Amazon River, NOAA (CC)

Providing shorebird tracking data in the Amazon Basin to guide the establishment of a shorebird monitoring program

Conservation Contribution #15

Conservation Action: Land/Water Management

Prepared by the Shorebird Science & Conservation Collective:

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September 2024

*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 in a full report to our partner.*

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MANOMET CONSERVATION SCIENCES

Smithsonian Migratory Bird Center

Project Background

Conservation Request

Manomet Conservation Sciences (hereafter, "Manomet") requested shorebird tracking data (see page 8 more information on shorebird tracking data) within the Amazon basin (**Figure 1**) from the Shorebird Science and Conservation Collective (hereafter, "Shorebird Collective") to help identify areas to initiate a shorebird monitoring program. The Shorebird Collective compiled contributed shorebird tracking data and summary information to support this request.

Important Note: This report describes how the Shorebird Collective fulfilled Manomet'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 Manomet 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 Manomet Conservation Sciences

Manomet is a conservation non-profit dedicated to using science and collaboration to strengthen bird migration routes, coastal ecosystems, and working lands and seas across the Western Hemisphere. They also host the Executive Office of the Western Hemisphere Shorebird Reserve Network. For 50+ years, Manomet has formed vital partnerships with businesses, producers, and educators, to help nature and local communities thrive. Learn more on Manomet's website: web link for Manomet's website.

Figure 1. Map of the Amazon Basin (pink polygon) in South America.

Summary of Results

Of 1,678 individuals tracked by GPS and Argos satellite technologies and contributed to the Shorebird Collective[1] (**Box 1**), **185** individuals of **eight** species made stops in the Amazon Basin during their annual cycle (see **Figure 2** for an example from a subset of individuals), with seven individuals of four species tracked in the region across multiple years. Tracked individuals included:

- **19** American Golden-Plover (*Pluvialis dominica*)
- **2** Black-bellied Plover (*Pluvialis squatarola*)
- **48** Buff-breasted Sandpiper (*Calidris subruficollis*)
- **5** Hudsonian Godwit (*Limosa haemastica*)
- **34** Lesser Yellowlegs (*Tringa flavipes*)
- **49** Pectoral Sandpiper (*Calidris melanotos*)
- **19** Upland Sandpiper (*Bartramia longicauda*)
- **9** Whimbrel (*Numenius phaeopus*)

Box 1. Summary of shorebird tracks in the Amazon Basin

1,678 individuals of **21** species contributed to the Shorebird Collective

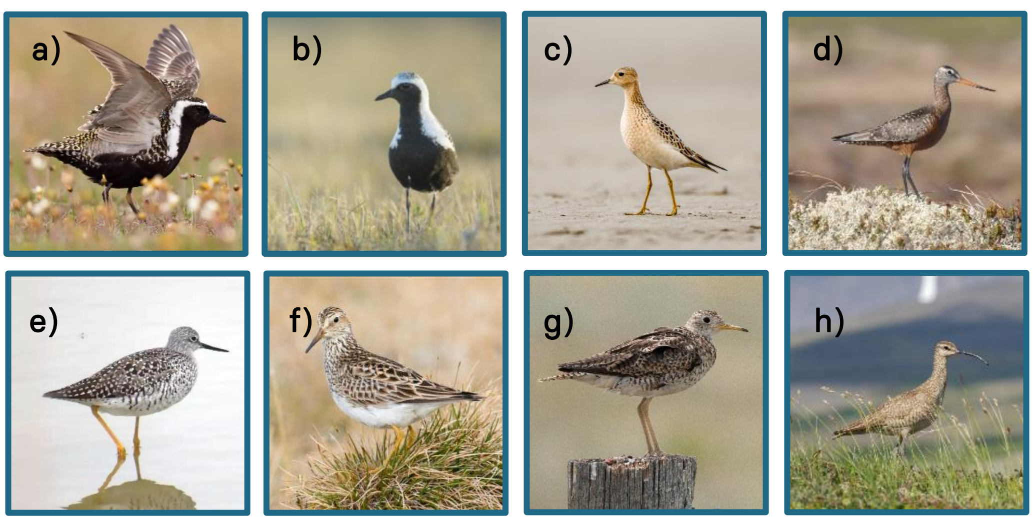
185 individuals of **8** species tracked in the Amazon Basin

Northbound migration:
169 individuals

Southbound migration:
16 individuals

Overwintering period:
11 individuals

Tracked locations in the Amazon Basin occurred during migration and overwintering periods. A total of 169 individuals were tracked during southbound migration, 16 during northbound migration, and 11 while overwintering. Stopover durations ranged from two to 225 days with an average stopover duration of 10 days.



