

Seabirds on the CalCOFI/CCE-LTER Surveys, 2015-2016

Data Report

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Introduction

Seabird studies are an integral part of the California Cooperative Oceanic Fisheries Investigation (CalCOFI), California Current Ecosystem - Long-term Ecological Research (CCE-LTER), and Southern California Coastal Ocean Observing System (SCCOOS) programs. The seabird data is valuable for several reasons. First, information on seabird distribution and abundance provides an upper trophic level perspective which complements the lower trophic level plankton and hydrographic data collected by others. Second, estimates of seabird abundance, diversity and distribution contribute to understanding the spatial ecology of the Southern California Bight and adjacent marine habitats, a region characterized by substantial temporal environmental heterogeneity and major oceanographic and biogeographic boundaries associated with Point Conception. Third, by extending our existing records (now 29 years and building; 1987-present) and coupling this information with long-term hydrographic and plankton data, seabird data contributes to understanding the effects of climate variability and change on the southern sector of the CCE. Other anthropogenic impacts for this region include coastal development, contaminant input, as well as other biotic changes due to fisheries and other extractive uses of marine life. Seabirds are responsive to all of these factors.

This data report summarizes observations made during 6 seasonal CalCOFI/CCE-LTER cruises in winter, spring and summer of 2015 and 2016. We present basic data on survey effort as well as summary information on seabird distribution and abundance. A total of 41 days of survey effort, covering 4,351 km (1,304 km²) of ocean habitat is summarized for 2015. A total of 55 days of survey effort, covering 6,393 km (1,918 km²) of ocean habitat is summarized for 2016.

Methods

Observations of seabirds are made continuously during daylight ship transits between oceanographic and plankton sampling stations. The observer, located on the bridge approximately 15 meters above sea level, uses hand-held binoculars to assist in the identification and enumeration of birds. The observer records all birds seen within a 300 meter strip transect to one side and front of the vessel while the ship is underway at > 5 knots. Observations are entered into a portable computer using the dedicated application “Dlog”; the ship’s position is automatically recorded periodically from an external GPS. Each observation includes the species, the number of individuals observed, and their behavior (mostly flying or sitting). At-sea

observation data are post-processed using standardized species codes, validation of positioning data, and binning of observations into along-track sections of 3 km in length. The data are then integrated into a survey database which includes data from May 1987 to the present. This data is used to derive summary statistics.

The seabird species summarized are listed in Table 2 and Table 3. Taxa excluded from this summary include all mammals, fish, terrestrial birds and most shorebirds except phalaropes which are largely pelagic. Species density is calculated as the total number of individuals observed per species divided by the area (km²) surveyed. The overall distribution of seabirds is illustrated by plotting density at each bin's center position. The density is represented by a circle whose diameter is scaled using the Jenks method in ArcGIS version 9.3.

Results

A summary of survey effort is shown in Table 1. Seasonal and overall transects surveyed are shown in Figures 1-8. A summary of species observations is shown in Table 2 (2016) and Table 3 (2015). Distribution maps for overall seabird density (all species) are shown in Appendix 1. A detailed species list is provided in Appendix 2.

Table 1. Summary of survey effort and seabird statistics, 2016 and 2015.

Annual Survey 2016	Winter	Spring	Summer	Total
Survey Vessel	Reuben Lasker	BM Shimada	Ocean Starr	-
Start Date	1/7/2016	4/1/2016	7/10/2016	-
End Date	1/24/2016	4/22/2016	7/26/2016	-
Number Survey Days	18	21	16	55
Distance Surveyed (km)	1660	2758	1976	6393
Area Surveyed (km ²)	498	827	593	1918
Number of Bird Species	29	39	35	53
Overall Bird Density (per km ²)	6.69	10.72	17.15	11.66
Total Individuals Counted	3333	8868	10165	22366
Annual Survey 2015	Winter	Spring	Summer	Total
Survey Vessel	New Horizon	New Horizon	Oceanus	-
Start Date	1/16/2015	4/4/2015	7/8/2015	-
End Date	1/24/2015	4/20/2015	7/24/2015	-
Number Survey Days	9	16	16	41
Distance Surveyed (km)	548	1745	2058	4351
Area Surveyed (km ²)	164	523	617	1305
Number of Bird Species	21	40	30	47
Overall Bird Density (per km ²)	1.77	23.20	16.23	17.2
Total Individuals Counted	291	12146	10018	22455

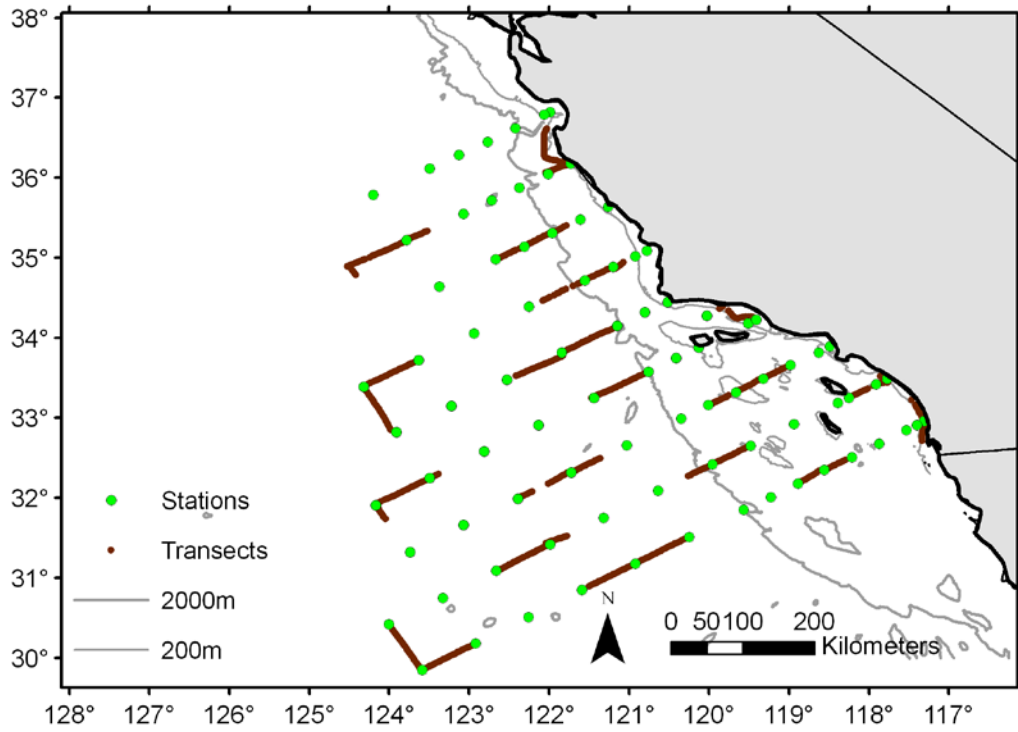


Figure 1. CalCOFI/CCE-LTER hydrographic and plankton sampling stations (green). Survey transects, winter 2016.

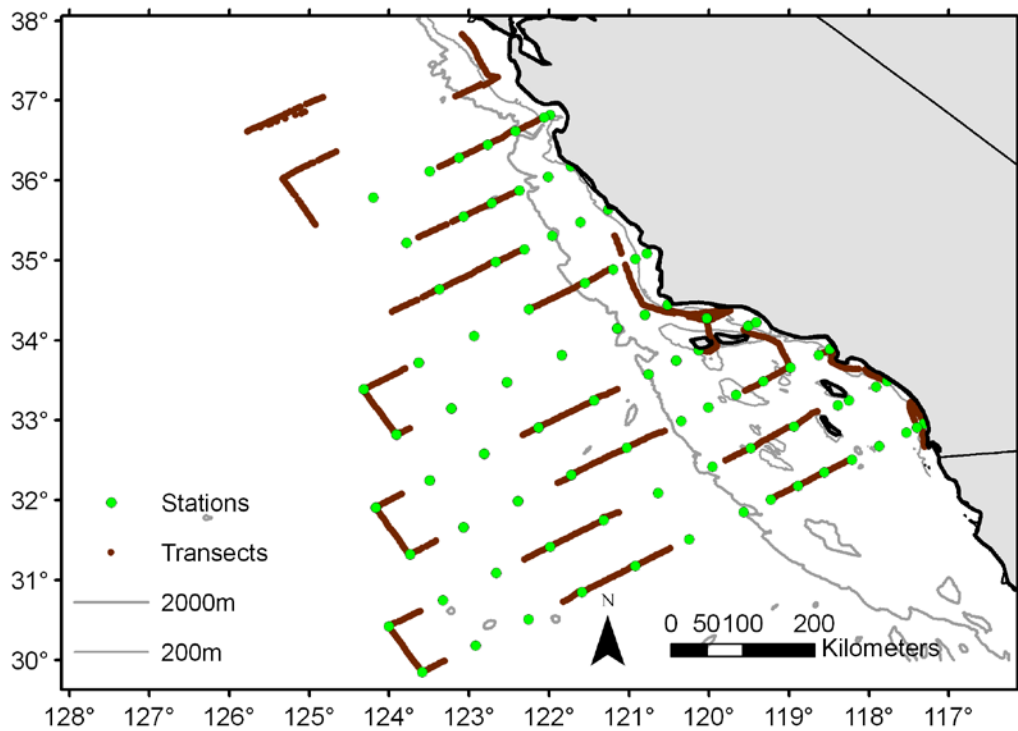


Figure 2. Survey transects, spring 2016.

