Seabirds and Marine Mammals on the NMFS
***Rockfish Recruitment and Ecosystem Assessment Survey*: 2019 Data Report**

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Introduction

Seabird and marine mammal observations are an integral part of the NMFS Rockfish Recruitment - 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 on this survey, (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 2019 cruise, and presents basic distribution and abundance estimates for seabirds and marine mammals. We thank John Field, Keith Sakuma, Jarrod Santora 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) and private sources.

Methods

Observations of seabirds and marine mammals are made continuously during daylight ship transits, often between oceanographic and mid-water trawl 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 "Dlog3"; 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 which includes data from May 1996 to the present. These data are used to derive summary statistics on density/relative abundance. Species data are presented for both the "core region" and the full 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	2019
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^2) 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 1996–2019. Seabirds highlighted in this report are black-footed albatross (*Phoebastria nigripes*), Brandt's cormorant (*Phalacrocorax penicillatus*), Cassin's auklet (*Ptychoramphus aleuticus*), common murre (*Uria aalge*), pink-footed shearwater (*Ardenna creatopus*), rhinoceros auklet (*Cerorhinca monocerata*), and sooty shearwater (*A. griseus*). Marine mammals included in the 2019 report are humpback whale

(*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), 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. In contrast to previous years, in which daytime predator surveys were largely conducted along random or opportunistic transit lines associated with CTD or MWT sampling stations, the survey this year emphasized nearshore regions expected to be important for anchovies, seabirds and marine mammals. This focus included strategic transects along the shelf-break (200m isobath) as well as fine-scale transects near the Channel Islands, Point Sal, Monterey Bay, Davenport, Farallon Islands, and Point Reyes, and replicate fine scale transects near Point Reyes (outer Drakes Bay) and Davenport to assess short-term shifts in predator-prey associations As a result of these efforts, , within the core area, nearshore regions within the 200 m shelf break were sampled much more thoroughly than in previous survey years; this effort pattern is depicted in Figure 2. The emphasis on nearshore surveys greatly amplified the observed densities of several seabird species, particularly species with nearby breeding colonies (Common Murre, Brandt's Cormorant; see Table 3). Therefore, in order to better compare densities in 2019 with earlier years, we removed five of the fine-scale transects within the core region (see Figure 2).

Summarized species observations for all species in the core region, "standardized" core region (five transects removed) and total survey area are shown in Tables 3 and 4 (see Appendix 1 for exclusions). A total of 28 days of survey effort covering 3,283 km (985 km^2) of ocean habitat is summarized; 15 days were spent covering 1,356 km (407 km^2) in the core survey area between Cypress Point (Big Sur) and Bodega Bay. Density/encounter rate over time in the core area for the selected species is shown in Figures 2 and 3. Notable results from the normalized 2019 survey for these species include high densities of sooty shearwater (highest density of the time series), and relatedly, the density of all focal species combined. Above average but within 1 s.d. of the mean, Brandt's cormorant and common murre had high densities, while pink-footed shearwater had slightly higher than average density and densities of rhinoceros and Cassin's auklets were below average. There was also low density of black-footed albatross, which was one standard deviation below the average. Our focal marine mammals, combined, had above average abundance within the core area. This is primarily attributed to the high encounter rate for humpback whales; this year was the third highest abundance of humpback whales in the history of the survey. Pacific white-sided dolphins also had higher than average abundance. On the other hand, no fin whales or Risso's dolphins were seen within the core region.

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

2019	Core Area	Core Area (normalized)	Full
Survey vessel			*R/V Reuben Lasker*
Start date			5/9/2019
End date			6/6/2019
Number of survey days	15	14	28
Distance surveyed (km)	1,356	1,096	3,283
Area surveyed (km^2)	407	329	985
Number of bird species	35	33	50
Overall bird density (per km^2)	72.361	63.342	42.544
Total birds observed	29,361	20,835	41,905
Number of mammal species	9	9	19
Overall mammal encounter rate (per 100 km)	60.5	71.2	73.1
Total mammals observed	821	781	2,399

Figure 1. 2019 survey transects for the full (left) and core (right) regions. Gaps usually reflect nighttime.

