Mixed flock of shorebirds at Quivira National Wildlife Refuge, Kansas; R. Laubhan, USFWS/Manomet

Using shorebird tracking data to inform shorebird-friendly habitat management in Kansas

Conservation Contribution #22

Conservation Action: Land/Water Management

Smithsonian *Migratory Bird Center*

KAWS KANSAS ALLIANCE FOR WETLANDS & STREAMS

Prepared by the Shorebird Science & Conservation Collective

Candace Stenzel, Allie Anderson, Autumn-Lynn Harrison

May 2025

*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 Kansas Alliance for Wetlands and Streams (KAWS) requested shorebird tracking data (see page 13 for more information on tracking data) from the Shorebird Science and Conservation Collective (hereafter, "Shorebird Collective") to support their management efforts at the Baker Wetlands in northeastern Kansas, USA (**Figure 1**). Specifically, KAWS requested shorebird location and timing data at the Baker Wetlands in northeastern Kansas and more broadly throughout the state of Kansas. In addition, KAWS requested general best management practices for creating shorebird-friendly habitat in the state. This document presents:

- Maps and summary information of shorebirds tracked near the Baker Wetlands and throughout Kansas.
- Water level, habitat management, and timing considerations for KAWS to consider when creating habitat for shorebirds.

Important Note: This report describes how the Shorebird Collective fulfilled KAWS' request and presents key outputs and findings showing only a subset of the data shared with KAWS. Due to the privacy settings of some datasets contributed to the Shorebird Collective, a full report of findings provided to KAWS 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 Kansas Alliance for Wetlands and Streams

KAWS aims to ensure the future of wetlands, streams, riparian areas, prairies, wildlife, and watersheds remain an integral part of the Kansas heritage. Learn more on KAWS' website: web link for KAWS' website.

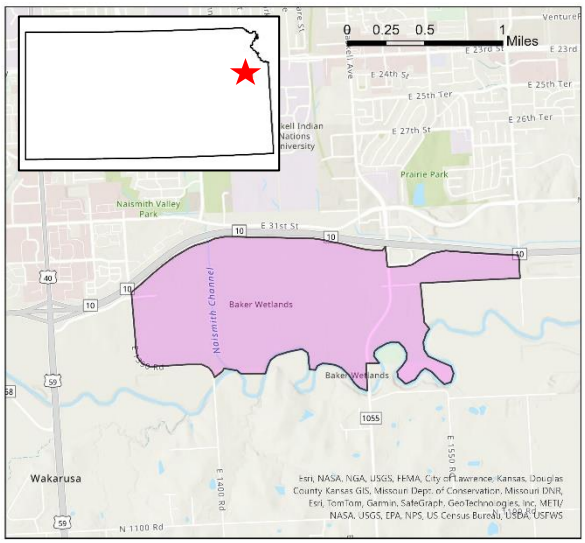

Figure 1. Map of KAWS' area of interest, the Baker Wetlands. The red star on the small state map indicates the general location of the wetlands.

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KAWS KANSAS ALLIANCE FOR WETLANDS & STREAMS

Key Outputs & Recommendations

Below we summarize key findings and outputs provided to KAWS:

1. The Shorebird Collective provided KAWS with detailed information on electronically tracked shorebird movements in or near the Baker Wetlands in northeastern Kansas. While no individuals had tracked locations on the Baker Wetlands, tracklines from **eight** individuals of **four** species intersected or were within 10 miles of the wetlands, indicating the birds could have passed through the area.

2. While tracking data are limited near the Baker Wetlands at this time, the Shorebird Collective explored contributed tracking data across Kansas to provide insights on shorebird distributions and timing throughout the state. 162 individuals of 13 species were tracked in Kansas at some point during their annual cycles.

3. Based on the tracking data contributed to the Shorebird Collective, we provided KAWS with a set of recommendations for creating shallow flooded habitats that benefit shorebirds. Additional information may become available as data contributors share new tracking data with the Shorebird Collective. We invited KAWS to periodically check in with the Shorebird Collective on the availability of new data to support their water deployment efforts.