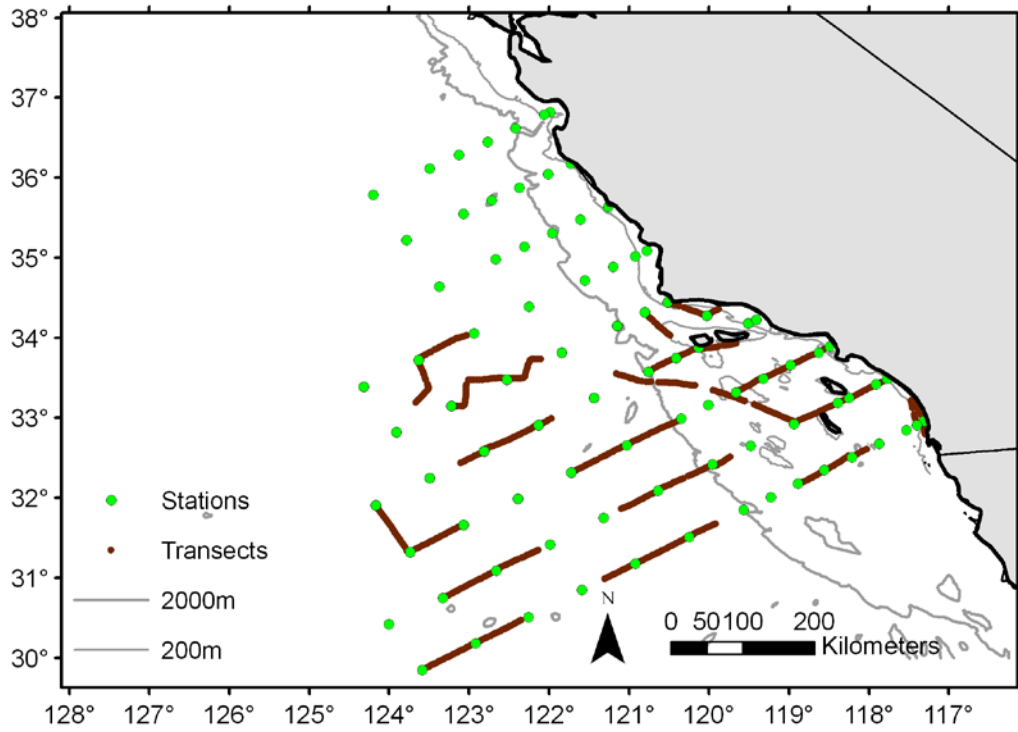


Figure 3. Survey transects, summer 2016.

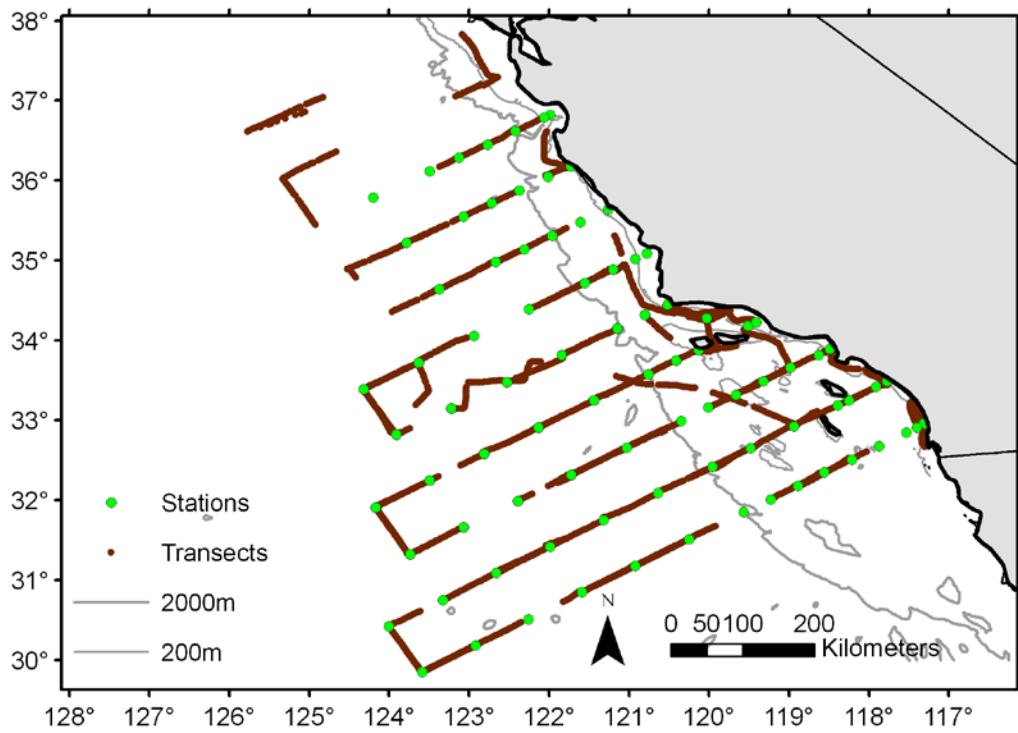


Figure 4. Survey transects, all seasons 2016.

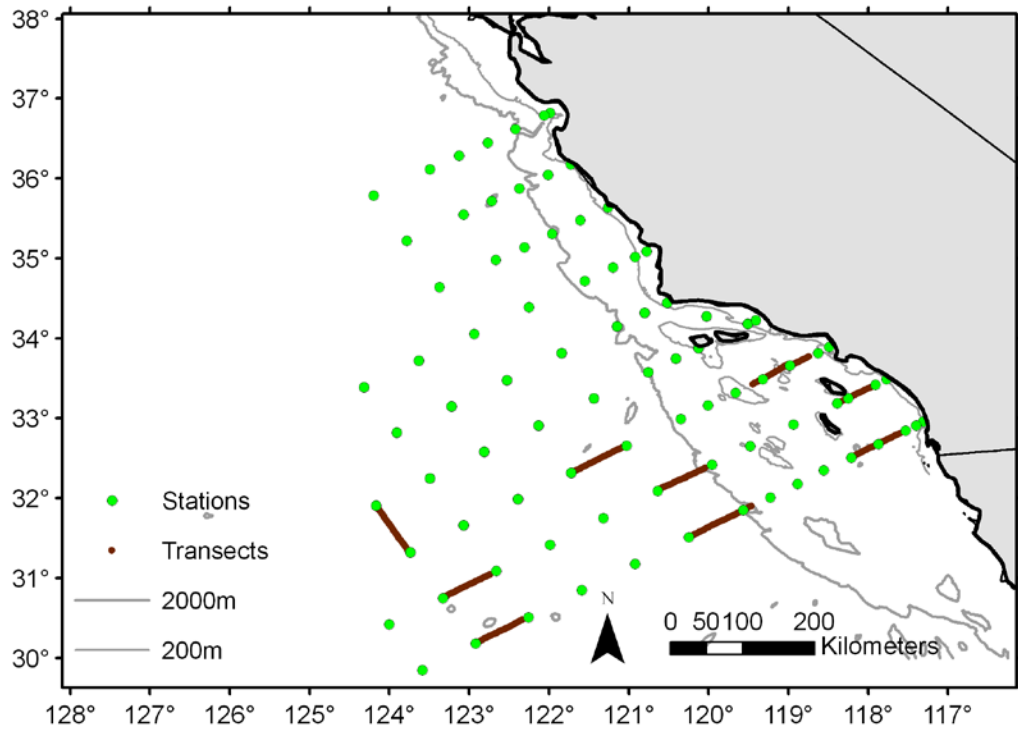


Figure 5. Survey transects, winter 2015.

