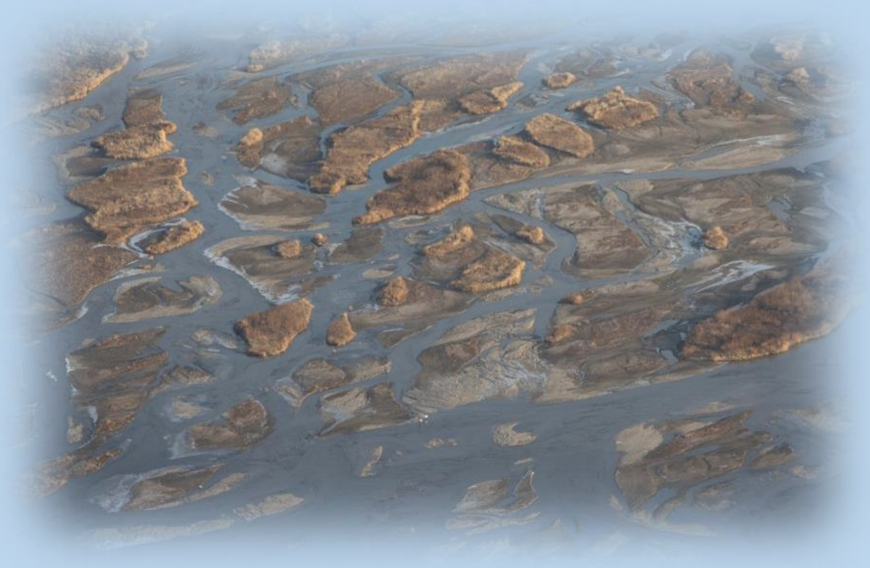
Platte River

Recovery Implementation Program:

IMPLEMENTATION OF THE WHOOPING CRANE MONITORING PROTOCOL

2022 FALL REPORT



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Preface

This is a report of the Platte River Recovery Implementation Program's (Program or PRRIP) monitoring and research efforts for whooping crane (WC, *Grus americana*) during the fall 2022 migratory season. The report was prepared to inform Program partners, licensing agencies, and the general public of our activities and to provide a seasonal summary of WC use of the Program's Associated Habitat Reach on the central Platte River. The data presented here will be integrated into multi-year analyses to inform habitat management decisions and provide benefits to WC that stop along the Program's AHR during migration.

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TABLE OF ABBREVIATIONS

AD	Adult
ACAS	Avian collision avoidance systems
AHR	Associated Habitat Reach
AKDE	Autocorrelated kernel density estimation
AM	Adaptive management
AMP	Adaptive Management Plan
AWB	Aransas-Wood Buffalo
cfs	Cubic feet per second
CSRT	Chapman secondary return transect
EBQ	Extension Big Question
EDO	Executive Director's Office
ESRT	Elm Creek secondary return transect
FA	Fall
Fig(s)	Figure
ft	Feet or foot
GC	Governance Committee
GPS	Global positioning system
ID	Identification
ISAC	Independent Scientific Advisory Committee
Juv	Juvenile
km	Kilometer
LAC	Land Advisory Committee
m	Meters
MPH	Miles per hour
MUCW	Maximum width unobstructed by dense vegetation
MUOCW	Maximum unobstructed channel width
NE	Nebraska
NF	Nearest forest
Opp	Opportunistic
PRRIP or Program	Platte River Recovery Implementation Program
PWRTE	Primary wetland return transect east
PWRTW	Primary wetland return transect west
QA/QC	Quality assurance/quality control
SP	Spring
Sys	Systematic
TAC	Technical Advisory Committee
TUCW	Total unvegetated channel width
UFCW	Unforested corridor width
UOCW	Unobstructed channel width
US	United States
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

UTM	Universal Traverse Mercator
WC	Whooping crane, *Grus americana*
WSRT	Wood River secondary return transect
0SE	East river transect
0SW	West river transect

