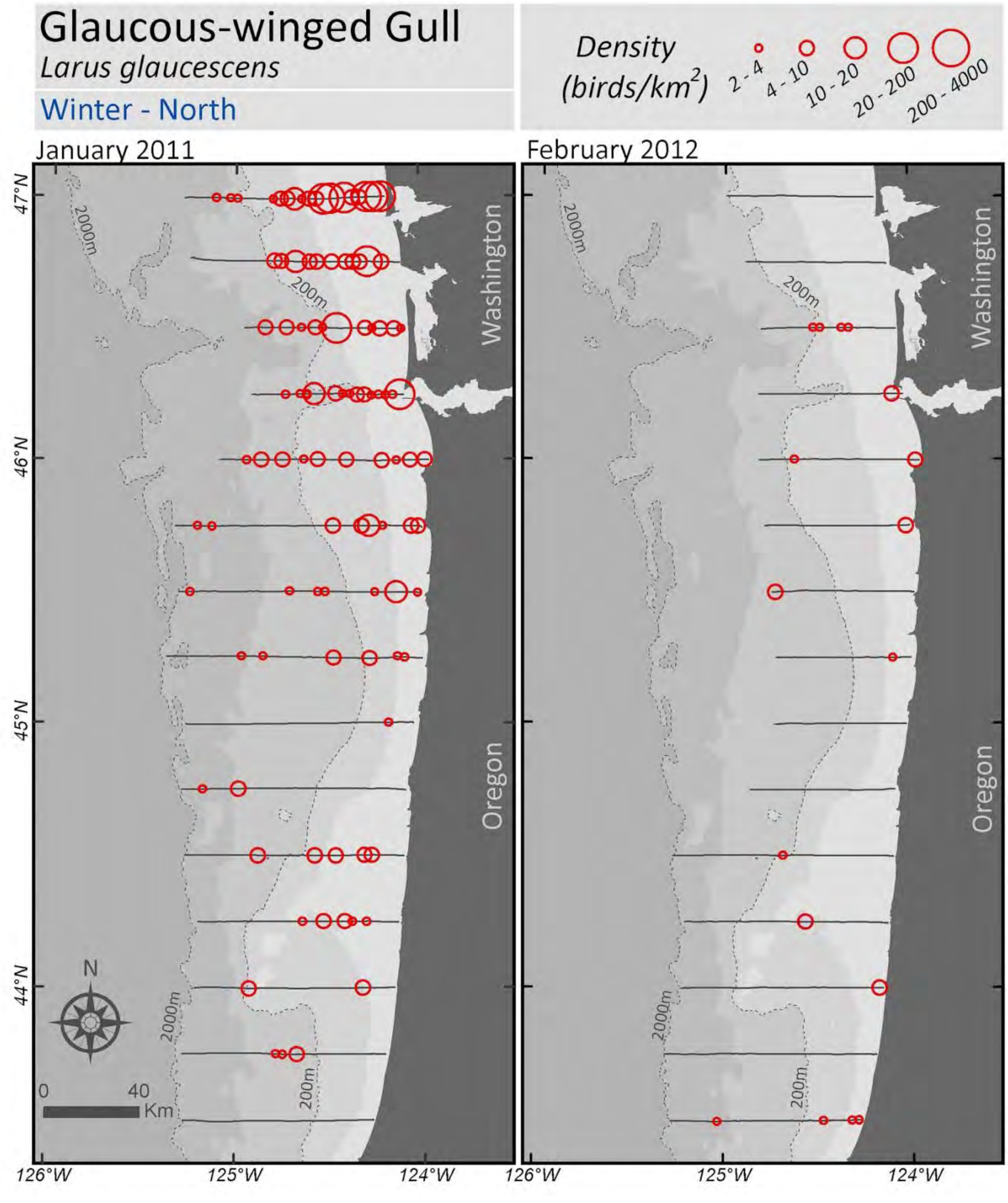
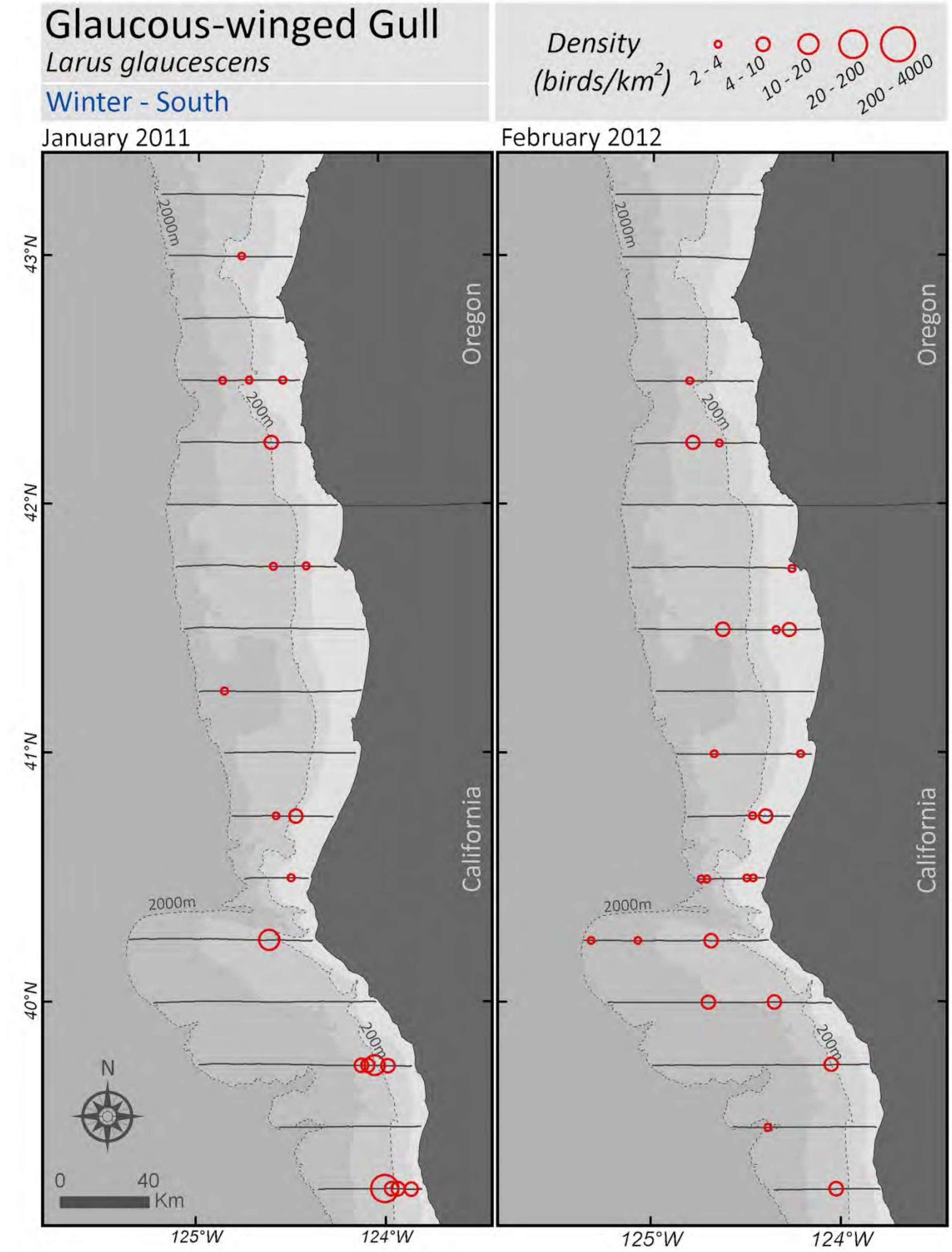


Figure 66. Mean density (birds km^{-2}) of Glaucous-winged Gulls (*Larus glaucescens*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Glaucous-winged Gull

Larus glaucescens

Winter - South



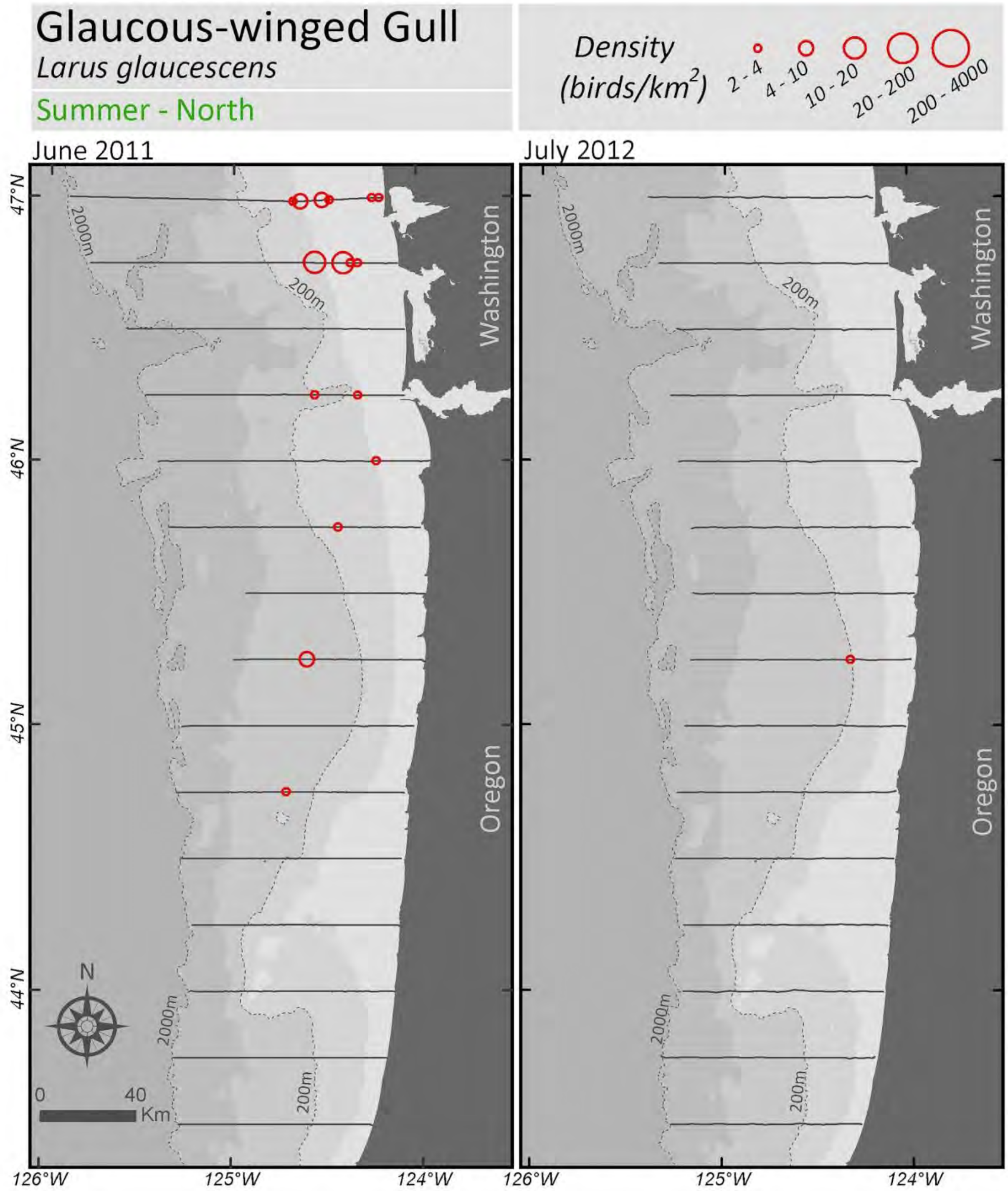
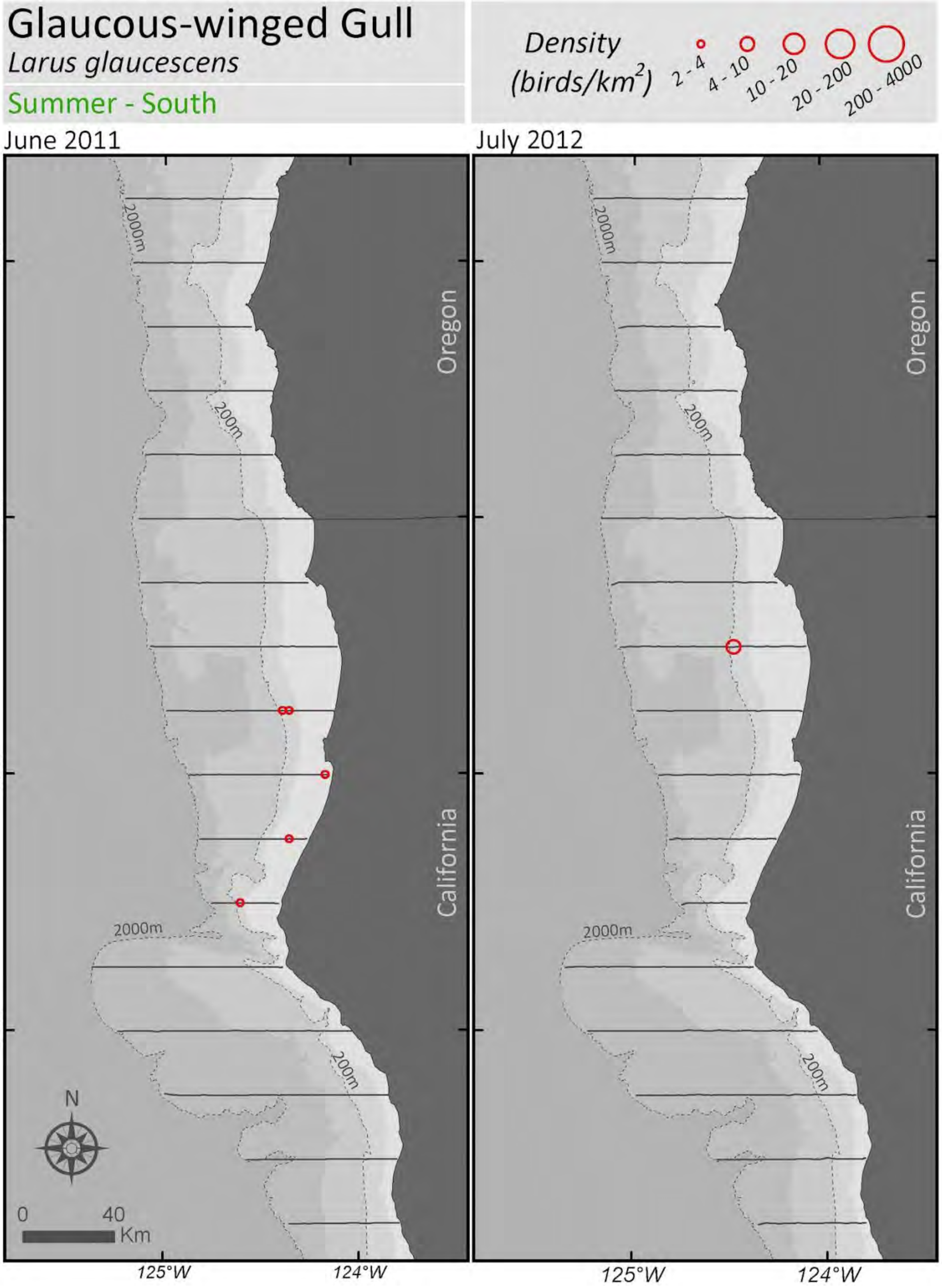


Figure 67. Mean density (birds km^{-2}) of Glaucous-winged Gulls (*Larus glaucescens*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Glaucous-winged Gull

Larus glaucescens

Summer - South



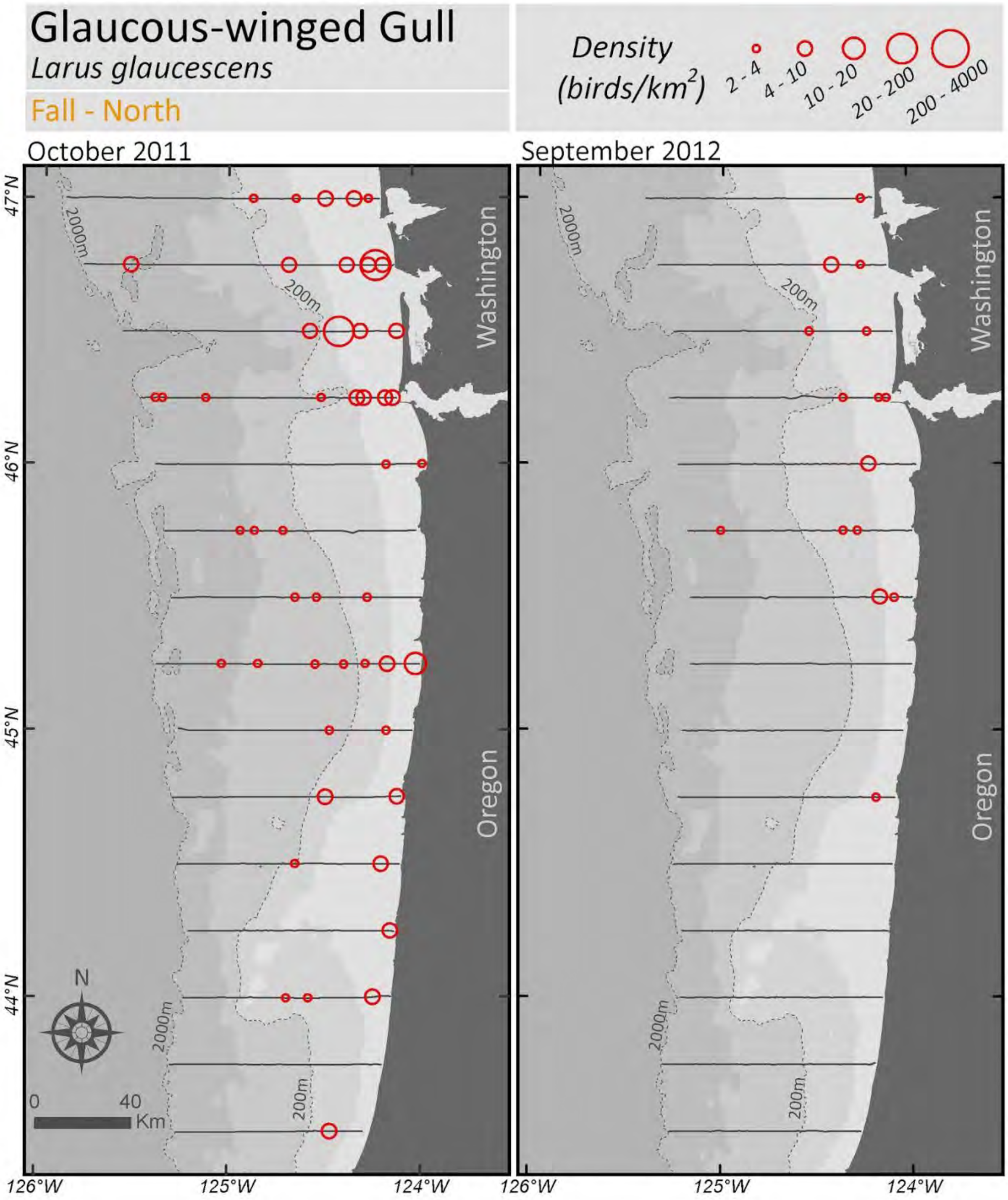
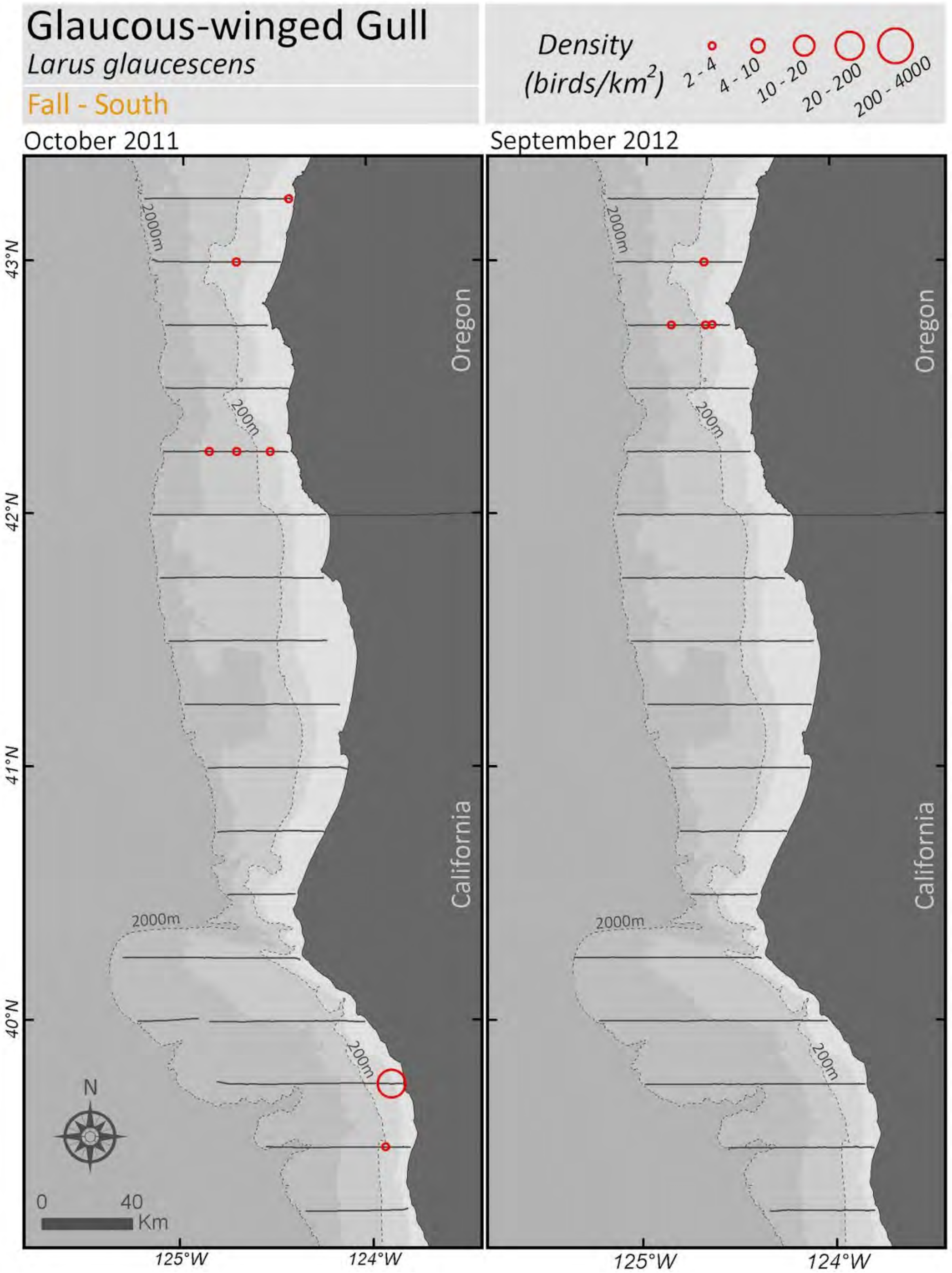


Figure 68. Mean density (birds km^{-2}) of Glaucous-winged Gulls (*Larus glaucescens*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Glaucous-winged Gull

Larus glaucescens

Fall - South



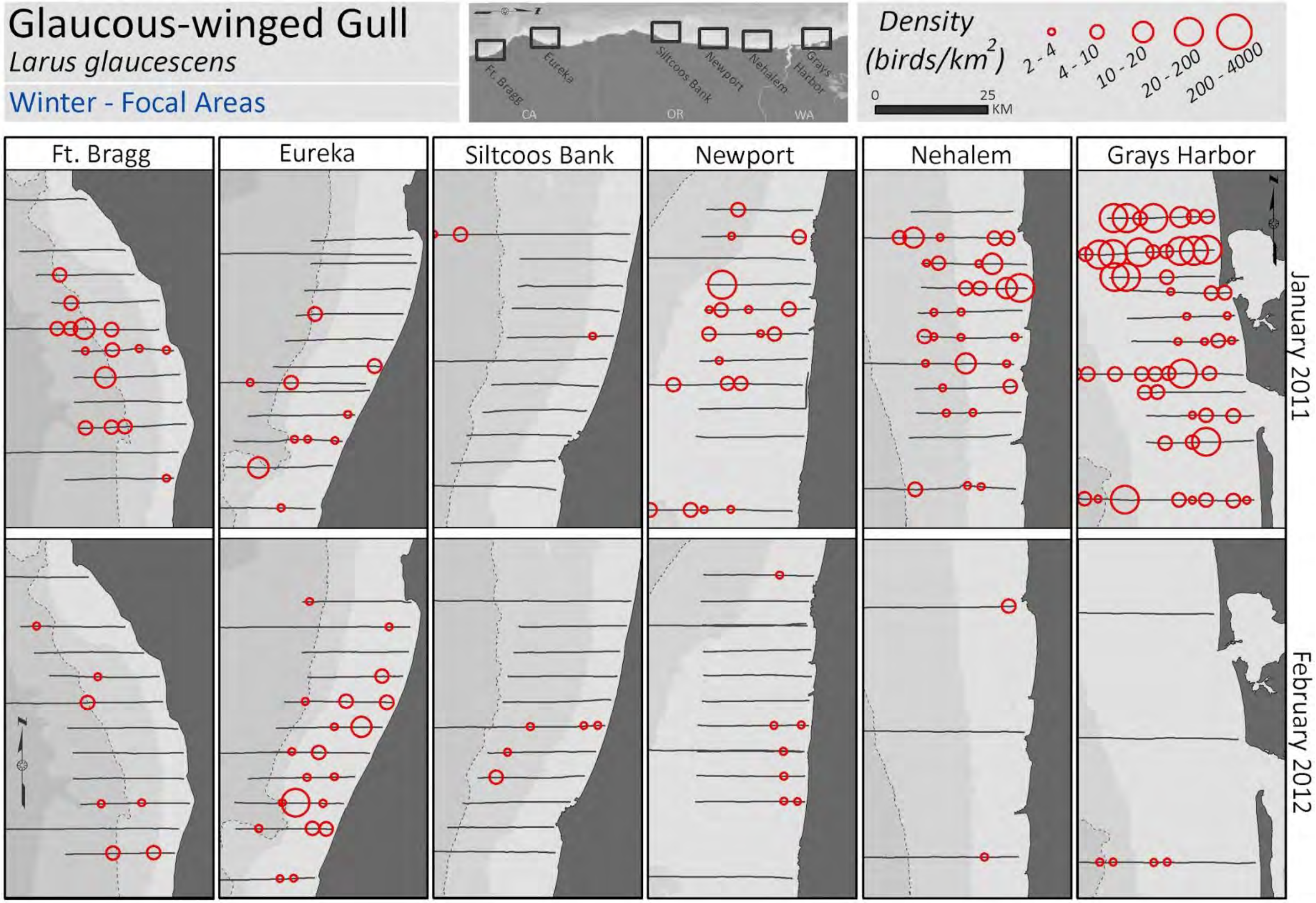


Figure 69. Mean density (birds km^{-2}) of Glaucous-winged Gulls (*Larus glaucescens*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

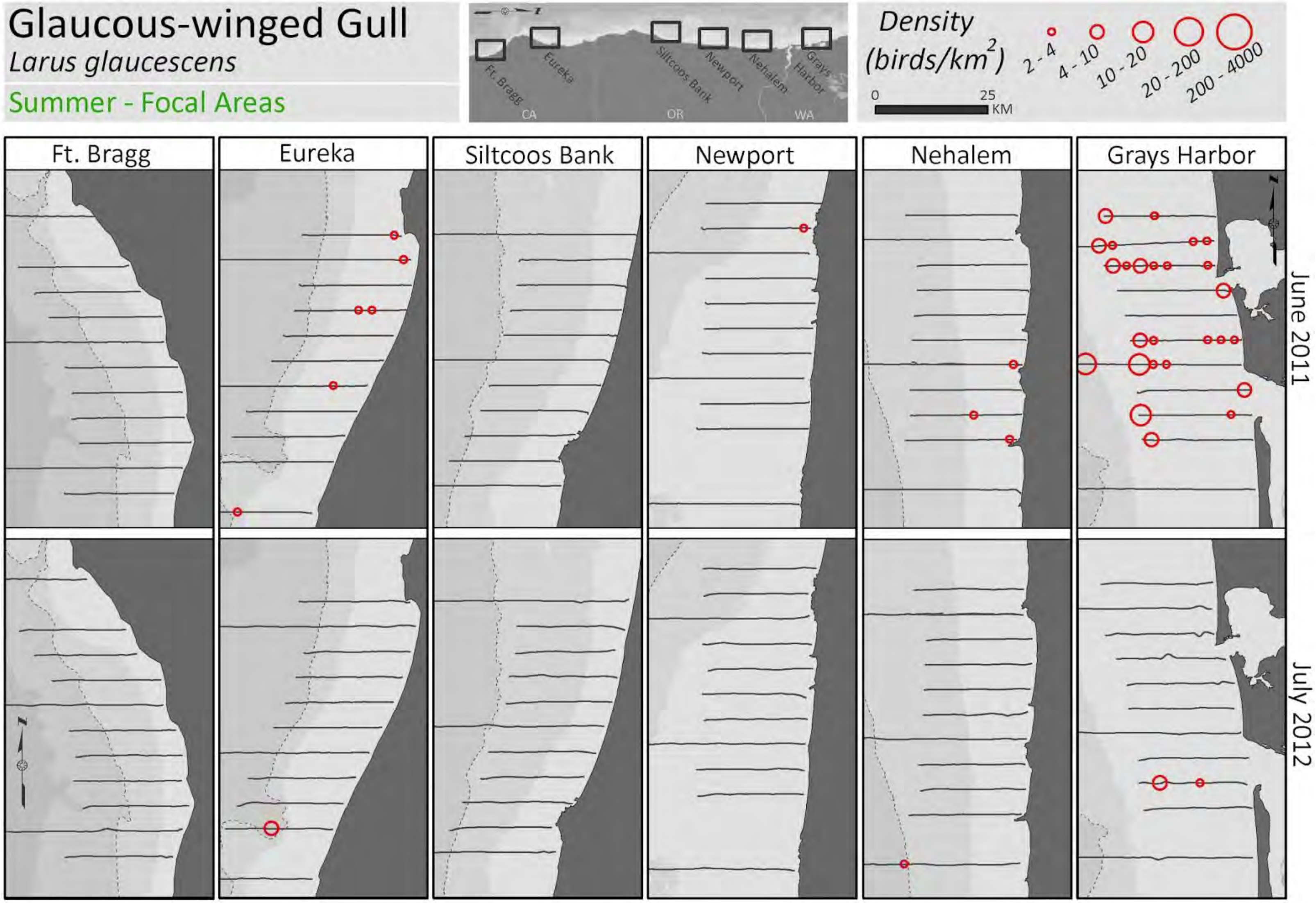


Figure 70. Mean density (birds km^{-2}) of Glaucous-winged Gulls (*Larus glaucescens*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

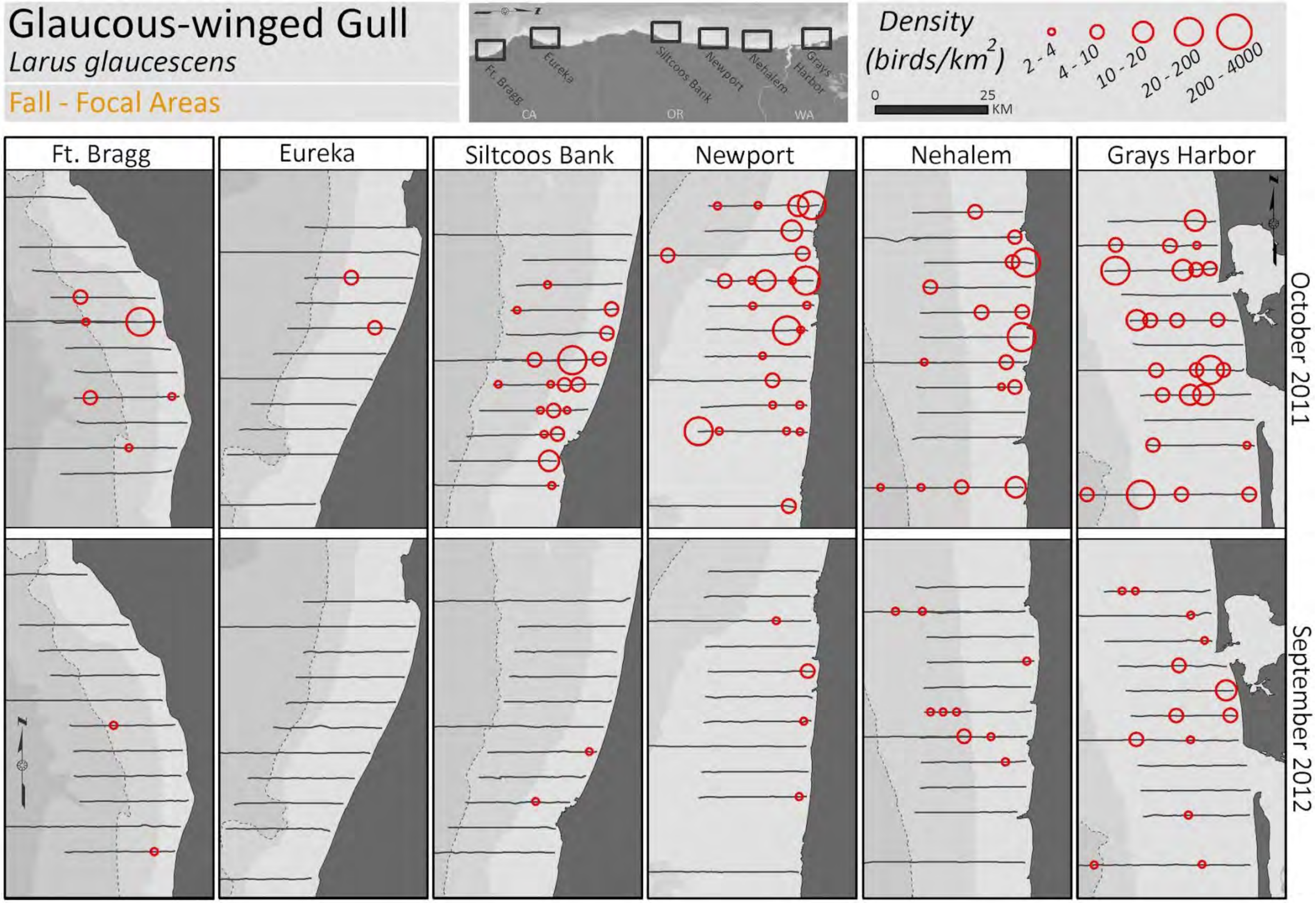


Figure 71. Mean density (birds km^{-2}) of Glaucous-winged Gulls (*Larus glaucescens*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

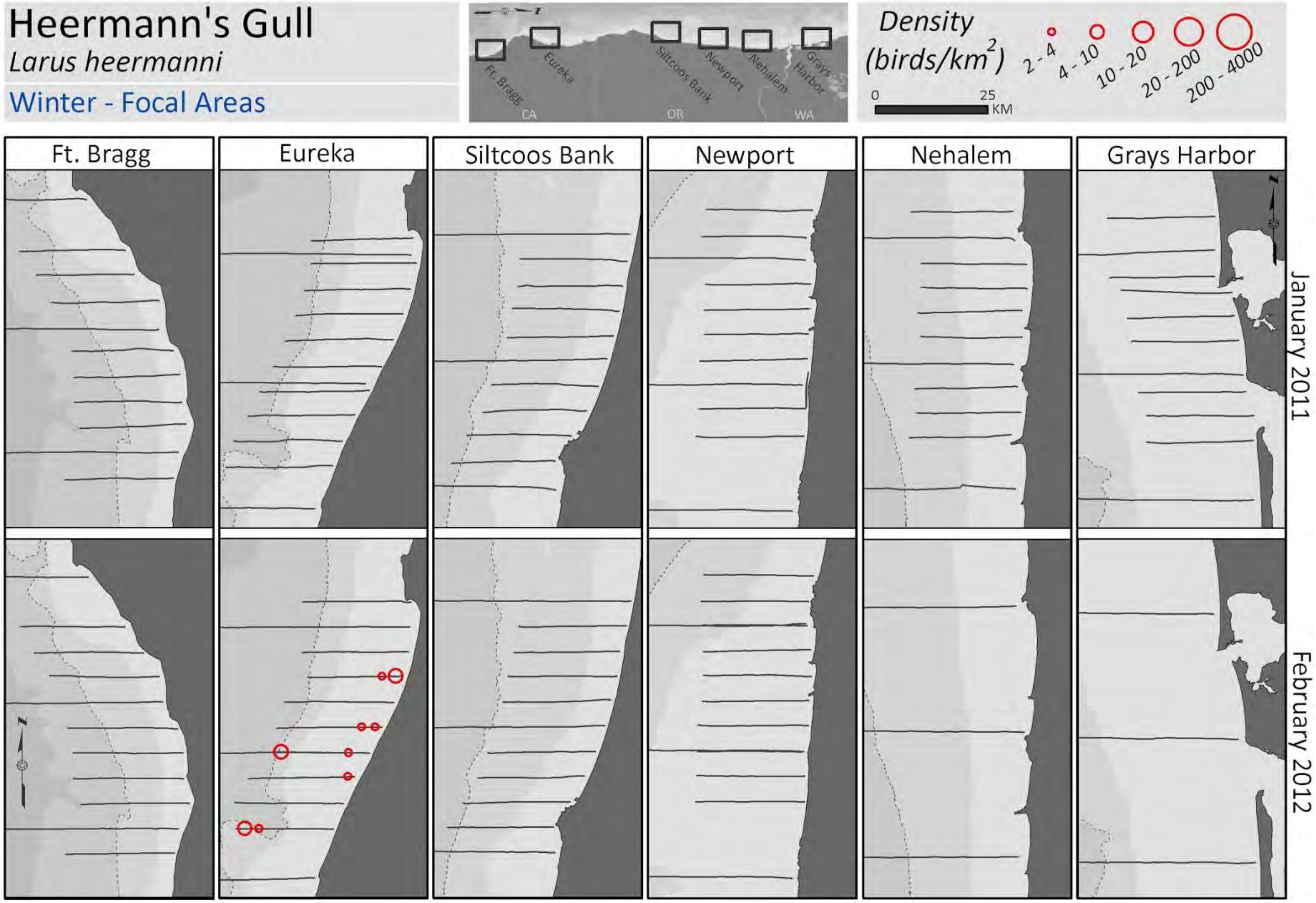


Figure 72. Mean density (birds km^{-2}) of Heermann's Gulls (*Larus heermanni*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

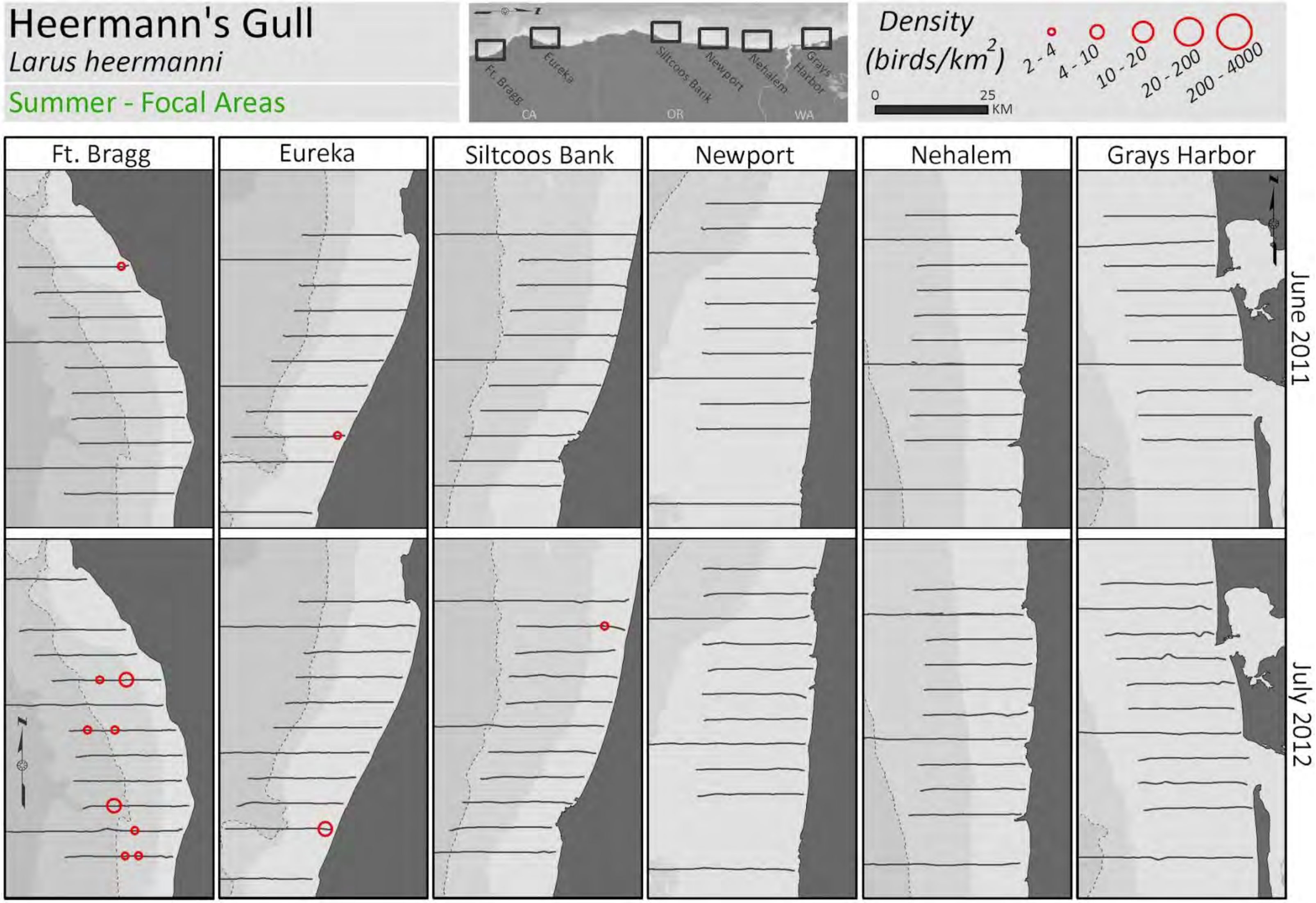


Figure 73. Mean density (birds km^{-2}) of Heermann's Gulls (*Larus heermanni*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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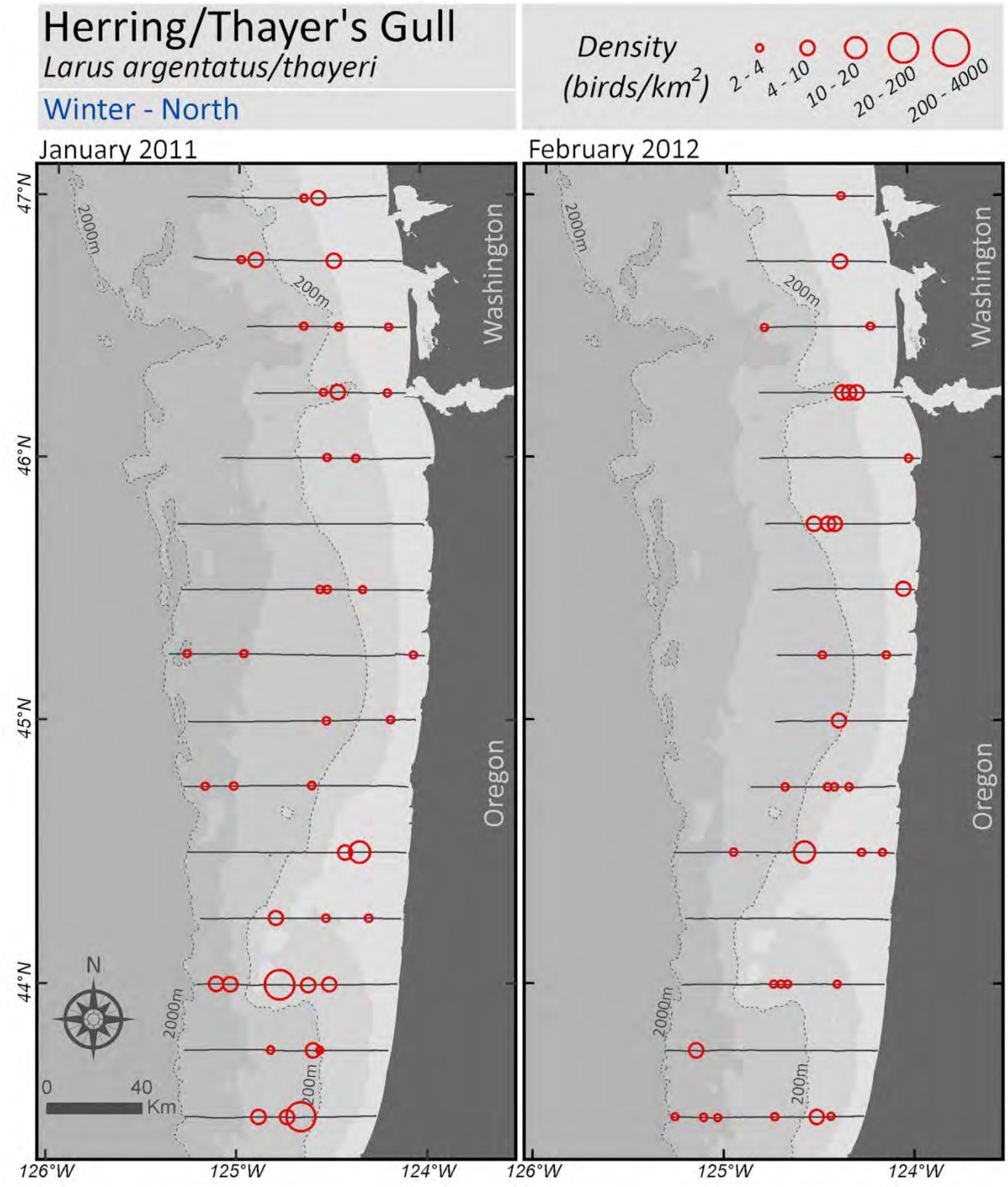
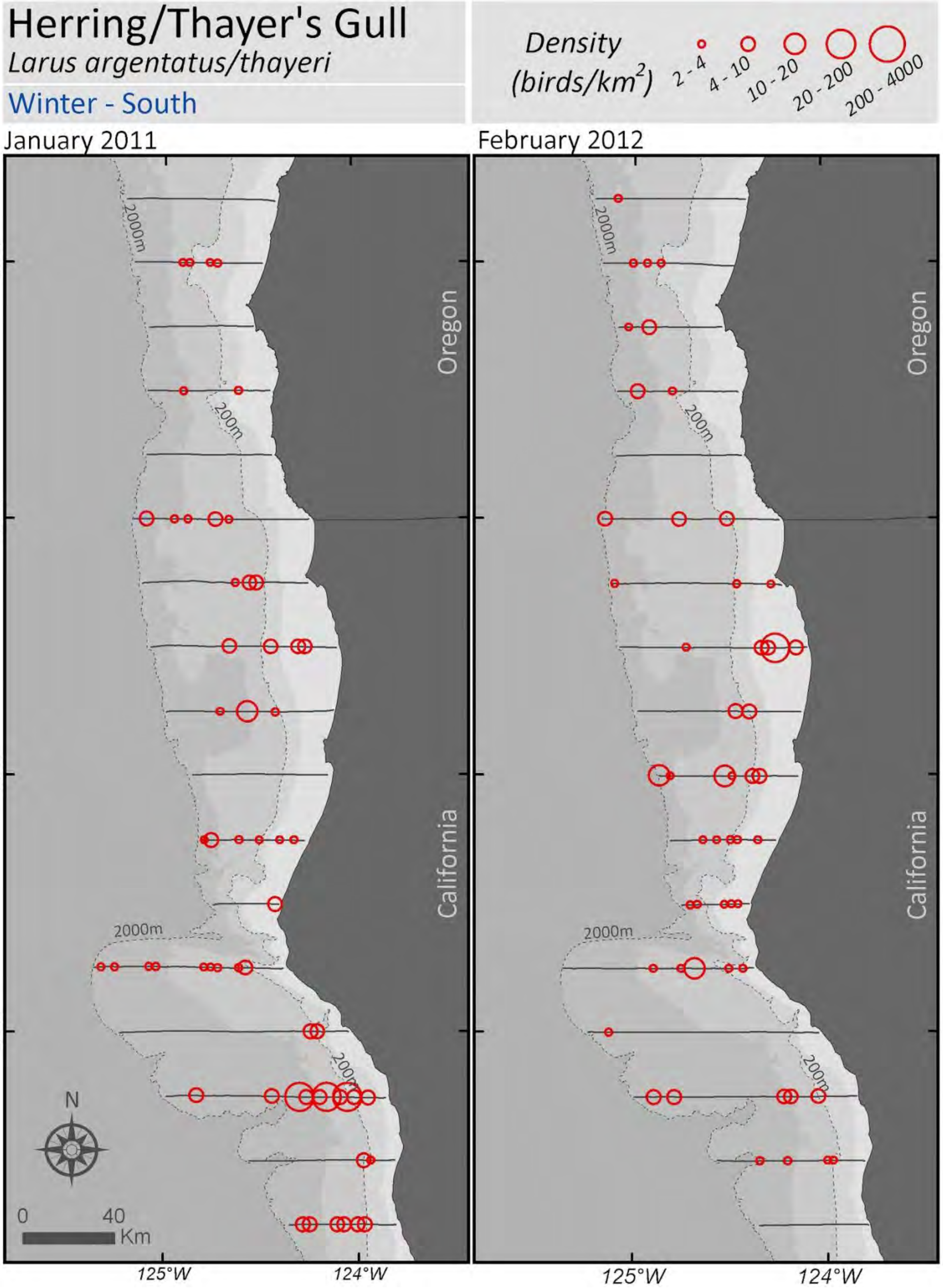