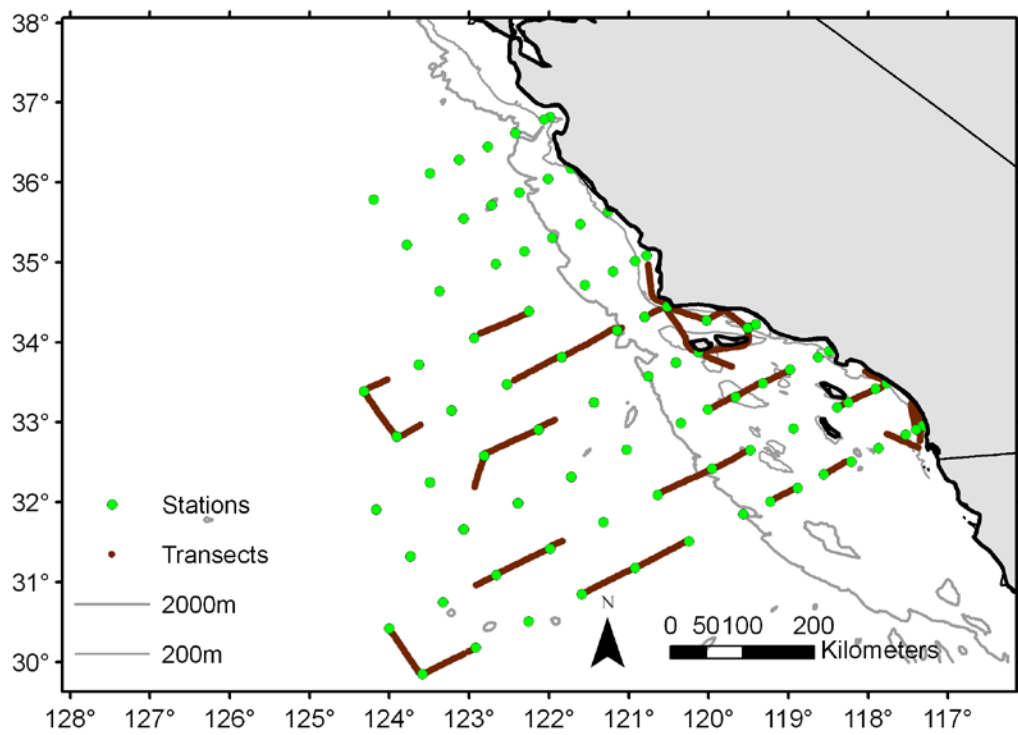


Figure 6. Survey transects, spring 2015.

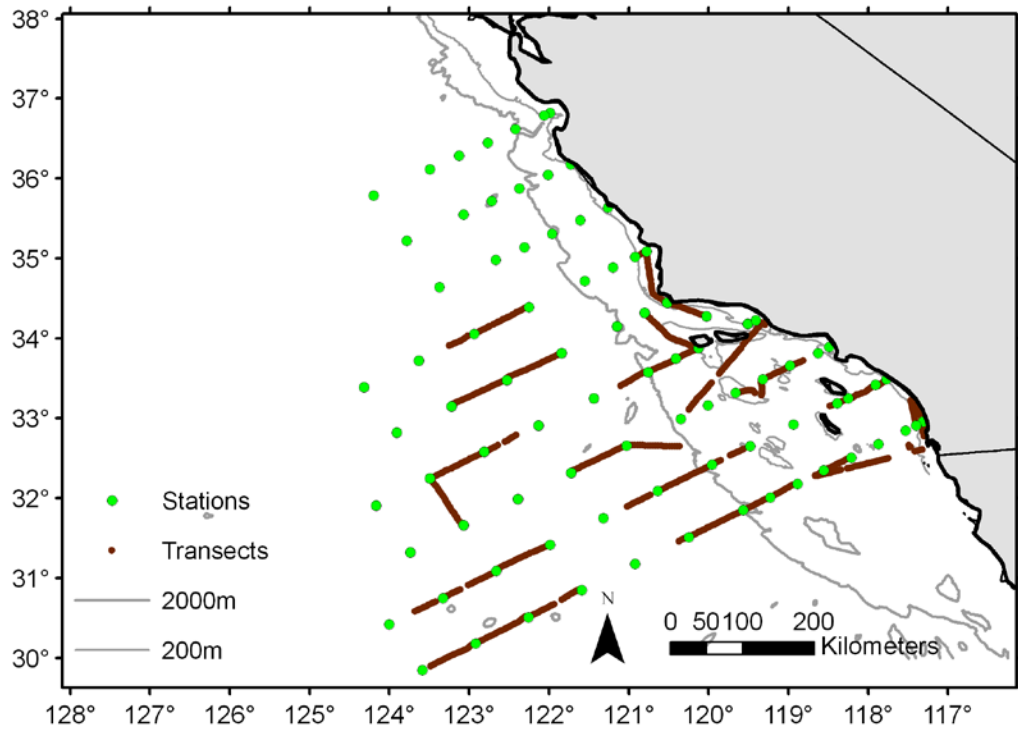


Figure 7. Survey transects, summer 2015.

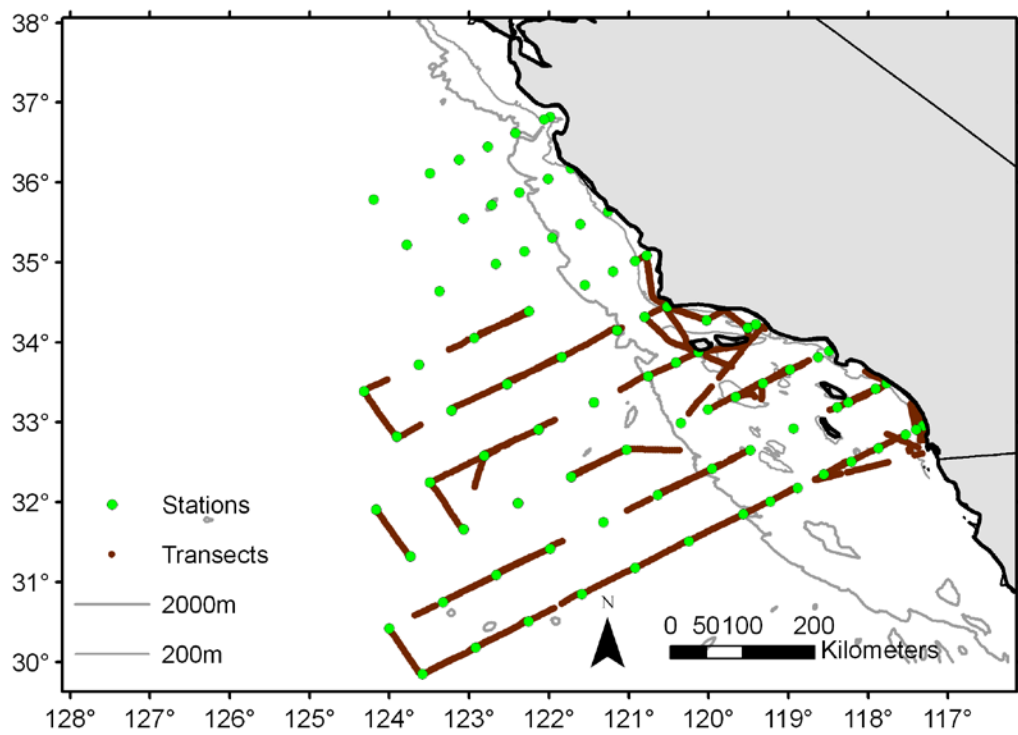


Figure 8. Survey transects, all seasons 2015.

Table 2. 2016 observations by season and species. Cell values represent: the total number of individuals (ind.) / the number of observations per species (obs.) / species density (dens.) in individuals per km².

Common Name	Latin Name	Winter 2016 (ind./obs./dens.)	Spring 2016 (ind./obs./dens.)	Summer 2016 (ind./obs./dens.)
American White Pelican	<i>Pelecanus erythrorhynchos</i>			
Ancient Murrelet	<i>Synthliboramphus antiquus</i>			
Arctic Loon	<i>Gavia arctica</i>			
Arctic Tern	<i>Sterna paradisaea</i>		1 / 1 / 0	
Ashy Storm-Petrel	<i>Oceanodroma homochroa</i>		3 / 3 / 0	28 / 18 / 0.05
Black guillemot	<i>Cepphus grylle</i>			
Black Scoter	<i>Melanitta nigra</i>			
Black Storm-Petrel	<i>Oceanodroma melania</i>			6 / 4 / 0.01
Black-Footed Albatross	<i>Phoebastria nigripes</i>	15 / 15 / 0.03	12 / 9 / 0.01	21 / 20 / 0.04
Black-Legged Kittiwake	<i>Rissa tridactyla</i>	21 / 12 / 0.04		
Black-Vented Shearwater	<i>Puffinus opisthomelas</i>	1257 / 150 / 2.52	1 / 1 / 0	857 / 85 / 1.45
Bonaparte's Gull	<i>Larus philadelphia</i>	263 / 13 / 0.53	591 / 71 / 0.71	
Brandt's Cormorant	<i>Phalacrocorax penicillatus</i>	34 / 14 / 0.07	1640 / 23 / 1.98	11 / 9 / 0.02
Brant	<i>Branta bernicla</i>		3 / 1 / 0	
Brown Booby	<i>Sula leucogaster</i>	1 / 1 / 0	2 / 2 / 0	1 / 1 / 0
Brown Noddy	<i>Anous stolidus</i>			
Brown Pelican	<i>Pelecanus occidentalis</i>	9 / 7 / 0.02	166 / 18 / 0.2	44 / 17 / 0.07
Buller's Shearwater	<i>Puffinus bulleri</i>			3 / 3 / 0.01
California Gull	<i>Larus californicus</i>	686 / 173 / 1.38	512 / 155 / 0.62	7 / 2 / 0.01
Caspian Tern	<i>Sterna caspia</i>	2 / 1 / 0		
Cassin's Auklet	<i>Ptychoramphus aleuticus</i>	414 / 122 / 0.83	113 / 34 / 0.14	16 / 15 / 0.03
Clark's Grebe	<i>Aechmophorus clarkii</i>			
Common Loon	<i>Gavia immer</i>		23 / 10 / 0.03	
Common Murre	<i>Uria aalge</i>	50 / 25 / 0.1	1124 / 194 / 1.36	1 / 1 / 0
Common Tern	<i>Sterna hirundo</i>		6 / 4 / 0.01	3 / 1 / 0.01