Executive Summary

The Executive Director's Office (EDO) of the Platte River Recovery Implementation Program ("Program" or "PRRIP") conducted whooping crane monitoring along PRRIP's Associated Habitat Reach (AHR) on the central Platte River during the fall 2022 migration in accordance with *Platte River Recovery Implementation Program – Whooping Crane Monitoring Protocol – Migrational Habitat Use in the Central Platte River Valley rev. June 2017*. Fall migration monitoring took place from October 9th through November 18th, 2022. During the 41-day monitoring period, surveys were conducted using systematic flight transects along the Platte River from Chapman to Lexington, NE. Of the 76 scheduled flights typical of a 38-day fall monitoring season, 66 (86.8%) were completed. To finalize data collection for whooping cranes remaining within the survey area beyond the usual November 15th cutoff, an additional three days of monitoring were conducted resulting in the completion of an additional five systematic monitoring flights. Systematic and opportunistic sightings resulted in the observation of 3 crane groups including 6 individual whooping cranes or 1.10% of the estimated Aransas – Wood Buffalo (AWB) migratory whooping crane population. Streamflow in the Platte River ranged from 21.9-1860 cfs (cubic feet per second) during the monitoring period. For the first crane group observed, instantaneous discharge at the nearest gaging station at the time of the observation was 128 cfs (discharge data are provisional). Two of the three crane groups observed this season were present at a time when the nearest gaging station was affected by ice. Unobstructed channel width at whooping crane use sites averaged 614 feet and distance to nearest forest averaged 570 feet. Information from this monitoring effort will be used to help evaluate the biological response of whooping cranes to the water and land management activities of the Program.

Introduction

The Program is responsible for implementing certain aspects of the endangered whooping crane (*Grus americana*) recovery plan. In 2007, the Platte River Recovery Implementation Program (Program or PRRIP) began its 13-year First Increment and implementation of an Adaptive Management Plan (AMP) to learn more about the physical processes of the central Platte River and the response of whooping crane (WC, *Grus americana*) to Program management of land and water along the central Platte River. In 2020 the Program began a 13-year Extension of the First Increment to continue the work being done and gather additional information to inform decisions for management of whooping crane habitat along the Program's 90-mile Associated Habitat Reach (AHR) from Lexington to Chapman, NE. The Program's original AMP was updated in 2022 as an Extension Science Plan (PRRIP 2022), providing a concise and practical roadmap of Program science priorities during the Extension.

Management objectives and indicators

The specific management objective for the whooping crane and indicators related to that objective, as noted in the 2006 First Increment AMP remain the same throughout the First Increment Extension. The Program's management objective for the whooping crane is to *contribute to the survival of whooping cranes during migration* (PRRIP 2021a). Performance indicators include:

- Increase area of suitable roosting and foraging habitat,
- Increase crane use days, and
- Increase proportion of whooping crane population use.

Priority hypotheses and Extension Big Questions

Several critical scientific and technical uncertainties about physical processes and the response of whooping cranes to management actions will be the focus of the application of rigorous adaptive management in the First Increment Extension through implementation of the Program's Extension Science Plan. These uncertainties are captured in statements of broad hypotheses in Table 1 on pages 8-9 of the Extension Science Plan (PRRIP 2022) and, as a means of better linking science learning to Program decision-making, those uncertainties comprise a set of "Extension Big Questions" that provide a template for linking specific hypotheses and performance measures to management objectives and overall Program goals (see PRRIP 2017a, PRRIP 2020).

Three Extension "Big Questions" (EBQs) relate directly to measuring whooping crane response to Program management:

- ***EBQ #4* –** What factors influence WC decision to stop or fly over the AHR?
- ***EBQ #5* –** What factors influence WC stopover length within the AHR?
- ***EBQ #6* –** Why is spring WC use of the AHR greater than fall WC use?

To gather information to reduce remaining uncertainties about whooping cranes during the Extension, several finer-scale priority management hypotheses were developed by Program participants to focus on the influence of river discharge for WC decision-making. Underlying physical process hypotheses were developed in support of the management hypotheses to explain how discharge interacts with channel morphology to provide suitable WC roosting habitat. Broader scope alternatives were also posed for investigation as potential factors affecting whooping crane behavior.