Figure 74. Mean density (birds km^{-2}) of Herring/Thayer's Gulls (*Larus argentatus/thayeri*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Herring/Thayer's Gull

Larus argentatus/thayeri

Winter - South



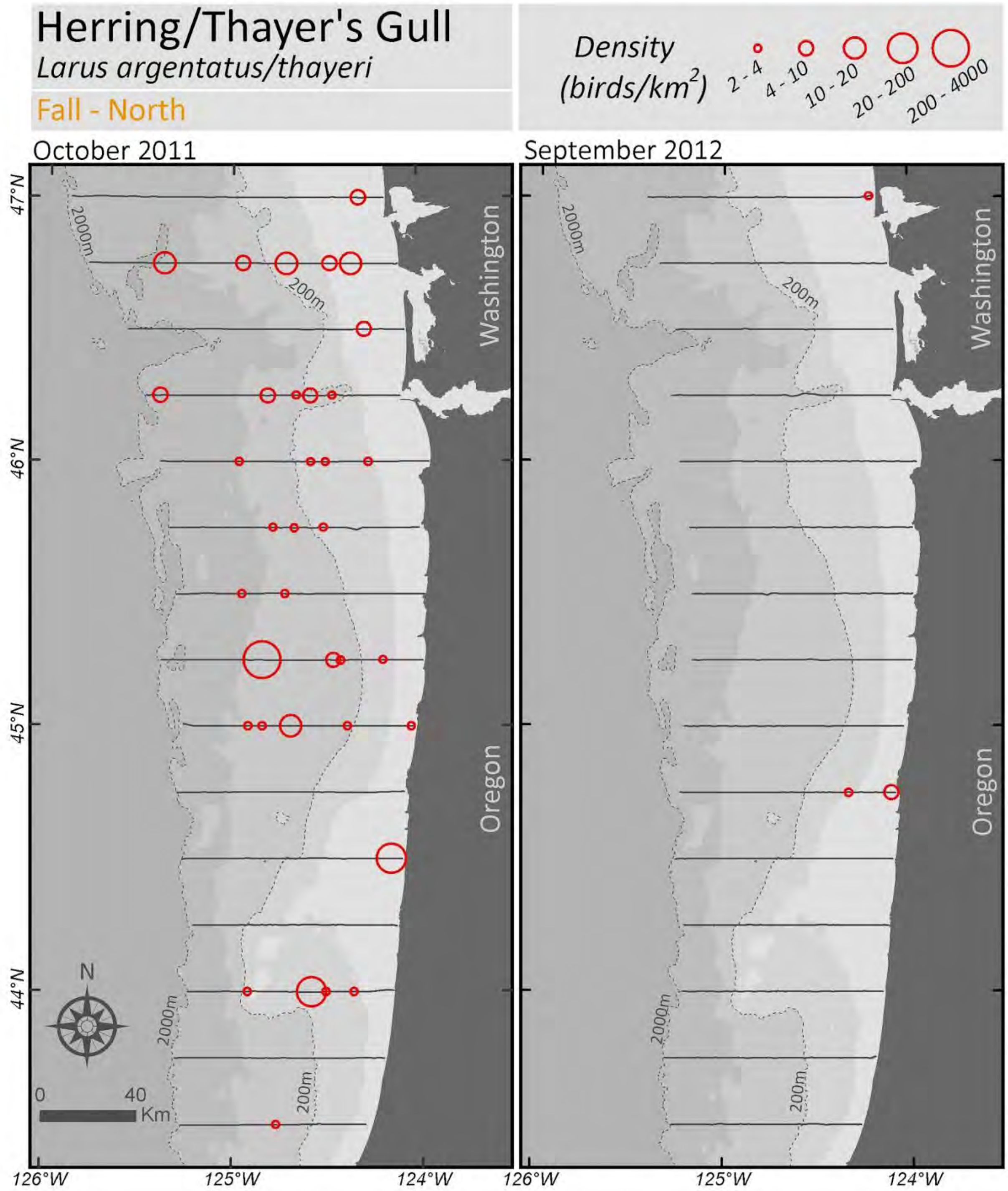
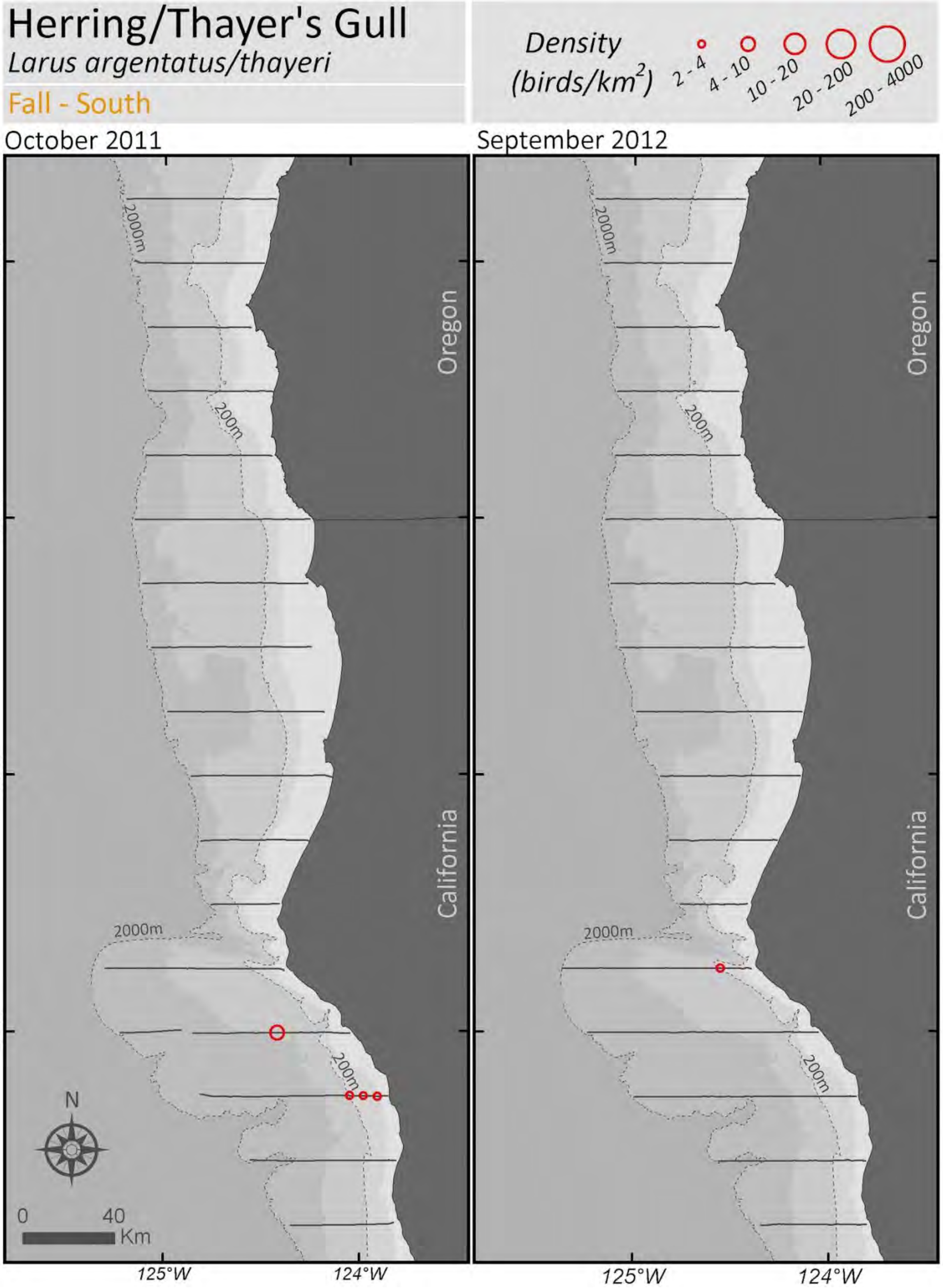


Figure 75. Mean density (birds km^{-2}) of Herring/Thayer's Gulls (*Larus argentatus/thayeri*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Herring/Thayer's Gull

Larus argentatus/thayeri

Fall - South



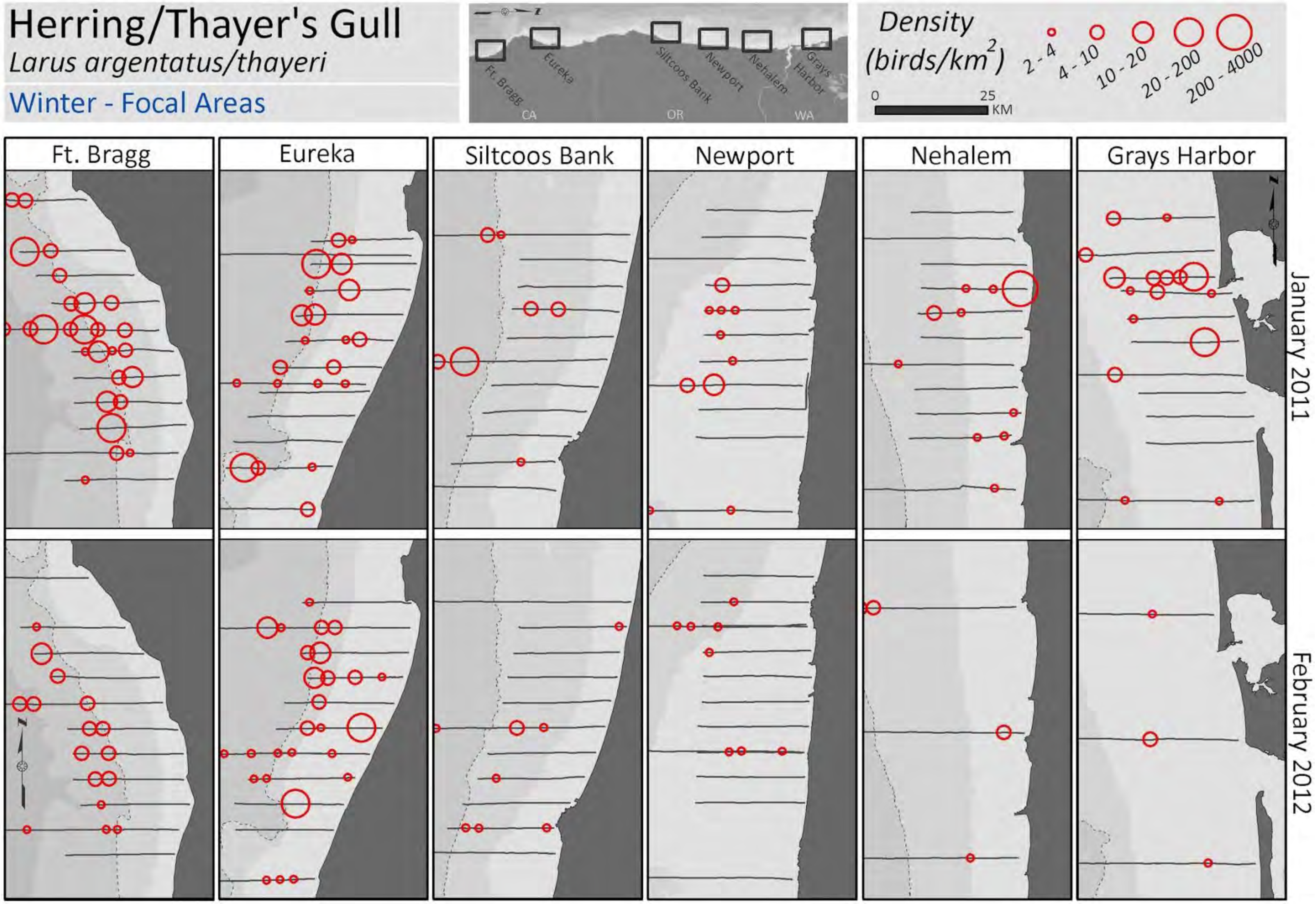


Figure 76. Mean density (birds km^{-2}) of Herring/Thayer's Gulls (*Larus argentatus/thayeri*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

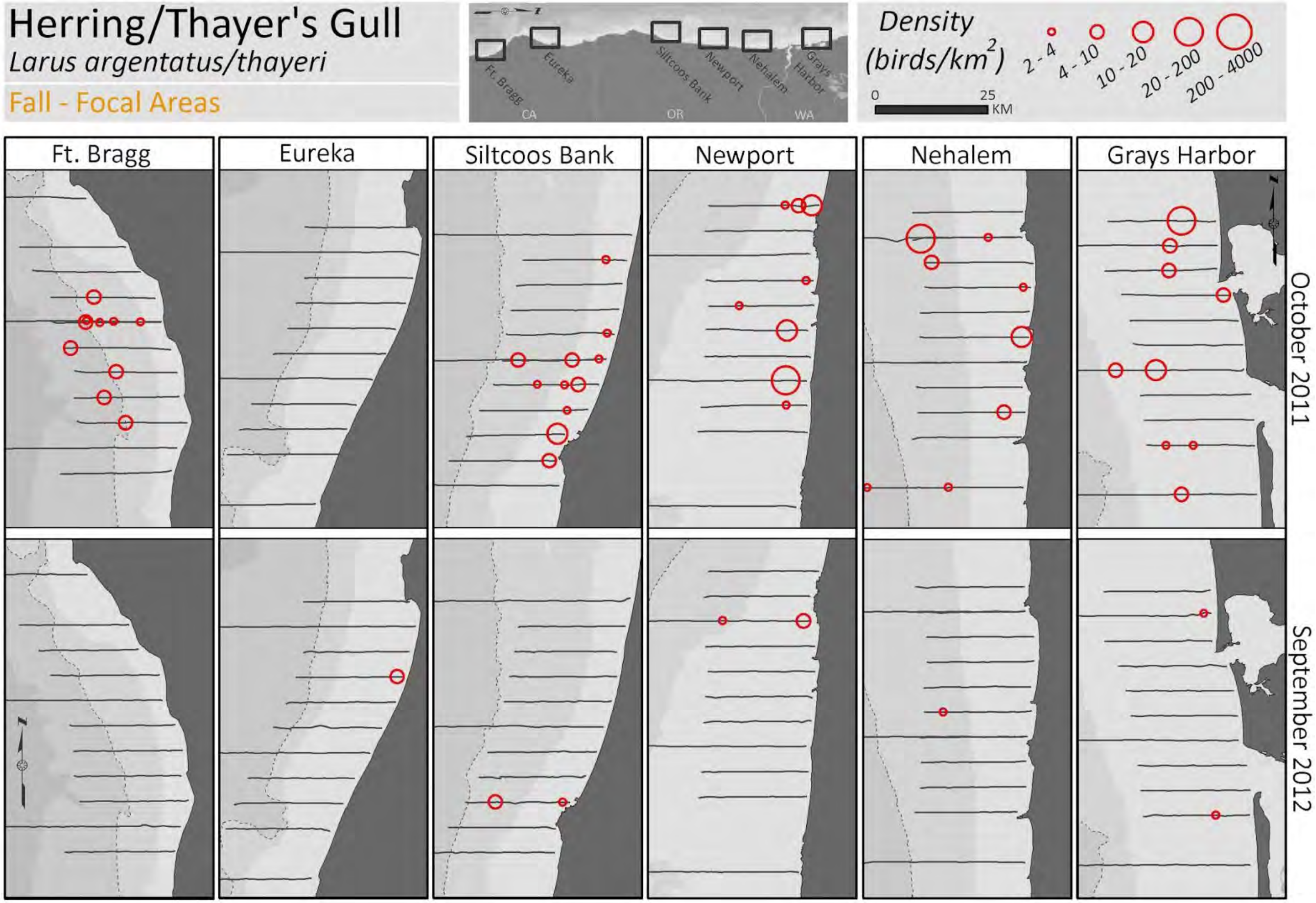


Figure 77. Mean density (birds km^{-2}) of Herring/Thayer's Gulls (*Larus argentatus/thayeri*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

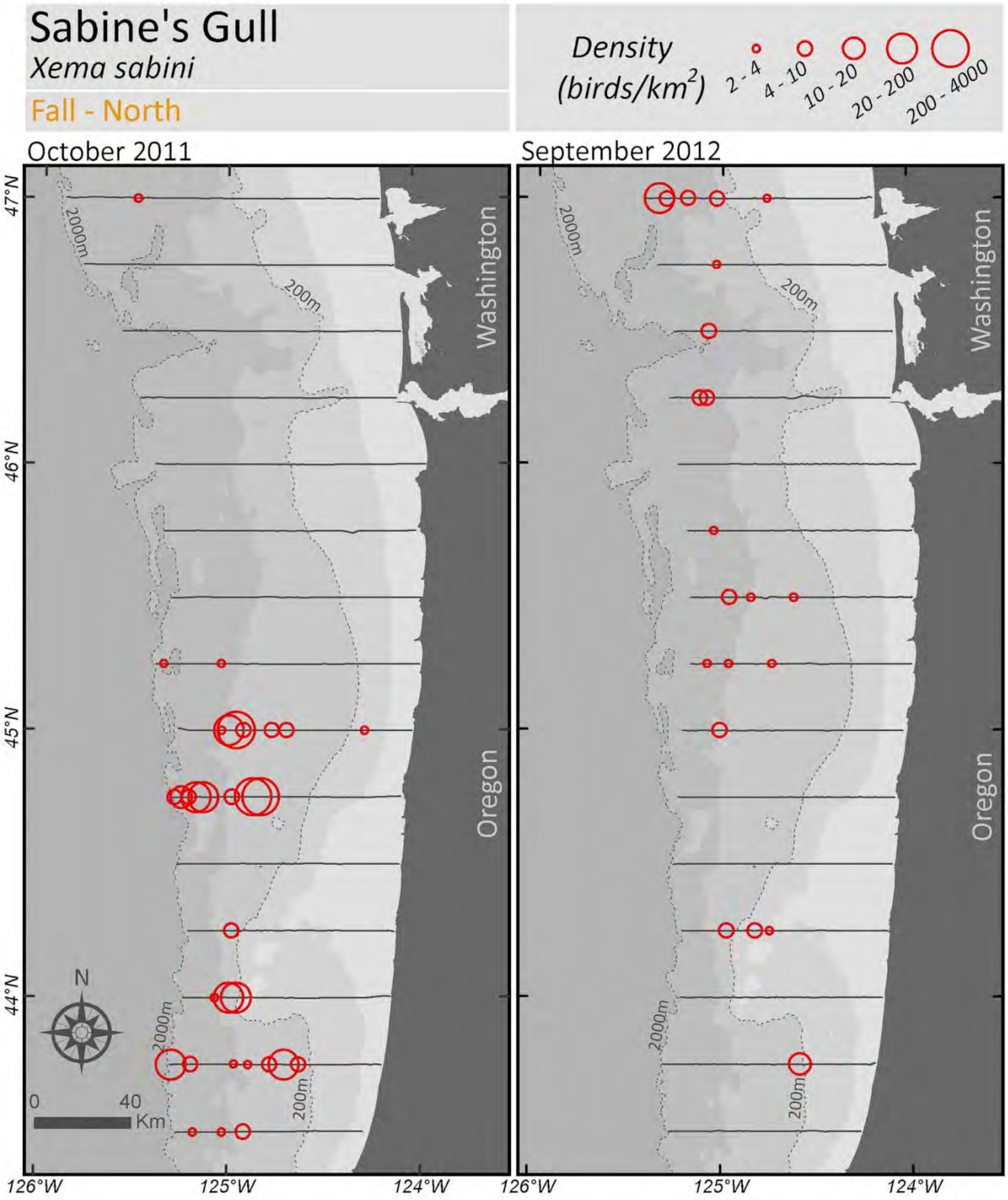
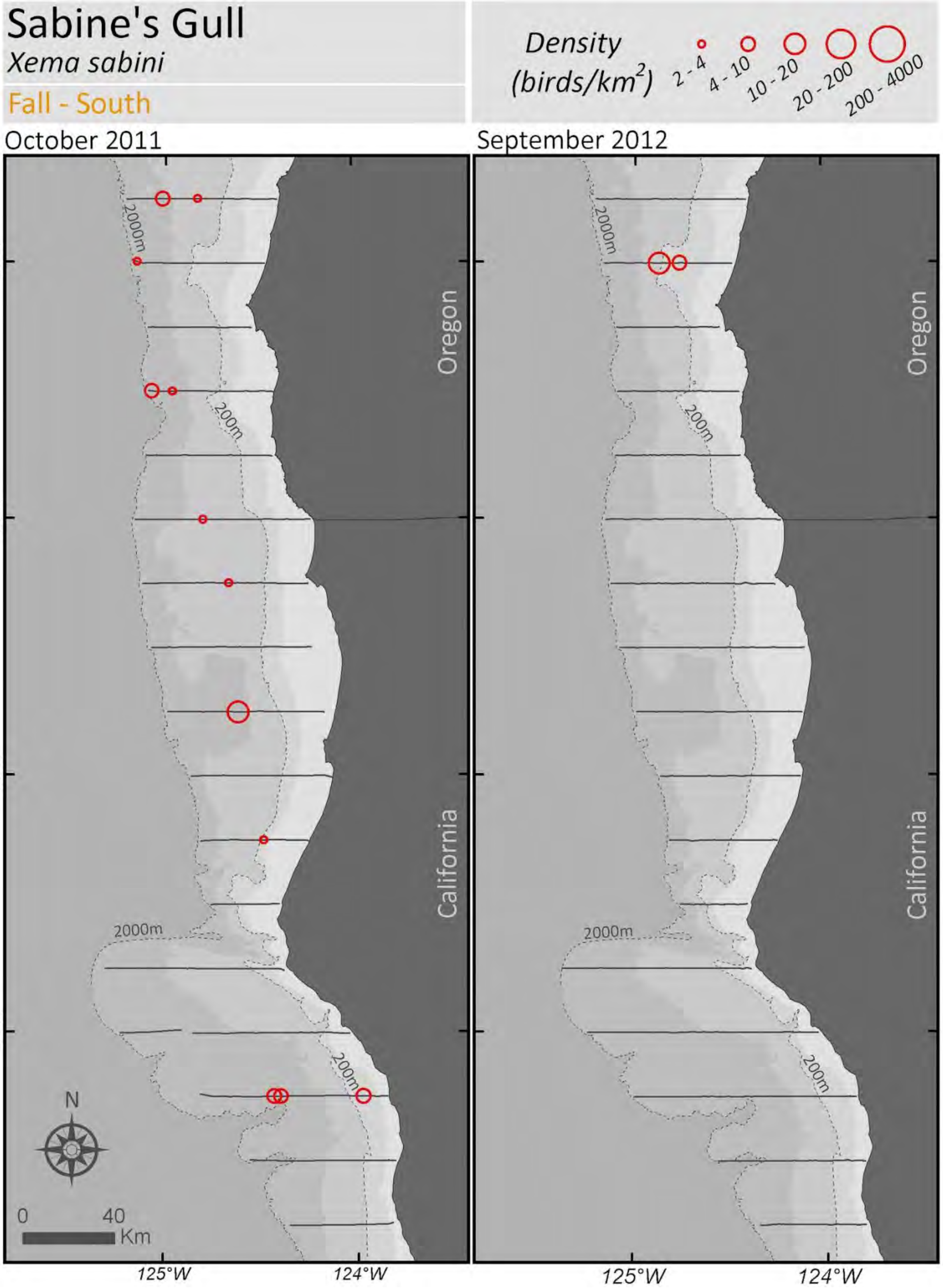


Figure 78. Mean density (birds km^{-2}) of Sabine's Gulls (*Xema sabini*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Sabine's Gull

Xema sabini

Fall - South



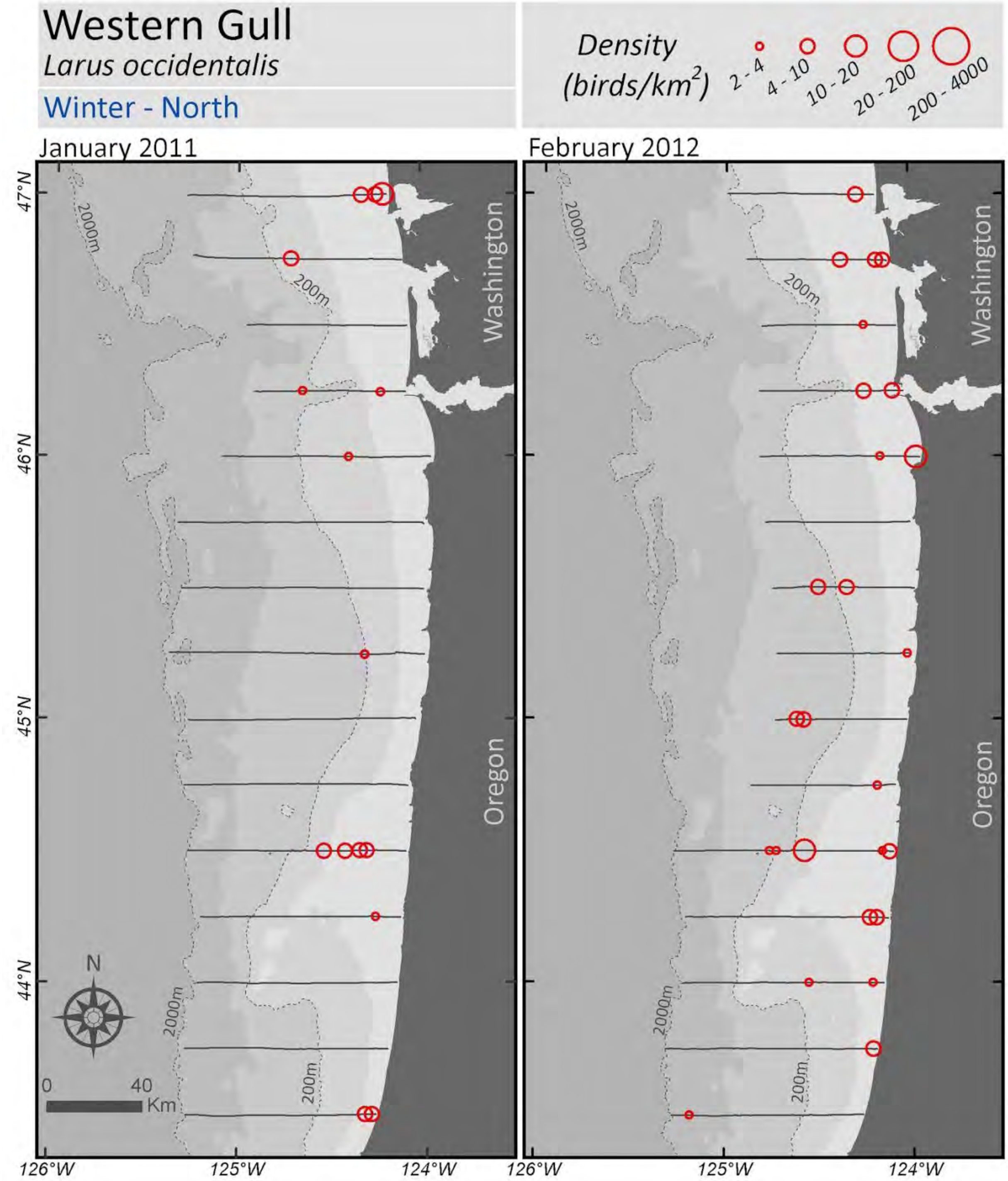
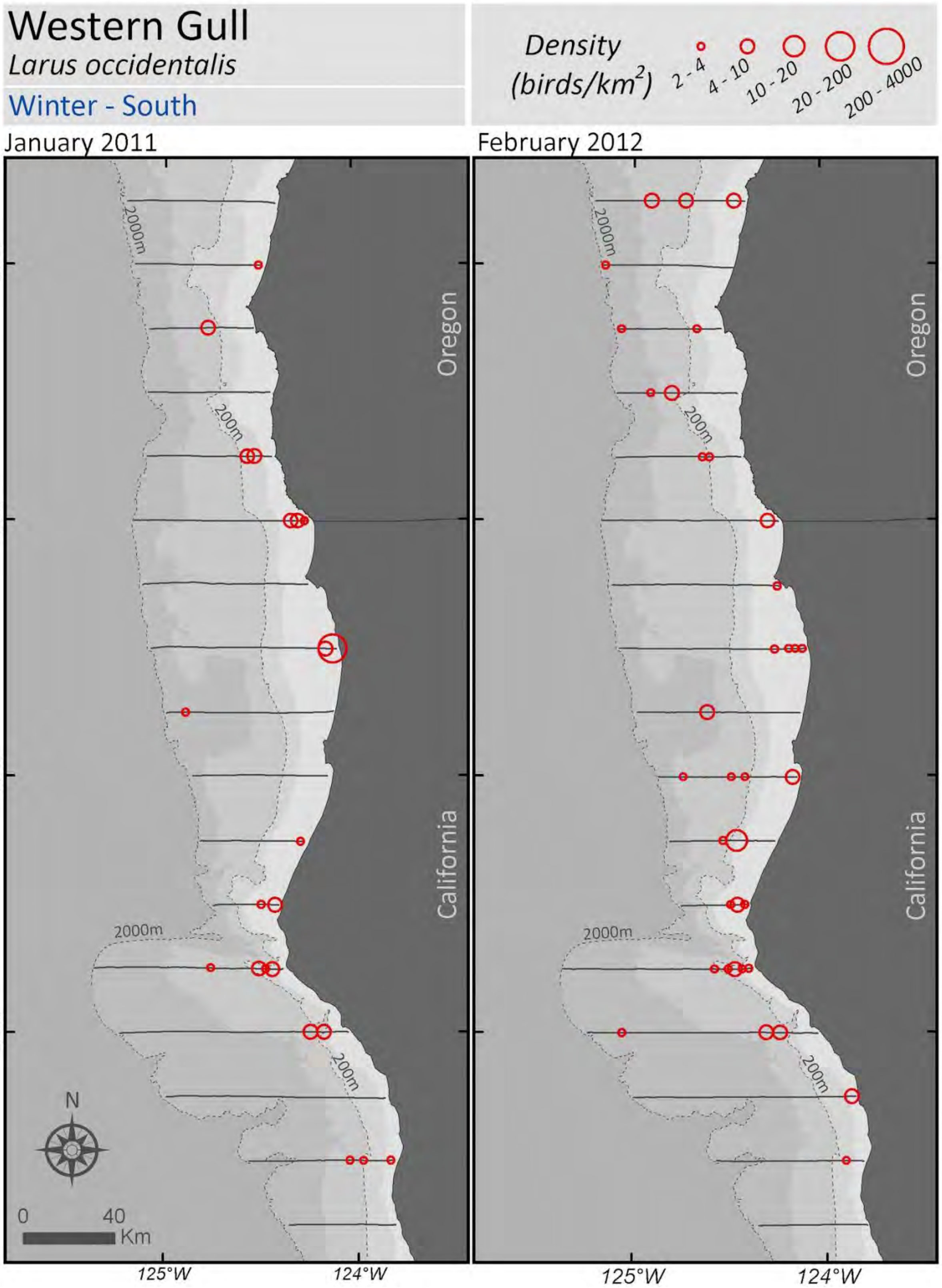


Figure 79. Mean density (birds km^{-2}) of Western Gulls (*Larus occidentalis*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Western Gull

Larus occidentalis

Winter - South



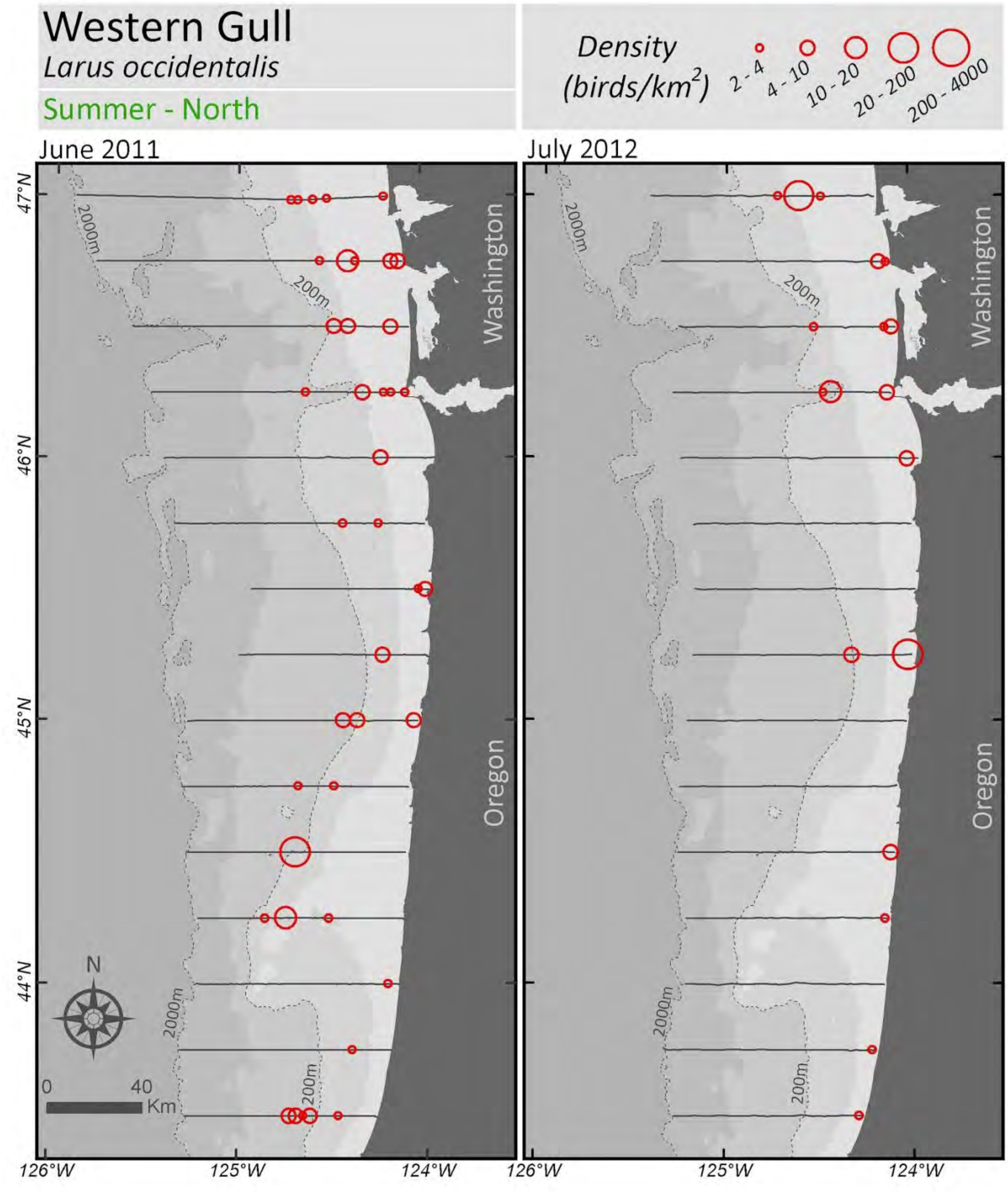
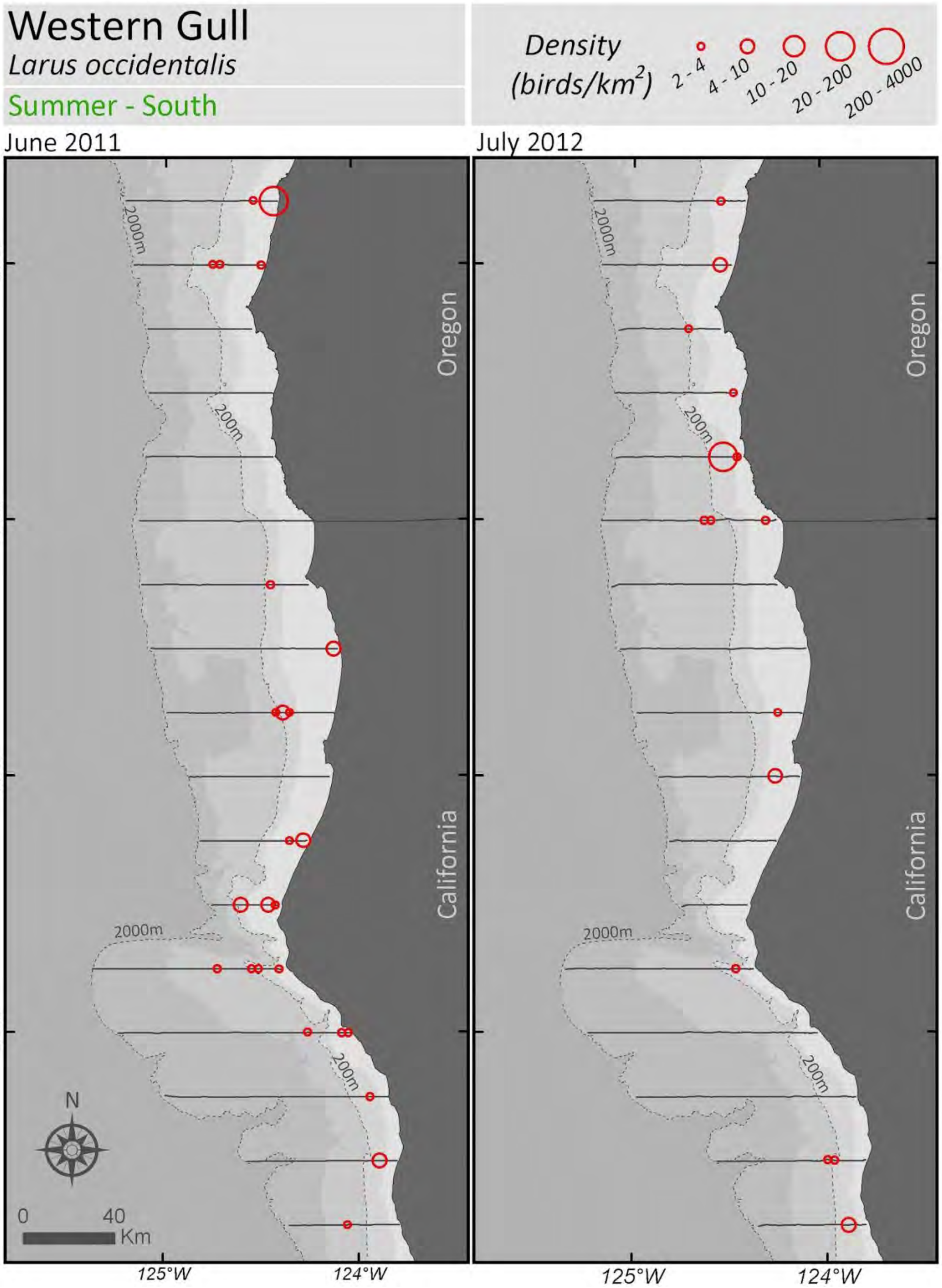


Figure 80. Mean density (birds km^{-2}) of Western Gulls (*Larus occidentalis*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Western Gull
Larus occidentalis
Summer - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
2000m
200m
2000m
200m
43°N
42°N
41°N
40°N
Oregon
California
N
0
40
Km
125°W
124°W
125°W
124°W

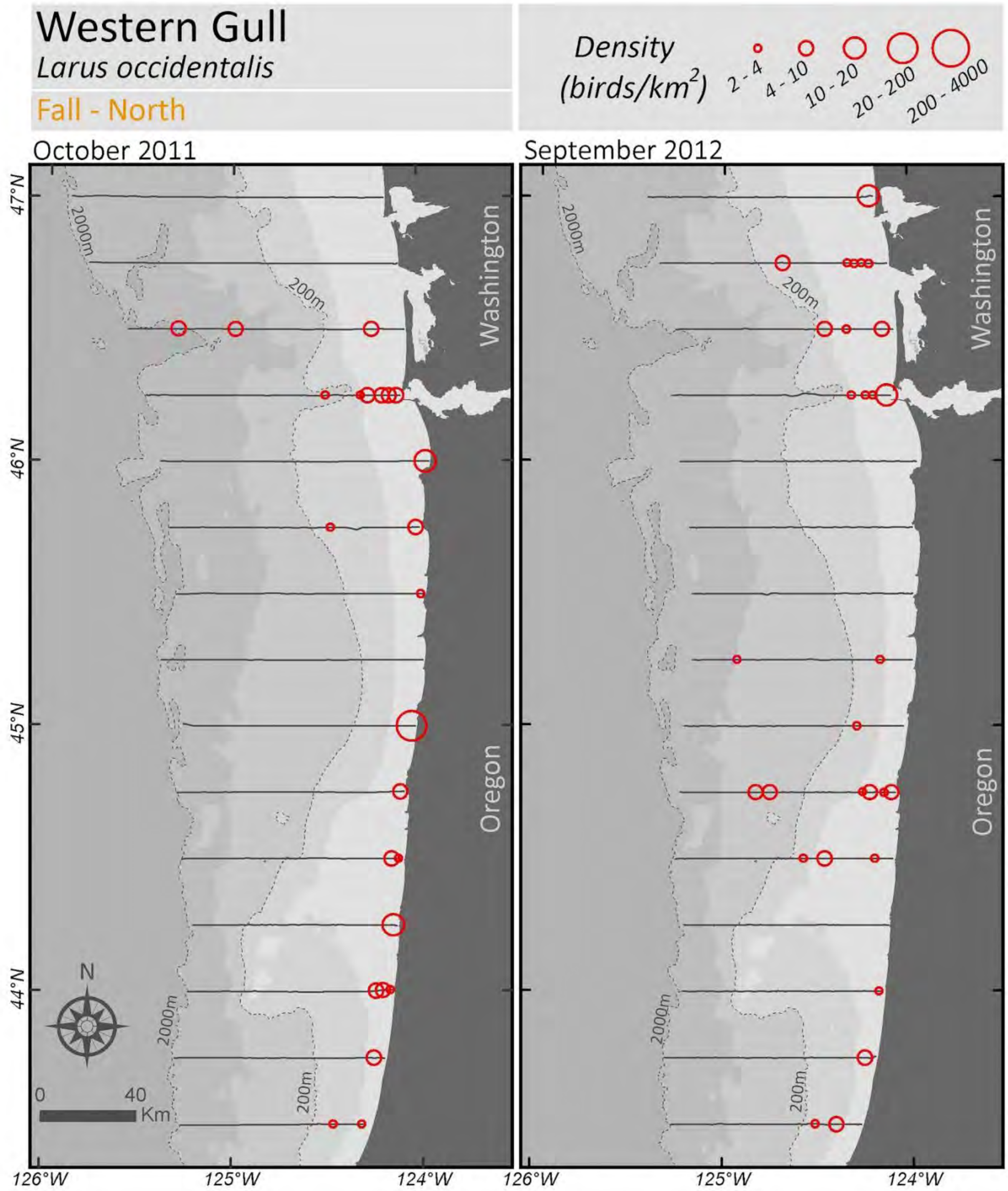
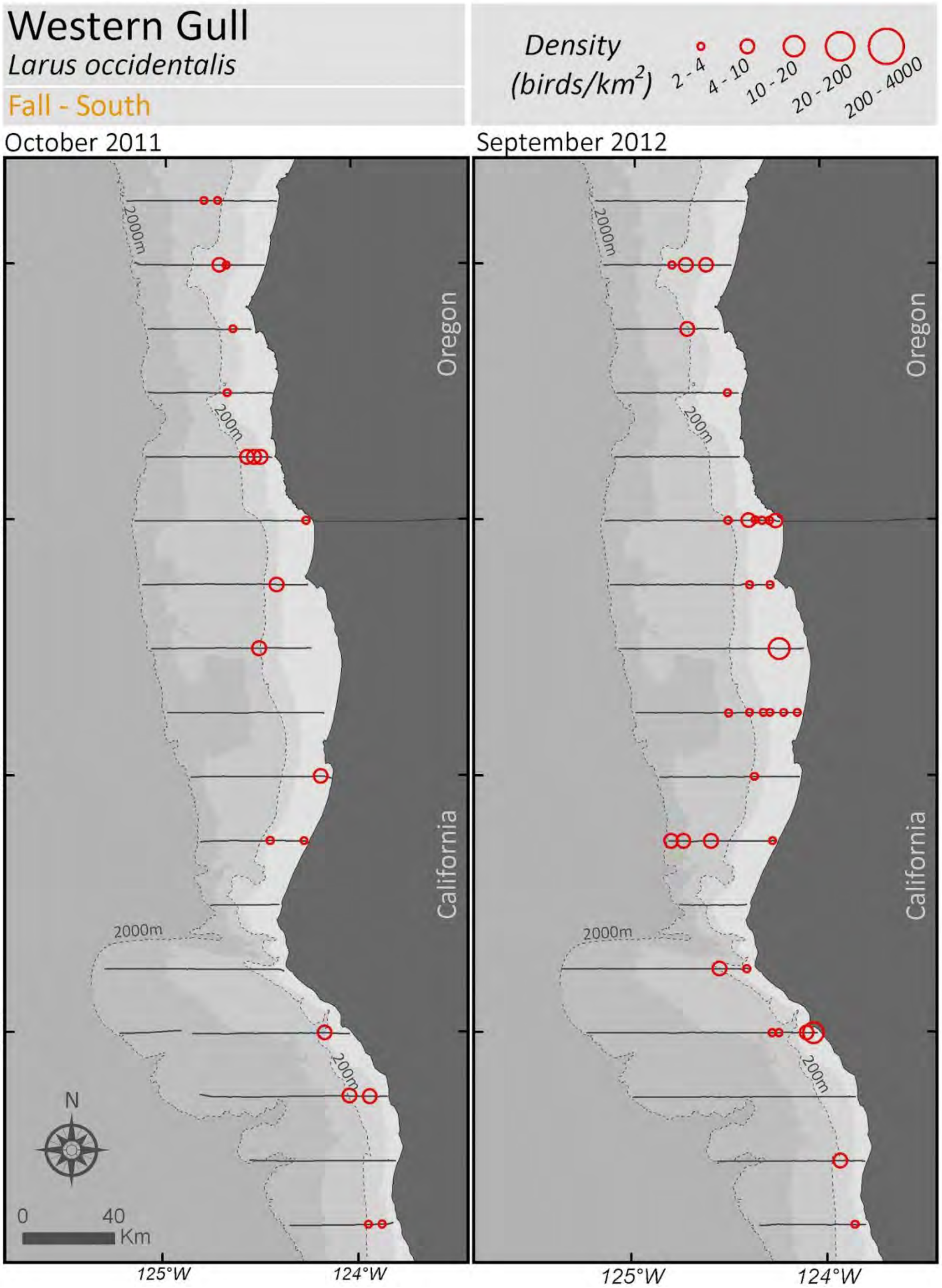


