

**Seabirds and Marine Mammals on the NMFS  
*Rockfish Recruitment and Ecosystem Assessment Survey: 2021 Data Report***

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## Introduction

Seabird and marine mammal observations are an integral part of the NMFS Rockfish Recruitment and Ecosystem Assessment Survey (RREAS). These data are valuable for several reasons: (1) measurements provide an upper trophic level perspective to complement the oceanographic and mid-trophic level data collected by NMFS, (2) estimates of seabird and marine mammal abundance, diversity and distribution may contribute to various aspects of ecosystem and fisheries management, and (3) by extending our existing time series, measuring annual variation in the top predator community contributes to understanding the effects of climate variability and change on the California Current Ecosystem (CCE). This data report summarizes the at-sea survey observations made during the 2021 cruise, and presents basic distribution and abundance estimates for seabirds and mammals. There was no survey in 2020 due to the COVID-19 pandemic. We thank John Field, Keith Sakuma, and the captain and crew of the *R/V Reuben Lasker* for facilitating this project. Funding for making observations was provided by NOAA (IOOS-SCCOOS), NSF-LTER CCE project, and private sources.

## Methods

Observations of seabirds and marine mammals are made continuously during daylight ship transits between oceanographic and fish 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 and mammals. For seabirds, the observer records all individuals seen within a 300-meter strip transect to one side and front of the vessel while the ship is underway at speeds greater than 5 knots. For mammals, the observer records all individuals out to the horizon while the ship is underway. 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 on the water” for birds). 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 that contains data from May 1996 to the present. These data are used to derive summary statistics on abundance. Species data are presented for both the core region and the full (core + extended) region surveyed since 2004 (see Sakuma et al. 2006 for delineations).

**Table 1.** The following criteria were applied to the survey database to select data for the data summary and report.

Criteria	Value
Behavior codes included	All values
Species categories included	Birds, Mammals, Unidentified
Species categories excluded	Fish, Excluded Species List
Year	2021
Month	All
Bin length	All bins > 0.1 km
Region	Core and Full

Taxa excluded from this summary were fish, terrestrial birds, and most shorebirds except phalaropes, which are largely pelagic. For seabirds, density is calculated as the total number of individuals observed per species divided by the area (km<sup>2</sup>) surveyed. For mammals, an “encounter rate” is defined as the total number of individuals observed per species divided by the linear amount of habitat (km) sampled. Density/encounter rate over time is shown for select seabird and mammal species in the core survey area 1996–2021. Seabirds highlighted in this report are black-footed albatross (*Phoebastria nigripes*), Brandt’s cormorant (*Phalacrocorax penicillatus*), brown pelican (*Pelecanus occidentalis*), Cassin’s auklet (*Ptychoramphus aleuticus*), common murre (*Uria aalge*), northern fulmar (*Fulmarus glacialis*), pink-footed shearwater (*Puffinus creatopus*), and sooty shearwater (*P. griseus*). Marine mammals included are blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), and Risso’s dolphin (*Grampus griseus*).

## Results

A summary of survey effort is shown in Table 2; transects surveyed are shown in Figure 1. Summarized species observations for all species in the core and total survey area are shown in Tables 3 and 4 (see Appendix 1 for exclusions). A total of 38 days of survey effort covering 4,212 km (1,263 km<sup>2</sup>) of ocean habitat is summarized; 17 days were spent covering 1,396 km (419 km<sup>2</sup>) in the core survey area between Cypress Point and Bodega Bay.

