Seabirds and ocean conditions from the CalCOFI/CCE-LTER Survey: Spring 2026 data report

William J. Sydeman, Principal Investigator
Brian Hoover, Lead Scientist
Michael Force, Observer
Sarah Ann Thompson, Analyst
Marisol García-Reyes, Oceanographer

FARALLON INSTITUTE

101 H Street, Suite Q
Petaluma, CA 94952
www.faralloninstitute.org

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Cover Photo: Elegant terns and floating kelp. Photo by Michael Force.

Introduction

Surveys of seabirds at sea in the greater Southern California Bight 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 are valuable for several reasons. First, information on seabird distribution and abundance provides an upper trophic level perspective that complements the lower trophic level plankton and hydrographic data collected by others. Second, estimates of seabird abundance, biodiversity, and distribution contribute to understanding the spatial ecology of the Southern California Bight and adjacent marine habitats (e.g., Santora et al. 2017), a region characterized by substantial temporal environmental heterogeneity and a major biogeographic boundary at Point Conception, with application to marine spatial planning. Third, by extending our existing records (currently 40 years and building; 1987–present) and coupling this information with long-term hydrographic and plankton data, the seabird data contribute to understanding the effects of climate variability and change on the southern sector of the CCE (e.g., Veit et al. 1996, Hyrenbach and Veit 2003, Santora and Sydeman 2015, Sydeman et al. 2015).

This data report summarizes observations of seabirds at sea made within the CalCOFI core and full regions during the 2026 spring CalCOFI/CCE-LTER cruise. We include metadata on survey effort as well as summary information on seabird relative abundance, expressed as density (birds/km^2), and ocean conditions during the survey period.

Methods

Ocean conditions. We present sea surface temperature (SST; C°) and wind averages for the period 31 March 2026 to 23 April 2026 for the full CalCOFI survey area. SST data and their anomalies (SSTa; baseline period 1991–2020) were downloaded from the Optimal Interpolation SST V.2.1 (OISST) dataset (https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html) and wind (speed and direction) data were downloaded for NOAA/NDBC buoys (https://www.ndbc.noaa.gov). Additionally, daily SST and wind averages for the study period are shown specifically for NOAA/NDBC buoy 46054 (https://www.ndbc.noaa.gov/station_page.php?station=46054).

Seabird observations. Observations of seabirds are made continuously during daylight ship transits between oceanographic/plankton sampling stations. The seabird observer, located on the flying bridge approximately 15 meters above sea level, uses hand-held binoculars and occasionally a digital camera 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 computer using the dedicated application "DLog"; the ship's position is automatically recorded every 20 seconds from an externally connected GPS. Each observation includes the species, the number of individuals observed, and their behavior (mostly "flying" or "sitting on the water"). 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 1987 to the present, and these data are used to derive summary statistics. The raw data are made publicly available in the fall each year on a NOAA ERDDAP server.

Calculation of seabird densities. Taxa excluded from this summary are all mammals, fish, turtles, terrestrial birds, and most shorebirds except phalaropes, which are found in the pelagic realm. Species densities were calculated as the total number of individuals observed divided by the total area (km^2) surveyed during the cruise. Density is expressed by log_{10} function; a constant of 0.01 was added to each species' density prior to transformation. Trends in anomalies of log_{10}-transformed density are shown for selected species for the period 1987 through 2026. In phylogenetic order, species included were sooty shearwater *Ardenna grisea*, pink-footed shearwater *A. creatopus*, black-footed albatross *Phoebastria nigripes*, Laysan albatross *P. immutabilis*, Cooks' petrel *Pterodroma cookii*, a Leach's storm-petrel complex (Leach's storm-petrel *Hydrobates leucorhous*, Townsend's storm-petrel *H. socorroensis*, and unidentified Leach's storm-petrels), small alcids (grouped Scripps' murrelet *Synthliboramphus scrippsi*, Craveri's murrelet *S. craveri*, and Guadalupe murrelet *S. hypoleucus*), Cassin's auklet *Ptychoramphus aleuticus*, common murre *Uria aalge*, rhinoceros auklet *Cerorhinca monocerata*, Brandt's cormorant *Urile penicillatus*, brown pelican *Pelecanus occidentalis*, western gull *Larus occidentalis*, Sabine's gull *Xema sabini*, and grouped red and red-necked phalaropes *Phalaropus fulicarius* and *P. lobatus*. Trends in seabird density were examined using Spearman rank correlation.

Results

Ocean conditions. The survey transited through a latitudinal range of water temperatures, with the nearshore waters north of Point Conception being substantially cooler (blue tones) than the waters in the southern portion of the study area (red tones; Figure 1A). The sea surface temperature (SST) anomalies map indicates that nearshore waters between Monterey Bay and Point Conception were cooler than the long-term seasonal average whereas much of the offshore waters were warmer than average (Figure 1B). Winds were blowing in different directions during the survey and there were two distinctive upwelling events with winds from the northwest, reflected in the simultaneous water temperature decline (Figure 2).