Figure 81. Mean density (birds km^{-2}) of Western Gulls (*Larus occidentalis*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Western Gull

Larus occidentalis

Fall - South



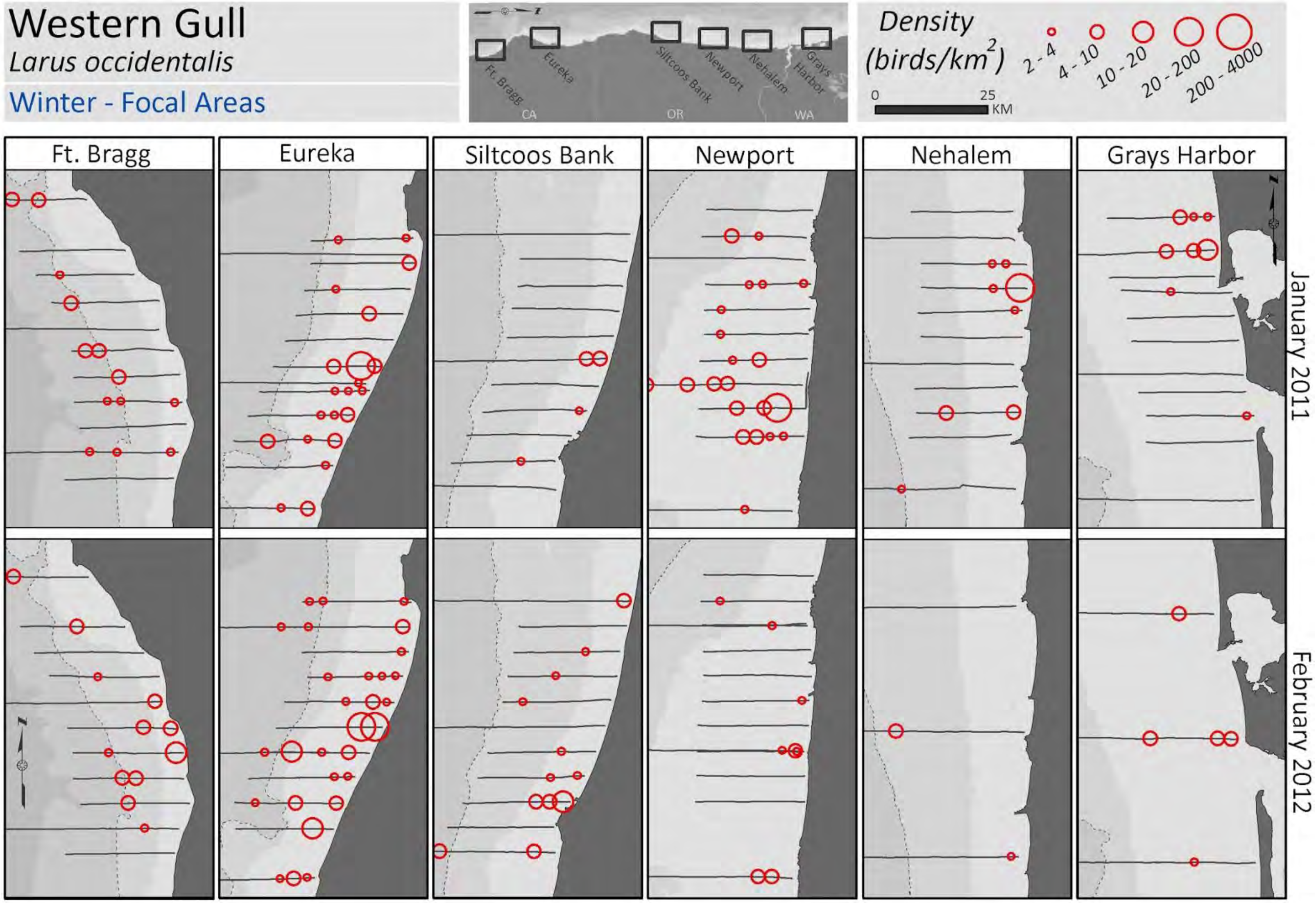


Figure 82. Mean density (birds km^{-2}) of Western Gulls (*Larus occidentalis*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

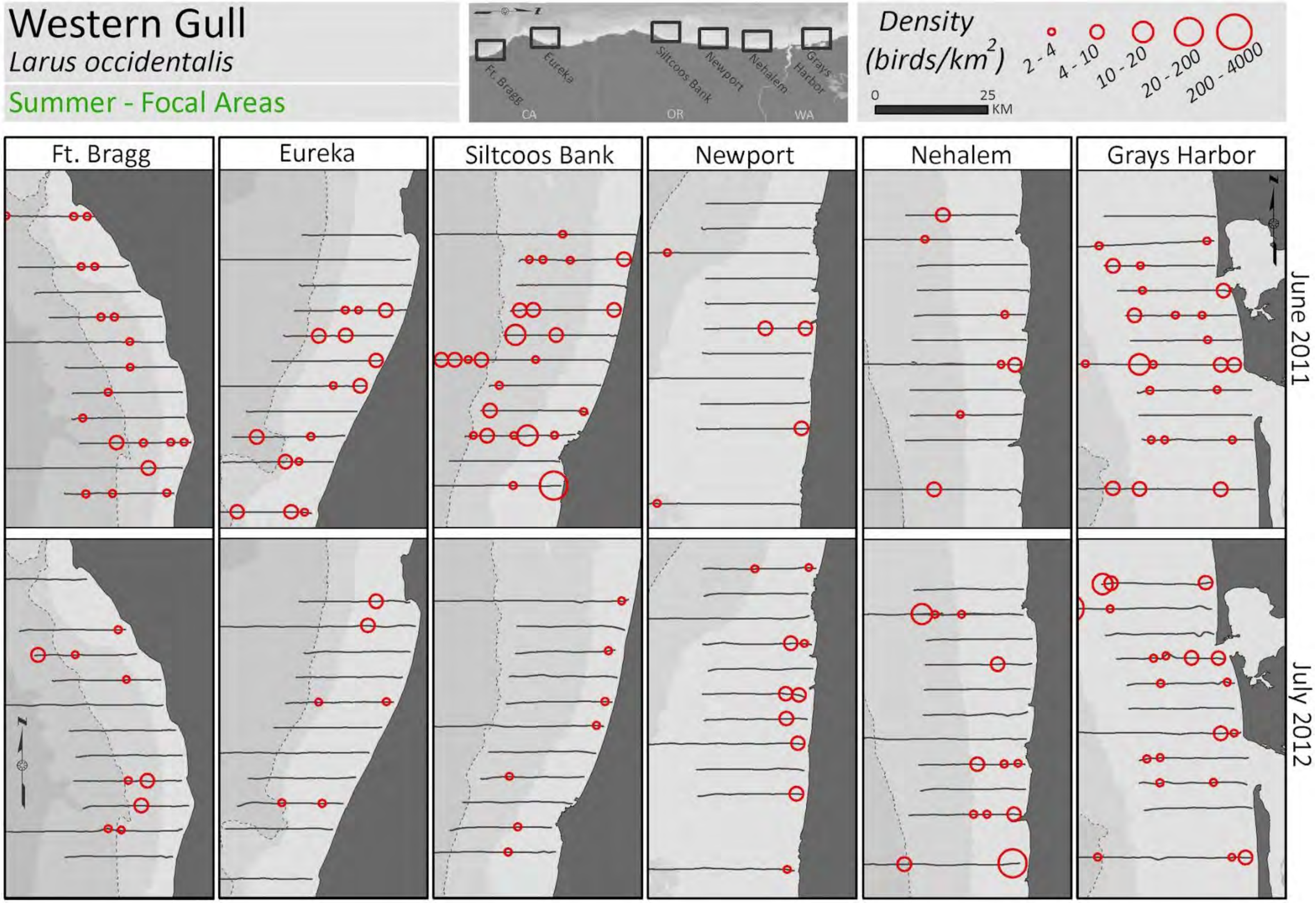


Figure 83. Mean density (birds km^{-2}) of Western Gulls (*Larus occidentalis*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

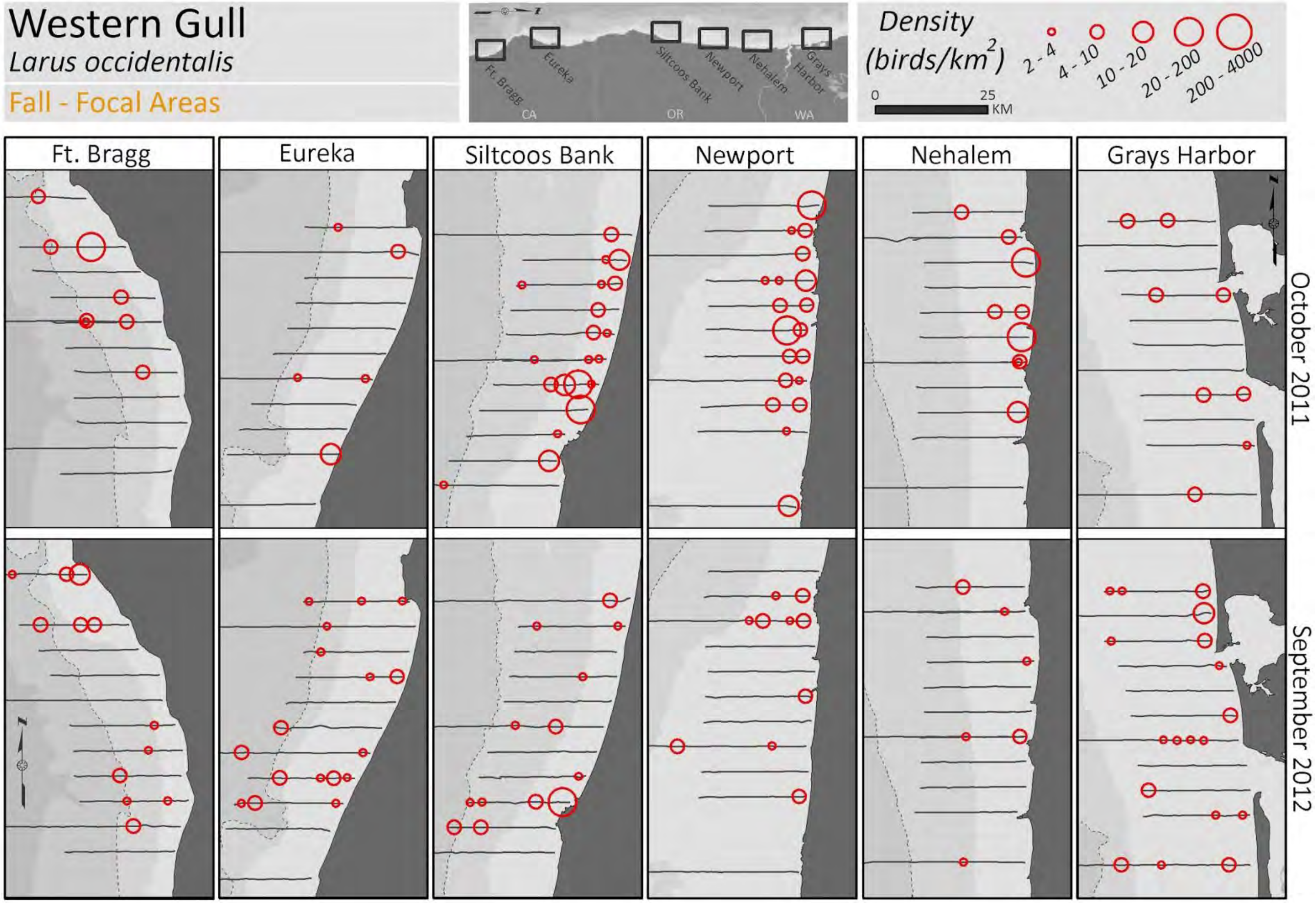


Figure 84. Mean density (birds km^{-2}) of Western Gulls (*Larus occidentalis*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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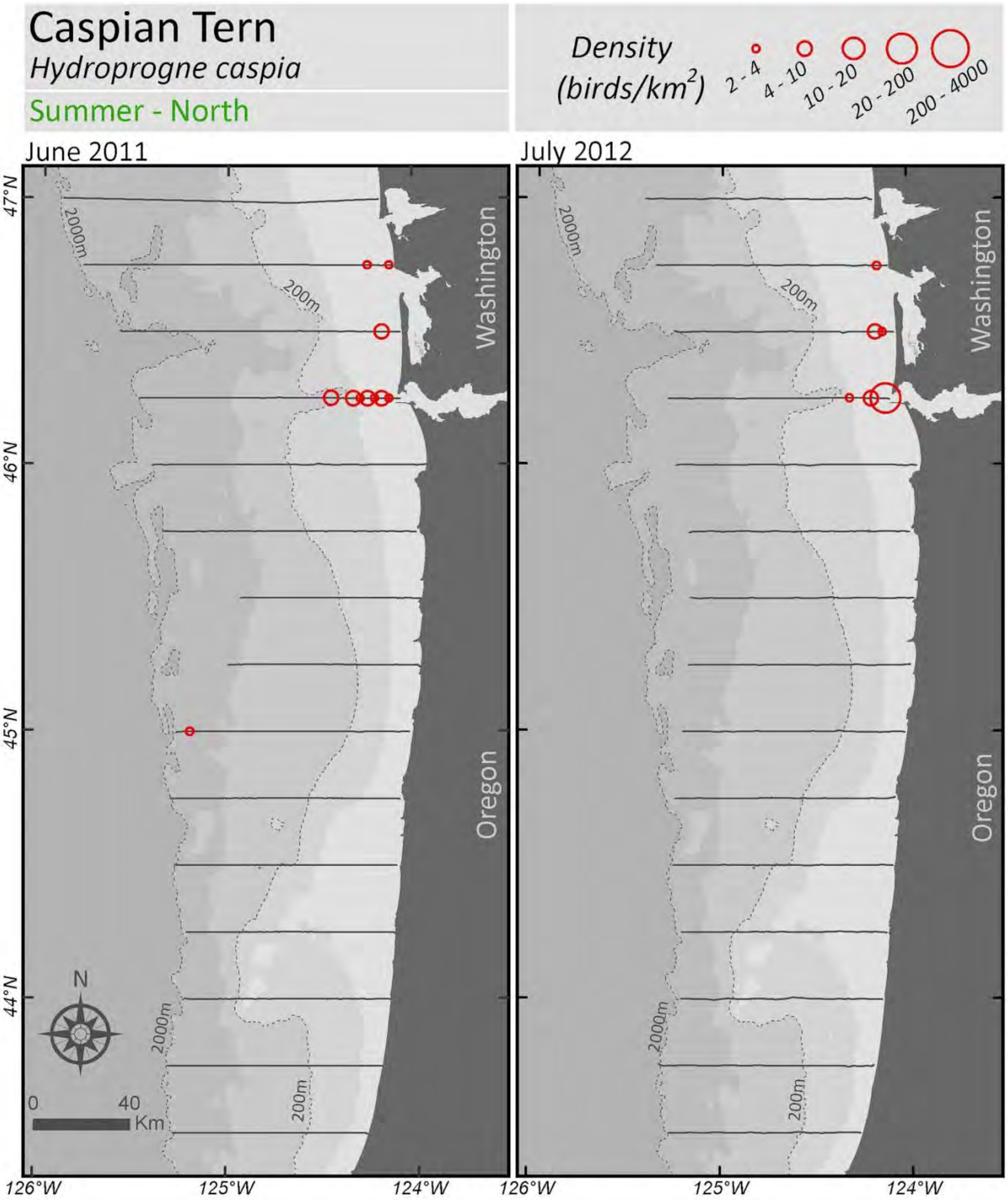
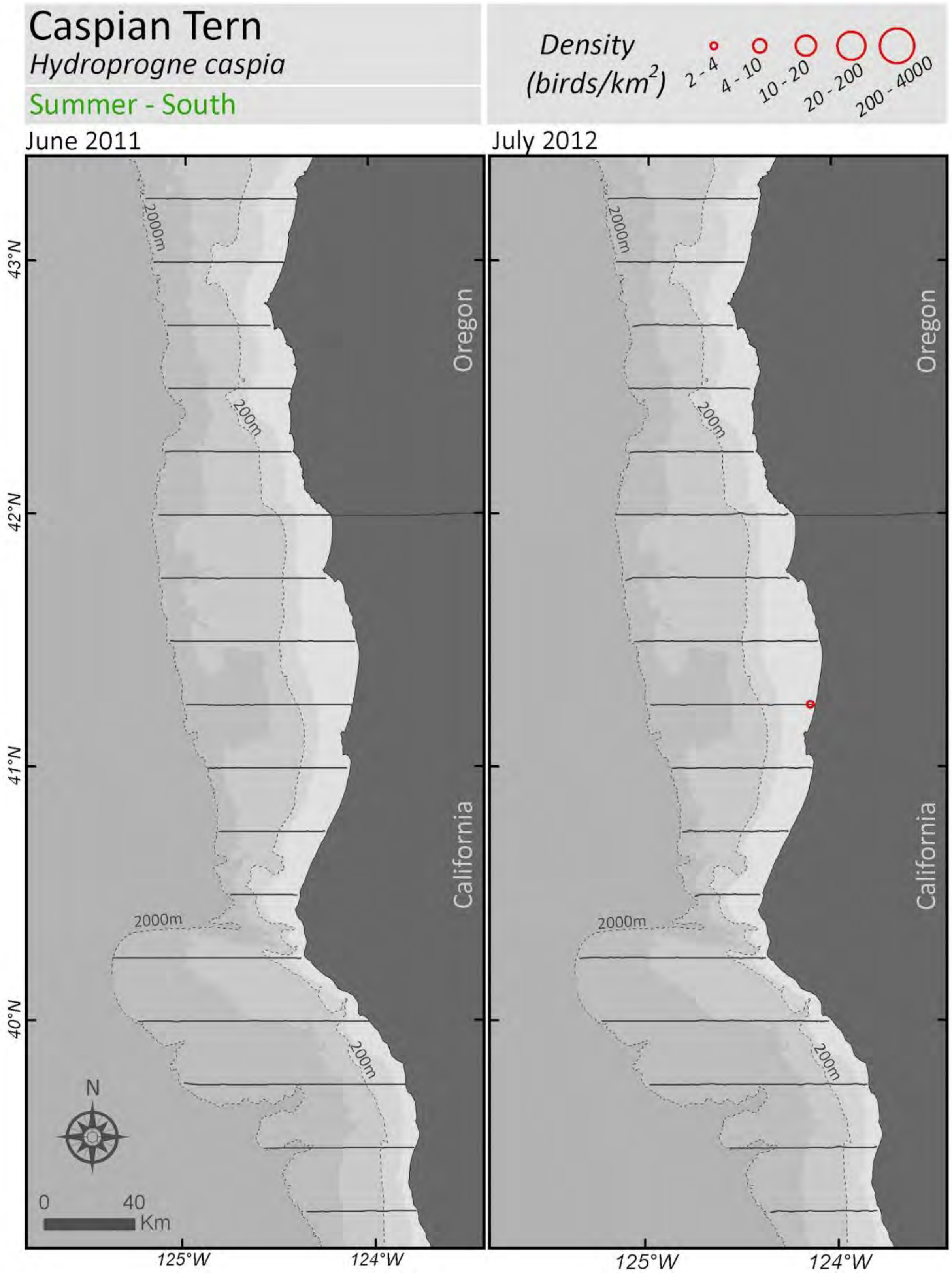


Figure 85. Mean density (birds km^{-2}) of Caspian Terns (*Hydroprogne caspia*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Caspian Tern
Hydroprogne caspia
Summer - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
43°N
42°N
41°N
40°N
125°W
124°W
2000m
200m
Oregon
California
N
0
40
Km

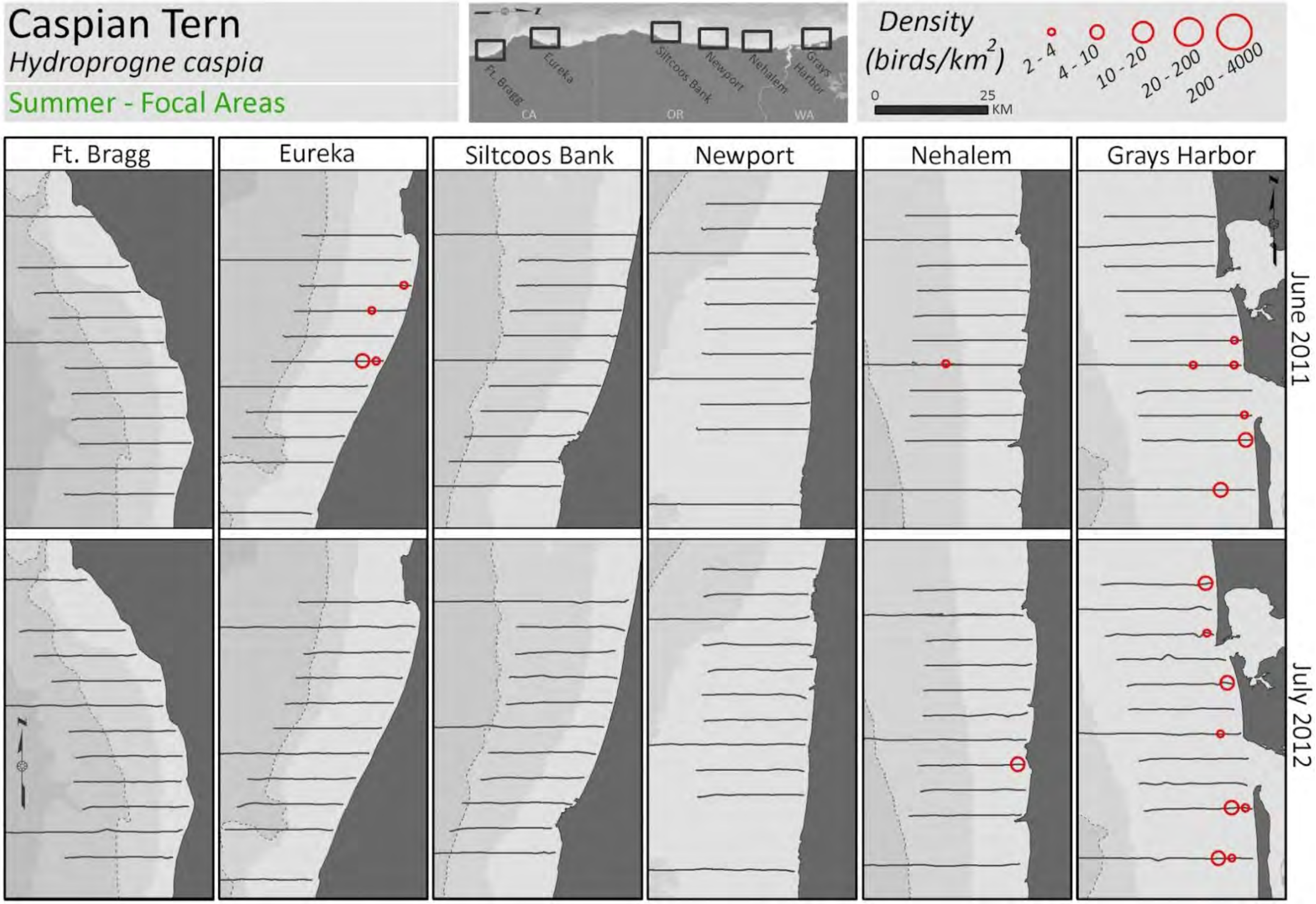


Figure 86. Mean density (birds km^{-2}) of Caspian Terns (*Hydroprogne caspia*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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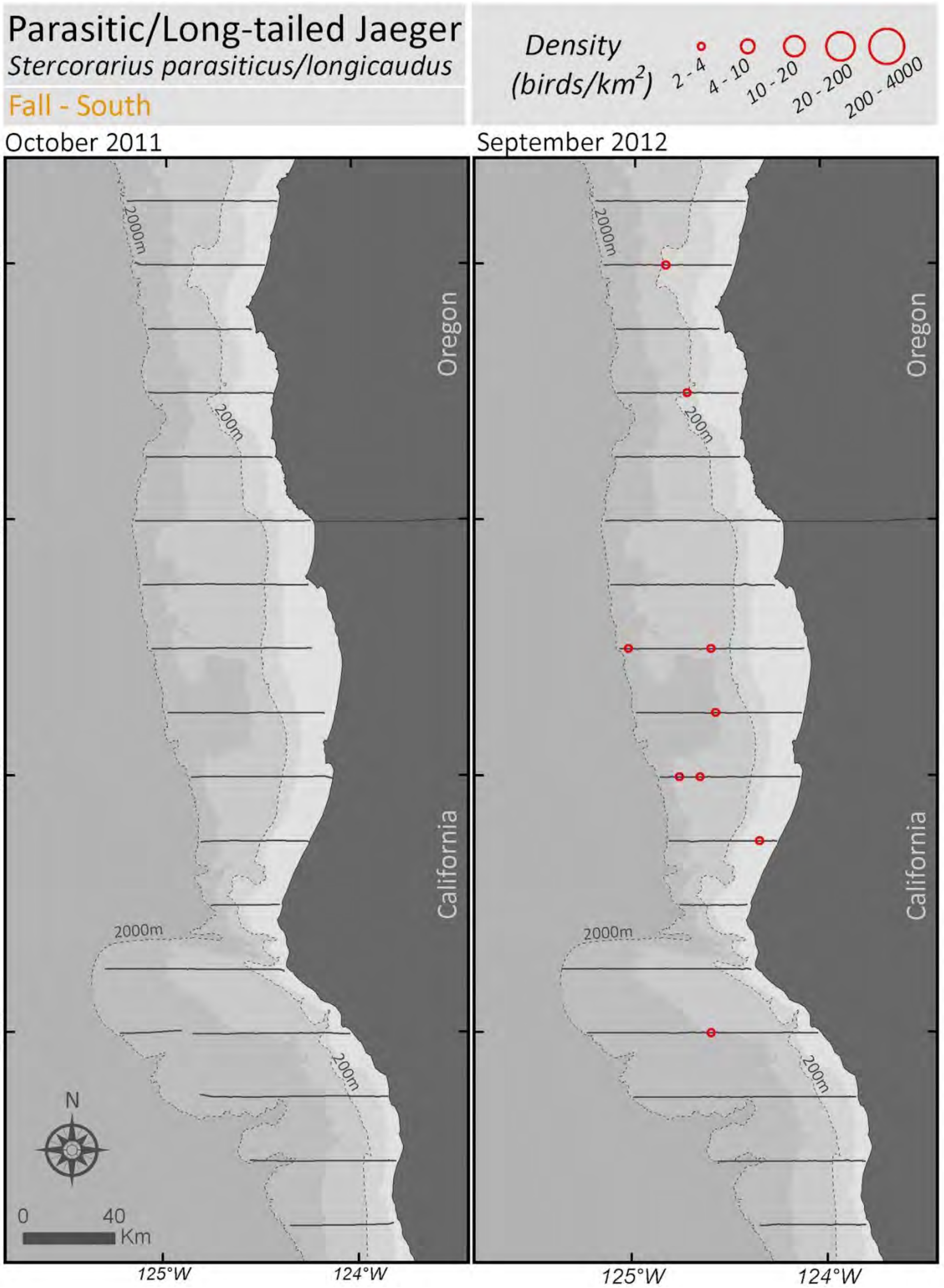
Figure 87. Mean density (birds km^{-2}) of Parasitic/Long-tailed Jaegers (*Stercorarius parasiticus/longicaudus*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Parasitic/Long-tailed Jaeger
Stercorarius parasiticus/longicaudus
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

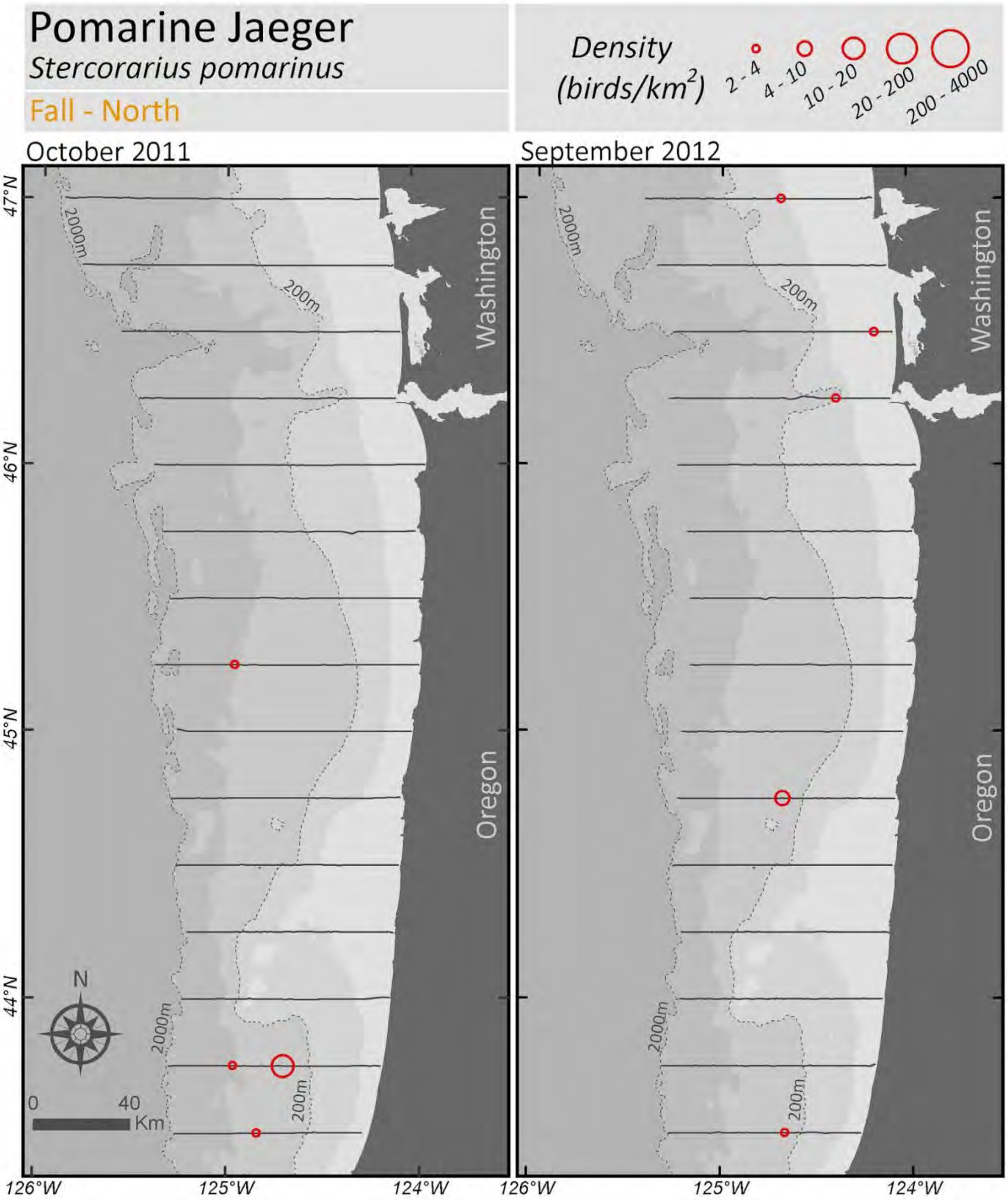
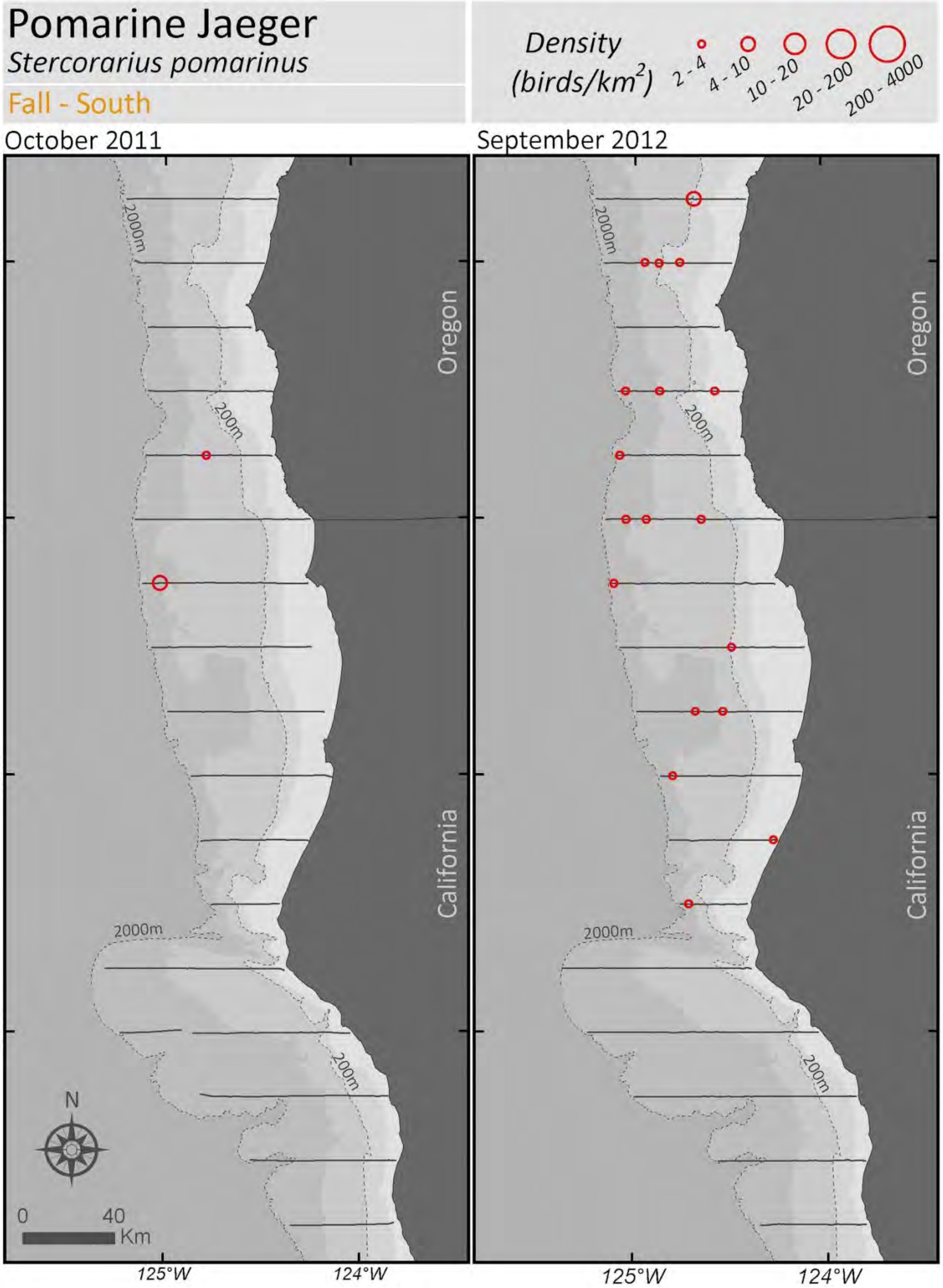


Figure 88. Mean density (birds km^{-2}) of Pomarine Jaegers (*Stercorarius pomarinus*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Pomarine Jaeger

Stercorarius pomarinus

Fall - South



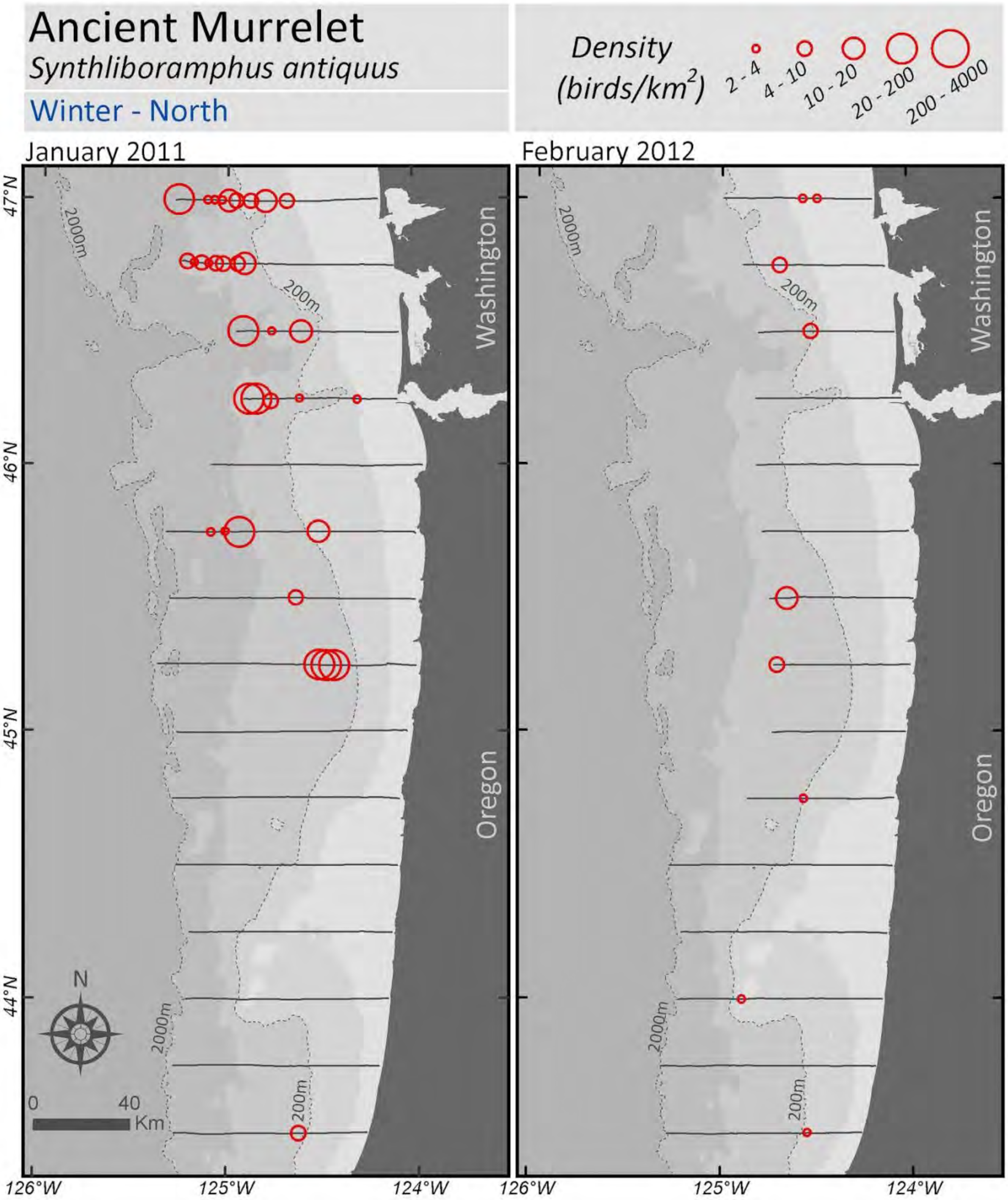
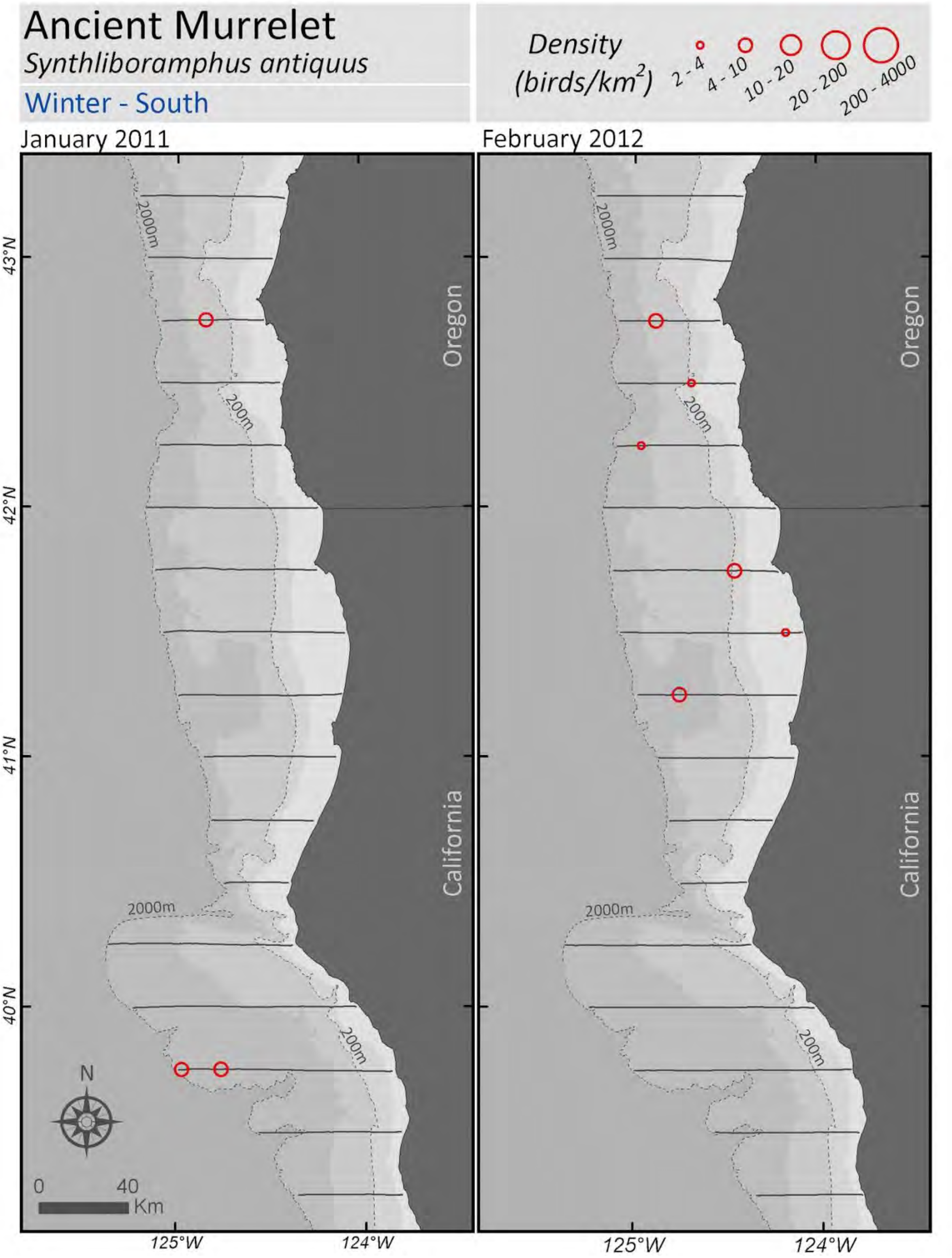


Figure 89. Mean density (birds km^{-2}) of Ancient Murrelets (*Synthliboramphus antiquus*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Ancient Murrelet

Synthliboramphus antiquus

Winter - South



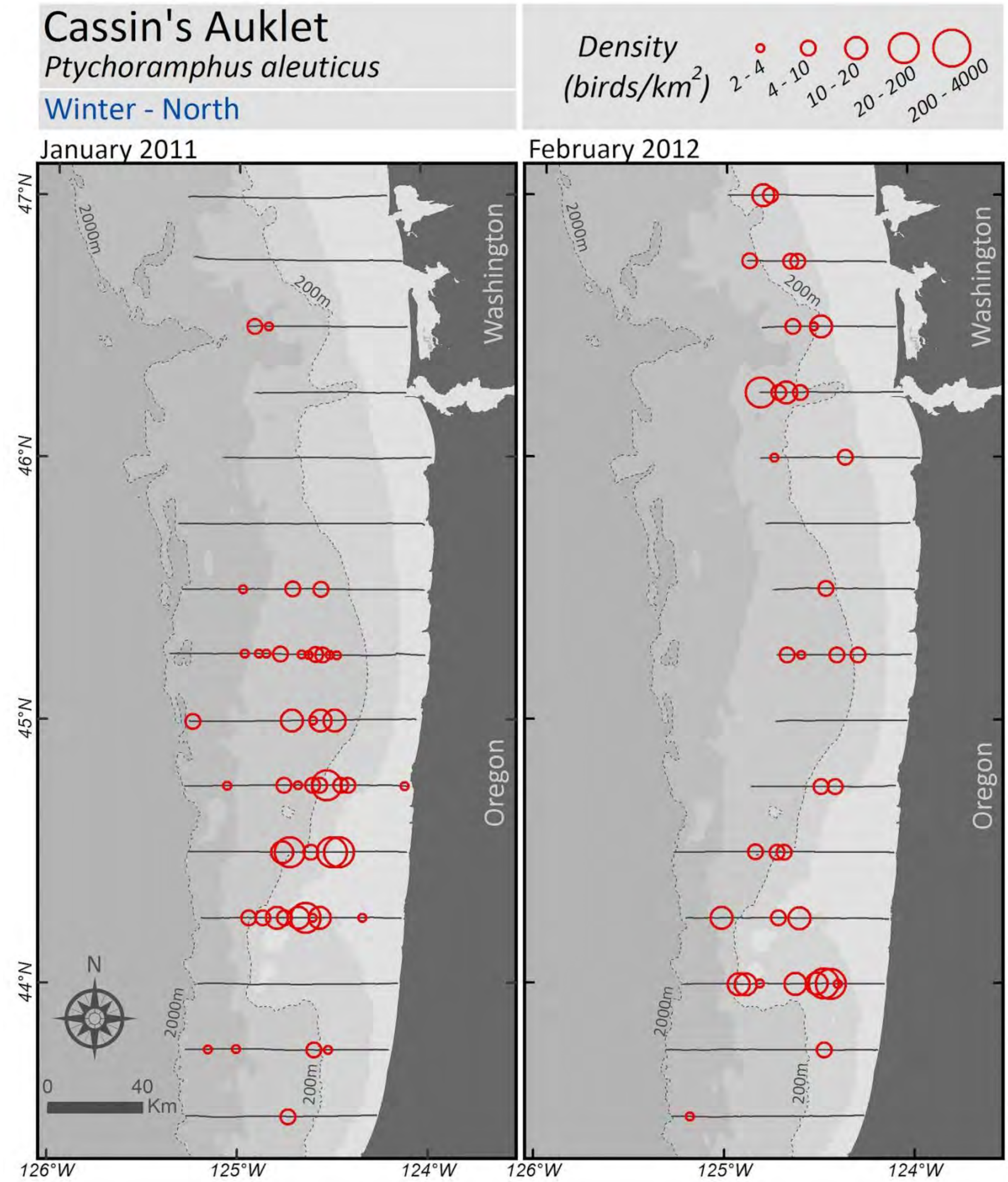
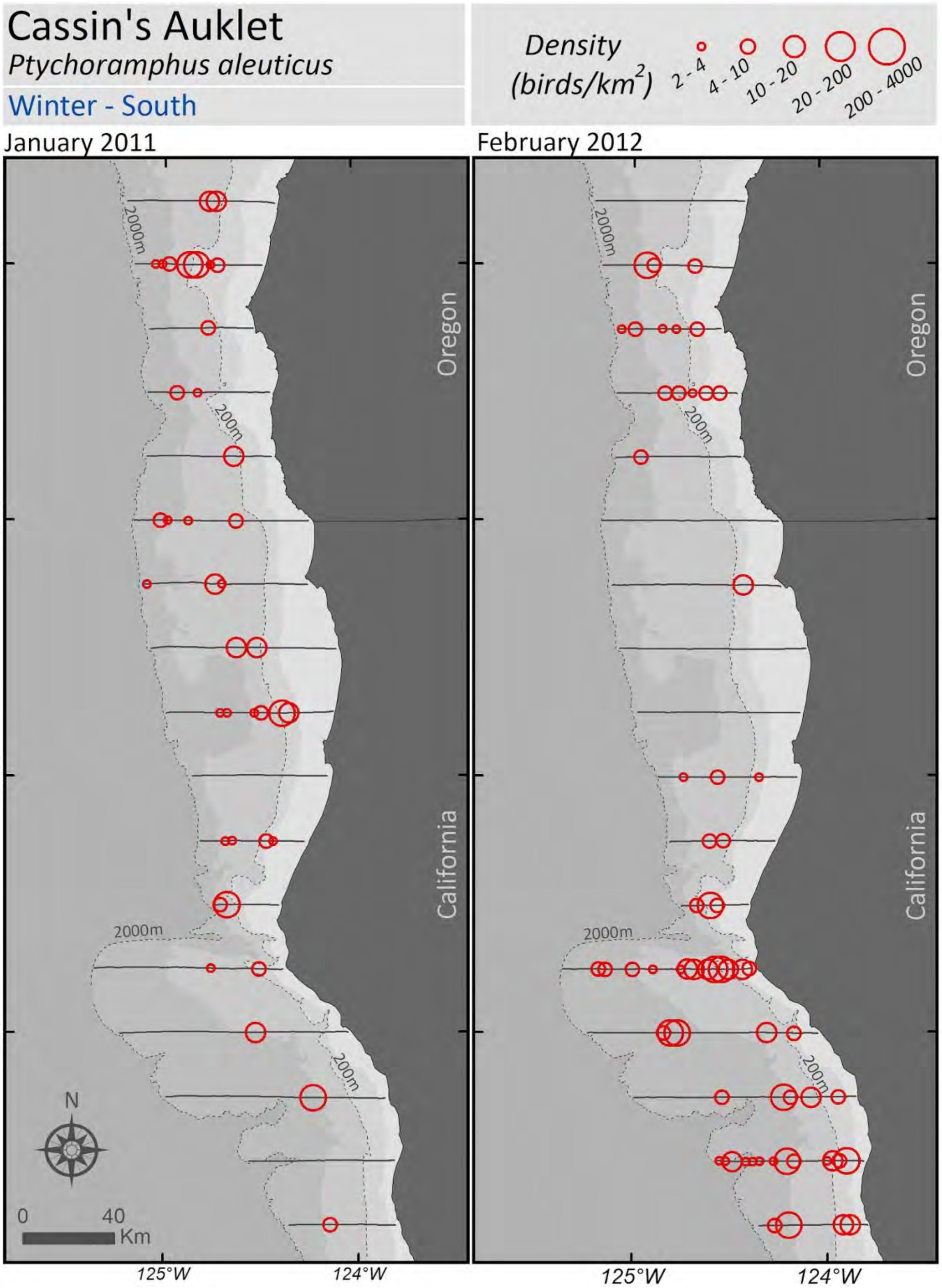


Figure 90. Mean density (birds km^{-2}) of Cassin's Auklets (*Ptychoramphus aleuticus*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.