For whooping cranes, those hypotheses are:

Extension Big Question #4: What factors influence WC decision to stop or fly over the AHR?

Management Hypothesis: Probability of WC stopping within the AHR is a function of discharge.

Underlying Physical Processes Hypothesis – The probability of a WC stopover is a function of the relationship between wetted width and the percent of the channel that is of suitable depth for roosting (< 1 ft deep).

Alternative Hypotheses:

- Time of day is the primary driver of WC stopovers with probability of use increasing with decreasing time until dark.
- The probability of WC stopping over is a function of MUCW and unforested corridor width.
- The probability of WC stopping over is a function of land cover or habitat suitability within a biologically relevant radius of flyover location.
- Weather (wind speed and direction, precipitation, temperature) encountered since the last stopover is an important predictor of WC stopovers with the probability of use of the AHR increasing as weather conditions become less favorable for flight.
- Length of stay at previous stopover (inverse relationship) and distance traveled since last stopover (direct relationship) are important predictors of WC stopovers.
- Point in migration (proportion of migration completed) is an important predictor of WC stopovers with the probability of use of the AHR demonstrating a quadratic relationship with proportion of migration completed.

Extension Big Question #5: What factors influence WC stopover length within the AHR?

Management Hypothesis: Length of WC stopover within the AHR is a function of discharge.

Underlying Physical Processes Hypothesis – WC stopover length is a function of the relationship between wetted width and the percent of the channel that is of suitable depth for roosting (< 1 ft deep).

Alternative Hypotheses:

- Length of stay within the AHR has an inverse relationship with length of stay at the previous stopover and a direct relationship with distance traveled since last stopover.
- WC stopover length is inversely related to daily variability in flow.
- WC stopover length is a function of MUCW and unforested corridor width.
- WC stopover length is a function of land cover or habitat suitability within a biologically relevant radius of use location.
- Weather (wind speed and direction, precipitation, temperature) is an important predictor of WC stopover length with the length of stay within the AHR increasing as weather conditions become less favorable for flight.
- The length of a WC stopover within the AHR is longer during the Fall migration. Stopover length within the AHR recapitulates the overall migratory pattern with longer Fall stopovers than Spring stopovers.
- Point in migration (proportion of migration completed) is an important predictor of WC stopover length with stopover length demonstrating a quadratic relationship with proportion of migration completed.
- WC group size, composition (adults, sub-adults, juveniles), and whether or not they are associated with sandhill cranes are important predictors of WC stopover length.

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Extension Big Question #6: Why is Spring WC use of the AHR greater than Fall use?

Management Hypothesis: WC use of the AHR in the Spring is greater than during the Fall due to higher flows during the Spring.

Underlying Physical Processes Hypothesis – WC use of the AHR is a function of the relationship between wetted width and the percent of the channel that is of suitable depth for roosting (<1 ft deep).

Alternative Hypotheses:

- WC use of the AHR in the Spring is greater because WC do not stage in other areas prior to reaching the Platte, WC are further along in migration when they arrive, distance traveled since last stopover is longer, and stay length at previous stopovers is shorter when compared to Fall migration.
- WC stay longer in the AHR during Spring migration because daily variability in flow is lower.
- WC use of the AHR in the Spring is greater because proportional wetland landcover is greater.
- WC use of the AHR in the Spring is greater due to more expansive unobstructed views (wider MUCW, reduced vegetation cover, lower vegetation heights, trees without leaves) that together increase perceived area of both on and off-channel suitable habitat during this period when compared with the Fall
- WC use of the AHR in the Spring is greater because they encounter the AHR later in the day during this migratory season than they do during the Fall migratory season, increasing the probability of a stopover.
- WC use of the AHR in the Spring is greater because weather (wind speed and direction, precipitation, temperature) conditions are less favorable for flight (heading into colder conditions, not away from them).

