



Dunlins (*Calidris alpina*) in Grays Harbor NWR; Jan Wieser, USFWS (CC)

Using shorebird tracking data to support school curricula in Grays Harbor County, Washington

Conservation Contribution #03
Conservation Action: Education and Awareness



Smithsonian
Migratory Bird Center

Prepared by the Shorebird Science & Conservation Collective:
Candace Stenzel, Allie Anderson, Autumn-Lynn Harrison

March 2023

Table of Contents

Project Background	3
Conservation Request	3
Conservation Impact.....	4
About the Shorebird Science and Conservation Collective	4
About Grays Harbor NWR’s Education Programs	4
About Shorebird Flyways	5
About Grays Harbor Estuary	6
About the Shorebirds Tracked to Grays Harbor Estuary	7
Shorebird Background	9
About Shorebird Tracking Data	10
Using Education for Conservation Action	11
Data Contributors	12
References	13



Project Background

Conservation Request

Educators at Grays Harbor National Wildlife Refuge (NWR) in Hoquiam, Washington, USA requested shorebird tracking data from the Shorebird Science and Conservation Collective (hereafter, “Shorebird Collective”) to help support their Shorebird Education Program for third and fourth grade students. Specifically, they requested data from electronically tracked shorebirds ([link to page with more information on tracking data](#)) tracked in or near Grays Harbor Estuary (see **Figure 1** as an example) to incorporate into a mapping exercise for the students. Data requested included 1) 10-15 geographic coordinates for each individual shorebird along its full migration for students to explore and practice plotting on maps, and 2) maps of individual movement paths to show the full migratory journeys of the birds in the Pacific flyway ([link to page with more information on flyways](#)). The Shorebird Collective compiled 17 movement paths contributed by 23 scientists. The paths were recorded from five shorebird species detected in or near Grays Harbor Estuary, including:

- 1 Black-bellied Plover (*Pluvialis squatarola*)
- 4 Marbled Godwit (*Limosa fedoa*)
- 4 *pacifica* Dunlin (*C. alpina pacifica*)
- 7 *roselaari* Red Knot (*Calidris canutus roselaari*)
- 1 Whimbrel (*Numenius phaeopus*)