Images: 1. Red Knot (*Calidris canutus*) with 3.4-gram GPS tag, Tim Romano, Smithsonian; **2.** Flock of Dunlins (*Calidris alpina*), Jan Wieser, USFWS (CC); **3.** Texas wetland, Tim Romano, Smithsonian

Baker Wetlands Tracking Data Summary

The Shorebird Collective examined all GPS and Argos satellite tracking data[1] contributed as of September 2024 (**Box 1**). No individuals were tracked on the Baker Wetlands; however, **eight** individuals of **four** species had tracklines intersecting or within 10 miles of the wetlands (but with tracked locations outside of the 10 miles), which indicates the birds could have passed through the area (**Figure 2**). These individuals moved through the area between 2018 and 2024 on northbound ($n = 5$) and southbound ($n = 3$) migration during the months of April-May and July-August, October. Tracked individuals include:

- **4** Lesser Yellowlegs (*Tringa flavipes*)
- **1** Long-billed Dowitcher (*Limnodromus scolopaceus*)
- **1** Pectoral Sandpiper (*Calidris melanotos*)
- **2** Short-billed Dowitcher (*Limnodromus griseus*)

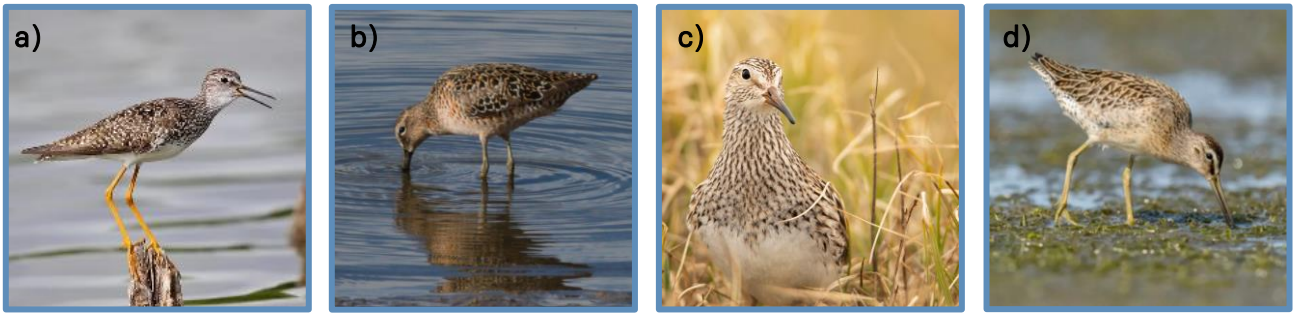
Box 1. Summary of shorebird tracks in area of interest

1,976 individuals of **24** species contributed to the Shorebird Collective

162 individuals of **13** species tracked in Kansas

8 individuals of **4** species with estimated tracklines on or within 10 miles of the

In general, tracking data showed limited use of the Central Irregular Plains Ecoregion in eastern Kansas (i.e., the ecoregion where the Baker Wetlands are located) compared to other ecoregions of Kansas (**Figure 3**); however, an absence of data does not necessarily indicate lack of use by or value to shorebirds because tracking data are limited to the individuals tagged with tracking devices. Other data types such as community science eBird data (web link to Baker Wetlands eBird page, Fink et al. 2022) suggest that shorebirds are present at the Baker Wetlands. Additional information may become available as data contributors continue to share new tracking data with the Shorebird Collective. We invited KAWS to periodically check in with the Shorebird Collective on the availability of new data to support their conservation efforts.



Images: a) Lesser Yellowlegs, Laura McDuffie, USGS (CC); **b)** Long-billed Dowitcher, Andy Boyce, Smithsonian; **c)** Pectoral Sandpiper, Lisa Hupp, USFWS (CC); **d)** Short-billed Dowitcher, Mick Thompson, USFWS (CC)

[1] These data come from 86 organizations, collected from 2006 to 2024. *Shorebird Collective Data Version 2024-09-24*

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KAWS KANSAS ALLIANCE FOR WETLANDS & STREAMS

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 tracks on both maps of the Baker Wetlands and state of Kansas.

In a full report to KAWS, we provided maps of tracked shorebird movements near the Baker Wetlands (see **Figure 2a** for an example), with additional details on seasonal timing of land use, stopover durations, and migratory connections to other parts of the Western Hemisphere (see **Figure2 b** for an example of full cycle movements).