- WC use of the AHR in the Spring is greater because group sizes are larger, more numerous and longer stopovers by juveniles and subadults (non-reproductive), and because of the presence of sandhill cranes (more abundant with longer stopovers within the AHR in the Spring).

Implementation of the whooping crane monitoring protocol is intended to provide the systematically-collected whooping crane use and habitat (i.e., landscape level attributes at roost sites and diurnal use sites) data necessary to test whooping crane hypotheses posed for the Extension as well as check in on First Increment hypotheses (PRRIP 2021b), evaluate learning related to the Program's Big Questions, and ultimately assess progress toward meeting the whooping crane management objective (PRRIP 2017a, PRRIP 2020).

The Program's whooping crane monitoring protocol includes two major components (PRRIP 2017b):

1) Detect and confirm whooping crane stopovers in the study area through systematic targeted aerial surveys of river channel and palustrine wetland habitat within the 90-mile Associated Habitat Reach (AHR). Stopover data is used to comparatively evaluate changes in the frequency and distribution of stopovers within the study area over time.
2) Collect landscape-level habitat data at use locations. Habitat data is used for resource selection analyses and other analyses intended to inform Program habitat creation and maintenance activities.

Whooping crane observations, proportion of the Aransas - Wood Buffalo (AWB) population observed using the AHR, number of days cranes use the AHR, use locations and associated habitat metrics resulting from survey efforts are summarized in this report for the fall 2022 migratory season. Maps and aerial photographs for observed crane groups provide further context. Effort dedicated to both systematic and opportunistic efforts and resulting observations are also summarized. Detection probabilities resulting from aerial sightings of known decoy placements are reported. No incidental take occurred as a result of the implementation of the fall 2022 monitoring protocol.

Previous data and analyses are included in seasonal reports produced by the Platte River Cooperative Agreement (2001-2006) and the Program (2007-present) and are available in the Program's online Public Library (https://platteriverprogram.org/program-library), located by selecting Whooping Crane as the target species and using Monitoring Report as the Title Keyword Search terms. Long-term monitoring and research are used to evaluate progress toward the management objective and to support adaptive management decisions related to our target species (see Appendix B which provides a synthesis of past Program research and published literature relevant to Program objectives). Data collected by the Program are available in published form or upon request for use by other programs to provide information on whooping crane use of the central Platte River that may be helpful for broader scale interpretation of migratory habitat use and factors to be considered when making management decisions.

Methods

The typical fall monitoring period is a 38-day season occurring from October 9th to November 15th. Due to continued presence of whooping cranes within the AHR, the survey period was extended three days to include October 9th through November 18th. The PRRIP EDO conducted fall 2022 migration monitoring in accordance with the *Platte River Recovery Implementation Program – Whooping Crane Monitoring Protocol – Migrational Habitat Use in the Central Platte River Valley rev. June 2017* (PRRIP 2017b). General methods are described below.

Study area

The area of study (Figs. 1-2) is the Program's AHR, extending from the Highway 283 Platte River bridge near Lexington, Nebraska (40˚ 44' 08.15" N; 99˚ 44' 37.31" W) to the Platte River bridge near Chapman, Nebraska (40˚ 59' 07.06" N; 98˚ 08' 40.40" W) focusing on Platte River channels and adjacent wetlands and ponds within 3.5 miles of the river channel(s). The monitoring area encompasses a total of approximately 90 linear miles of river.

Systematic flight transects

Two Cessna 172 aircraft, each crewed by a pilot and two observers, were used to make aerial observations along predetermined systematic flight transects. The pilot utilized a GPS unit to follow the pre-loaded route and track miles flown. Systematic aerial transects were flown daily, conditions permitting, at an air speed of approximately 100 MPH and an altitude of approximately 750 feet, unless conditions demanded higher altitudes. Two flights were initiated each morning, one from Grand Island (east route, shown in red on Figs. 1-2) and one from Kearney (west route, shown in green on Figs.1-2). Planes were required to be at transect starting points ½ hour before sunrise. Flights were typically completed in less than two hours. In the event of adverse weather, crews were able to wait up to two hours after sunrise for conditions to improve before cancelling the flight. Pilots were also able to cancel flights the night before or morning of a flight if they judged weather to be unsuitable for flying.

