Seabirds on the CalCOFI/CCE-LTER Survey, Spring 2018
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 are 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 (e.g., Santora et al. 2017), a region characterized by substantial temporal environmental heterogeneity and a major biogeographic boundary associated with Point Conception. Third, by extending our existing records (currently over 30 years and building; 1987-present) and coupling this information with long-term hydrographic and plankton data, 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). Other anthropogenic impacts for this region include coastal oil and gas development and shipping, as well as other biotic changes due to fisheries and other extractive uses of marine life. Seabirds may be responsive to all of these factors.

This data report summarizes observations made during the 2018 spring CalCOFI/CCE-LTER cruise. We present basic data on survey effort as well as summary information on seabird distribution and abundance.

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 every 20 seconds. 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 which includes data from May 1987 to the present. These data are used to derive summary statistics.

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

Criteria	Value
Behavior codes included	All values
Species categories included	Birds, Unidentified
Species categories excluded	Mammals, Fish, Excluded Species List
Year	2018
Month	All
Bin length	All bins > 0.1 km
Region	Lines 60-93 (core + extended areas)
Season	Spring

Taxa excluded from this summary were 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 (km^2) surveyed. Density over time in the spring in the "core" survey area (defined as the six lines 77–93) is shown for select species of warm- and cold-water affinities, 1987–2018. For spring, we have defined species with warm-water affinity to include black-footed albatross, Cook's petrel, and elegant tern (Hyrenbach and Veit 2003). Cold-water affinity species include Bonaparte's gull, Sabine's gull, pink-footed shearwater, and sooty shearwater (Hyrenbach and Veit 2003).

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 area are shown in Table 3 (see Appendix 1 for exclusions). A total of 22 days of survey effort covering 2,576 km (773 km^2) of ocean habitat was tallied over the entire survey. Based on 16 days of survey effort covering 1,741 km (522 km^2) of ocean, density over time in the core area for the selected seabird species (listed above) was calculated and is shown (as anomalies) in Figures 2 (warm-water affinity) and 3 (cold-water affinity), and for all species of seabirds (Figure 4).

There were several notable results from the 2018 spring survey for these species. First, there was the highest ever recorded density of Sabine's gull in the spring CalCOFI survey and very high densities of elegant tern (Figs 2, 3). Interestingly, both of these species were more abundant on this survey than average even though they are considered as preferring opposing water mass characteristics—Sabine's gull prefer colder water and elegant tern prefer warmer waters. There is recent evidence that elegant terns are experiencing a range expansion northward in southern California (Velarde et al. 2015) and our data support these observations. Lastly, there was low abundance of black-footed albatross for the third consecutive year during the spring survey (near -1 s.d. in 2017 and 2018, Fig. 2). Density of all species overall was near average for the time series (Fig. 4).

Table 2. Summary of survey effort and seabird statistics for the core and extended areas, spring 2018.

Spring 2018	Core + Extended	Core only
Survey Vessel	RV *Bell Shimada*	
Start Date	4/5/2018	4/5/2018
End Date	4/26/2018	4/20/2018
Number of Survey Days	22	16
Distance Surveyed (km)	2,576	1,741
Area Surveyed (km^2)	773	522
Number of Bird Species	51	47
Overall Bird Density (per km^2)	17.433	9.316
Total Individuals Counted	13,470	4,865

Figure 1. Transects sampled in the core and extended area, spring 2018. The core survey area is indicated by the outlined box.

