

# Seabird Surveys on CalCOFI/CCE-LTER Cruises, 2011

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## Introduction

Seabird surveys are an integral part of the CalCOFI/CCE-LTER programs, providing data that is valuable on several fronts: 1) measurements provide an upper trophic level perspective to complement the lower trophic level plankton data collected by CalCOFI; 2) estimates of seabird abundance, diversity and distribution may contribute to marine spatial planning and specifically the planning and implementation of Marine Protected Areas in the Southern California Bight region; and, 3) by extending our existing time series (now 25 years and counting), variation in seasonal and annual variation in the seabird community contributes to understanding of the effects of climate variability and change on the California Current Ecosystem. This data report summarizes the at-sea survey observations made during the 2011 CalCOFI/CCE-LTER cruises, and presents basic distribution and density estimates of seabirds. A total of 4517 km (1355 km<sup>2</sup>) of ocean habitat was surveyed on 3 cruises conducted along the CalCOFI grid in winter, spring and summer. A total of 50 days of survey effort is summarized.

## Methods

At-sea observations are made continuously during daylight ship transits between oceanographic-plankton measurement stations. The observer is located on the bridge, approximately 15 meters above sea level and uses hand-held binoculars to assist in the identification and enumeration of birds. The observer records all birds (and mammals) 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 every 10 seconds 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.

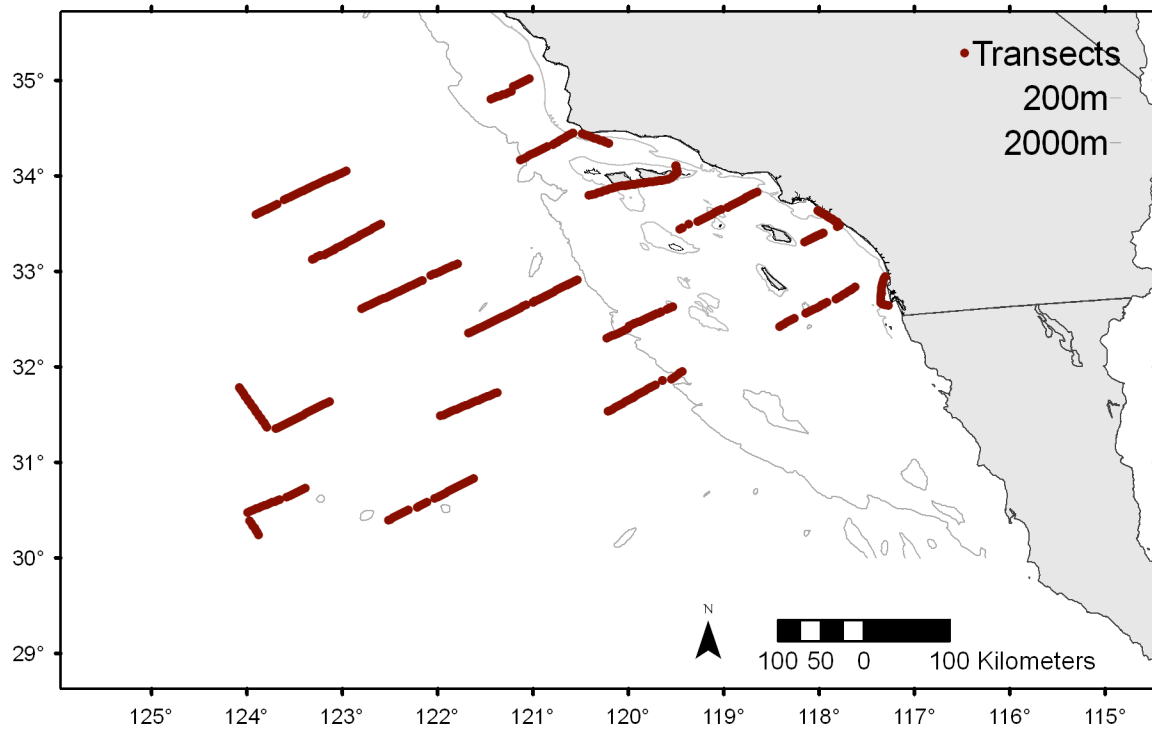
This report summarizes observations for all seasonal surveys conducted in 2011 and is limited to the region covered by CalCOFI lines 76 to 93; the relevant seabird species are listed in Table 2. The taxa excluded from this summary are mammals, fish, terrestrial birds and most shorebirds except phalaropes which are largely pelagic. Species density is calculated as the total number of individuals observed per species divided by the area (km<sup>2</sup>) 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 9.0.

## Results

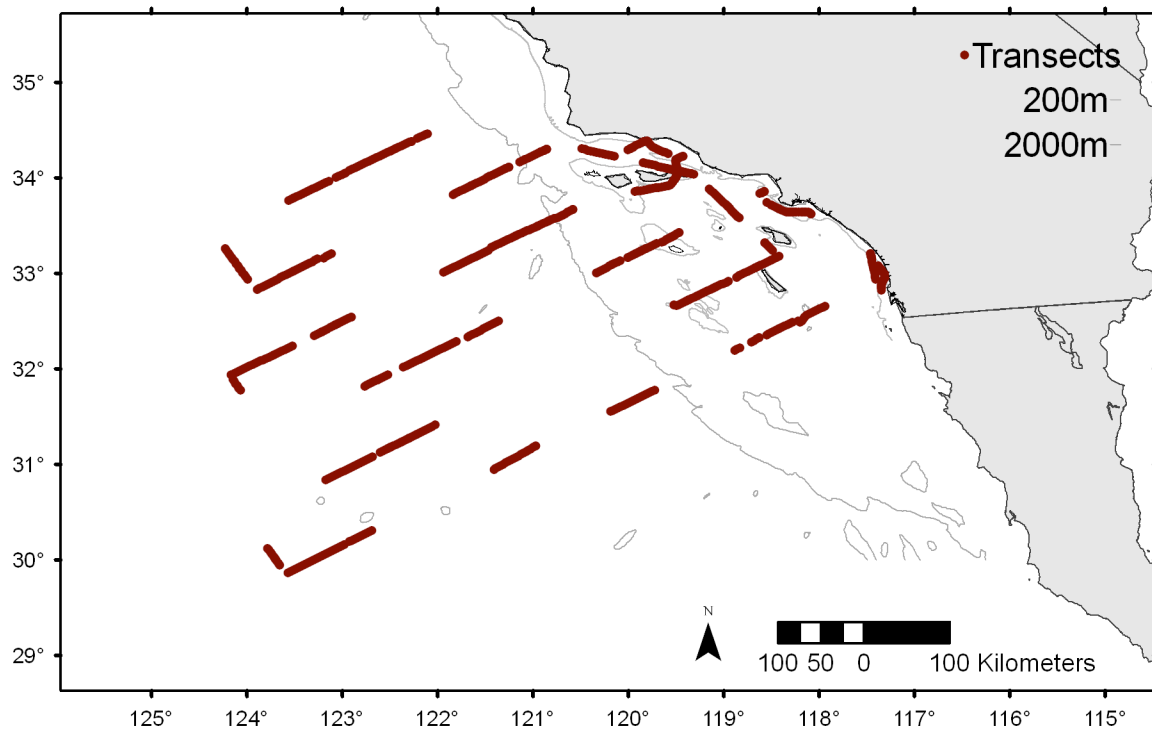
A summary of survey effort is shown in Table 1. Seasonal and overall transects surveyed are shown in Figure 1-4. A summary of species observations is shown in Table 2. Spatial distribution maps for overall seabird density (all species) are shown in Appendix 1. A detailed species list is provided in Appendix 2.