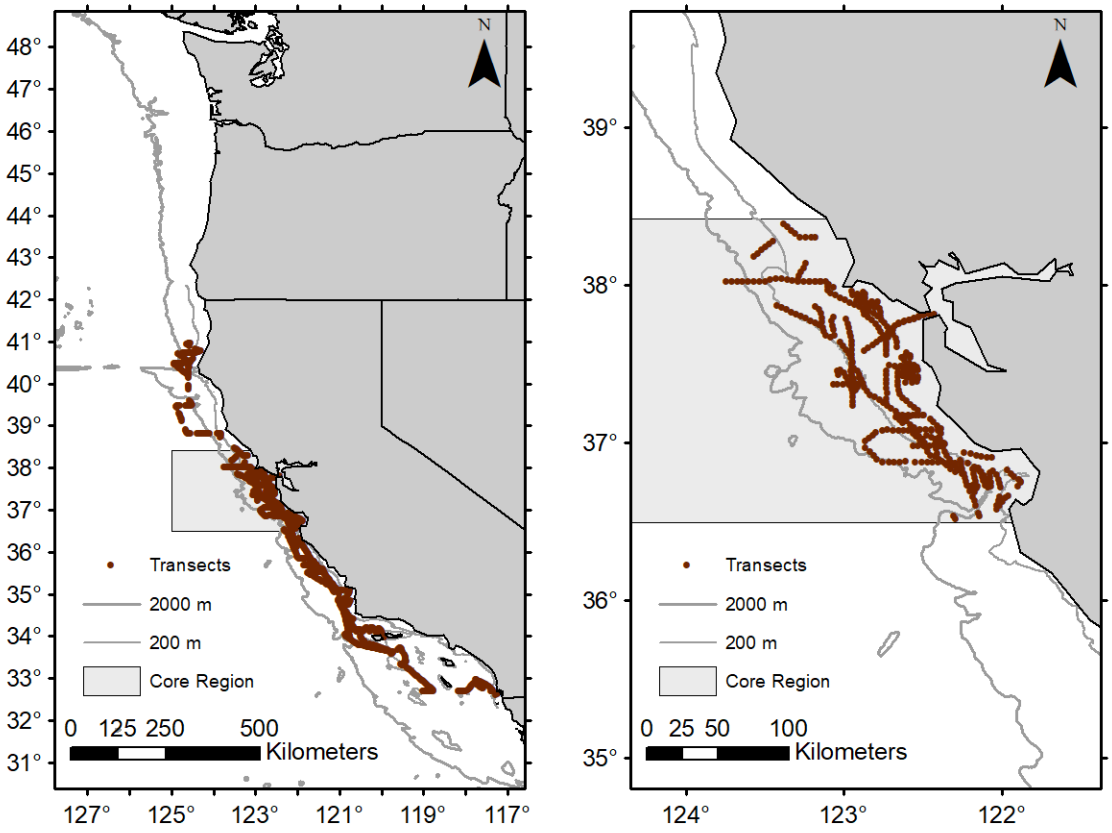


Figure 2. 2019 survey trackline overlaid onto the overall RREAS survey effort map (2004 - 2018). Effort map is presented as 3 km bin midpoints. Circled regions depict transects that were removed in 2019 in order to standardize interannual comparisons.

