



Upland Sandpiper
(*Bartramia longicauda*);
Andy Boyce, Smithsonian

Using shorebird tracking data as an outreach tool for programs through the Minnesota Board of Water and Soil Resources

Conservation Contribution #06

Conservation Action: Education and Awareness



Smithsonian
Migratory Bird Center

Prepared by the Shorebird Science & Conservation Collective:

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Project Background

Conservation Request

The Minnesota Board of Water and Soil Resources (MN BWSR) requested shorebird tracking data from the Shorebird Science and Conservation Collective (hereafter, "Shorebird Collective") to help raise public and departmental awareness about the importance of Minnesota habitats for shorebirds. Specifically, they requested movement maps and summary information of electronically tracked shorebirds ([link to page with more information on shorebird tracking data](#)) tracked in Minnesota to use as examples they could integrate into newsletters and other outreach tools. The Shorebird Collective compiled and described relevant movement paths for species tracked in Minnesota, created maps of their local movements indicating commonly used habitats, and summarized natural history information about each species tracked in the state to support the MN BWSR's outreach efforts.

Conservation Impact

The MN BWSR shared the Shorebird Collective's full report on their website and began outreach efforts with MN BWSR staff and conservation partners. They hope these initial data will help increase awareness about the role that wetland restoration and water management projects have in protecting shorebird populations. The MN BWSR intends to keep in communication with the Shorebird Collective as they move forward with any shorebird conservation effort.

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 the Minnesota Board of Water and Soil Resources

The MN BWSR is the administrative agency for soil and water conservation districts, watershed districts, and watershed management organizations in the state of Minnesota, USA. Their overall mission is to improve and protect the state's water and soil resources by working in partnership with local organizations and private landowners. Learn more on MN BWSR's website: [link to MN BWSR's website](#).

Summary of Results

Of 1,480 individuals tracked by GPS and Argos satellite technologies and contributed to the Shorebird Collective¹ (**Box 1**), **56** individuals of **eight** species were recorded in (or flying over) Minnesota. **21** of these individuals stopped or bred within the state (**Figure 1**).

- **14** Pectoral Sandpiper (*Calidris melanotos*)
- **5** American Woodcock (*Scolopax minor*)
- **1** Buff-breasted Sandpiper (*Calidris subruficollis*)
- **1** Lesser Yellowlegs (*Tringa flavipes*)

The highest concentrations of tracked species (**Figure 2a**) and individuals (**Figure 2b**) were found in the Prairie Potholes region of the western part of the state. Note that while the number of tracked individuals is limited, these birds could act as sentinels that may highlight where many more birds are present since many shorebird species travel in flocks. Thus, additional survey work could be done on the ground to confirm the importance of these areas/regions used by the tracked birds.

In a full report to the MN BWSR and with permission of data owners, the Shorebird Collective provided tracking maps and summary information for a subset of individuals tracked in Minnesota. The following pages provide excerpts from the report. The MN BWSR can use these data to aid in the development of newsletter articles and other outreach products pertaining to shorebirds.

Box 1. Summary of shorebird tracks in Minnesota

1,480 individuals of 17 species contributed to the Shorebird Collective



35 individuals of 8 species flew over the state of Minnesota



21 individuals of 4 species stopped or bred within the state



Figure 1. Shorebird species tracked in Minnesota based on the contributed tracking data. Tracked species include **a**) Pectoral Sandpiper (*Calidris melanotos*), Peter Pearsall, USFWS (CC); **b**) American Woodcock (*Scolopax minor*), Keith Ramos, USFWS (CC); **c**) Buff-breasted Sandpiper (*Calidris subruficollis*), Shiloh Schulte, USFWS (CC), and **d**) Lesser Yellowlegs (*Tringa flavipes*), Jill Shannon, USFWS (CC).

¹ These data come from 52 organizations, collected from 2006 to 2022.