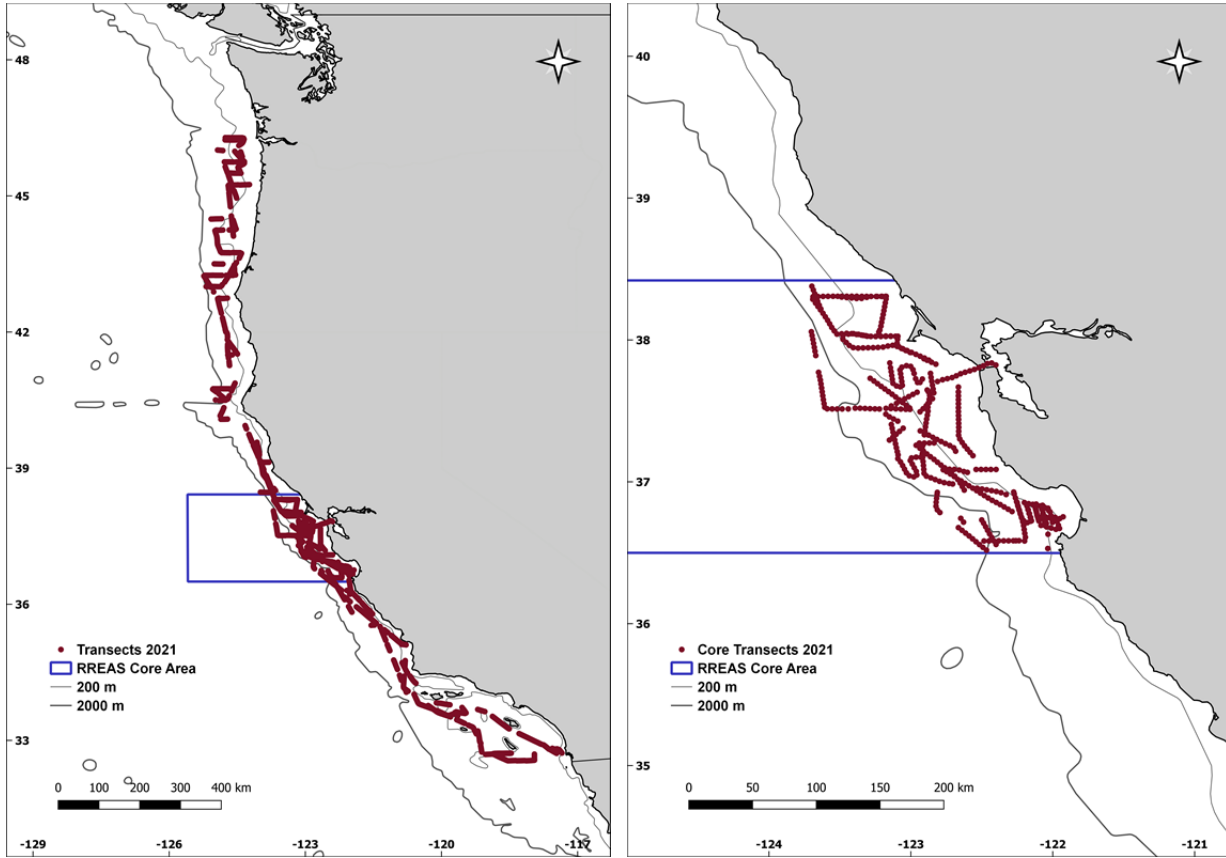
Density/encounter rates over time in the core area for the selected species are shown in Figures 2–5. Notable results from the 2021 survey include very high densities of three seabird species with cold-water habitat affinity: common murre, northern fulmar, and sooty shearwater (highest density of the time series) (Figure 3). Additionally, Brandt’s cormorant, a warmer-water species (but one that is largely endemic to the California Current upwelling domain), showed high density (Figure 2). Within 1 s.d. of the long-term mean density, black-footed albatross and Cassin’s auklet were below average, and brown pelican and pink-footed shearwater were present at average densities. Density for the eight species combined was the second highest in the survey time series; only 2019 was higher (Figure 5). One particular notable seabird observation on this survey was the rare sighting of short-tailed albatross (*Phoebastria albatrus*; see cover photo).

Our focal marine mammals, combined, had below average abundance (Figure 5). Blue whales were above average in abundance in 2020, and show an increasing trend since 2010 (Figure 4). Humpback whales were present at average abundance, having come down from the higher abundances generally seen since 2012. Pacific white-sided dolphins had lower than average abundance, but Risso’s dolphins were above average in abundance this year.

**Table 2.** Summary of survey effort and seabird and mammal community statistics.

2021	Core Area	Full Area
Survey vessel		<i>R/V Reuben Lasker</i>
Start date		4/28/2021
End date		6/10/2021
Number of survey days	17	38
Distance surveyed (km)	1,396	4,212
Area surveyed (km <sup>2</sup> )	419	1,263
Number of bird species	45	56
Overall bird density (per km <sup>2</sup> )	79.55	40.1
Total birds observed	33,320	50,721
Number of mammal species	14	22
Overall mammal encounter rate (per 100 km)	20.4	89.9
Total mammals observed	285	3,785

**Figure 1.** 2021 survey transects for the full (left) and core (right) regions. Gaps usually reflect nighttime.



**Table 3.** Bird survey observations, stratified by area and species. Cell values represent: total number of individuals seen / number of species sightings / average density (birds/km<sup>2</sup>).