Surveying effort. A summary of survey effort is shown in Table 1; transects surveyed are shown in Figure 3. Summarized species observations for all species are shown in Table 2 (see Appendix 1 for exclusions). Survey effort occurred over 24 days and covered 2,435 km (730 km^2) of ocean habitat; 1,704 km (511 km^2) were surveyed over 18 days in the core survey area (Figure 3).

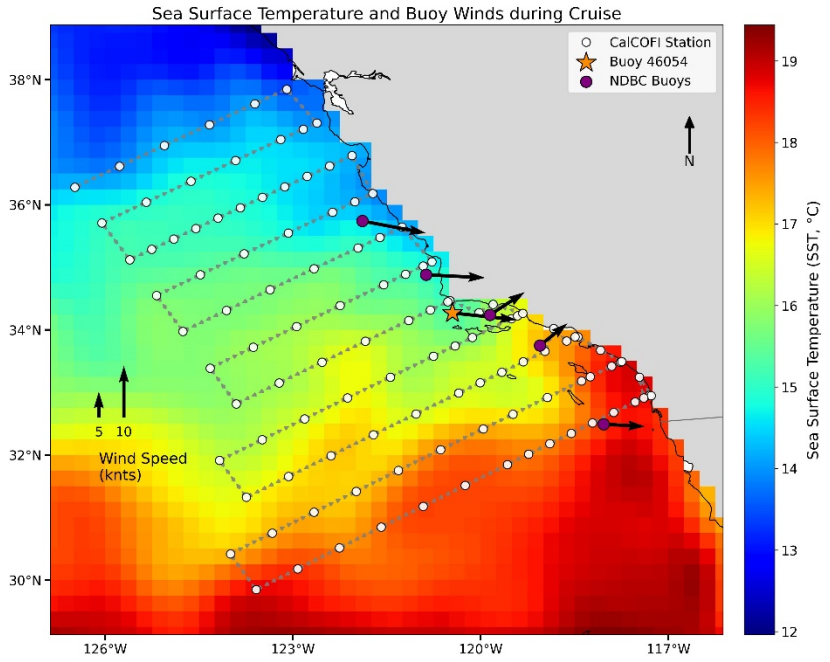
Seabirds. Density over time for the selected seabird species (listed above) was calculated for the core survey area and are shown as anomalies within the long-term survey record in Figures 4–6. Sooty and pink-footed shearwaters were present at higher densities: sooty shearwaters were within 1 standard deviation of the long-term average while density of pink-footed shearwaters was greater than 1 s.d. of the mean (Figure 4). Cook's petrels and Laysan albatross had near-average densities (Figure 4). Black-footed albatross were seen at low density but within 1 s.d. of the mean, and birds belonging to the Leach's storm-petrel complex were present at very low

density, continuing a pattern in recent years (Figure 4). Small *Synthliboramphus* alcids and common murres had above average densities with common murres greater than 1 s.d. of the long-term mean (Figure 5). There were no sightings of Cassin's auklets, on the other hand, for the third consecutive year (Figure 5). Rhinoceros auklets also had very low density below 1 s.d. (Figure 5). Phalaropes were present at near-average density this year, while western and Sabine's gulls had high densities within 1 s.d. of the mean (Figure 6). Brown pelicans were observed at a high density in their time series at 1 s.d. above the average, continuing an increasing trend in recent years (Figure 6). Brandt's cormorants had very high density (Figure 6).

Rank correlation analysis showed significant increasing trends for pink-footed shearwater, common murre, and Brandt's cormorant, and decreasing trends for black-footed albatross, Leach's storm-petrel complex, and Cassin's auklet ($p < 0.1$; Table 3).

Figure 1. Ocean conditions in the greater CalCOFI area for the period 31 March 2026 to 23 April 2026. White dots indicate CalCOFI sampling stations and NOAA/NDBC buoys are indicated with purple dots and orange star. A) Sea surface temperature (SST; C°) and wind averages (speed and direction the wind is blowing). B) Sea surface temperature anomalies (SSTa; C°) averages derived from a OISST climatology.

A)



B)

