Scientists surveying a Texas wetland; Tim Romano, Smithsonian

Using shorebird tracking data to assess shorebird use of habitat in response to prescribed burns and water level management in coastal Texas

Conservation Contribution #05

Conservation Action: Land/Water Management; Species Management

Smithsonian *Migratory Bird Center*

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June 2023

*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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Project Background

Conservation Request

The Coastal Bend Bays & Estuaries Program (CBBEP) requested shorebird tracking data from the Shorebird Science and Conservation Collective (hereafter, "Shorebird Collective") to support an initiative focused on refining management techniques for shorebirds. Specifically, CBBEP requested data from electronically tracked shorebirds (see page 10 for more information on tracking data) within their Nueces Delta Preserve and Mission River properties along the Texas coast (**Figure 1**) to assess shorebird use of habitat in response to prescribed burns and water level management. 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 CBBEP'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 report of findings provided to CBBEP 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 Coastal Bend Bays & Estuaries Program

CBBEP is a Texas nonprofit dedicated to protecting and restoring the health and productivity of the state's bays and estuaries while supporting continued economic growth and public use of the bays. Learn more on CBBEP's website: web link for CBBEP's website.

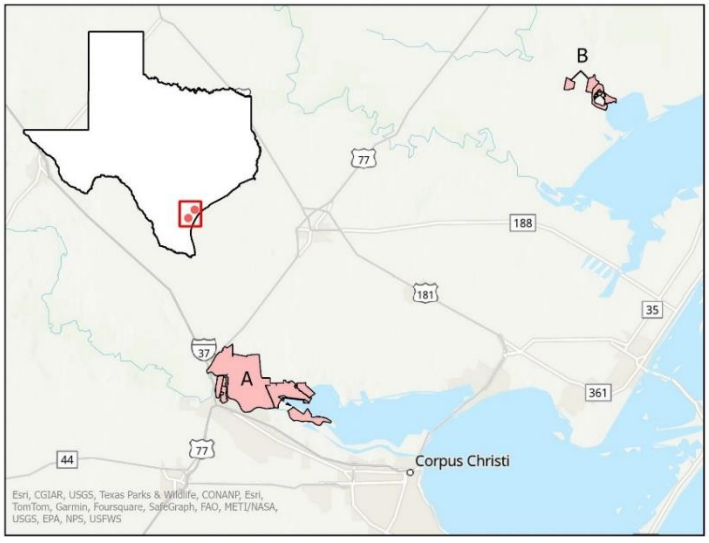


Figure 1. Locations of CBBEP's Nueces Delta Preserve (**A**) and Mission River (**B**) properties in Texas.

About the CBBEP Properties

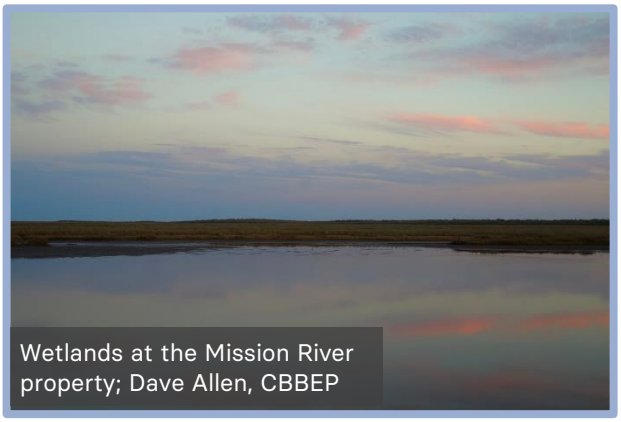
The Nueces Delta Preserve and Mission River properties are two main areas of focus for CBBEP's land conversation efforts. Both sites host a myriad of riparian and coastal prairie habitats and provide critical habitat for shorebirds, waterfowl, waterbirds, and other coastal wildlife species (CBBEP 2020).

Killdeer (*Charadrius vociferus*) in Nueces Delta Preserve; Dave Allen, CBBEP

Nueces Delta Preserve is a 10,500 acre preserve located in the San Patricio and Nueces Counties of coastal Texas. The preserve includes the Rincon Bayou, which serves as an important inflow route between the Nueces River and Nueces Bay (CBBEP 2020). CBBEP hosts several educational programs at the preserve, in addition to various monitoring, freshwater inflow, and wildlife and habitat restoration projects (CBBEP 2020). Mission River is a 1,350-acre property located in Refugio County along the Texas Coast. The property borders Mission Bay and serves as an important conservation corridor within the Mission River Delta (CBBEP 2020).