Common Name	Scientific Name	Core Area	Full Area
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>	7 / 1 / 0.02	15 / 4 / 0.01
Ashy Storm-Petrel	<i>Oceanodroma homochroa</i>	17 / 10 / 0.04	21 / 13 / 0.02
Black guillemot	<i>Cephus grylle</i>		
Black Scoter	<i>Melanitta nigra</i>		
Black Storm-Petrel	<i>Oceanodroma melania</i>		25 / 16 / 0.02
Black-Footed Albatross	<i>Phoebastria nigripes</i>	137 / 121 / 0.33	471 / 415 / 0.37
Black-Legged Kittiwake	<i>Rissa tridactyla</i>	15 / 15 / 0.04	23 / 23 / 0.02
Black-Vented Shearwater	<i>Puffinus opisthomelas</i>		
Bonaparte's Gull	<i>Larus philadelphia</i>	3 / 2 / 0.01	3 / 2 / 0
Brandt's Cormorant	<i>Phalacrocorax penicillatus</i>	499 / 94 / 1.19	703 / 181 / 0.56
Brant	<i>Branta bernicla</i>	23 / 1 / 0.05	23 / 1 / 0.02
Brown Booby	<i>Sula leucogaster</i>		
Brown Noddy	<i>Anous stolidus</i>		
Brown Pelican	<i>Pelecanus occidentalis</i>	17 / 14 / 0.04	106 / 55 / 0.08
Buller's Shearwater	<i>Puffinus bulleri</i>		
California Gull	<i>Larus californicus</i>	130 / 76 / 0.31	219 / 130 / 0.17
Caspian Tern	<i>Sterna caspia</i>		
Cassin's Auklet	<i>Ptychoramphus aleuticus</i>	226 / 70 / 0.54	306 / 103 / 0.24
Clark's Grebe	<i>Aechmophorus clarkii</i>		
Common Loon	<i>Gavia immer</i>	2 / 2 / 0	3 / 3 / 0
Common Murre	<i>Uria aalge</i>	7435 / 1451 / 17.75	8836 / 1777 / 6.99
Common Tern	<i>Sterna hirundo</i>		
Cook's Petrel	<i>Pterodroma cookii</i>		5 / 5 / 0
Craveri's Murrelet	<i>Synthliboramphus craveri</i>		
Dark Shearwater	(species group)	2048 / 41 / 4.89	2148 / 65 / 1.7
Dark-Rumped Petrel	<i>Pterodroma phaeopygia sandwichensis</i>		
Double-Crested Cormorant	<i>Phalacrocorax auritus</i>	2 / 2 / 0	3 / 3 / 0
Eared Grebe	<i>Podiceps nigricollis</i>		1 / 1 / 0
Elegant Tern	<i>Sterna elegans</i>	5 / 2 / 0.01	29 / 19 / 0.02
Flesh-Footed Shearwater	<i>Puffinus carneipes</i>		1 / 1 / 0
Fork-Tailed Storm-Petrel	<i>Oceanodroma furcata</i>	4 / 3 / 0.01	316 / 215 / 0.25
Forster's Tern	<i>Sterna forsteri</i>	47 / 3 / 0.11	53 / 7 / 0.04
Franklin's Gull	<i>Larus pipixcan</i>		
Glaucous Gull	<i>Larus hyperboreus</i>		
Glaucous-Winged Gull	<i>Larus glaucescens</i>	1 / 1 / 0	1 / 1 / 0
Glaucous-winged / Western Hybrid Gull		1 / 1 / 0	30 / 30 / 0.02
Guadalupe Murrelet	<i>Synthliboramphus hypoleucus</i>		
Hawaiian Petrel	<i>Pterodroma sandwichensis</i>	1 / 1 / 0	1 / 1 / 0

Heermann's Gull	<i>Larus heermanni</i>		
Herring Gull	<i>Larus argentatus</i>	31 / 25 / 0.07	36 / 30 / 0.03
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>		
Leach's Storm-Petrel	<i>Oceanodroma leucorhoa</i>	1 / 1 / 0	67 / 53 / 0.05
Least Storm-Petrel	<i>Oceanodroma microsoma</i>		
Least Tern	<i>Sterna antillarum</i>		
Long-Tailed Jaeger	<i>Stercorarius longicaudus</i>		4 / 4 / 0
Manx Shearwater	<i>Puffinus puffinus</i>		1 / 1 / 0
Marbled Murrelet	<i>Brachyramphus marmoratus</i>		
Masked Booby	<i>Sula dactylatra</i>		1 / 1 / 0
Mew Gull	<i>Larus canus</i>		
Mottled Petrel	<i>Pterodroma inexpectata</i>		
Murphy's Petrel	<i>Pterodroma ultima</i>	1 / 1 / 0	1 / 1 / 0
Northern Fulmar	<i>Fulmarus glacialis</i>	205 / 167 / 0.49	313 / 265 / 0.25
Osprey	<i>Pandion haliaetus</i>		
Pacific Loon	<i>Gavia pacifica</i>	16 / 13 / 0.04	29 / 20 / 0.02
Parakeet Auklet	<i>Aethia psittacula</i>		1 / 1 / 0
Parasitic Jaeger	<i>Stercorarius parasiticus</i>	1 / 1 / 0	20 / 17 / 0.02
Parkinson's Petrel	<i>Procellaria parkinsoni</i>		
Pelagic Cormorant	<i>Phalacrocorax pelagicus</i>	7 / 6 / 0.02	7 / 6 / 0.01
Peregrine Falcon	<i>Falco peregrinus</i>	1 / 1 / 0	1 / 1 / 0
Pigeon Guillemot	<i>Cephus columba</i>		
Pink-Footed Shearwater	<i>Puffinus creatopus</i>	194 / 149 / 0.46	885 / 468 / 0.7
Pomarine Jaeger	<i>Stercorarius pomarinus</i>	10 / 9 / 0.02	14 / 13 / 0.01
Red Phalarope	<i>Phalaropus fulicaria</i>		
Red-Billed Tropicbird	<i>Phaethon aethereus</i>		
Red-Footed Booby	<i>Sula sula</i>		
Red-Necked Grebe	<i>Podiceps grisegena</i>		
Red-Necked Phalarope	<i>Phalaropus lobatus</i>	1708 / 227 / 4.08	2574 / 339 / 2.04
Red-Tailed Tropicbird	<i>Pheathon rubricauda</i>		
Red-Throated Loon	<i>Gavia stellata</i>	1 / 1 / 0	1 / 1 / 0
Rhinoceros Auklet	<i>Cerorhinca monocerata</i>	143 / 87 / 0.34	298 / 182 / 0.24
Ring-Billed Gull	<i>Larus delawarensis</i>		
Royal Tern	<i>Sterna maxima</i>		1 / 1 / 0
Ruddy Turnstone	<i>Arenaria interpres</i>		
Sabine's Gull	<i>Larus sabini</i>	78 / 26 / 0.19	160 / 52 / 0.13
Scripps's murrelet	<i>Synthliboramphus scrippsi</i>	4 / 2 / 0.01	17 / 8 / 0.01
Short-Tailed / Slender-Billed Shearwater	<i>Puffinus tenuirostris</i>	2 / 2 / 0	3 / 3 / 0
Short-Tailed Albatross	<i>Phoebastria albatrus</i>	3 / 3 / 0.01	3 / 3 / 0
Solander's Petrel	<i>Pterodroma solandri</i>		
Sooty Shearwater	<i>Puffinus griseus</i>	19580 / 1167 / 46.75	31621 / 2567 / 25.03