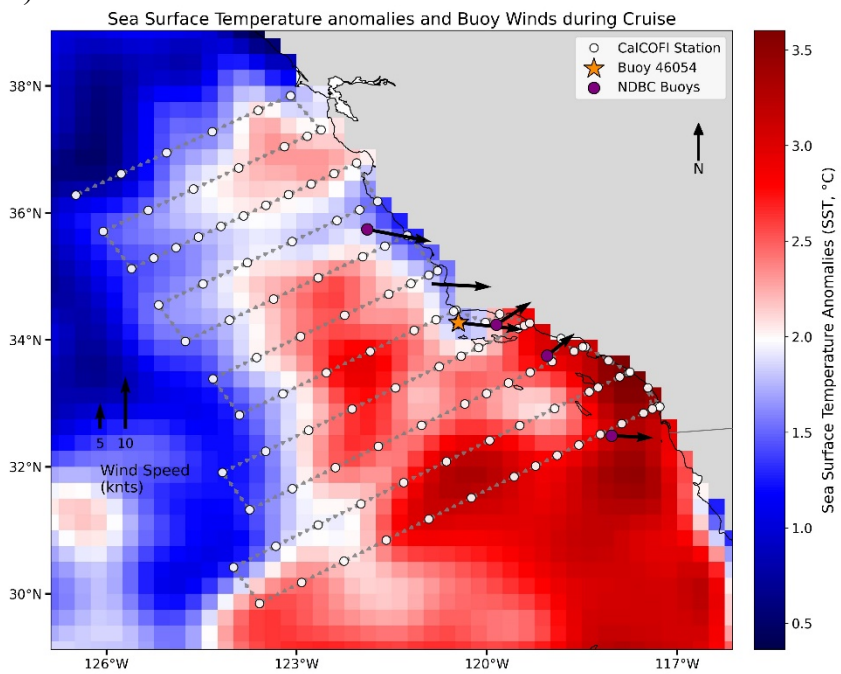


Figure 2. Daily SST (C°) and wind averages for the period 31 March 2026 to 23 April 2026 at NOAA/NDBC buoy 46054; location is marked in Figure 1 with an orange star. Bottom panel: arrow direction indicates the direction the wind is blowing (up = north) and the y-axis indicates wind speed scale in knots. Upwelling-favorable winds are strong winds to the southeast.

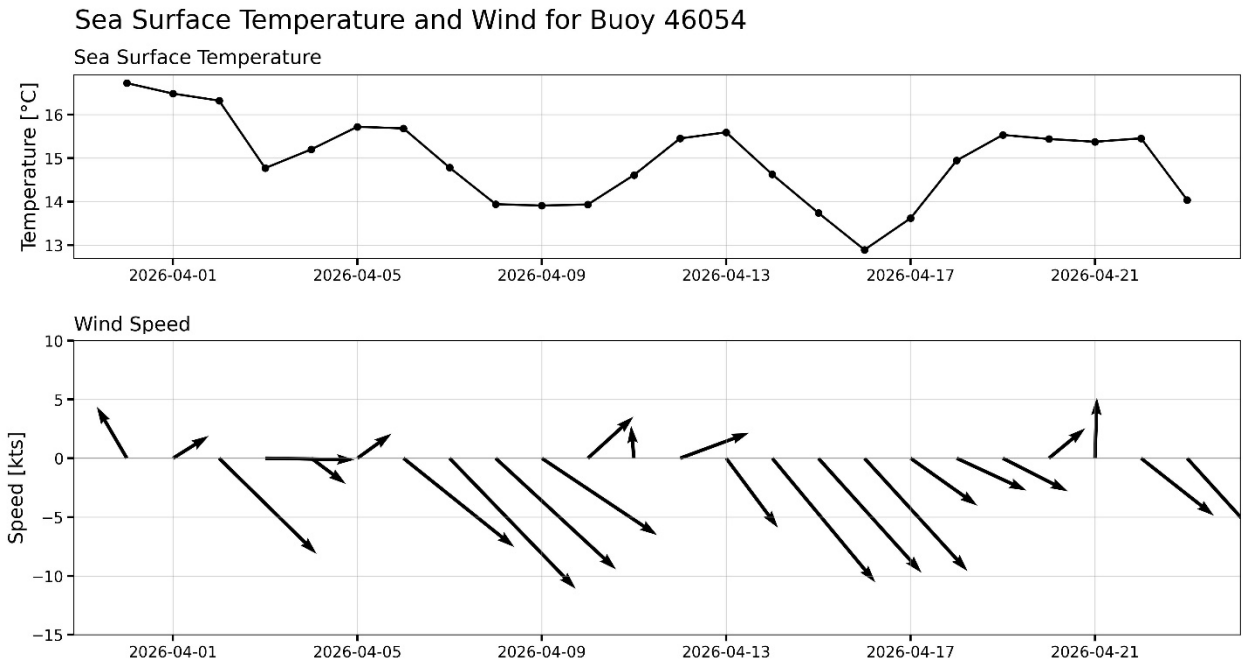


Table 1. Summary of survey effort and seabird statistics for the full and core survey areas, spring 2026.

Spring 2026	Full survey area	Core survey area
Survey vessel	RV *Bell M. Shimada*	
Start date	3/31/2026	
End date	4/23/2026	
Number of survey days	24	18
Distance surveyed (km)	2,435	1,704
Area surveyed (km^2)	730	511
Number of bird species	44	40
Overall bird density (per km^2)	6.524	6.047
Total individuals counted	4,765	3,092

Figure 3. Transects sampled during the CalCOFI spring 2026 survey. The core study area is denoted with the blue box and includes CalCOFI lines 93 (south) to 77 (north).