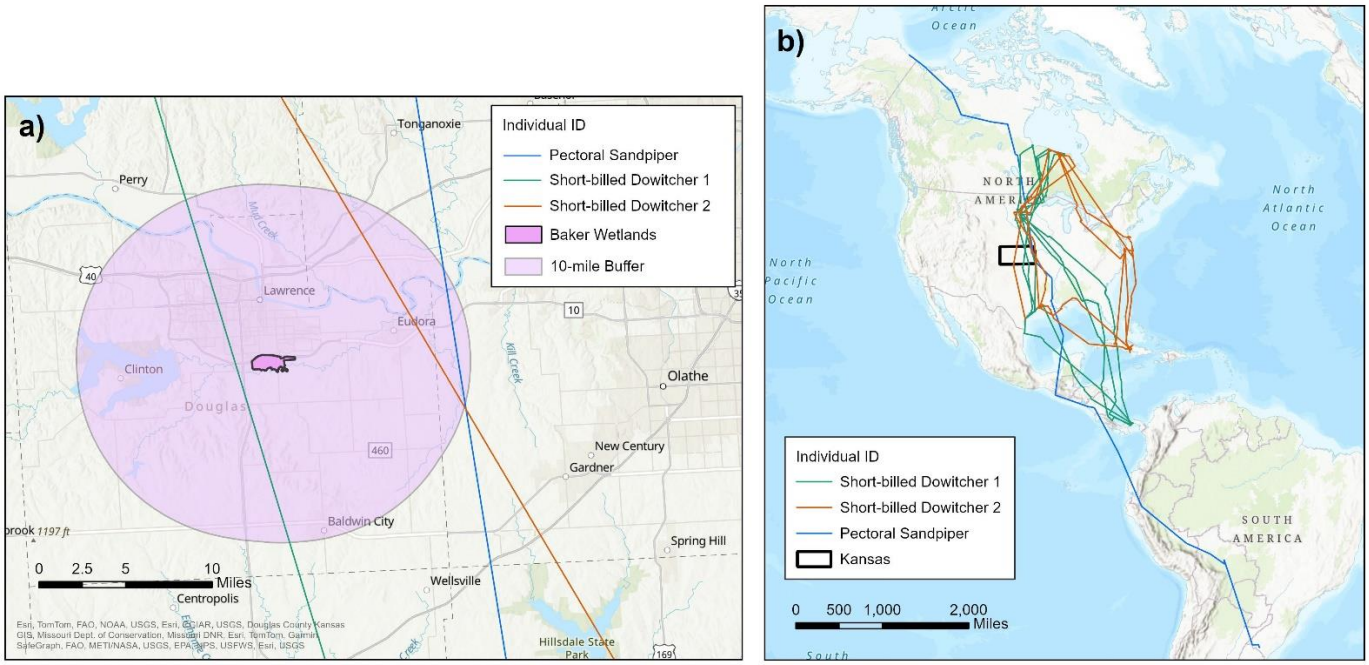

Figure 2. (a) An example of estimated movement paths (tracklines) of one Pectoral Sandpiper and two Short-billed Dowitcher within 10 miles of the Baker Wetlands. Tracklines were drawn between estimated tracking locations and do not represent the exact movement path of the bird. Tracklines for four Lesser Yellowlegs and one Long-billed Dowticher are not shown in this public-facing summary report due to the privacy settings of the datasets but were provided to KAWS for their internal planning use. Note that all tag transmissions occurred outside of this 10-mile buffer. **(b)** Annual cycle movements of the three individuals in Figure 2a. See page 14 for data contributor information.

Kansas-wide Tracking Data Summary

A total of **162** individuals of **13** species had tracked locations in the state of Kansas (*Table 1*, see **Figure 3** for gridded densities of the number of species and individuals tracked, respectively). Most shorebirds were tracked in the central and western portions of the state, primarily within the Central Great Plains, High Plains, and Southwestern Tablelands Ecoregions (**Figure 3**). Individuals were predominantly tracked in the state during migration, with peak northbound activity occurring from early April to late May, and peak southbound activity from late July to early September (**Figure 4**).

Table 1. Number of tracked shorebird individuals with data contributed to the Shorebird Collective with estimated movements in Kansas.