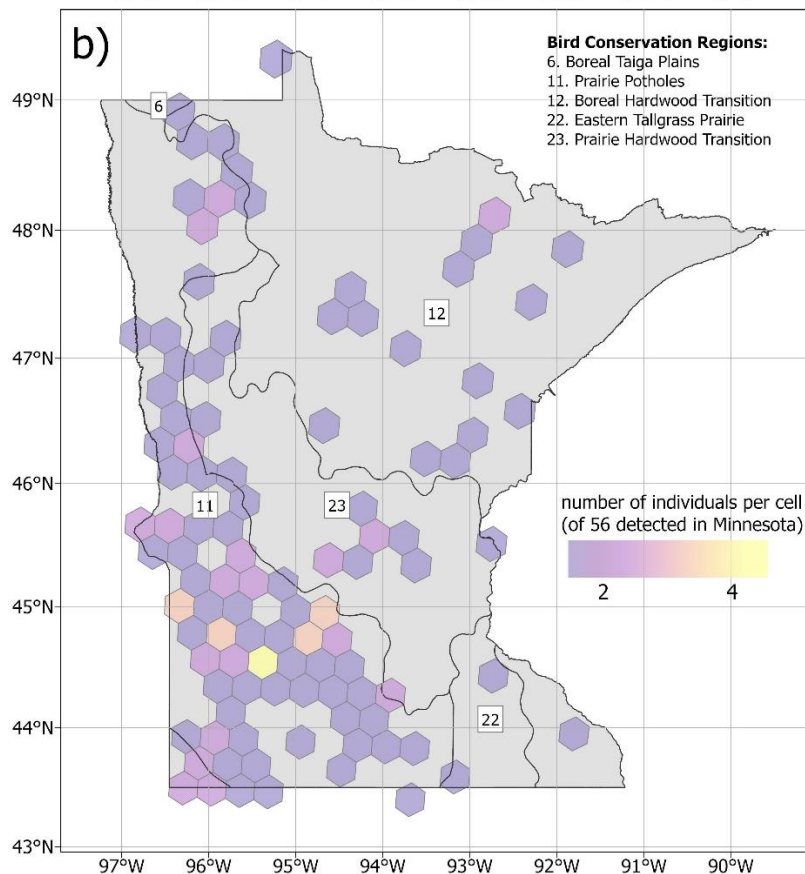
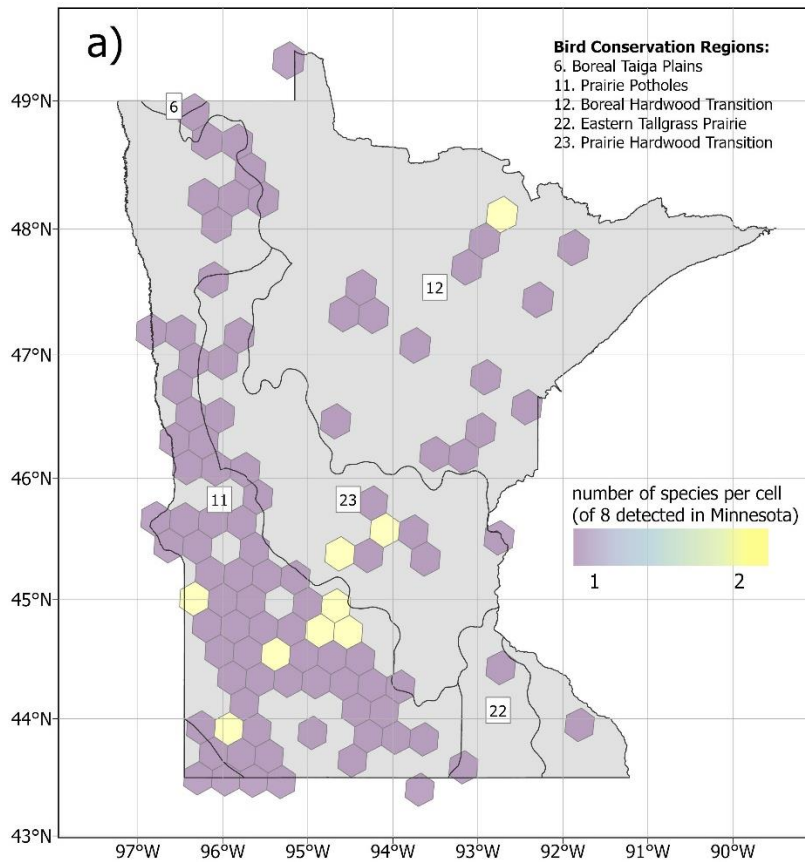


Figure 2. Summary of **a)** species and **b)** individual concentrations from contributed satellite tracking data overlaid with Bird Conservation Regions. Summarized data are for eight species and 56 tracked individuals tracked in Minnesota. This includes both individuals that flew over the state on migration and/or stopped or bred in the state.