Common Name	Latin Name	Winter 2016 (ind./obs./dens.)	Spring 2016 (ind./obs./dens.)	Summer 2016 (ind./obs./dens.)
Cook's Petrel	<i>Pterodroma cookii</i>	18 / 9 / 0.04	273 / 184 / 0.33	65 / 51 / 0.11
Craveri's Murrelet	<i>Synthliboramphus craveri</i>			4 / 2 / 0.01
Dark Shearwater	(species group)			
Dark-Rumped Petrel	<i>Pterodroma phaeopygia sandwichensis</i>			
Double-Crested Cormorant	<i>Phalacrocorax auritus</i>		1 / 1 / 0	1 / 1 / 0
Eared Grebe	<i>Podiceps nigricollis</i>		2 / 2 / 0	
Elegant Tern	<i>Sterna elegans</i>		279 / 70 / 0.34	169 / 78 / 0.29
Flesh-Footed Shearwater	<i>Puffinus carneipes</i>			
Fork-Tailed Storm-Petrel	<i>Oceanodroma furcata</i>			
Forster's Tern	<i>Sterna forsteri</i>			
Franklin's Gull	<i>Larus pipixcan</i>			
Glaucous Gull	<i>Larus hyperboreus</i>			
Glaucous-Winged Gull	<i>Larus glaucescens</i>	5 / 5 / 0.01		
Hawaiian Petrel	<i>Pterodroma sandwichensis</i>			
Heermann's Gull	<i>Larus heermanni</i>	86 / 34 / 0.17	1 / 1 / 0	5 / 5 / 0.01
Herring Gull	<i>Larus argentatus</i>	4 / 4 / 0.01		
Horned Puffin	<i>Fratercula corniculata</i>			
Hybrid Gull	(species group)			
Juan Fernandez Petrel	<i>Pterodroma externa</i>			
Kelp Gull	<i>Larus dominicanus</i>			
Kermadec Petrel	<i>Pterodroma neglecta</i>			
Laughing Gull	<i>Larus atricilla</i>			
Laysan Albatross	<i>Phoebastria immutabilis</i>	2 / 2 / 0	4 / 4 / 0	
Leach's Storm-Petrel	<i>Oceanodroma leucorhoa</i>	191 / 100 / 0.38	3 / 3 / 0	12 / 12 / 0.02
Least Storm-Petrel	<i>Oceanodroma microsoma</i>			
Least Tern	<i>Sterna antillarum</i>			1 / 1 / 0
Long-Tailed Jaeger	<i>Stercorarius longicaudus</i>			1 / 1 / 0

Common Name	Latin Name	Winter 2016 (ind./obs./dens.)	Spring 2016 (ind./obs./dens.)	Summer 2016 (ind./obs./dens.)
Marbled Murrelet	Brachyramphus marmoratus			
Mew Gull	Larus canus			
Mottled Petrel	Pterodroma inexpectata			
Murphy's Petrel	Pterodroma ultima			
Northern Fulmar	Fulmarus glacialis	13 / 13 / 0.03	14 / 12 / 0.02	3 / 3 / 0.01
Osprey	Pandion haliaetus			
Pacific Loon	Gavia pacifica	7 / 5 / 0.01	105 / 29 / 0.13	
Parakeet Auklet	Aethia psittacula			
Parasitic Jaeger	Stercorarius parasiticus	2 / 2 / 0	4 / 4 / 0	1 / 1 / 0
Parkinson's Petrel	Procellaria parkinsoni			
Pelagic Cormorant	Phalacrocorax pelagicus	1 / 1 / 0	36 / 12 / 0.04	7 / 6 / 0.01
Peregrine Falcon	Falco peregrinus			
Pigeon Guillemot	Cephus columba		1 / 1 / 0	
Pink-Footed Shearwater	Puffinus creatopus		404 / 35 / 0.49	1293 / 212 / 2.18
Pomarine Jaeger	Stercorarius pomarinus	1 / 1 / 0	4 / 3 / 0	3 / 3 / 0.01
Red Phalarope	Phalaropus fulcarius	30 / 12 / 0.06	285 / 31 / 0.34	15 / 7 / 0.03
Red-Billed Tropicbird	Phaethon aethereus		1 / 1 / 0	4 / 4 / 0.01
Red-Footed Booby	Sula sula			
Red-Necked Grebe	Podiceps grisegena			
Red-Necked Phalarope	Phalaropus lobatus	2 / 1 / 0	1034 / 43 / 1.25	6 / 1 / 0.01
Red-Tailed Tropicbird	Pheathon rubricauda	4 / 2 / 0.01		
Red-Throated Loon	Gavia stellata		2 / 2 / 0	
Rhinoceros Auklet	Cerorhinca monocerata	78 / 49 / 0.16	29 / 16 / 0.04	
Ring-Billed Gull	Larus delawarensis			
Royal Tern	Sterna maxima			5 / 5 / 0.01
Ruddy Turnstone	Arenaria interpres			
Sabine's Gull	Larus sabini		7 / 4 / 0.01	4 / 2 / 0.01
Scripps's murrelet	Synthliboramphus scrippsi		32 / 14 / 0.04	2 / 2 / 0

Common Name	Latin Name	Winter 2016 (ind./obs./dens.)	Spring 2016 (ind./obs./dens.)	Summer 2016 (ind./obs./dens.)
Short-Tailed / Slender-Billed Shearwater	<i>Puffinus tenuirostris</i>			1 / 1 / 0
Short-Tailed Albatross	<i>Phoebastria albatrus</i>			
Solander's Petrel	<i>Pterodroma solandri</i>			
Sooty Shearwater	<i>Puffinus griseus</i>		1354 / 163 / 1.64	7097 / 450 / 11.97
South Polar Skua	<i>Stercorarius maccormicki</i>			5 / 4 / 0.01
Stejneger's Petrel	<i>Pterodroma longirostris</i>			
Surf Scoter	<i>Melanitta perspicillata</i>	4 / 2 / 0.01	17 / 4 / 0.02	
Thayer's Gull	<i>Larus thayeri</i>			
Tufted Puffin	<i>Fratercula cirrhata</i>			
Unidentified Albatross	(species group)	5 / 5 / 0.01	2 / 1 / 0	1 / 1 / 0
Unidentified Auklet	(species group)			
Unidentified Cormorant	(species group)		8 / 1 / 0.01	
Unidentified Duck	(species group)			
Unidentified Grebe	(species group)			
Unidentified Gull	(species group)	10 / 10 / 0.02	2 / 2 / 0	1 / 1 / 0
Unidentified Jaeger	(species group)			
Unidentified Large Alcid	(species group)			
Unidentified Loon	(species group)			
Unidentified Murre	(species group)	1 / 1 / 0		
Unidentified Petrel	(species group)		4 / 4 / 0	
Unidentified Phalarope	(species group)	3 / 2 / 0.01	33 / 4 / 0.04	
Unidentified Procellarid	(species group)			
Unidentified Shearwater	(species group)	1 / 1 / 0		2 / 2 / 0
Unidentified Skua	(species group)			
Unidentified Small Alcid	(species group)			
Unidentified Storm-Petrel	(species group)	4 / 4 / 0.01	188 / 134 / 0.23	136 / 131 / 0.23
Unidentified Tern	(species group)		2 / 2 / 0	

Common Name	Latin Name	Winter 2016 (ind./obs./dens.)	Spring 2016 (ind./obs./dens.)	Summer 2016 (ind./obs./dens.)
Unidentified Tropicbird	(species group)			
Wedge-Rumped Storm-Petrel	<i>Oceanodroma tethys</i>			
Wedge-Tailed Shearwater	<i>Puffinus pacificus</i>			
Western Grebe	<i>Aechmophorus occidentalis</i>	20 / 1 / 0.04		
Western Gull	<i>Larus occidentalis</i>	89 / 77 / 0.18	539 / 248 / 0.65	323 / 78 / 0.54
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>		1 / 1 / 0	
Xantus's / Craveri's Murrelet	(species group)			
Xantus's Murrelet	<i>Synthliboramphus hypoleucus</i>			

Table 3. 2015 observations by season and species. Cell values represent: the total number of individuals (ind.) / the number of observations per species (obs.) / species density (dens.) in individuals per km².