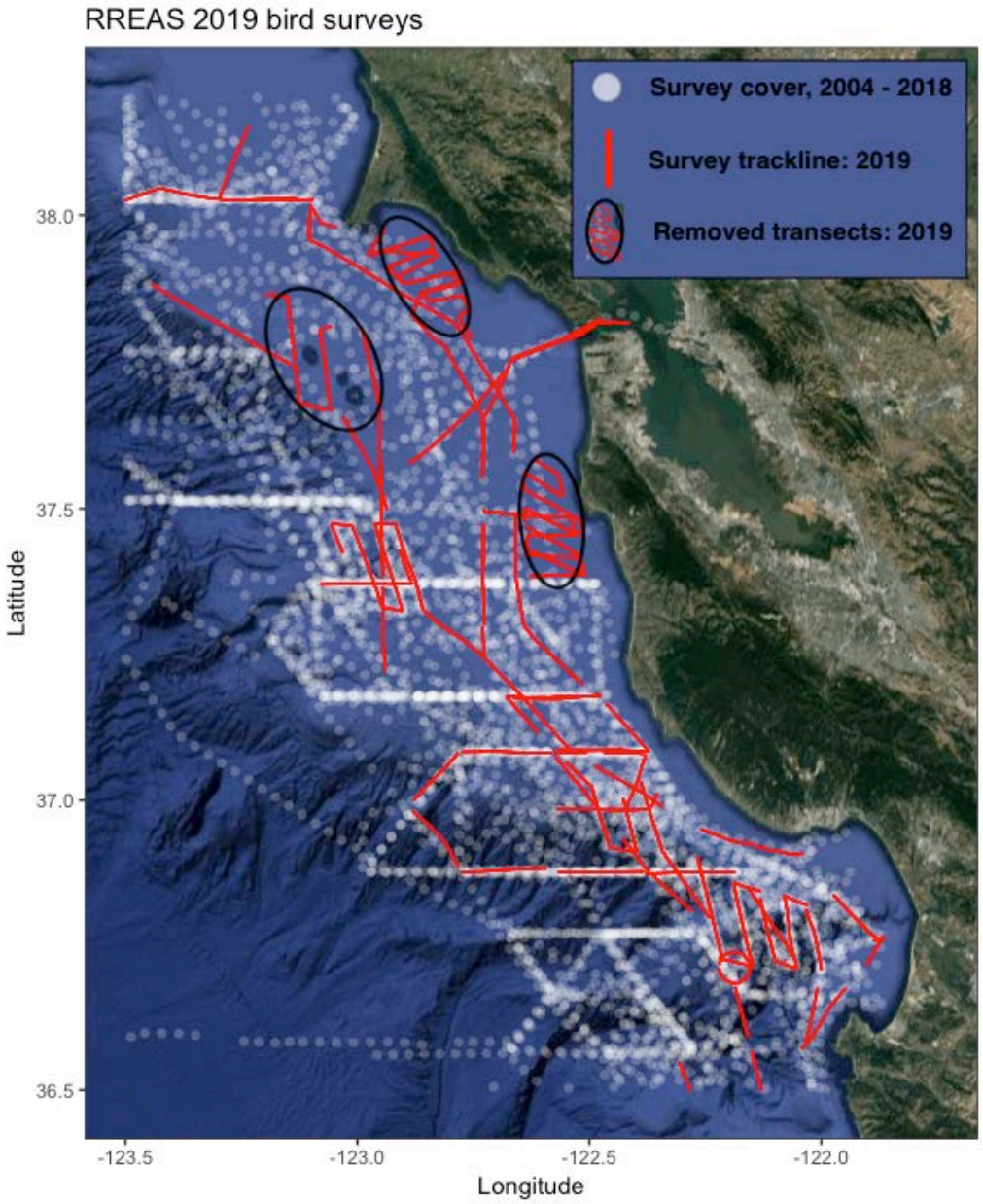


Table 3. Bird survey observations, stratified by area and species. Cell values represent: total number of individuals seen / number of species sightings / average density (birds/km^2).

Common Name	Scientific Name	Core Area	Core Area (standardized)	Full Area
American White Pelican	*Pelecanus erythrorhynchos*			
Ancient Murrelet	*Synthliboramphus antiquus*			
Arctic Loon	*Gavia arctica*			
Arctic Tern	*Sterna paradisaea*			
Ashy Storm-Petrel	*Oceanodroma homochroa*	1 / 1 / 0	1 / 1 / 0	37 / 3 / 0.04
Black guillemot	*Cepphus grylle*			
Black Scoter	*Melanitta nigra*			
Black Storm-Petrel	*Oceanodroma melania*			52 / 29 / 0.05
Black-Footed Albatross	*Phoebastria nigripes*	85 / 77 / 0.21	85 / 77 / 0.26	180 / 167 / 0.18
Black-Legged Kittiwake	*Rissa tridactyla*			
Black-Vented Shearwater	*Puffinus opisthomelas*			5 / 2 / 0.01
Bonaparte's Gull	*Larus philadelphia*			5 / 1 / 0.01
Brandt's Cormorant	*Phalacrocorax penicillatus*	647 / 251 / 1.59	250 / 116 / 0.76	839 / 324 / 0.85
Brant	*Branta bernicla*			
Brown Booby	*Sula leucogaster*			1 / 1 / 0
Brown Noddy	*Anous stolidus*			
Brown Pelican	*Pelecanus occidentalis*	84 / 36 / 0.21	74 / 31 / 0.22	152 / 68 / 0.15
Buller's Shearwater	*Puffinus bulleri*			
California Gull	*Larus californicus*	28 / 12 / 0.07	16 / 8 / 0.05	30 / 14 / 0.03
Caspian Tern	*Sterna caspia*	5 / 4 / 0.01	4 / 3 / 0.01	8 / 7 / 0.01
Cassin's Auklet	*Ptychoramphus aleuticus*	105 / 52 / 0.26	96 / 48 / 0.29	205 / 106 / 0.21