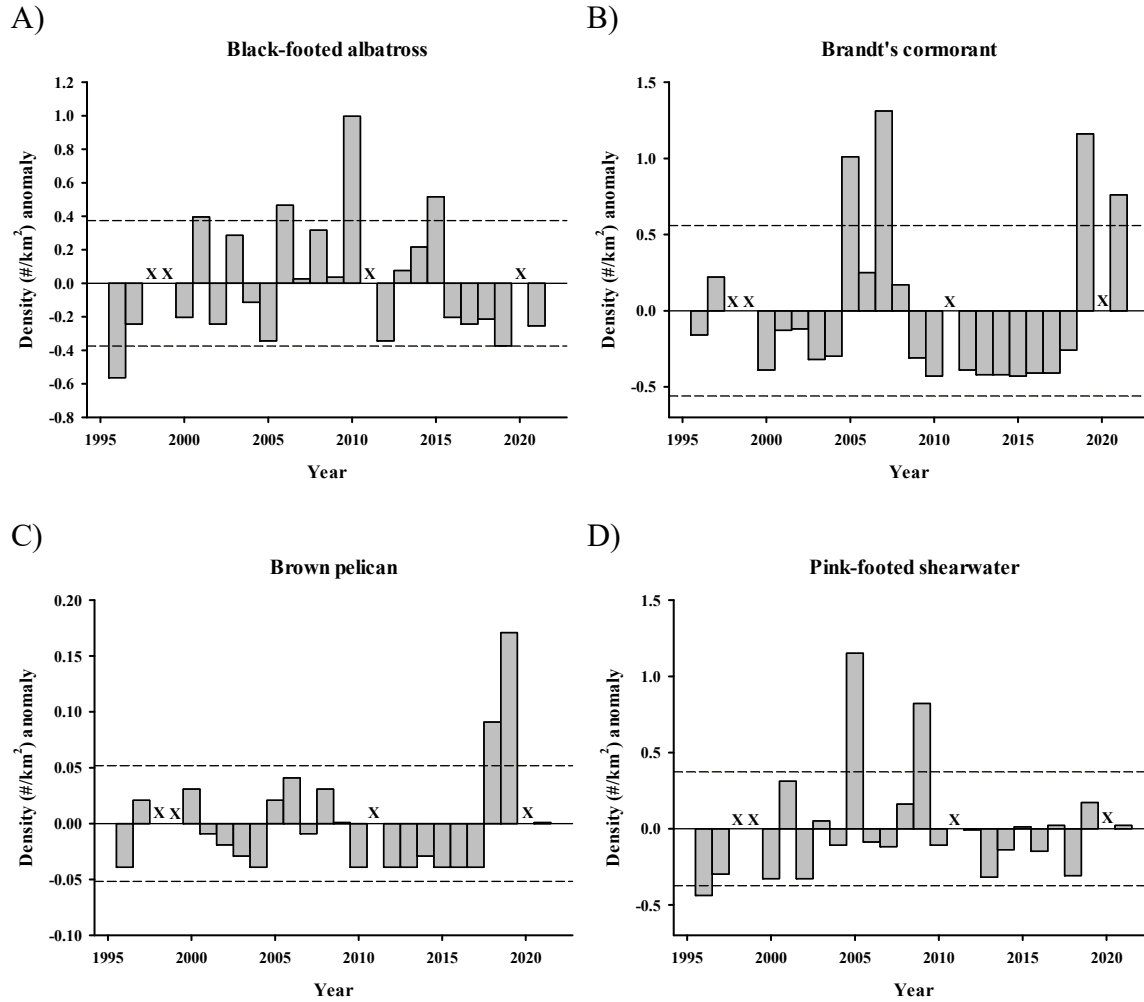
South Polar Skua	<i>Stercorarius maccormicki</i>		2 / 2 / 0
Stejneger's Petrel	<i>Pterodroma longirostris</i>		
Surf Scoter	<i>Melanitta perspicillata</i>	16 / 4 / 0.04	16 / 4 / 0.01
Thayer's Gull	<i>Larus thayeri</i>		
Townsend's Storm-Petrel	<i>Oceanodroma socorroensis</i>		
Tufted Puffin	<i>Fratercula cirrhata</i>	6 / 5 / 0.01	9 / 8 / 0.01
Unidentified Albatross	(species group)		
Unidentified Auklet	(species group)		
Unidentified Cormorant	(species group)	2 / 2 / 0	2 / 2 / 0
Unidentified Duck	(species group)		
Unidentified Grebe	(species group)		
Unidentified Gull	(species group)	115 / 68 / 0.27	201 / 130 / 0.16
Unidentified Jaeger	(species group)		
Unidentified Large Alcid	(species group)		
Unidentified Leach's Storm-Petrel	(species group)		
Unidentified Loon	(species group)		
Unidentified Murre	(species group)		
Unidentified Petrel	(species group)		
Unidentified Phalarope	(species group)		
Unidentified Procellarid	(species group)		
Unidentified Shearwater	(species group)		
Unidentified Skua	(species group)		
Unidentified Small Alcid	(species group)	4 / 3 / 0.01	6 / 5 / 0
Unidentified Storm-Petrel	(species group)		22 / 3 / 0.02
Unidentified Tern	(species group)		
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>	3 / 3 / 0.01	3 / 3 / 0
Western Gull	<i>Larus occidentalis</i>	568 / 350 / 1.36	1059 / 717 / 0.84
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>		
Xantus's / Craveri's Murrelet	(species group)		2 / 1 / 0
Xantus's Murrelet	<i>Synthliboramphus hypoleucus</i>		