Species and photo credits: a) American Golden-Plover, Lisa Hupp, USFWS (CC); **b)** Black-bellied Plover, USGS/Smithsonian; **c)** Buff-breasted Sandpiper, Shiloh Schulte, USFWS (CC); **d)** Hudsonian Godwit, Kristine Sowl, USFWS (CC); **e)** Lesser Yellowlegs, Jill Shannon, USFWS (CC); **f)** Pectoral Sandpiper, Lisa Hupp, USFWS (CC); **g)** Upland Sandpiper, Andy Boyce, Smithsonian; **h)** Whimbrel, Rachel Richardson, USGS Alaska Science Center (CC)

[1] These data come from 86 organizations, collected from 2006 to 2024 (Data Version: 2024-06-01).

Methods

The Shorebird Collective used statistical models to account for spatial uncertainty and determined the most likely movement path of each bird recorded by the tracking device (example code is available on GitHub: [web link for GitHub page](#)). We then overlayed the cleaned shorebird tracks on a map of the Amazon Basin and retained tracking points that fell within the Amazon Basin boundary. Once we identified relevant tracks, we split data for each bird into separate groups of tracking points (hereafter, “segments”) if the time elapsed between tracking points exceeded 45 days because birds that migrated through the region in both northbound and southbound migration were absent for at least 45 days while they spent the non-breeding season south of the Amazon. Splitting tracks into segments allowed us to group points within a season. For each segment, we estimated that the bird stopped in the Amazon Basin if the time elapsed between the first and last tracking point in the Basin was greater than four days (the time required for a bird to cross the average distance between the north and south boundaries of the Amazon Basin at a slow flight speed of 9 m/s). For segments flagged to contained stops, we manually examined tracking points and grouped points within 25 km of each other into a stopover event. We excluded short stops < 1 day in duration. We exported stopover points and tracklines for these birds as KML files to share with Manomet.