Common Name	Scientific Name	Tag Count
Black-bellied Plover	*Pluvialis squatarola*	2
Buff-breasted	*Calidris subruficollis*	35
Hudsonian Godwit	*Limosa haemastica*	15
Lesser Yellowlegs	*Tringa flavipes*	11
Long-billed Curlew	*Numenius americanus*	45
Long-billed Dowitcher	*Limnodromus scolopaceus*	12
Marbled Godwit*	*Limosa fedoa*	1
Mountain Plover	*Charadrius montanus*	5
Pectoral Sandpiper	*Calidris melanotos*	13
Short-billed Dowitcher	*Limnodromus griseus*	4
Stilt Sandpiper	*Calidris himantopus*	2
Upland Sandpiper	*Bartramia longicauda*	13
Whimbrel	*Numenius phaeopus*	4
	TOTAL	162

* Listed as a Species in Need of Conservation in the Kansas State Wildlife Action Plan (Rohweder 2022).

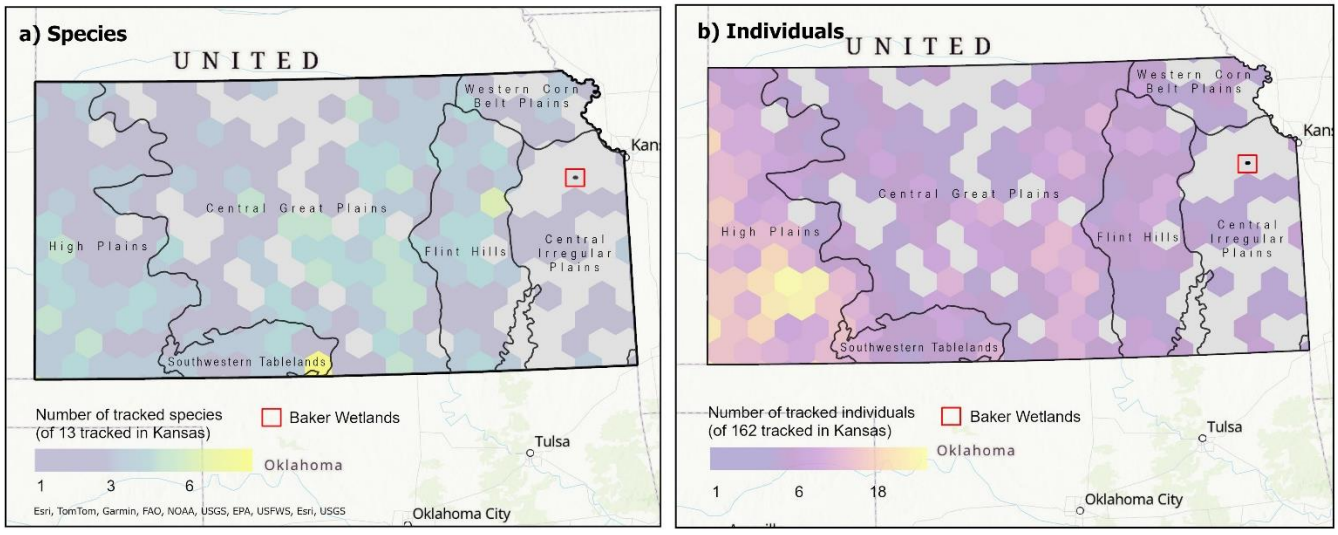

Figure 3. Gridded density maps of the number of shorebird species (**a**) and individuals (**b**) tracked with GPS or Argos satellite technologies per 30 x 30 km hexagonal cell across all seasons in the state of Kansas. Data were summarized at the original timestep of each tag and include tag transmissions that occurred during stops and flights. EPA Level III Ecoregions (U.S. EPA 2013) are also shown to provide additional context of the state's landscapes.