**Table 1. Summary of survey effort and seabird community statistics, 2011 and 2010.**

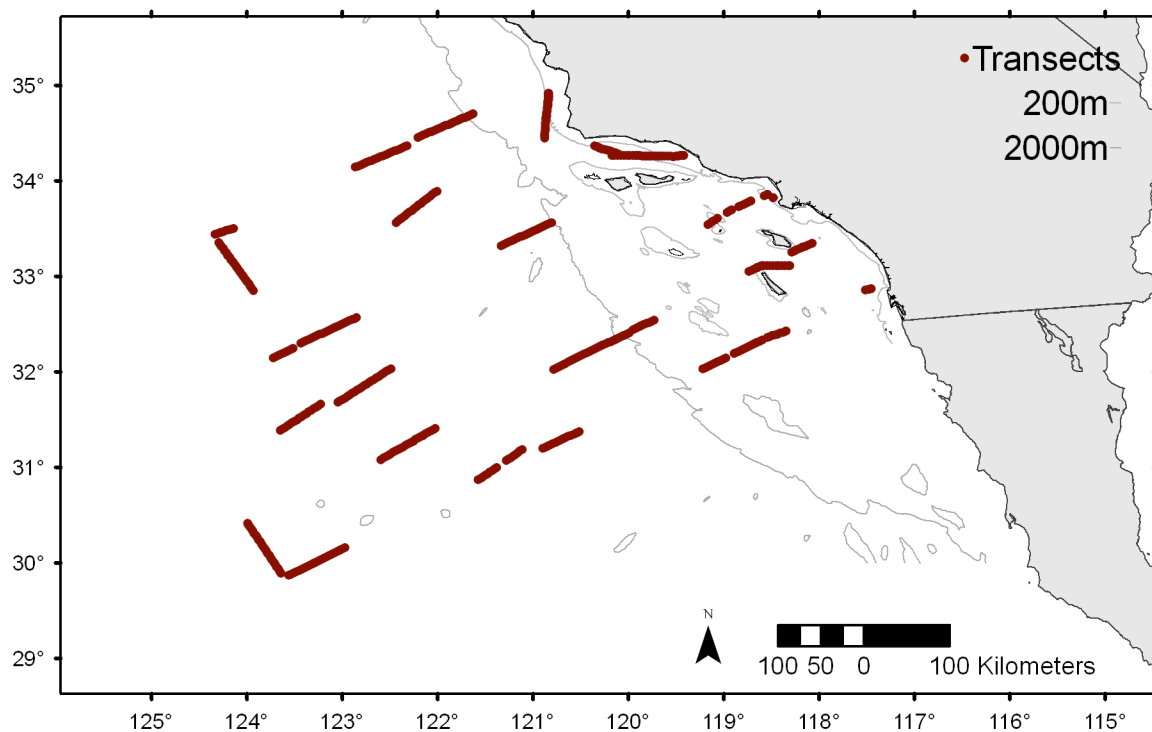
<b>Annual Survey 2011</b>	<b>Winter</b>	<b>Spring</b>	<b>Summer</b>	<b>Total</b>
Survey Vessel	New Horizon	New Horizon	Melville	-
Start Date	1/12/2011	4/9/2011	7/27/2011	-
End Date	1/28/2011	4/26/2011	8/12/2011	-
Survey Days	17	17	16	50
Surveyed Distance (km)	1391	1,823	1,302	4517
Surveyed Area (km <sup>2</sup> )	417	547	391	1355
Number of Bird Species	27	35	28	47
Overall Bird Density (per km <sup>2</sup> )	2.84	5.24	1.62	3.45
Total Individuals Counted	1183	2866	633	4682
<b>Annual Survey 2010</b>				
Survey Vessel	New Horizon	Miller Freeman	New Horizon	-
Start Date	1/12/2010	4/26/2010	7/30/2010	-
End Date	1/31/2010	5/16/2010	8/15/2010	-
Survey Days	18	13	17	48
Surveyed Distance (km)	1080	1188.19	1823.73	4091.92
Surveyed Area (km <sup>2</sup> )	324	356.48	547.12	1227.6
Number of Bird Species	33	29	29	45
Overall Bird Density (per km <sup>2</sup> )	4.929	6.441	7.284	6.417
Total Individuals Counted	1597	2296	3985	7878