Common Name	Latin Name	Winter 2015 (ind./obs./dens.)	Spring 2015 (ind./obs./dens.)	Summer 2015 (ind./obs./dens.)
American White Pelican	<i>Pelecanus erythrorhynchos</i>			
Ancient Murrelet	<i>Synthliboramphus antiquus</i>			
Arctic Loon	<i>Gavia arctica</i>			
Arctic Tern	<i>Sterna paradisaea</i>			
Ashy Storm-Petrel	<i>Oceanodroma homochroa</i>		260 / 5 / 0.5	27 / 21 / 0.04
Black guillemot	<i>Cephus grylle</i>			
Black Scoter	<i>Melanitta nigra</i>			
Black Storm-Petrel	<i>Oceanodroma melania</i>		5 / 5 / 0.01	9 / 9 / 0.01
Black-Footed Albatross	<i>Phoebastria nigripes</i>	3 / 3 / 0.02	32 / 32 / 0.06	5 / 5 / 0.01
Black-Legged Kittiwake	<i>Rissa tridactyla</i>			
Black-Vented Shearwater	<i>Puffinus opisthomelas</i>	3 / 3 / 0.02	20 / 6 / 0.04	631 / 55 / 1.02
Bonaparte's Gull	<i>Larus philadelphia</i>		676 / 30 / 1.29	
Brandt's Cormorant	<i>Phalacrocorax penicillatus</i>		165 / 39 / 0.32	58 / 29 / 0.09
Brant	<i>Branta bernicla</i>		29 / 3 / 0.06	
Brown Booby	<i>Sula leucogaster</i>		3 / 3 / 0.01	4 / 3 / 0.01

Common Name	Latin Name	Winter 2015 (ind./obs./dens.)	Spring 2015 (ind./obs./dens.)	Summer 2015 (ind./obs./dens.)
Brown Noddy	Anous stolidus			
Brown Pelican	Pelecanus occidentalis		152 / 29 / 0.29	14 / 6 / 0.02
Buller's Shearwater	Puffinus bulleri			2 / 2 / 0
California Gull	Larus californicus	100 / 29 / 0.61	613 / 77 / 1.17	
Caspian Tern	Sterna caspia			1 / 1 / 0
Cassin's Auklet	Ptychoramphus aleuticus	21 / 13 / 0.13	35 / 16 / 0.07	14 / 8 / 0.02
Clark's Grebe	Aechmophorus clarkii			
Common Loon	Gavia immer		1 / 1 / 0	
Common Murre	Uria aalge		1459 / 229 / 2.79	29 / 9 / 0.05
Common Tern	Sterna hirundo		2 / 1 / 0	1 / 1 / 0
Cook's Petrel	Pterodroma cookii	1 / 1 / 0.01	155 / 114 / 0.3	25 / 22 / 0.04
Craveri's Murrelet	Synthliboramphus craveri			
Dark Shearwater	(species group)			
Dark-Rumped Petrel	Pterodroma phaeopygia sandwichensis			
Double-Crested Cormorant	Phalacrocorax auritus	1 / 1 / 0.01	1 / 1 / 0	
Eared Grebe	Podiceps nigricollis		4 / 3 / 0.01	
Elegant Tern	Sterna elegans		446 / 86 / 0.85	230 / 65 / 0.37
Flesh-Footed Shearwater	Puffinus carneipes			
Fork-Tailed Storm-Petrel	Oceanodroma furcata			
Forster's Tern	Sterna forsteri			
Franklin's Gull	Larus pipixcan			
Glaucous Gull	Larus hyperboreus			
Glaucous-Winged Gull	Larus glaucescens	5 / 5 / 0.03		
Hawaiian Petrel	Pterodroma sandwichensis			
Heermann's Gull	Larus heermanni	5 / 4 / 0.03	35 / 8 / 0.07	4 / 4 / 0.01
Herring Gull	Larus argentatus	1 / 1 / 0.01	1 / 1 / 0	
Horned Puffin	Fratercula corniculata			

Common Name	Latin Name	Winter 2015 (ind./obs./dens.)	Spring 2015 (ind./obs./dens.)	Summer 2015 (ind./obs./dens.)
Hybrid Gull	(species group)			
Juan Fernandez Petrel	Pterodroma externa			
Kelp Gull	Larus dominicanus			
Kermadec Petrel	Pterodroma neglecta			
Laughing Gull	Larus atricilla			
Laysan Albatross	Phoebastria immutabilis	1 / 1 / 0.01	3 / 3 / 0.01	
Leach's Storm-Petrel	Oceanodroma leucorhoa	5 / 5 / 0.03	96 / 75 / 0.18	245 / 194 / 0.4
Least Storm-Petrel	Oceanodroma microsoma			
Least Tern	Sterna antillarum			4 / 2 / 0.01
Long-Tailed Jaeger	Stercorarius longicaudus	1 / 1 / 0.01		
Marbled Murrelet	Brachyramphus marmoratus			
Mew Gull	Larus canus			
Mottled Petrel	Pterodroma inexpectata		1 / 1 / 0	
Murphy's Petrel	Pterodroma ultima		2 / 2 / 0	1 / 1 / 0
Northern Fulmar	Fulmarus glacialis	16 / 9 / 0.1	25 / 23 / 0.05	4 / 4 / 0.01
Osprey	Pandion haliaetus			
Pacific Loon	Gavia pacifica		66 / 33 / 0.13	1 / 1 / 0
Parakeet Auklet	Aethia psittacula			
Parasitic Jaeger	Stercorarius parasiticus		5 / 5 / 0.01	
Parkinson's Petrel	Procellaria parkinsoni			
Pelagic Cormorant	Phalacrocorax pelagicus		65 / 17 / 0.12	5 / 5 / 0.01
Peregrine Falcon	Falco peregrinus			
Pigeon Guillemot	Cephus columba		36 / 14 / 0.07	4 / 3 / 0.01
Pink-Footed Shearwater	Puffinus creatopus		408 / 65 / 0.78	3782 / 167 / 6.13
Pomarine Jaeger	Stercorarius pomarinus	1 / 1 / 0.01	10 / 10 / 0.02	
Red Phalarope	Phalaropus fulcarius	4 / 3 / 0.02	579 / 57 / 1.11	2 / 2 / 0
Red-Billed Tropicbird	Phaethon aethereus		2 / 2 / 0	7 / 7 / 0.01
Red-Footed Booby	Sula sula			

Common Name	Latin Name	Winter 2015 (ind./obs./dens.)	Spring 2015 (ind./obs./dens.)	Summer 2015 (ind./obs./dens.)
Red-Necked Grebe	Podiceps grisegena			
Red-Necked Phalarope	Phalaropus lobatus	17 / 1 / 0.1	632 / 88 / 1.21	259 / 30 / 0.42
Red-Tailed Tropicbird	Pheathon rubricauda	1 / 1 / 0.01		2 / 2 / 0
Red-Throated Loon	Gavia stellata			
Rhinoceros Auklet	Cerorhinca monocerata	20 / 12 / 0.12	47 / 28 / 0.09	
Ring-Billed Gull	Larus delawarensis			
Royal Tern	Sterna maxima			
Ruddy Turnstone	Arenaria interpres			
Sabine's Gull	Larus sabini		4 / 3 / 0.01	
Scripps's murrelet	Synthliboramphus scrippsi	2 / 2 / 0.01	21 / 12 / 0.04	
Short-Tailed / Slender-Billed Shearwater	Puffinus tenuirostris			
Short-Tailed Albatross	Phoebastria albatrus			
Solander's Petrel	Pterodroma solandri			
Sooty Shearwater	Puffinus griseus	1 / 1 / 0.01	4759 / 200 / 9.09	4423 / 390 / 7.16
South Polar Skua	Stercorarius maccormicki			1 / 1 / 0
Stejneger's Petrel	Pterodroma longirostris			
Surf Scoter	Melanitta perspicillata		50 / 4 / 0.1	
Thayer's Gull	Larus thayeri			
Tufted Puffin	Fratercula cirrhata			
Unidentified Albatross	(species group)			
Unidentified Auklet	(species group)			
Unidentified Cormorant	(species group)			
Unidentified Duck	(species group)			
Unidentified Grebe	(species group)			
Unidentified Gull	(species group)		42 / 6 / 0.08	
Unidentified Jaeger	(species group)		2 / 2 / 0	
Unidentified Large Alcid	(species group)			

Common Name	Latin Name	Winter 2015 (ind./obs./dens.)	Spring 2015 (ind./obs./dens.)	Summer 2015 (ind./obs./dens.)
Unidentified Loon	(species group)			
Unidentified Murre	(species group)		8 / 5 / 0.02	3 / 2 / 0
Unidentified Petrel	(species group)		4 / 4 / 0.01	
Unidentified Phalarope	(species group)		6 / 6 / 0.01	1 / 1 / 0
Unidentified Procellarid	(species group)			
Unidentified Shearwater	(species group)		1 / 1 / 0	
Unidentified Skua	(species group)			
Unidentified Small Alcid	(species group)			
Unidentified Storm-Petrel	(species group)		2 / 2 / 0	20 / 20 / 0.03
Unidentified Tern	(species group)		5 / 2 / 0.01	1 / 1 / 0
Unidentified Tropicbird	(species group)			
Wedge-Rumped Storm-Petrel	<i>Oceanodroma tethys</i>			
Wedge-Tailed Shearwater	<i>Puffinus pacificus</i>			
Western Grebe	<i>Aechmophorus occidentalis</i>			
Western Gull	<i>Larus occidentalis</i>	82 / 47 / 0.5	1171 / 376 / 2.24	199 / 138 / 0.32
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>			
Xantus's / Craveri's Murrelet	(species group)			
Xantus's Murrelet	<i>Synthliboramphus hypoleucus</i>			

Appendix 1. Overall seabird distribution maps by season for 2016 and 2015.