Clark's Grebe	*Aechmophorus clarkii*	1 / 1 / 0	1 / 1 / 0	1 / 1 / 0
Common Loon	*Gavia immer*	1 / 1 / 0	1 / 1 / 0	2 / 2 / 0
Common Murre	*Uria aalge*	7805 / 2138 / 19.19	3561 / 1091 / 10.83	8997 / 2545 / 9.13
Common Tern	*Sterna hirundo*			
Cook's Petrel	*Pterodroma cookii*			7 / 7 / 0.01
Craveri's Murrelet	*Synthliboramphus craveri*			
Dark Shearwater	(species group)			
Dark-Rumped Petrel	*Pterodroma phaeopygia sandwichensis*			
Double-Crested Cormorant	*Phalacrocorax auritus*	2 / 2 / 0	2 / 2 / 0.01	3 / 3 / 0
Eared Grebe	*Podiceps nigricollis*			
Elegant Tern	*Sterna elegans*	1 / 1 / 0	1 / 1 / 0	32 / 14 / 0.03
Flesh-Footed Shearwater	*Puffinus carneipes*			
Fork-Tailed Storm-Petrel	*Oceanodroma furcata*			10 / 10 / 0.01
Forster's Tern	*Sterna forsteri*			
Franklin's Gull	*Larus pipixcan*			
Glaucous Gull	*Larus hyperboreus*			
Glaucous-Winged Gull	*Larus glaucescens*			1 / 1 / 0
Guadalupe Murrelet	*Synthliboramphus hypoleucus*			
Hawaiian Petrel	*Pterodroma sandwichensis*			
Heermann's Gull	*Larus heermanni*			2 / 2 / 0
Herring Gull	*Larus argentatus*			
Horned Puffin	*Fratercula corniculata*			
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*	2 / 2 / 0	2 / 2 / 0.01	4 / 4 / 0
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	1 / 1 / 0	1 / 1 / 0	13 / 12 / 0.01
Least Storm-Petrel	*Oceanodroma microsoma*			
Least Tern	*Sterna antillarum*			
Long-Tailed Jaeger	*Stercorarius longicaudus*			
Marbled Murrelet	*Brachyramphus marmoratus*			
Masked Booby	*Sula dactylatra*			1 / 1 / 0
Mew Gull	*Larus canus*			
Mottled Petrel	*Pterodroma inexpectata*			
Murphy's Petrel	*Pterodroma ultima*			
Northern Fulmar	*Fulmarus glacialis*	5 / 5 / 0.01	5 / 5 / 0.02	8 / 8 / 0.01
Osprey	*Pandion haliaetus*			
Pacific Loon	*Gavia pacifica*	25 / 14 / 0.06	19 / 11 / 0.06	36 / 18 / 0.04
Parakeet Auklet	*Aethia psittacula*			
Parasitic Jaeger	*Stercorarius parasiticus*	5 / 5 / 0.01	4 / 4 / 0.01	7 / 7 / 0.01
Parkinson's Petrel	*Procellaria parkinsoni*			
Pelagic Cormorant	*Phalacrocorax pelagicus*	13 / 11 / 0.03	2 / 2 / 0.01	17 / 13 / 0.02
Peregrine Falcon	*Falco peregrinus*			
Pigeon Guillemot	*Cepphus columba*	14 / 11 / 0.03	3 / 2 / 0.01	15 / 12 / 0.02
Pink-Footed Shearwater	*Puffinus creatopus*	249 / 161 / 0.61	227 / 144 / 0.69	683 / 401 / 0.69
Pomarine Jaeger	*Stercorarius pomarinus*			1 / 1 / 0

Red Phalarope	*Phalaropus fulicaria*	299 / 52 / 0.74	299 / 52 / 0.91	444 / 99 / 0.45
Red-Billed Tropicbird	*Phaethon aethereus*			3 / 2 / 0
Red-Footed Booby	*Sula sula*			
Red-Necked Grebe	*Podiceps grisegena*			
Red-Necked Phalarope	*Phalaropus lobatus*	75 / 16 / 0.18	57 / 14 / 0.17	484 / 71 / 0.49
Red-Tailed Tropicbird	*Pheathon rubricauda*			
Red-Throated Loon	*Gavia stellata*	1 / 1 / 0		1 / 1 / 0
Rhinoceros Auklet	*Cerorhinca monocerata*	67 / 51 / 0.16	66 / 50 / 0.2	87 / 65 / 0.09
Ring-Billed Gull	*Larus delawarensis*	2 / 2 / 0		5 / 4 / 0.01
Royal Tern	*Sterna maxima*	7 / 2 / 0.02	4 / 1 / 0.01	18 / 10 / 0.02
Ruddy Turnstone	*Arenaria interpres*			
Sabine's Gull	*Larus sabini*	5 / 2 / 0.01	5 / 2 / 0.02	27 / 10 / 0.03
Scripps's murrelet	*Synthliboramphus scrippsi*			63 / 36 / 0.06
Short-Tailed / Slender-Billed Shearwater	*Puffinus tenuirostris*			
Short-Tailed Albatross	*Phoebastria albatrus*			
Solander's Petrel	*Pterodroma solandri*			
Sooty Shearwater	*Puffinus griseus*	18852 / 1539 / 46.35	15346 / 1234 / 46.65	27966 / 2867 / 28.39
South Polar Skua	*Stercorarius maccormicki*			
Stejneger's Petrel	*Pterodroma longirostris*			
Surf Scoter	*Melanitta perspicillata*	2 / 1 / 0	2 / 1 / 0.01	2 / 1 / 0
Thayer's Gull	*Larus thayeri*			
Townsend's Storm-Petrel	*Oceanodroma socorroensis*			