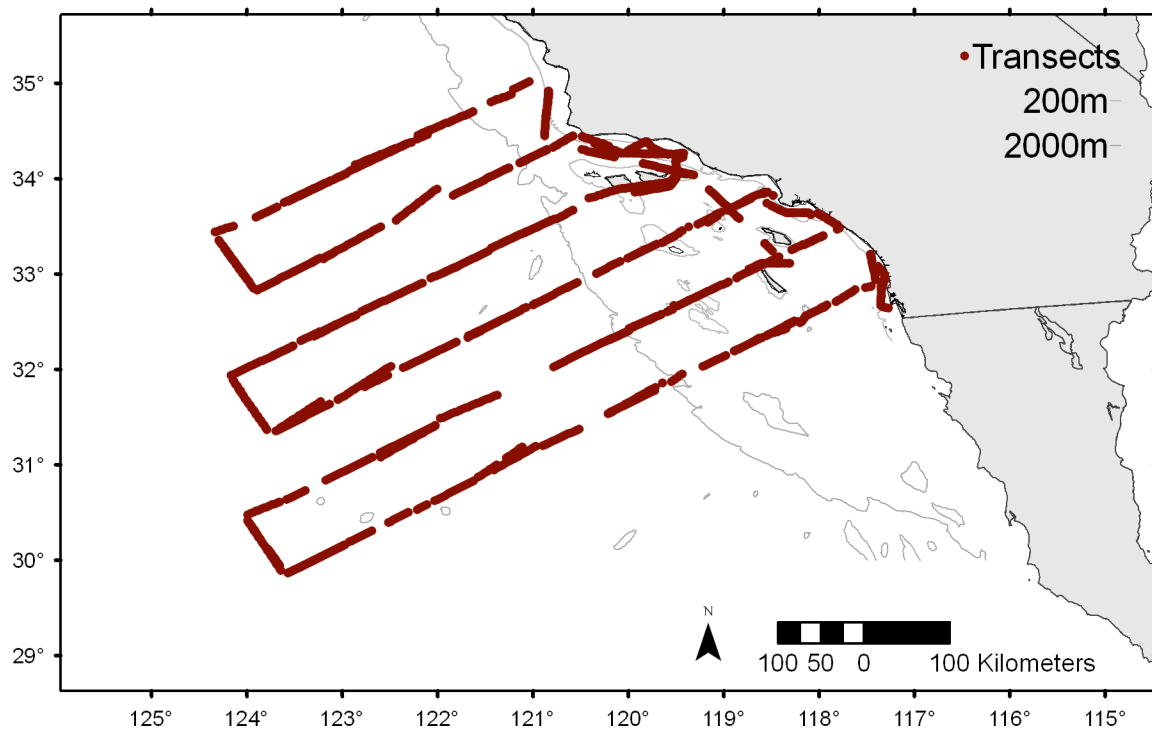
**Figure 1. 2011 Transects, winter survey.**



**Figure 2. 2011 Transects, spring survey.**



**Figure 3. 2011 Transects, summer survey.**



**Figure 4. 2011 Transects, all surveys.**

**Table 2. Annual observation summary, broken down by season and by species. Cell values represent: the total number of individuals (ind.) / the number of observations per species (obs.) / the average species density (number km<sup>-2</sup>).**

<b>Common Name</b>	<b>Latin Name</b>	<b>Winter Ind.,obs.,dens.</b>	<b>Spring Ind.,obs.,dens.</b>	<b>Summer Ind.,obs.,dens.</b>
Ancient Murrelet	<i>Synthliboramphus antiquus</i>			
Arctic Loon	<i>Gavia arctica</i>			
Arctic Tern	<i>Sterna paradisaea</i>		1/1/0.002	
Ashy Storm-Petrel	<i>Oceanodroma homochroa</i>			
American White Pelican	<i>Pelecanus erythrorhynchos</i>			
Black-Footed Albatross	<i>Phoebastria nigripes</i>	2/2/0.005	16/15/0.038	26/24/0.062
Black-Legged Kittiwake	<i>Rissa tridactyla</i>	4/4/0.01		
Black Scoter	<i>Melanitta nigra</i>			
Black Storm-Petrel	<i>Oceanodroma melania</i>			5/4/0.012
Bonaparte's Gull	<i>Larus philadelphia</i>	38/4/0.091	62/11/0.149	
Brandt's Cormorant	<i>Phalacrocorax penicillatus</i>	114/41/0.273	54/18/0.129	1/1/0.002
Brant	<i>Branta bernicla</i>		100/3/0.24	
Brown Booby	<i>Sula leucogaster</i>			1/1/0.002
Brown Noddy	<i>Anous stolidus</i>			
Brown Pelican	<i>Pelecanus occidentalis</i>	109/30/0.261	152/23/0.365	10/4/0.024
Buller's Shearwater	<i>Puffinus bulleri</i>		2/2/0.005	2/2/0.005
Black-Vented Shearwater	<i>Puffinus opisthomelas</i>		6/2/0.014	3/2/0.007
Cassin's Auklet	<i>Ptychoramphus aleuticus</i>	84/52/0.201	19/11/0.046	3/2/0.007
California Gull	<i>Larus californicus</i>	292/116/0.7	43/21/0.103	5/2/0.012
Caspian Tern	<i>Sterna caspia</i>	2/2/0.005		
Clark's Grebe	<i>Aechmophorus clarkii</i>	2/1/0.005		
Common Loon	<i>Gavia immer</i>		3/2/0.007	
Common Murre	<i>Uria aalge</i>	23/15/0.055	125/12/0.3	26/18/0.062
Cook's Petrel	<i>Pterodroma cookii</i>	12/10/0.029	32/25/0.077	61/31/0.146
Common Tern	<i>Sterna hirundo</i>			
Craveri's Murrelet	<i>Synthliboramphus craveri</i>			