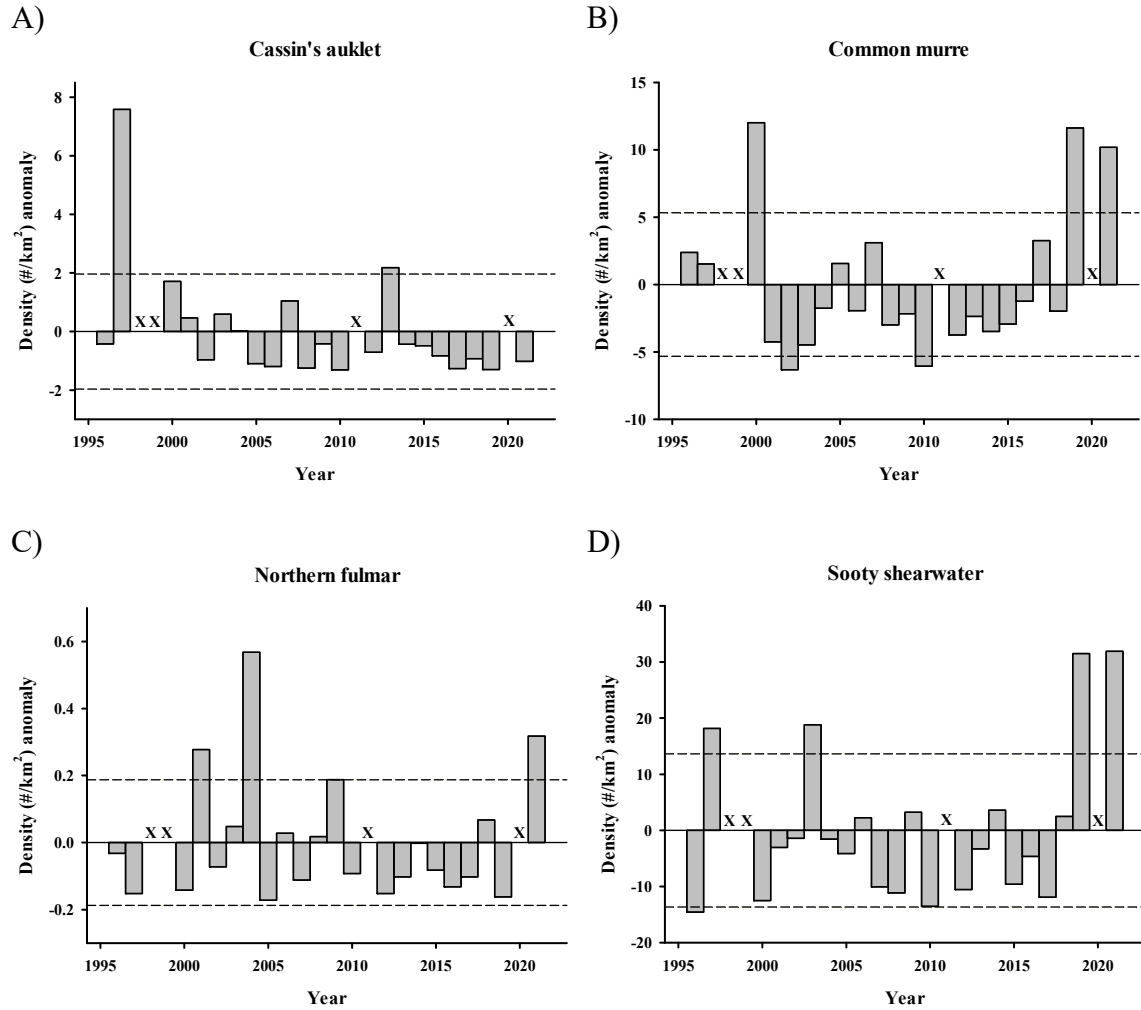
**Table 4.** Mammal survey observation summary, broken down by survey area and species. Cell values represent: total number of species individuals / number of species sightings / average species encounter rate (individuals per 100 km).