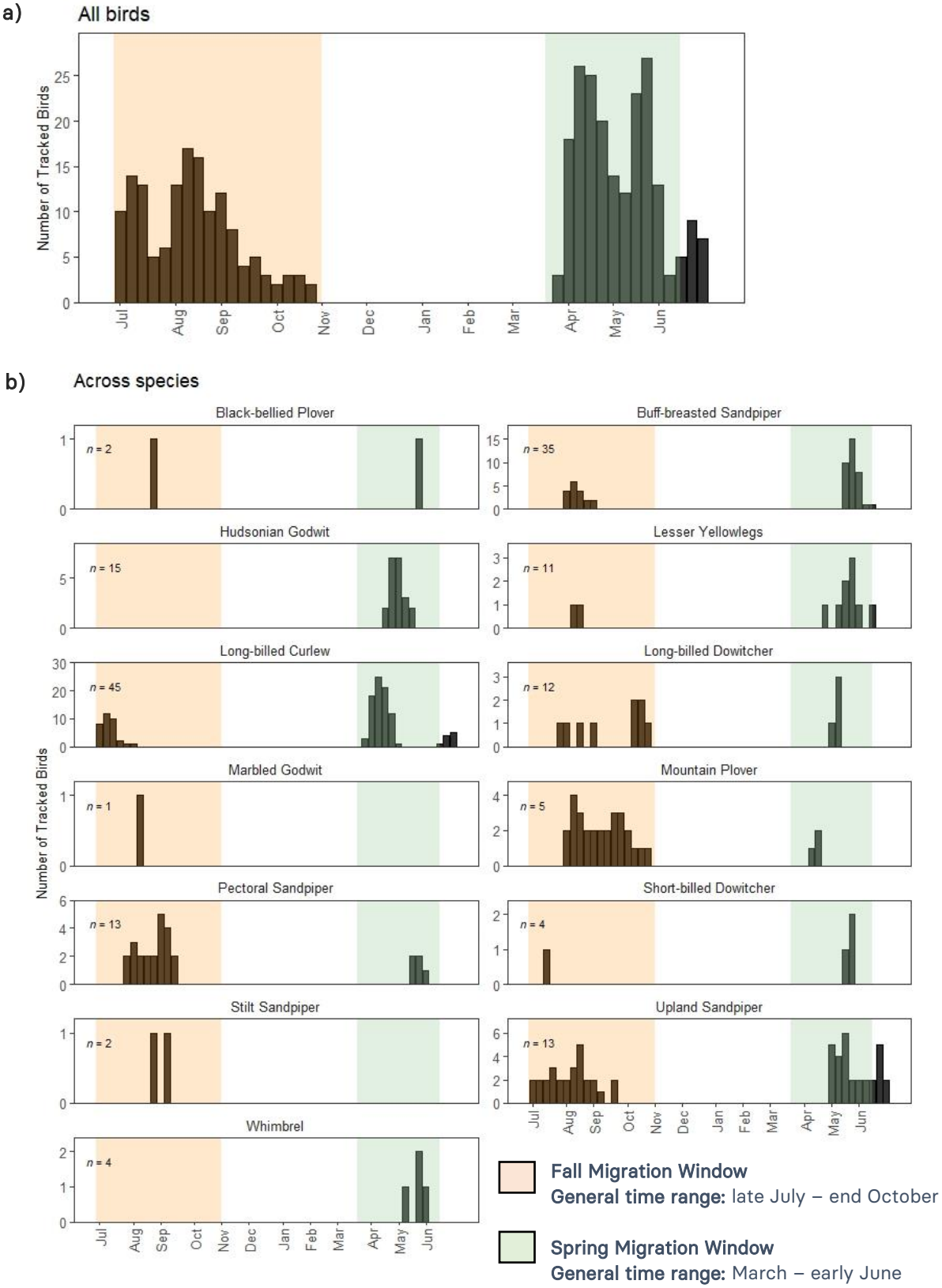

Figure 4. Timing of detections of all GPS and Argos satellite tracked shorebirds in Kansas combined **(a)** and across species **(b)**. Note that some individuals were detected in more than one year. Data include tag transmissions that occurred during both stops and flights. See page 14 for data contributor information.

Seasonal Timing for Water Management Activities

Shorebirds require shallow water (≤ 4 Inches) habitats with low vegetation for feeding and resting during their long migrations (Iglecia and Winn 2021). The creation of shallow water habitat at the right times of year through flooding or adjustment of water levels, when possible, can provide needed habitat for shorebirds. Based off the tracking data contributed to the Shorebird Collective, we provide a summary of the timing of shorebird movements in Kansas (**Figure 5**), and a set of recommendations for the timing of water management activities to create shallow flooded habitat for shorebirds in the state (**Table 2**). Ideally, management activities should take place two to four weeks prior to the expected arrival of shorebirds to allow the invertebrate population that shorebirds feed on to grow (Iglesia and Winn 2021).

Table 2. Recommendations for timing of water management activities in Kansas based off tracking data contributed to the Shorebird Collective.