<b>Common Name</b>	<b>Latin Name</b>	<b>Winter Ind.,obs.,dens.</b>	<b>Spring Ind.,obs.,dens.</b>	<b>Summer Ind.,obs.,dens.</b>
Double-Crested Cormorant	Phalacrocorax auritus		26/12/0.062	7/6/0.017
Dark Shearwater	(species group)			
Dark-Rumped Petrel	Pterodroma phaeopygia sandwichensis			
Eared Grebe	Podiceps nigricollis			
Elegant Tern	Sterna elegans		107/31/0.257	50/25/0.12
Flesh-Footed Shearwater	Puffinus carneipes			
Forster's Tern	Sterna forsteri	3/1/0.007	1/1/0.002	
Franklin's Gull	Larus pipixcan			
Fork-Tailed Storm-Petrel	Oceanodroma furcata			
Glaucous Gull	Larus hyperboreus			
Glaucous-Winged Gull	Larus glaucescens	1/1/0.002	1/1/0.002	
Hawaiian Petrel	Pterodroma sandwichensis			
Heermann's Gull	Larus heermanni	62/16/0.149		20/2/0.048
Herring Gull	Larus argentatus	3/3/0.007		
Horned Puffin	Fratercula corniculata			
Hybrid Gull	(species group)			
Juan Fernandez Petrel	Pterodroma externa			
Kelp Gull	Larus dominicanus			
Kermadec Petrel	Pterodroma neglecta			
Laysan Albatross	Phoebastria immutabilis	2/2/0.005	2/2/0.005	
Laughing Gull	Larus atricilla			
Least Tern	Sterna antillarum		2/1/0.005	
Leach's Storm-Petrel	Oceanodroma leucorhoa	13/7/0.031	42/32/0.101	86/81/0.206
Long-Tailed Jaeger	Stercorarius longicaudus			1/1/0.002
Least Storm-Petrel	Oceanodroma microsoma			
Marbled Murrelet	Brachyramphus marmoratus			
Mew Gull	Larus canus			
Mottled Petrel	Pterodroma inexpectata			

<b>Common Name</b>	<b>Latin Name</b>	<b>Winter Ind.,obs.,dens.</b>	<b>Spring Ind.,obs.,dens.</b>	<b>Summer Ind.,obs.,dens.</b>
Murphy's Petrel	<i>Pterodroma ultima</i>		1/1/0.002	1/1/0.002
Northern Fulmar	<i>Fulmarus glacialis</i>	20/18/0.048	11/9/0.026	19/16/0.046
Osprey	<i>Pandion haliaetus</i>			
Parakeet Auklet	<i>Aethia psittacula</i>			
Parasitic Jaeger	<i>Stercorarius parasiticus</i>	4/4/0.01	4/4/0.01	4/4/0.01
Pacific Loon	<i>Gavia pacifica</i>	2/2/0.005	15/11/0.036	
Parkinson's Petrel	<i>Procellaria parkinsoni</i>			
Pelagic Cormorant	<i>Phalacrocorax pelagicus</i>			
Peregrine Falcon	<i>Falco peregrinus</i>			
Pink-Footed Shearwater	<i>Puffinus creatopus</i>		27/24/0.065	30/21/0.072
Pigeon Guillemot	<i>Cepphus columba</i>			
Pomarine Jaeger	<i>Stercorarius pomarinus</i>	2/2/0.005	6/6/0.014	8/7/0.019
Ring-Billed Gull	<i>Larus delawarensis</i>		6/4/0.014	
Red-Billed Tropicbird	<i>Phaethon aethereus</i>			1/1/0.002
Red Phalarope	<i>Phalaropus fulcarius</i>	92/39/0.221	650/117/1.559	42/16/0.101
Red-Footed Booby	<i>Sula sula</i>			
Rhinoceros Auklet	<i>Cerorhinca monocerata</i>	67/41/0.161	12/7/0.029	1/1/0.002
Red-Necked Grebe	<i>Podiceps grisegena</i>			
Red-Necked Phalarope	<i>Phalaropus lobatus</i>		877/37/2.103	28/7/0.067
Royal Tern	<i>Sterna maxima</i>	1/1/0.002		
Red-Throated Loon	<i>Gavia stellata</i>			
Red-Tailed Tropicbird	<i>Phaethon rubricauda</i>			
Ruddy Turnstone	<i>Arenaria interpres</i>			
Sabine's Gull	<i>Larus sabini</i>		5/1/0.012	
Short-Tailed / Slender-Billed Shearwater	<i>Puffinus tenuirostris</i>	2/2/0.005	5/5/0.012	
Solander's Petrel	<i>Pterodroma solandri</i>			
Sooty Shearwater	<i>Puffinus griseus</i>		196/81/0.47	78/36/0.187
South Polar Skua	<i>Stercorarius maccormicki</i>			1/1/0.002

<b>Common Name</b>	<b>Latin Name</b>	<b>Winter Ind.,obs.,dens.</b>	<b>Spring Ind.,obs.,dens.</b>	<b>Summer Ind.,obs.,dens.</b>
Short-Tailed Albatross	Phoebastria albatrus			
Stejneger's Petrel	Pterodroma longirostris			
Surf Scoter	Melanitta perspicillata		9/3/0.022	
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)	2/2/0.005	4/4/0.01	1/1/0.002
Unidentified Jaeger	(species group)			
Unidentified Large Alcid	(species group)			
Unidentified Loon	(species group)			
Unidentified Murre	(species group)			
Unidentified Procellariid	(species group)			
Unidentified Petrel	(species group)			
Unidentified Phalarope	(species group)		3/1/0.007	5/3/0.012
Unidentified Small Alcid	(species group)			
Unidentified Shearwater	(species group)			
Unidentified Skua	(species group)			
Unidentified Storm-Petrel	(species group)			
Unidentified Tern	(species group)			
Unidentified Tropicbird	(species group)			
Western Grebe	Aechmophorus occidentalis	2/1/0.005		
Western Gull	Larus occidentalis	223/160/0.535	239/180/0.573	107/59/0.257
Wilson's Storm-Petrel	Oceanites oceanicus			
Wedge-Rumped Storm-Petrel	Oceanodroma tethys			



<b>Common Name</b>	<b>Latin Name</b>	<b>Winter Ind.,obs.,dens.</b>	<b>Spring Ind.,obs.,dens.</b>	<b>Summer Ind.,obs.,dens.</b>
Wedge-Tailed Shearwater	<i>Puffinus pacificus</i>			
Xantus's Murrelet	<i>Synthliboramphus hypoleucus</i>			
Xantus's / Craveri's Murrelet	(species group)			