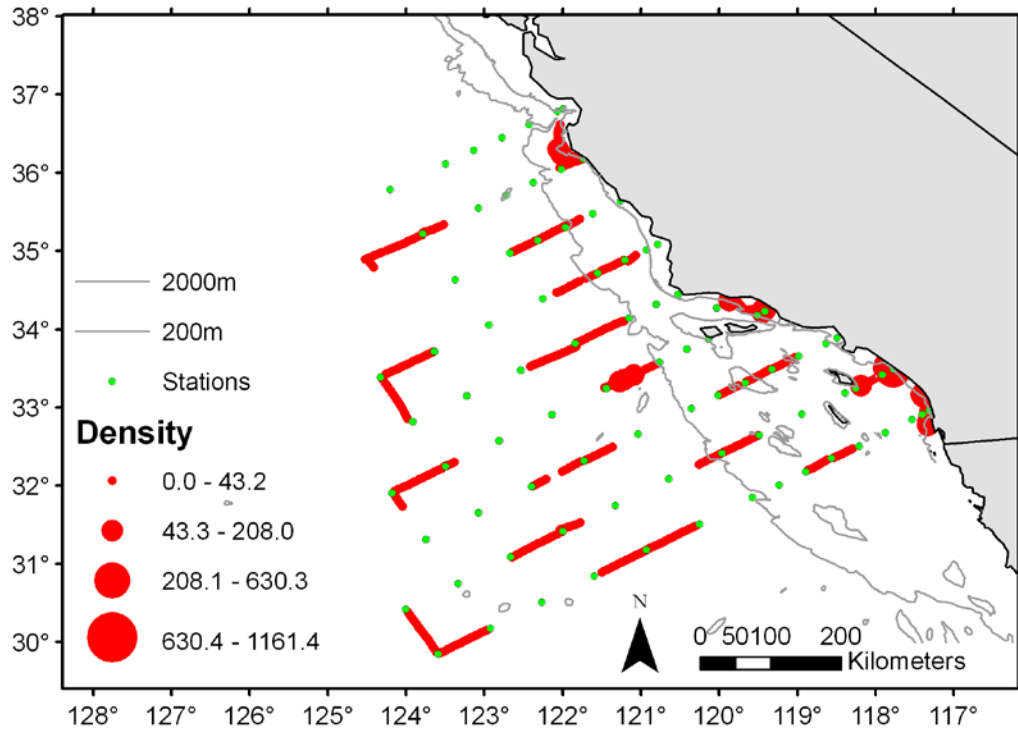


Figure 9. Spatial distribution of all seabird species, winter 2016.

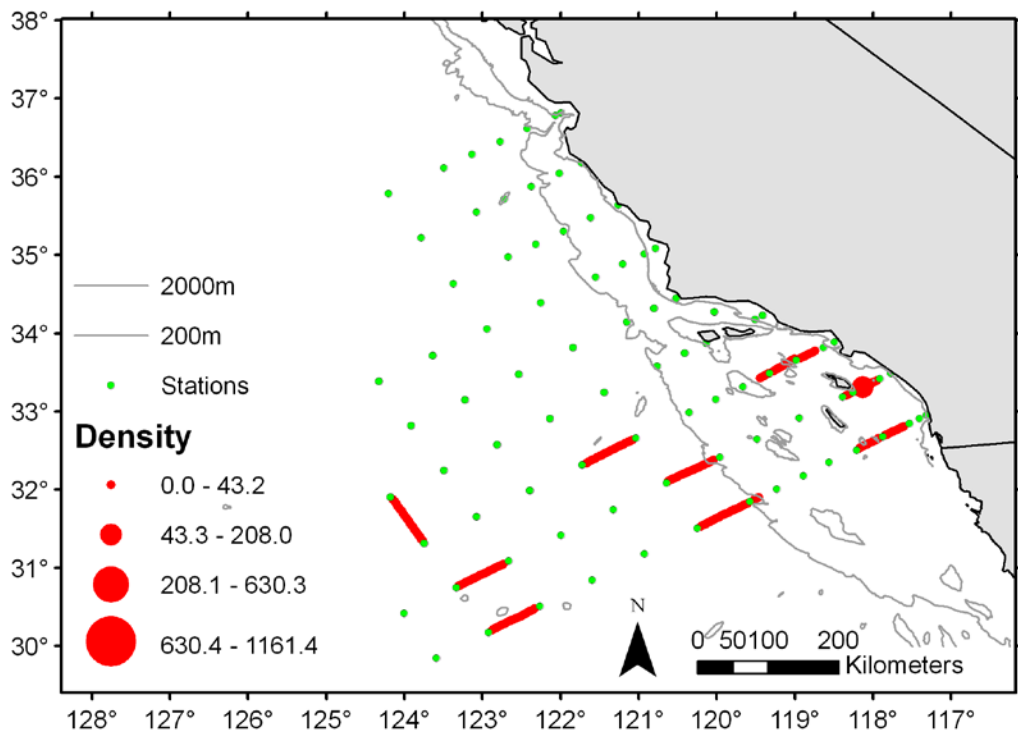


Figure 10. Spatial distribution of all seabird species, winter 2015.

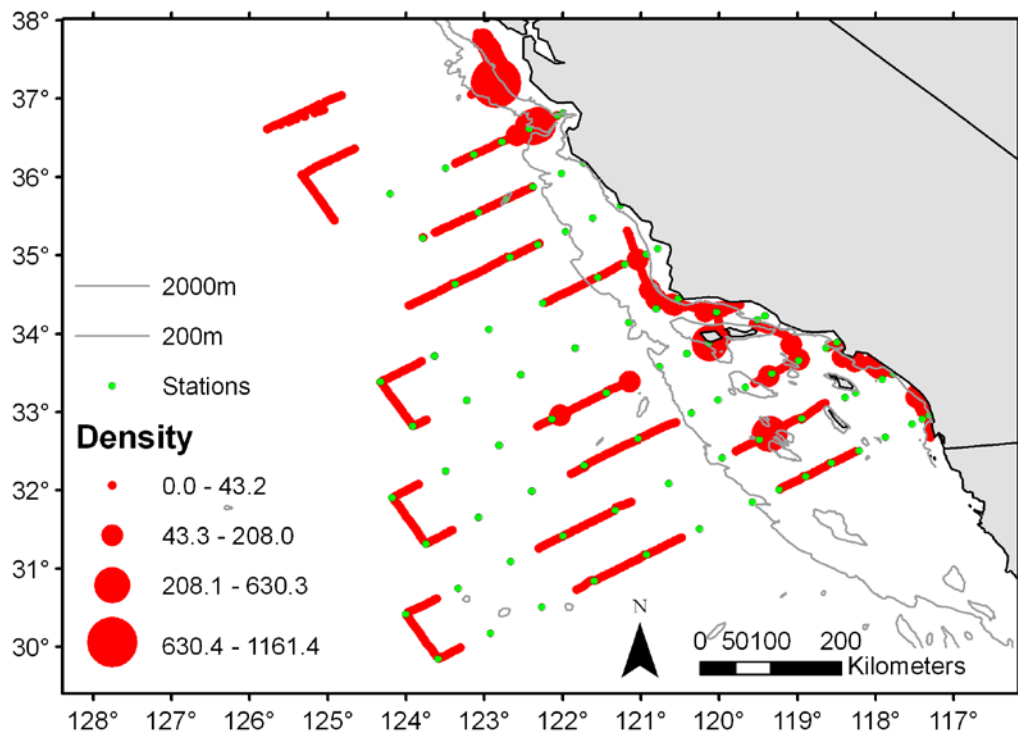


Figure 11. Spatial distribution of all seabird species, spring 2016.