Fall Water Management	Spring Water Management
➢ Ideally, the creation of shallow flooded habitat should take place **early July and sustained through October** to provide habitat for southbound migrant shorebirds. ➢ If possible, water should be sustained at levels suitable for shorebirds for as long as possible throughout the fall.	➢ Ideally, the creation of shallow flooded habitat should take place **early March and sustained through June** to provide habitat for northbound migrant shorebirds. ➢ If possible, water should be sustained at levels suitable for shorebirds for as long as possible throughout the spring and early summer. ➢ **Spring activities** have the potential to support a higher number of species because a subset of shorebird species only migrate through the region in spring.

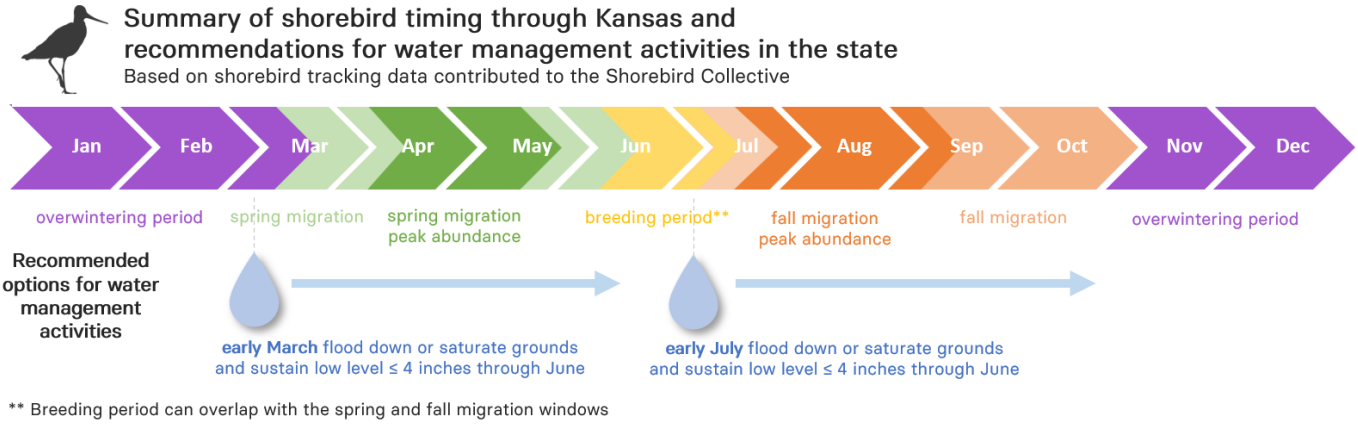

Figure 5. A simplified guide to the timing of shorebird migration and movements through Kansas and recommended times for the creation of shallow flooded habitat to support shorebirds.

Habitat Management Considerations

Water depths and density and height of vegetation are all critical factors to consider when managing habitats for shorebirds. Below we provide a set of shorebird habitat management recommendations for KAWS to consider when moving forward with their land management efforts.

Water Levels ≤ 4 Inches

Shallow water foraging areas are essential shorebird habitat. Most shorebird species require water depths **no more than 4 inches** for foraging and probing into the ground for food (Iglecia and Winn 2021). In areas where flooding can be controlled, water levels should be set and sustained at the shallow depths desired for shorebirds (preferred) or left to drain naturally if deeper depths are necessary. When possible, efforts should be taken to maintain these consistent low water levels after management activities are complete.

Minimal Vegetation

Flooded areas should be in **open landscapes** with **minimal to no vegetation** above the water line or in the surrounding area (Iglecia and Winn 2021). If flooding an area, stubble should be worked into the ground by chopping or disking, which speeds up decomposition and enhances the habitat by increasing invertebrate production (Elphick et al. 2010).

Other Habitat Considerations

Some shorebird species use upland habitats, agricultural fields, or may prefer for turf farms (such as Buff-breasted Sandpipers [Lanctot et al. 2010], a species that moves through the state during migration). If management activities in these habitats are of interest, the Shorebird Collective could work with KAWS to identify best management practices.