Tufted Puffin	*Fratercula cirrhata*	10 / 7 / 0.02	10 / 7 / 0.03	11 / 8 / 0.01
Unidentified Albatross	(species group)			
Unidentified Auklet	(species group)			
Unidentified Cormorant	(species group)			
Unidentified Duck	(species group)			
Unidentified Grebe	(species group)			
Unidentified Gull	(species group)	61 / 38 / 0.15	57 / 34 / 0.17	93 / 67 / 0.09
Unidentified Jaeger	(species group)			1 / 1 / 0
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)			5 / 3 / 0.01
Unidentified Procellarid	(species group)			
Unidentified Shearwater	(species group)	1 / 1 / 0	1 / 1 / 0	5 / 4 / 0.01
Unidentified Skua	(species group)			
Unidentified Small Alcid	(species group)			
Unidentified Storm-Petrel	(species group)			1 / 1 / 0
Unidentified Tern	(species group)	1 / 1 / 0	1 / 1 / 0	20 / 6 / 0.02
Unidentified Tropicbird	(species group)			
Wedge-Rumped Storm-Petrel	*Oceanodroma tethys*			
Wedge-Tailed Shearwater	*Puffinus pacificus*			
Western Grebe	*Aechmophorus occidentalis*	7 / 4 / 0.02	7 / 4 / 0.02	7 / 4 / 0.01

Western Gull	*Larus occidentalis*	965 / 621 / 2.37	625 / 370 / 1.9	1308 / 878 / 1.33
Wilson's Storm-Petrel	*Oceanites oceanicus*			
Xantus's / Craveri's Murrelet	(species group)			
Xantus's Murrelet	*Synthliboramphus hypoleucus*			

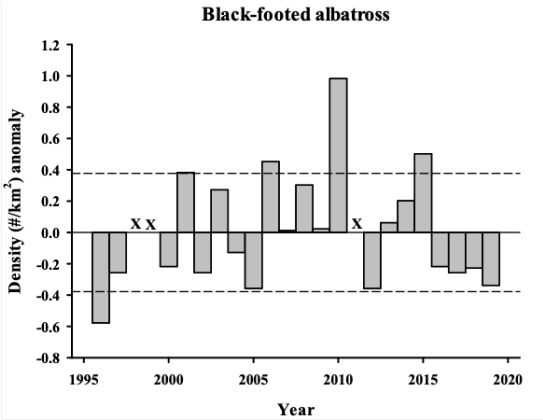
Table 4. Mammal survey observation summary, broken down by survey area and species. Cell values represent: total number of species individuals / number of species sightings / average species encounter rate (individuals per 100 km).

Common Name	Scientific Name	Core Area	Core Area (standardized)	Full Area
Baird's Beaked Whale	*Berardius bairdii*			
Blue Whale	*Balaenoptera musculus*			1 / 1 / 0
Bottlenose Dolphin	*Tursiops truncatus*			35 / 3 / 1.1
California Sea Lion	*Zalophus californianus*	38 / 29 / 2.8	33 / 24 / 3	530 / 184 / 16.1
Common Dolphin	*Delphinus delphis*			
Cuvier's Beaked Whale	*Ziphius cavirostris*			
Dall's Porpoise	*Phocoenoides dalli*	27 / 5 / 2	27 / 5 / 2.5	30 / 6 / 0.9
False Killer Whale	*Pseudorca crassidens*			
Fin Whale	*Balaenoptera physalus*			8 / 4 / 0.2
Gray Whale	*Eschrichtius robustus*			
Green Sea Turtle	*Chelonia mydas*			
Guadalupe Fur Seal	*Arctocephalus townsendi*			
Harbor Porpoise	*Phocoena phocoena*			
Harbor Seal	*Phoca vitulina*	1 / 1 / 0.1	1 / 1 / 0.1	2 / 2 / 0.1
Humpback Whale	*Megaptera novaeangliae*	175 / 140 / 12.9	141 / 114 / 12.9	347 / 254 / 10.6
Killer Whale	*Orcinus orca*			5 / 1 / 0.2
Long-beaked Common Dolphin	*Delphinus capensis*			30 / 1 / 0.9
Minke Whale	*Balaenoptera acutorostrata*			1 / 1 / 0
Northern Elephant Seal	*Mirounga angustirostris*	1 / 1 / 0.1	1 / 1 / 0.1	4 / 4 / 0.1
Northern Fur Seal	*Callorhinus ursinus*	12 / 10 / 0.9	12 / 10 / 1.1	42 / 28 / 1.3
Northern Right Whale Dolphin	*Lissodelphis borealis*	100 / 6 / 7.4	100 / 6 / 9.1	200 / 7 / 6.1

Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	464 / 28 / 34.2	464 / 28 / 42.3	910 / 85 / 27.7
Pilot Whale	*Globicephala spp.*			
Pygmy Sperm Whale	*Kogia breviceps*			
Ridley Sea Turtle	*Lepidochelys olivacea*			
Right whale dolphin	*Lissodelphis spp*			
Risso's Dolphin	*Grampus griseus*			14 / 2 / 0.4
Sea Otter	*Enhydra lutris*			
Sei Whale	*Balaenoptera borealis*			
Short-Beaked Common Dolphin	*Delphinus delphis*			130 / 9 / 4
Short-Finned Pilot Whale	*Globicephala macrorhynchus*			
Sperm Whale	*Physeter macrocephalus*			
Steller Sea Lion	*Eumetopias jubatus*			
Striped Dolphin	*Stenella coeruleoalba*			
Unidentified Balaenoptera	(species group)			12 / 1 / 0.4
Unidentified Beaked Whale	(species group)			
Unidentified Cetacean	(species group)			
Unidentified Dolphin	(species group)			80 / 2 / 2.4
Unidentified Large Whale	(species group)			
Unidentified Pinniped	(species group)			
Unidentified Sea Lion	(species group)			
Unidentified Seal	(species group)			
Unidentified Whale	(species group)	3 / 3 / 0.2	2 / 2 / 0.2	18 / 14 / 0.5

Figure 2. Density (number/km^2; expressed as anomalies) over time from standardized core area surveys, 1996–2019. A) black-footed albatross, B) Brandt's cormorant, C) Cassin's auklet, D) common murre, E) pink-footed shearwater, F) rhinoceros auklet, G) sooty shearwater, and H) the previously shown seven species (note not all seven species were seen every year). The dashed lines indicate ± 1 s.d. of the long-term mean, and 'x' indicates years when no survey was conducted.

A)



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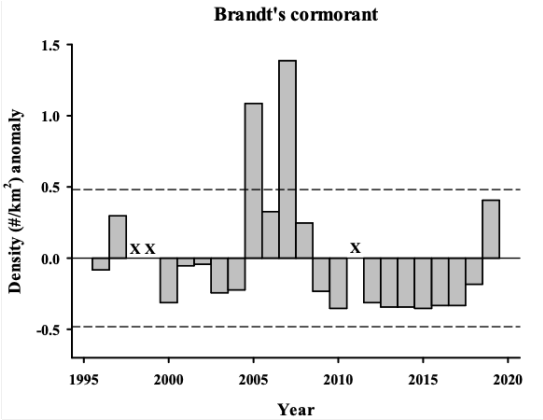

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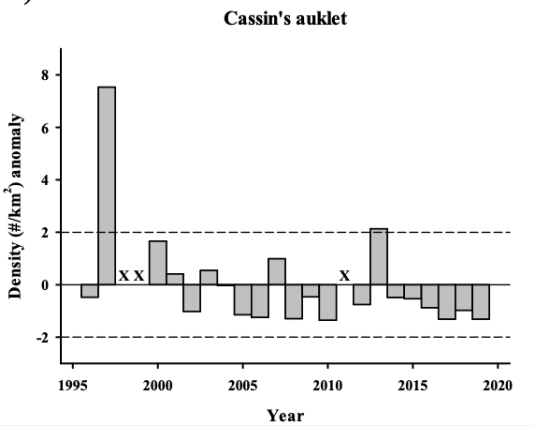

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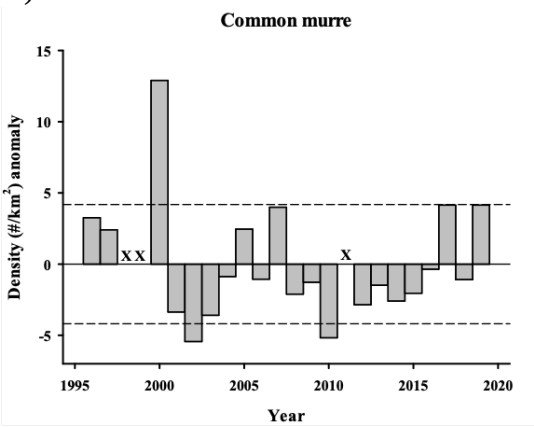