Pectoral Sandpiper

Tracked Pectoral Sandpipers in Minnesota

Fourteen Pectoral Sandpipers were tracked primarily in the Prairie Potholes region of western Minnesota during stopover on southbound migration. Here we use the tracking data from one of these individuals to provide an example of species summary information we provided to the MN BWSR to support their outreach efforts (**Figure 3** and **Figure 4**). The sandpiper stopped for three days along an agricultural impoundment in Stearns County (**Figure 3a**) before flying 30 miles south to a small natural wetland in Nicollet County for another 15 days (**Figure 3b**).

About Pectoral Sandpipers

Pectoral Sandpipers are a medium-sized shorebird with a brown streaked breast and white belly (Farmer et al. 2020). They are typically present in the Prairie Potholes region of Minnesota during spring and fall migration (peak months: April-May, July-September). As a long-distance migrant, they breed on tundra in the high arctic and winter throughout South America (Farmer et al. 2020). They prefer upland and wet grassland landscapes (e.g., grassy shorelines and marshes, flooded fields, wet meadows) and feed mostly on aquatic and terrestrial invertebrates (Farmer et al. 2020).



Pectoral Sandpiper
(*Calidris melanotos*);
Lisa Hupp, USFWS (CC)

Pectoral Sandpiper Facts

- Breeding males have an inflatable throat sac which puffs out during display flights to attract mates (Farmer et al. 2020). They can go for weeks at a time without sleep during this courtship period (Lesku et al. 2012).
- Some Pectoral Sandpipers breed as far west as Siberia, Russia, making impressive 10,000+ mile journeys (one-way) as they migrate to and from their breeding and wintering grounds (Farmer et al. 2020).

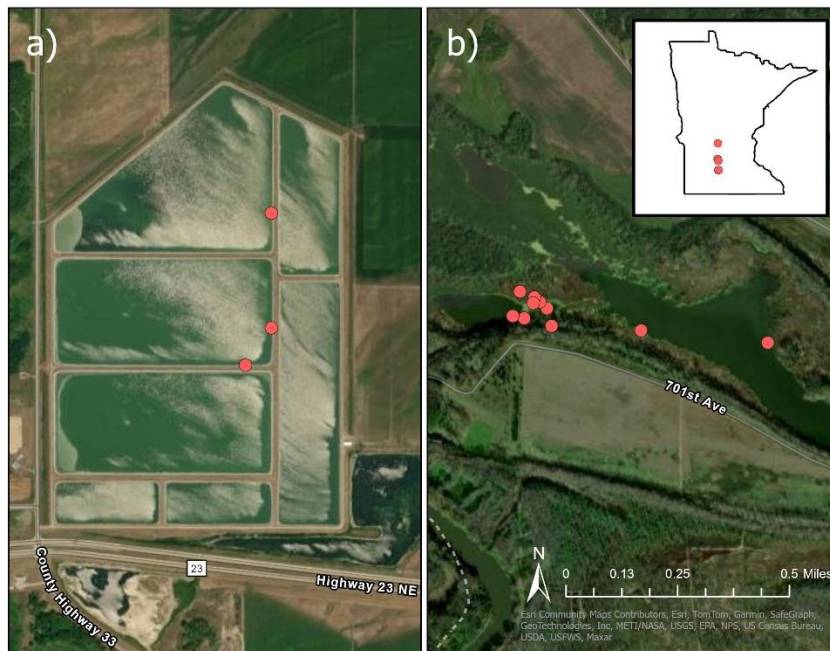


Figure 3. Tracked GPS locations of an example Pectoral Sandpiper (*Calidris melanotos*) in Stearns (a) and Nicollet (b) Counties, Minnesota. The bird stopped for 18 days on southbound migration in the Prairie Potholes region of the state. Figure 4 provides details of its annual movements. Pectoral Sandpiper tracking data contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 14 for additional data contributor information.