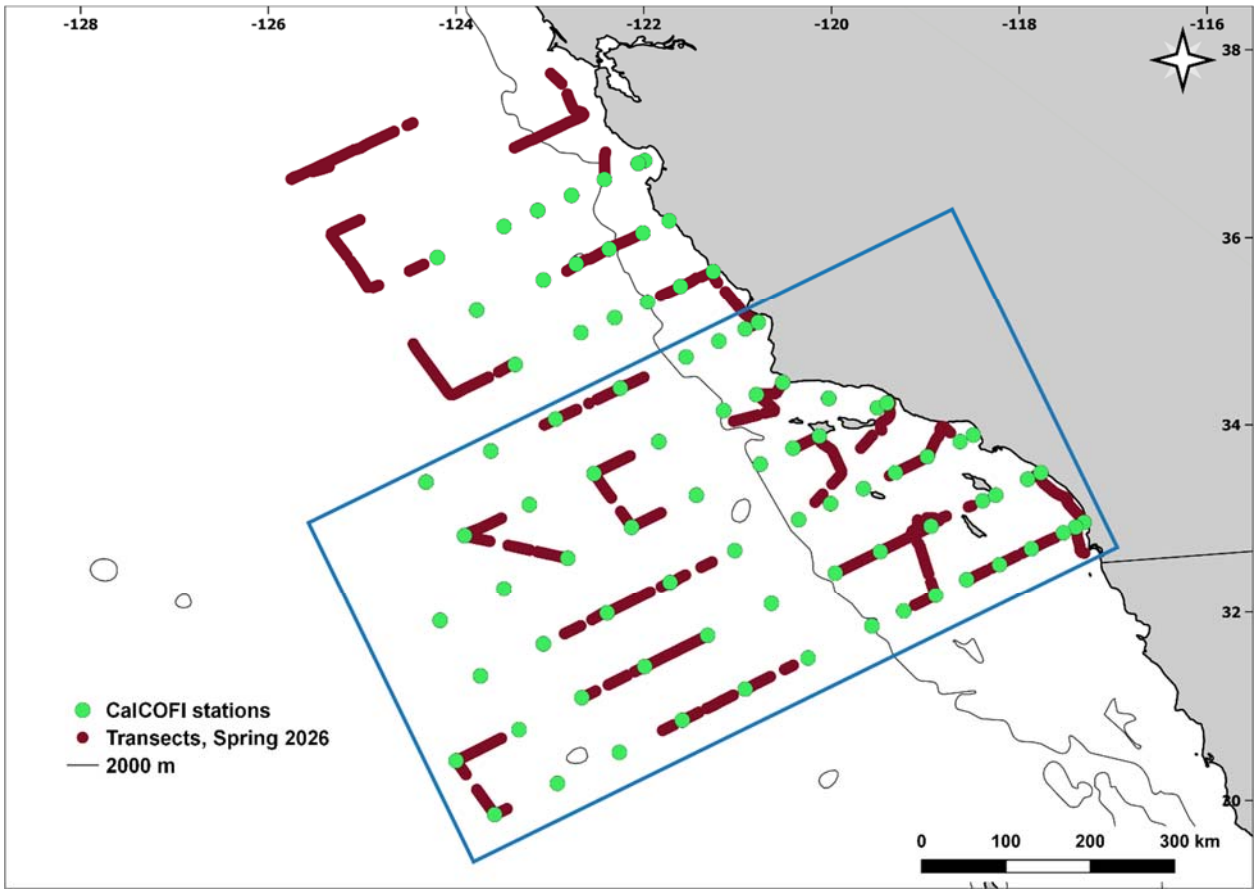


Table 2. Observations in spring 2026 by species in the full and core survey areas (see Figure 3). Cell values: total number of individuals (ind.) / number of observations per species (obs.) / species density (dens.) in individuals per km^2.