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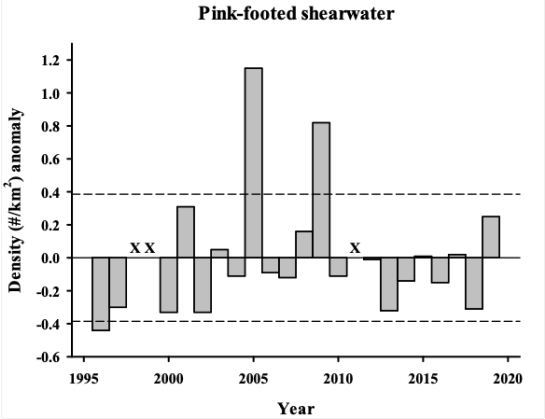
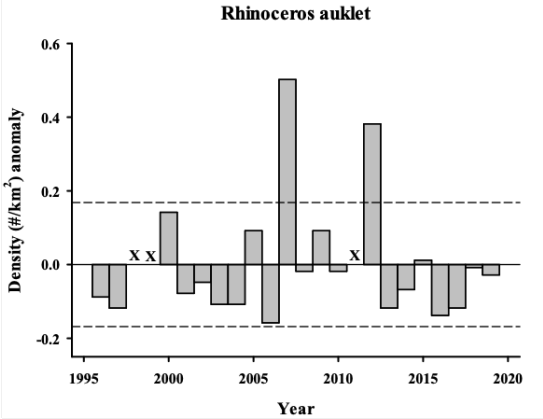
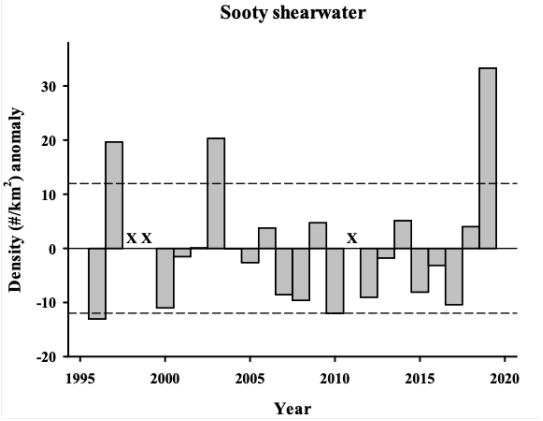

Pink-footed shearwater
Density (#/km^2) anomaly
Year
1995
2000
2005
2010
2015
2020
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
X X
X

F)


Rhinoceros auklet
Density (#/km^2) anomaly
Year
1995
2000
2005
2010
2015
2020
0.6
0.4
0.2
0.0
-0.2
X X
X

G)


Sooty shearwater
Density (#/km^2) anomaly
Year
1995
2000
2005
2010
2015
2020
30
20
10
0
-10
-20
X X
X

H)

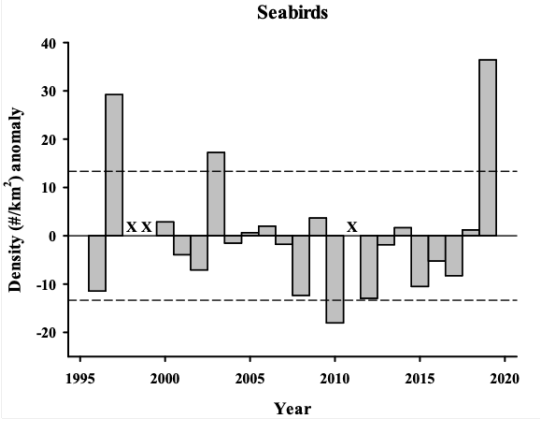
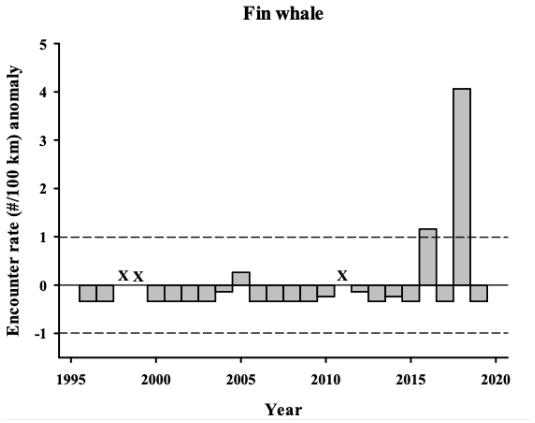
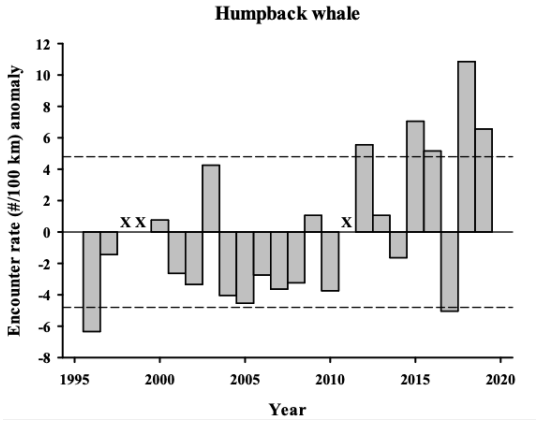