Common Name	Scientific Name	Core Area	Full Area
Baird's Beaked Whale	<i>Berardius bairdii</i>		
Blue Whale	<i>Balaenoptera musculus</i>	23 / 12 / 1.6	40 / 26 / 0.9
Bottlenose Dolphin	<i>Tursiops truncatus</i>		
California Sea Lion	<i>Zalophus californianus</i>	22 / 9 / 1.6	280 / 34 / 6.6
Common Dolphin	<i>Delphinus delphis</i>		34 / 5 / 0.8
Cuvier's Beaked Whale	<i>Ziphius cavirostris</i>		
Dall's Porpoise	<i>Phocoenoides dalli</i>	24 / 3 / 1.7	53 / 7 / 1.3
False Killer Whale	<i>Pseudorca crassidens</i>		
Fin Whale	<i>Balaenoptera physalus</i>	8 / 3 / 0.6	31 / 15 / 0.7
Gray Whale	<i>Eschrichtius robustus</i>		1 / 1 / 0
Green Sea Turtle	<i>Chelonia mydas</i>		
Guadalupe Fur Seal	<i>Arctocephalus townsendi</i>		1 / 1 / 0
Harbor Porpoise	<i>Phocoena phocoena</i>	8 / 4 / 0.6	8 / 4 / 0.2
Harbor Seal	<i>Phoca vitulina</i>		
Humpback Whale	<i>Megaptera novaeangliae</i>	86 / 61 / 6.2	275 / 170 / 6.5
Killer Whale	<i>Orcinus orca</i>		8 / 1 / 0.2
Long-beaked Common Dolphin	<i>Delphinus capensis</i>		100 / 1 / 2.4
Minke Whale	<i>Balaenoptera acutorostrata</i>		
Northern Elephant Seal	<i>Mirounga angustirostris</i>	1 / 1 / 0.1	7 / 7 / 0.2
Northern Fur Seal	<i>Callorhinus ursinus</i>	1 / 1 / 0.1	19 / 16 / 0.5
Northern Right Whale Dolphin	<i>Lissodelphis borealis</i>		1170 / 6 / 27.8
Pacific White-Sided Dolphin	<i>Lagenorhynchus obliquidens</i>	59 / 9 / 4.2	1338 / 42 / 31.8
Pilot Whale	<i>Globicephala spp.</i>		
Pygmy Sperm Whale	<i>Kogia breviceps</i>		
Ridley Sea Turtle	<i>Lepidochelys olivacea</i>		
Right whale dolphin	<i>Lissodelphis spp</i>		
Risso's Dolphin	<i>Grampus griseus</i>	40 / 2 / 2.9	70 / 5 / 1.7
Sea Otter	<i>Enhydra lutris</i>		
Sei Whale	<i>Balaenoptera borealis</i>		
Short-Beaked Common Dolphin	<i>Delphinus delphis</i>		269 / 10 / 6.4
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)	2 / 1 / 0.1	6 / 5 / 0.1
Unidentified Beaked Whale	(species group)		
Unidentified Cetacean	(species group)		
Unidentified Dolphin	(species group)		52 / 4 / 1.2
Unidentified Large Whale	(species group)	3 / 3 / 0.2	9 / 8 / 0.2
Unidentified Pinniped	(species group)		
Unidentified Sea Lion	(species group)		
Unidentified Seal	(species group)	2 / 2 / 0.1	7 / 7 / 0.2
Unidentified Whale	(species group)	6 / 6 / 0.4	7 / 7 / 0.2