Common Name	Scientific Name	Full area	Core area
American white pelican	*Pelecanus erythrorhynchos*		
Ancient murrelet	*Synthliboramphus antiquus*		
Arctic loon	*Gavia arctica*		
Arctic tern	*Sterna paradisaea*		
Ashy storm-petrel	*Hydrobates homochroa*		
Black guillemot	*Cepphus grylle*		
Black scoter	*Melanitta americana*		
Black storm-petrel	*Hydrobates melania*		
Black-footed albatross	*Phoebastria nigripes*	23 / 23 / 0.03	8 / 8 / 0.02
Black-legged kittiwake	*Rissa tridactyla*		
Black-vented shearwater	*Puffinus opisthomelas*	3 / 3 / 0	3 / 3 / 0.01
Blue-footed booby	*Sula nebouxii*		
Bonaparte's gull	*Chroicocephalus philadelphia*	315 / 27 / 0.43	294 / 22 / 0.58
Brandt's cormorant	*Urile penicillatus*	274 / 68 / 0.38	225 / 45 / 0.44
Brant	*Branta bernicla*	2 / 1 / 0	2 / 1 / 0
Brown booby	*Sula leucogaster*		
Brown noddy	*Anous stolidus*		
Brown pelican	*Pelecanus occidentalis*	163 / 50 / 0.22	153 / 43 / 0.3
Buller's shearwater	*Ardenna bulleri*		
California gull	*Larus californicus*	119 / 48 / 0.16	109 / 38 / 0.21
Caspian tern	*Hydroprogne caspia*		
Cassin's auklet	*Ptychoramphus aleuticus*		
Clark's grebe	*Aechmophorus clarkii*	2 / 2 / 0	2 / 2 / 0
Common loon	*Gavia immer*	3 / 3 / 0	3 / 3 / 0.01
Common murre	*Uria aalge*	713 / 221 / 0.98	165 / 54 / 0.32
Common tern	*Sterna hirundo*		
Cook's petrel	*Pterodroma cookii*	39 / 35 / 0.05	31 / 27 / 0.06
Craveri's murrelet	*Synthliboramphus craveri*		
Dark shearwater	(species group)		
Dark-rumped petrel	*Pterodroma phaeopygia sandwichensis*		
Double-crested cormorant	*Nannopterum auritum*	2 / 2 / 0	2 / 2 / 0
Eared grebe	*Podiceps nigricollis*		
Elegant tern	*Thalasseus elegans*	95 / 35 / 0.13	84 / 31 / 0.16
Flesh-footed shearwater	*Ardenna carneipes*	1 / 1 / 0	1 / 1 / 0
Fork-tailed storm-petrel	*Hydrobates furcata*		
Forster's tern	*Sterna forsteri*	3 / 1 / 0	3 / 1 / 0.01
Franklin's gull	*Leucophaeus pipixcan*		
Glaucous gull	*Larus hyperboreus*		
Glaucous-winged gull	*Larus glaucescens*		
Glaucous-winged/Western hybrid gull			
Guadalupe murrelet	*Synthliboramphus hypoleucus*		
Hawaiian petrel	*Pterodroma sandwichensis*		
Heermann's gull	*Larus heermanni*	25 / 13 / 0.03	22 / 11 / 0.04
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	*Leucophaeus atricilla*		
Laysan albatross	*Phoebastria immutabilis*	4 / 4 / 0.01	3 / 3 / 0.01
Leach's storm-petrel complex	(species group)	16 / 12 / 0.02	14 / 10 / 0.03
Least storm-petrel	*Hydrobates microsoma*		
Least tern	*Sterna antillarum*		
Long-tailed jaeger	*Stercorarius longicaudus*		
Manx shearwater	*Puffinus puffinus*		
Marbled murrelet	*Brachyramphus marmoratus*		
Masked booby	*Sula dactylatra*		
Mottled petrel	*Pterodroma inexpectata*		
Murphy's petrel	*Pterodroma ultima*	1 / 1 / 0	
Nazca booby	*Sula granti*	1 / 1 / 0	1 / 1 / 0
Northern fulmar	*Fulmarus glacialis*	3 / 3 / 0	1 / 1 / 0
Osprey	*Pandion haliaetus*		
Pacific loon	*Gavia pacifica*	224 / 55 / 0.31	103 / 30 / 0.2
Parakeet auklet	*Aethia psittacula*		
Parasitic jaeger	*Stercorarius parasiticus*	5 / 5 / 0.01	4 / 4 / 0.01
Pelagic cormorant	*Urile pelagicus*	1 / 1 / 0	1 / 1 / 0
Peregrine falcon	*Falco peregrinus*		
Pigeon guillemot	*Cepphus columba*	4 / 2 / 0.01	
Pink-footed shearwater	*Ardenna creatopus*	224 / 66 / 0.31	177 / 33 / 0.35
Pomarine jaeger	*Stercorarius pomarinus*	8 / 7 / 0.01	4 / 3 / 0.01
Providence/Solander's petrel	*Pterodroma solandri*		
Red phalarope	*Phalaropus fulicaria*	628 / 65 / 0.86	299 / 41 / 0.58
Red-billed tropicbird	*Phaethon aethereus*		
Red-footed booby	*Sula sula*		
Red-necked grebe	*Podiceps grisegena*		
Red-necked phalarope	*Phalaropus lobatus*	337 / 33 / 0.46	213 / 16 / 0.42
Red-tailed tropicbird	*Pheathon rubricauda*		
Red-throated loon	*Gavia stellata*	3 / 3 / 0	3 / 3 / 0.01
Rhinoceros auklet	*Cerorhinca monocerata*	5 / 4 / 0.01	2 / 2 / 0
Ring-billed gull	*Larus delawarensis*		
Royal tern	*Thalasseus maximus*	6 / 4 / 0.01	6 / 4 / 0.01
Ruddy turnstone	*Arenaria interpres*		
Sabine's gull	*Xema sabini*	28 / 10 / 0.04	17 / 6 / 0.03
Scripps's murrelet	*Synthliboramphus scrippsi*	10 / 5 / 0.01	10 / 5 / 0.02
Short-billed gull	*Larus brachyrhynchus*		
Short-tailed / Slender-billed shearwater	*Ardenna tenuirostris*	1 / 1 / 0	
Short-tailed albatross	*Phoebastria albatrus*		
Sooty shearwater	*Ardenna grisea*	711 / 96 / 0.97	422 / 33 / 0.83
South polar skua	*Stercorarius maccormicki*		
Stejneger's petrel	*Pterodroma longirostris*		
Surf scoter	*Melanitta perspicillata*		
Thayer's gull	*Larus glaucoides thayeri*		
Tufted puffin	*Fratercula cirrhata*	1 / 1 / 0	
Unidentified albatross	(species group)		
Unidentified auklet	(species group)		