Seabirds
Density (#/km^2) anomaly
Year
1995
2000
2005
2010
2015
2020
40
30
20
10
0
-10
-20
X X
X

Figure 3. Encounter rate (number/100 km; expressed as anomalies) over time from standardized core area surveys, 1996–2019, of A) fin whale, B) humpback whale, C) Pacific white-sided dolphin, D) Risso's dolphin, and E) the previously shown four species (note not all four species were seen every year). The dashed lines indicate ± 1 s.d. of the long-term mean, and 'x' indicates years when no survey was conducted.

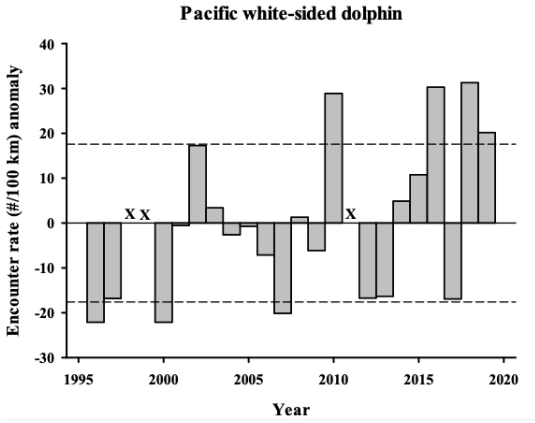
A)



B)



C)



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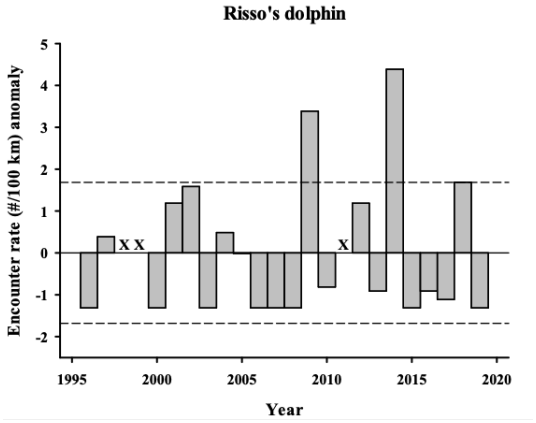

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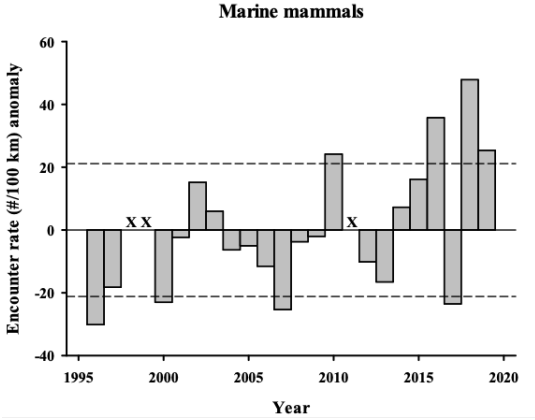

Reference

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.

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

Common Name	**Scientific Name**
American coot	*Fulica americana*
Black oystercatcher	*Haematopus bachmani*
Black skimmer	*Rynchops niger*
Black tern	*Chlidonias niger*
Black turnstone	*Arenaria melanocephala*
Black-throated gray warbler	*Setophaga nigrescens*
Brewer's sparrow	*Spizella breweri*
Brown-headed cowbird	*Molothrus ater*
Bufflehead	*Bucephala albeola*
Chaplan's storm-petrel	*Oceanodroma leucorhoa chapmani*
Eurasian collared dove	*Streptopelia decaocto*
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*
Nazca booby	*Sula granti*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*
Sanderling	*Calidris alba*
Savannah sparrow	*Passerculus sandwichensis*
Snow goose	*Chen caerulescens*
Snowy egret	*Egretta thula*
Townsend's warbler	*Setophaga townsendi*

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	*Tringa incana*
Western sandpiper	*Calidris mauri*
Whimbrel	*Numenius phaeopus*
White-winged scoter	*Melanitta fusca*
Willet	*Catoptrophorus semipalmatus*
Wilson's warbler	*Cardellina pusilla*
Yellow-rumped warbler	*Dendroica coronata*