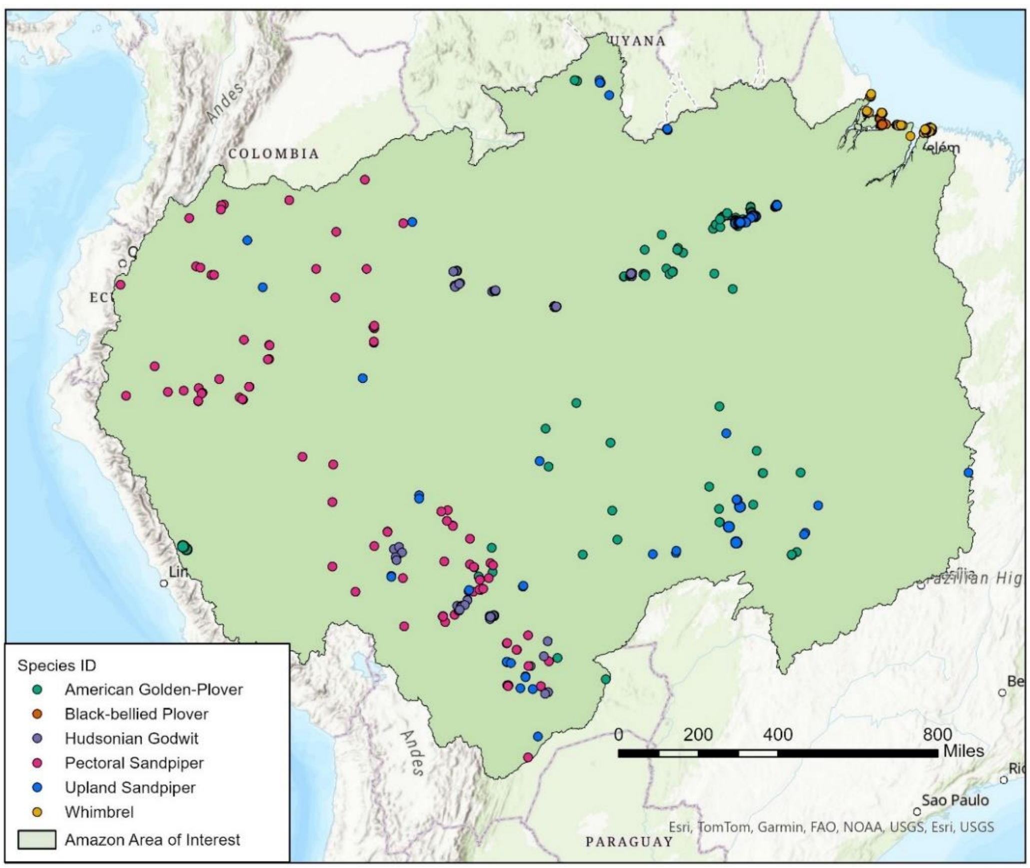


Figure 2. An example of tracked GPS and Argos satellite locations of individual shorebirds (*n* = 52) stopped in the Amazon Basin during migration or while overwintering. Tracking points are mapped at the original time sampling interval of the tag. Due to the privacy settings of some of the tracking datasets, this public-facing map contains only a subset of the tracks shared with Manomet. Note that this is a summary of tracked shorebird locations across multiple years and does not necessarily reflect the birds co-occurring in the area at the same time.

Shorebirds and the Amazon Basin

The Amazon is the world's largest drainage basin, covering roughly 7 million square kilometers (Alsbach et al. 2024, Linscott et al. 2024), and one of the most biodiverse regions on Earth (Guayasamin et al. 2024). The area also provides critical habitat for shorebirds, supporting both migratory and resident species across its extensive network of wetlands, floodplains, riverbanks, and coastal estuaries. Nearly two dozen North American-breeding shorebird species are estimated to pass through the Amazon *en route* to other overwintering areas in South America (Morrison and Ross 1989), yet knowledge of their presence has been limited to a small number of studies (Antas 1983, Lanctot et al. 2002, Linscott et al. 2024, Serrano 2010).

Despite its ecological importance, the Amazon faces growing threats from deforestation, wetland drainage, large-scale agriculture, mining operations, and hydrological changes from dam construction (Latrubesse et al. 2017, Malhi et al. 2008, Sonter et al. 2017). These pressures can alter water flow and degrade habitat (Latrubesse et al. 2017, Malhi et al 2008), thereby diminishing the resources available for shorebirds and other wildlife. Climate change intensifies these challenges, altering rainfall patterns and increasing the frequency of extreme weather events (Malhi et al. 2008), further jeopardizing critical shorebird habitats.

Conserving the Amazon is essential not only for preserving its rich biodiversity but also for sustaining the shorebirds and other avian species that rely on its habitats year-round. Protecting key wetlands, implementing sustainable land-use practices, and strengthening conservation efforts in collaboration with local communities and international organizations are vital steps to ensure the Amazon remains a thriving ecosystem for generations to come.


Riverbank of the Amazon River; Fernando Angulo, Manomet.


Buff-breasted Sandpiper on a river sandbank in the Peruvian Amazon; Fernando Angulo, Manomet.

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

MANOMET CONSERVATION SCIENCES

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About Shorebird Tracking Data

Tracking data provide valuable insight into where shorebirds move and are located throughout the year (**Figure 3**). 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 Manomet.

Black-bellied Plover 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 Manomet'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.