## Appendix 1. Species distribution maps by season for 2011 and 2010

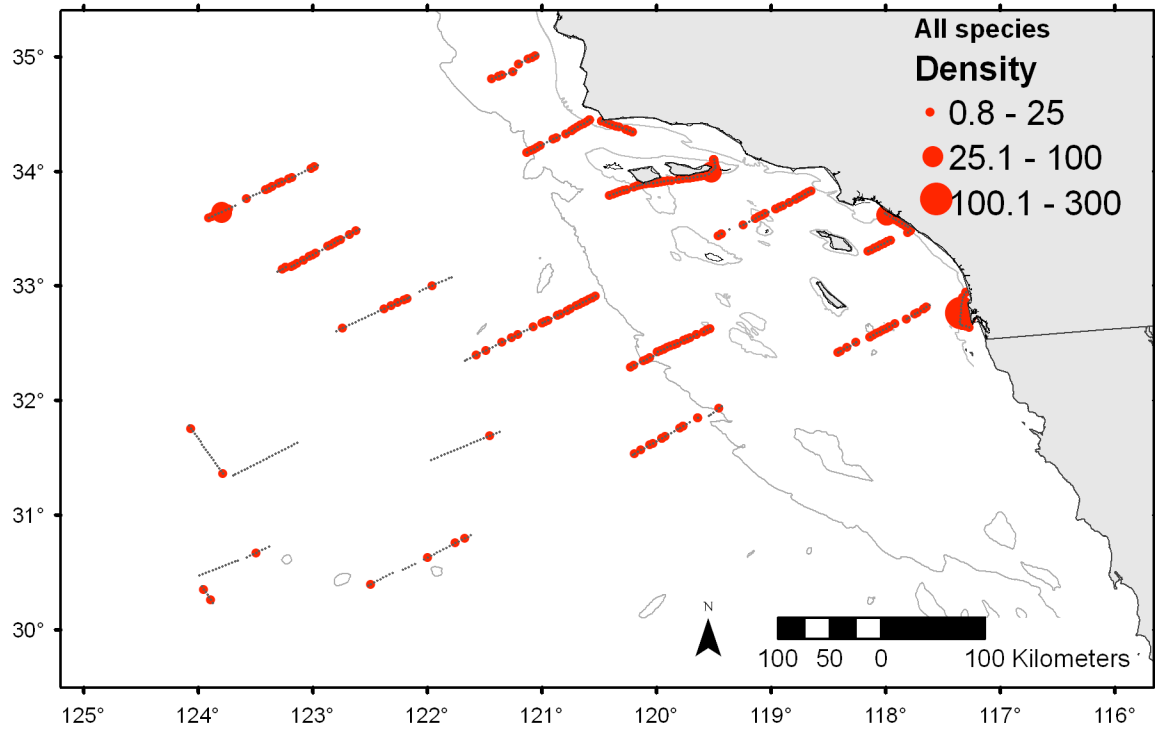


Figure 5. 2011 Spatial distribution of all species, winter survey.

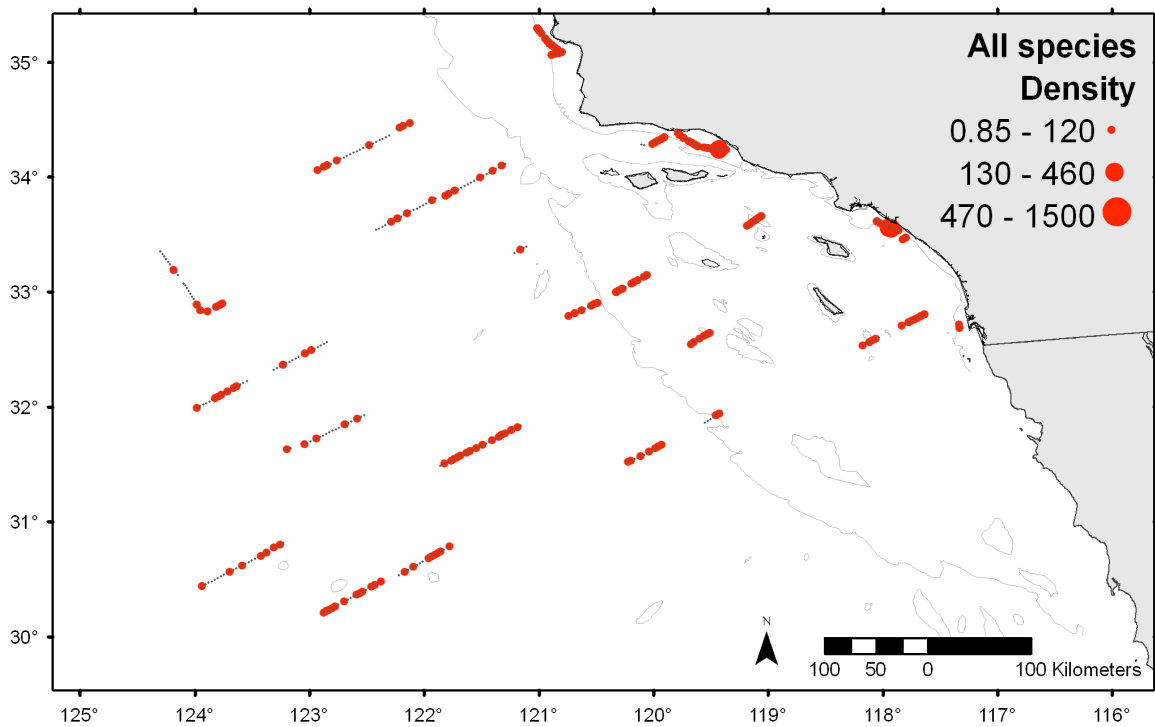


Figure 6. 2010 Spatial distribution of all species, winter survey. Note the difference in scale with 2011.