Images: 1. Flock of Long-billed Dowitchers, USFWS (CC); **2.** Hudsonian Godwits in shallowly flooded field, Krista Lundgren, USFWS (CC); **3.** Buff-breasted Sandpiper, Shiloh Schulte, USFWS (CC)

Kansas and Shorebirds

The state of Kansas is an important state for many shorebirds, providing critical breeding and/or stopover habitat for at least 38 North American shorebird species (Fellows at al. 2001). Common shorebird habitats in Kansas include short and tallgrass prairies, freshwater and saline wetlands, agricultural fields, playa lakes, rivers, reservoirs, and other shallow water sources (Fellows at al. 2001). Three Western Hemisphere Shorebird Reserve Network (WHSRN) sites[2] exist in the state, including Cheyenne Bottoms, Flint Hills, and Quivira National Wildlife Refuge (**Figure 6**). These sites provide important habitat for hundreds of thousands of individual shorebirds annually.

A major threat to shorebirds in the state is the alteration and loss of wetland habitat, paired with the challenge of unpredictable fluctuations of water levels and wetland conditions (Fellows et al. 2001). Nevertheless, many shorebirds are opportunistic and will find and use suitable habitat when it is created. Additionally, a significant portion of shorebird habitat falls on private lands in the state (Fellows et al. 2001), making landowners a key stakeholder for successful conservation.

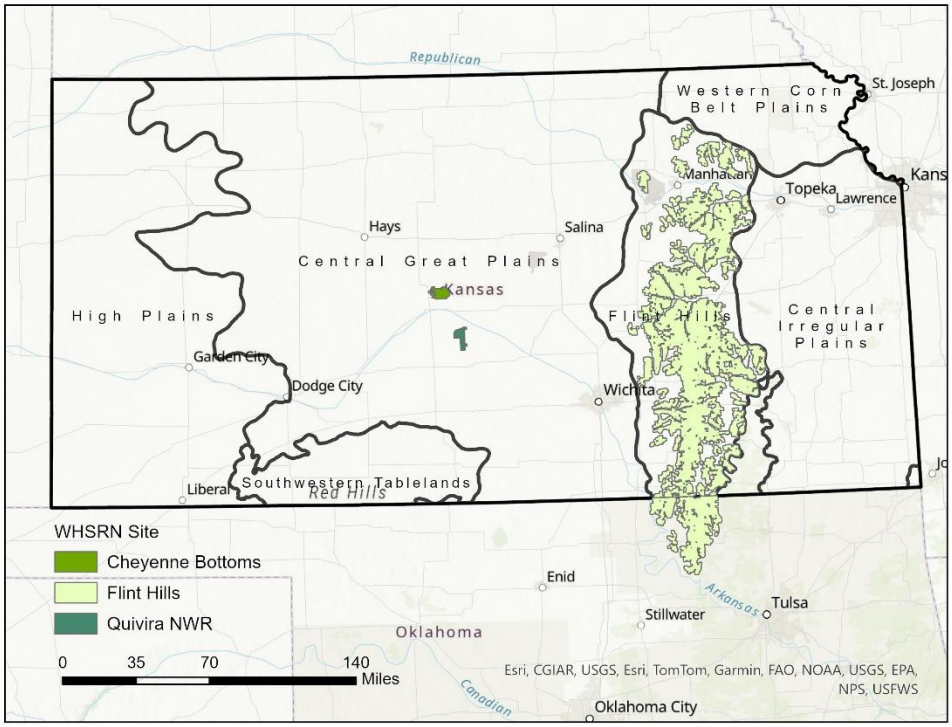

Figure 6. Map of WHSRN sites in Kansas. EPA Level III Ecoregions (U.S. EPA 2013) are also shown to provide additional context of the state's landscapes.

[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 125 WHSRN sites in 20 countries covering over 39.1 million acres of shorebird habitat across the Americas. Learn more at on WHSRN's website: web link to WHSRN's 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 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; 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 next to a shorebird scientist; Tim Romano, Smithsonian

Scientists attaching a GPS transmitter to a Red Knot 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 7**). 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 KAWS.

Black-bellied Plover (*Pluvialis squatarola*) with <5 g 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 contributed GPS and Argos satellite data to support KAWS' 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 7. 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 <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 analysis 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.