Unidentified booby	(species group)		
Unidentified cormorant	(species group)	1 / 1 / 0	1 / 1 / 0
Unidentified gull	(species group)	158 / 12 / 0.22	156 / 10 / 0.31
Unidentified jaeger	(species group)		
Unidentified large alcid	(species group)		
Unidentified loon	(species group)	2 / 2 / 0	2 / 2 / 0
Unidentified murre	(species group)		
Unidentified murrelet	(species group)		
Unidentified petrel	(species group)		
Unidentified phalarope	(species group)	102 / 5 / 0.14	102 / 5 / 0.2
Unidentified procellarid	(species group)		
Unidentified shearwater	(species group)		
Unidentified small alcid	(species group)		
Unidentified storm-petrel	(species group)		
Unidentified tern	(species group)		
Wedge-rumped storm-petrel	*Hydrobates tethys*		
Wedge-tailed shearwater	*Puffinus pacificus*		
Western grebe	*Aechmophorus occidentalis*	23 / 4 / 0.03	23 / 4 / 0.04
Western gull	*Larus occidentalis*	476 / 204 / 0.65	421 / 162 / 0.82
Wilson's storm-petrel	*Oceanites oceanicus*		
Xantus's murrelet	*Synthliboramphus hypoleucus*		

Figure 4. Log_{10} density anomalies for select procellariform seabird species, core survey area, spring 1987–2026. A) sooty shearwater, B) pink-footed shearwater, C) black-footed albatross, D) Laysan albatross, E) Cook's petrel, and F) Leach's storm-petrel complex (includes unidentified and subspecies identified since 2017). The shearwaters, albatrosses, and petrels are migrant species to the Southern California Bight region. Dashed lines indicate ± 1 s.d. of the long-term mean, and 'X' indicates years when no spring survey was conducted. A constant of 0.01 was added to each density prior to log_{10} transformation and the anomaly calculation.

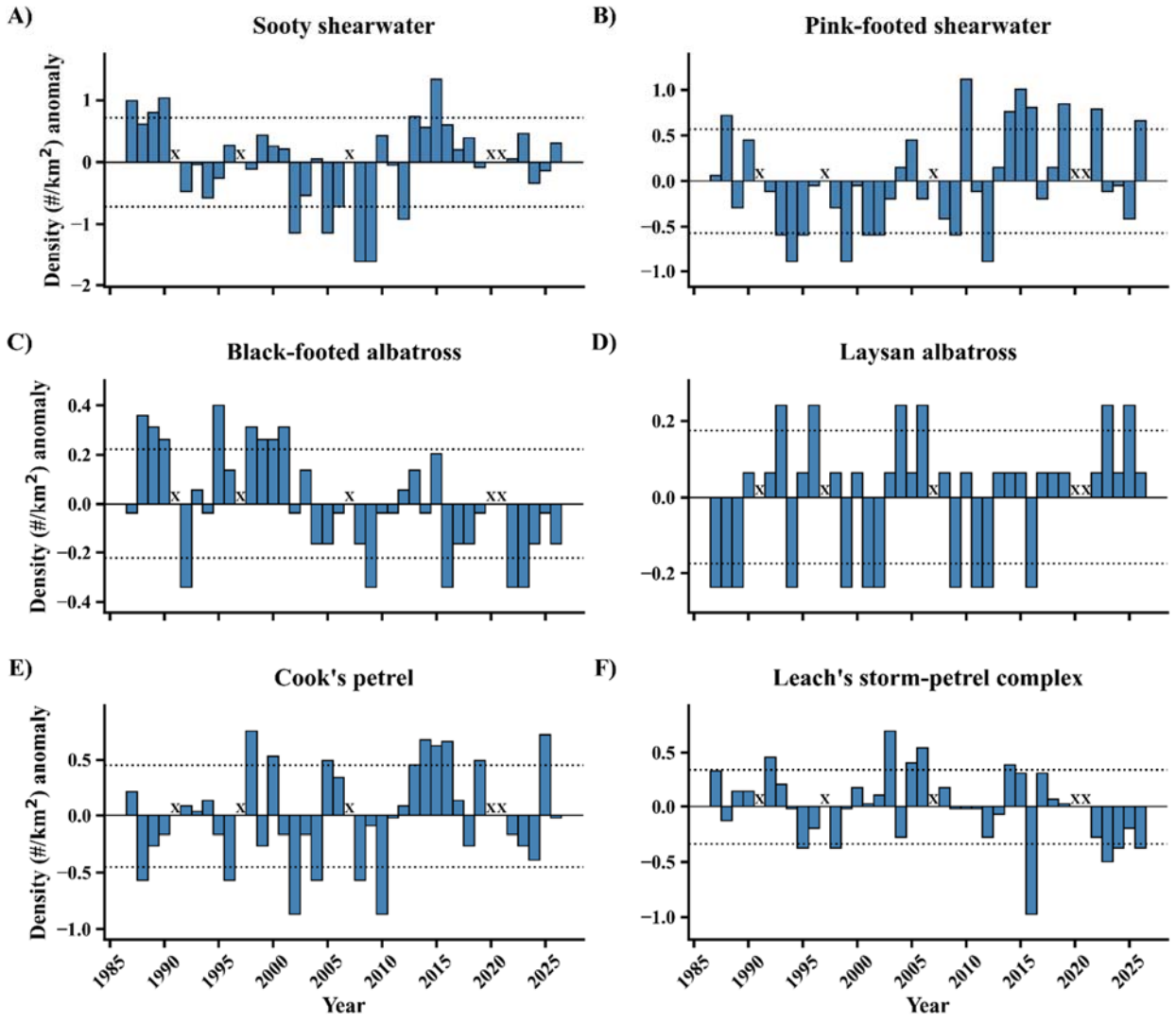


Figure 5. Log_{10} density anomalies for select alcid species, core survey area, spring 1987–2026. A) Small *Synthliboramphus* alcids (Scripps', Xantus', Craveri's, and Guadalupe murrelets grouped), B) Cassin's auklet, C) common murre, and D) rhinoceros auklet. All of these species are locally breeding species in the California Current Ecosystem. The dashed lines indicate ± 1 s.d. of the long-term mean, and 'X' indicates years when no spring survey was conducted. A constant of 0.01 was added to each density prior to log_{10} transformation and the anomaly calculation.