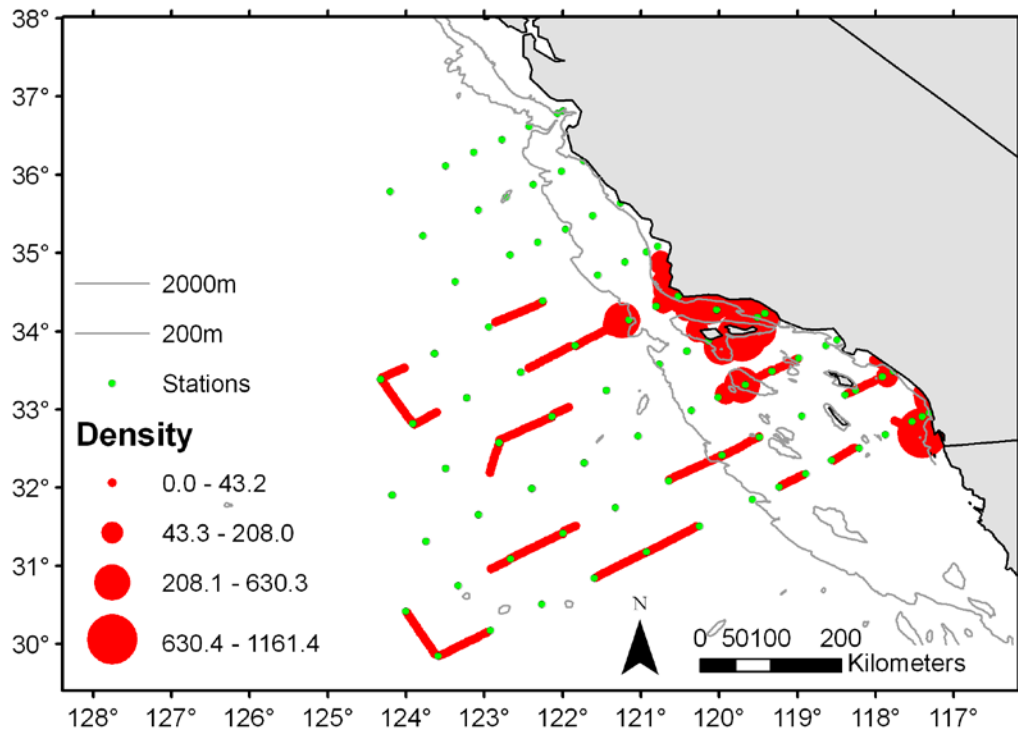


Figure 12. Spatial distribution of all seabird species, spring 2015.

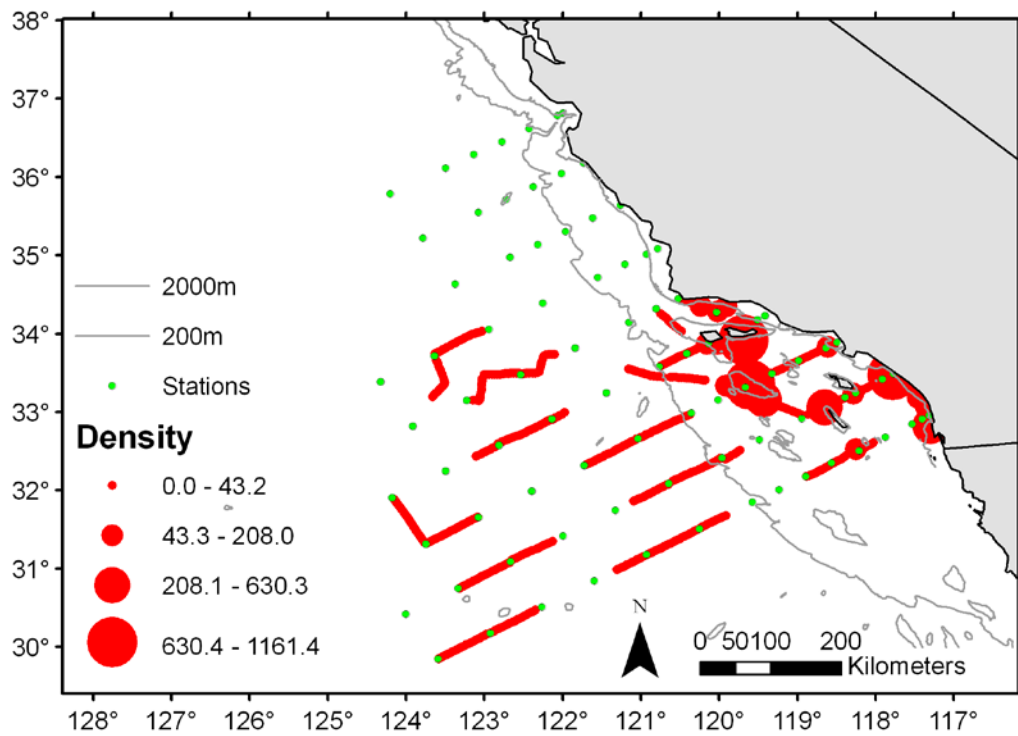


Figure 13. Spatial distribution of all seabird species, summer 2016.

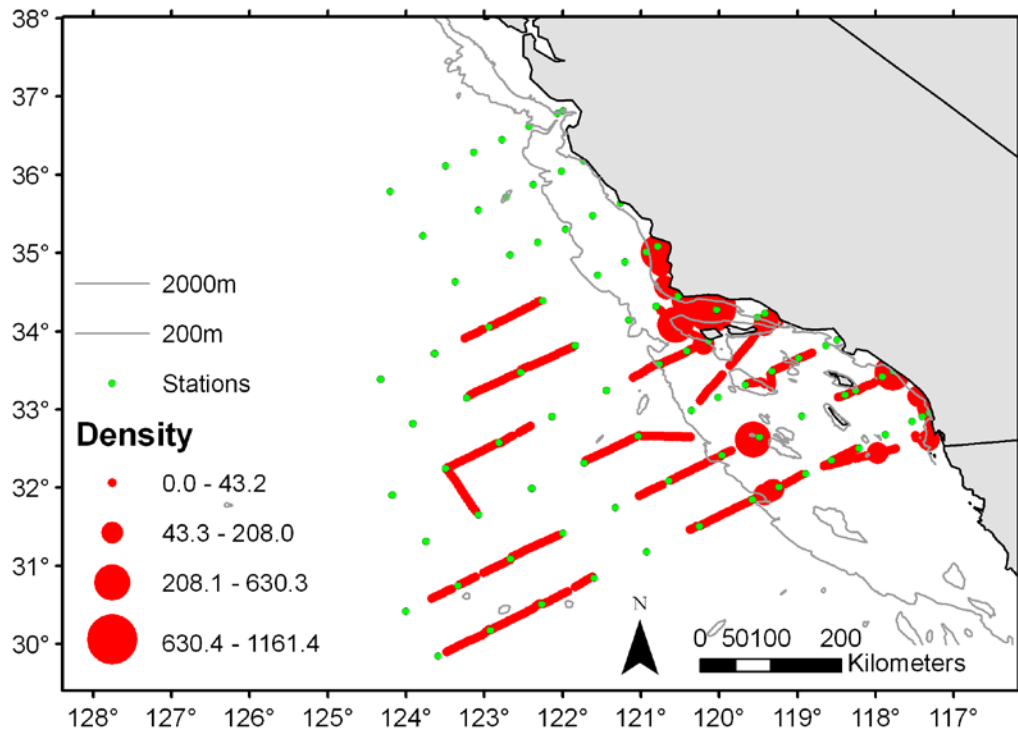


Figure 14. Spatial distribution of all seabird species, summer 2015.

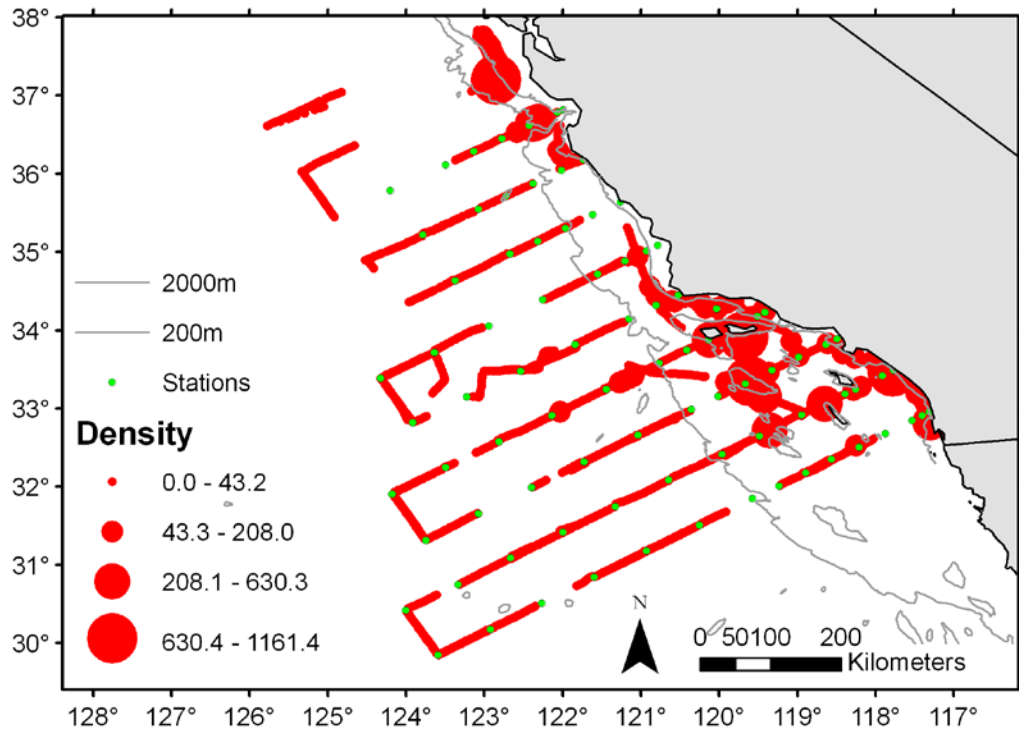


Figure 15. Spatial distribution of all seabird species across all seasons, 2016.