Annual Movements

The example Pectoral Sandpiper from **Figure 3** was fitted with a tracking device in June 2018 on its breeding grounds in Utqiagvik, Alaska, USA (**Figure 4**). It began its southbound migration in mid-July and initially made multiple short stops (i.e., less than four days) in the Yukon, Northwest Territories, and Nunavut provinces of Canada. From Nunavut, it flew to Minnesota, USA where it stopped for 18 days in August, then flew 2,500 miles nonstop to Port-au-Prince, Haiti where it stayed for 20 days. From Haiti, the bird made an additional two stops in Apure, Venezuela and Beni, Bolivia, and by mid-October, reached what is presumed to be its wintering grounds in Corrientes, Argentina though the tracking device's signal was lost a week later. **Approximate one-way flight distance between its Alaskan breeding grounds and Argentine wintering grounds: 8,900 miles.**

Note: This individual bird flew non-stop for 2,500 miles after stopping in Minnesota in the fall, highlighting the value of Minnesota landscapes (i.e., agricultural fields, wetlands) as critical stopover habitat for shorebirds.



Figure 4. Annual movements of the example Pectoral Sandpiper (*Calidris melanotos*) with labeled breeding, wintering, and stopover locations. Pectoral Sandpiper tracking data contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 14 for additional data contributor information.

American Woodcock

Tracked American Woodcocks in Minnesota

Five American Woodcocks were tracked in the Boreal Hardwood Transition region of northern Minnesota during northbound migration and the breeding season. Here we use the tracking data from one of these individuals to provide another example of species summary information we provided to the MN BWSR to support their outreach efforts (Figure 5. and Figure 6). The woodcock spent the breeding season in forested landscapes within St. Louis County, arriving early April and departing mid-July. The bird initially spent nine days in Kabetogama State Forest (Figure 5.) before flying 30 miles south near McCarthy Beach State Park (Figure 5.) where it spent the remainder of the breeding season.

About American Woodcocks

American Woodcocks are a plump, short-legged shorebird with a short neck and long, straight bill (McAuley et al. 2020). They are a breeding species in Minnesota and found exclusively in the eastern half of the United States and southern Canada (McAuley et al. 2020). Woodcocks favor both young forests and open landscapes and are one of the only North American shorebird species to nest in forested habitats (McAuley et al. 2020). They feed mostly on earthworms and insects, which they capture with their flexible bill (McAuley et al. 2020). As Minnesota's smallest game bird, state management actions include cutting willow and alder brush to renew brush growth used for nesting and feeding (MN DNR 2023).



American Woodcock
(*Scolopax minor*);
Keith Ramos, USFWS (CC)

American Woodcock Facts

- A woodcock's eyes are large and positioned high and far back on its head. This provides panoramic vision to detect predators while probing into the ground for food (McAuley et al. 2020).
- Male woodcocks attract mates with a series of calls and elaborate, spiraling flight displays, otherwise known as the "sky dance" (McAuley et al. 2020). This mating ritual takes place every spring at dawn and dusk.

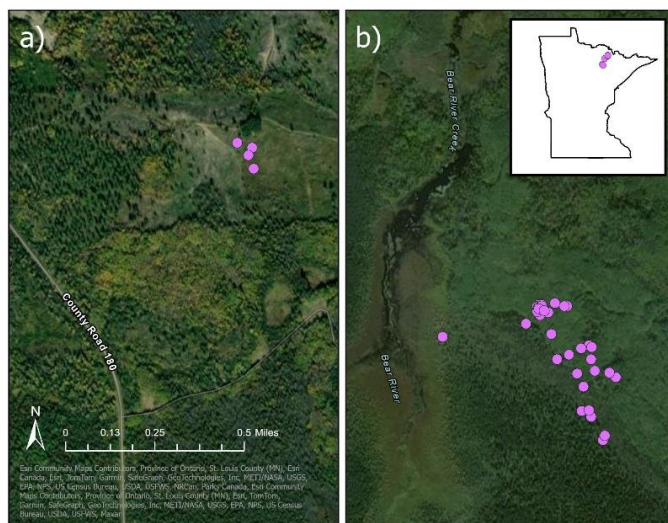


Figure 5. Tracked GPS locations of an example American Woodcock (*Scolopax minor*) in St. Louis County, Minnesota. The bird spent the breeding season in Minnesota, initially stopping for nine days in Kabetogama State Forest (a) before flying 30 miles south near McCarthy Beach State Park (b). Figure 6 provides details of its annual movements. American Woodcock tracking data contributed by Erik Blomberg, University of Maine. See page 14 for additional data contributor information.