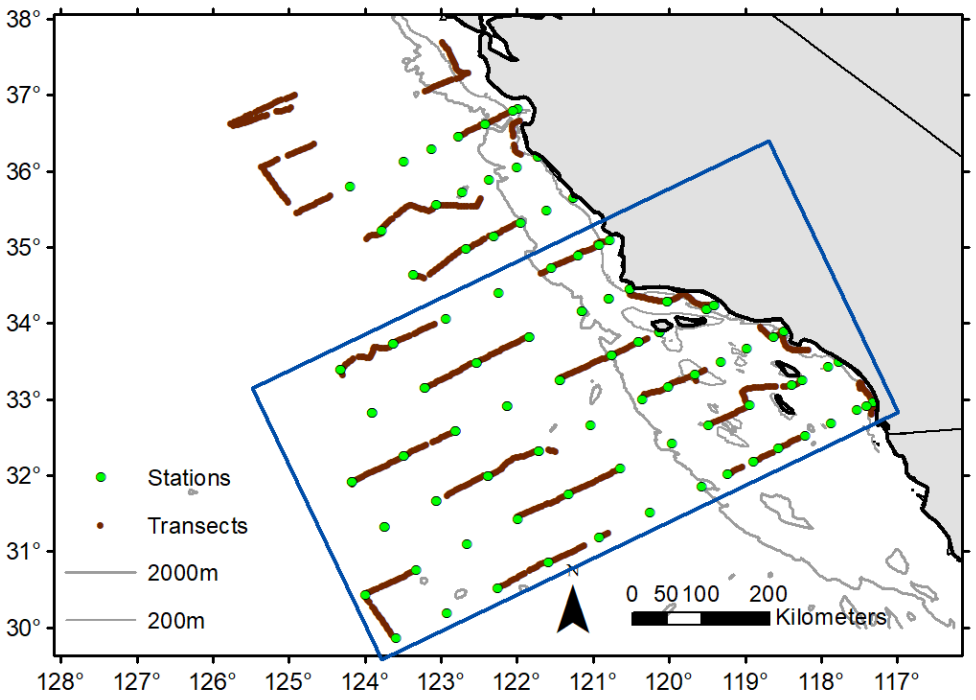


Table 3. Observations in spring 2018 by species in the core and core + extended survey areas. Cell values: total number of individuals (ind.) / number of observations per species (obs.) / species density (dens.) in individuals per km^2.

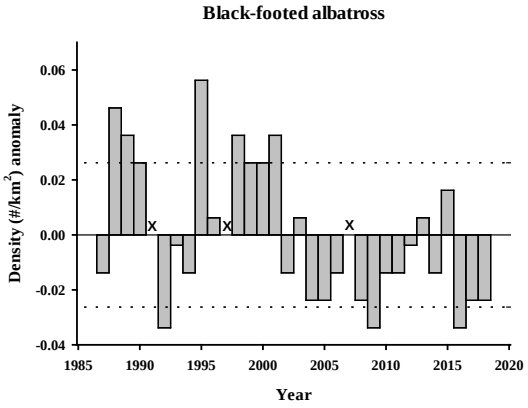
Common Name	Scientific Name	Core only	Core + Extended
American White Pelican	*Pelecanus erythrorhynchos*		
Ancient Murrelet	*Synthliboramphus antiquus*		
Arctic Loon	*Gavia arctica*		
Arctic Tern	*Sterna paradisaea*		
Ashy Storm-Petrel	*Oceanodroma homochroa*	5 / 3 / 0.01	6 / 4 / 0.01
Black guillemot	*Cepphus grylle*		
Black Scoter	*Melanitta nigra*		
Black Storm-Petrel	*Oceanodroma melania*		
Black-Footed Albatross	*Phoebastria nigripes*	10 / 9 / 0.02	25 / 23 / 0.03
Black-Legged Kittiwake	*Rissa tridactyla*		
Black-Vented Shearwater	*Puffinus opisthomelas*	15 / 10 / 0.03	15 / 10 / 0.02
Bonaparte's Gull	*Larus philadelphia*	331 / 75 / 0.63	393 / 96 / 0.51
Brandt's Cormorant	*Phalacrocorax penicillatus*	29 / 20 / 0.06	269 / 24 / 0.35
Brant	*Branta bernicla*	9 / 1 / 0.02	9 / 1 / 0.01
Brown Booby	*Sula leucogaster*		
Brown Noddy	*Anous stolidus*		
Brown Pelican	*Pelecanus occidentalis*	8 / 6 / 0.02	8 / 6 / 0.01
Buller's Shearwater	*Puffinus bulleri*		
California Gull	*Larus californicus*	39 / 22 / 0.07	40 / 23 / 0.05
Caspian Tern	*Sterna caspia*		
Cassin's Auklet	*Ptychoramphus aleuticus*	14 / 9 / 0.03	17 / 12 / 0.02
Clark's Grebe	*Aechmophorus clarkii*	2 / 1 / 0	2 / 1 / 0
Common Loon	*Gavia immer*	6 / 4 / 0.01	7 / 5 / 0.01
Common Murre	*Uria aalge*	13 / 11 / 0.02	2792 / 125 / 3.61
Common Tern	*Sterna hirundo*	1 / 1 / 0	1 / 1 / 0
Cook's Petrel	*Pterodroma cookii*	17 / 15 / 0.03	24 / 20 / 0.03
Craveri's Murrelet	*Synthliboramphus craveri*		
Dark Shearwater	(species group)		2 / 2 / 0
Dark-Rumped Petrel	*Pterodroma phaeopygia sandwichensis*		
Double-Crested Cormorant	*Phalacrocorax auritus*	1 / 1 / 0	1 / 1 / 0
Eared Grebe	*Podiceps nigricollis*		
Elegant Tern	*Sterna elegans*	317 / 71 / 0.61	324 / 74 / 0.42
Flesh-Footed Shearwater	*Puffinus carneipes*		
Fork-Tailed Storm-Petrel	*Oceanodroma furcata*		
Forster's Tern	*Sterna forsteri*	8 / 5 / 0.02	8 / 5 / 0.01
Franklin's Gull	*Larus pipixcan*		
Glaucous Gull	*Larus hyperboreus*		
Glaucous-Winged Gull	*Larus glaucescens*		
Guadalupe Murrelet	*Synthliboramphus hypoleucus*		
Hawaiian Petrel	*Pterodroma sandwichensis*		
Heermann's Gull	*Larus heermanni*	3 / 2 / 0.01	3 / 2 / 0
Herring Gull	*Larus argentatus*	15 / 14 / 0.03	16 / 15 / 0.02

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*	3 / 3 / 0.01	3 / 3 / 0
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	38 / 22 / 0.07	97 / 42 / 0.13
Least Storm-Petrel	*Oceanodroma microsoma*		
Least Tern	*Sterna antillarum*		
Long-Tailed Jaeger	*Stercorarius longicaudus*		
Marbled Murrelet	*Brachyramphus marmoratus*		
Mew Gull	*Larus canus*		
Mottled Petrel	*Pterodroma inexpectata*		
Murphy's Petrel	*Pterodroma ultima*	2 / 2 / 0	3 / 3 / 0
Northern Fulmar	*Fulmarus glacialis*	18 / 18 / 0.03	59 / 54 / 0.08
Osprey	*Pandion haliaetus*		
Pacific Loon	*Gavia pacifica*	96 / 40 / 0.18	352 / 60 / 0.46
Parakeet Auklet	*Aethia psittacula*		
Parasitic Jaeger	*Stercorarius parasiticus*	1 / 1 / 0	1 / 1 / 0
Parkinson's Petrel	*Procellaria parkinsoni*		
Pelagic Cormorant	*Phalacrocorax pelagicus*	1 / 1 / 0	1 / 1 / 0
Peregrine Falcon	*Falco peregrinus*		
Pigeon Guillemot	*Cepphus columba*	10 / 4 / 0.02	17 / 11 / 0.02
Pink-Footed Shearwater	*Puffinus creatopus*	50 / 28 / 0.1	68 / 46 / 0.09
Pomarine Jaeger	*Stercorarius pomarinus*	8 / 6 / 0.02	11 / 9 / 0.01
Red Phalarope	*Phalaropus fulicaria*	547 / 46 / 1.05	1132 / 75 / 1.47
Red-Billed Tropicbird	*Phaethon aethereus*	1 / 1 / 0	1 / 1 / 0
Red-Footed Booby	*Sula sula*		
Red-Necked Grebe	*Podiceps grisegena*		
Red-Necked Phalarope	*Phalaropus lobatus*	2213 / 28 / 4.24	2718 / 62 / 3.52
Red-Tailed Tropicbird	*Pheathon rubricauda*		
Red-Throated Loon	*Gavia stellata*	1 / 1 / 0	2 / 2 / 0
Rhinoceros Auklet	*Cerorhinca monocerata*	19 / 10 / 0.04	48 / 33 / 0.06
Ring-Billed Gull	*Larus delawarensis*		
Royal Tern	*Sterna maxima*		
Ruddy Turnstone	*Arenaria interpres*		
Sabine's Gull	*Larus sabini*	111 / 19 / 0.21	112 / 20 / 0.14
Scripps's murrelet	*Synthliboramphus scrippsi*		
Short-Tailed / Slender-Billed Shearwater	*Puffinus tenuirostris*	2 / 2 / 0	2 / 2 / 0
Short-Tailed Albatross	*Phoebastria albatrus*		
Solander's Petrel	*Pterodroma solandri*		
Sooty Shearwater	*Puffinus griseus*	528 / 105 / 1.01	2109 / 192 / 2.73
South Polar Skua	*Stercorarius maccormicki*		
Stejneger's Petrel	*Pterodroma longirostris*		
Surf Scoter	*Melanitta perspicillata*	4 / 2 / 0.01	5 / 3 / 0.01
Thayer's Gull	*Larus thayeri*		

Townsend's Storm-Petrel	*Oceanodroma socorroensis*	2 / 2 / 0	2 / 2 / 0
Tufted Puffin	*Fratercula cirrhata*		2 / 2 / 0
Unidentified Albatross	(species group)		
Unidentified Auklet	(species group)		
Unidentified Cormorant	(species group)		
Unidentified Duck	(species group)		
Unidentified Grebe	(species group)	1 / 1 / 0	1 / 1 / 0
Unidentified Gull	(species group)	58 / 15 / 0.11	420 / 21 / 0.54
Unidentified Jaeger	(species group)		
Unidentified Large Alcid	(species group)		2 / 2 / 0
Unidentified Leach's Storm-Petrel	(species group)	14 / 8 / 0.03	14 / 8 / 0.02
Unidentified Loon	(species group)		2 / 2 / 0
Unidentified Murre	(species group)		
Unidentified Petrel	(species group)		
Unidentified Phalarope	(species group)	21 / 2 / 0.04	23 / 3 / 0.03
Unidentified Procellarid	(species group)		
Unidentified Shearwater	(species group)		
Unidentified Skua	(species group)		
Unidentified Small Alcid	(species group)	1 / 1 / 0	2 / 2 / 0
Unidentified Storm-Petrel	(species group)		
Unidentified Tern	(species group)		
Unidentified Tropicbird	(species group)		
Wedge-Rumped Storm-Petrel	*Oceanodroma tethys*		
Wedge-Tailed Shearwater	*Puffinus pacificus*		
Western Grebe	*Aechmophorus occidentalis*	37 / 8 / 0.07	37 / 8 / 0.05
Western Gull	*Larus occidentalis*	231 / 156 / 0.44	2258 / 178 / 2.92
Wilson's Storm-Petrel	*Oceanites oceanicus*		
Xantus's / Craveri's Murrelet	(species group)	4 / 2 / 0.01	4 / 2 / 0.01
Xantus's Murrelet	*Synthliboramphus hypoleucus*		

Figure 2. Density (expressed as anomalies) over time from spring surveys for species with warm-water affinity, core survey area, 1987–2018. A) black-footed albatross, B) Cook's petrel, and C) elegant tern. The dashed lines indicate ± 1 s.d. of the long-term mean, and 'x' indicates years when no spring survey was conducted.

A)



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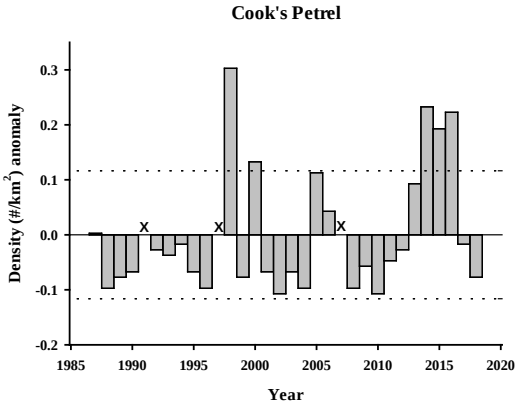


C)

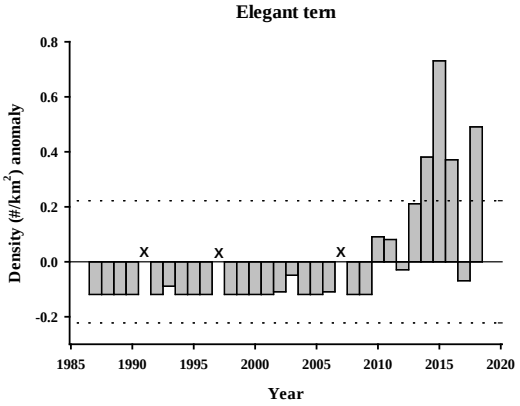


Figure 3. Density (expressed as anomalies) over time in the spring for species with cold-water affinities, core area only, 1987–2018. A) Bonaparte's gull, B) Sabine's gull, C) sooty shearwater, and D) pink-footed shearwater. The dashed lines indicate ± 1 s.d. of the long-term mean, and 'x' indicates years when no spring survey was conducted.

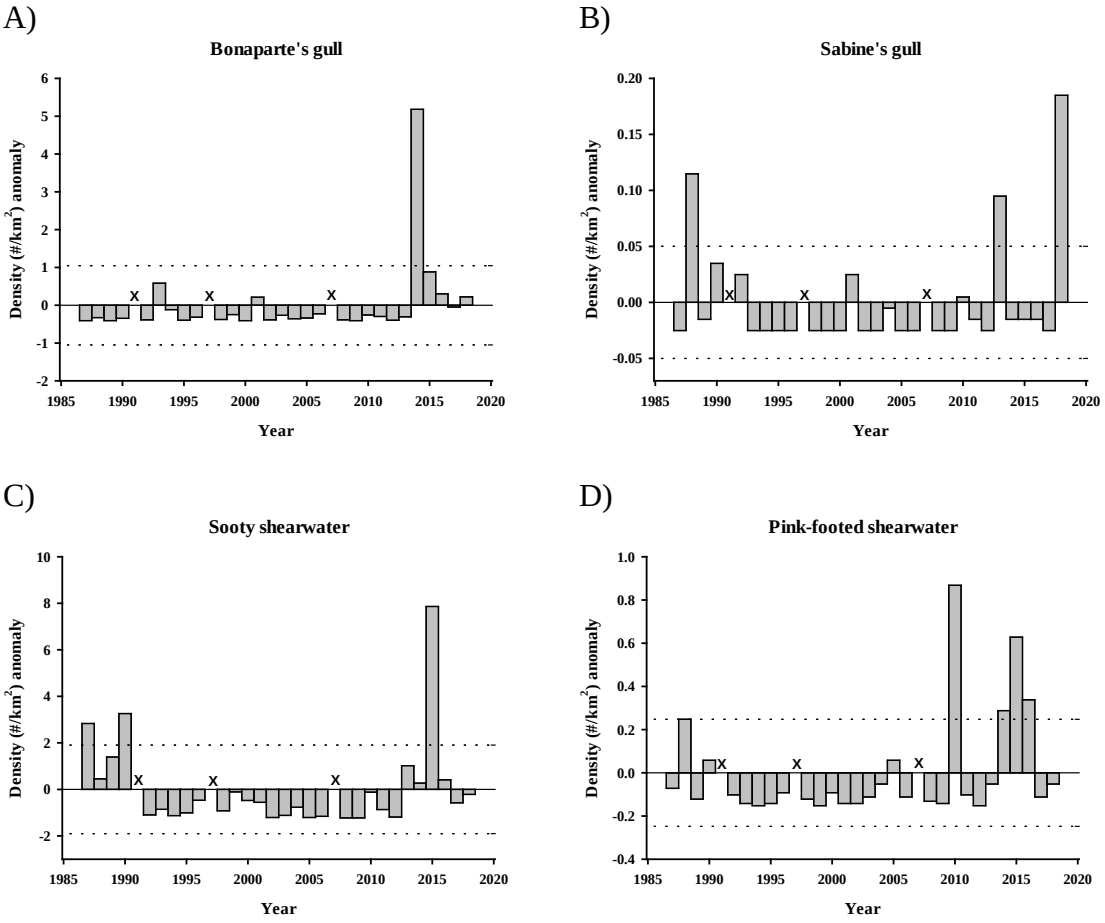
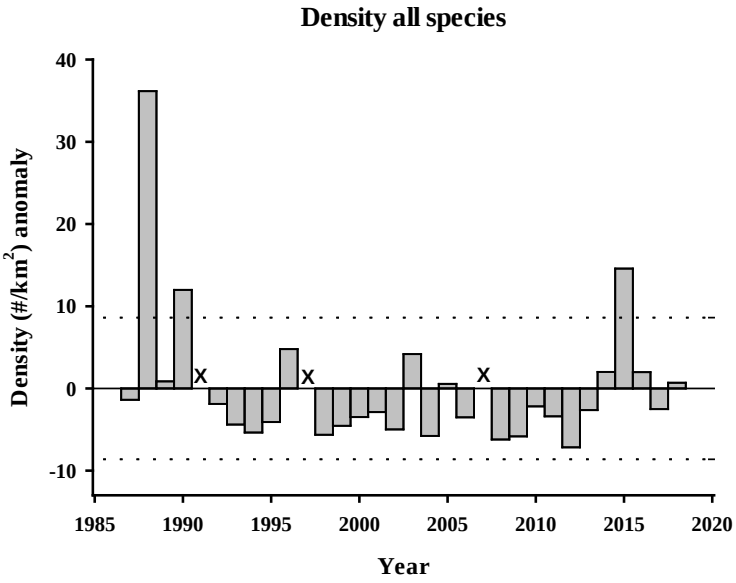


Figure 4. Density (expressed as anomalies) over time in the spring for all species in the core area only, 1987–2018. The dashed lines indicate ± 1 s.d. of the long-term mean, and 'x' indicates years when no spring survey was conducted.



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Cover photo: Sabine's gull. Photo by Matt Van Wallene, Wikimedia Commons (CC 4.0).

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*
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*
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*