Pectoral Sandpiper;
Lisa Hupp, USFWS (CC)

Providing Pectoral Sandpiper (*Calidris melanotos*) tracking data in Missouri, USA to help inform and validate Bayesian Belief Network Models

Conservation Contribution #21

Conservation Action: Species Management; Land/Water Management

Smithsonian Migratory Bird Center

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

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*This report for public audiences describes how the Shorebird Collective fulfilled a conservation request, presents key findings, and due to data privacy settings, **shows only a subset of the data** used to support our partner.*

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Project Background

Conservation Request

The Missouri Department of Conservation (MDC) manages wetlands for wildlife. To inform management decisions, MDC developed probabilistic models (Bayesian Belief Networks) that generate species-specific distribution models linking life history needs to habitat conditions found in Missouri's wetlands. Eight wetland dependent species, including Pectoral Sandpiper (*Calidris melanotos*), were chosen for this analysis. MDC requested state-wide Pectoral Sandpiper tracking data (see page 8 for more information on shorebird tracking data) from the Shorebird Science and Conservation Collective (hereafter, "Shorebird Collective") to help validate and improve their models for informing management decisions of wetland habitat in the state. The Shorebird Collective compiled contributed Pectoral Sandpiper tracking data and summary information within the state of Missouri to support this request.

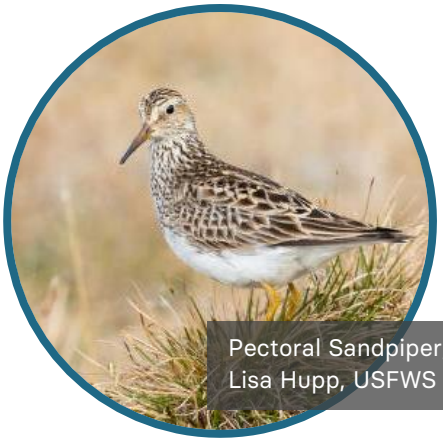
Important Note: This report describes how the Shorebird Collective fulfilled MDC's request and presents key outputs and findings showing only a subset of the data used to inform our partner. Due to the privacy settings of some datasets contributed to the Shorebird Collective, a full summary of findings provided to MDC is for internal planning use only.

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: web link for the Shorebird Collective's webpage.

About the Missouri Department of Conservation

MDC protects and manages Missouri's fish, forest, and wildlife, and facilitates opportunities for all citizens to use, enjoy, and learn about these resources. Learn more on MDC's website: web link for MDC's website.



Pectoral Sandpiper; Lisa Hupp, USFWS (CC)

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Summary of Results

Of 227 Pectoral Sandpipers tracked by GPS and Argos satellite technologies and contributed to the Shorebird Collective[1], **27 individuals** had **Argos (*n* = 25)** or **GPS (*n* = 2)** tag transmissions (i.e., tracked locations) in the state of Missouri between 2012 and 2021. All individuals were tracked in the state during migration, with 12 individuals during northbound (spring) migration and 20 during southbound (fall) migration. Five individuals were tracked in more than one season, and all birds were tagged at breeding sites in Alaska, USA. Due to the privacy settings of the Pectoral Sandpiper datasets, maps of tracked locations cannot be shown in this public-facing summary report. However, **Figure 1** provides a gridded density map showing the number of Pectoral Sandpipers with tag transmissions per 30 x 30 km hexagonal cell across all seasons in the state of Missouri. Preliminary findings show most tracked locations occurred in the southeastern portion of the state.

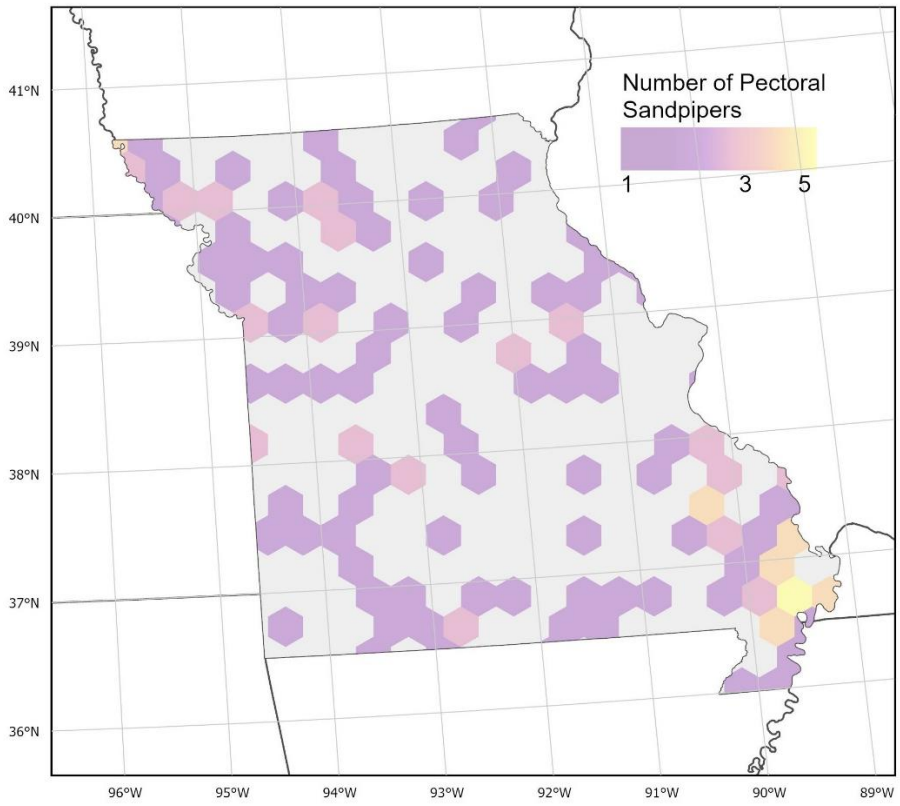

Figure 1. Gridded density map of the number of individual Pectoral Sandpipers tracked with Argos or GPS technologies per 30 x 30 km hexagonal cell across all seasons in Missouri, USA. Data were summarized at the original timestep of each tag and include tag transmissions that occurred during stops and flights.