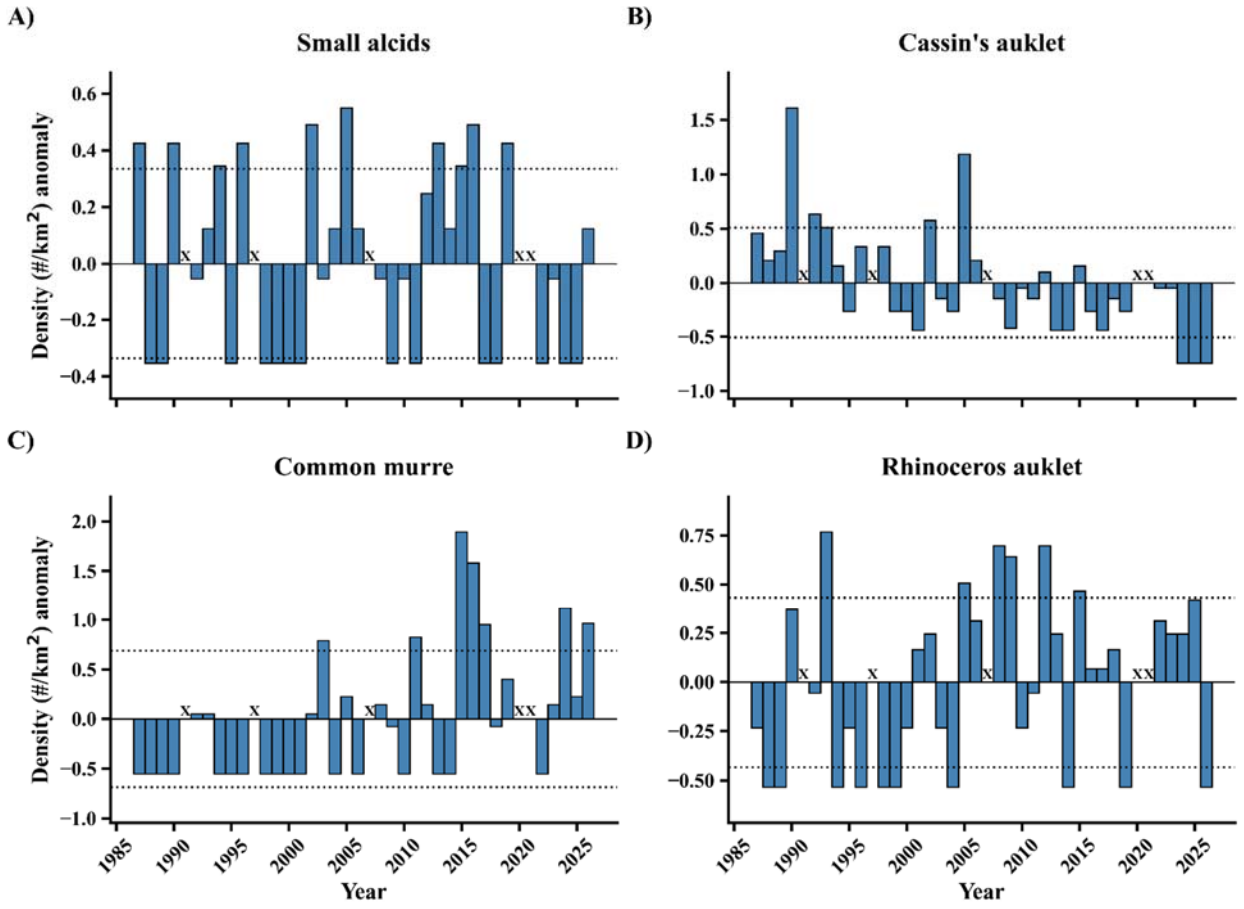


Figure 6. Log_{10} density anomalies for select seabird species, core survey area, spring 1987–2026. A) Brandt's cormorant, B) brown pelican, C) western gull, D) Sabine's gull, and E) phalaropes (grouped red and red-necked phalaropes). Brandt's cormorant, brown pelican, and western gull are locally breeding species. The dashed lines indicate ± 1 s.d. of the long-term mean, and 'X' indicates years when no spring survey was conducted. A constant of 0.01 was added to each density prior to log_{10} transformation and the anomaly calculation.