Cassin's Auklet

Ptychoramphus aleuticus

Winter - South

January 2011

February 2012

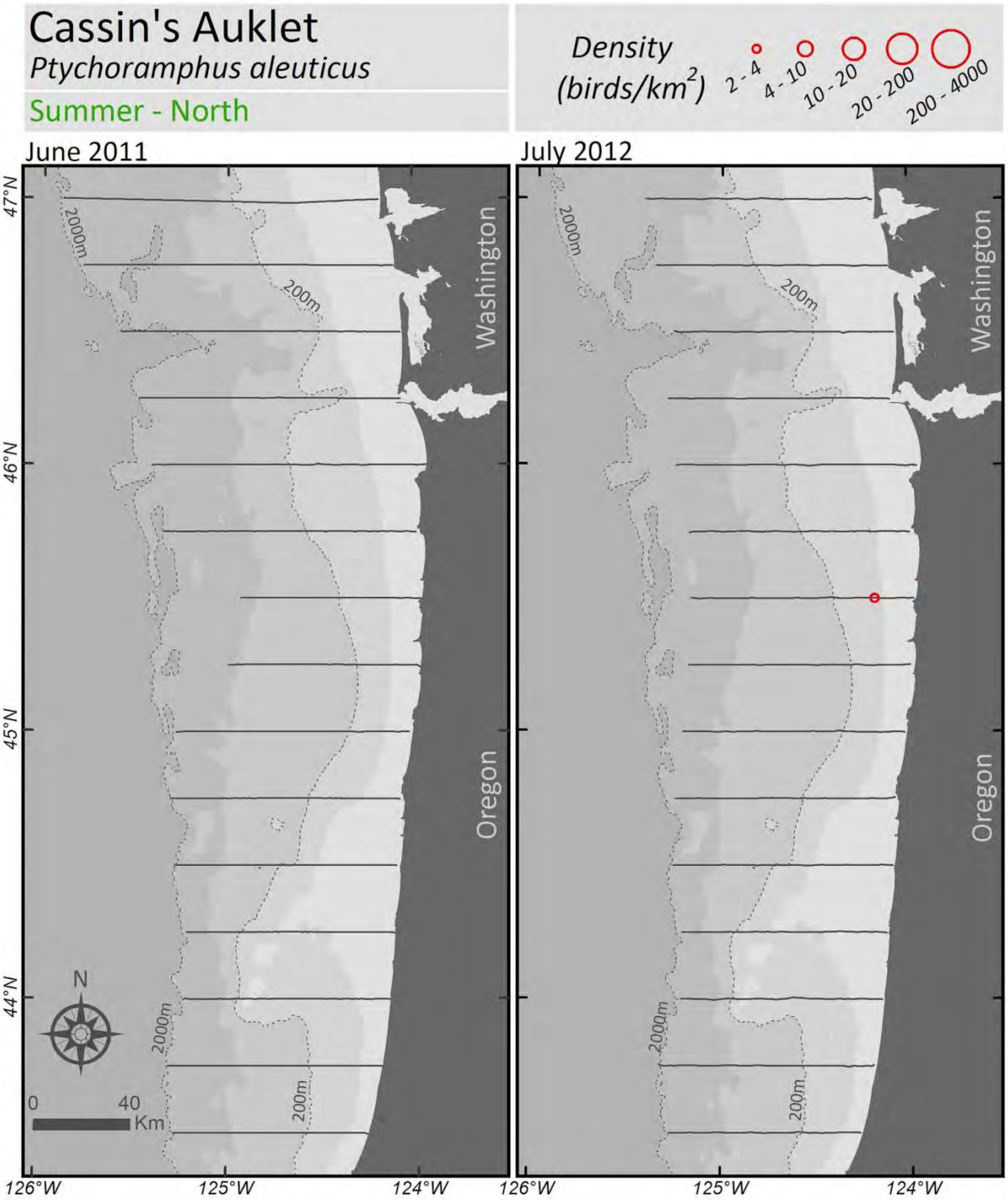
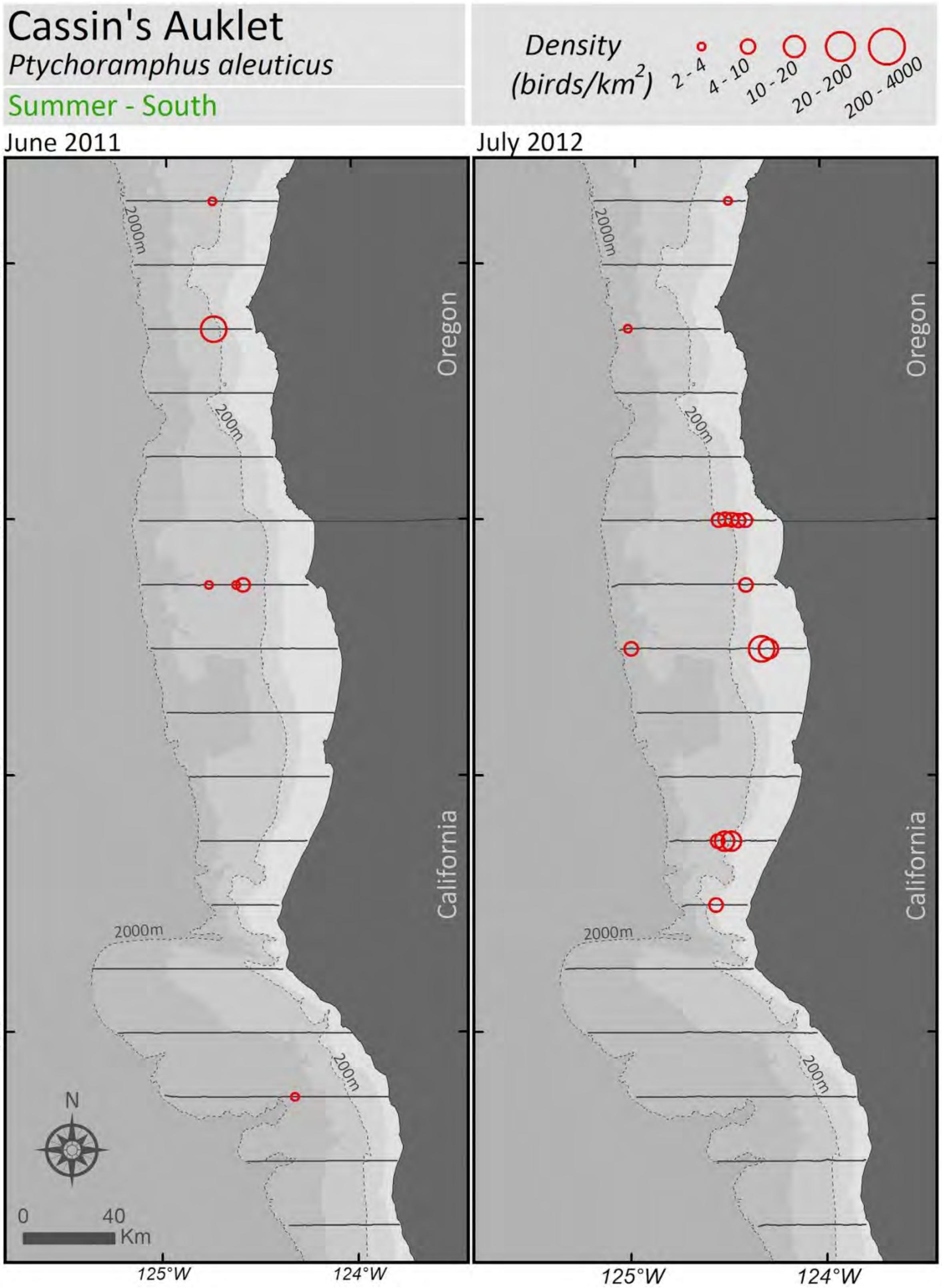


Figure 91. Mean density (birds km^{-2}) of Cassin's Auklets (*Ptychoramphus aleuticus*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Cassin's Auklet
Ptychoramphus aleuticus
Summer - South
Density (birds/km^2)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
June 2011
July 2012
2000m
200m
43°N
42°N
41°N
40°N
Oregon
California
N
0
40
Km
125°W
124°W

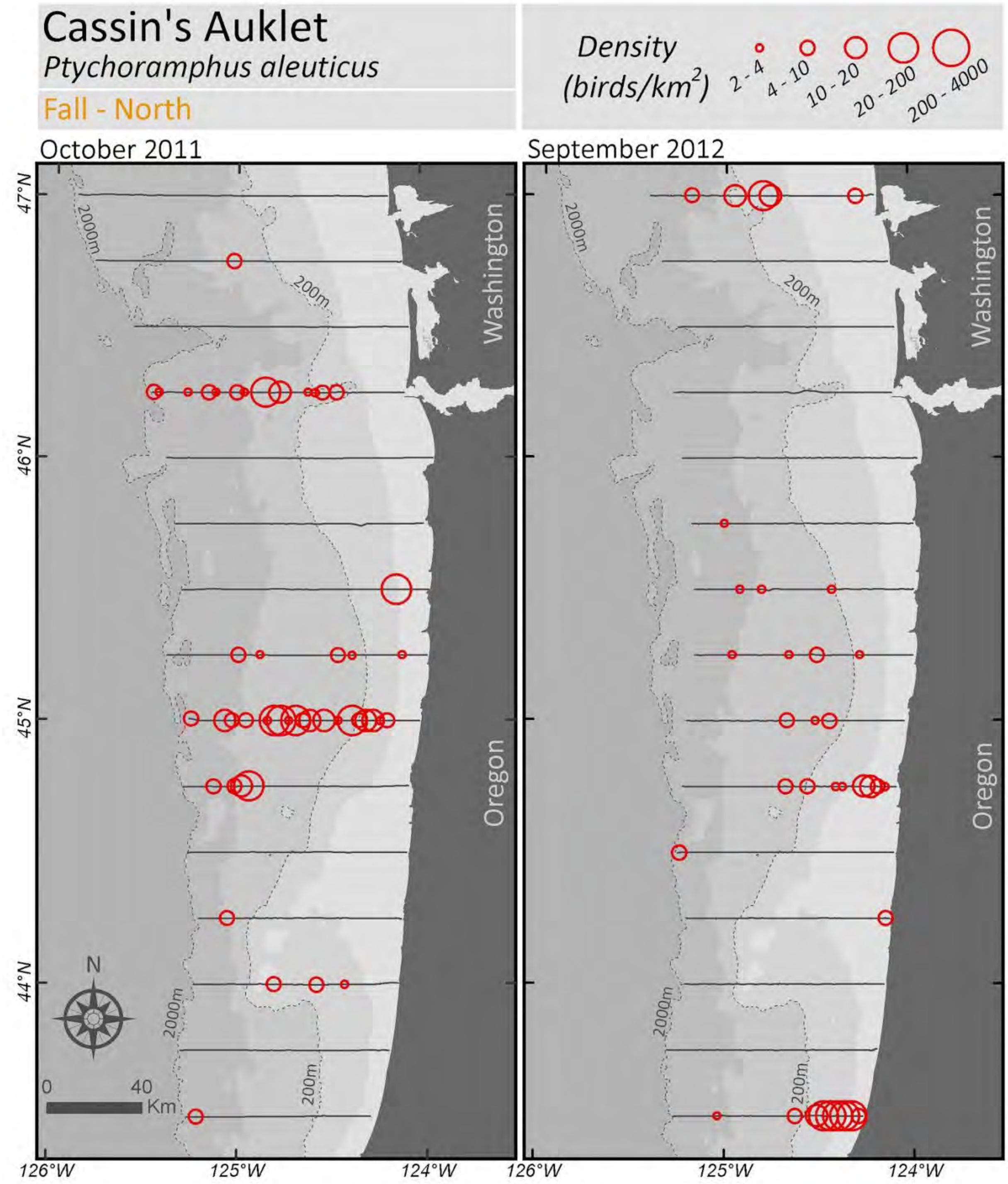
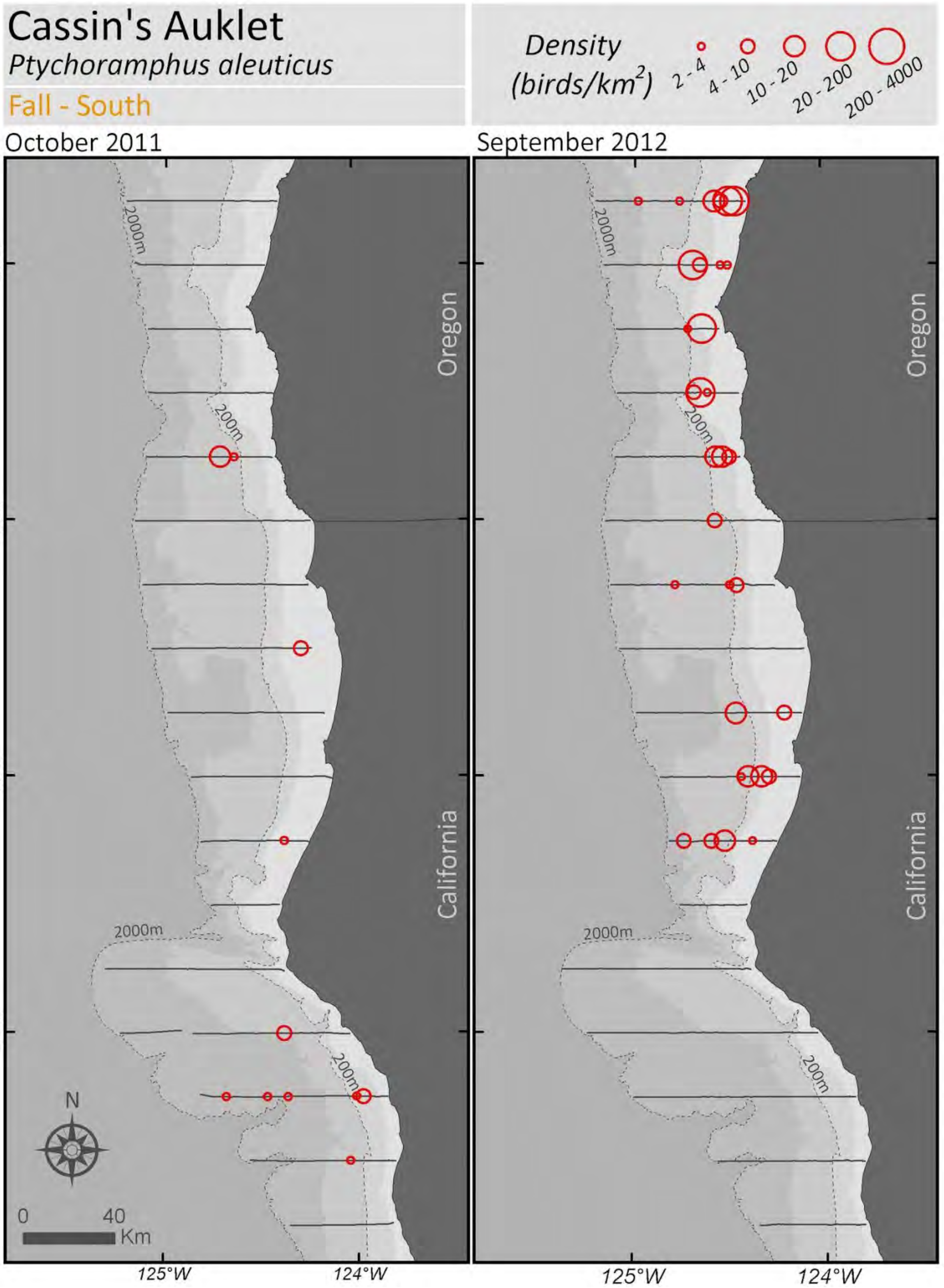


Figure 92. Mean density (birds km^{-2}) of Cassin's Auklets (*Ptychoramphus aleuticus*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Cassin's Auklet

Ptychoramphus aleuticus

Fall - South



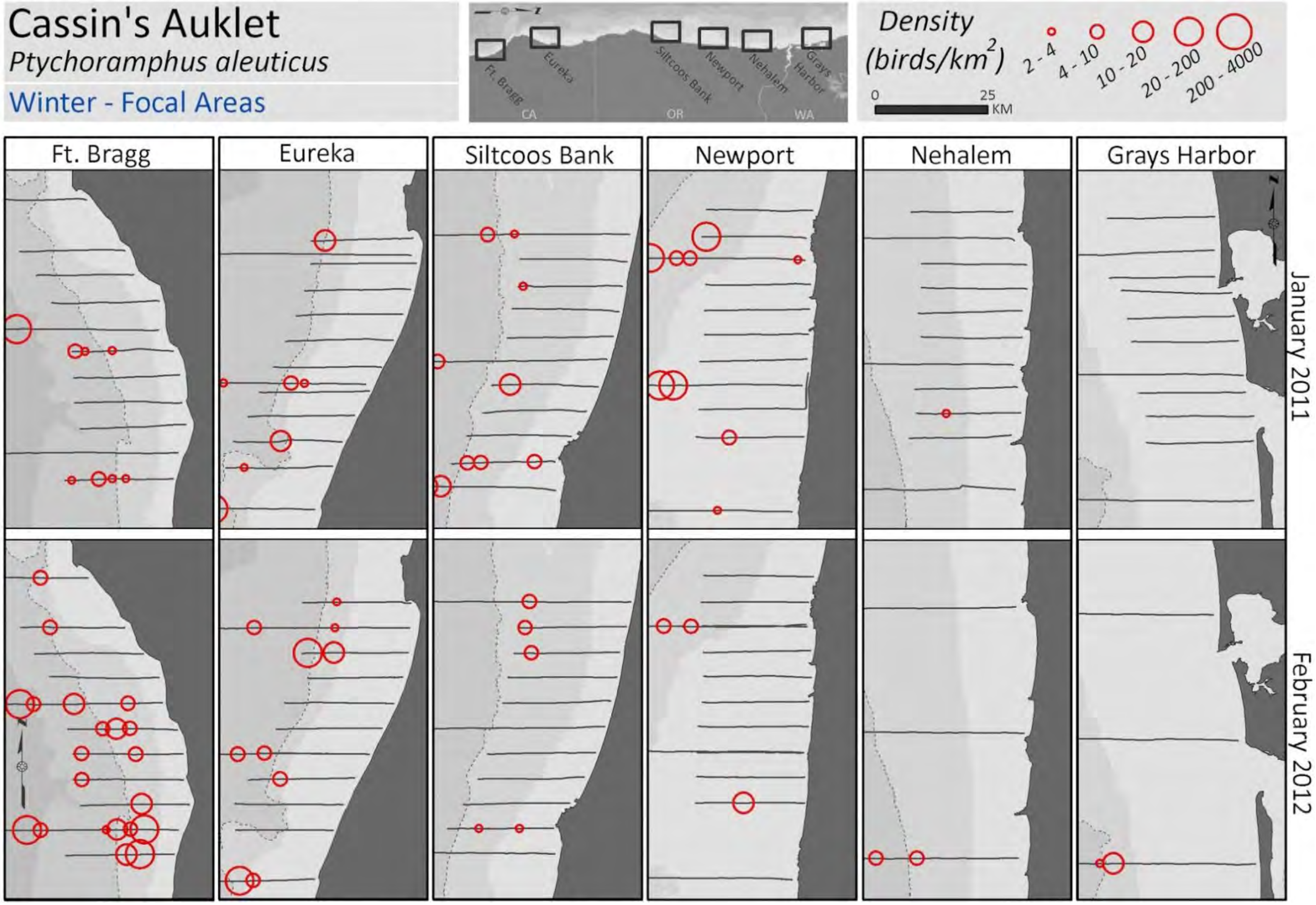


Figure 93. Mean density (birds km^{-2}) of Cassin's Auklets (*Ptychoramphus aleuticus*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

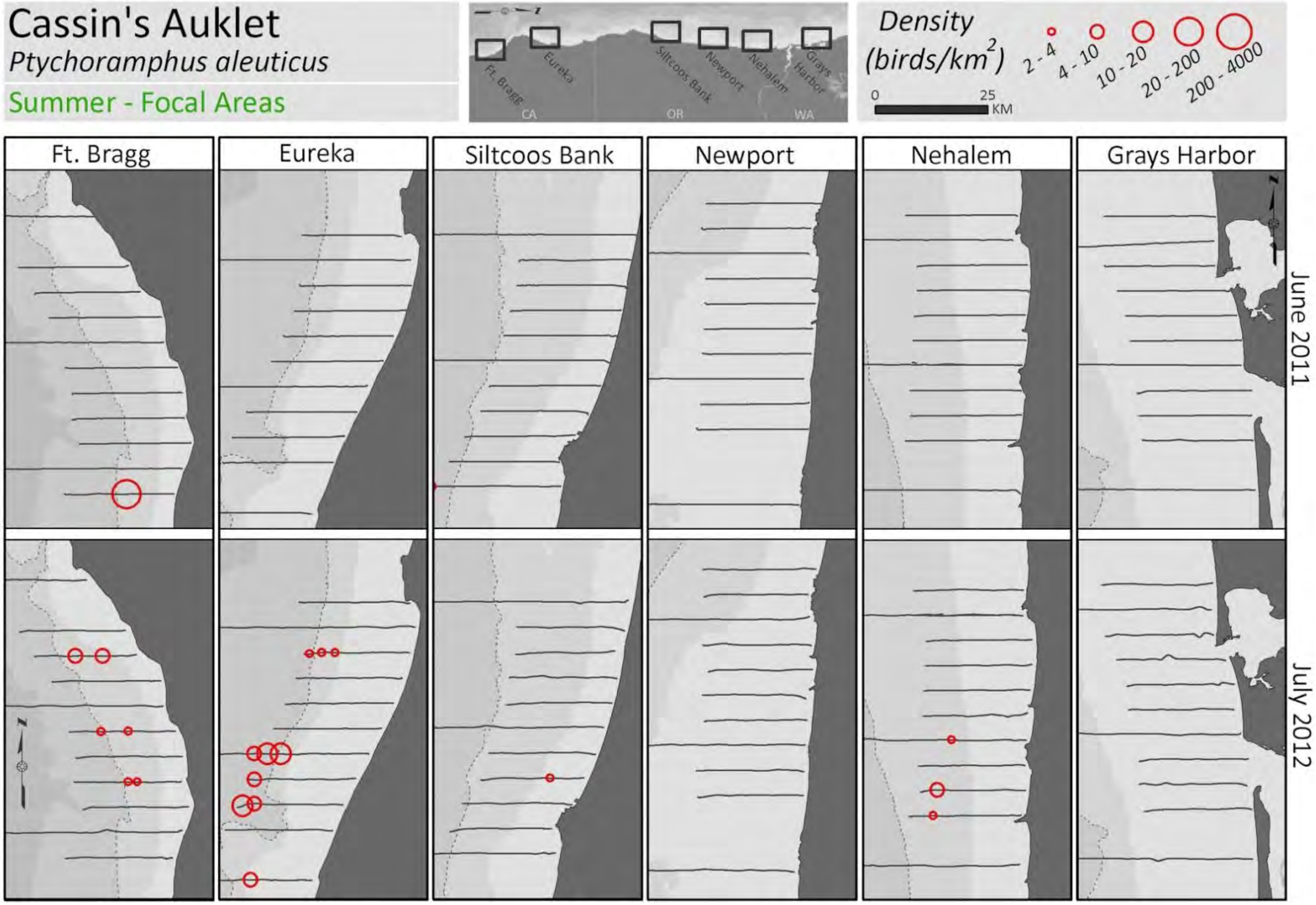


Figure 94. Mean density (birds km^{-2}) of Cassin's Auklets (*Ptychoramphus aleuticus*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

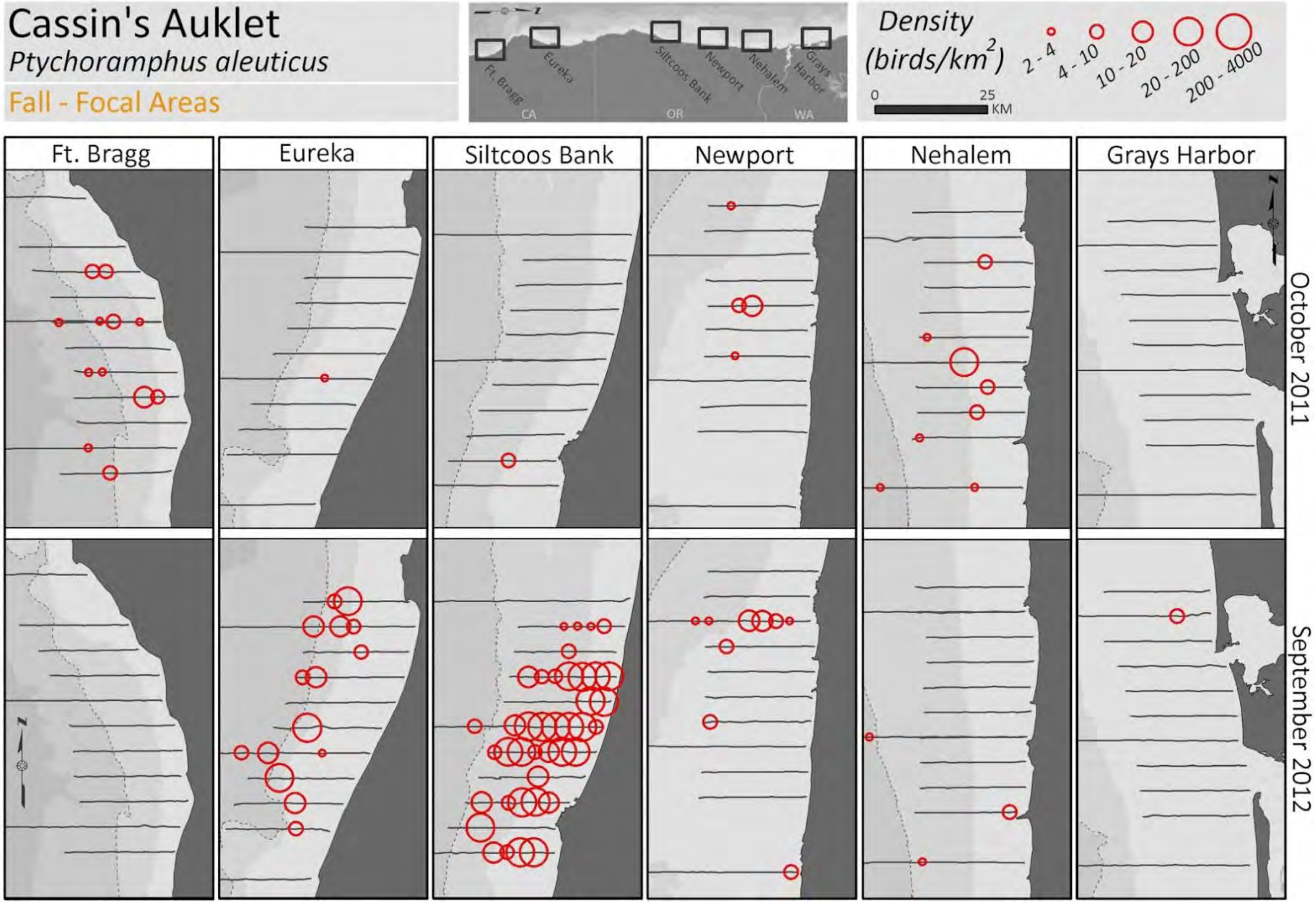


Figure 95. Mean density (birds km^{-2}) of Cassin's Auklets (*Ptychoramphus aleuticus*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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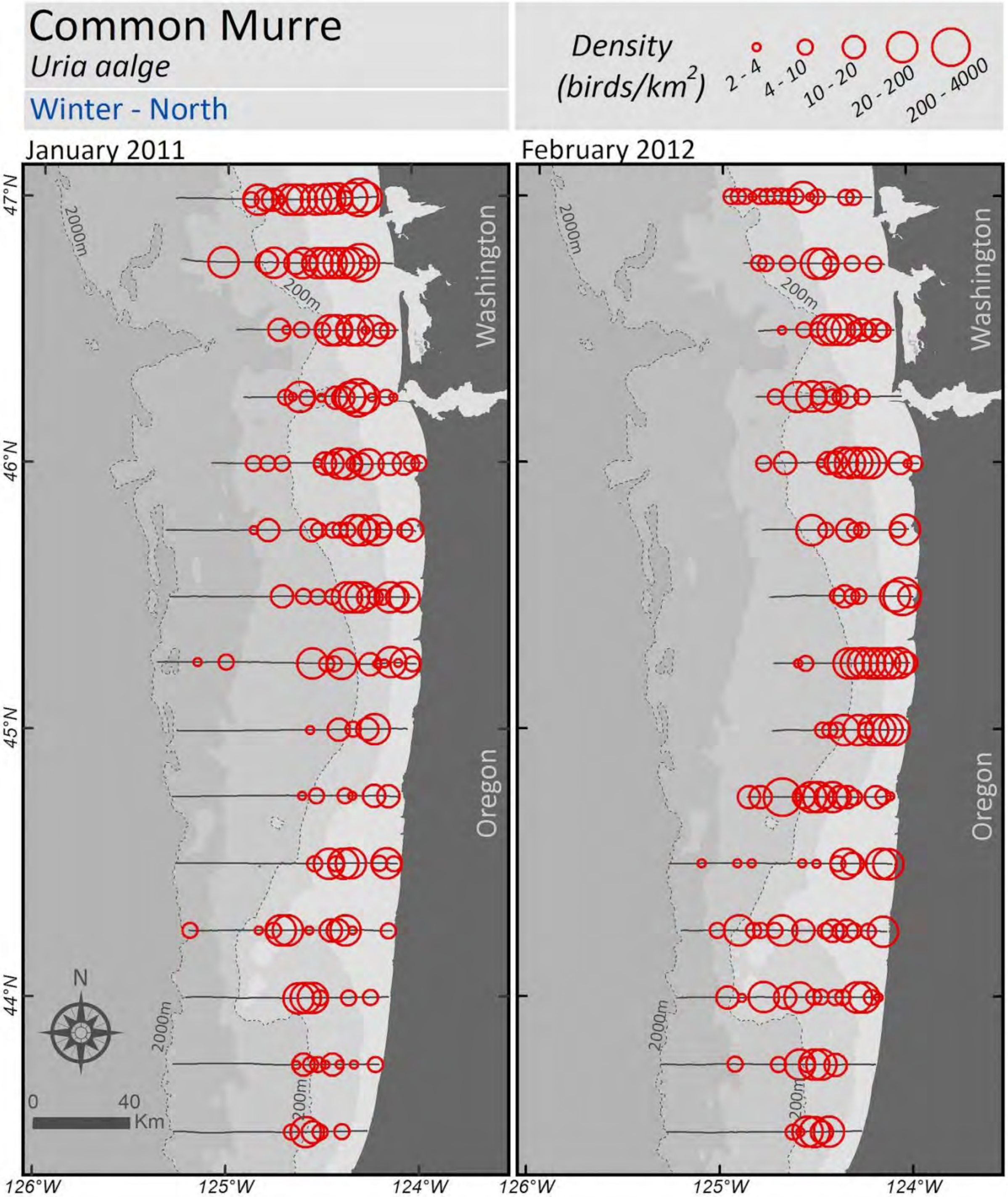
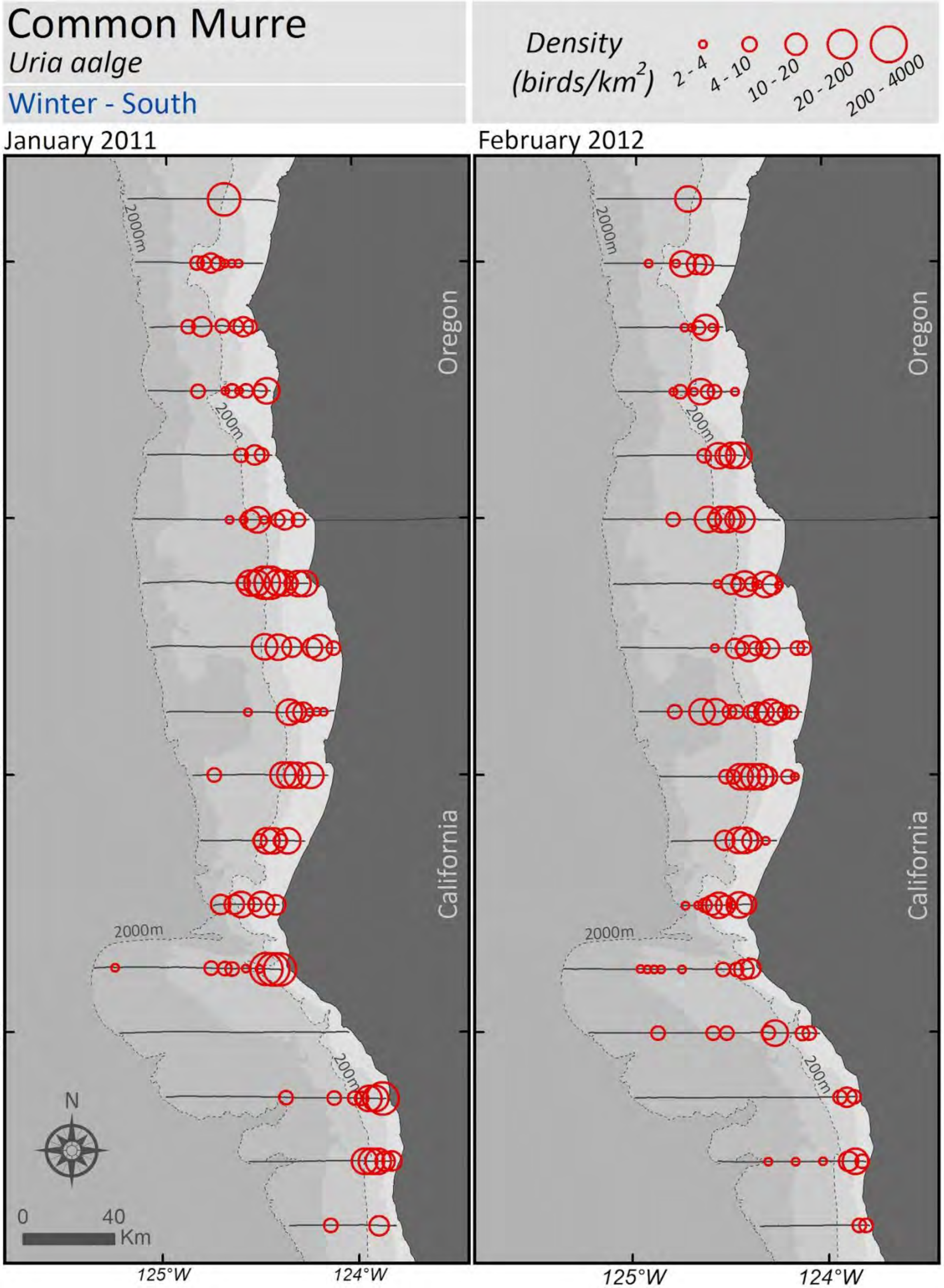


Figure 96. Mean density (birds km^{-2}) of Common Murres (*Uria aalge*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Common Murre

Uria aalge

Winter - South



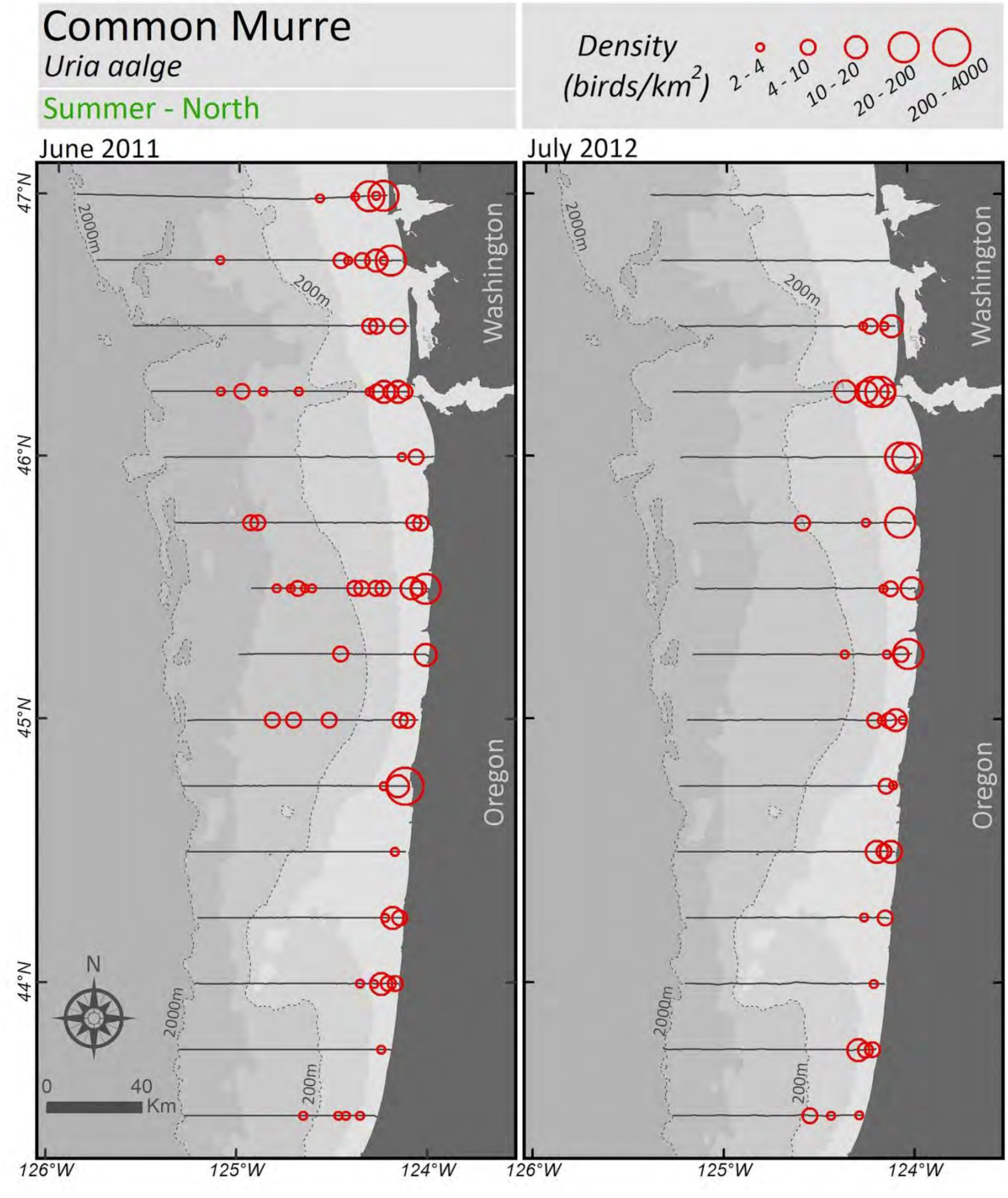
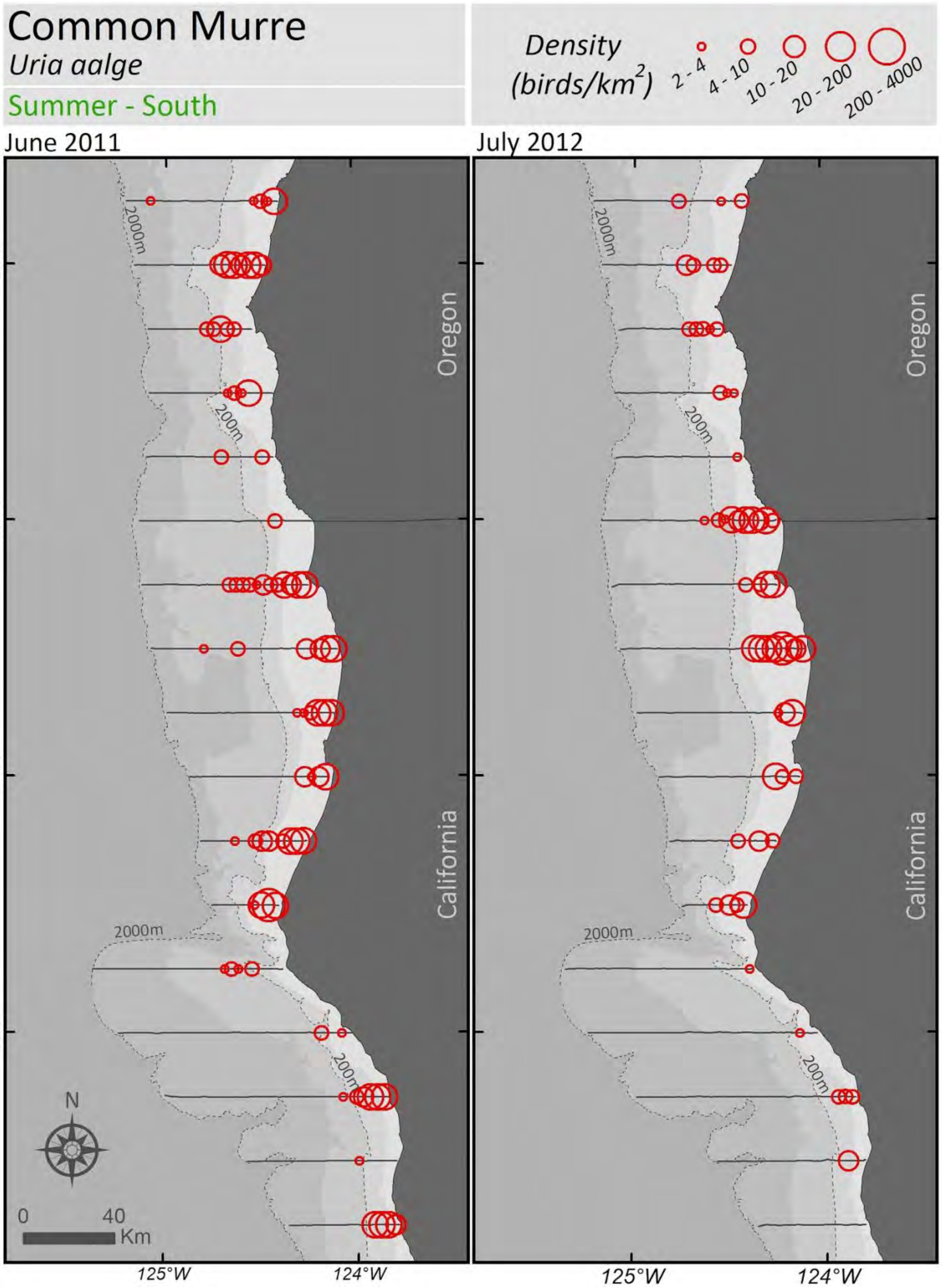