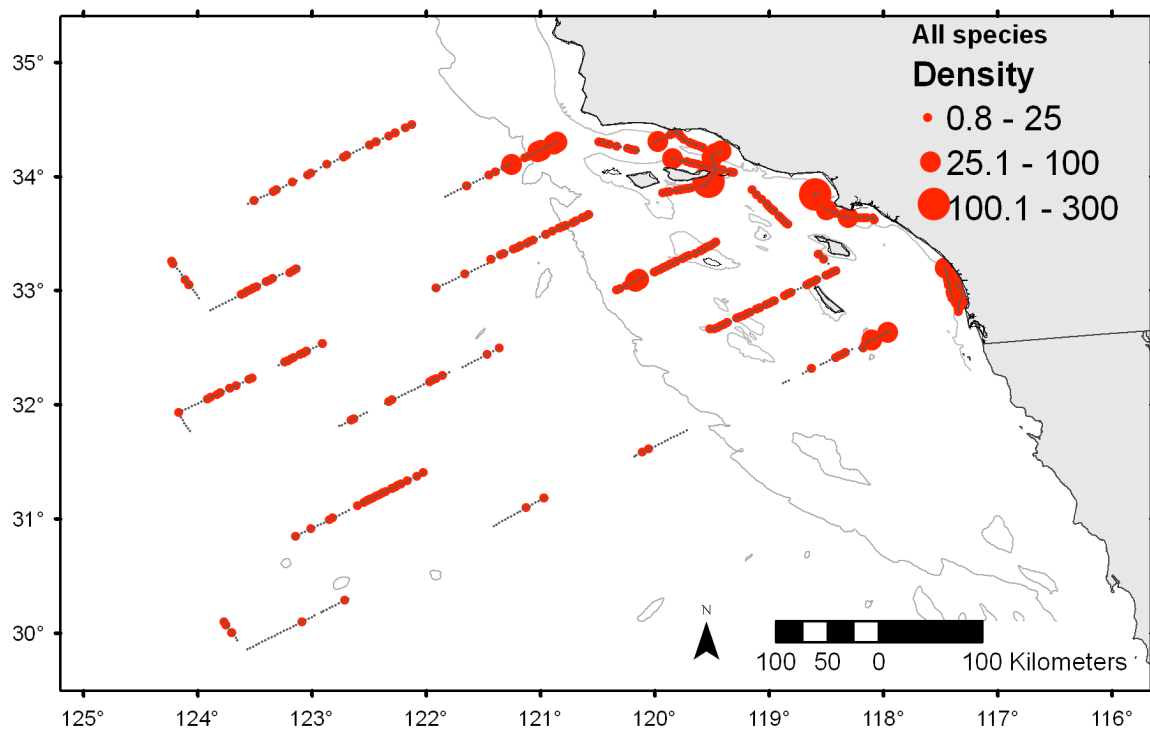


Figure 7. 2011 Spatial distribution of all species, spring survey.

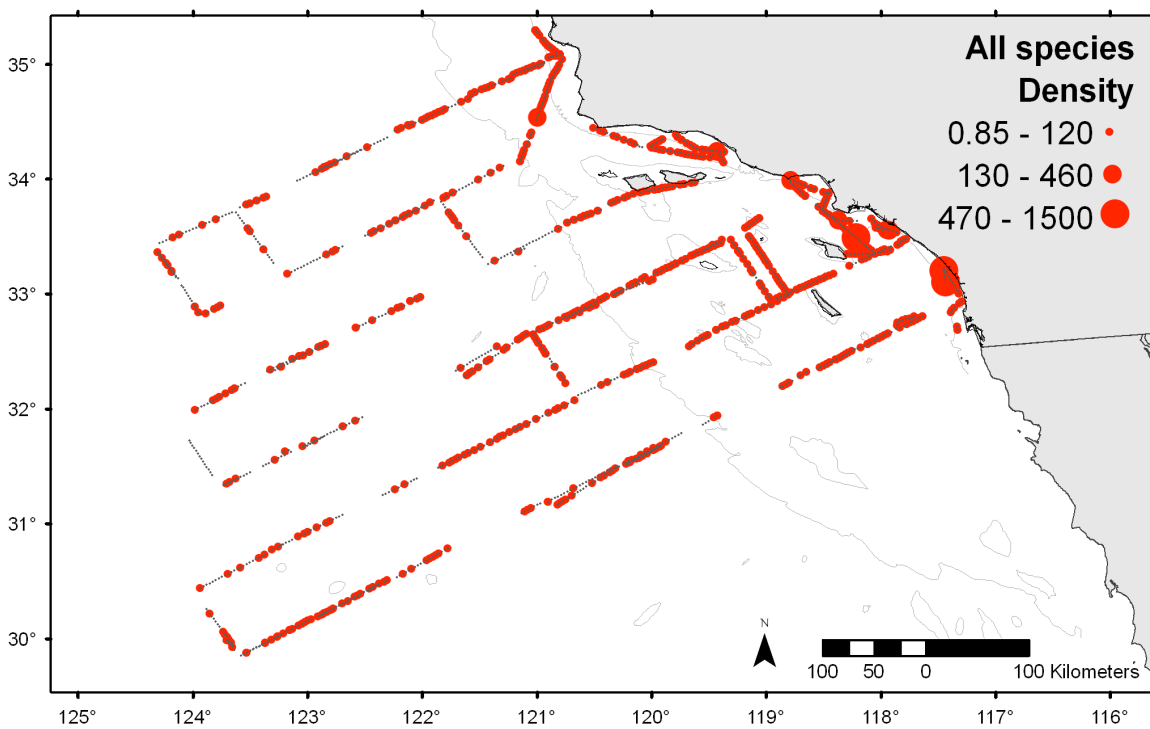


Figure 8. 2010 Spatial distribution of all species, spring survey. Note the difference in scale with 2011.