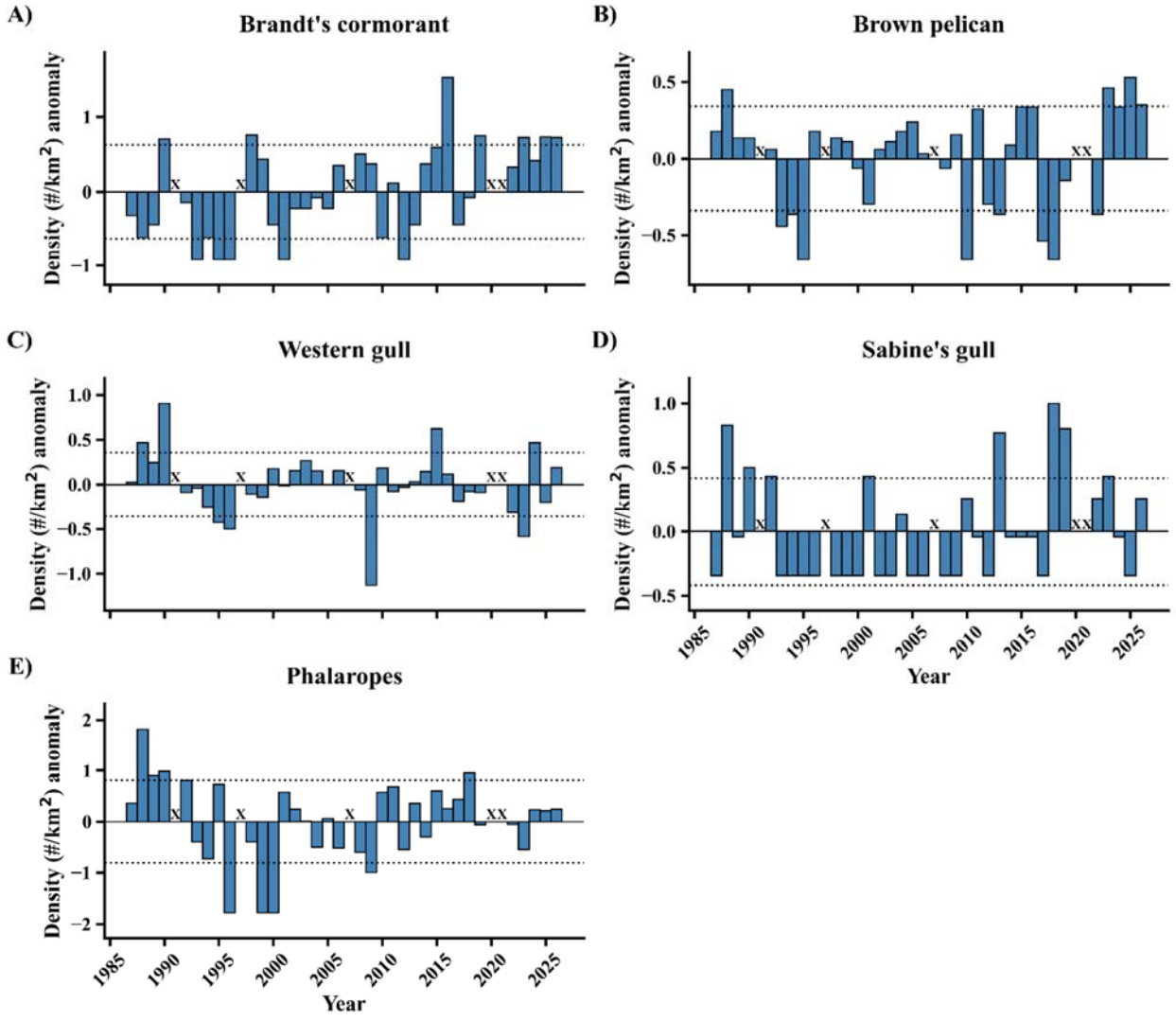


Table 3. Results of Spearman rank correlation of seabird density over time indicating trends. Bold: nominal significance $p < 0.1$. N = 35 years of data.

Species/Group	rho	p-value
Sooty shearwater	-0.06	0.711
Pink-footed shearwater	**0.32**	**0.057**
Black-footed albatross	**-0.56**	**0.001**
Laysan albatross	0.27	0.115
Cook's petrel	0.18	0.303
Leach's storm-petrel complex	**-0.32**	**0.057**
Small alcids	-0.06	0.742
Cassin's auklet	**-0.63**	**<0.001**
Common murre	**0.59**	**<0.001**
Rhinoceros auklet	0.26	0.129
Brandt's cormorant	**0.50**	**0.002**
Brown pelican	0.13	0.470
Western gull	-0.11	0.540
Sabine's gull	0.23	0.180
Phalaropes	-0.10	0.570

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Appendix 1. 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*
Blue-footed booby	*Sula nebouxii*
Brewer's Sparrow	*Spizella breweri*
Brown-headed cowbird	*Molothrus ater*
Bufflehead	*Bucephala albeola*
Chapman'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*
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	
Unidentified Goose	(species group)
Unidentified Hummingbird	(species group)
Unidentified Passerine	(species group)
Unidentified raptor	(species group)
Unidentified Shorebird	(species group)
Wandering tattler	*Tringa incana*
Waved albatross	*Phoebastria irrorata*
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*