Annual Movements

The example American Woodcock in **Figure 5** was fitted with a tracking device on its wintering grounds in Georgia, USA in February 2021 (**Figure 6**). It departed north in early March and made its first stop in wooded lands just south of Louisville, Kentucky, USA. After three weeks, it stopped for another week in western Michigan, USA before making its way to its breeding grounds in northern Minnesota, USA. The tracking device's signal was lost during the breeding season. **Approximate one-way flight distance between its Georgia wintering grounds and Minnesota breeding grounds: 1,200 miles.**

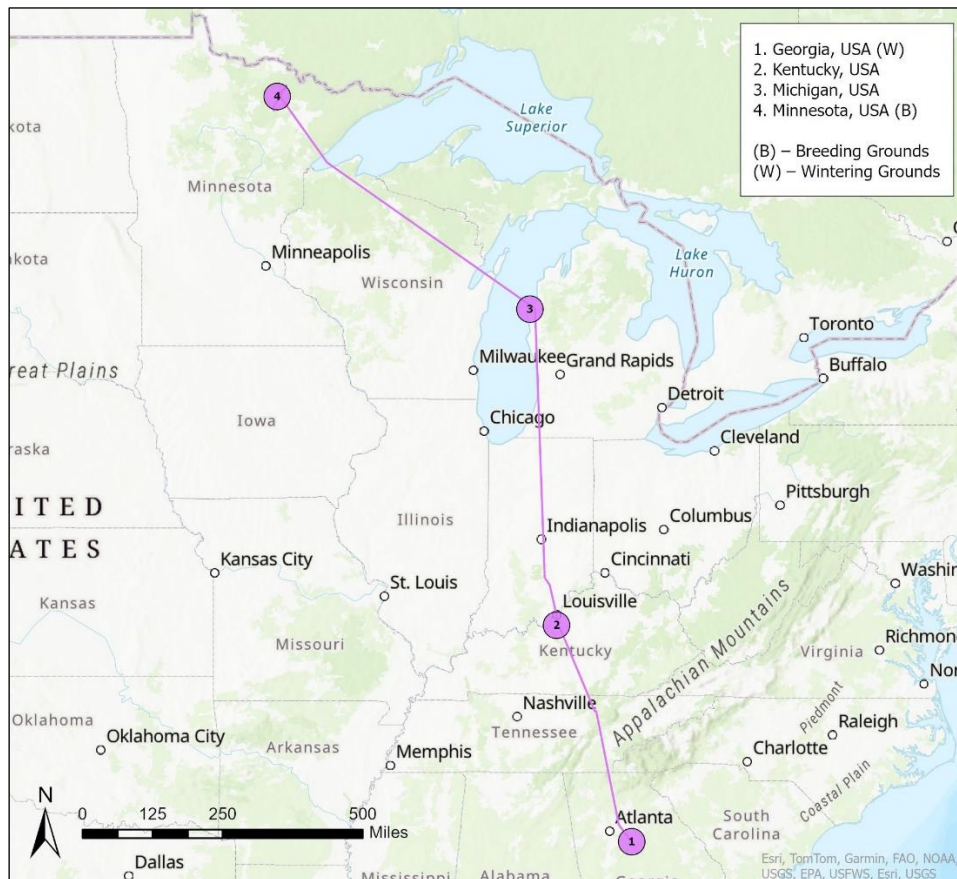


Figure 6. Annual movements of the example American Woodcock (*Scolopax minor*) with labeled breeding, wintering, and stopover locations. American Woodcock tracking data contributed by Erik Blomberg, University of Maine. See page 14 for additional data contributor information.

Lesser Yellowlegs

Tracked Lesser Yellowlegs in Minnesota

One Lesser Yellowlegs was tracked in the Prairie Potholes region of western Minnesota. Here we use the tracking data from this individual to provide an additional example of species summary information we provided to the MN BWSR to support their outreach efforts (Figure 7. and Figure 8). The bird stopped in the state for 15 days on southbound migration and rotated between different agricultural fields near the town of Mehurin in Lac qui Parle County.