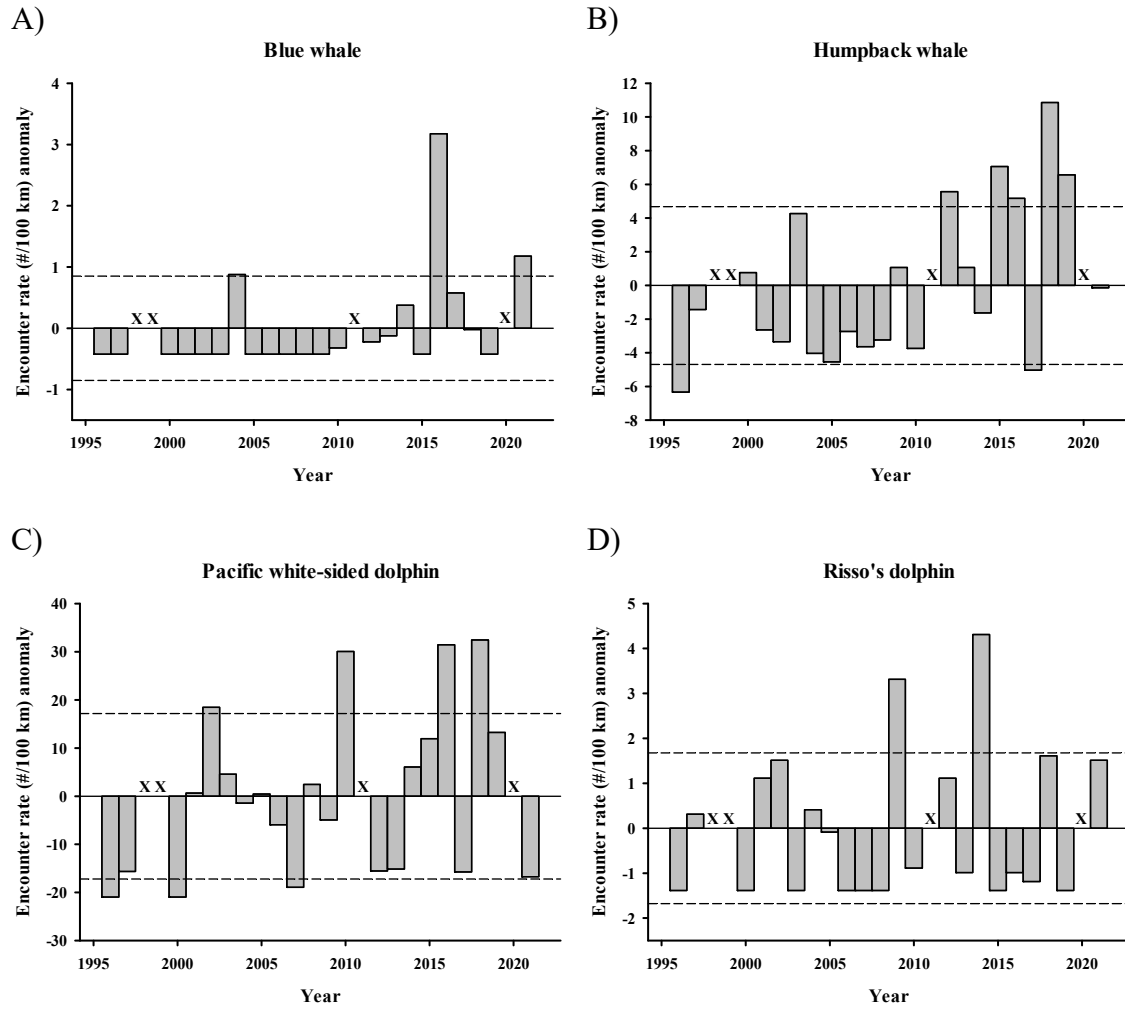
**Figure 2.** Density (number/km<sup>2</sup>; expressed as anomalies) over time from core area surveys for species with warmer-water habitat affinities, 1996–2021. A) black-footed albatross, B) Brandt’s cormorant, C) brown pelican, and D) pink-footed shearwater. The dashed lines indicate  $\pm 1$  s.d. of the long-term mean, and ‘x’ indicates years when no survey was conducted.