With these lands, CBBEP aims to conserve and protect the coastal habitats in the coastal bend of Texas (CBBEP 2020). The CBBEP Land Conservation and Stewardship Program conducts routine maintenance and management at both properties (e.g., prescribed fire, brush management, native plantings, hydrological restoration, fencing, installation of signage) and promotes stewardship of the region's coastal resources (CBBEP 2020).

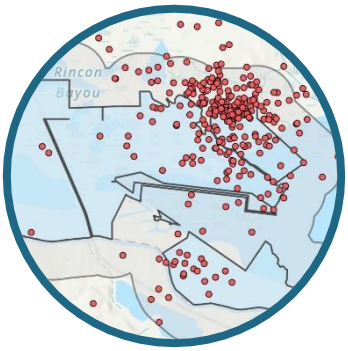
Shorebirds foraging in Nueces Delta Preserve; Dave Allen, CBBEP



Wetlands at the Mission River property; Dave Allen, CBBEP

Key Outputs & Recommendations

Below we summarize key outputs, findings, and recommendations provided to CBBEP to support their shorebird management efforts:



1. The Shorebird Collective provided CBBEP with detailed information on electronically tracked shorebird movements in the Nueces Delta Preserve and Mission River properties along the Texas coast to help support an initiative focused on refining management techniques for shorebirds. Specifically, CBBEP requested shorebird location data within the two properties to assess shorebird use of habitat in response to prescribed burns and water level management. **Nine** individuals of **three** species were tracked within 800 meters of either property.

2. In a full report to CBBEP and with permission of data owners, we provided maps of tracked shorebird movements on these two properties with additional details of habitat use, stopover durations, and timing of tracked locations. CBBEP can use these data to compare with the timing of prescribed burns and other habitat management activities on the properties.

3. Additional information may become available as data contributors continue to share new tracking data with the Shorebird Collective. We did not query community science data (e.g., eBird, Texas bird count) for the report to CBBEP, but such data could provide additional valuable information to help inform efforts. We invited CBBEP to periodically check in with the Shorebird Collective on the availability of new data to support their work.

Images: 1. Laying fire down for a prescribed burn, Ryan Hagerty, USFWS (CC); **2.** Tracked Black-bellied Plover (*Pluvialis squatarola*) locations in Nueces Delta Preserve, contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center. See page 11 for additional data contributor information; **3.** Red Knot (*Calidris canutus*) with 3.4 gram GPS tag, Tim Romano, Smithsonian

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Summary of Results

Of 1,480 individuals tracked by GPS and Argos satellite technologies and contributed to the Shorebird Collective[1] (**Box 1**), **18%** (*n* = 260) moved through the state of Texas during their annual cycle.

Nine individuals of **three** species were tracked between 2015 and 2021 during migration and while overwintering within 800 meters of the Nueces Delta Preserve or Mission River properties (see **Figures 2-4** as examples). Tracked individuals include:

- **7** Long-billed Curlew (*Numenius americanus*)
- **1** Hudsonian Godwit (*Limosa haemastica*)
- **1** Black-bellied Plover (*Pluvialis squatarola*)

Tracked locations ranged from a single observation during a flyover to an overwintering duration of 239 days. The Shorebird Collective provided details on timing and location of these tracked locations for CBBEP to compare with the timing of prescribed burns and other habitat management activities at the Nueces Delta Preserve and Mission River properties.

Box 1. Summary of shorebird tracks in areas of interest

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

260 individuals of **12** species tracked in Texas

9 individuals of **3** species within 800m of the Nueces Delta Preserve or Mission River properties

Additional information may become available as data contributors continue to share new tracking data with the Shorebird Collective. Note that we did not query community science data (e.g., eBird, Texas bird count) for this analysis. We invited CBBEP to periodically check in with the Shorebird Collective on the availability of new data to support their efforts.

Long-billed Curlew (*Numenius americanus*); Andy Boyce, Smithsonian

Hudsonian Godwit (*Limosa haemastica*); Kristine Sowl, USFWS (CC)

Black-bellied Plover (*Pluvialis squatarola*); Ryan Askren, USGS/Smithsonian

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

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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 maps of the Nueces Delta Preserve and Mission River properties and summarized information of birds tracked within 800 meters of either property. We considered distances of up to 800 meters to include birds using intertidal areas or areas just outside of the property boundaries.

In a full report to CBBEP, we provided maps of tracked shorebirds in the Nueces Delta Preserve and Mission River properties and provided additional tables and graphs detailing land use, stopover durations, and timing movements for CBBEP to compare with the timing of prescribed burns and other habitat management activities on the properties (see **Figures 2-4** as examples). We also provided details of tracked shorebirds that flew over the two properties. Flyover data could be useful to CBBEP as individuals may have flown over the areas if habitat was not suitable at the time.