About Lesser Yellowlegs

Lesser Yellowlegs are a medium-sized shorebird with grayish brown plumage and distinct yellow legs (Tibbitts et al. 2020). They are typically present in the Prairie Potholes region of Minnesota during spring and fall migration (peak months: April-May, July-September). As a long distant migrant, they breed in the boreal wetlands of Canada and Alaska and winter throughout Central and South America (Tibbitts et al. 2020). They occur in a variety of shallow wetland habitats, including mudflats, marshes, lake and pond edges, meadows, and flooded agricultural fields (Tibbitts et al. 2020). Their diet primarily consists of aquatic insects, though they also feed on crustaceans, snails, and small fish (Tibbitts et al. 2020).



Lesser Yellowlegs
(*Tringa flavipes*);
Jill Shannon, USFWS (CC)

Lesser Yellowlegs Facts

- While Lesser and Greater Yellowlegs look quite similar, Lesser Yellowlegs are comparatively smaller with a shorter and thinner bill (Tibbitts et al. 2020).
- Lesser Yellowlegs sometimes bathe by repeatedly flying into the air and plunging into water, otherwise known as “flight bathing” (Dodd et al. 1989, Rowan 1929).

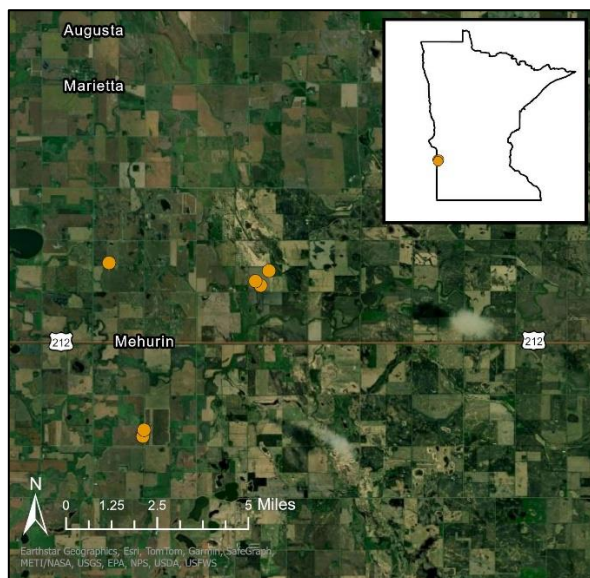


Figure 7. Tracked Argos and GPS locations of an example Lesser Yellowlegs (*Tringa flavipes*) in Lac qui Parle, Minnesota. The bird stopped for 15 days on southbound migration in the Prairie Potholes region of the state. Figure 8 provides details of its annual movements. Lesser Yellowlegs tracking data contributed by Callie Gesmundo and Jim Johnson, U.S. Fish and Wildlife Service. See page 14 for additional data contributor information.

Annual Movements

The example Lesser Yellowlegs in **Figure 7**, was fitted with a tracking device in June 2019 on its breeding grounds along the Hudson Bay in Manitoba, Canada (**Figure 8**). It began its southbound migration in early July, making its first stop in Minnesota, USA where it stayed for 15 days. From Minnesota, it flew 3,000+ miles nonstop to St. George's, Grenada, stopping for another 15 days. From Grenada, it flew to Beni, Bolivia and finally reached its wintering grounds in Rivera, Uruguay in early September. The bird wintered in Uruguay through March then shifted west to Buenos Aires, Argentina for another month. By early May, it departed north and made its first stop near Golfo de Nicoya, a Western Hemisphere Shorebird Reserve Network (WHSRN) site² in Guanacaste, Costa Rica. The tracking device's signal was lost a few days later as it continued its way north. The last location was transmitted from South Dakota, USA. **Approximate one-way flight distance between its Canadian breeding grounds and Uruguayan wintering grounds: 7,300 miles.**

Note: Similar to the Pectoral Sandpiper in **Figure 4**, this Lesser Yellowlegs flew an impressive 3,000+ mile nonstop flight after stopping in Minnesota in the fall, highlighting again, the value of local landscapes in Minnesota as stopover habitat for shorebirds.