Figure 97. Mean density (birds km^{-2}) of Common Murres (*Uria aalge*) in summer on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Common Murre

Uria aalge

Summer - South



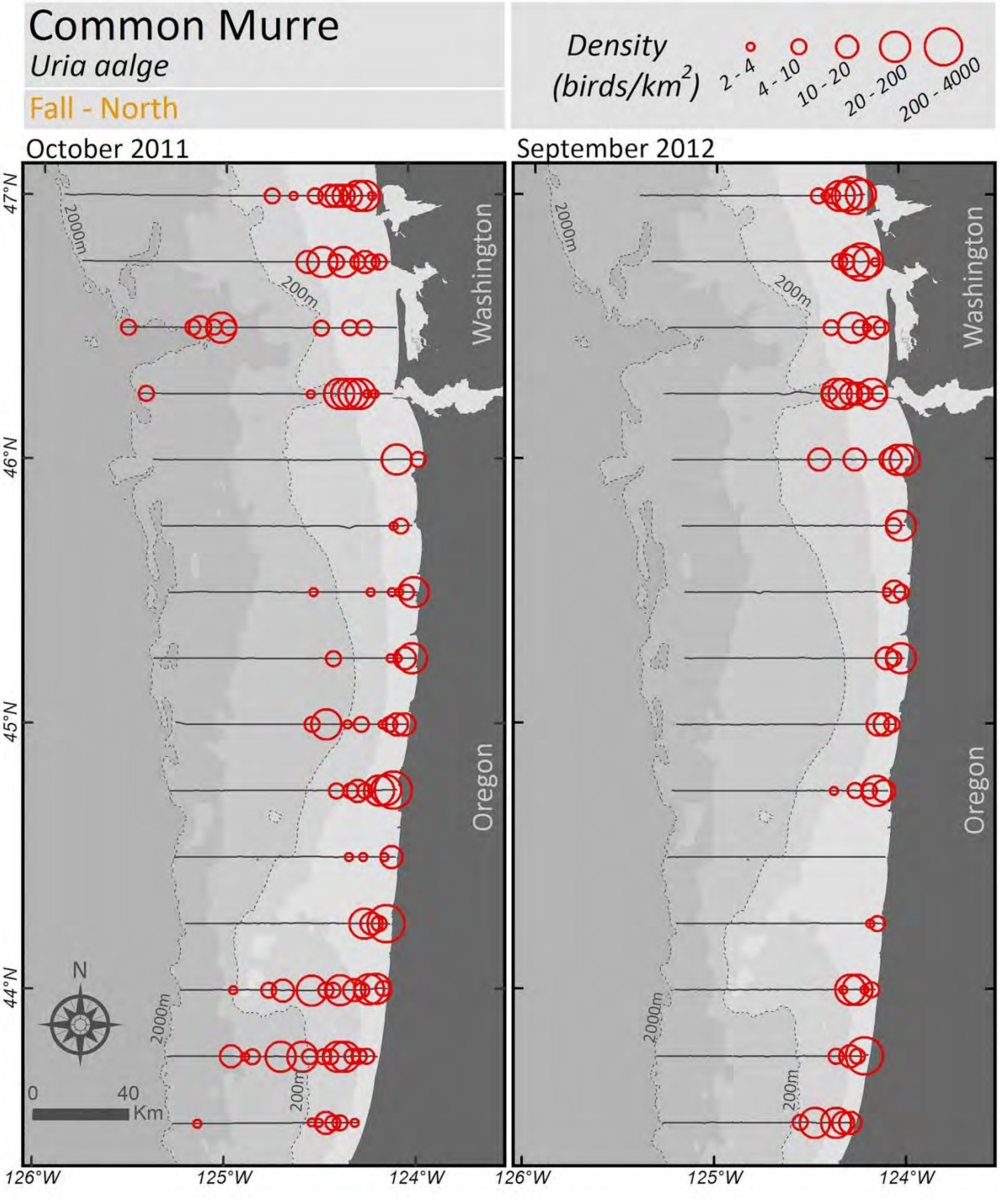
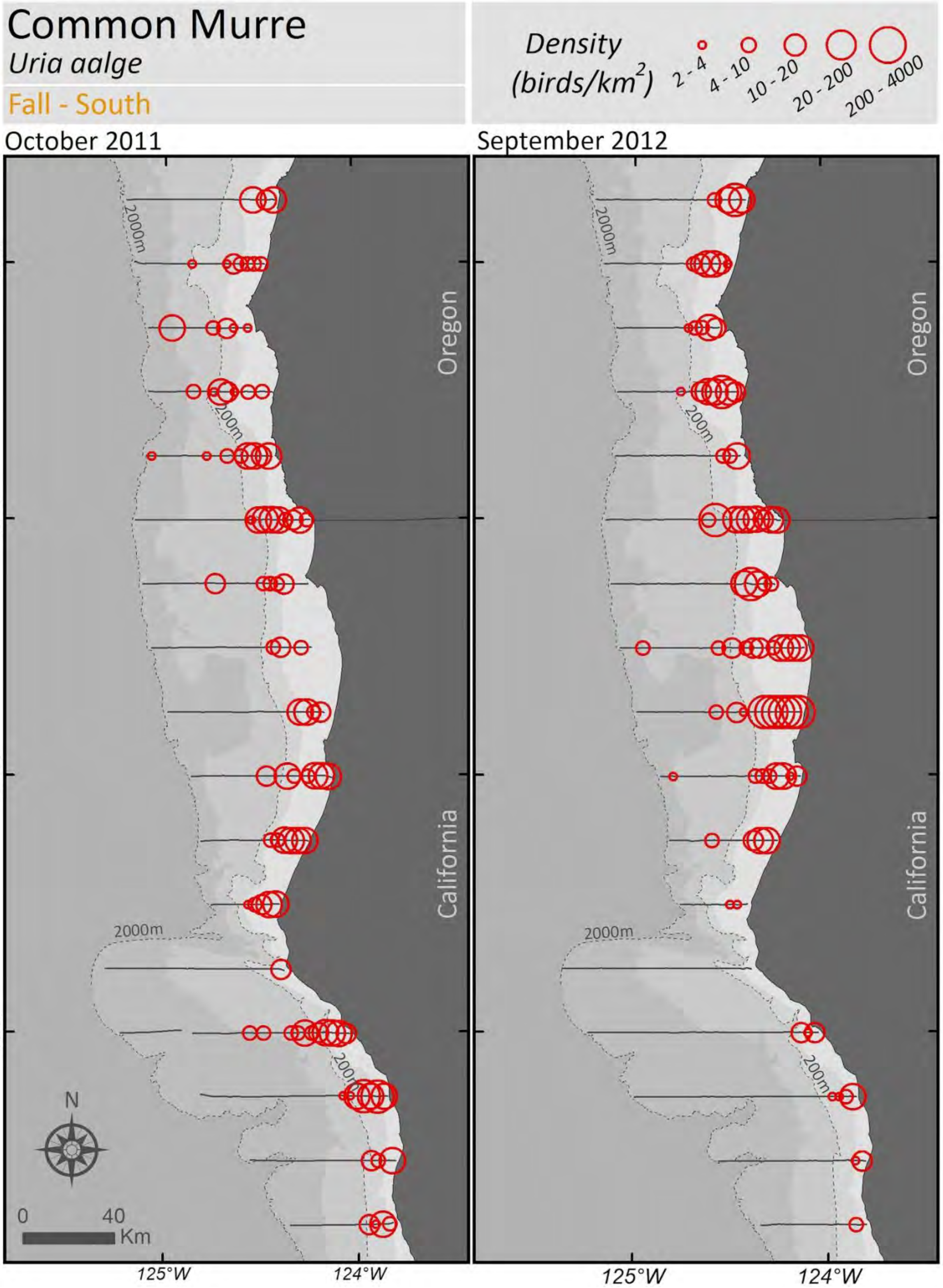


Figure 98. Mean density (birds km^{-2}) of Common Murres (*Uria aalge*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Common Murre
Uria aalge
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

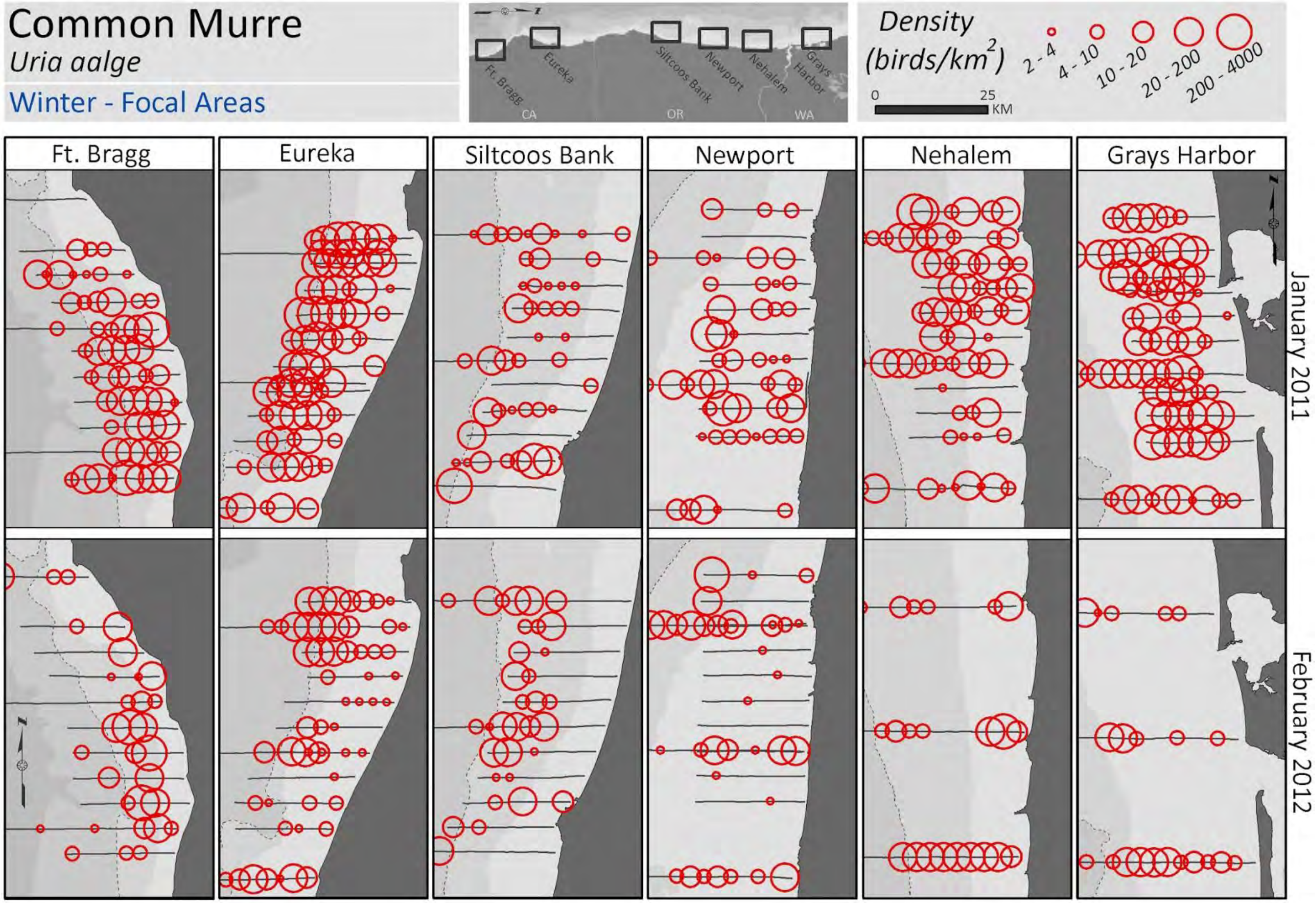


Figure 99. Mean density (birds km^{-2}) of Common Murres (*Uria aalge*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

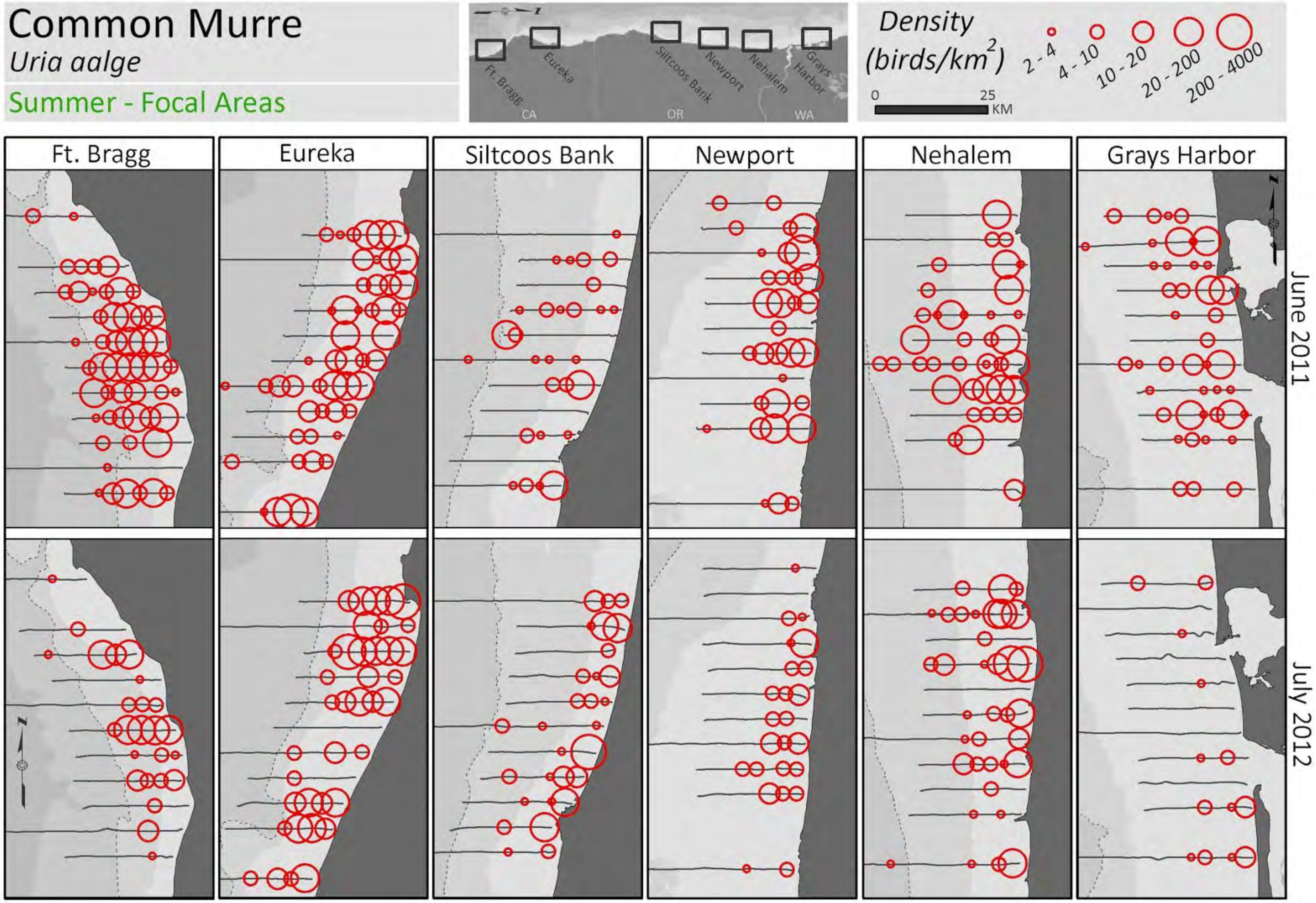


Figure 100. Mean density (birds km^{-2}) of Common Murres (*Uria aalge*) in summer on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

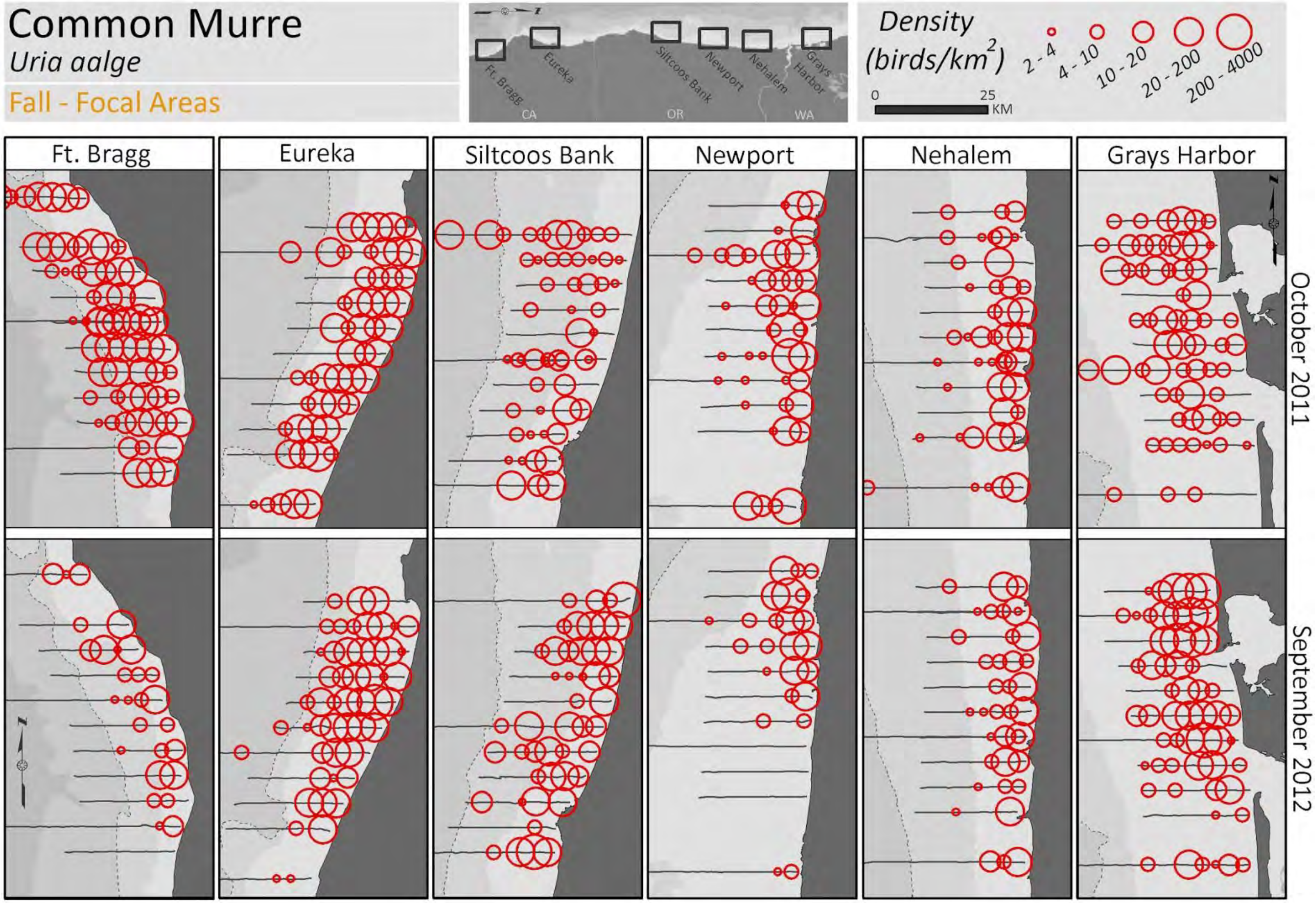


Figure 101. Mean density (birds km^{-2}) of Common Murres (*Uria aalge*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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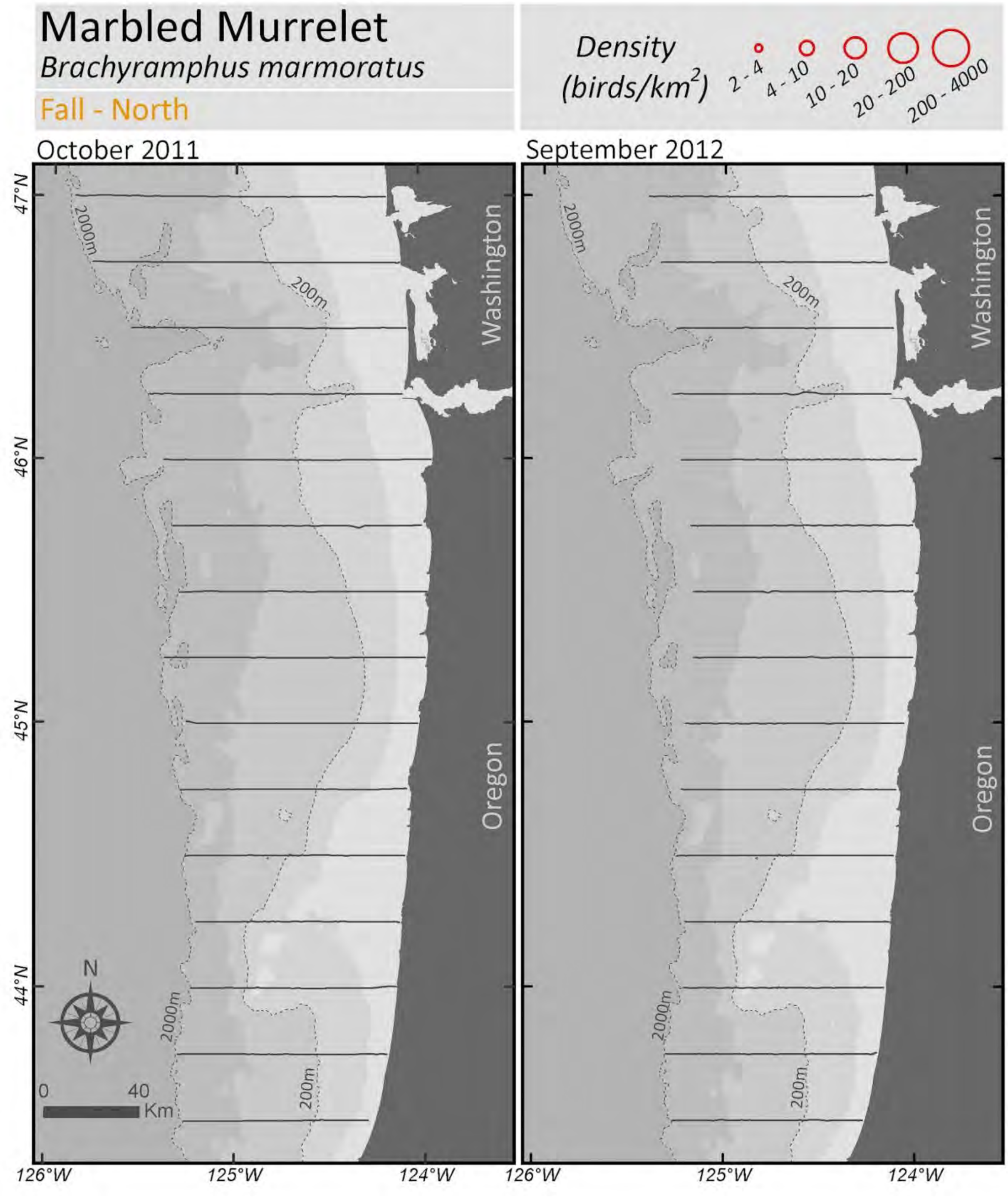
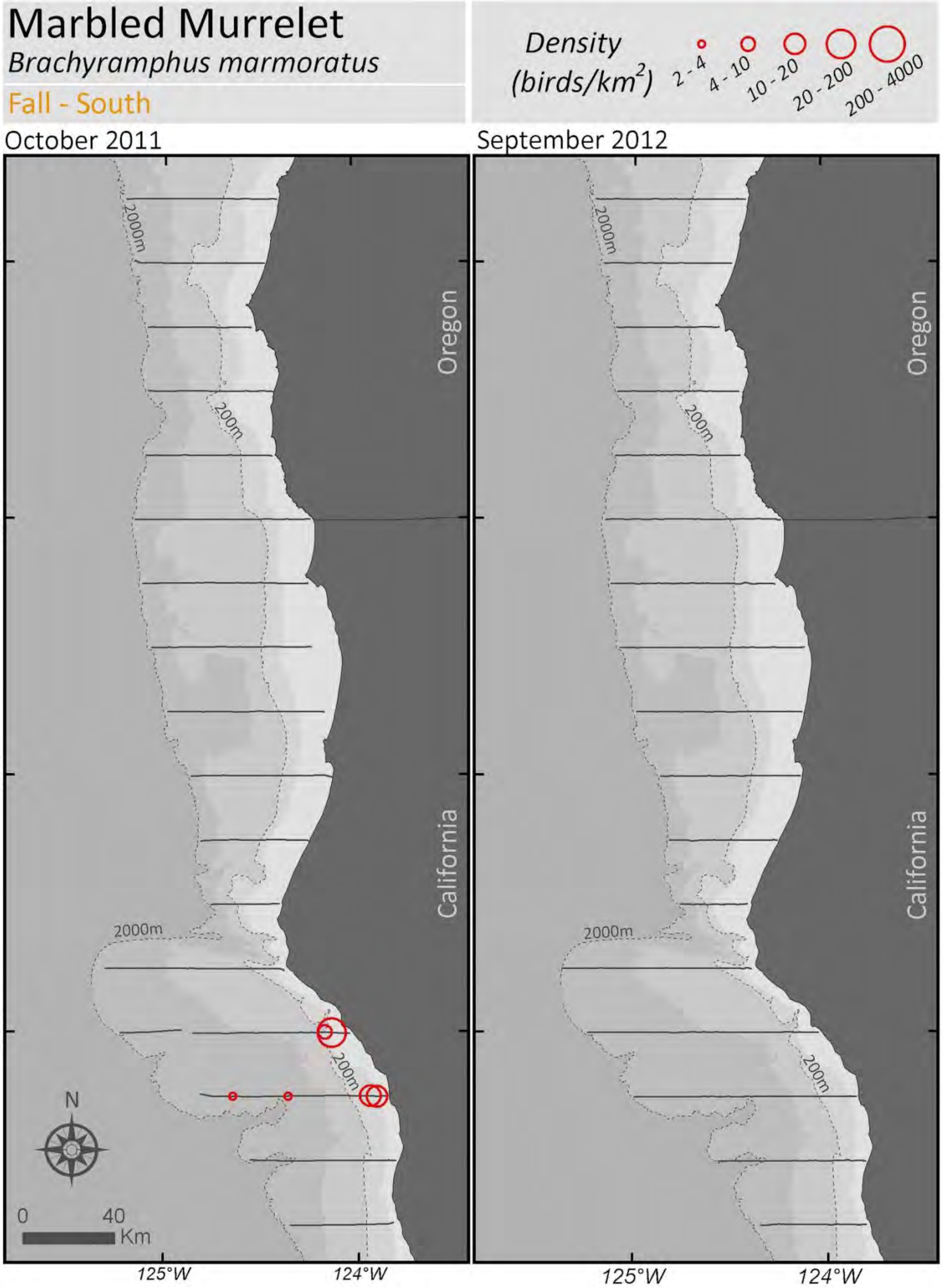


Figure 102. Mean density (birds km^{-2}) of Marbled Murrelets (*Brachyramphus marmoratus*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Marbled Murrelet

Brachyramphus marmoratus

Fall - South



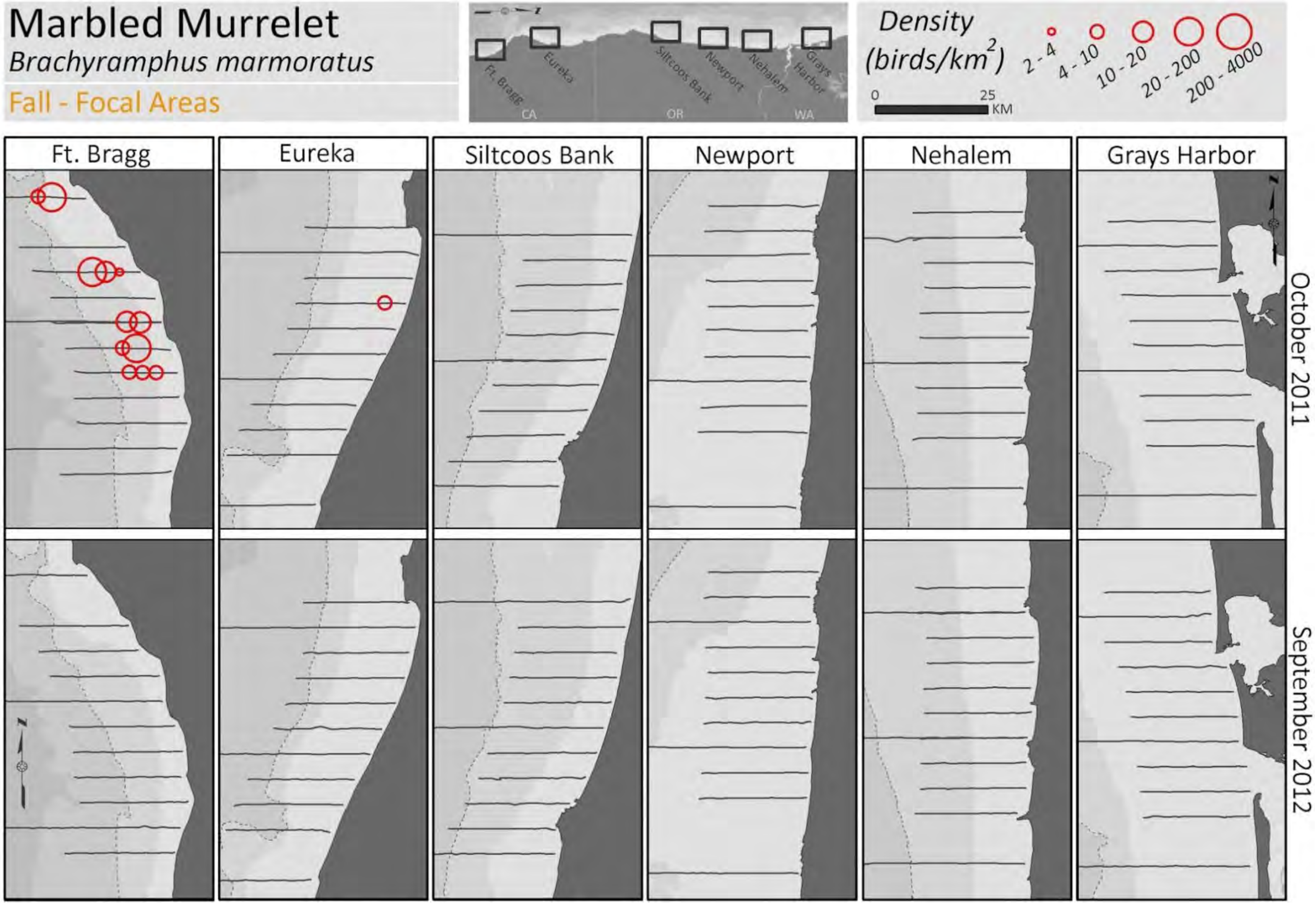


Figure 103. Mean density (birds km^{-2}) of Marbled Murrelets (*Brachyramphus marmoratus*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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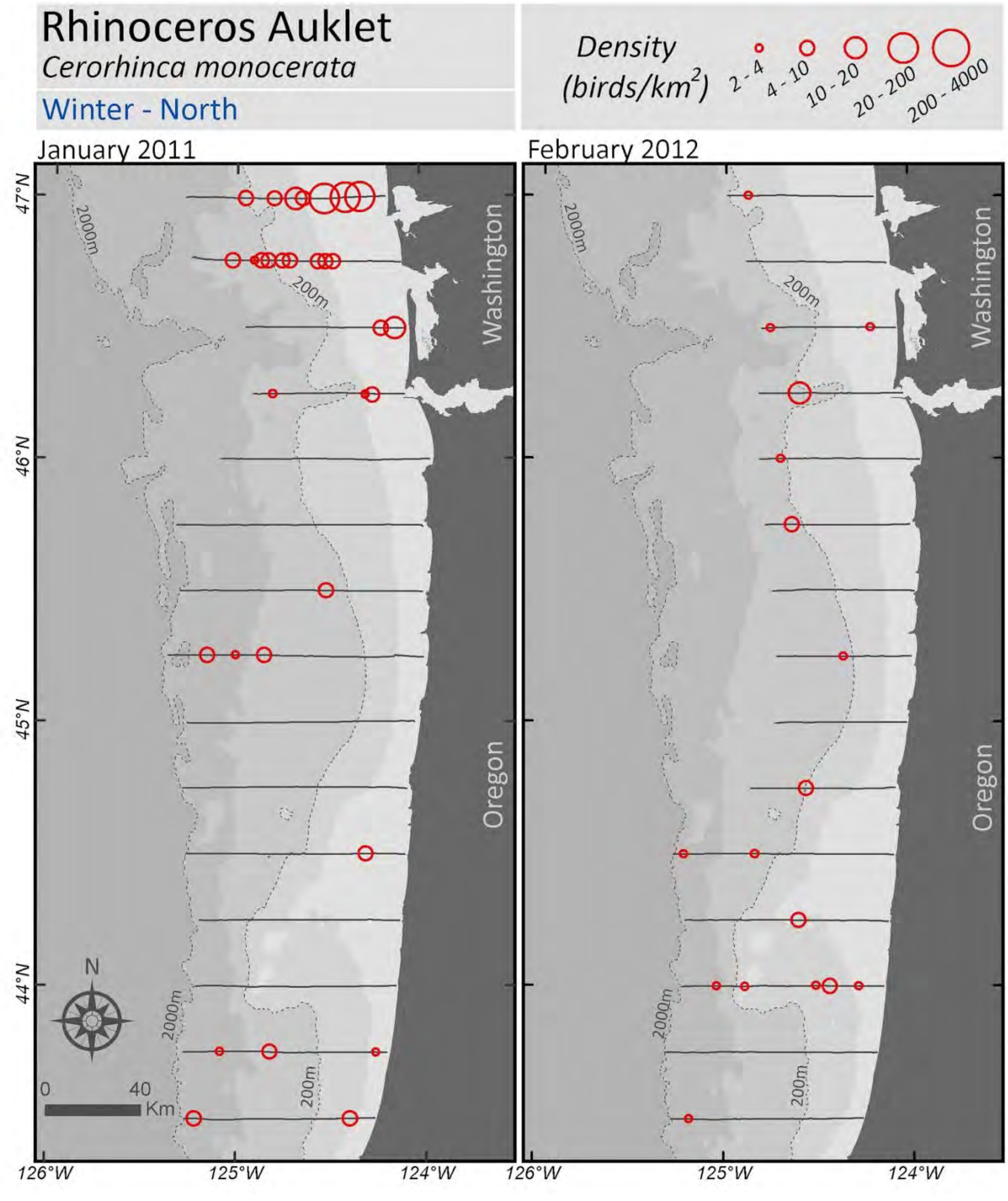
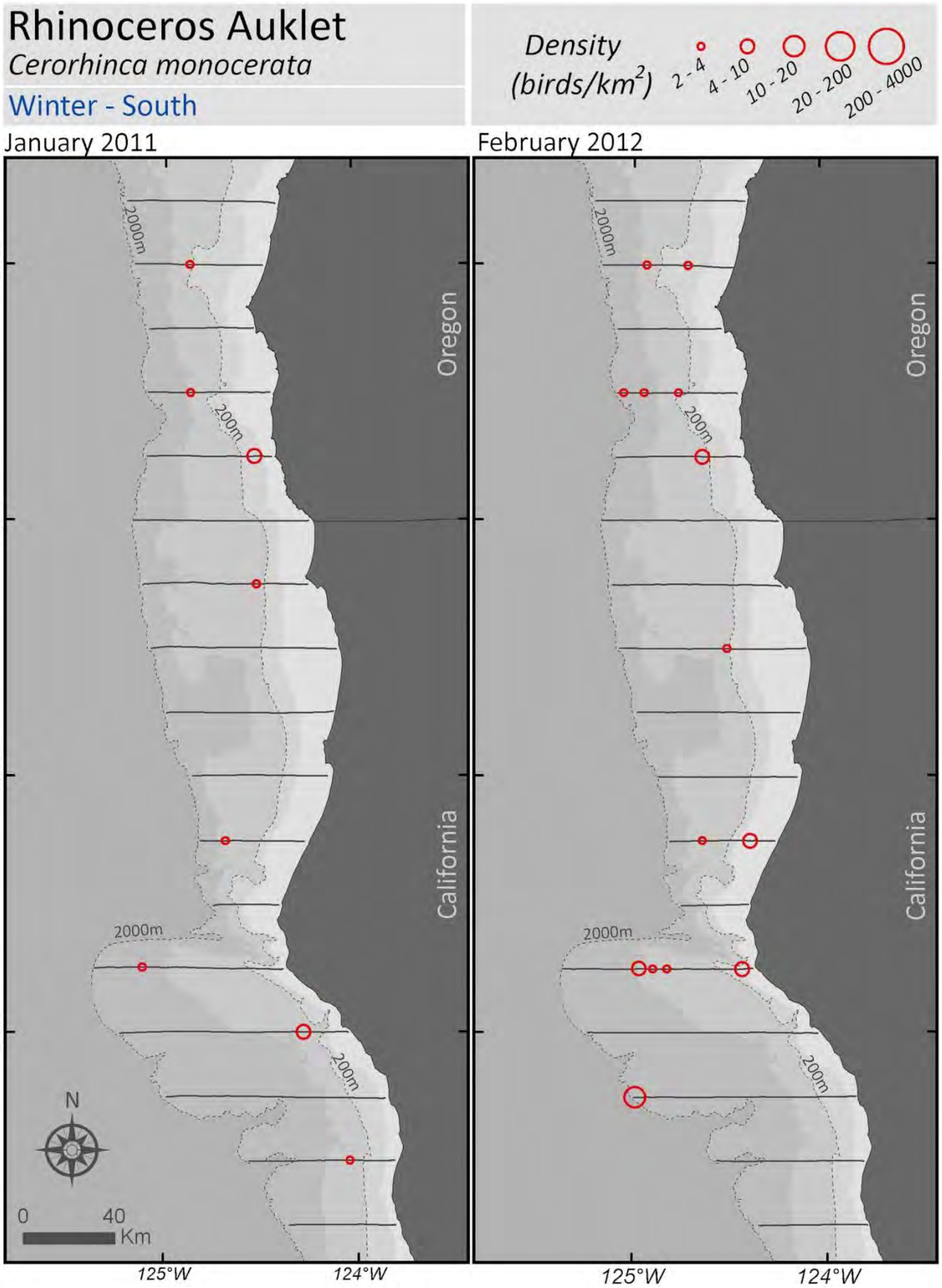


Figure 104. Mean density (birds km^{-2}) of Rhinoceros Auklets (*Cerorhinca monocerata*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Rhinoceros Auklet

Cerorhinca monocerata

Winter - South



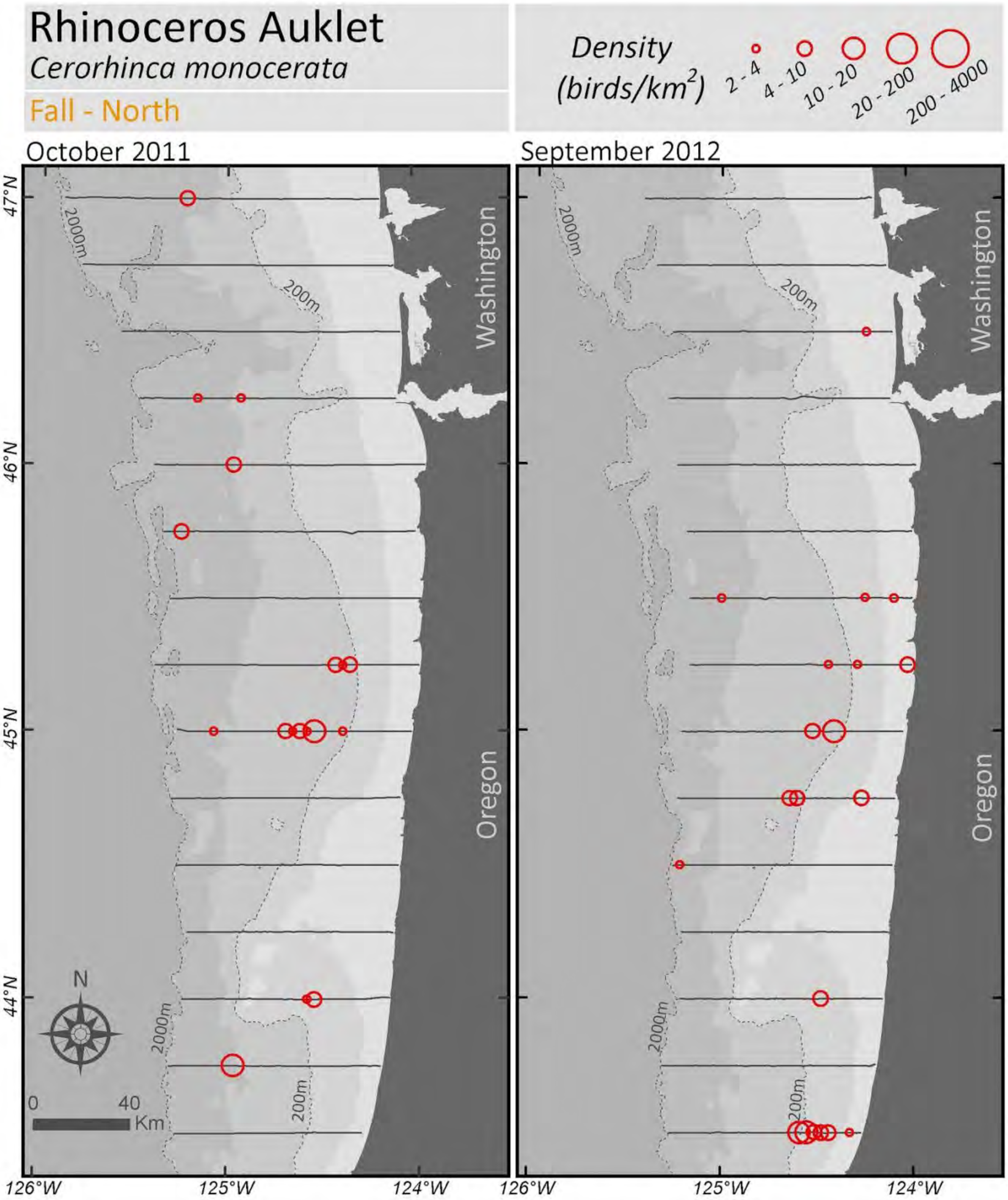
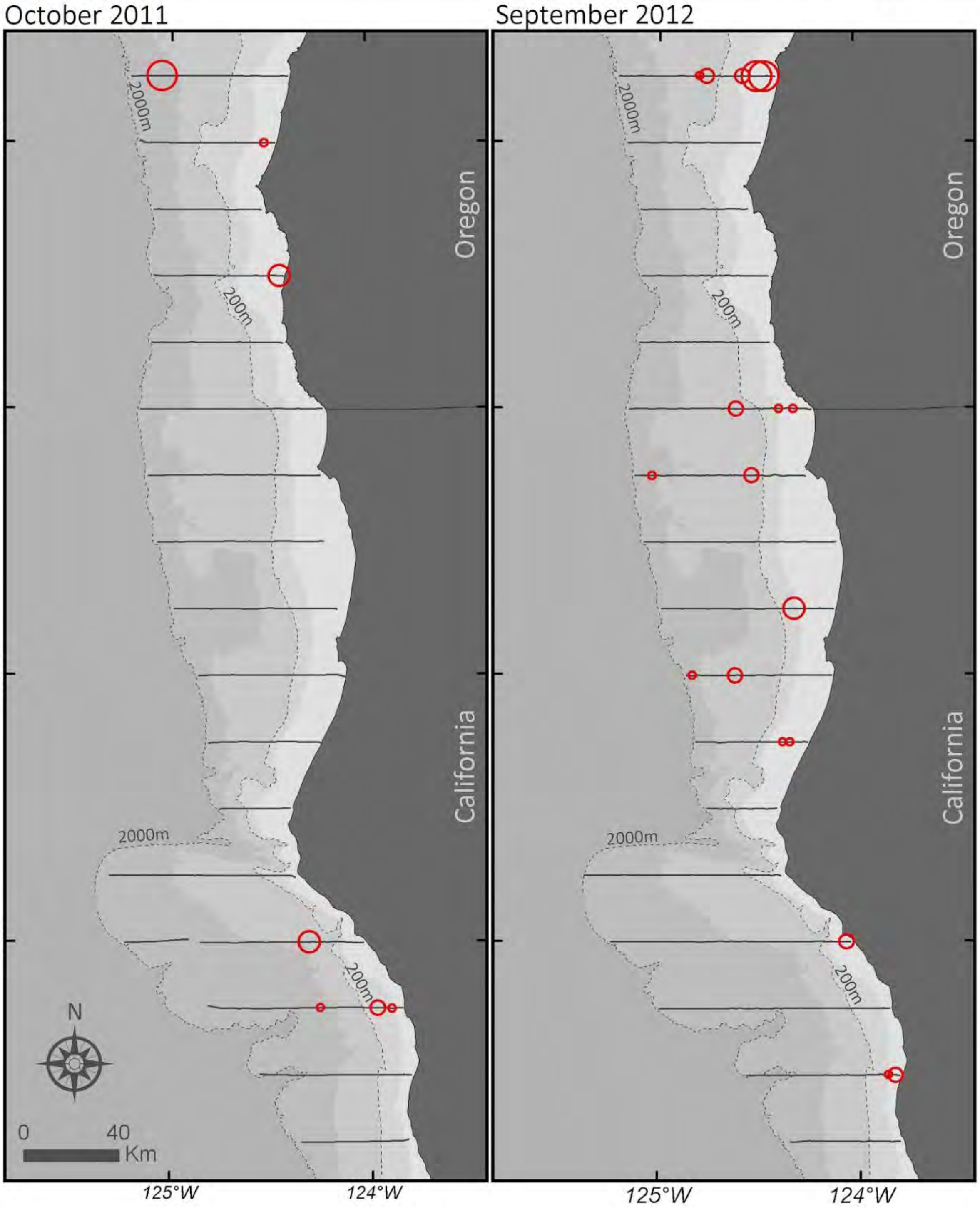


Figure 105. Mean density (birds km^{-2}) of Rhinoceros Auklets (*Cerorhinca monocerata*) in fall on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.