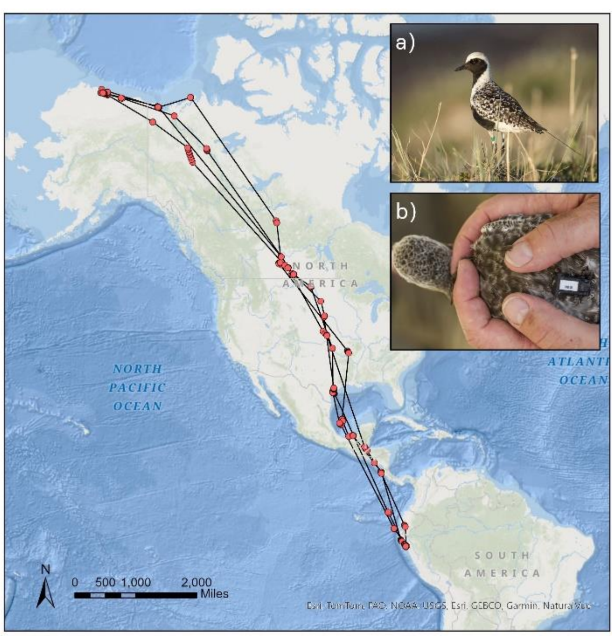

Figure 3. Full cycle track line across two years for an individual Black-bellied Plover; contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center; David Newstead, Coastal Bend Bays & Estuaries Program; and Lee Tibbitts, U.S. Geological Survey, Alaska Science Center. Photos: **a)** Breeding 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.

American Golden Plover
Tracking data contributed by Richard Lanctot (U.S. Fish and Wildlife Service), and co-owned by Sarah Saalfeld (U.S. Fish and Wildlife Service), Joël Bêty (Université du Québec à Rimouski), Jean-François Lamarre (Polar Knowledge Canada, Canadian High Arctic Research Station, Université du Québec à Rimouski), Kyle Elliott (McGill University), Paul Smith (National Wildlife Research Centre, Environment and Climate Change Canada), Willow English (Carleton University), Marie-Andrée Giroux and Nicolas Lecomte (Université de Moncton), Stephen Brown and Shiloh Schulte (Manomet), Autumn-Lynn Harrison (Smithsonian Migratory Bird Center), Pete Marra (Georgetown University), Rebecca McGuire (Wildlife Conservation Society), Mike Russell (Government of Alberta)

Black-bellied Plover
Tracking data contributed by Jennie Rausch (Canadian Wildlife Service, Environment and Climate Change Canada), and co-owned by Paul Woodard (Canadian Wildlife Service, Environment and Climate Change Canada)

Buff-breasted Sandpiper
Tracking data contributed by Lee Tibbitts (U.S. Geological Survey, Alaska Science Center), and co-owned by Richard Lanctot (U.S. Fish and Wildlife Service), Dan Ruthrauff and Dave Douglas (U.S. Geological Survey, Alaska Science Center)

Hudsonian Godwit
Tracking data contributed by Jennie Rausch (Canadian Wildlife Service, Environment and Climate Change Canada), Nathan Senner (University of Massachusetts Amherst, University of South Carolina), Mitch Weegman (University of Missouri, University of Saskatchewan), Bart Ballard (Texas A&M University, Kingsville), and co-owned by Fletcher Smith (College of William and Mary, Georgia Department of Natural Resources), Bryan Watts (College of William and Mary), Jennifer Linscott (University of South Carolina), Jorge Ruiz and Juan Navedo (Universidad Austral de Chile)

Lesser Yellowlegs
Tracking data contributed by Jim Johnson and Callie Gesmundo (U.S. Fish and Wildlife Service), Katie Christie (Alaska Department of Fish and Game), and co-owned by Laura McDuffie (U.S. Geological Survey, Alaska Science Center), Christian Friis, Benoit Laliberté, and Jennie Rausch (Canadian Wildlife Service, Environment and Climate Change Canada), Christopher Harwood (U.S. Fish and Wildlife Service), Erica Nol (Trent University), Audrey Taylor (University of Alaska Anchorage), Jay Wright (Ohio State University), Department of Defense - Joint Base Elmendorf-Richardson

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), and 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)

Upland Sandpiper

Tracking data contributed by Jim Johnson and Callie Gesmundo (U.S. Fish and Wildlife Service), Jason Hill (Vermont Center for Ecostudies), and co-owned by Zachary Pohlen (U.S. Fish and Wildlife Service), Rosalind Renfrew (Vermont Center for Ecostudies, Vermont Fish and Wildlife Department), Department of Defense - Joint Base Elmendorf-Richardson

Whimbrel

Tracking data contributed by Jennie Rausch (Canadian Wildlife Service, Environment and Climate Change Canada), and co-owned by Fletcher Smith (College of William and Mary, Georgia Department of Natural Resources), Bryan Watts (College of William and Mary), Brad Winn (Manomet), Julie Paquet (Canadian Wildlife Service, Environment and Climate Change Canada)

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