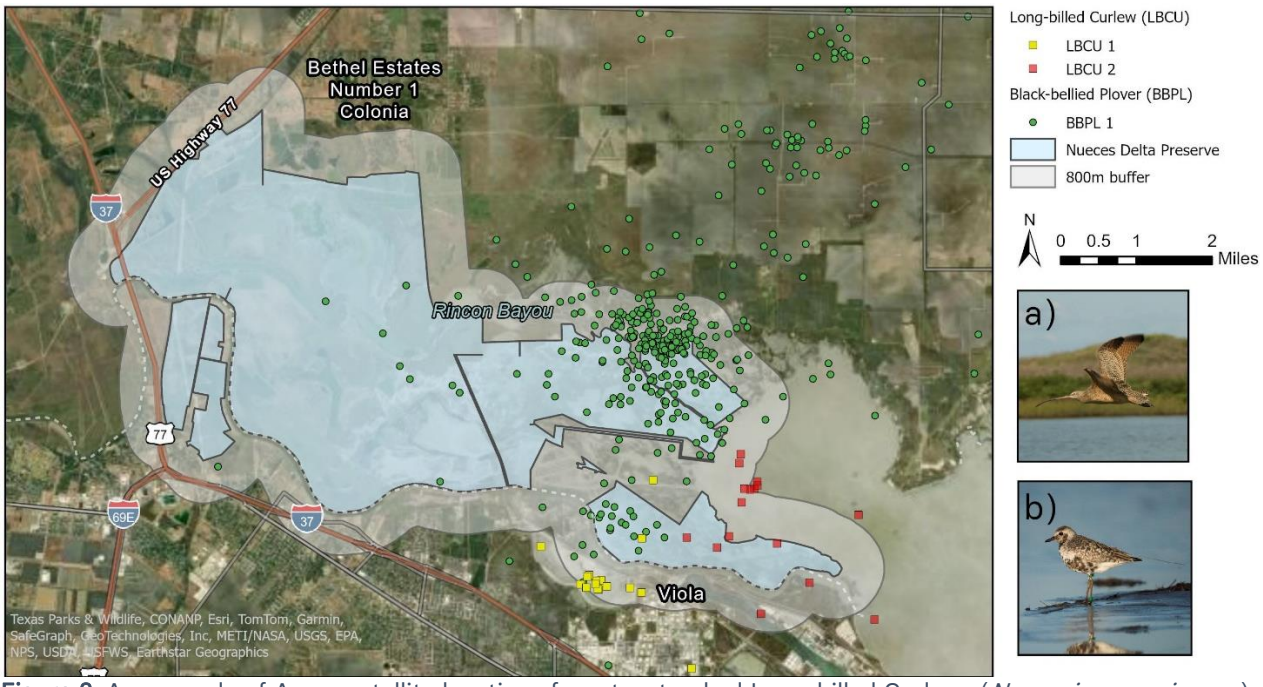

Figure 2. An example of Argos satellite locations from two tracked Long-billed Curlews (*Numenius americanus*) and one Black-bellied Plover (*Pluvialis squatarola*) overlayed on a map of Nueces Delta Preserve. All three birds overwintered in the surrounding area. The plover primarily wintered in wetland habitat in the northeast portion of the preserve while the two curlews spent short periods in the preserve and otherwise wintered in nearby areas to the east. Shorebird locations are from multiple years and the map does not necessarily reflect the birds co-occurring in the area at the same time. Not shown are points for two other curlews tracked within 800m of Nueces Delta due to the privacy settings of the datasets but were provided to CBBEP for their internal planning use. Data shown were contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center. See page 11 for additional data contributor information. Photos: **a)** Long-billed Curlew, Tim Romano, Smithsonian; **b)** Female Black-bellied Plover, Ryan Askren, USGS Alaska Science Center.