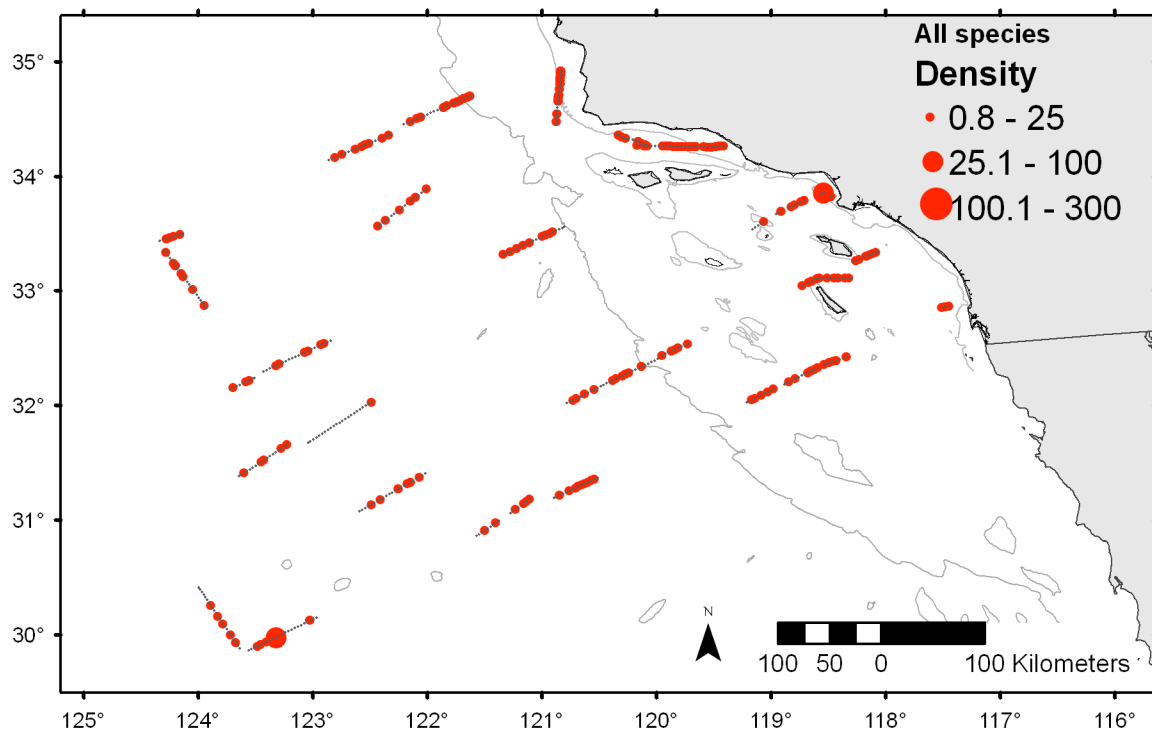


Figure 9. 2011 Spatial distribution of all species, summer survey.

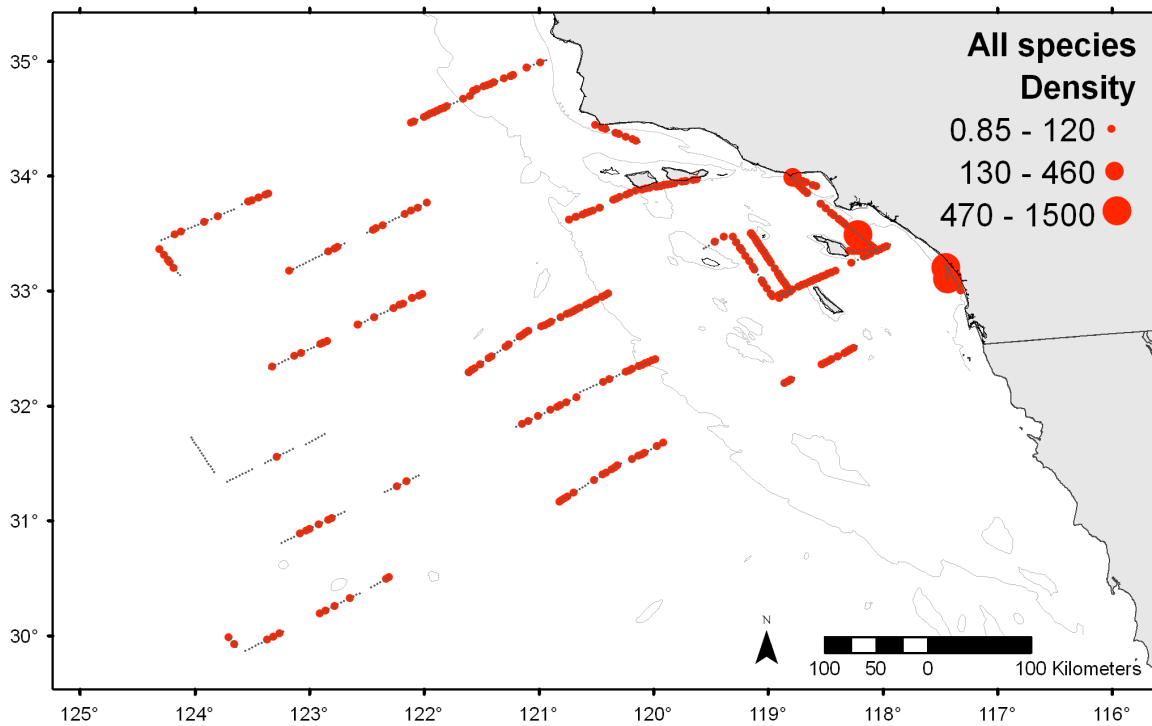


Figure 10. 2010 Spatial distribution of all species, summer survey. Note the difference in scale with 2011.