[1] These data come from 7 organizations, collected from 2012 to 2021. *Shorebird Collective Data version: 2024-09-24*

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Methods

Data Processing

The Shorebird Collective processed data to remove obvious errors (e.g., transmissions from the tag manufacturing facility or transmissions after a tag fell off a bird). We then used statistical models to estimate the most likely movement path of each bird taking into account spatial uncertainty of the tracking technology (example code is available on GitHub: web link for GitHub page).

Creation of Track Lines & Assignment of Seasons

The Shorebird Collective subset tracking points to the state of Missouri and created track lines by connecting sequential points. We included the first point before and after the bird entered the state when creating track lines to show the trajectory of the bird entering and leaving the state for additional context on movements to and from Missouri wetlands. Because Pectoral Sandpiper use of wetlands could differ between spring and fall migration in Missouri, we assigned each track line and point to season of the annual cycle based on the month (i.e., pre-breeding [spring] migration between March and May; post-breeding [fall] migration between July and November). We provided MDC with a geopackage of the tracked points and track lines in both the original and filtered datasets.

Data Considerations

Data shared by the Shorebird Collective are currently not assigned to flights or stopover periods. The Shorebird Collective is currently developing methods for behavioral classifications and could provide MDC with an updated dataset in summer 2025.

About Pectoral Sandpipers

Pectoral Sandpipers are medium-sized shorebirds with a brown streaked breast and white belly (Farmer et al. 2020). They are typically only present in Missouri during spring and fall migration. Spring migrants start to appear in the state in late March with numbers peaking in early May, while fall migrants appear in late July with peak numbers in September (MDC 2024). As a long-distance migrant, they breed on tundra in the Arctic and spend the non-breeding season in 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 Facts

- Breeding males have an inflatable throat sac that 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).
- Male Pectoral Sandpipers do not help the female incubate eggs or raise young (Myers 1982). In fact, most males depart their breeding grounds and head south well before the eggs even hatch (Myers 1982).
- 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 in the Americas (Farmer et al. 2020).

Pectoral Sandpiper with satellite tag; Rick Lanctot, USFWS (CC)

Pectoral Sandpiper taking flight; Peter Pearsall, USFWS (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 at 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

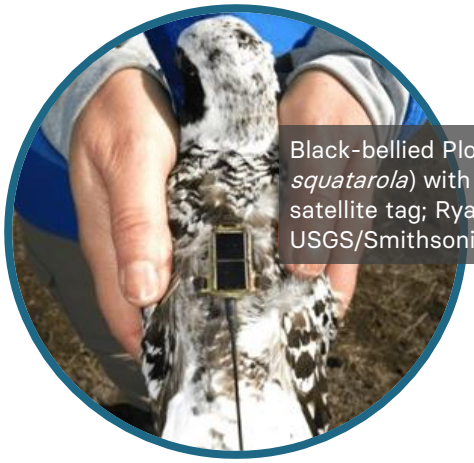
Although shorebirds are often seen in large flocks, it may surprise some to know that their populations are rapidly declining. Many populations have lost over 70% of their numbers in the past 50 years (NABCI 2022, Rosenberg et al. 2019, Smith et al. 2023), making them one of the most vulnerable bird groups in North America. Habitat loss and alteration, human disturbance, and climate change are just some of the major threats shorebirds face 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, 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 2**). 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. Data from shorebirds tracked with satellite tags were shared with MDC.



Black-bellied Plover (*Pluvialis squatarola*) with <5g solar satellite tag; Ryan Askren, USGS/Smithsonian

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 MDC's request. Web 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 2. Full cycle track line across two years for an individual Black-bellied Plover; contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center; David Newstead, Coastal Bend Bays & Estuaries Program; 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.

Data Contributors

Tracking data for this project were contributed to the Shorebird Collective by the following people and organizations. A full list of data contributors to the Shorebird Collective can be found on our webpage: web link for the Shorebird Collective's webpage.

Pectoral Sandpiper tracking data contributed by: Bart Kempenaers (Department of Ornithology, Max Planck Institute for Biological Intelligence), Richard Lanctot (U.S. Fish and Wildlife Service); **co-owned by**: Mihai Valcu (Department of Ornithology, Max Planck Institute for Biological Intelligence), Sarah Saalfeld and Christopher Latty (U.S. Fish and Wildlife Service), Stephen Brown and Shiloh Schulte (Manomet), Daniel Ruthrauff (U.S. Geological Survey, Alaska Science Center), Rebecca McGuire (Wildlife Conservation Society), Jean-François Lamarre (Polar Knowledge Canada, Canadian High Arctic Research Station, Université du Québec à Rimouski)

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