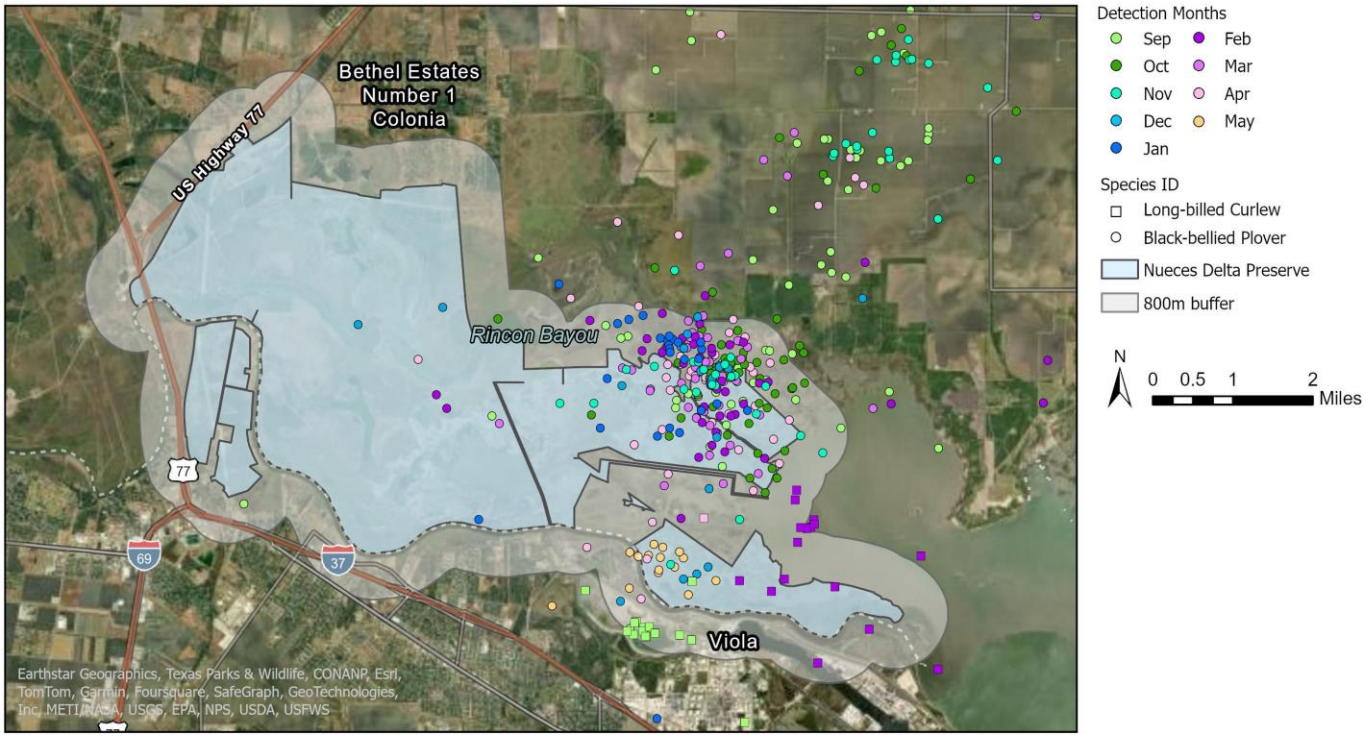

Figure 3. An example of Argos satellite locations from two tracked Long-billed Curlews (*Numenius americanus*) and one Black-bellied Plover (*Pluvialis squatarola*), grouped by species across months, for the three individuals in Figure 2 that stopped within 800m of Nueces Delta Preserve. CBBEP could compare these data with the timing of prescribed burns and other habitat management activities at the preserve. Shorebird locations are from multiple years and the map does not necessarily reflect the birds co-occurring in the area at the same time. Data from these example tracks contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center. See page 11 for additional data contributor information.