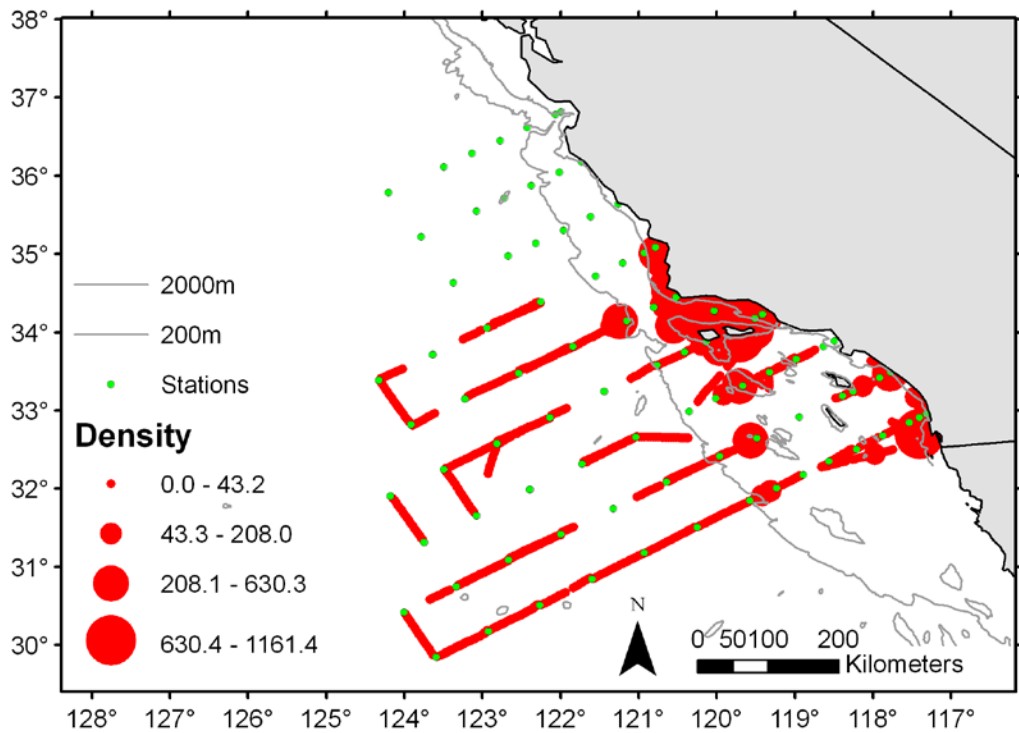


Figure 16. Spatial distribution of all seabird species across all seasons, 2015.

Appendix 2. Species Lists

The following criteria were applied to the survey database to select data for the summary.

Behavior codes included	All values
Species categories included	Birds, Unidentified
Species categories excluded	Mammals, Fish, Excluded Species List
Years	2015, 2016
Months	All months
Bin length	All bins > 0.1km
Region	All regions
Seasons	All seasons

The following species were excluded from this analysis.

Common Name	Latin Name
American Coot	<i>Fulica americana</i>
Black Oystercatcher	<i>Haematopus bachmani</i>
Black Skimmer	<i>Rynchops niger</i>
Black Tern	<i>Chlidonias niger</i>
Black Turnstone	<i>Arenaria melanocephala</i>
Brewer's Sparrow	<i>Spizella breweri</i>
Bufflehead	<i>Bucephala albeola</i>
European Starling	<i>Sturnus vulgaris</i>
Great Blue Heron	<i>Ardea herodias</i>
Great Egret	<i>Ardea alba</i>
Green Heron	<i>Butorides virescens</i>
Least Sandpiper	<i>Calidris minutilla</i>
Long-billed Curlew	<i>Numenius americanus</i>
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>
Mallard Duck	<i>Anas platyrhynchos</i>
Marbled Godwit	<i>Limosa fedoa</i>
Mourning Dove	<i>Zenaida macroura</i>
Red-Breasted Merganser	<i>Mergus serrator</i>
Ruddy Duck	<i>Oxyura jamaicensis</i>
Sanderling	<i>Calidris alba</i>
Snow Goose	<i>Chen caerulescens</i>
Snowy Egret	<i>Egretta thula</i>
Unidentified Bird	(species group)
Unidentified Dowitcher	(species group)
Unidentified Goose	(species group)
Unidentified Hummingbird	(species group)
Unidentified Passerine	(species group)
Unidentified Shorebird	(species group)
Western Sandpiper	<i>Calidris mauri</i>
Whimbrel	<i>Numenius phaeopus</i>
White-Winged Scoter	<i>Melanitta fusca</i>
Willet	<i>Catoptrophorus semipalmatus</i>
Yellow-Rumped Warbler	<i>Dendroica coronata</i>

Baird's Beaked Whale	<i>Berardius bairdii</i>
Blue Shark	<i>Prionace glauca</i>
Blue Whale	<i>Balaenoptera musculus</i>
Bottlenose Dolphin	<i>Tursiops truncatus</i>
California Sea Lion	<i>Zalophus californianus</i>
Common Dolphin	<i>Delphinus delphis</i>
Cuvier's Beaked Whale	<i>Ziphius cavirostris</i>
Dall's Porpoise	<i>Phocoenoides dalli</i>
False Killer Whale	<i>Pseudorca crassidens</i>
Fin Whale	<i>Balaenoptera physalus</i>
Gray Whale	<i>Eschrichtius robustus</i>
Green Sea Turtle	<i>Chelonia mydas</i>
Guadalupe Fur Seal	<i>Arctocephalus townsendi</i>
Hammerhead Shark	<i>Sphyrna</i> spp.
Harbor Porpoise	<i>Phocoena phocoena</i>
Harbor Seal	<i>Phoca vitulina</i>
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>
Humpback Whale	<i>Megaptera novaeangliae</i>
Killer Whale	<i>Orcinus orca</i>
Leatherback Turtle	<i>Dermochelys coriacea</i>
Long-beaked Common Dolphin	<i>Delphinus capensis</i>
Mako Shark	<i>Isurus oxyrinchus</i>
Minke Whale	<i>Balaenoptera acutorostrata</i>
Mola Mola	<i>Mola mola</i>
Northern Elephant Seal	<i>Mirounga angustirostris</i>
Northern Fur Seal	<i>Callorhinus ursinus</i>
Northern Right Whale Dolphin	<i>Lissodelphis borealis</i>
Pacific White-Sided Dolphin	<i>Lagenorhynchus obliquidens</i>
Pilot Whale	<i>Globicephala</i> spp.
Pygmy Sperm Whale	<i>Kogia breviceps</i>
Ridley Sea Turtle	<i>Lepidochelys olivacea</i>
Risso's Dolphin	<i>Grampus griseus</i>
Sea Otter	<i>Enhydra lutris</i>
Sei Whale	<i>Balaenoptera borealis</i>
Short-Beaked Common Dolphin	<i>Delphinus delphis</i>
Short-Finned Pilot Whale	<i>Globicephala macrorhynchus</i>
Sperm Whale	<i>Physeter macrocephalus</i>
Steller Sea Lion	<i>Eumetopias jubatus</i>
Striped Dolphin	<i>Stenella coeruleoalba</i>
Unidentified Balaenoptera	(species group)
Unidentified Beaked Whale	(species group)
Unidentified Cetacean	(species group)
Unidentified Dolphin	(species group)
Unidentified Large Whale	(species group)
Unidentified Mammal	(species group)

Unidentified Pinniped	(species group)
Unidentified Sea Lion	(species group)
Unidentified Seal	(species group)
Unidentified Shark	(species group)
Unidentified Turtle	(species group)
Unidentified Whale	(species group)

For a list of species included in the analysis, please refer to Table 2.