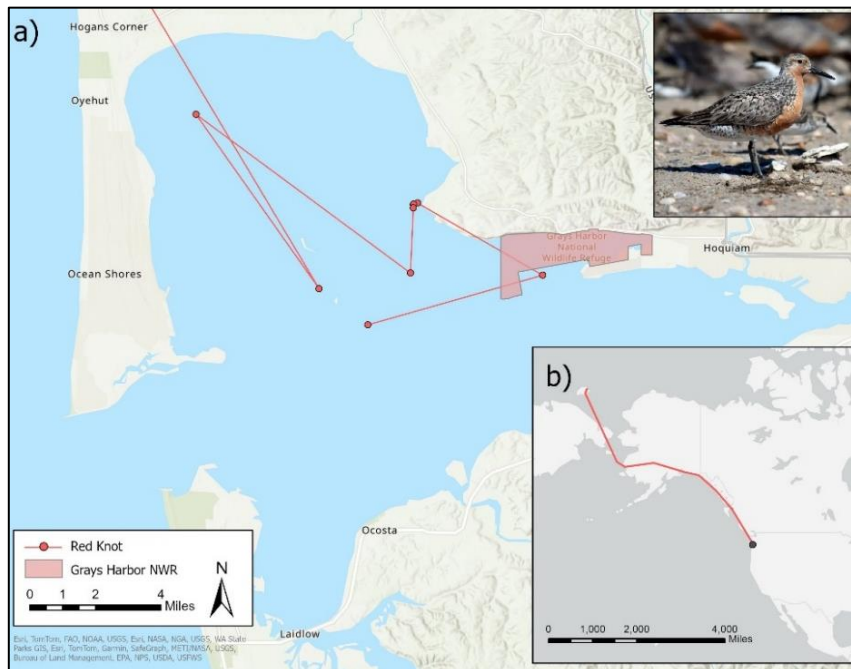


Figure 1. (a) An example of tracked GPS locations of a *roselaari* Red Knot (*Calidris canutus roselaari*) in Grays Harbor Estuary. Here the bird was also fitted with a tracking device by a team of scientists in May 2017. The Red Knot stopped in the estuary for two weeks before continuing north to its Russian breeding grounds. The light pink polygon shows the boundaries of Grays Harbor NWR within the estuary. (b) Northbound migration of the Red Knot after being fitted with the tracking device. Tracking data show the bird spending the 2017 breeding season in Wrangel Island Reserve, Russia. Data for the other individuals recorded in or near the estuary, including one Black-bellied Plover (*Pluvialis squatarola*), four Marbled Godwit (*Limosa fedoa*), four *pacifica* Dunlin (*C. alpina pacifica*), six additional *roselaari* Red Knot, and one Whimbrel (*Numenius phaeopus*), are not shown in this public-facing summary report due to the privacy settings of the datasets but were provided to Grays Harbor NWR to support their mapping exercise. Red Knot tracking data contributed by Jim Johnson, U.S. Fish and Wildlife Service. See page 12 for additional data contributor information. Red Knot photo credit: Gregory Breese, USFWS (CC).

Conservation Impact

The data provided to Grays Harbor NWR were incorporated into four different lessons for third and fourth grade classrooms, allowing students to explore shorebird movements at multiple scales while improving skills in reading and graphing geographic coordinates (**Figure 2**). 870 students across 14 schools participated in this lesson over the 2022-23 school year, with Grays Harbor educators visiting multiple classrooms every month.



Figure 2. Grays Harbor NWR educator presenting maps of shorebird tracks at Taholah School in Grays Harbor County, Washington; USFWS (CC)

About the Shorebird Science and Conservation Collective

The Shorebird Collective is a partnership of scientists and practitioners working to translate the collective findings of shorebird tracking and community science data into effective on-the-ground actions to advance shorebird conservation in the Western Hemisphere. Learn more on our webpage: [link to the Shorebird Collective webpage](#).

About Grays Harbor NWR's Education Programs

The Grays Harbor NWR's environmental education program is a collaboration with local schools, community members, and other educational groups to engage students in nature and conservation. Their Shorebird Education Program provides in-classroom lessons on shorebirds for third and fourth grade students located in Grays Harbor County, Washington. Lessons are focused on topics such as shorebird migration, ecology, adaptations, and conservation. Learn more on their webpage: [link to Grays Harbor NWR's environmental education programs](#).

About Shorebird Flyways

The term “flyway” refers to a general flight path used by a large number of birds when migrating between their breeding and wintering grounds. The three primary shorebird flyways in the Americas include the Pacific, Midcontinent, and Atlantic flyways (**Figure 3**). The Pacific (**Figure 3a**) and Atlantic flyways (**Figure 3c**) are used by shorebirds that depend on coastal landscapes, while the Midcontinent flyway (**Figure 3b**) is used by those that favor interior habitats, such as grasslands, fields, and inland wetlands.

During migration, shorebirds stop at several key sites along a flyway to rest and refuel, otherwise known as a “stopover site”. These stops can last from less than a day to multiple weeks. Many shorebirds (and other migratory birds) depend on the same stopover sites year after year, highlighting the importance of protecting these key places so that migrating birds always get the resources they need to complete their migrations.

Shorebirds encounter a range of threats on migration. While some threats occur across all three flyways (e.g., habitat loss and alteration, human disturbance, predation, and climate change), others are more specific to a region. For example, shorebirds that migrate through the midcontinent of North America may encounter wind turbines and/or face unpredictable water resources across years (Niemuth et al. 2013, Steen et al. 2018), while those that use the Atlantic flyway face increased hunting pressures in parts of the Caribbean and northeastern South America (ASFI 2016). Recognizing these varying levels of threats across different regions is critical for developing strategic and targeted conservation actions.

The recent development of three flyway-scale shorebird conservation initiatives aim to address these threats and reverse the decline of shorebird populations. These initiatives are a collaborative effort across different sectors and include multiple stakeholders and partnering organizations along each flyway. Learn more on the Shorebird Conservation Initiatives of the Americas website: [link to the Shorebird Conservation Initiatives website](#).