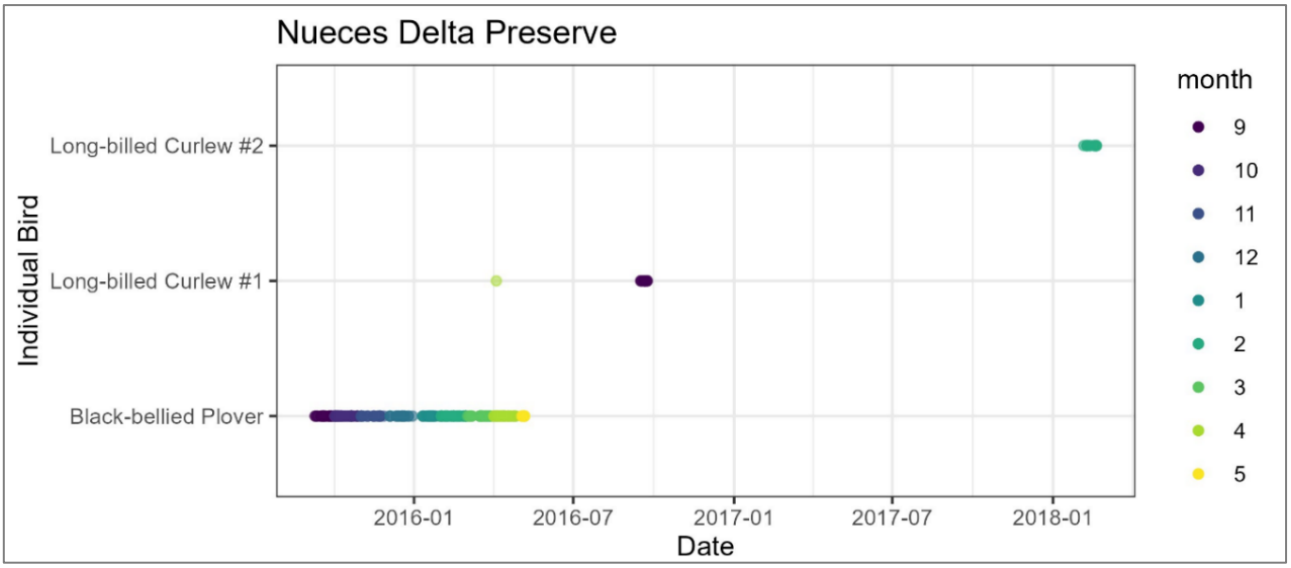

Figure 4. Timing of tracked locations of example shorebirds within 800m of Nueces Delta Preserve to compare with the timing of prescribed burns and other habitat management activities at the preserve. Data from these example tracks contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center. See page 11 for additional data contributor information.

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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 5**). 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 CBBEP.

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 CBBEP. 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.

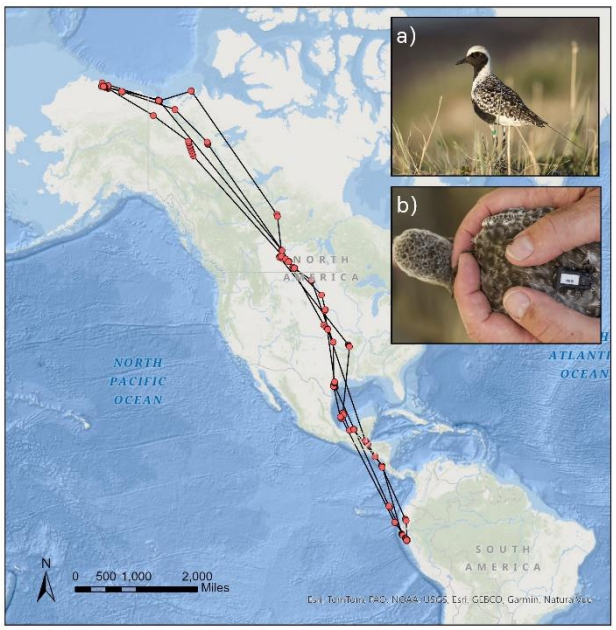

Figure 5. Full cycle track line across two years for an individual Black-bellied Plover (*Pluvialis squatarola*); contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center; David Newstead, Coastal Bend Bays & Estuaries Program; and Lee Tibbitts, U.S. Geological Survey, Alaska Science Center. Photos: **a)** Breeding male Black-bellied Plover with leg flag and <5 g 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. 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: web link for the Shorebird Collective's webpage.

Black Bellied Plover Track

Autumn-Lynn Harrison*[1], Lee Tibbitts[2], David Newstead[3]
Unpublished data, Migratory Connectivity Project

Hudsonian Godwit Track

Nathan Senner*[4,5], Jennifer Linscott[4], Jorge Ruiz[6], Mitch Weegman*[7,8], Bart Ballard*[9], Juan Navedo[6]
Associated Citation: Linscott, J. A., Navedo, J. G., Clements, S. J., Loghry, J. P., Ruiz, J., Ballard, B. M., Weegman, M. D., and Senner, N. R. 2022. Compensation for wind drift prevails for a shorebird on a long-distance, transoceanic flight. *Movement Ecology*, 10(1), 1-16.

Long-billed Curlew Tracks

Andy Boyce*[1], Jeff Kelly[10], Kate Goodenough[10], Paula Cimprich[10]
Unpublished data, Great Plains Science Program

Autumn-Lynn Harrison*[1], David Newstead[3], David Bradley[11]
Unpublished data, Migratory Connectivity Project

Contributor Organizations

[1] Smithsonian Migratory Bird Center, [2] U.S. Geological Survey, Alaska Science Center, [3] Coastal Bend Bays & Estuaries Program, [4] University of South Carolina, [5] University of Massachusetts Amherst, [6] Universidad Austral de Chile, [7] University of Missouri, [8] University of Saskatchewan, [9] Texas A&M University, Kingsville, [10] University of Oklahoma, [11] Birds Canada

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