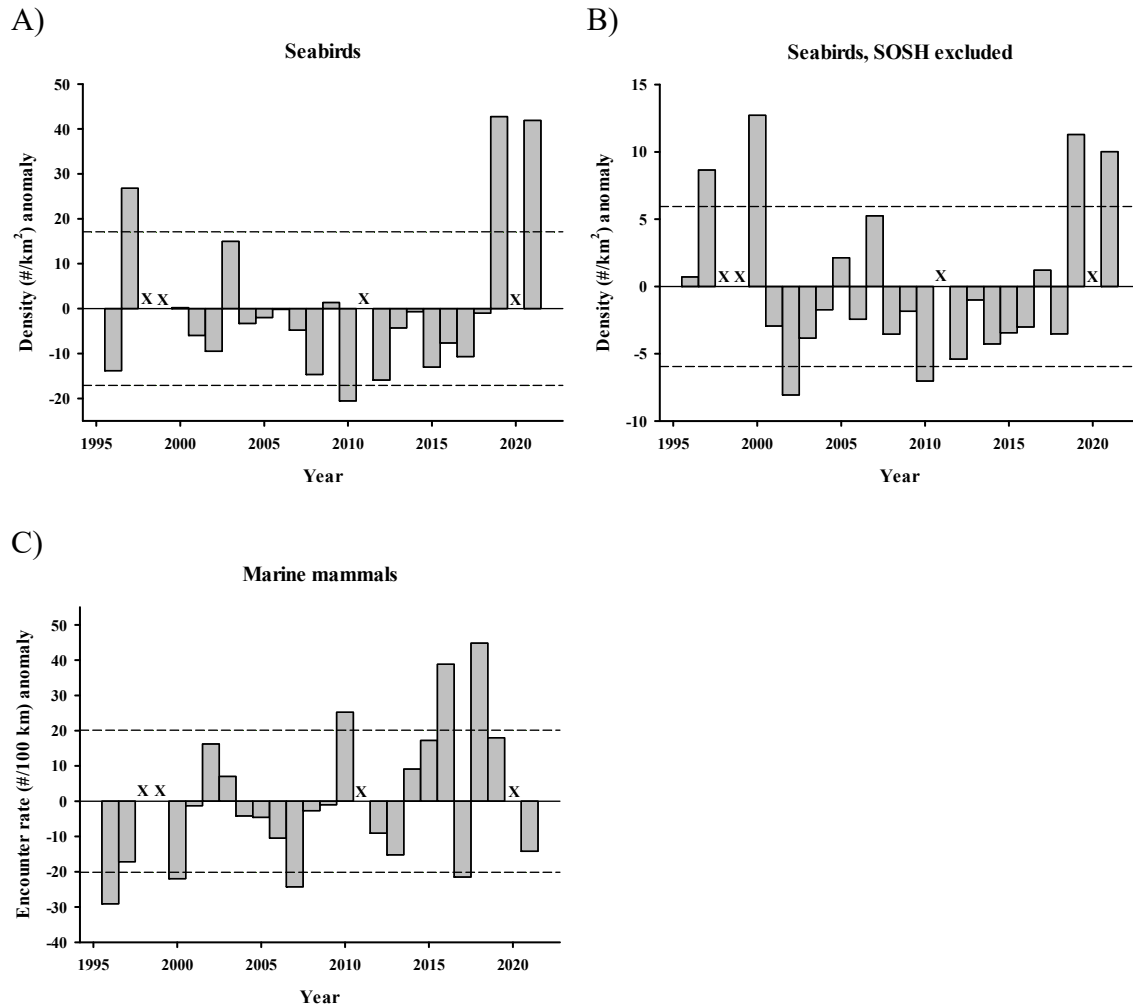
**Figure 3.** Density (number/km<sup>2</sup>; expressed as anomalies) over time from core area surveys for species with cold-water habitat affinities, 1996–2021. A) Cassin’s auklet, B) common murre, C) northern fulmar, and D) sooty shearwater. The dashed lines indicate  $\pm 1$  s.d. of the long-term mean, and ‘x’ indicates years when no survey was conducted.



**Figure 4.** Encounter rate (number/100 km; expressed as anomalies) over time from core area surveys, 1996–2021, of A) blue whale, B) humpback whale, C) Pacific white-sided dolphin, D) Risso’s dolphin, and E) these four species (note that not all four species were seen every year). The dashed lines indicate  $\pm 1$  s.d. of the long-term mean, and ‘x’ indicates years when no survey was conducted.



**Figure 5.** Density (number/km<sup>2</sup>; expressed as anomalies) over time (1996–2021) from core area surveys for A) the eight seabird species combined and B) those species but with sooty shearwater (SOSH) excluded due to their high abundance. C) Encounter rate (number/100 km; expressed as anomalies) over time from core area surveys for the four marine mammal species combined (note that not all four species were seen every year). The dashed lines indicate  $\pm 1$  s.d. of the long-term mean, and ‘x’ indicates years when no survey was conducted.



## Reference

Sakuma, K.M., Ralston, S., and Wespestad, V.G. 2006. Interannual and spatial variation in the distribution of young-of-the-year rockfish (*Sebastes* spp.): Expanding and coordinating a survey sampling frame. California Cooperative Oceanic Fisheries Investigations (CalCOFI) Report 47:127-139.

Title page photo: Short-tailed albatross (*Phoebastria albatrus*) seen off of the central California coast on May 1, 2021. Photo by Michael Force.

**Appendix.** List of bird species excluded from this summary. These species may or may not have been observed during the survey.

<b>Common Name</b>	<b>Scientific Name</b>
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>
Black-throated gray warbler	<i>Setophaga nigrescens</i>
Brewer's sparrow	<i>Spizella breweri</i>
Brown-headed cowbird	<i>Molothrus ater</i>
Bufflehead	<i>Bucephala albeola</i>
Chaplan's storm-petrel	<i>Oceanodroma leucorhoa chapmani</i>
Eurasian collared dove	<i>Streptopelia decaocto</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>
Nazca booby	<i>Sula granti</i>
Red-breasted merganser	<i>Mergus serrator</i>
Ruddy duck	<i>Oxyura jamaicensis</i>
Sanderling	<i>Calidris alba</i>
Savannah sparrow	<i>Passerculus sandwichensis</i>
Snow goose	<i>Chen caerulescens</i>
Snowy egret	<i>Egretta thula</i>
Townsend's warbler	<i>Setophaga townsendi</i>
Unidentified bird	(species group)
Unidentified dowitcher	(species group)
Unidentified goose	(species group)
Unidentified hummingbird	(species group)
Unidentified passerine	(species group)
Unidentified raptor	(species group)
Unidentified shorebird	(species group)
Wandering tattler	<i>Tringa incana</i>
Western sandpiper	<i>Calidris mauri</i>
Whimbrel	<i>Numenius phaeopus</i>
White-winged scoter	<i>Melanitta fusca</i>
Willet	<i>Catoptrophorus semipalmatus</i>
Wilson's warbler	<i>Cardellina pusilla</i>
Yellow-rumped warbler	<i>Dendroica coronata</i>