Rhinoceros Auklet

Cerorhinca monocerata

Fall - South



October 2011

September 2012

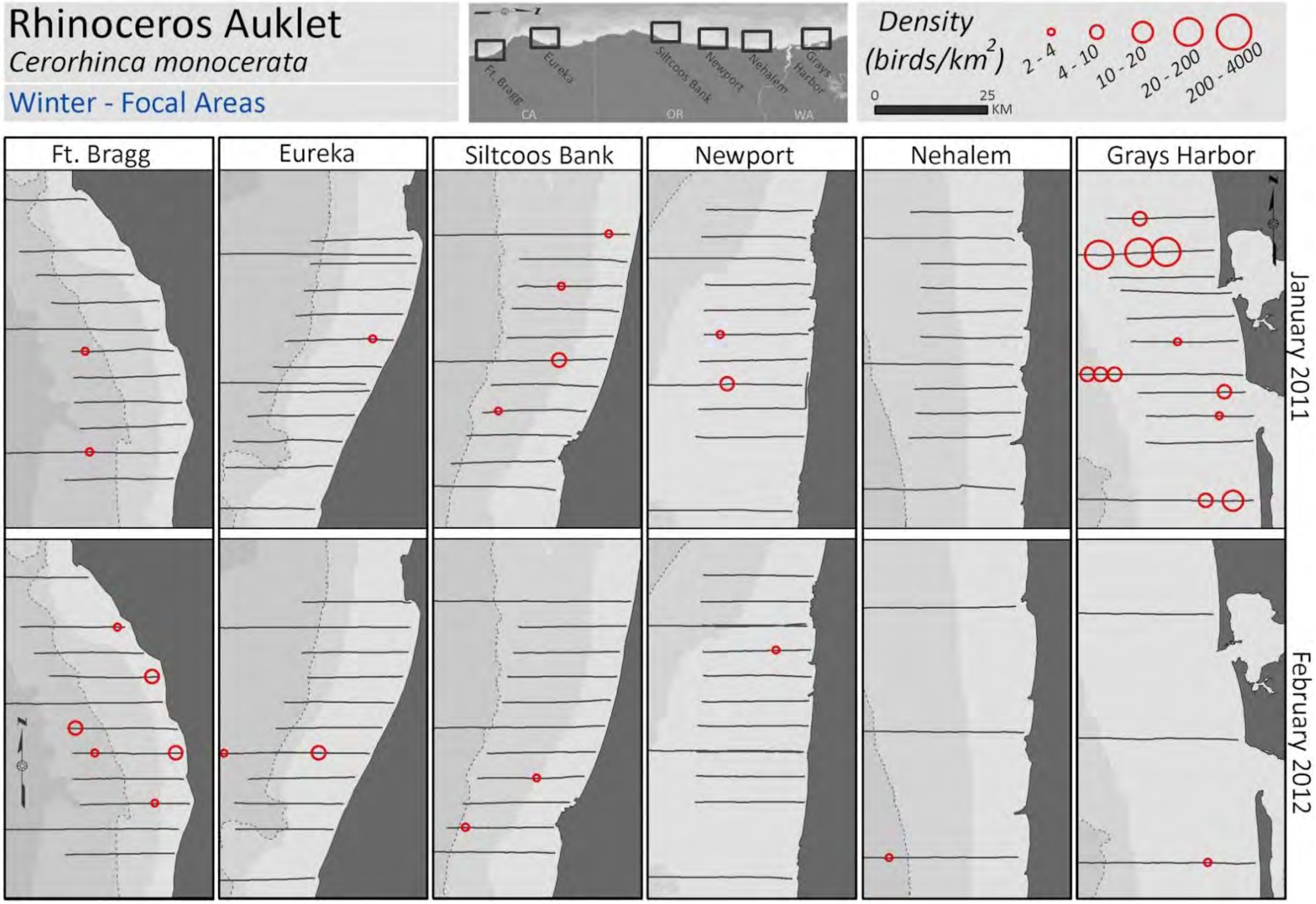


Figure 106. Mean density (birds km^{-2}) of Rhinoceros Auklets (*Cerorhinca monocerata*) in winter on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

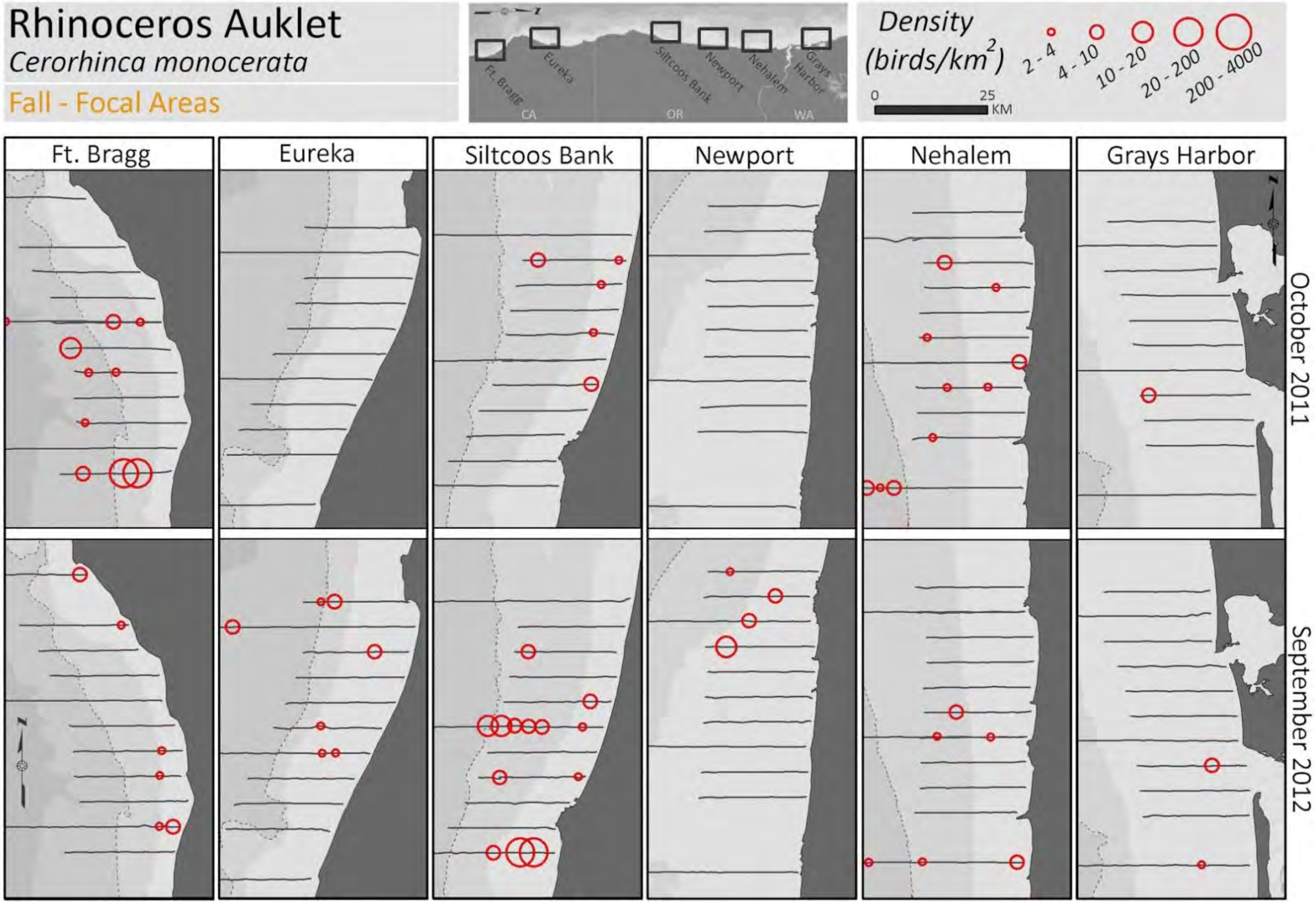


Figure 107. Mean density (birds km^{-2}) of Rhinoceros Auklets (*Cerorhinca monocerata*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

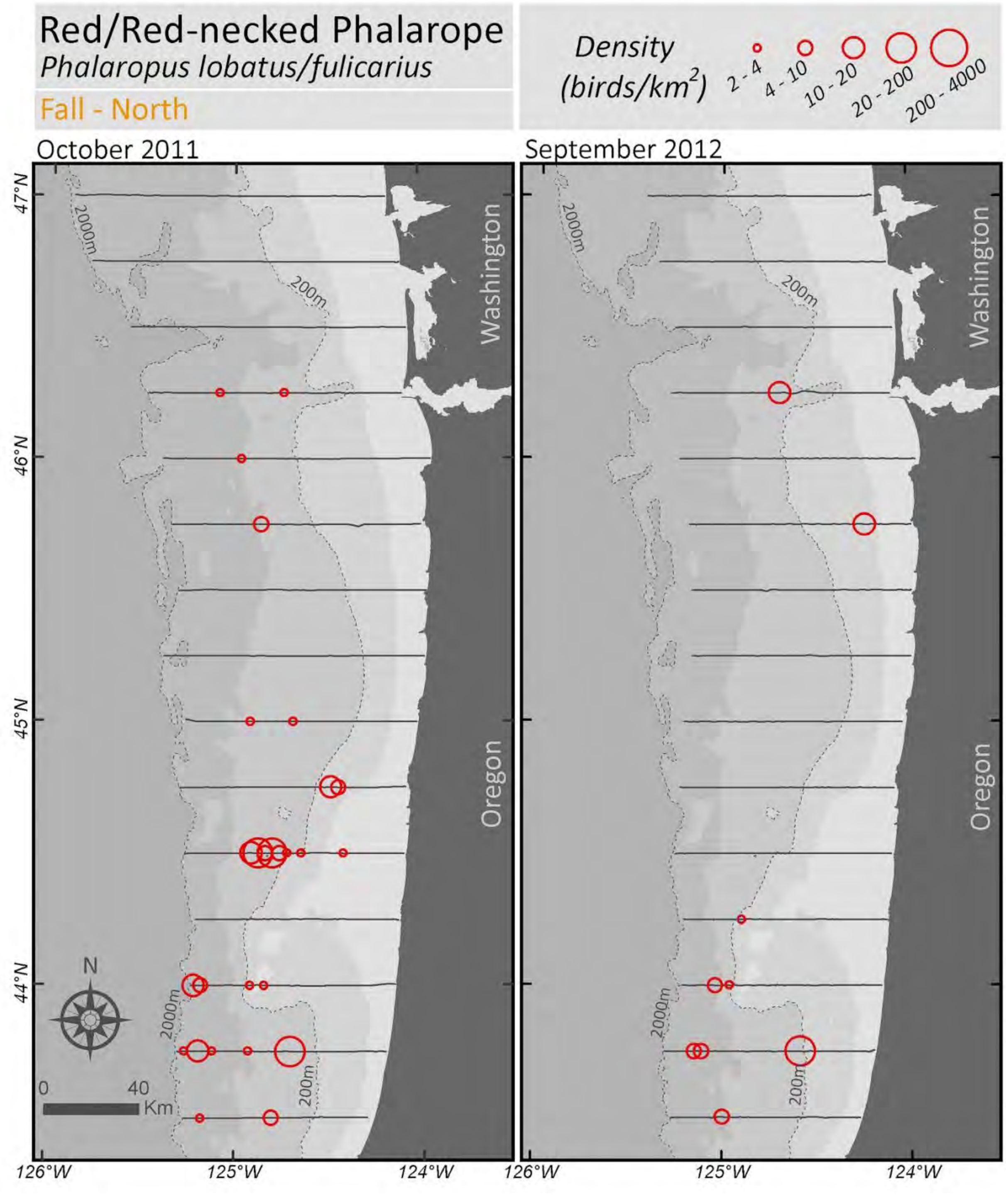
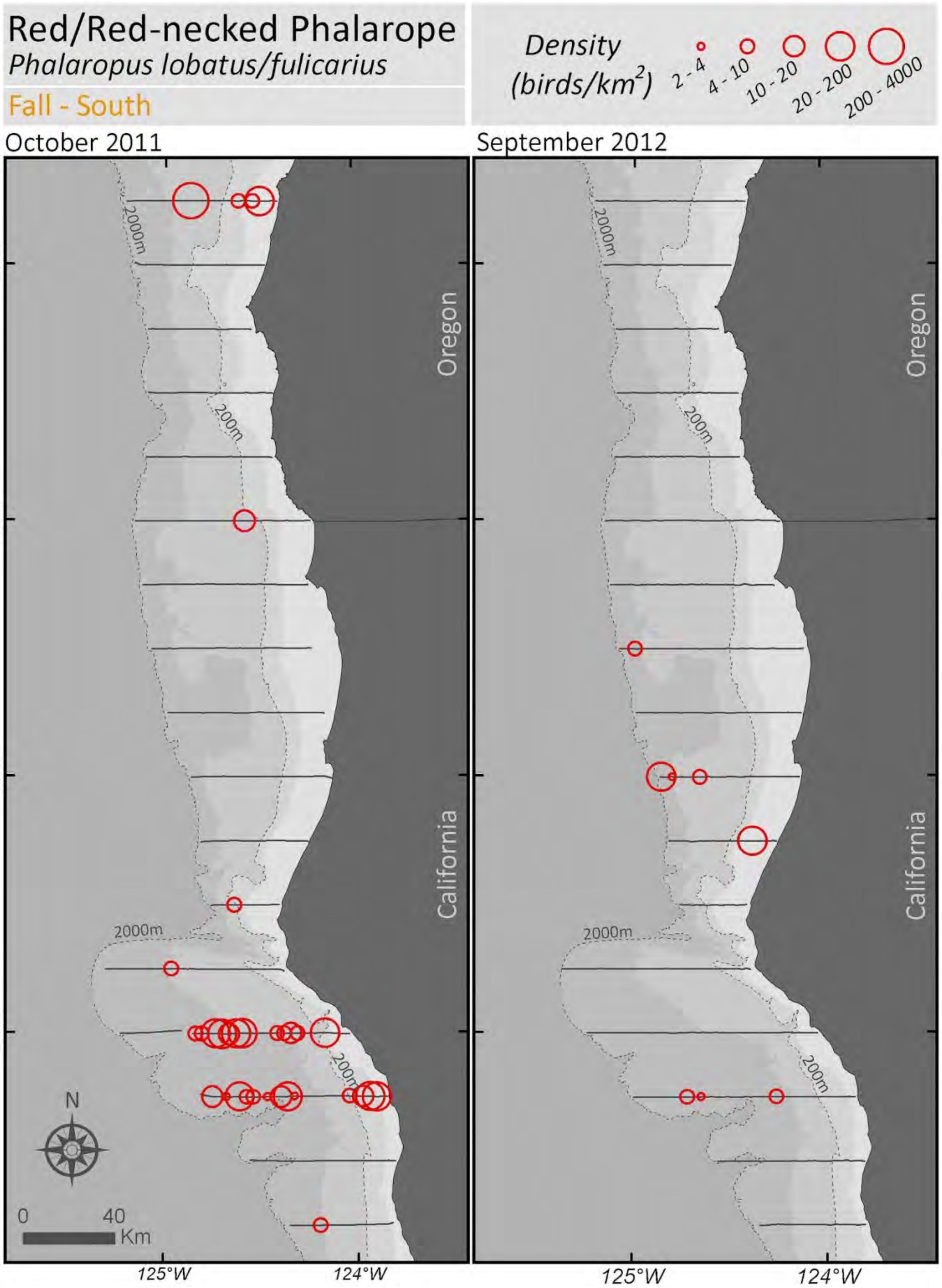


Figure 108. Mean density (birds km^{-2}) of Red/Red-necked Phalaropes (*Phalaropus lobatus/fulicarius*) in winter on broad-scale transects in northern (above) and southern (opposite page) study area. Densities are analyzed and mapped at a 3-km scale.


Red/Red-necked Phalarope
Phalaropus lobatus/fulicarius
Fall - South
Density (birds/km²)
2 - 4
4 - 10
10 - 20
20 - 200
200 - 4000
October 2011
September 2012
43°N
42°N
41°N
40°N
125°W
124°W
2000m
200m
Oregon
California
N
0
40
Km

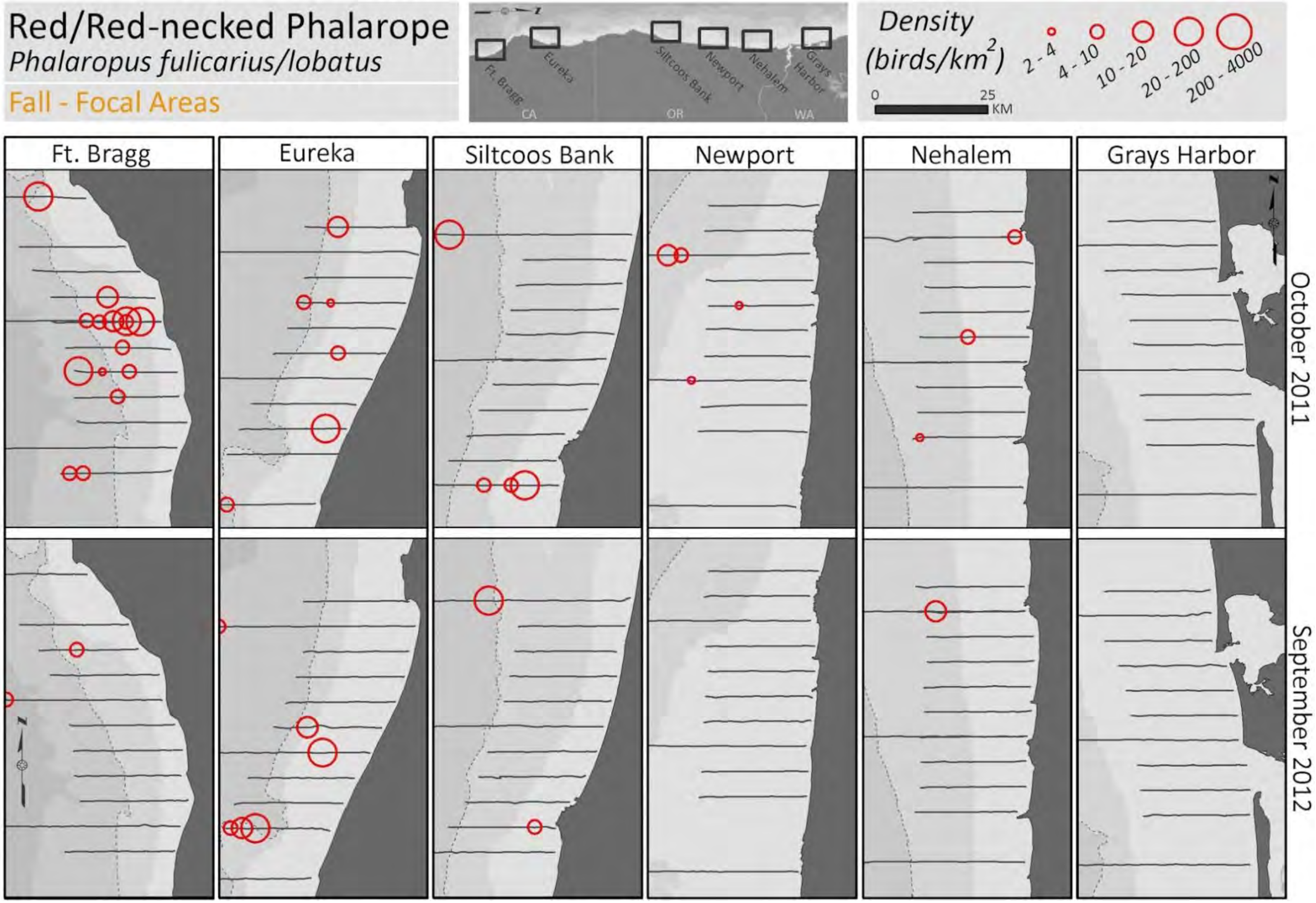


Figure 109. Mean density (birds km^{-2}) of Red/Red-necked Phalaropes (*Phalaropus lobatus/fulicarius*) in fall on Focal Area transects. Densities are analyzed and mapped at a 3-km scale.

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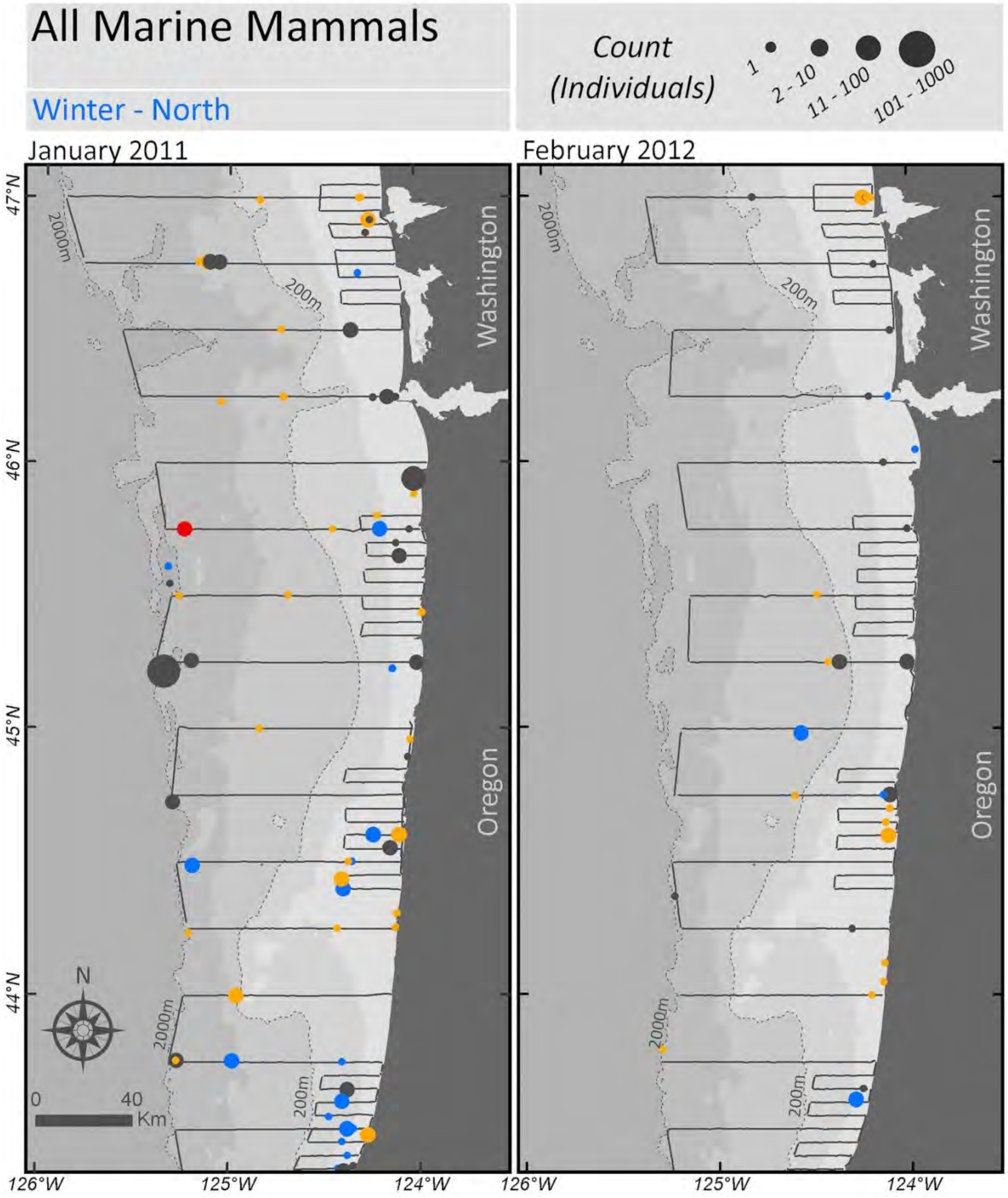
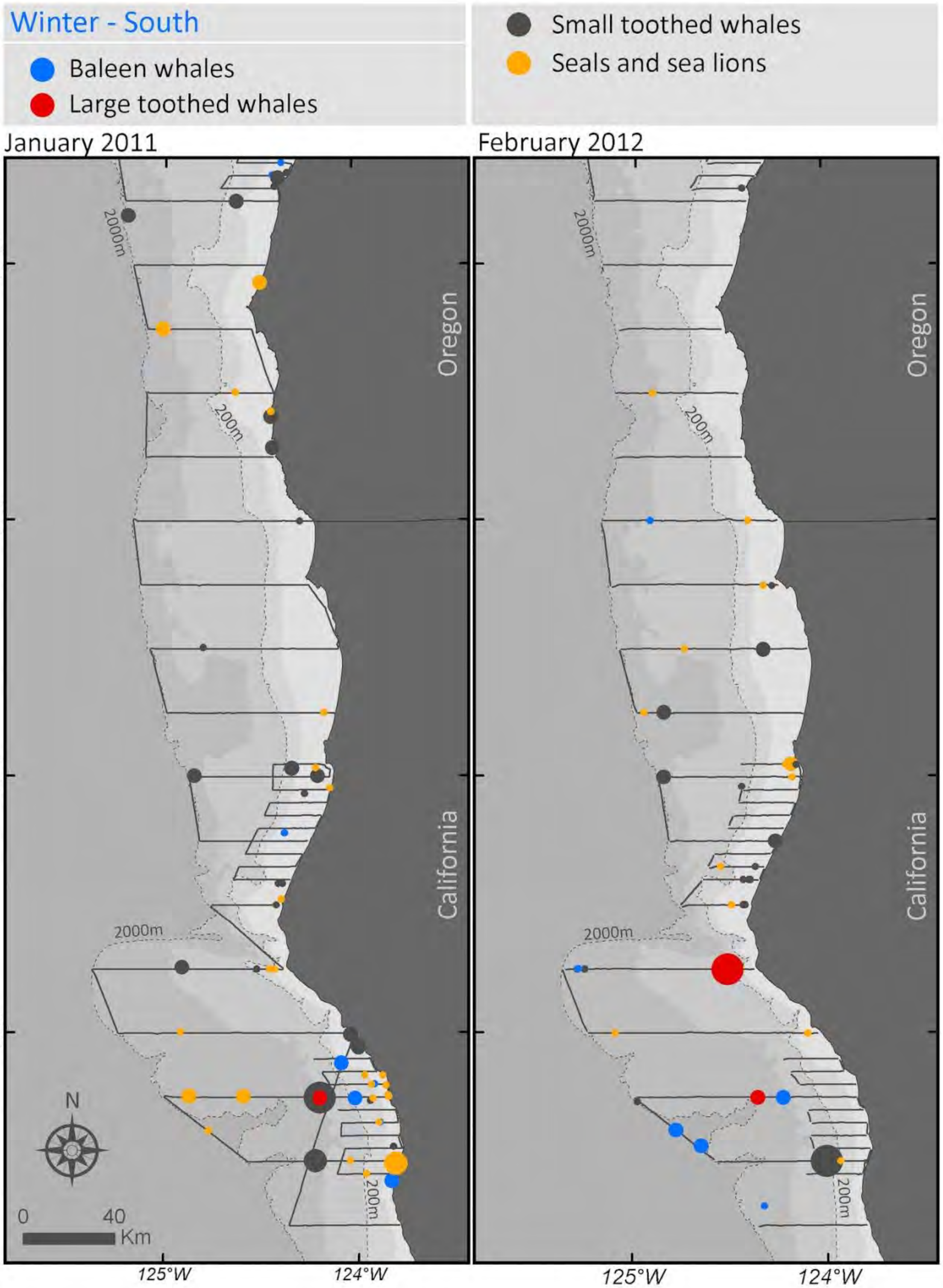


Figure 110. Counts of all marine mammal sightings in winter on all transects in northern (above) and southern (opposite page) study area.


Winter - South
● Baleen whales
● Large toothed whales
● Small toothed whales
● Seals and sea lions
January 2011
February 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

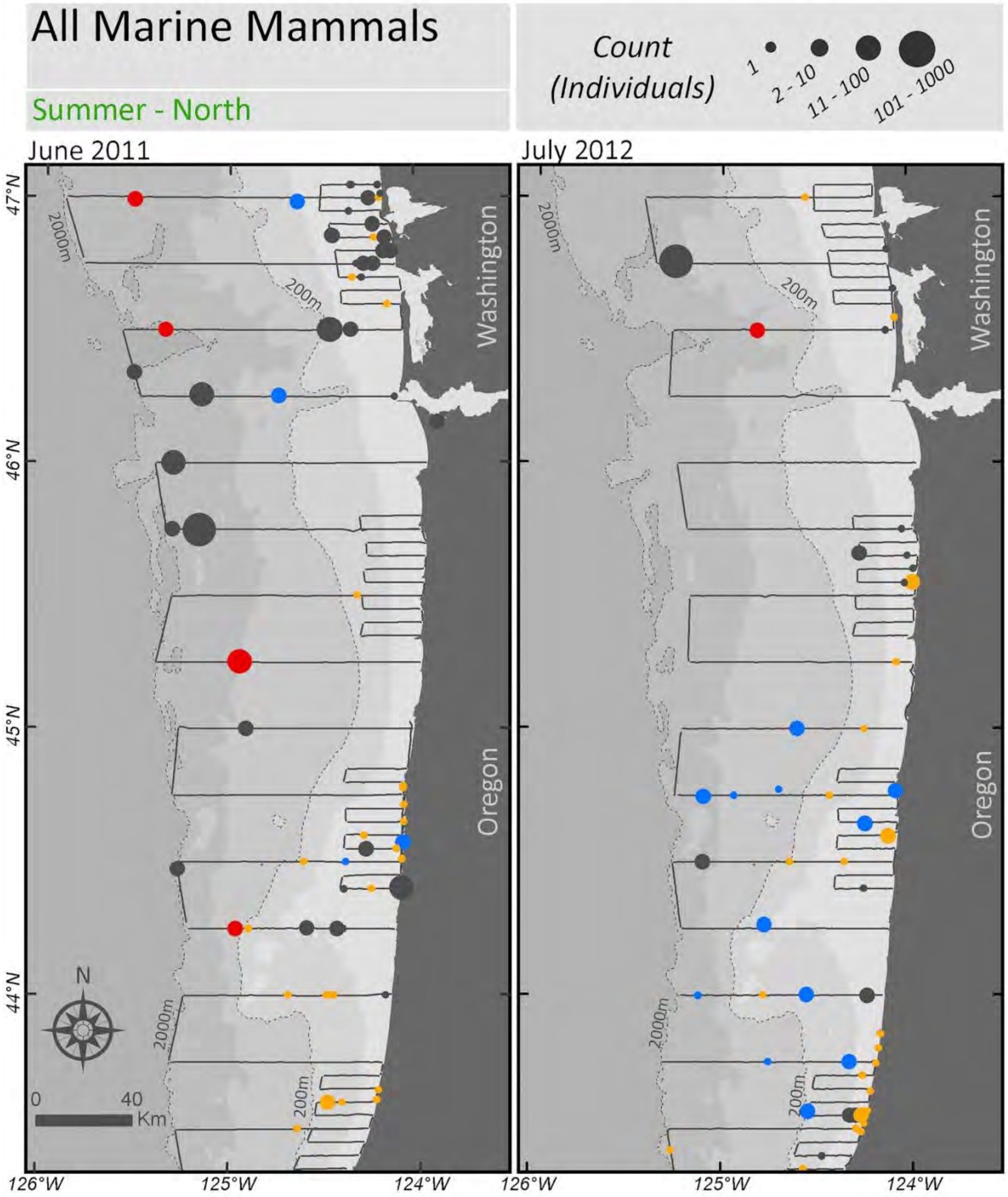
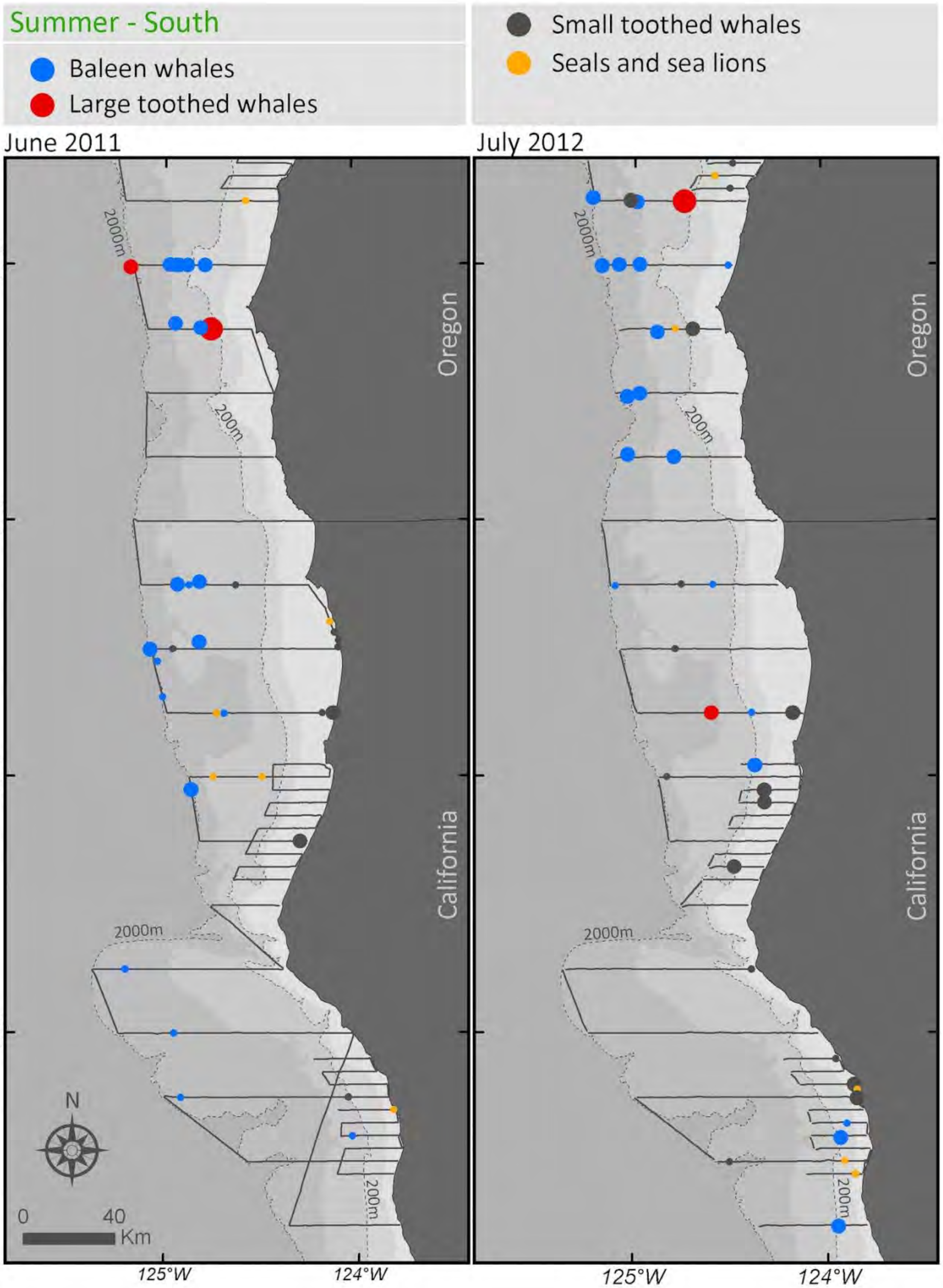


Figure 111. Counts of all marine mammal sightings in summer on all transects in northern (above) and southern (opposite page) study area.


Summer - South
Baleen whales
Large toothed whales
Small toothed whales
Seals and sea lions
June 2011
July 2012
43°N
42°N
41°N
40°N
2000m
200m
Oregon
California
N
0
40
Km
125°W
124°W

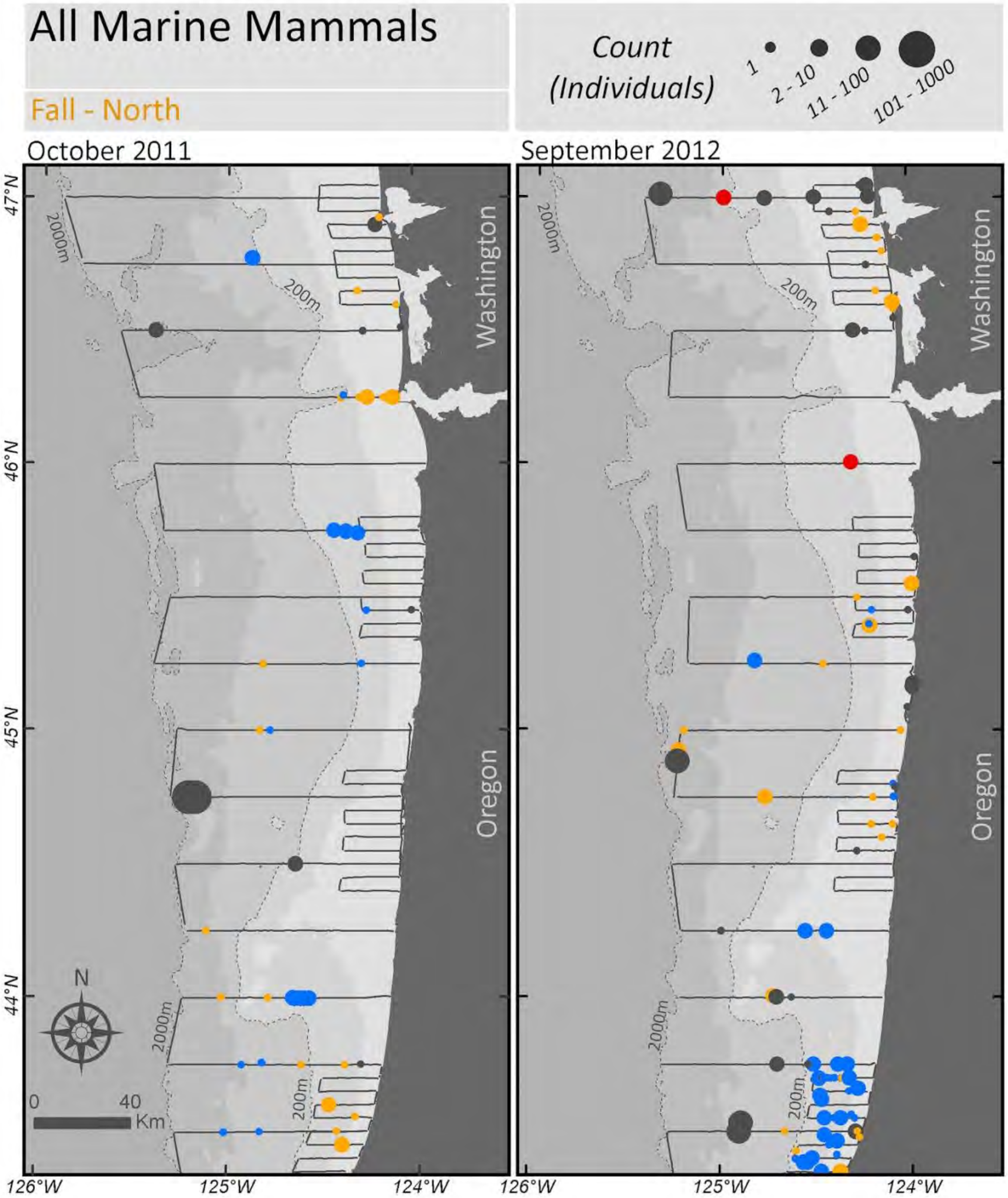
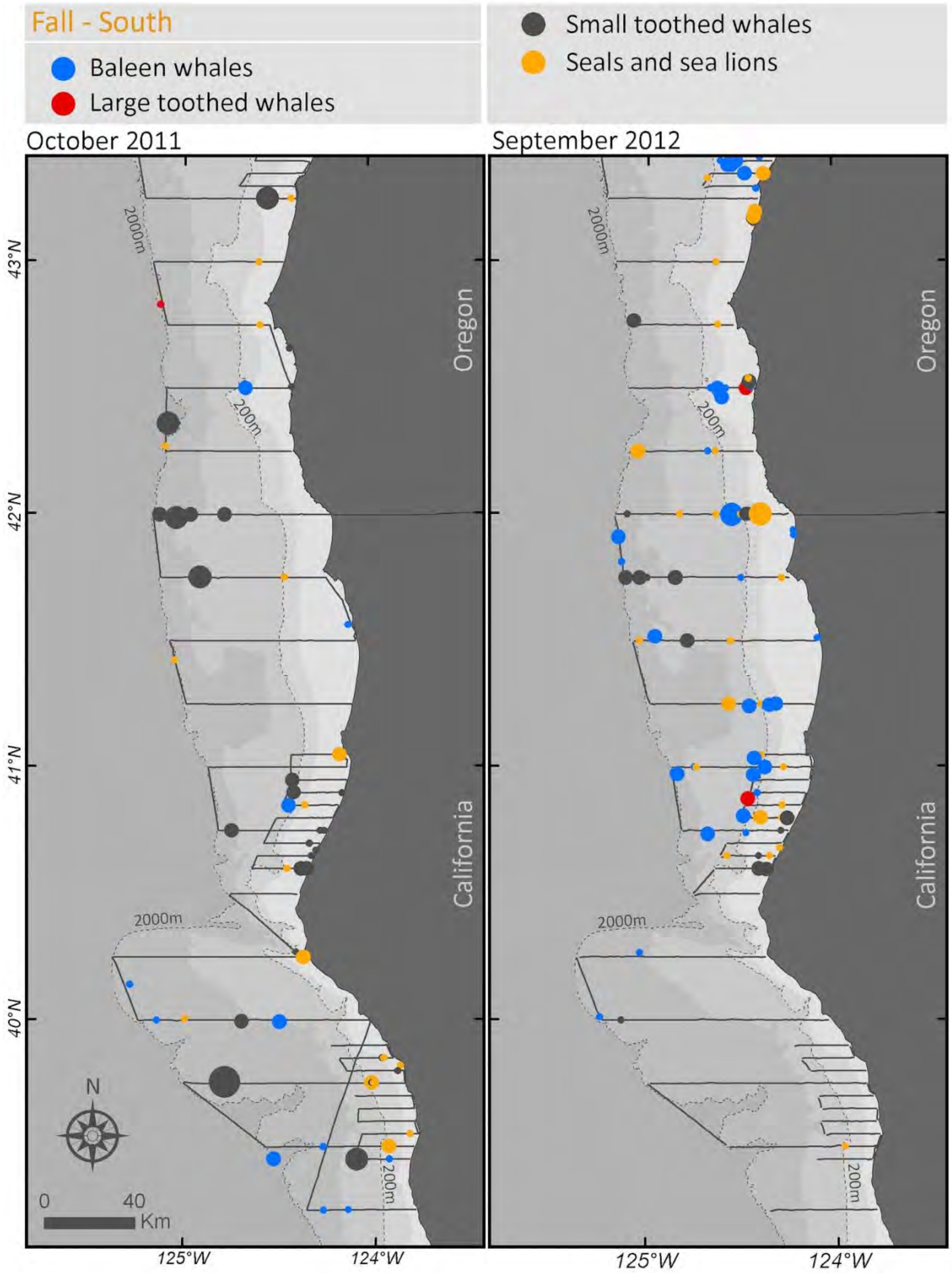


Figure 112. Counts of all marine mammal sightings in fall on all transects in northern (above) and southern (opposite page) study area.