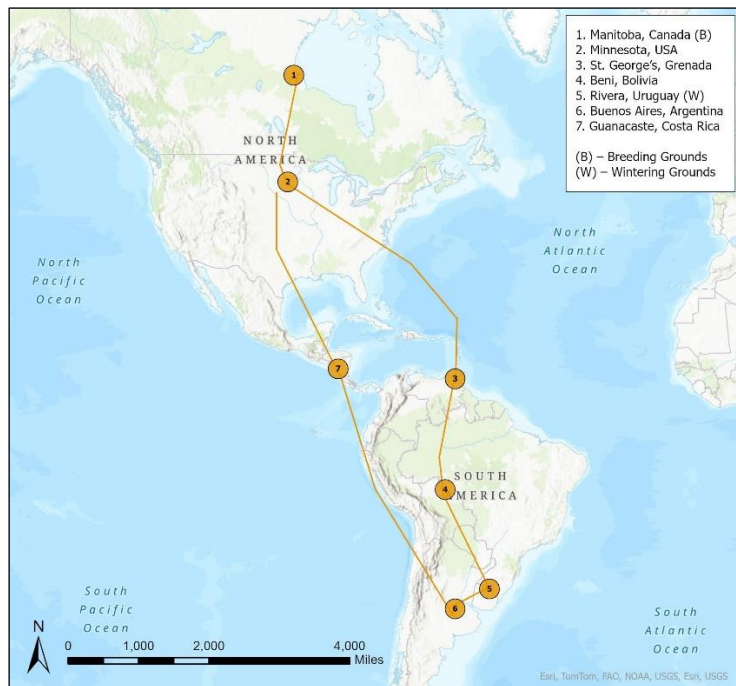


Figure 8. Annual movements of the Lesser Yellowlegs (*Tringa flavipes*) with labeled breeding, wintering, and stopover locations. Lesser Yellowlegs tracking data contributed by Callie Gesmundo and Jim Johnson, U.S. Fish and Wildlife Service. See page 14 for additional data contributor information.

² 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](#).

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 (Figure 9). 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 shared with the MN BWSR were satellite 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 MN BWSR. [Link for more information on satellite 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.

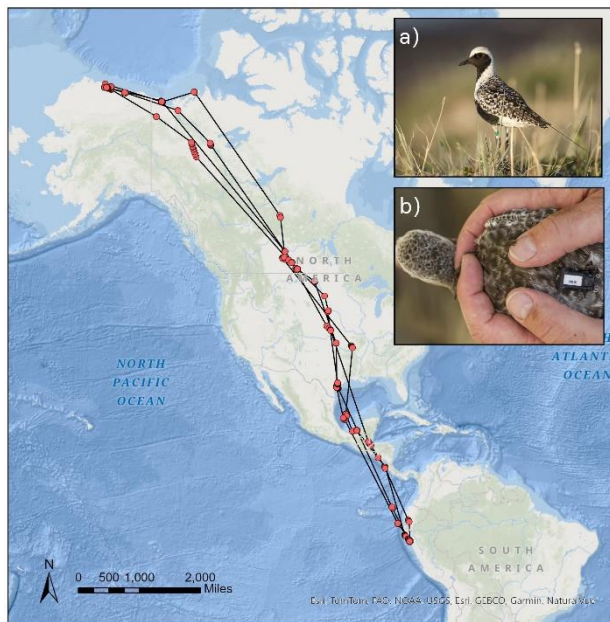


Figure 9. Full cycle track line across two years for an individual Black-bellied Plover (*Pluvialis squatarola*); contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center and Lee Tibbitts, U.S. Geological Survey, Alaska Science Center. Photos: **a)** Breeding male Black-bellied Plover with leg flag and <5g solar satellite tag, Ryan Askren, USGS/Smithsonian; **b)** Satellite tag attached to the back of a Black-bellied Plover; Tim Romano, Smithsonian.

Using Education for Conservation Action

Education and outreach programs offer a unique opportunity to raise awareness about, and action towards, specific conservation concerns. Its application can increase 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 MN BWSR shorebird outreach efforts is one example of a local 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. MN BWSR plans to share these initial data with MN BWSR staff and conservation partners in hopes that it will help spread awareness about the role that local wetland restoration and water management projects have in protecting shorebird populations.