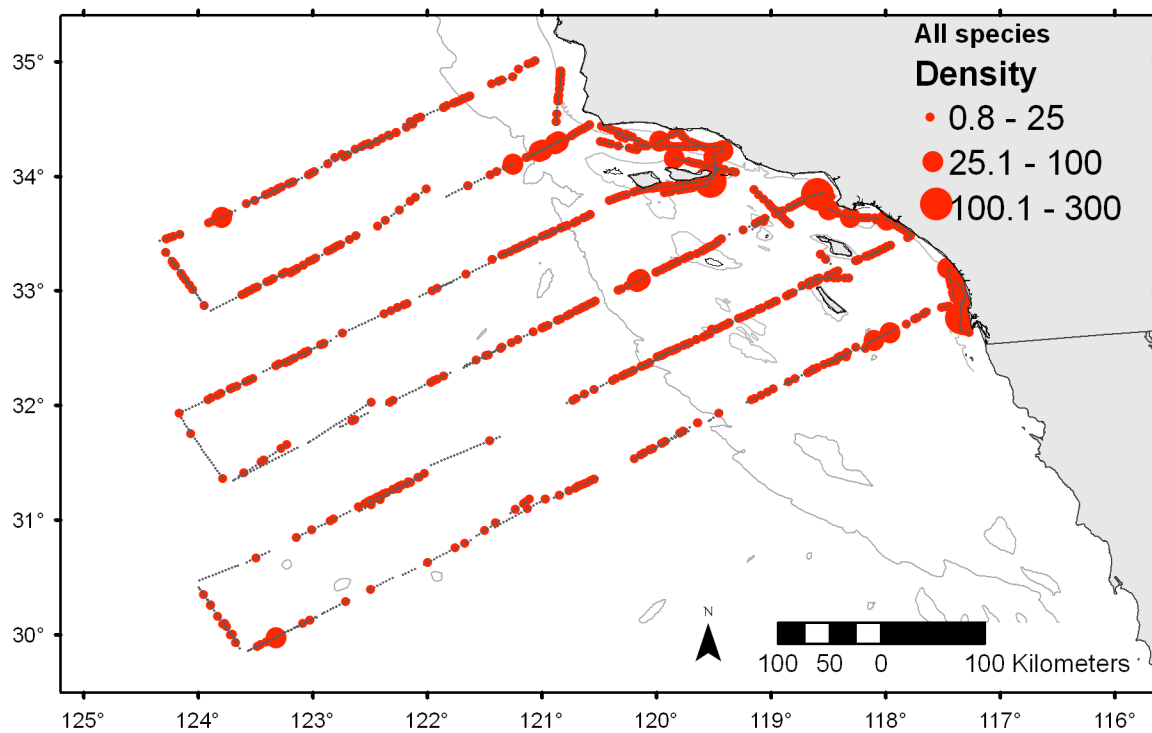


Figure 11. 2011 Spatial distribution of all species, all seasons.

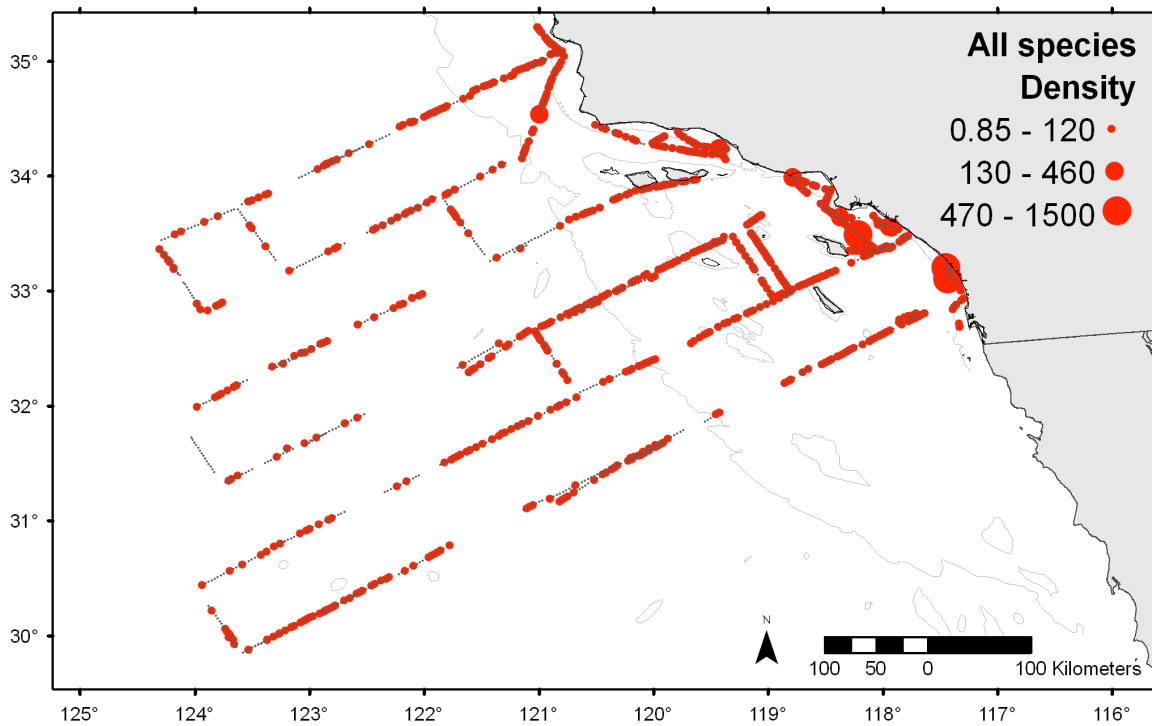


Figure 12. 2010 Spatial distribution of all species, all seasons. Note the difference in scale with 2011.

## Appendix 2. Species Lists

### *Data selection criteria*

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	2011
Months	All months
Bin length	All bins > 0.1km
Region	Core region: lines 76 to 93 (south of 35°N)
Seasons	All seasons

### *Excluded Species List*

The following species were excluded from the analysis.

Common Name	Latin Name
American Coot	Fulica americana
Black Oystercatcher	Haematopus bachmani
Black Skimmer	Rynchops niger
Black Tern	Chlidonias niger
Black Turnstone	Arenaria melanocephala
Brewer's Sparrow	Spizella breweri
Bufflehead	Bucephala albeola
European Starling	Sturnus vulgaris
Great Blue Heron	Ardea herodias
Great Egret	Ardea alba
Green Heron	Butorides virescens
Least Sandpiper	Calidris minutilla
Long-billed Curlew	Numenius americanus
Long-billed Dowitcher	Limnodromus scolopaceus
Mallard Duck	Anas platyrhynchos
Marbled Godwit	Limosa fedoa
Mourning Dove	Zenaida macroura
Red-Breasted Merganser	Mergus serrator
Ruddy Duck	Oxyura jamaicensis
Sanderling	Calidris alba
Snow Goose	Chen caerulescens
Snowy Egret	Egretta thula
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>
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	Stenella coeruleoalba
Unidentified Baleinoptera	(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)

### ***Included Species List***

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