Fall - South
Baleen whales
Large toothed whales
Small toothed whales
Seals and sea lions
October 2011
September 2012
2000m
200m
43°N
42°N
41°N
40°N
Oregon
California
N
0
40
Km
125°W
124°W

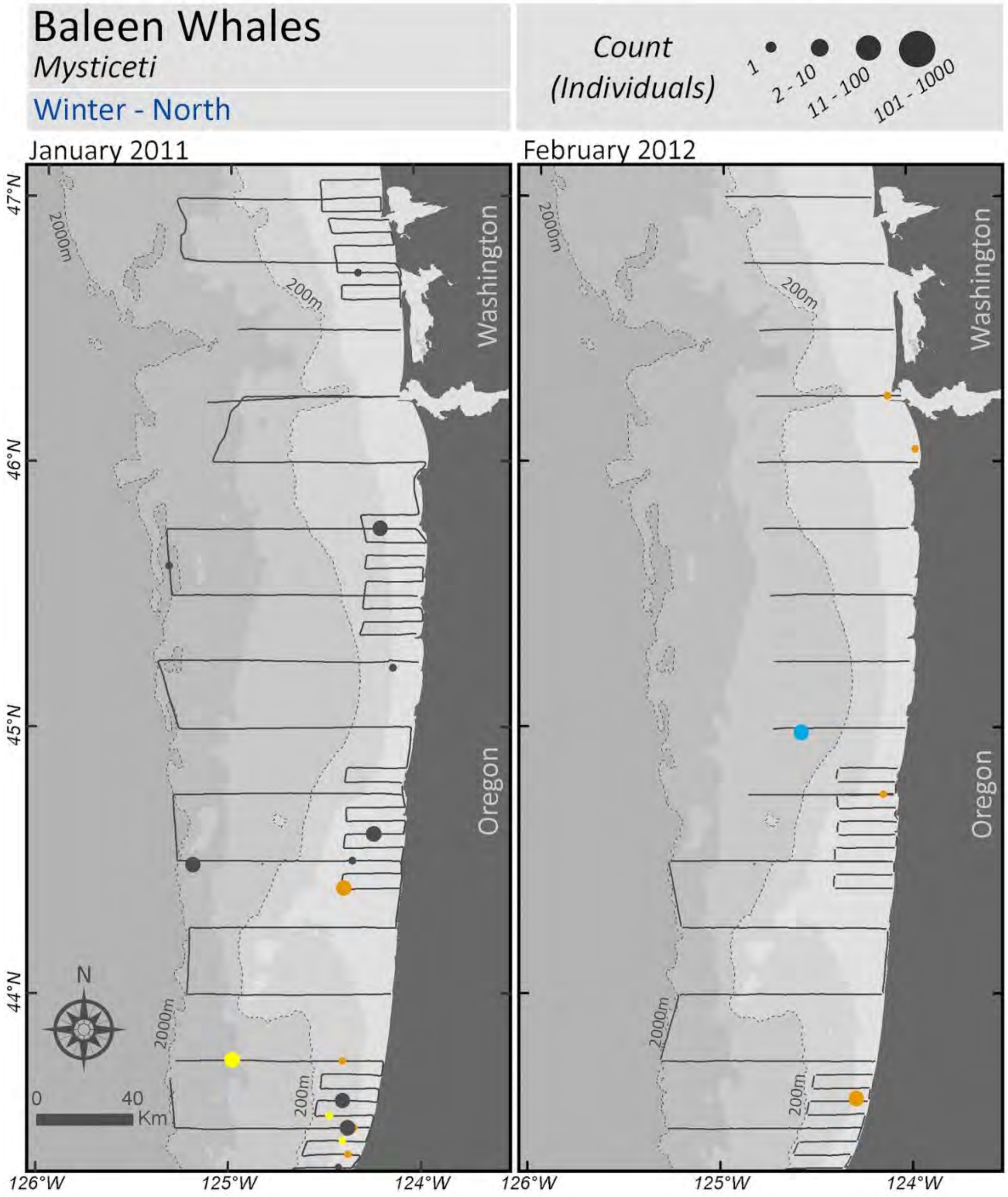
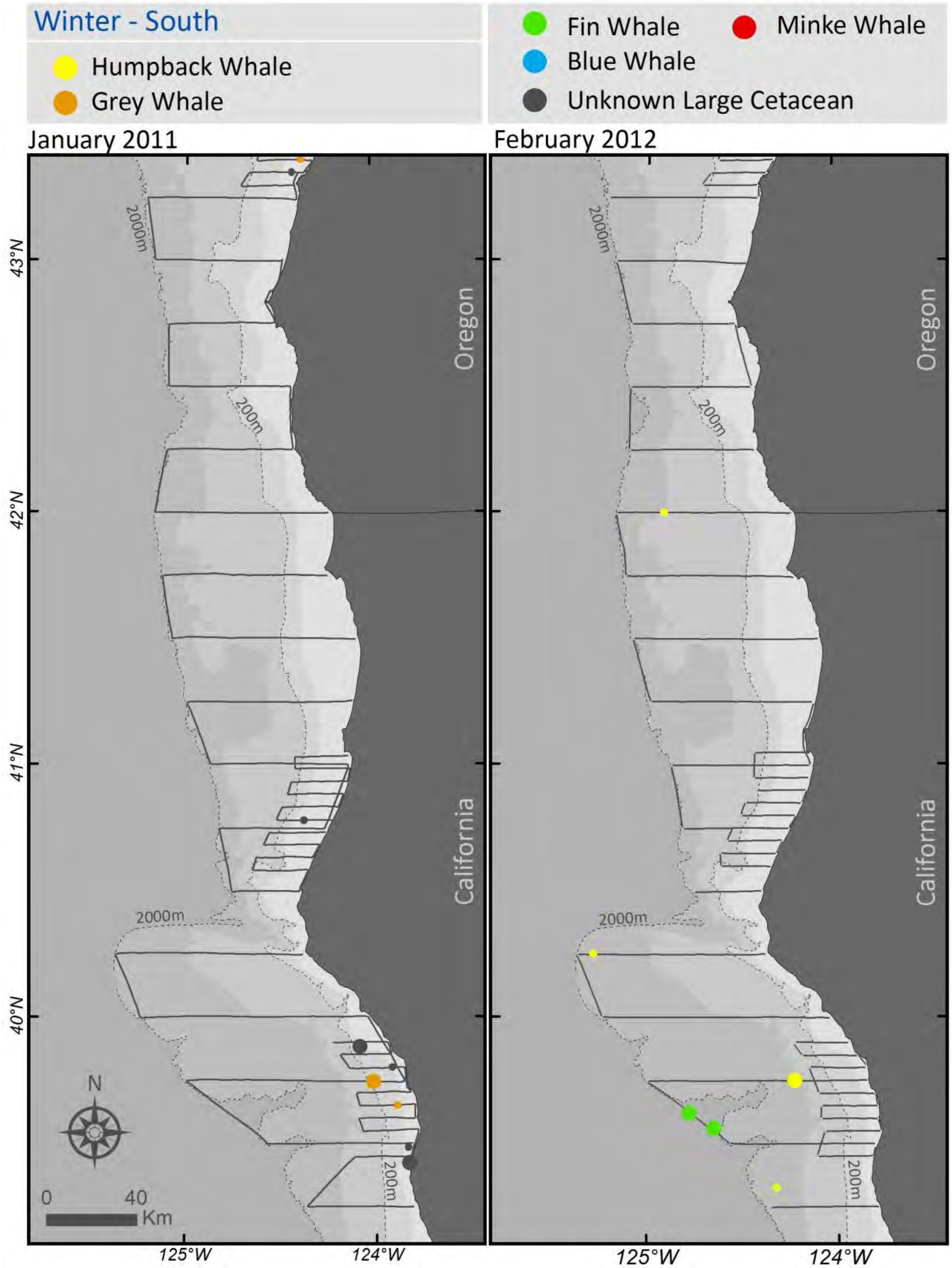


Figure 113. Counts of all baleen whale sightings in winter on all transects in northern (above) and southern (opposite page) study area.


Winter - South
Humpback Whale
Grey Whale
Fin Whale
Blue Whale
Unknown Large Cetacean
Minke Whale
January 2011
February 2012
Oregon
California
2000m
200m
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

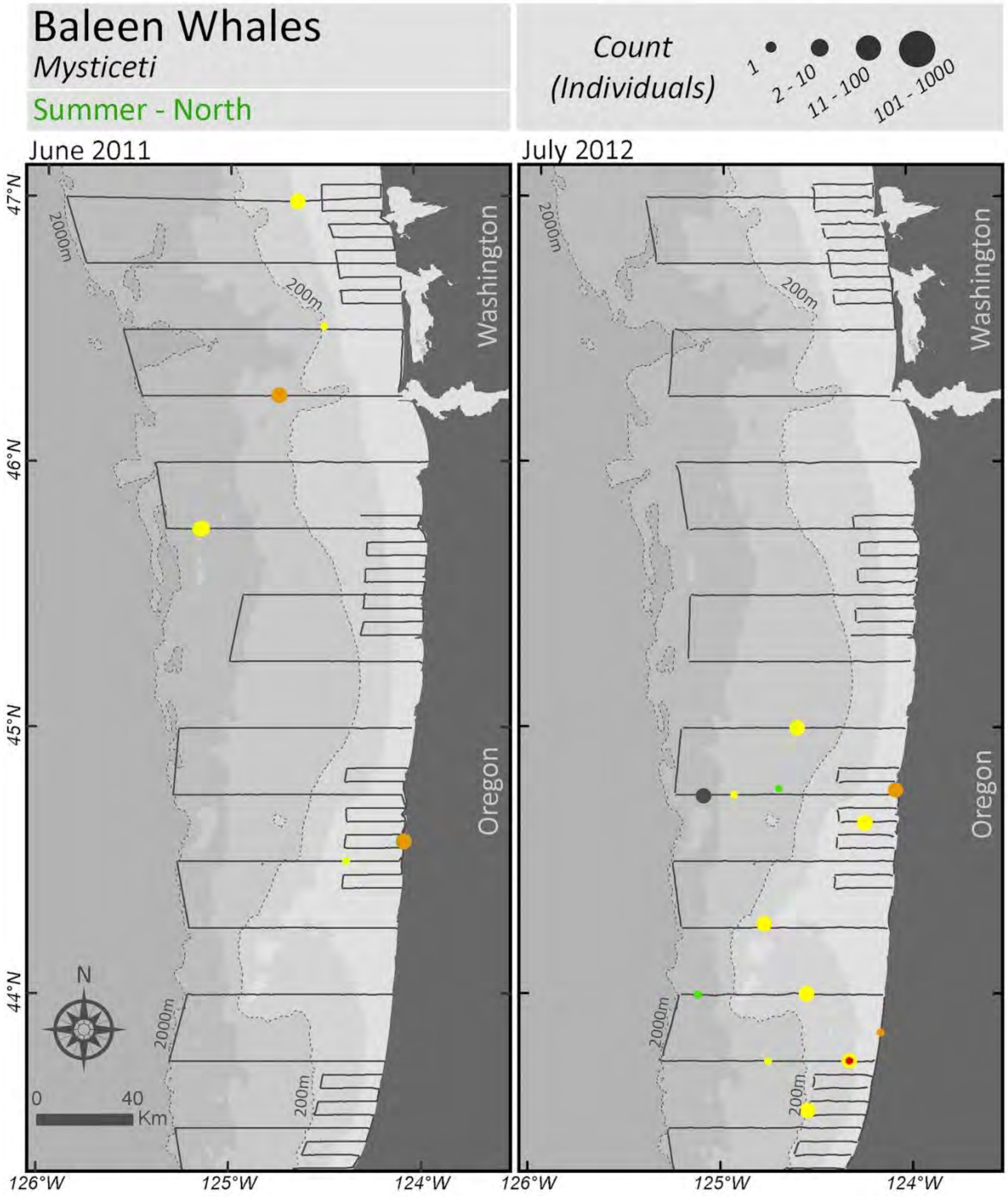
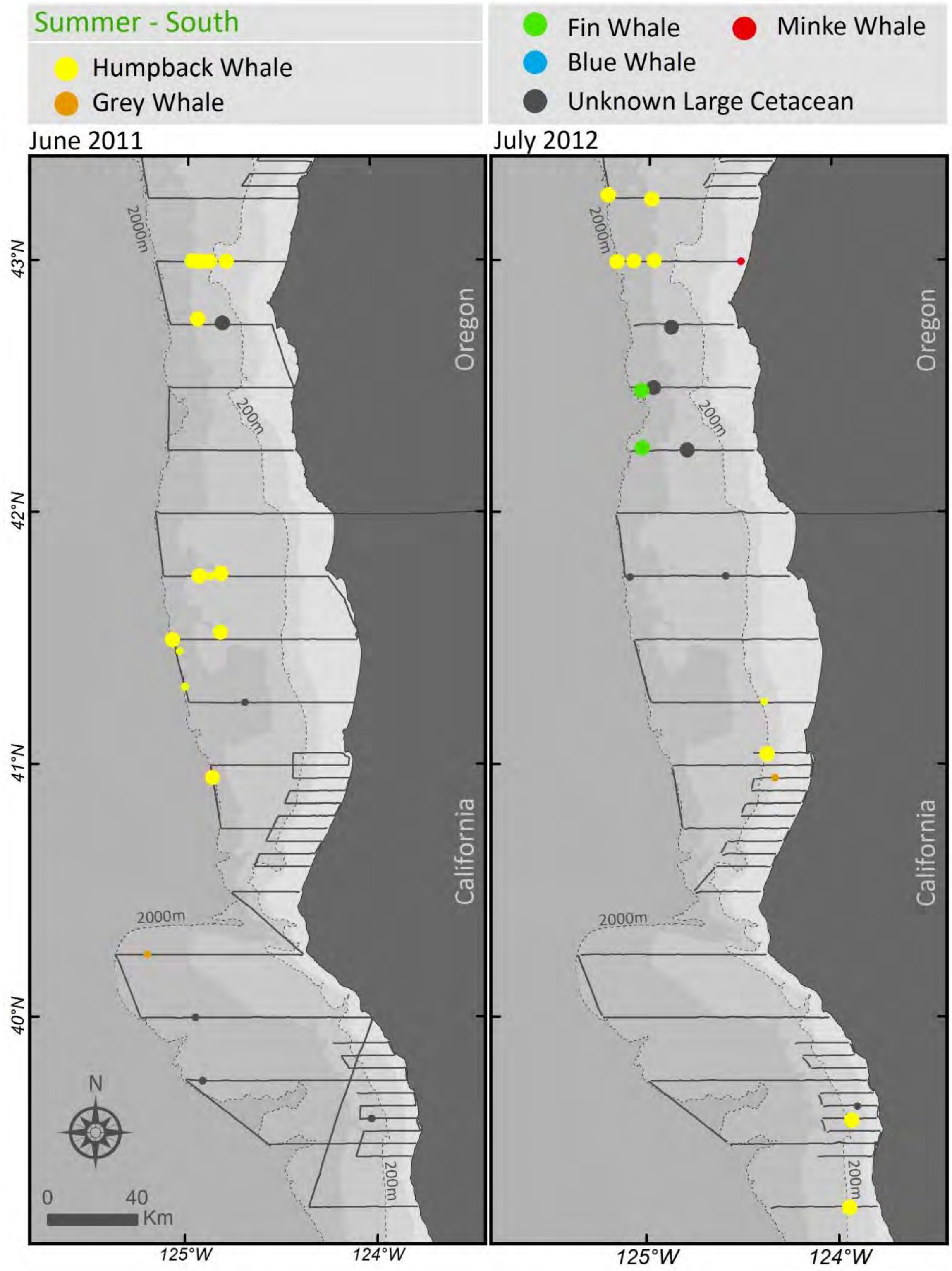


Figure 114. Counts of all baleen whale sightings in summer on all transects in northern (above) and southern (opposite page) study area.


Summer - South
Humpback Whale
Grey Whale
Fin Whale
Minke Whale
Blue Whale
Unknown Large Cetacean
June 2011
July 2012
43°N
42°N
41°N
40°N
125°W
124°W
2000m
200m
Oregon
California
N
0
40
Km

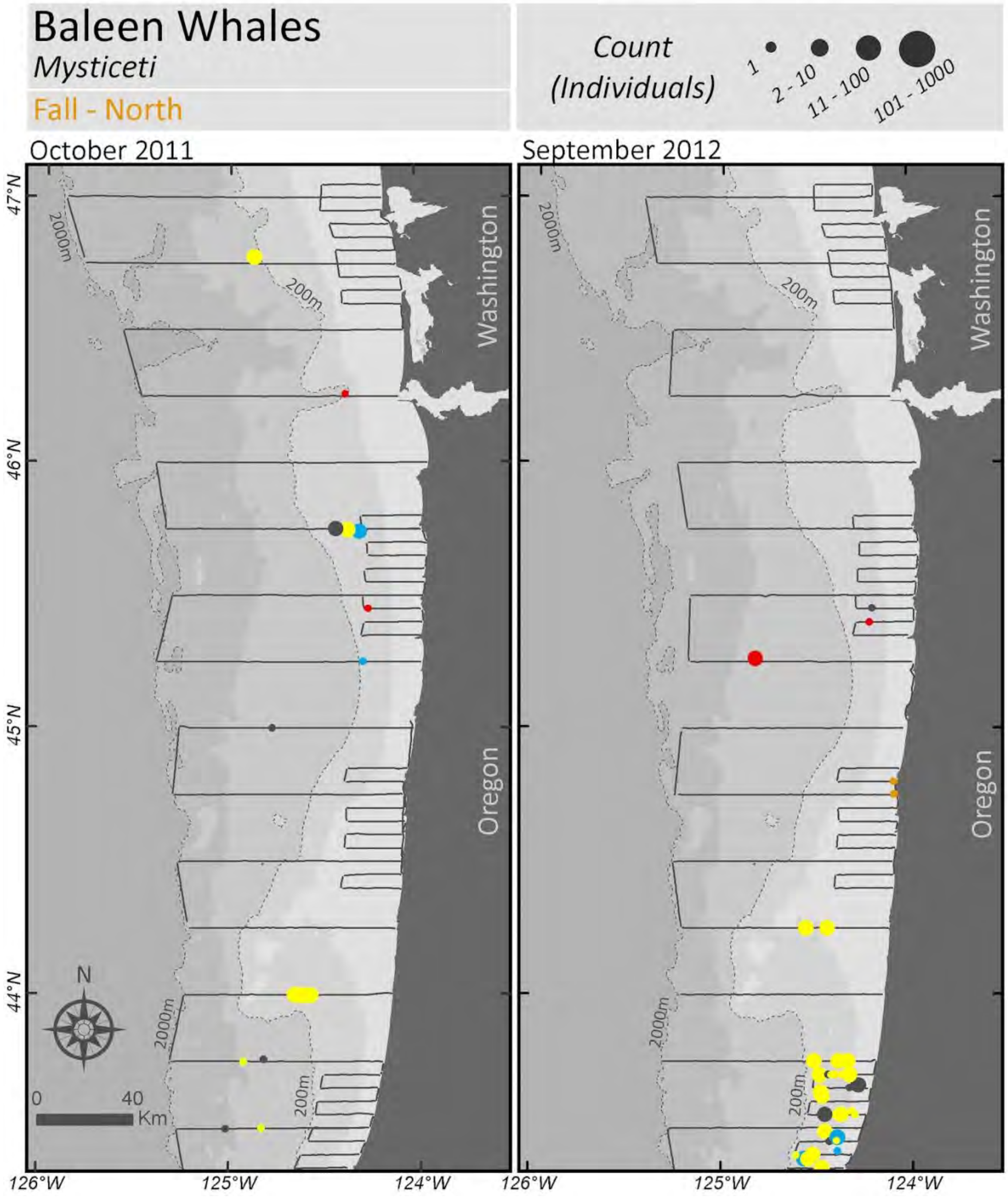
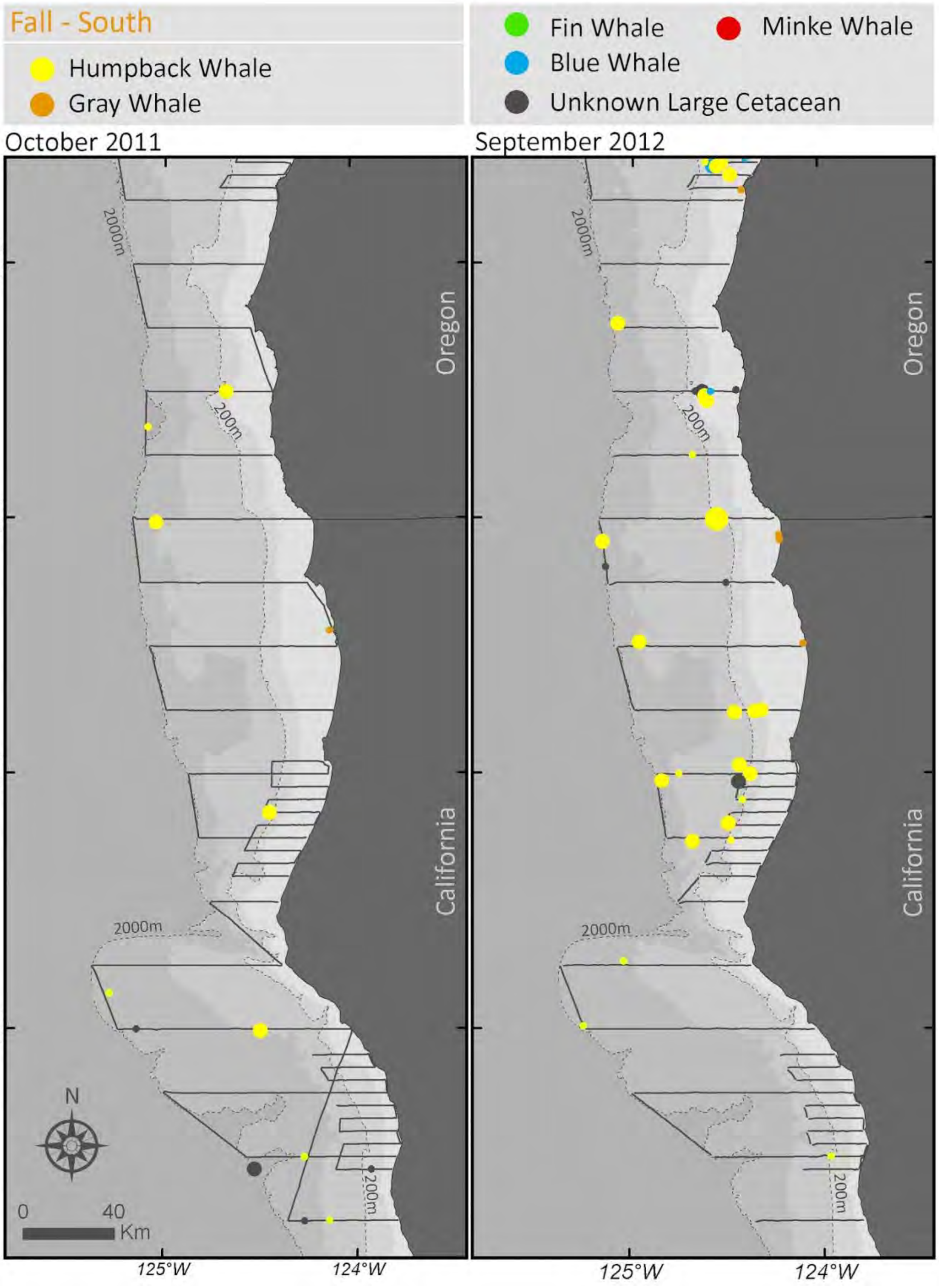


Figure 115. Counts of all baleen whale sightings in fall on all transects in northern (above) and southern (opposite page) study area.


Fall - South
Humpback Whale
Gray Whale
Fin Whale
Blue Whale
Unknown Large Cetacean
Minke Whale
October 2011
September 2012
Oregon
California
2000m
200m
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

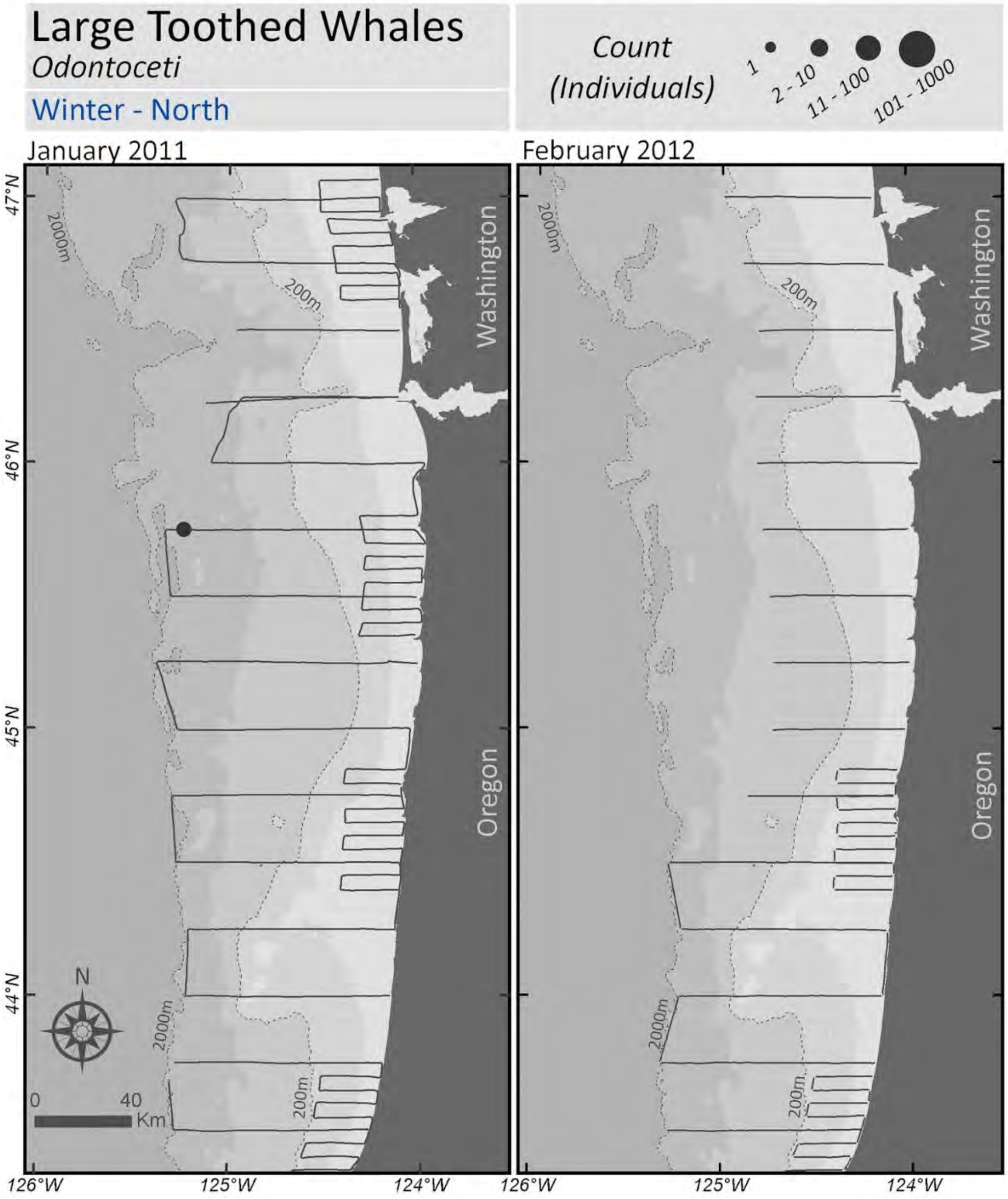
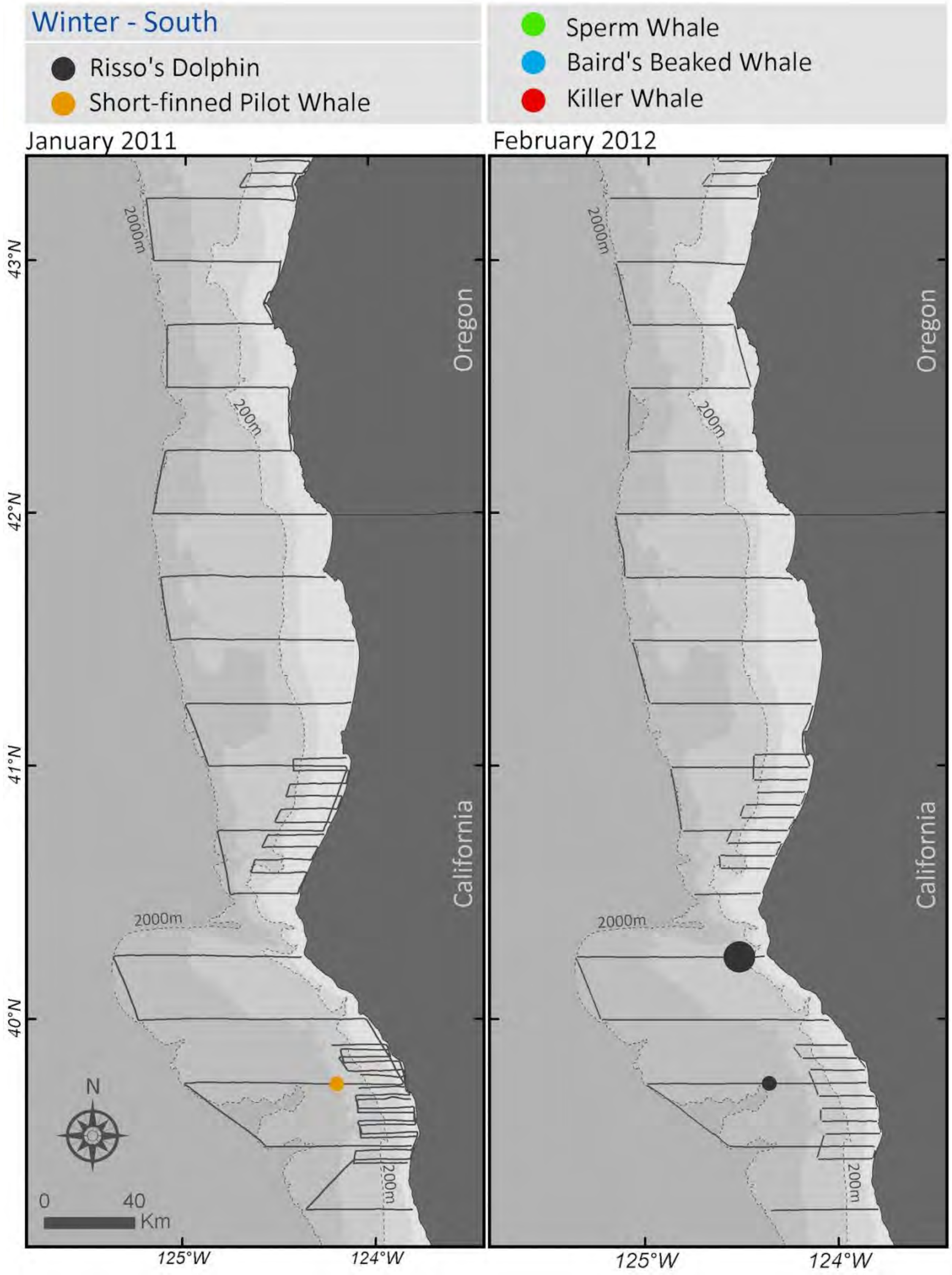


Figure 116. Counts of all large toothed-whale sightings in winter on all transects in northern (above) and southern (opposite page) study area.


Winter - South
● Risso's Dolphin
● Short-finned Pilot Whale
● Sperm Whale
● Baird's Beaked Whale
● Killer Whale
January 2011
February 2012
2000m
200m
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
N
0
40
Km
125°W
124°W
2000m
200m
2000m
200m
Oregon
California
125°W
124°W

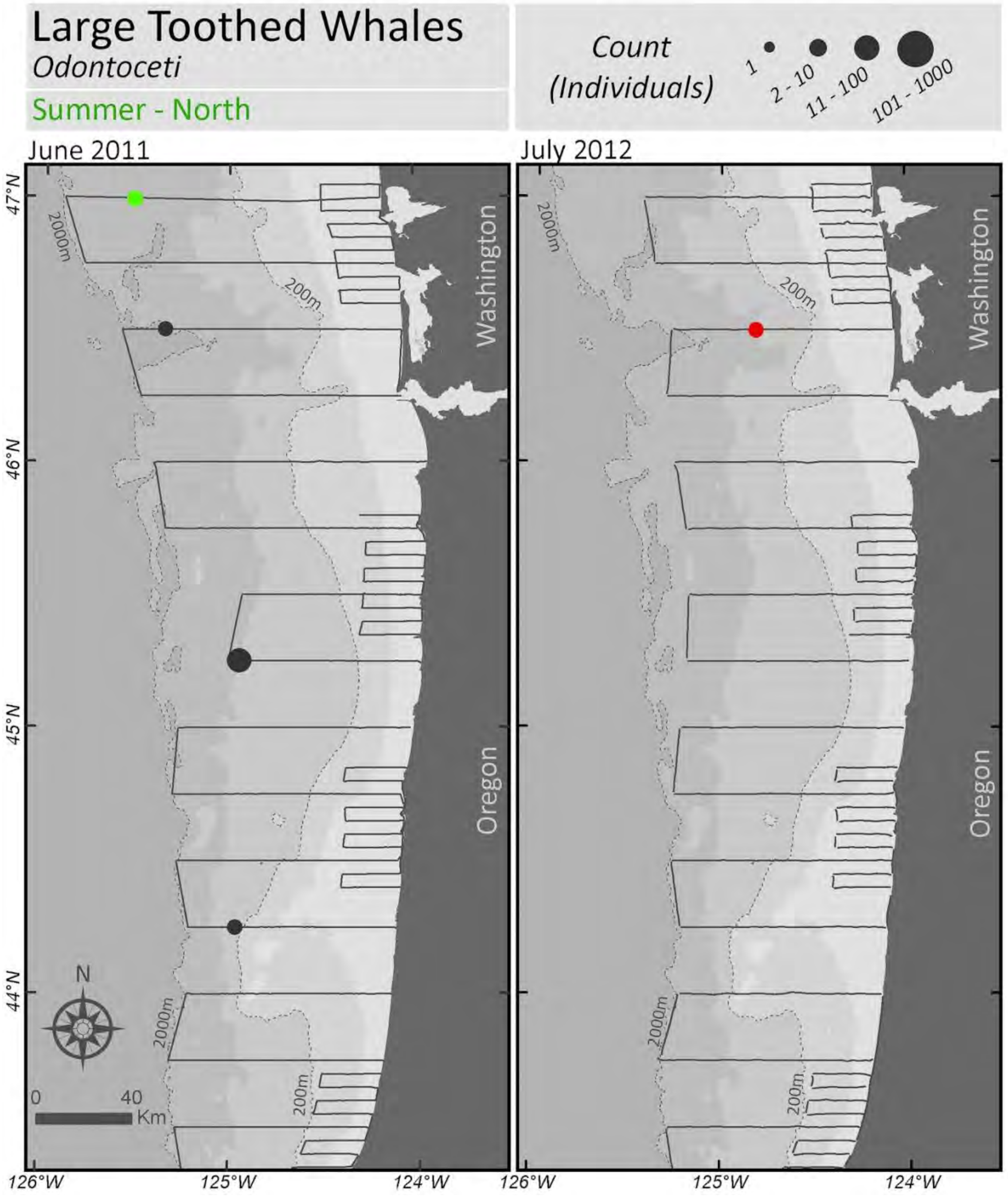
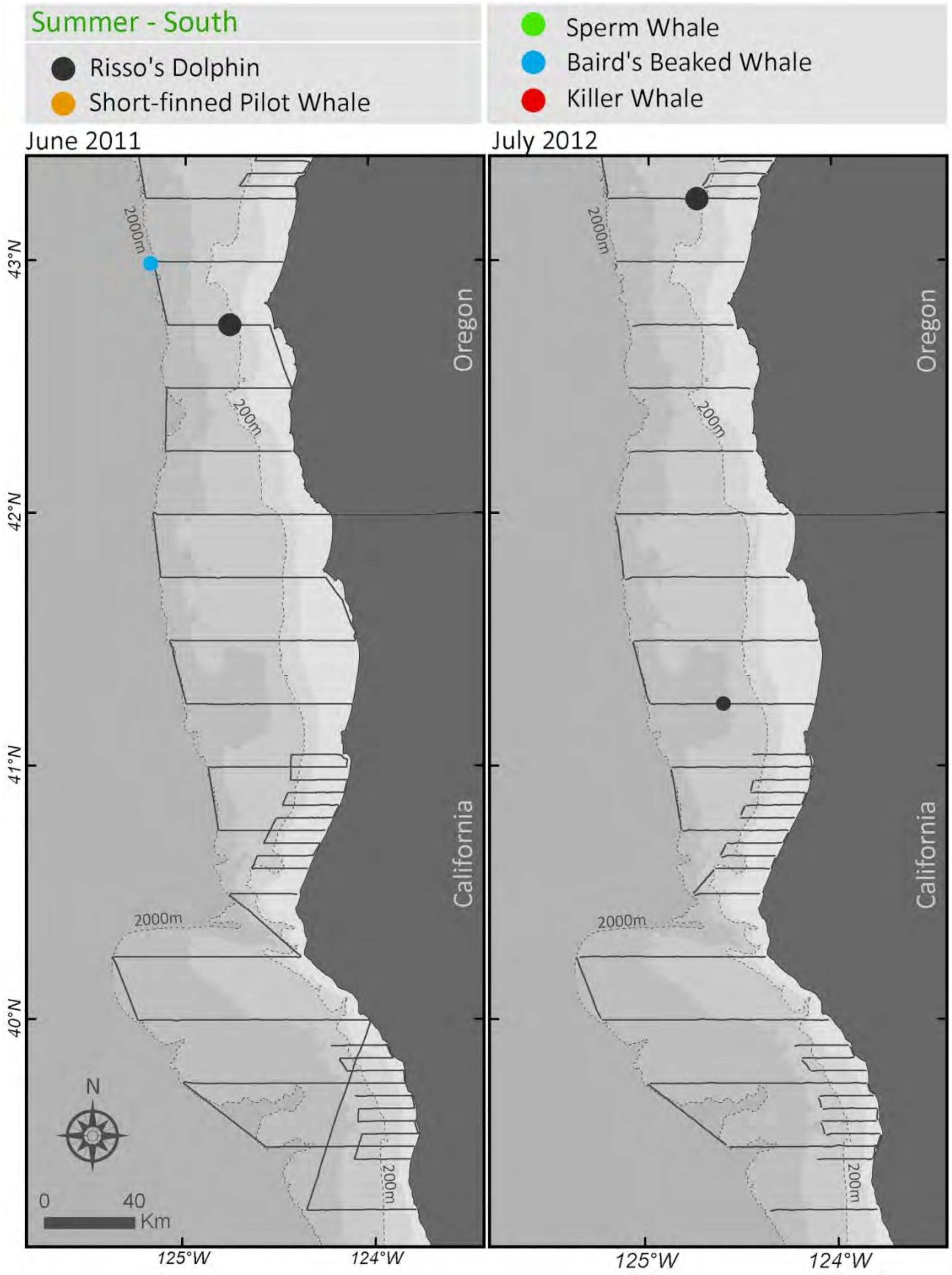


Figure 117. Counts of all large toothed-whale sightings in summer on all transects in northern (above) and southern (opposite page) study area.


Summer - South
● Risso's Dolphin
● Short-finned Pilot Whale
● Sperm Whale
● Baird's Beaked Whale
● Killer Whale
June 2011
July 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

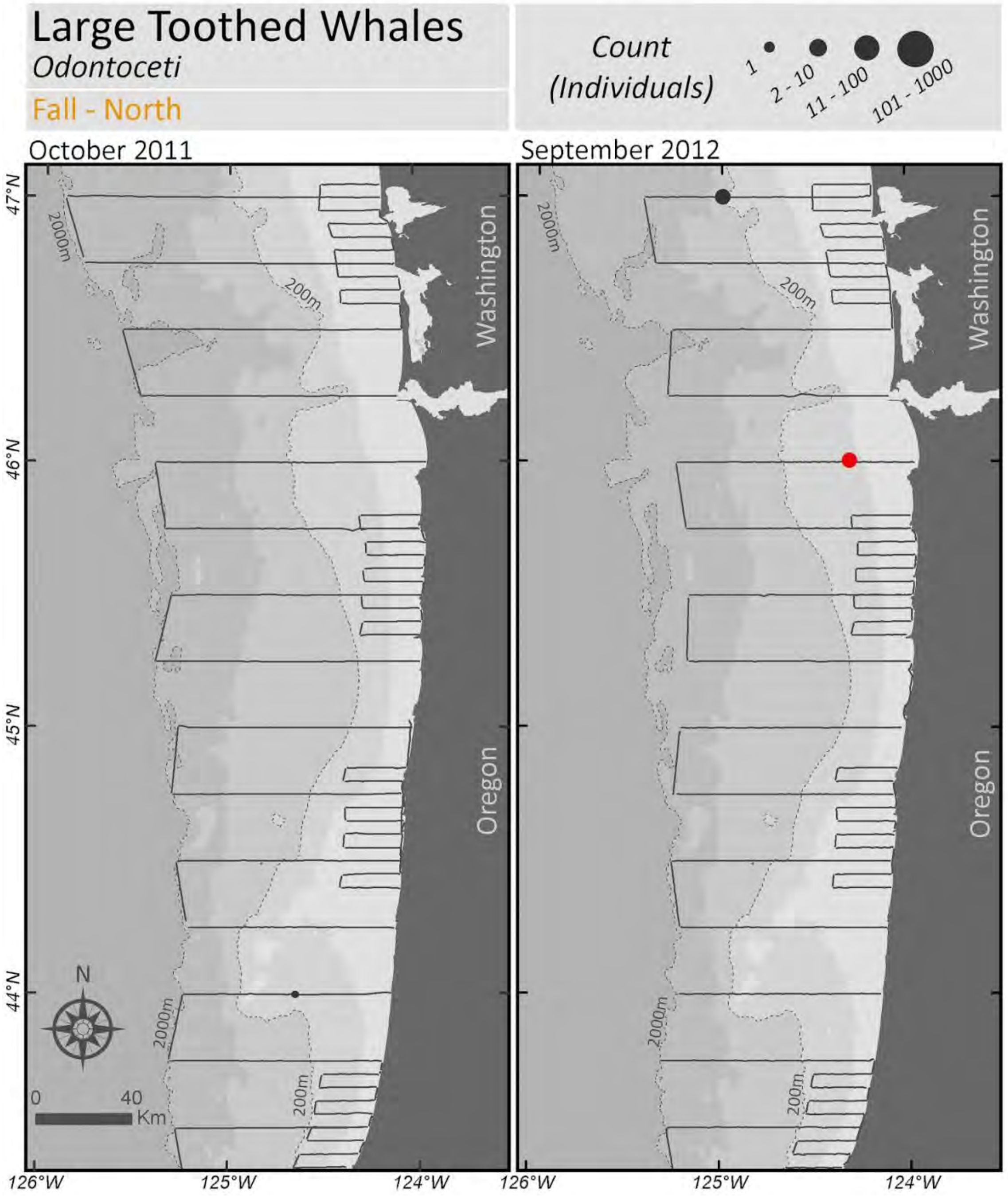
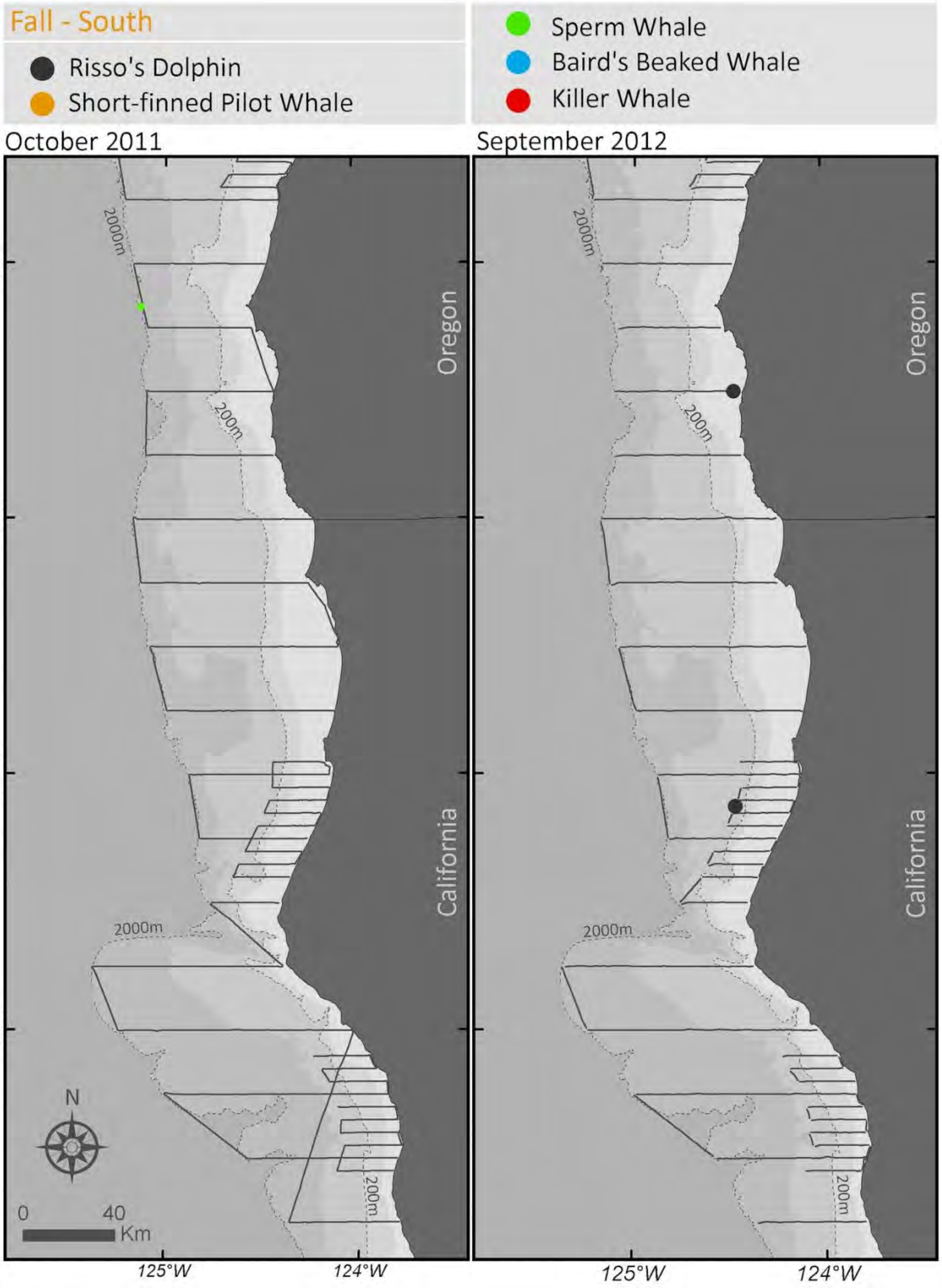


Figure 118. Counts of all large toothed-whale sightings in fall on all transects in northern (above) and southern (opposite page) study area.