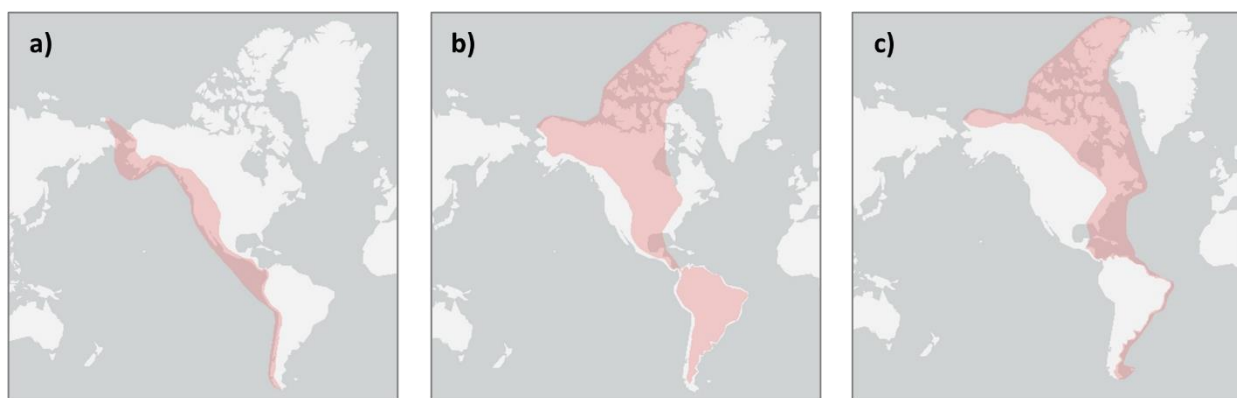


Figure 3. The Pacific (a), Midcontinent (b), and Atlantic (c) shorebird flyways of the Americas (USFWS 2023).

About Grays Harbor Estuary

Grays Harbor Estuary is located at the mouth of the Chehalis River on the Pacific Coast of Washington state (Figure 3). The 60,160-acre landscape is one of six major estuary systems along the Pacific and hosts one of the largest concentrations of shorebirds along the Pacific Flyway (USFWS 2023). As an official Western Hemisphere Shorebird Reserve Network site¹ (link to [Grays Harbor WHSRN site](#)), the estuary contains a mix of salt marsh, intertidal flat, forested wetland, and open water landscapes and provides critical habitat for over 500,000 shorebirds of 24 species during spring and fall migration (USFWS 2023). In addition to shorebirds, the deciduous woodlands and willows bordering the estuary provide important stopover habitat for migratory songbirds (USFWS 2023). Grays Harbor NWR is a 1,500-acre refuge located on the northeastern edge of the estuary in Hoquiam, Washington (Figure 4). While the NWR only occupies 2% of the estuary, it hosts up to 50% of the migrating shorebirds using the estuary in the spring (USFWS 2023).



Figure 4. Aerial map of Grays Harbor Estuary, located in Washington, USA. The light pink polygon shows the boundaries of Grays Harbor NWR within the estuary.

¹ WHSRN is a voluntary, non-regulatory network of public and private partners working to protect shorebirds through a network of key sites throughout the Americas. There are currently 120 WHSRN sites in 20 countries covering over 38.9 million acres of shorebird habitat across the Americas. Learn more at on WHSRN's website: [link to WHSRN website](#).



About the Shorebirds Tracked to Grays Harbor Estuary

Of the 17 individuals in the Shorebird Collective dataset that were tracked in or near Grays Harbor Estuary, 11 used the estuary as stopover habitat northbound migration in the spring while six individuals simply flew over or near the estuary and were used by Grays Harbor educators as additional examples for the lesson plan. Most of the birds traveled to Grays Harbor from their wintering grounds in California or Mexico en route to their breeding grounds in Alaska, though one individual flew all the way to northern Russia. All 17 individuals flew along the Pacific flyway during their migration.



roseaari Red Knot

Medium-sized shorebird with a stocky body; breeding adults have cinnamon underparts with mottled brown and tan upperparts (Baker et al. 2020). The *roseaari* subspecies breeds in northern Russia and Alaska and winters along the coasts of California and Mexico (Baker et al. 2020). Photo Credit: Gregory Breese, USFWS (CC).



Marbled Godwit

Large, long-legged shorebird with a small head and long, slightly upturned, bicolored bill; breeding adults are cinnamon-toned with barring above and below (Gratto-Trevor 2020). Most breed in the northern Great Plains with the exception of two smaller populations found on the Alaska Peninsula and southwest coast of James Bay; wintering sites occur along the coasts of the U.S., Mexico, and Central America (Gratto-Trevor 2020). Photo Credit: Cory Enger, USFS (CC).



pacifica Dunlin

Medium-sized shorebird with a stocky body and long, drooping bill; breeding adults have a black belly and rufous mottled back (Warnock and Gill 2020). The *pacifica* subspecies breeds in western Alaska and winters along the Pacific Coast in the U.S. and Mexico (Warnock and Gill 2020). Photo Credit: Dow Lamert, USFWS (CC).



Black-bellied Plover

Medium-sized shorebird; breeding males have black and white plumage with mottled black and white upperwings (Poole et al. 2020). Breeds in the high Arctic and winters on the coasts of southern Canada, the U.S., Mexico, and Central and South America (Poole et al. 2020). Photo Credit: Ryan Askren, USGS/Smithsonian.



Whimbrel

Large, long-legged shorebird with a long neck, small, striped head, and downward curved bill; mottled brown plumage (Skeel and Mallory 2020). Individuals breed on the tundra in Alaska and Canada and along the western coast of the Hudson Bay; wintering sites occur along the coasts of the southern U.S., Mexico, and Central and South America (Skeel and Mallory 2020). Photo Credit: Rachel Richardson, USGS (CC).

Shorebird Background

Shorebirds are a diverse group of birds in the order Charadriiformes, including sandpipers, plovers, avocets, oystercatchers, and phalaropes. There are approximately 217 shorebird species in the world (O'Brien et al. 2006), 81 of which occur in the Americas. 52 species breed in North America (Morrison et al. 2000) and 35 species breed in Latin America and the Caribbean (Lesterhuis and Clay 2019). They are among the planet's most migratory groups of animals. Many species in the Western Hemisphere, for example, travel thousands of miles every year between their breeding grounds in the Arctic and wintering grounds in the Caribbean and Central and South America, stopping at key sites along the way to rest and refuel. Across their vast range, shorebirds depend on a variety of habitats, including coastlines, shallow wetlands, mudflats, lake and pond edges, grasslands, and fields.

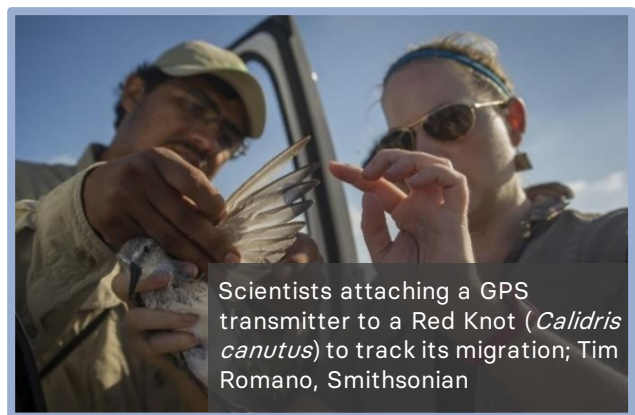


Long-billed Curlew (*Numenius americanus*);
Tim Romano, Smithsonian

While shorebirds are champion migrants, their populations are rapidly declining. Many populations have lost over 70% of their numbers in the past 50 years (NABCI 2022, Rosenberg et al. 2019, Smith et al. 2023), making them one of the most vulnerable bird groups in North America. Habitat loss and alteration, human disturbance, and climate change are just some of the major threats facing shorebirds today. Effective shorebird management is even more of a challenge due to many species depending on habitats across multiple countries under different political jurisdictions. Despite these trends and logistical challenges, many public and private groups are working to protect shorebirds and the habitats they depend on.



Flock of Marbled Godwits (*Limosa fedoa*) next to a shorebird scientist;
Tim Romano, Smithsonian



Scientists attaching a GPS transmitter to a Red Knot (*Calidris canutus*) to track its migration;
Tim Romano, Smithsonian

About Shorebird Tracking Data

Tracking data provide valuable insight into where shorebirds move and are located throughout the year. These data can ultimately help biologists and practitioners make more informed conservation and land management decisions to protect shorebirds and their habitats. Tracking data are collected via tiny electronic devices (often called “tags”) which are attached directly to individual birds (typically with either leg bands, harnesses, or glue) and may be carried by the birds year-round. Tag types of the tracked birds contributed to the Grays Harbor mapping exercise included both satellite and geolocator tags.



Satellite tags work by sending signals to orbiting satellites that re-transmit location data back to a receiving station which researchers can access through their computer. The two types of satellite tags commonly used to study birds include Global Positioning System (GPS) and Argos tags. GPS tags typically have high spatial accuracy (i.e., minimal location error, generally <10 meters), while Argos tags can have location error of 500-2,500 meters. The Shorebird Collective compiled both contributed GPS and Argos satellite data to support the Grays Harbor request. [Link for more information on satellite tags.](#)



Light-level geolocators record ambient light levels which can be used to estimate an animal's location based on the timing and intensity of sunlight patterns around the globe. A drawback to using this tag type is scientists must recapture the bird to retrieve data from the tag and then convert the light level data to estimated geographic locations. These location estimates are less accurate (i.e., error up to 200 km) compared to location data retrieved from satellite tags. However, geolocator tags are significantly cheaper than satellite tags and are incredibly lightweight, allowing them to be used on smaller birds. [Link for more information on geolocator tags.](#)



One key benefit of tracking data compared to other data types such as survey or count data is that they give detailed information on movements and habitat use of individual animals in areas that are otherwise difficult to access, such as remote areas or private lands. Therefore, the birds themselves show us where they are, independent of the need for direct human observation.

Images: 1. Black-bellied Plover (*Pluvialis squatarola*) with <5g solar satellite tag, Ryan Askren, USGS/Smithsonian; 2. Migration pathways of individually tracked Black-bellied Plovers, contributed by Smithsonian Migratory Bird Center and Environment and Climate Change Canada; 3. Light-level geolocator tag, Smithsonian

Using Education for Conservation Action

Education offers a unique opportunity to raise awareness about, and action towards, specific conservation concerns. Its application can impact knowledge, shape attitudes and values, build skills that prepare individuals to take positive conservation action, and foster engagement between community members, scientists, practitioners, and decision-makers (Ardoin et al. 2020).

The Grays Harbor NWR's Shorebird Education Program is one example of a local community outreach effort designed to raise awareness about shorebirds and their conservation. With many shorebird populations in decline (NABCI 2022, Rosenberg et al. 2019, Smith et al. 2023), now is more important than ever to spread knowledge about these birds. Additionally, many of the students may not have otherwise known about shorebirds or the value that their local landscape (i.e., Grays Harbor Estuary) provides for shorebirds using the Pacific Flyway. The Grays Harbor mapping exercise provided an interactive opportunity for the students to explore shorebird movements in a nearby area they are all familiar with.



Picking up trash on a beach
Tim Romano, Smithsonian

When planning any conservation education program, lesson, or activity, efforts must be designed in a way that align with the participants' attitudes and values and framed in way that makes them care (Lakoff 2010). For example, Grays Harbor NWR educators used shorebird tracks detected in Grays Harbor Estuary to support their mapping exercise which provided a local element for the students to explore and take interest in. Additionally, encouraging simple and manageable actions is often a first step to motivate change and initiate greater conservation action (Mengak et al. 2019, Schultz 2002). Relevant to helping shorebirds, there are several examples of simple and manageable "shorebird-friendly" actions that anyone can take or recommend to others.

Shorebird-Friendly Actions

- 1. Avoid closed areas** – Avoid walking through roped or blocked off areas on beaches where shorebirds may be nesting.
- 2. Keep dogs leashed** – Keeping dogs leashed at beaches will prevent them from rushing towards areas where shorebirds nest, rest, and feed.
- 3. Don't get too close** – While it's exciting to get close to wildlife, being too close can disturb the birds. It's better to grab a pair of binoculars and observe from afar!
- 4. Pick up trash** – Keeping beaches and other natural landscapes clean will prevent birds from choking or becoming entangled in trash. Garbage can also attract predators, which prey on shorebird eggs.
- 5. Avoid pesticides** – Limit pesticide use around the home and yard as most are toxic to birds and other wildlife.
- 6. Turn lights out** – Turning off excess lighting during the migration months will help shorebirds (and other migratory birds) become less disoriented while migrating.
- 7. Protect wetlands** – Support the protection of your local wetlands, which provide important habitat for shorebirds.
- 8. Share sightings on eBird** – Report your shorebird observations on eBird to help scientists better understand where shorebirds are and when, allowing for more effective conservation and land management efforts ([link to eBird](#)).