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, as part of a phase II, the MN BWSR could work with the Shorebird Collective to provide landowners with tailored maps of shorebird tracks from their property to encourage interest in shorebirds. 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 the MN BWSR could recommend to private landowners participating in MN BWSR programs.



Picking up trash on a beach;
Tim Romano, Smithsonian

Shorebird-Friendly Actions

1. **Reduce or time the use of pesticides** near aquatic and grassland habitats so applications do not limit invertebrate availability and/or degrade shorebird habitat.
2. **Limit disturbance** (e.g., vehicles, humans/pets) in areas with high shorebird concentrations.
3. **Control tall/dense vegetation** in grassland and aquatic habitats through brush management or prescribed burning.
4. **Protect on-site wetlands** from livestock by installing fencing around the site and/or placing livestock watering facilities away from the wetlands to prevent erosion and habitat degradation.
5. For managed wetlands, **maintain appropriate water levels** when shorebirds are present.
6. **Maintain a mosaic of different habitats** to provide resources for multiple shorebird species.
7. **Incorporate prescribed grazing systems** on rangelands by providing shorter grass during spring and fall migration.
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](#).

The following contributors provided detailed tracks and maps of shorebird movements:

Pectoral Sandpiper Track

Rick Lanctot^{*1}, Sarah Saalfeld¹, Christopher Latty¹, Stephen Brown², Shiloh Schulte², Dan Ruthrauff³, Rebecca McGuire⁴, Jean-François Lamarre^{5,6}

Unpublished data, U.S. Fish and Wildlife Service, Manomet, U.S. Geological Survey-Alaska Science Center, Wildlife Conservation Society, Polar Knowledge Canada, Canadian High Arctic Research Station, Université du Québec à Rimouski

American Woodcock Track

Erik Blomberg^{*7}, Amber Roth⁷, Alexander Fish⁷, Liam Berigan⁷

Unpublished data, American Woodcock Migration Research Cooperative

Lesser Yellowlegs Track

Jim Johnson^{*1}, Katie Christie^{*8}, Laura McDuffie³, Christian Friis⁹, Callie Gesmundo^{*1}, Christopher Harwood¹, Benoit Laliberté⁹, Erica Nol¹⁰, Jennie Rausch⁹, Audrey Taylor¹¹, Jay Wright¹², Joint Base Elmendorf-Richardson¹³

Associated Citation: McDuffie, L. A., Christie, K. S., Taylor, A. R., Nol, E., Friis, C., Harwood, C. M., Rausch, J., Laliberté, B., Gesmundo, C., and Johnson, J. A. 2022. Flyway-scale GPS tracking reveals migratory routes and key stopover and non-breeding locations of lesser yellowlegs. *Ecology and Evolution*, 12(11), e9495.

These additional contributors shared data of shorebirds tracked in Minnesota:

Paul Woodward⁹, Lee Tibbitts³, Joaquín Aldabe², Juliana Almeida², Gabriel Castresana¹⁴, Dave Douglas³, Bob Gill³, Nathan Senner^{15,16}, Mitch Weegman^{17,18}, Bart Ballard¹⁹, Jennifer Linscott¹⁶, Jorge Ruiz²⁰, Juan Navedo²⁰, Bart Kempenaers²¹, Mihai Valcu²¹, Eunbi Kwon²¹, Bridget Olson¹

Contributor Organizations

¹ U.S. Fish and Wildlife Service, ² Manomet, ³ U.S. Geological Survey, Alaska Science Center, ⁴ Wildlife Conservation Society, ⁵ Polar Knowledge Canada, Canadian High Arctic Research Station, ⁶ Université du Québec à Rimouski, ⁷ University of Maine, ⁸ Alaska Department of Fish and Game, ⁹ Environment and Climate Change Canada's Canadian Wildlife Service, ¹⁰ Trent University, ¹¹ University of Alaska Anchorage, ¹² Ohio State University, ¹³ Joint Base Elmendorf-Richardson, ¹⁴ Ministerio de Ambiente de la Provincia de Buenos Aires, ¹⁵ University of Massachusetts Amherst, ¹⁶ University of South Carolina, ¹⁷ University of Saskatchewan, ¹⁸ University of Missouri, ¹⁹ Texas A&M University – Kingsville, ²⁰ Universidad Austral de Chile, ²¹ Max Planck Institute for Biological Intelligence

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