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

Lesser Yellowlegs: Data contributed by: Jim Johnson and Callie Gesmundo (U.S. Fish and Wildlife Service). Data co-owned by: Katie Christie (Alaska Department of Fish and Game), Laura McDuffie (U.S. Geological Survey, Alaska Science Center), Christian Friis, Benoit Laliberté, and Jennie Rausch (Canadian Wildlife Service, Environment and Climate Change Canada), Callie Gesmundo, James Johnson, and 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.
Long-billed Dowitcher: Data contributed by: Bart Kempenaers (Department of Ornithology, Max Planck Institute for Biological Intelligence). Data co-owned by: Eunbi Kwon (Department of Ornithology, Max Planck Institute for Biological Intelligence).
Pectoral Sandpiper: Data contributed by: Richard Lanctot (U.S. Fish and Wildlife Service). Data co-owned by: Sarah Saalfeld and Christopher Latty (U.S. Fish and Wildlife Service), Stephen Brown and Shiloh Schulte (Manomet Conservation Sciences), 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).
Short-billed Dowitcher: Data contributed by: Autumn-Lynn Harrison (Smithsonian Migratory Bird Center). Data co-owned by: David Newstead (Coastal Bend Bays & Estuaries Program).

The following data contributors provided summary information on shorebird movements in Kansas:

Black-bellied Plover: Data contributed by: Autumn-Lynn Harrison (Smithsonian Migratory Bird Center). Data co-owned by: Lee Tibbitts (U.S. Geological Survey, Alaska Science Center), David Newstead (Coastal Bend Bays & Estuaries Program).
Buff-breasted Sandpiper: Data contributed by: Lee Tibbitts (U.S. Geological Survey, Alaska Science Center). Data co-owned by: Richard Lanctot (U.S. Fish and Wildlife Service), Dave Douglas (U.S. Geological Survey, Alaska Science Center).
Hudsonian Godwit: Data contributed by: 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). Data co-owned by: Jennifer Linscott (University of South Carolina), Jorge Ruiz and Juan Navedo (Universidad Austral de Chile).
Lesser Yellowlegs: Data contributed by: Katie Christie (Alaska Department of Fish and Game). Data co-owned by: Jim Johnson (U.S. Fish and Wildlife Service).
Long-billed Curlew: Data contributed by: Lee Tibbitts and Daniel Ruthrauff (U.S. Geological Survey, Alaska Science Center), Andy Boyce and Autumn-Lynn Harrison (Smithsonian Migratory Bird Center), Alina Olalla Kerstupp (Universidad Autónoma de Nuevo León), Jay Carlisle (Intermountain Bird Observatory, Boise State University). Data co-owned by: Gary Page (Point Blue Conservation Science), Nils Warnock (Audubon Canyon Ranch), Dave Douglas (U.S. Geological Survey, Alaska Science Center), Jeff Kelly, Kate Goodenough, and Paula Cimprich (University of Oklahoma), José Ignacio González Rojas, Antonio Guzmán Velasco, and Gabriel Ruiz Aymá (Universidad Autónoma de Nuevo León), David Newstead (Coastal Bend Bays & Estuaries Program), David Bradley (Birds Canada), Stephanie Coates (Intermountain Bird Observatory, Boise State University).
Marbled Godwit: Data contributed by: Bridget Olson (U.S. Fish and Wildlife Service).
Mountain Plover: Data contributed by: Allison Pierce (University of Colorado Denver). Data co-owned by: Michael Wunder (University of Colorado Denver), Migratory Connectivity Project.
Pectoral Sandpiper: Data contributed by: Bart Kempenaers (Department of Ornithology, Max Planck Institute for Biological Intelligence). Data co-owned by: Mihai Valcu (Department of Ornithology, Max Planck Institute for Biological Intelligence).
Stilt Sandpiper: Data contributed by: Richard Lanctot (U.S. Fish and Wildlife Service). Data co-owned by: Kirsti Carr (Point Blue Conservation Science), Shiloh Schulte (Manomet Conservation Sciences), Sarah Hoepfner (Iowa State University), Philipp Maleko (University of Wisconsin-Madison), Sarah Saalfeld (U.S. Fish and Wildlife Service).
Upland Sandpiper: Data contributed by: Jason Hill (Vermont Center for Ecostudies), Jim Johnson and Callie Gesmundo (U.S. Fish and Wildlife Service). Data co-owned by: Rosalind Renfrew (Vermont Center for Ecostudies, Vermont Fish and Wildlife Department), Zachary Pohlen (U.S. Fish and Wildlife Service), Department of Defense - Joint Base Elmendorf-Richardson.
Whimbrel: Data contributed by: Jennie Rausch (Canadian Wildlife Service, Environment and Climate Change Canada). Data 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 Conservation Sciences), Julie Paquet (Canadian Wildlife Service, Environment and Climate Change Canada).

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