Data Contributors

Tracking data for this project were contributed to the Shorebird Collective by the following people and organizations. Individuals with an asterisk (*) indicates the technical point of contact for the dataset. A full list of data contributors to the Shorebird Collective can be found on our webpage: [link to Shorebird Collective webpage](#).

Black-bellied Plover Track

Autumn-Lynn Harrison*¹

Unpublished data: Migratory Connectivity Project

Marbled Godwit Tracks

Daniel Ruthrauff*³, Lee Tibbitts*³, Bob Gill³, Dave Douglas³, Cheri Gratto-Trevor⁴

Associated Citation: Ruthrauff, D. R., Tibbitts, T. L., Gill, R. E., Jr., and Douglas, D. C. 2019. Tracking data for Marbled Godwit (*Limosa fedoa*): U.S. Geological Survey data release, <https://doi.org/10.5066/P9NORY48>.

pacifica Dunlin Tracks

Benjamin Lagassé*⁵, Richard Lanctot⁶, Mark Barter⁷, Stephen Brown⁸, Chung-Yu Chiang⁹, Chi-Yeung Choi¹⁰, H. River Gates¹¹, Steve Kendall⁶, Joseph Liebezeit¹², Sarah Saalfeld⁶

Unpublished data, University of Alaska Fairbanks, U.S. Fish & Wildlife Service, Wetlands International, Manomet, Tunghai University, Duke Kunshan University, National Audubon Society, Wildlife Conservation Society, Portland Audubon

roselaari Red Knot Tracks

Callie Gesmundo*⁶, Jim Johnson*⁶, Lucas DeCicco¹³, Nick Hajdukovich⁶, Zachary Pohlen⁶, U.S. Department of Defense - Joint Base Elmendorf-Richardson¹⁴, Washington Department of Fish and Wildlife¹⁵

Unpublished Data, U.S. Fish & Wildlife Service, Washington Department of Fish & Wildlife, U.S. Department of Defense

Whimbrel Track

Daniel Ruthrauff*³, Lee Tibbitts*³, Nils Warnock¹⁶, Chris Harwood⁶, Dave Douglas³, Bob Gill³

Associated Citation: Tibbitts, T. L., Ruthrauff, D. R., Gill, R. E. Jr., and Douglas, D. C., 2021. Tracking data for Whimbrel (*Numenius phaeopus*) (ver 2.0, May 2021): U.S. Geological Survey data release, <https://doi.org/10.5066/P978PX2X>.

Contributor Organizations

¹ Smithsonian Migratory Bird Center, ² Coastal Bend Bays and Estuaries Coastal Bird Program, ³ U.S. Geological Survey, Alaska Science Center, ⁴ Prairie and Northern Wildlife Research Centre, Environment and Climate Change Canada, ⁵ University of Alaska Fairbanks, ⁶ U.S. Fish & Wildlife Service, ⁷ Wetlands International, ⁸ Manomet, ⁹ Tunghai University, ¹⁰ Southern University of Science and Technology, ¹¹ National Audubon Society, ¹² Portland Audubon, ¹³ University of Kansas, ¹⁴ U.S. Department of Defense - Joint Base Elmendorf-Richardson, ¹⁵ Washington Department of Fish and Wildlife, ¹⁶ Audubon Canyon Ranch



References

[AFSI] Atlantic Flyway Shorebird Initiative. 2016. A plan to address the sustainability of shorebird harvest in the Western Atlantic Flyway.

Ardoin, N. M., Bowers, A. W., and Gaillard, E. 2020. Environmental education outcomes for conservation: a systematic review. *Biological Conservation*, 241:108224.

Baker, A., Gonzalez, P., Morrison, R. I. G., and Harrington, B. A. 2020. Red Knot (*Calidris canutus*), version 1.0. In *Birds of the World* (S. M. Billerman, Ed.). Cornell Lab of Ornithology, Ithaca, NY.