Fall - South
● Risso's Dolphin
● Short-finned Pilot Whale
● Sperm Whale
● Baird's Beaked Whale
● Killer Whale
October 2011
September 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
N
0
40
Km
125°W
124°W

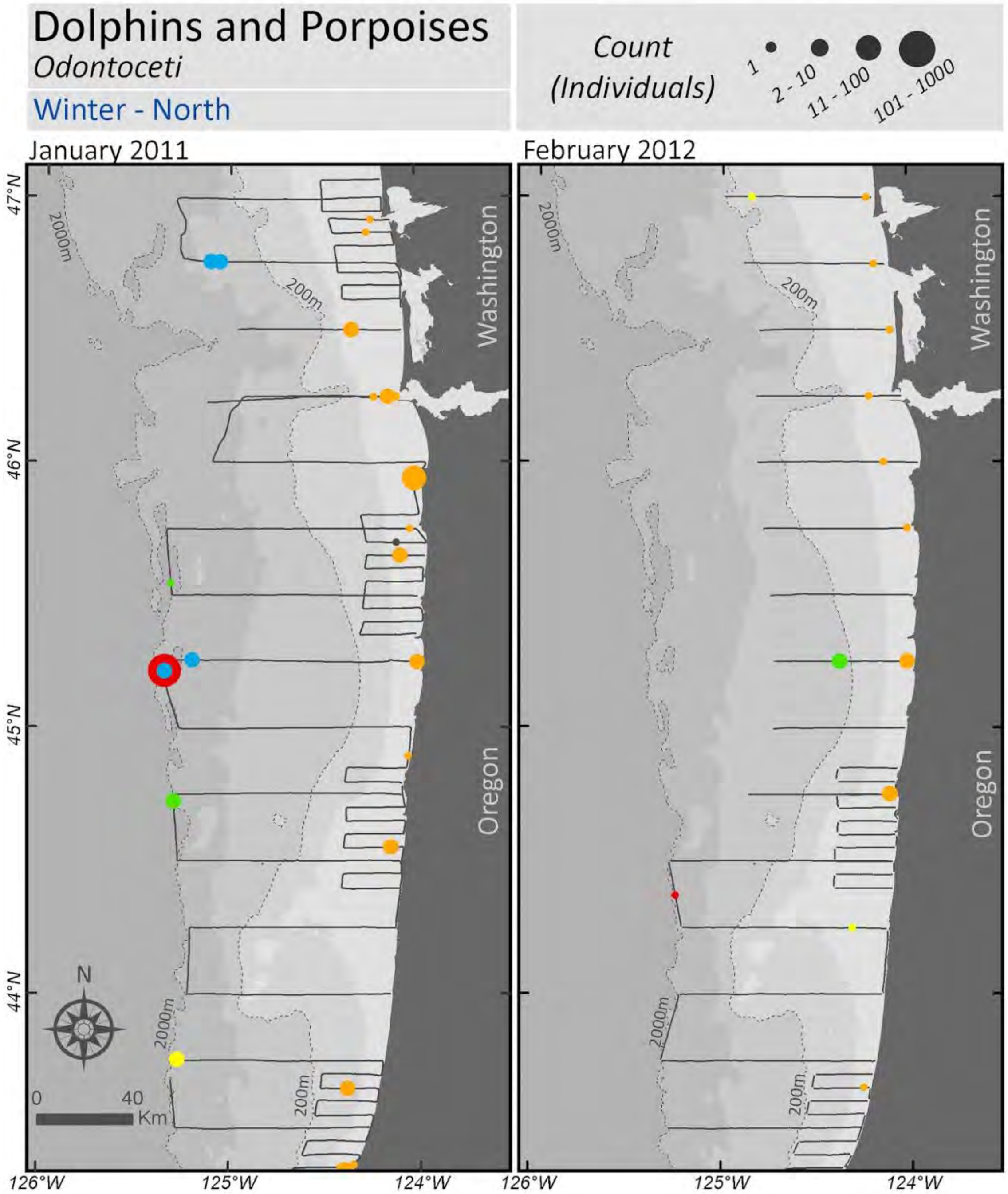
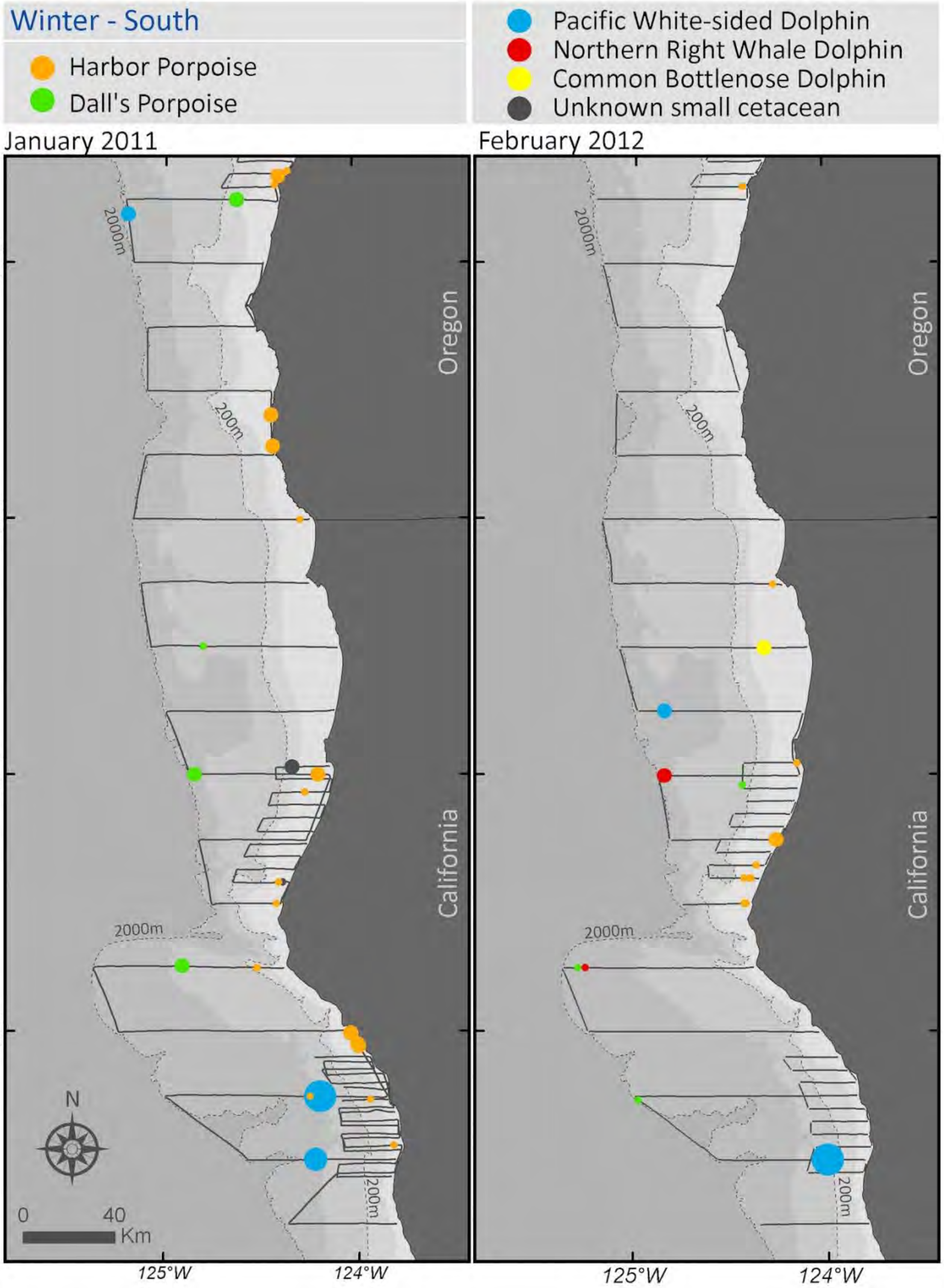


Figure 119. Counts of all dolphin and porpoise sightings in winter on all transects in northern (above) and southern (opposite page) study area.


Winter - South
Harbor Porpoise
Dall's Porpoise
Pacific White-sided Dolphin
Northern Right Whale Dolphin
Common Bottlenose Dolphin
Unknown small cetacean
January 2011
February 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
125°W
124°W
N
0
40
Km

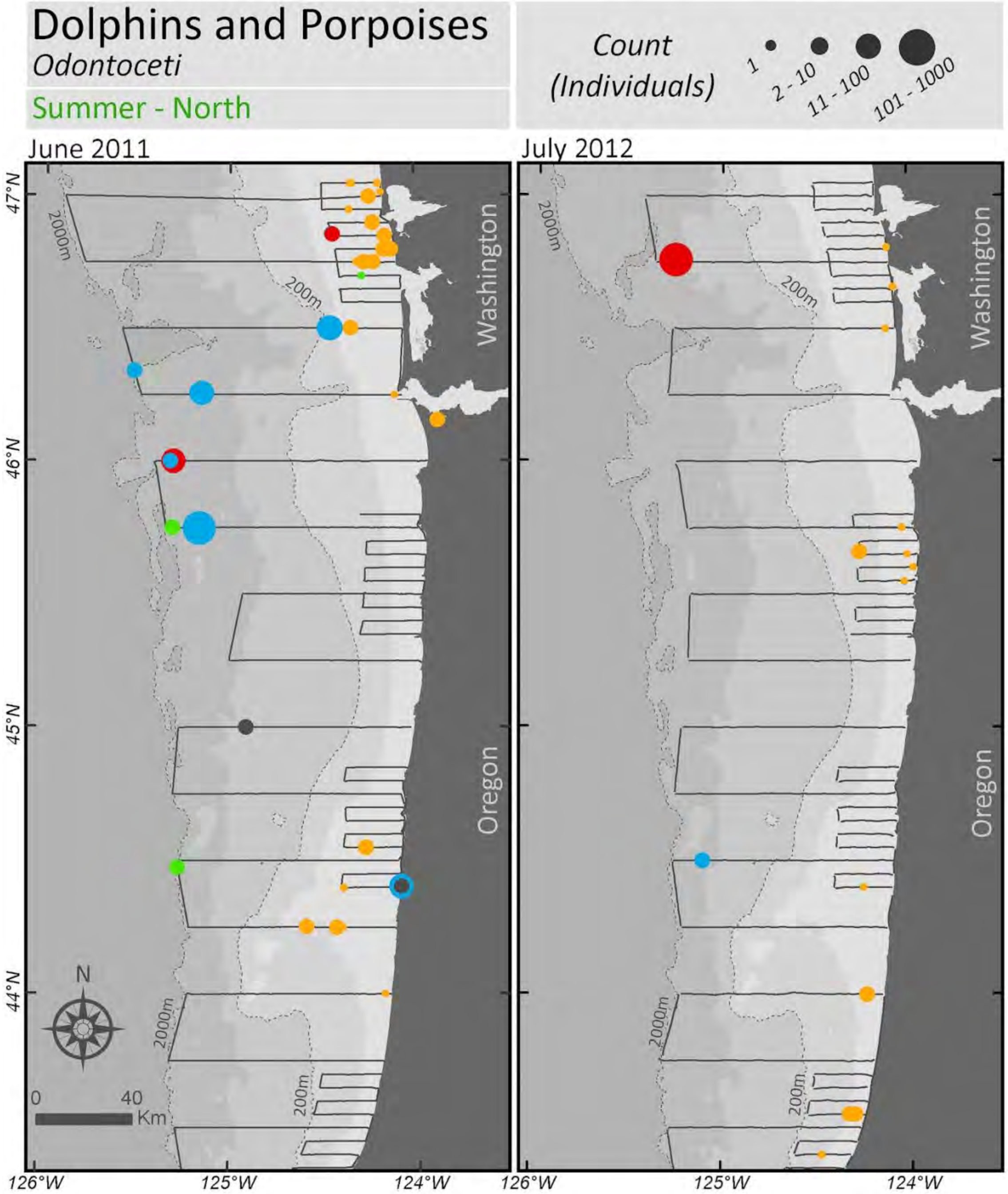
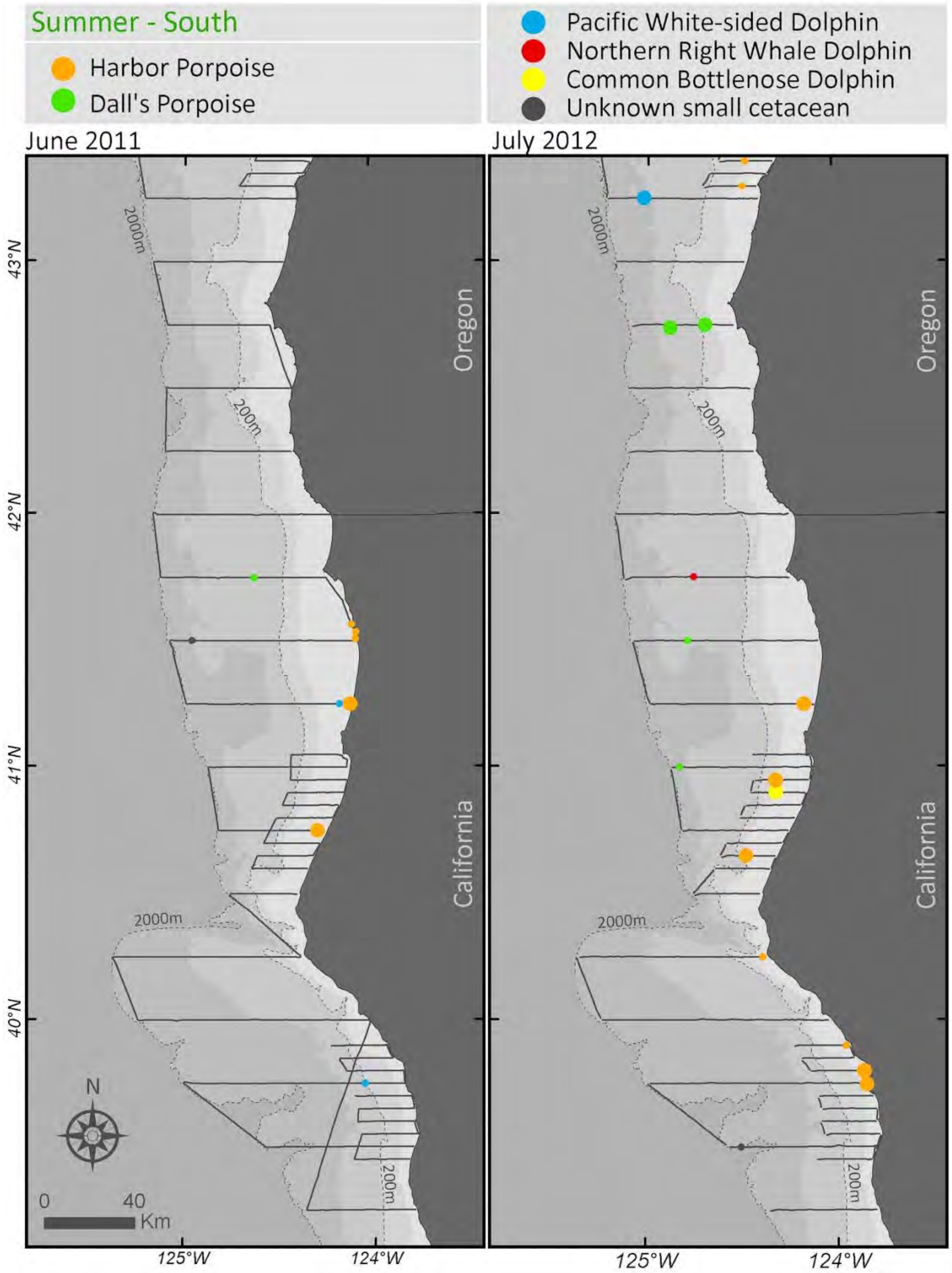


Figure 120. Counts of all dolphin and porpoise sightings in summer on all transects in northern (above) and southern (opposite page) study area.


Summer - South
Harbor Porpoise
Dall's Porpoise
Pacific White-sided Dolphin
Northern Right Whale Dolphin
Common Bottlenose Dolphin
Unknown small cetacean
June 2011
July 2012
43°N
42°N
41°N
40°N
2000m
200m
Oregon
California
N
0
40
Km
125°W
124°W

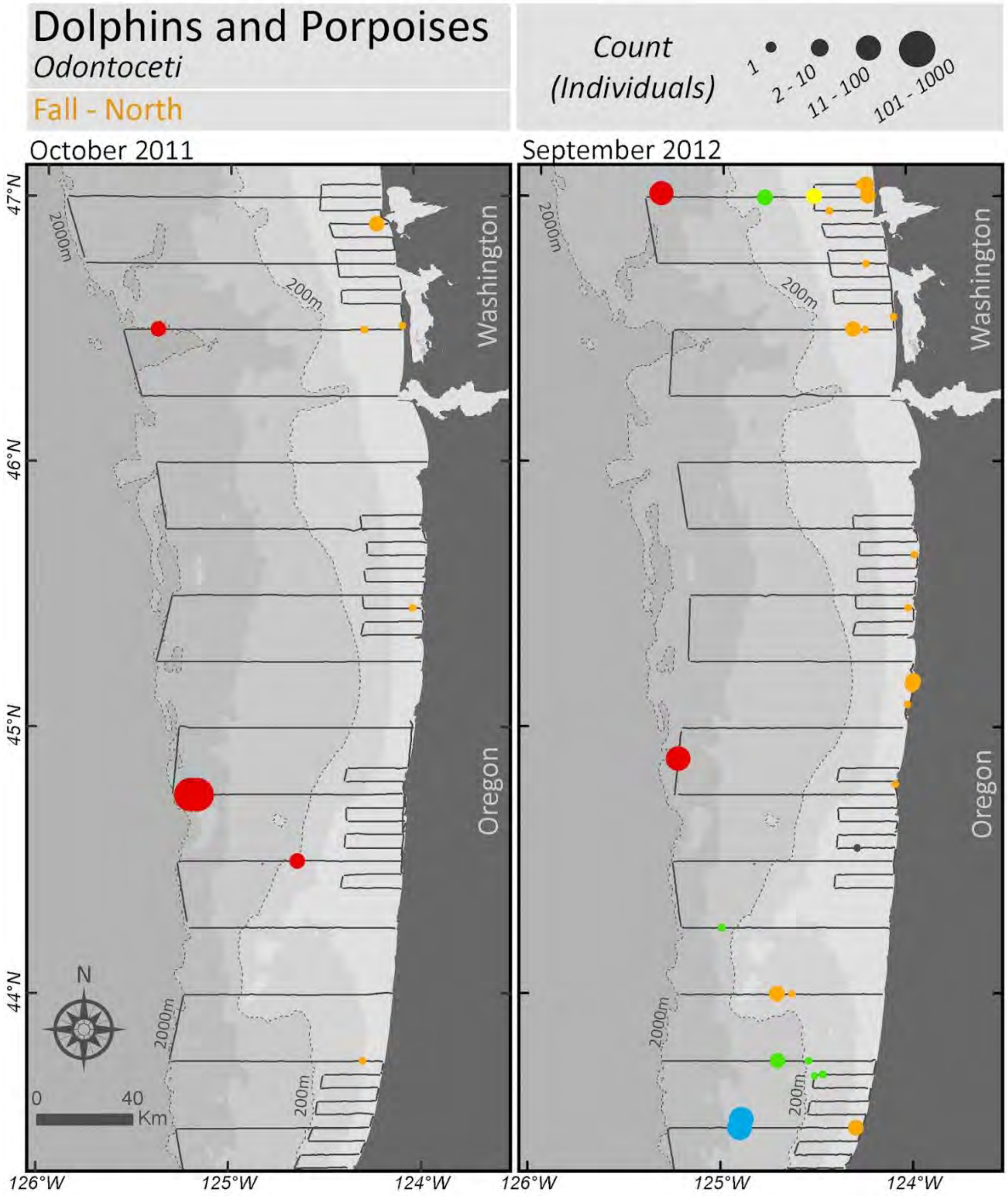
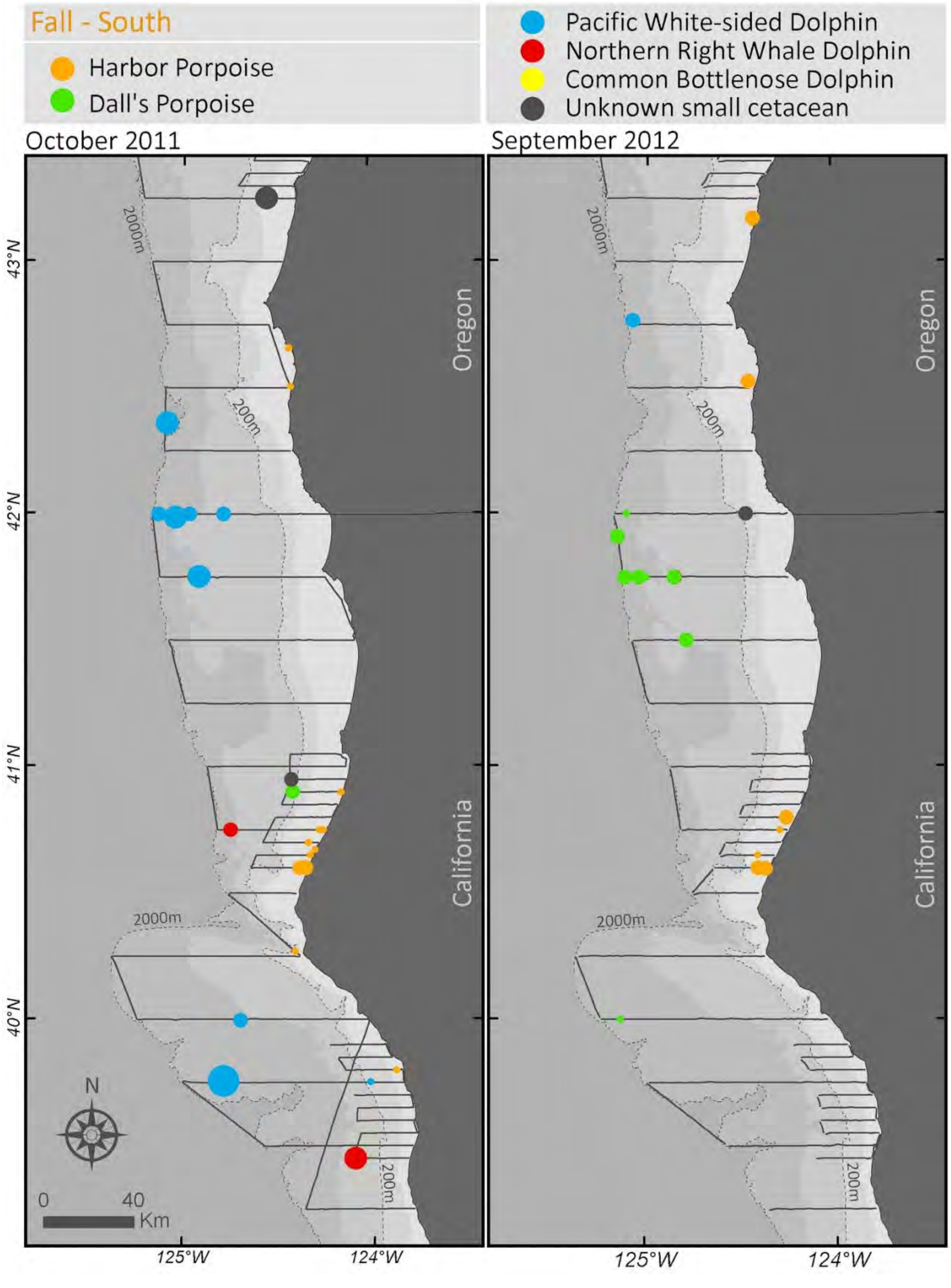


Figure 121. Counts of all dolphin and porpoise sightings in fall on all transects in northern (above) and southern (opposite page) study area.


Fall - South
Harbor Porpoise
Dall's Porpoise
Pacific White-sided Dolphin
Northern Right Whale Dolphin
Common Bottlenose Dolphin
Unknown small cetacean
October 2011
September 2012
2000m
200m
43°N
42°N
41°N
40°N
Oregon
California
N
0
40
Km
125°W
124°W

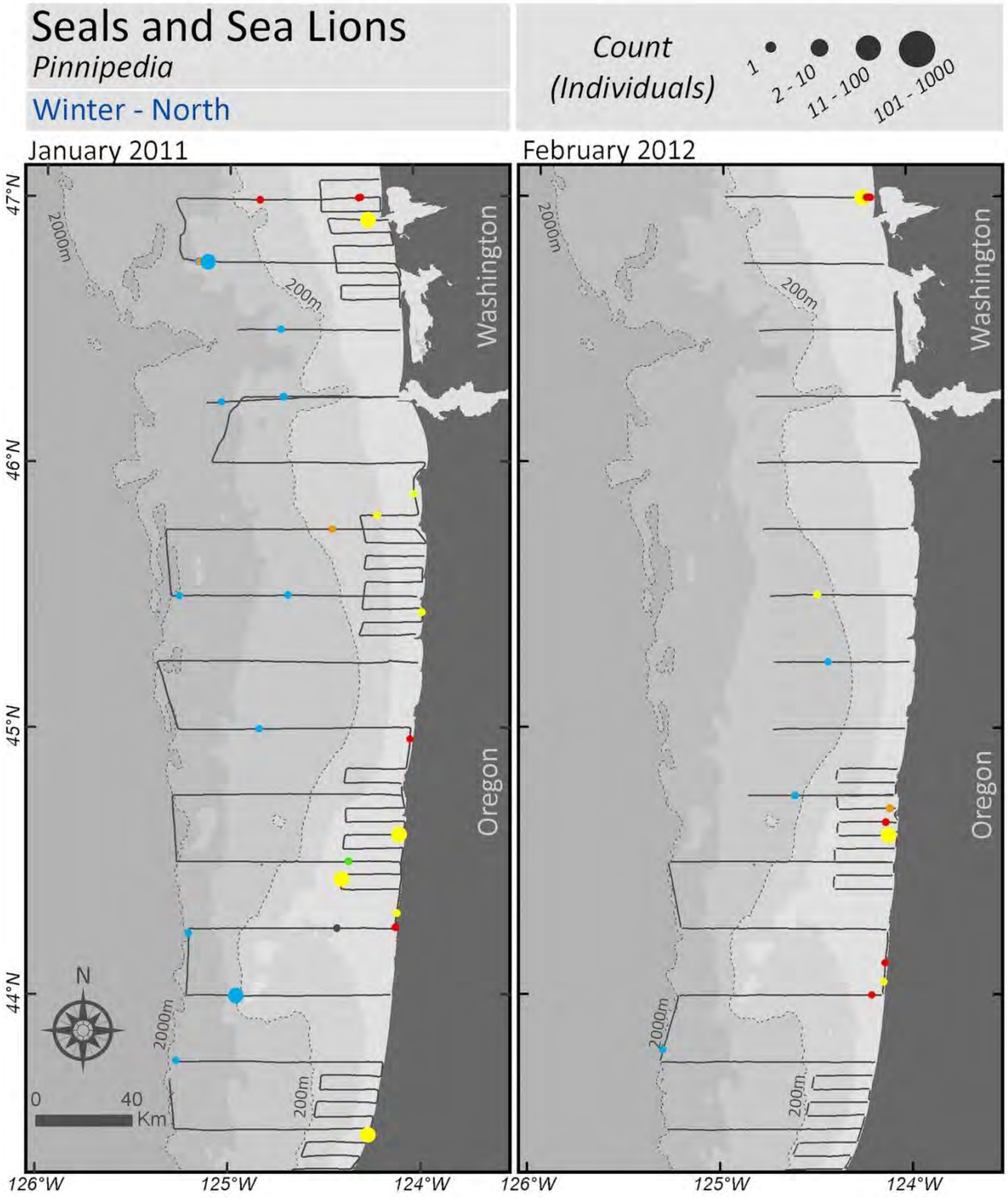
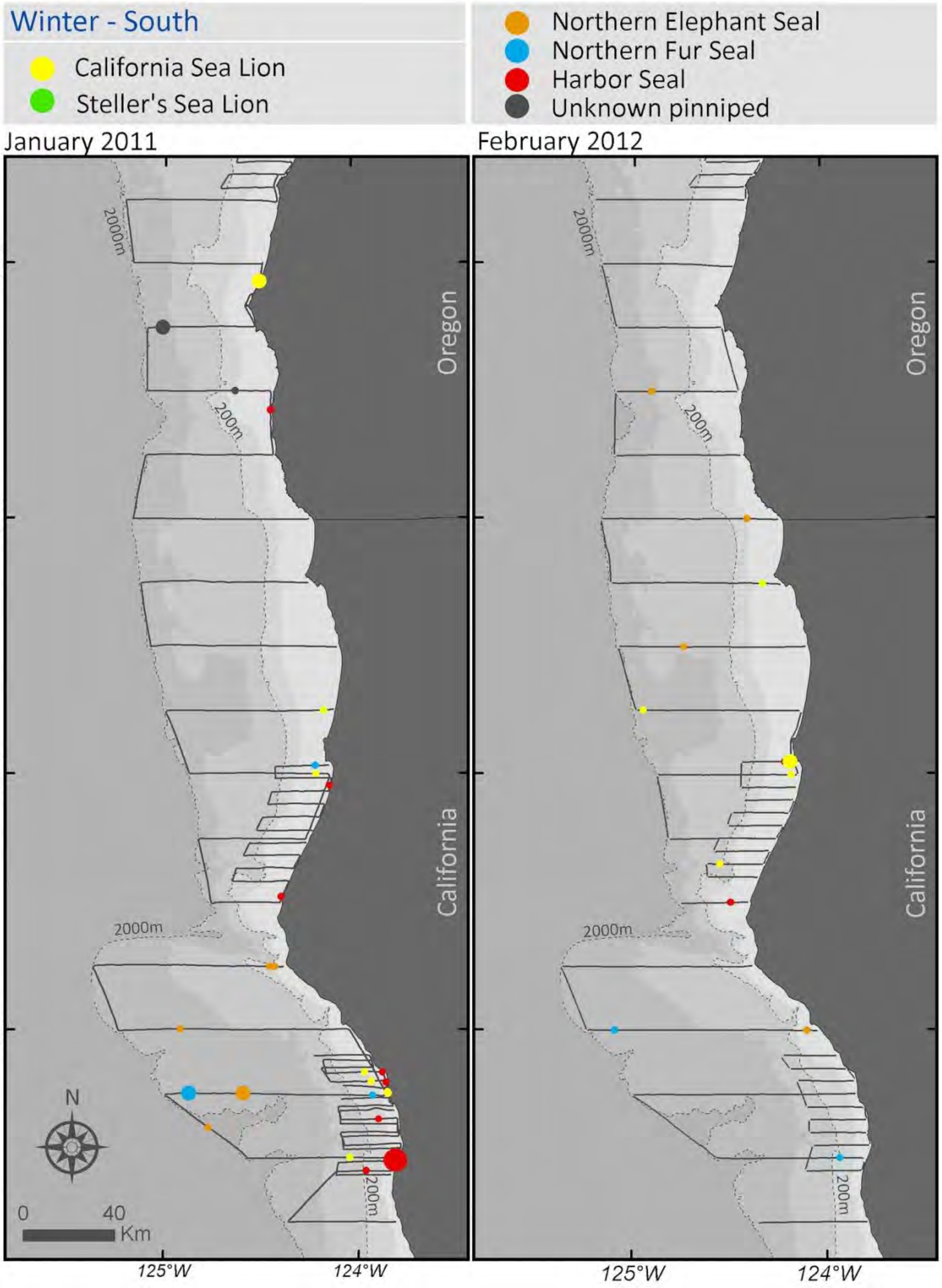


Figure 122. Counts of all seal and sea lion sightings in winter on all transects in northern (above) and southern (opposite page) study area.


Winter - South
California Sea Lion
Steller's Sea Lion
Northern Elephant Seal
Northern Fur Seal
Harbor Seal
Unknown pinniped
January 2011
February 2012
43°N
42°N
41°N
40°N
125°W
124°W
Oregon
California
2000m
200m
N
0
40
Km

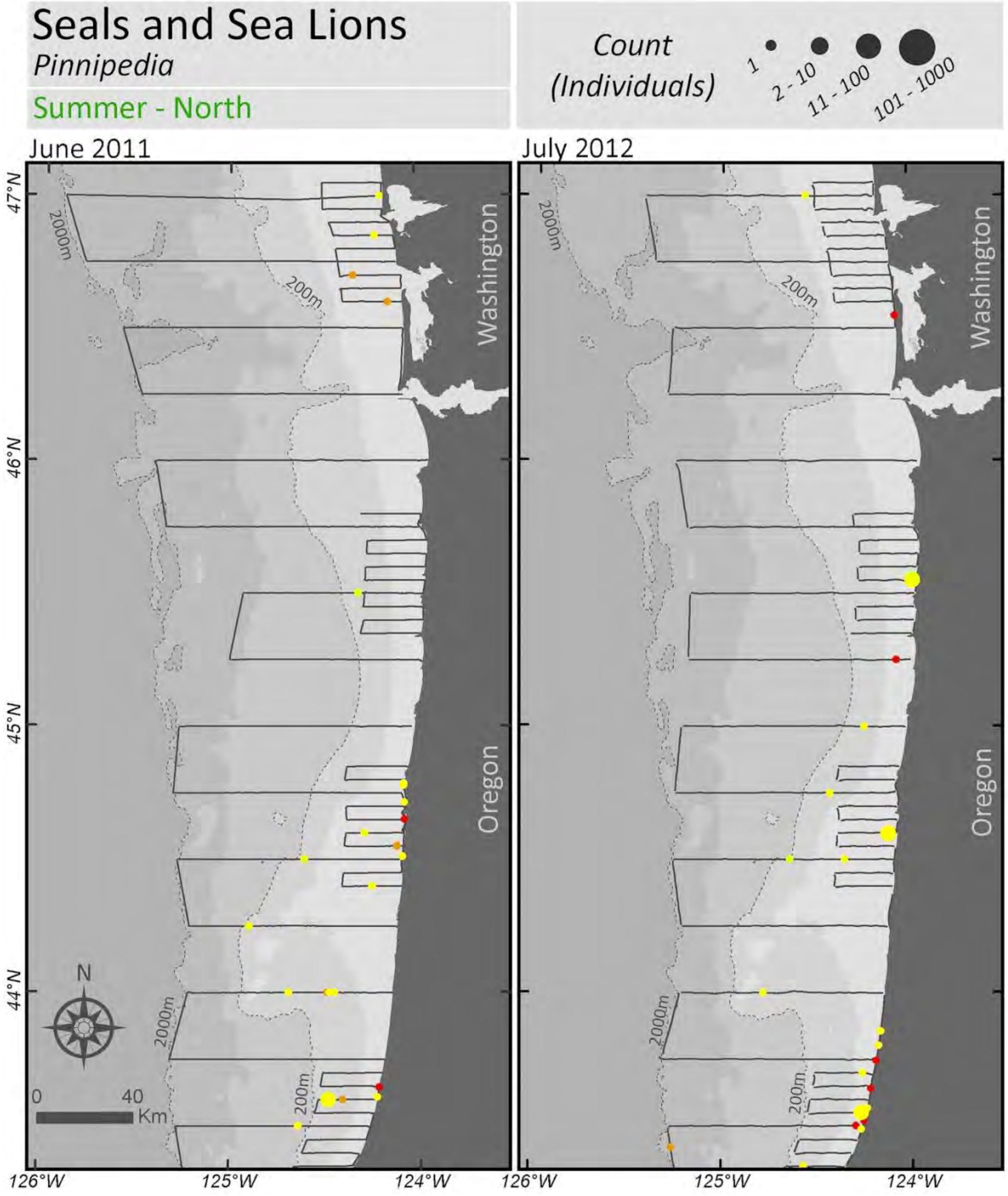
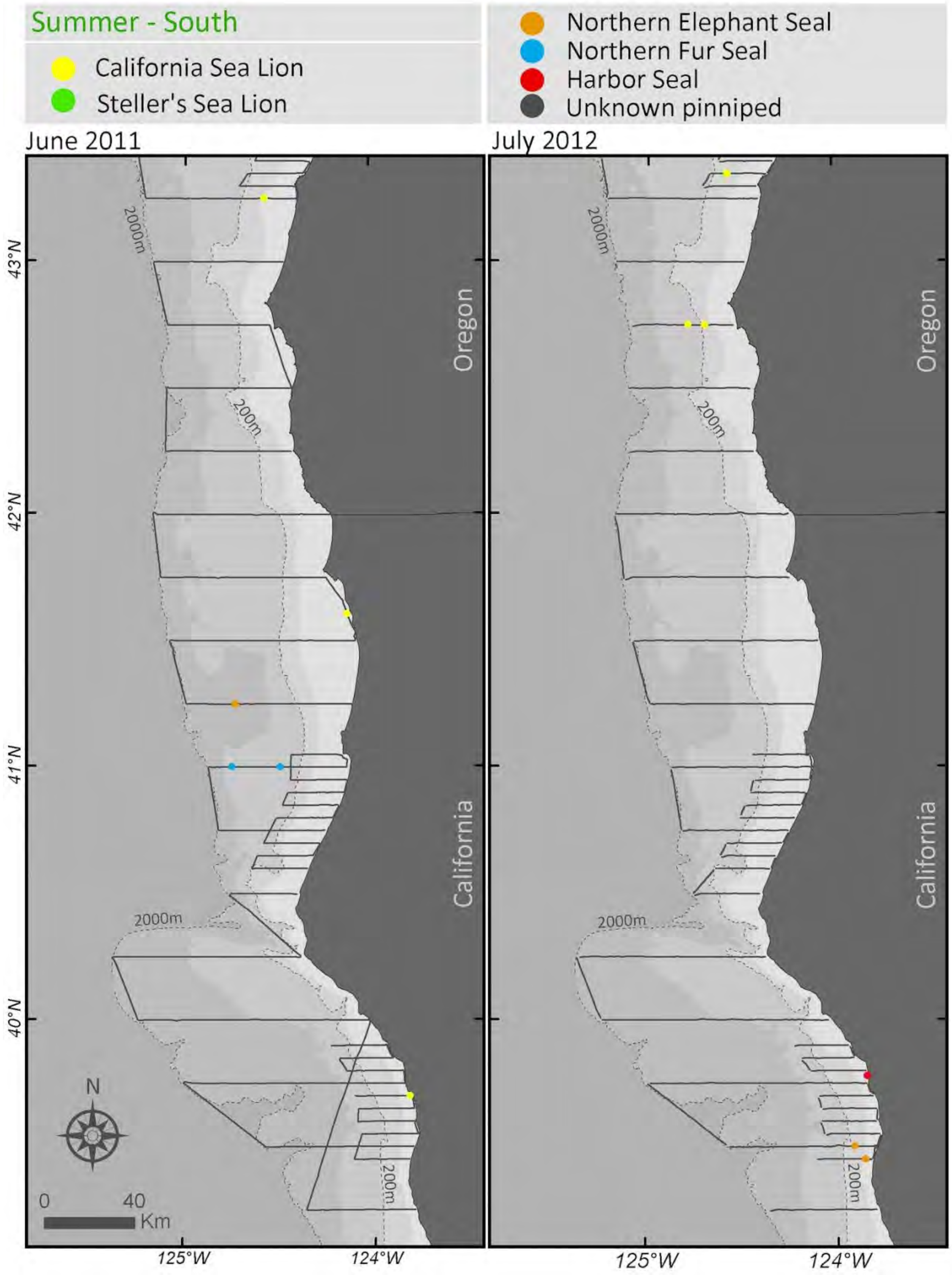


Figure 123. Counts of all seal and sea lion sightings in summer on all transects in northern (above) and southern (opposite page) study area.


Summer - South
California Sea Lion
Steller's Sea Lion
Northern Elephant Seal
Northern Fur Seal
Harbor Seal
Unknown pinniped
June 2011
July 2012
43°N
42°N
41°N
40°N
2000m
200m
Oregon
California
N
0
40
Km
125°W
124°W

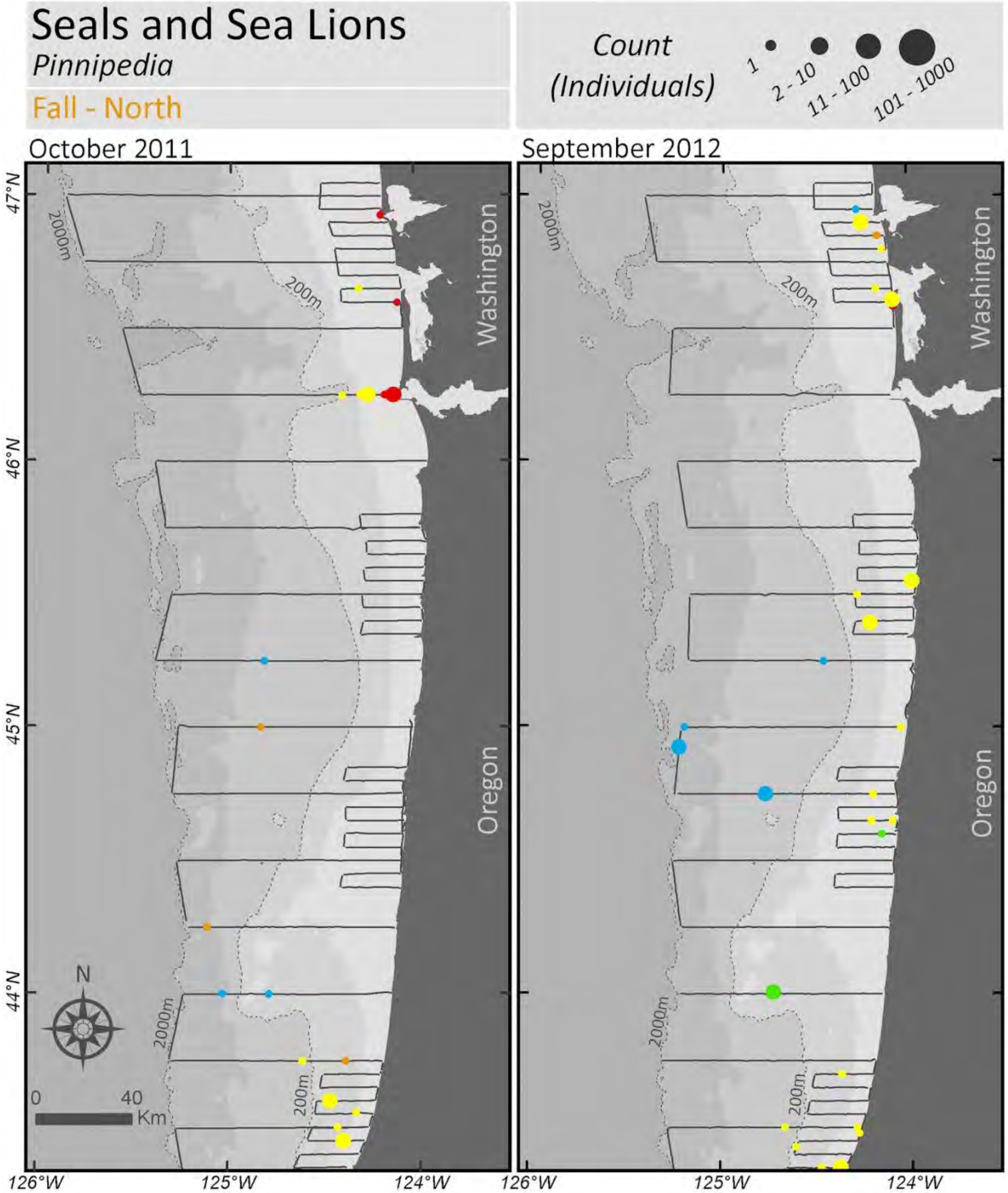
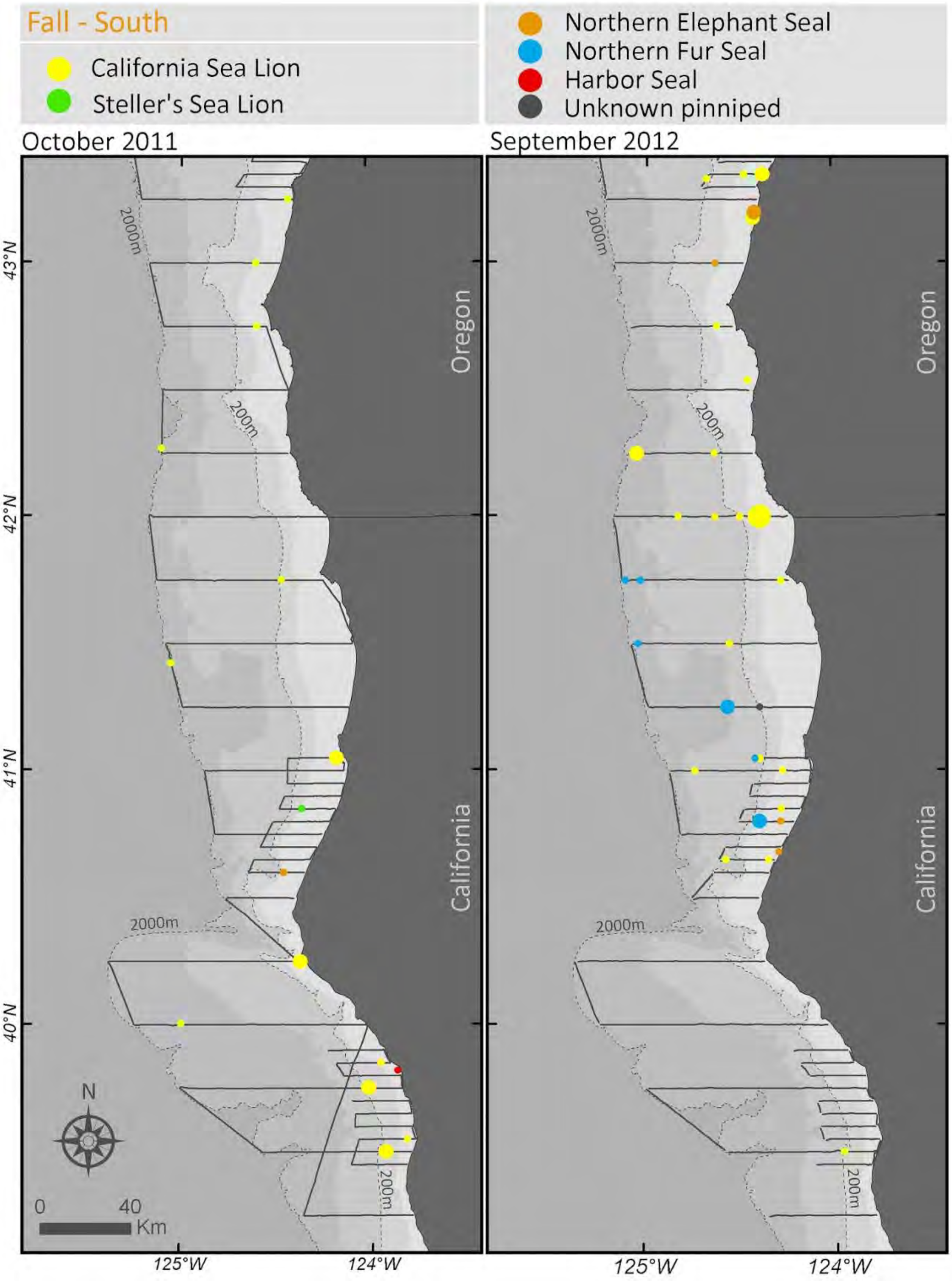


Figure 124. Counts of all seal and sea lion sightings in fall on all transects in northern (above) and southern (opposite page) study area.


Fall - South
California Sea Lion
Steller's Sea Lion
Northern Elephant Seal
Northern Fur Seal
Harbor Seal
Unknown pinniped
October 2011
September 2012
2000m
200m
Oregon
California
43°N
42°N
41°N
40°N
N
0
40
Km
125°W
124°W

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources, protecting our fish, wildlife and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management

As a bureau of the Department of the Interior, the Bureau of Ocean Energy Management (BOEM) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS) in an environmentally sound and safe manner.

The BOEM Environmental Studies Program

The mission of the Environmental Studies Program (ESP) is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments.