



**PACIFIC BIRDS**  
HABITAT JOINT VENTURE

## **TECHNICAL REPORT**

December 2025

For the project entitled:

### **Pacific Birds Conservation Tool version 1.0: Explore and download multispecies eBird maps and data for the Pacific Birds Habitat Joint Venture region**

Prepared by:

Jenny Muñoz

Laura Farwell

Andrew Huang

Monica Iglecia

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[https://conservationtools.shinyapps.io/birdsconservationtoolpacificbirds\\_vf/](https://conservationtools.shinyapps.io/birdsconservationtoolpacificbirds_vf/)

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Pacific Birds Habitat Joint Venture. 2025. Pacific Birds Conservation Tool version 1.0: Explore and download multispecies eBird maps and data for the Pacific Birds Habitat Joint Venture region. Technical Report. Portland, OR.

## **ABOUT THE CONSERVATION TOOL**

The Pacific Birds Conservation Tool is a web-based application that provides access to multispecies modeled eBird data, maps, and geospatial information within the Pacific Birds Habitat Joint Venture (Pacific Birds) region. This tool is intended to support conservation planners and practitioners in landscape-scale planning and decision-making by highlighting bird hotspots and areas of high potential conservation value for birds, across the JV geography.

## **METHODS**

The maps in this tool were created by overlaying multiple modeled species distribution layers derived from eBird Status & Trends data. The composite maps show patterns of bird richness and relative abundance across the region. Maps display modeled distributions, not direct observations.

Each species distribution layer used in the composite maps represents modeled relative abundance estimates, generated using filtered and reviewed eBird citizen-science observations combined with environmental variables, to predict where and how abundantly each species occurs at a 3×3 km resolution.

To learn more about the statistical and machine learning models and environmental predictors that eBird uses to generate species relative abundance estimates, visit [FAQ - eBird](#) and [\(Fink et al 2019\)](#).

## **HOW ESTIMATES ARE CALCULATED**

We used eBird relative abundance estimates for each species, calculated as the count of individuals of a given species detected by an expert eBirder during a 1-hour, 2-kilometer traveling checklist at the optimal time of day. To maximize detection rates, these predictions are optimized for observer skill and hourly weather conditions, specific to the region, season, and species.

For each species, relative abundance was estimated for distinct seasons (breeding, non-breeding, pre-breeding and post-breeding) and annually in a 3 × 3 km-resolution spatial grid. Estimates for each location and date are based on local habitat, elevation, and topography. The predicted values represent a relative measure rather than an exact count. This standardized index allows meaningful comparisons between regions for the same species (e.g., an abundance of 10 in one area vs. 5 in another indicates twice as many individuals in the first).

In this tool, these relative abundance estimates are used to generate composite maps of multiple species based on three core metrics:

- **Species richness:** Calculated by converting relative abundance values into presence–absence data and summing the total number of predicted species occurring in a given pixel. This can be calculated for all birds or for a specific bird group (e.g., shorebirds) for the selected season or year-round.

**What this means:** this metric shows the total number of different species predicted to be present in each pixel, for all birds or a selected bird group.

- **Mean relative abundance:** Calculated by averaging the normalized (0–1) relative abundance values of all species within a bird group (e.g., waterfowl) in each pixel. This highlights areas with higher average predicted abundance for the selected group and season. Darker pixels indicate areas where most species in the group have higher abundance.

**What this means:** this metric shows the average predicted abundance of all species in a selected bird group (e.g., waterfowl) in each pixel, scaled from 0 to 1. Darker areas show places where, on average, species in the group are more abundant.

- **Percent of population:** Calculated by first determining the percentage of the total population for each species by dividing its relative abundance in a pixel by the total relative abundance across all pixels for that species. These percentages are then summed across all species in the selected group for each pixel, and the mean is calculated. This method corrects for species with larger populations and highlights pixels that hold a higher average share of the group’s total population.

**What this means:** this metric shows the average share of a bird group’s total modeled population found in each pixel. This makes it easier to see which areas hold the largest percentage of global populations of the bird group of interest.

To learn more about eBird estimates visit [FAQ - eBird](#)

## BIRD GROUPS

To support conservation planning, species are organized into broad, taxonomically or ecologically informed groups that share habitats and management needs:

- **All-bird species group:** Includes shorebirds, waterfowl, waterbirds, and wetland birds. For a complete list of included species, download the species list for the selected group.
- **Shorebirds:** Members of the order Charadriiformes that rely on intertidal zones, beaches, mudflats, and shorelines (sandpipers, plovers, avocets, stilts, and allies).

- **Waterbirds:** Species closely tied to aquatic habitats (e.g., loons, grebes, cormorants, pelicans, herons, cranes, rails, gulls, terns).
- **Waterfowl:** Aquatic birds that are strongly wetland dependent; family Anatidae (ducks, geese, swans).
- **Wetland birds:** Other wetland-associated landbird species that use marshes, swamps, floodplains, or other wetlands for key life stages (non-waterfowl, non-shorebird, non-waterbird).

## PRIORITY

- **High-Priority species:** Includes coastal wetland species identified as very high (Tier 1) or high (Tier 2) priority species for conservation action, in the [Pacific Birds Coastal Wetlands Strategic Plan](#).

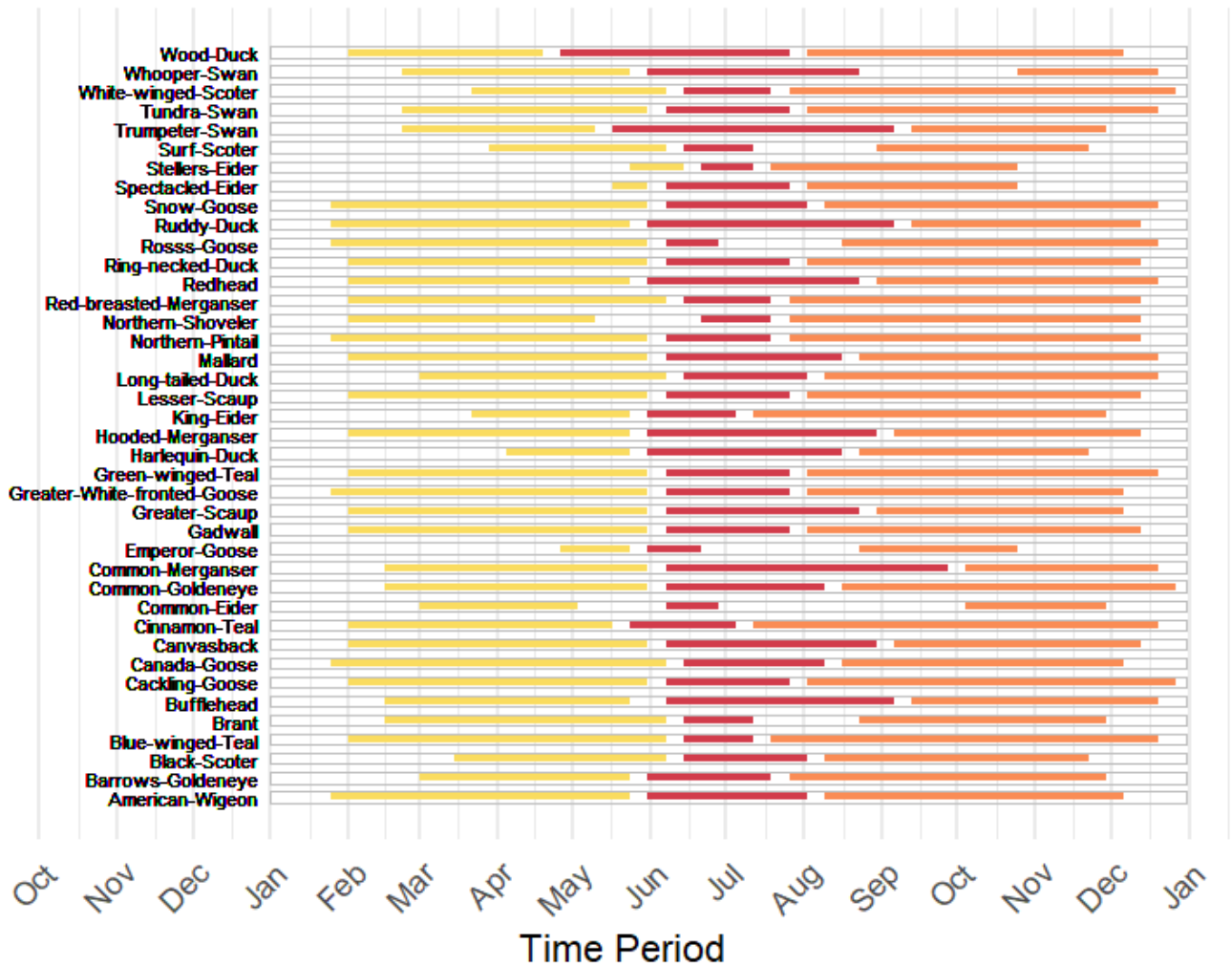
## SEASON DEFINITIONS

The breeding, non-breeding, pre-breeding (spring migration), and post-breeding (fall migration) seasons shown in this dashboard are species-specific estimates derived from eBird Status & Trends data.

- **Breeding and non-breeding season** dates are defined for each species as the weeks when the species' population does not move. These stationary periods were identified by experts using weekly abundance maps and refined to align with known patterns of migration and breeding phenology.
- **Pre-breeding and post-breeding season** migration periods represent the intervals of movement between the stationary breeding and non-breeding seasons. These can include movement from breeding grounds to non-breeding grounds, post-breeding dispersal, molt migration, or other transitional movements. In some species, these transitions are not clearly defined, and transitional weeks are excluded to provide the clearest view of distinct seasons. Some species have pre-breeding and post-breeding migration seasons combined into a single migratory season. In cases where the transition between stationary and migratory seasons is not clear, transitional weeks were excluded to provide the clearest picture of individual seasons.

Here is an example of how seasons are defined for some waterfowl species: yellow indicates the pre-breeding season, red indicates the breeding season, and orange indicates the post-breeding season:

## Phenology of Waterfowl Species



### AREAS OF NO PREDICTION

Some areas have insufficient data to predict whether a species is present or absent, or whether a group of species is present or absent.

### SUGGESTED USES AND KEY LIMITATIONS

This conservation tool is designed to provide a regional-scale perspective of bird diversity hotspots, helping users assess potential areas of conservation importance for birds. The following are examples of use-cases of this tool:

- **Identifying Conservation Priorities:** The dashboard can highlight regions with high avian diversity, guiding partners in prioritizing areas for habitat protection, restoration, or stewardship activities.
- **Enhancing Communication and Outreach:** The dashboard provides a clear and interactive way to tell the story of bird diversity across the Joint Venture geography, helping engage partners, communities, and the public in conservation efforts
- **Supporting Research and Monitoring:** Researchers can use the spatial layers to design monitoring programs in key areas.
- **Supporting Land-Use Planning:** Spatial summaries of bird diversity can inform regional planning processes, and land-use decisions to minimize impacts on biodiversity.

Although this tool offers powerful capabilities to explore bird hotspots and areas of potential conservation importance, it is important to also understand its limitations. Users should consider whether these data are suitable for their specific questions and be aware of potential scale-related limitations that may affect interpretation. The layers are based on modeled data at a 3\*3 km resolution, which may be too coarse to capture fine-scale habitat or landscape variation that influences bird distributions. Furthermore the data presented in this tool is predicted data not raw data, and therefore there are limitations inherent to the models:

- **Errors when predicting species range and abundance:** Like all predictive models, the eBird Status & Trends models are subject to uncertainty and errors in estimating species ranges and abundance. Errors can occur when species are predicted to be present where they are absent, or absent where they actually occur, as well as when abundance estimates are too high or too low. The models address data gaps by borrowing information from nearby areas, which works best when sufficient eBird observations exist and when environmental predictors accurately represent the species' ecological requirements.

Error rates increase in regions with sparse checklist coverage, low detection rates for a species, or inadequate environmental data such as in remote areas where extrapolations may be less reliable.

- **Low detection rates:** Species that are rare, cryptic, or difficult to identify may have higher uncertainty because few observations are available to train the models.
- **Incomplete environmental data:** Predictions may be less accurate in areas where environmental variables do not fully capture key ecological conditions for the species.

- **Species gaps:** It is possible that some species occurring within the JV geography did not have sufficient data to be modeled across the entire area and were therefore excluded from the analysis. Additionally, some pixels may contain insufficient data to predict whether a species is present or absent. In such cases, when the rasters are stacked, those pixels are assigned an NA value and are not included in the species count for that pixel.
- **Citizen-science data** such as eBird provide vast and valuable information for modeling species distributions, but they also contain inherent biases. Sampling effort is uneven across space and time, detection rates vary among observers and species, and certain habitats are under-represented. Although the eBird models correct for many of these factors, residual uncertainty remains — particularly in regions with limited data or low detection rates.
- **Staking multiple species layers** When multiple species layers are combined pixels with missing predictions for some species (due to insufficient data) reduce the total number of species counted in that cell, potentially underestimating richness in poorly sampled regions.

## DATA AVAILABLE FOR DOWNLOAD

Data from the Conservation Tool website are available for download in three formats: raster files (.tif), map images (.jpg), and species lists (.csv). All files can be accessed via the download link located at the bottom left of the tool. Raster (.tif) files are intended for use in GIS analyses, map images (.jpg) are suitable for presentations and visual displays, and species lists (.csv) provide supporting tabular information.

## SPECIES LIST

We stacked relative abundance maps for 161 species within PacificBirds Habitat Joint Venture. See Appendix for the full list of species included in this analysis.

## DATA SOURCE

The original data used in this tool are from:

Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, S. Ligocki, O. Robinson, W. Hochachka, L. Jaromczyk, C. Crowley, K. Dunham, A. Stillman, I. Davies, A. Rodewald, V. Ruiz-Gutierrez, and C. Wood. 2023. eBird Status and Trends, Data Version: 2022; Released: 2023. Cornell Lab of Ornithology, Ithaca, New York. <https://doi.org/10.2173/ebirdst.2022>

## REFERENCES

Fink, D., T. Auer, A. Johnston, V. Ruiz-Gutierrez, W. M. Hochachka, and S. Kelling (2020). Modeling avian full annual cycle distribution and population trends with citizen science data. *Ecological Applications* 30:e02056.

Pacific Birds Habitat Joint Venture. 2024. Coastal Wetlands Strategic Plan: 2024-2034. Pacific Birds Habitat Joint Venture. URL: [https://pacificbirds.org/wp-content/uploads/2024/07/PBHJV-Coastal-Wetlands-Plan-7.7.24\\_reduced-for-web.pdf](https://pacificbirds.org/wp-content/uploads/2024/07/PBHJV-Coastal-Wetlands-Plan-7.7.24_reduced-for-web.pdf)

## APPENDIX

Species list included in the stacked rasters for Pacific Birds Habitat Joint Venture (PacificBirds).

JV_name	common_name	scientific_name
PacificBirds	Alder-Flycatcher	<i>Empidonax alnorum</i>
PacificBirds	American-Avocet	<i>Recurvirostra americana</i>
PacificBirds	American-Bittern	<i>Botaurus lentiginosus</i>
PacificBirds	American-Dipper	<i>Cinclus mexicanus</i>
PacificBirds	American-Pipit	<i>Anthus rubescens</i>
PacificBirds	American-Wigeon	<i>Mareca americana</i>
PacificBirds	American-Golden-Plover	<i>Pluvialis dominica</i>
PacificBirds	American-White-Pelican	<i>Pelecanus erythrorhynchos</i>
PacificBirds	Arctic-Loon	<i>Gavia arctica</i>
PacificBirds	Arctic-Tern	<i>Sterna paradisaea</i>
PacificBirds	Ash-throated-Flycatcher	<i>Myiarchus cinerascens</i>
PacificBirds	Bald-Eagle	<i>Haliaeetus leucocephalus</i>
PacificBirds	Bank-Swallow	<i>Riparia riparia</i>
PacificBirds	Barn-Swallow	<i>Hirundo rustica</i>
PacificBirds	Bar-tailed-Godwit	<i>Limosa lapponica</i>
PacificBirds	Black-crowned-Night-Heron	<i>Nycticorax nycticorax</i>
PacificBirds	Belted-Kingfisher	<i>Megaceryle alcyon</i>
PacificBirds	Black-bellied-Plover	<i>Pluvialis squatarola</i>
PacificBirds	Black-necked-Stilt	<i>Himantopus mexicanus</i>
PacificBirds	Black-Oystercatcher	<i>Haematopus bachmani</i>
PacificBirds	Black-Phoebe	<i>Sayornis nigricans</i>
PacificBirds	Black-Scoter	<i>Melanitta americana</i>
PacificBirds	Black-Swift	<i>Cypseloides niger</i>
PacificBirds	Black-Tern	<i>Chlidonias niger</i>
PacificBirds	Black-Turnstone	<i>Arenaria melanocephala</i>

PacificBirds	Brant	<i>Branta bernicla</i>
PacificBirds	Brown-Pelican	<i>Pelecanus occidentalis</i>
PacificBirds	Bristle-thighed-Curlew	<i>Numenius tahitiensis</i>
PacificBirds	Buff-breasted-Sandpiper	<i>Calidris subruficollis</i>
PacificBirds	Bufflehead	<i>Bucephala albeola</i>
PacificBirds	Blue-winged-Teal	<i>Spatula discors</i>
PacificBirds	Cackling-Goose	<i>Branta hutchinsii</i>
PacificBirds	California-Gull	<i>Larus californicus</i>
PacificBirds	Canada-Goose	<i>Branta canadensis</i>
PacificBirds	Canvasback	<i>Aythya valisineria</i>
PacificBirds	Caspian-Tern	<i>Hydroprogne caspia</i>
PacificBirds	Cinnamon-Teal	<i>Spatula cyanoptera</i>
PacificBirds	Cliff-Swallow	<i>Petrochelidon pyrrhonota</i>
PacificBirds	Common-Eider	<i>Somateria mollissima</i>
PacificBirds	Common-Goldeneye	<i>Bucephala clangula</i>
PacificBirds	Common-Loon	<i>Gavia immer</i>
PacificBirds	Common-Merganser	<i>Mergus merganser</i>
PacificBirds	Common-Nighthawk	<i>Chordeiles minor</i>
PacificBirds	Common-Tern	<i>Sterna hirundo</i>
PacificBirds	Common-Yellowthroat	<i>Geothlypis trichas</i>
PacificBirds	Common-Ringed-Plover	<i>Charadrius hiaticula</i>
PacificBirds	Double-crested-Cormorant	<i>Nannopterum auritum</i>
PacificBirds	Dunlin	<i>Calidris alpina</i>
PacificBirds	Eared-Grebe	<i>Podiceps nigricollis</i>
PacificBirds	Eastern-Kingbird	<i>Tyrannus tyrannus</i>
PacificBirds	Eastern-Yellow-Wagtail	<i>Motacilla tschutschensis</i>
PacificBirds	Elegant-Tern	<i>Thalasseus elegans</i>
PacificBirds	Emperor-Goose	<i>Anser canagicus</i>
PacificBirds	Eurasian-Wigeon	<i>Mareca penelope</i>

PacificBirds	Gadwall	<i>Mareca strepera</i>
PacificBirds	Glaucous-Gull	<i>Larus hyperboreus</i>
PacificBirds	Glaucous-winged-Gull	<i>Larus glaucescens</i>
PacificBirds	Green-winged-Teal	<i>Anas crecca</i>
PacificBirds	Great-Blue-Heron	<i>Ardea herodias</i>
PacificBirds	Great-Egret	<i>Ardea alba</i>
PacificBirds	Greater-Scaup	<i>Aythya marila</i>
PacificBirds	Greater-Yellowlegs	<i>Tringa melanoleuca</i>
PacificBirds	Green-Heron	<i>Butorides virescens</i>
PacificBirds	Greater-White-fronted-Goose	<i>Anser albifrons</i>
PacificBirds	Harlequin-Duck	<i>Histrionicus histrionicus</i>
PacificBirds	Herring-Gull	<i>Larus argentatus</i>
PacificBirds	Hooded-Merganser	<i>Lophodytes cucullatus</i>
PacificBirds	Horned-Grebe	<i>Podiceps auritus</i>
PacificBirds	Horned-Lark	<i>Eremophila alpestris</i>
PacificBirds	Hudsonian-Godwit	<i>Limosa haemastica</i>
PacificBirds	Ivory-Gull	<i>Pagophila eburnea</i>
PacificBirds	Killdeer	<i>Charadrius vociferus</i>
PacificBirds	King-Eider	<i>Somateria spectabilis</i>
PacificBirds	Least-Sandpiper	<i>Calidris minutilla</i>
PacificBirds	Lesser-Scaup	<i>Aythya affinis</i>
PacificBirds	Lesser-Yellowlegs	<i>Tringa flavipes</i>
PacificBirds	Long-billed-Curlew	<i>Numenius americanus</i>
PacificBirds	Long-billed-Dowitcher	<i>Limnodromus scolopaceus</i>
PacificBirds	Long-tailed-Duck	<i>Clangula hyemalis</i>
PacificBirds	Long-tailed-Jaeger	<i>Stercorarius longicaudus</i>
PacificBirds	Mallard	<i>Anas platyrhynchos</i>
PacificBirds	Marbled-Godwit	<i>Limosa fedoa</i>
PacificBirds	Marbled-Murrelet	<i>Brachyramphus marmoratus</i>

PacificBirds	Marsh-Wren	<i>Cistothorus palustris</i>
PacificBirds	Merlin	<i>Falco columbarius</i>
PacificBirds	Short-billed-Gull	<i>Larus brachyrhynchus</i>
PacificBirds	Northern-Harrier	<i>Circus hudsonius</i>
PacificBirds	Northern-Pintail	<i>Anas acuta</i>
PacificBirds	Northern-Shoveler	<i>Spatula clypeata</i>
PacificBirds	Northern-Waterthrush	<i>Parkesia noveboracensis</i>
PacificBirds	Northern-Rough-winged-Swallow	<i>Stelgidopteryx serripennis</i>
PacificBirds	Olive-sided-Flycatcher	<i>Contopus cooperi</i>
PacificBirds	Osprey	<i>Pandion haliaetus</i>
PacificBirds	Pacific-Loon	<i>Gavia pacifica</i>
PacificBirds	Pacific-Golden-Plover	<i>Pluvialis fulva</i>
PacificBirds	Parasitic-Jaeger	<i>Stercorarius parasiticus</i>
PacificBirds	Pectoral-Sandpiper	<i>Calidris melanotos</i>
PacificBirds	Pelagic-Cormorant	<i>Urile pelagicus</i>
PacificBirds	Peregrine-Falcon	<i>Falco peregrinus</i>
PacificBirds	Pied-billed-Grebe	<i>Podilymbus podiceps</i>
PacificBirds	Pigeon-Guillemot	<i>Cephus columba</i>
PacificBirds	Pomarine-Jaeger	<i>Stercorarius pomarinus</i>
PacificBirds	Purple-Martin	<i>Progne subis</i>
PacificBirds	Red-breasted-Merganser	<i>Mergus serrator</i>
PacificBirds	Redhead	<i>Aythya americana</i>
PacificBirds	Red-Knot	<i>Calidris canutus</i>
PacificBirds	Red-faced-Cormorant	<i>Urile urile</i>
PacificBirds	Red-necked-Grebe	<i>Podiceps grisegena</i>
PacificBirds	Red-necked-Phalarope	<i>Phalaropus lobatus</i>
PacificBirds	Red-throated-Loon	<i>Gavia stellata</i>
PacificBirds	Red-winged-Blackbird	<i>Agelaius phoeniceus</i>
PacificBirds	Ring-billed-Gull	<i>Larus delawarensis</i>

PacificBirds	Ring-necked-Duck	<i>Aythya collaris</i>
PacificBirds	Rock-Sandpiper	<i>Calidris ptilocnemis</i>
PacificBirds	Ruddy-Duck	<i>Oxyura jamaicensis</i>
PacificBirds	Ruddy-Turnstone	<i>Arenaria interpres</i>
PacificBirds	Rusty-Blackbird	<i>Euphagus carolinus</i>
PacificBirds	Sandhill-Crane	<i>Antigone canadensis</i>
PacificBirds	Sanderling	<i>Calidris alba</i>
PacificBirds	Semipalmated-Plover	<i>Charadrius semipalmatus</i>
PacificBirds	Semipalmated-Sandpiper	<i>Calidris pusilla</i>
PacificBirds	Short-billed-Dowitcher	<i>Limnodromus griseus</i>
PacificBirds	Slaty-backed-Gull	<i>Larus schistisagus</i>
PacificBirds	Snow-Bunting	<i>Plectrophenax nivalis</i>
PacificBirds	Snowy-Egret	<i>Egretta thula</i>
PacificBirds	Snow-Goose	<i>Anser caerulescens</i>
PacificBirds	Snowy-Owl	<i>Bubo scandiacus</i>
PacificBirds	Snowy-Plover	<i>Anarhynchus nivosus</i>
PacificBirds	Solitary-Sandpiper	<i>Tringa solitaria</i>
PacificBirds	Sora	<i>Porzana carolina</i>
PacificBirds	Spectacled-Eider	<i>Somateria fischeri</i>
PacificBirds	Spotted-Sandpiper	<i>Actitis macularius</i>
PacificBirds	Stilt-Sandpiper	<i>Calidris himantopus</i>
PacificBirds	Surfbird	<i>Calidris virgata</i>
PacificBirds	Surf-Scoter	<i>Melanitta perspicillata</i>
PacificBirds	Swamp-Sparrow	<i>Melospiza georgiana</i>
PacificBirds	Tree-Swallow	<i>Tachycineta bicolor</i>
PacificBirds	Tricolored-Blackbird	<i>Agelaius tricolor</i>
PacificBirds	Trumpeter-Swan	<i>Cygnus buccinator</i>
PacificBirds	Tundra-Swan	<i>Cygnus columbianus</i>
PacificBirds	Upland-Sandpiper	<i>Bartramia longicauda</i>

PacificBirds	Violet-green-Swallow	<i>Tachycineta thalassina</i>
PacificBirds	Virginia-Rail	<i>Rallus limicola</i>
PacificBirds	Wandering-Tattler	<i>Tringa incana</i>
PacificBirds	Warbling-Vireo	<i>Vireo gilvus</i>
PacificBirds	Western-Flycatcher	<i>Empidonax difficilis</i>
PacificBirds	Western-Grebe	<i>Aechmophorus occidentalis</i>
PacificBirds	Western-Gull	<i>Larus occidentalis</i>
PacificBirds	Western-Sandpiper	<i>Calidris mauri</i>
PacificBirds	White-faced-Ibis	<i>Plegadis chihi</i>
PacificBirds	Whimbrel	<i>Numenius phaeopus</i>
PacificBirds	White-Wagtail	<i>Motacilla alba</i>
PacificBirds	White-rumped-Sandpiper	<i>Calidris fuscicollis</i>
PacificBirds	White-winged-Scoter	<i>Melanitta deglandi</i>
PacificBirds	Willow-Flycatcher	<i>Empidonax traillii</i>
PacificBirds	Willet	<i>Tringa semipalmata</i>
PacificBirds	Wood-Duck	<i>Aix sponsa</i>
PacificBirds	American-Coot	<i>Fulica americana</i>
PacificBirds	Iceland-Gull	<i>Larus glaucoides</i>
PacificBirds	Yellow-billed-Loon	<i>Gavia adamsii</i>
PacificBirds	Yellow-headed-Blackbird	<i>Xanthocephalus xanthocephalus</i>