Gratto-Trevor, C. L. 2020. Marbled Godwit (*Limosa fedoa*), version 1.0. In *Birds of the World* (A. F. Poole and F. B. Gill, Eds.). Cornell Lab of Ornithology, Ithaca, NY.

Lakoff, G. 2010. Why it matters how we frame the environment. *Environmental Communication*, 4: 70-81.

Lesterhuis, A. J., and R. P. Clay. 2019. Conservation status of shorebird species resident to Latin America and the Caribbean, v1. WHSRN Executive Office and Manomet, Inc., Manomet, MA.

Mengak, L., Dayer, A. A., Longenecker, R., and Spiegel, C. S. 2019. Guidance and best practices for evaluating and managing human disturbances to migrating shorebirds on coastal lands in the northeastern United States. U.S. Fish and Wildlife Service.

Morrison, R. I. G., Gill, R. E., Harrington, B. A., Skagen, S., Page, G. W., Gratto-Trevor, C. L., and Haig, S. M. 2000. Population estimates of Nearctic shorebirds. *Waterbirds*, 23:337-352.

[NABC] North American Bird Conservation Initiative. 2022. The State of the Birds, USA, 2022.

Niemuth, N. D., Walker, J. A., Gleason, J. S., Loesch, C. R., Reynolds, R. E., Stephens, S. E., and Erickson, M. A. 2013. Influence of wind turbines on presence of Willet, Marbled Godwit, Wilson's Phalarope and Black Tern on wetlands in the Prairie Pothole Region of North Dakota and South Dakota. *Waterbirds*, 36:263-276.

O'Brien, M., Crossley, R., and Karlson, K. 2006. The shorebird guide. Houghton Mifflin Company, New York, NY.

Poole, A. F., Pyle, P., Patten, M. A., and Paulson, D. R. 2020. Black-bellied Plover (*Pluvialis squatarola*), version 1.0. In *Birds of the World* (S. M. Billerman, Ed.). Cornell Lab of Ornithology, Ithaca, NY.

Rosenberg, K. V., Dokter, A. M., Blancher, P. J., Sauer, J. R., Smith, A. C., Smith, P. A., Stanton, J. C., Panjabi, A., Helft, L., Parr, M., and Marra, P. 2019. Decline of the North American avifauna. *Science*, 366(6461):120-124.

Schultz, P. W. 2002. Knowledge, information, and household recycling: examining the knowledge deficit model of behavior Change. In *New tools for environmental protection: education, information and voluntary measures* (T. Dietz and P. C. Stern, Eds.), National Academy Press, Washington D.C., 67-82.

Skeel, M. A. and E. P. Mallory. 2020. Whimbrel (*Numenius phaeopus*), version 1.0. In *Birds of the World* (S. M. Billerman, Ed.). Cornell Lab of Ornithology, Ithaca, NY.



Smith, P. A., Smith, A. C., Andres, B., Francis, C. M., Harrington, B., Friis, C., Guy Morrison, R. I., Paquet, J., Winn, B., and Brown, S. 2023. Accelerating declines of North America's shorebirds signal the need for urgent conservation action. *Ornithological Applications*, 125:1-14.

Steen, V., Skagen, S. K., and Noon, B. R. 2018. Preparing for an uncertain future: migrating shorebird response to past climatic fluctuations in the Prairie Potholes. *Ecosphere*, 9:e02095.

[USFWS] U.S. Fish and Wildlife Service. 2023. Grays Harbor National Wildlife Refuge. U.S. Fish and Wildlife Service. Retrieved from: <https://www.fws.gov/refuge/grays-harbor>.

Warnock, N. D. and R. E. Gill. 2020. Dunlin (*Calidris alpina*), version 1.0. In *Birds of the World* (S. M. Billerman, Ed.). Cornell Lab of Ornithology, Ithaca, NY.

[WHSRN] Western Hemisphere Shorebird Reserve Network. 2019. Grays Harbor Estuary. Western Hemisphere Shorebird Reserve Network, Manomet, Massachusetts. Retrieved from: https://whsrn.org/whsrn_sites/grays-harbor-estuary/.