Two types of transects were flown to ensure coverage of both on-channel riverine and off-channel wetland habitat. On-channel river transects (0SE and 0SW, river shown in blue on Figs. 1-2) were flown east to west and the plane was oriented south of the southern-most river channel to reduce the effect of sun glare. Starting points along riverine transects were alternated daily between two flight routes to allow different sections of the study area to be observed as early as possible in the flight times. Off-channel transects (in red and green on Figs. 1-2) were designed to sample existing off-channel habitat within the 3.5-mile limit, as well as to serve as functional routes for planes to return to starting airports.

Route 1 (Fig. 1)**:** Transects began at Minden bridge and Chapman bridge and followed the southern channel of the Platte River (0SW and 0SE shown in blue) ending at Lexington bridge and Minden bridge, respectively. The primary wetland return transects (PWRTW, PWRTE) were then flown back east, along with one secondary transect (CSRT) in the east route, to get back to the airports.

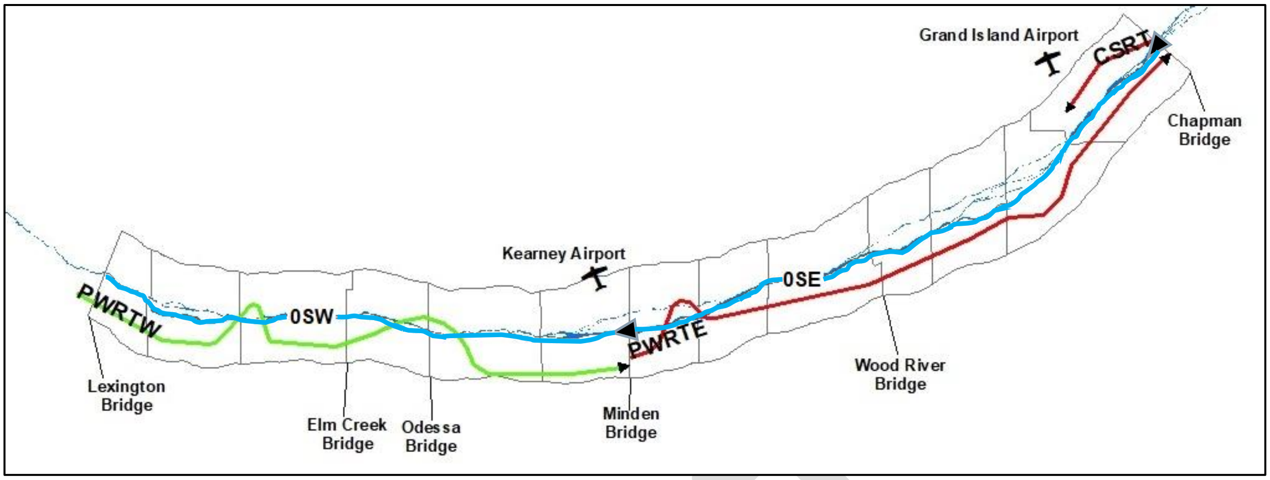

Figure 1. Route 1 east and west flight transects. Black and grey triangles indicate starting points. River channel transect shown in blue (0SW,0SE). West primary wetland return transect (PWRTW) is shown as a green line. East primary wetland return transect (PWRTE) and secondary return transect (CRST) are shown as red lines.

Route 2 (Fig. 2)**:** Transects began at the midpoint of the 0SW and 0SE river channel transects (Odessa bridge and Wood River bridge, respectively). The west half of the river transects were flown first and ended at Lexington and Minden bridges. The primary wetland return transects (PWRTW, PWRTE) were then flown back east ending at Minden bridge and Chapman bridge. Once the primary return transects were completed, the east half the river channel transects were then completed and ended at Odessa bridge and Wood River bridge. To return to the airports, secondary return transects (ESRT, WSRT) were then flown east from Elm Creek (Hwy 183) and Wood River bridges.

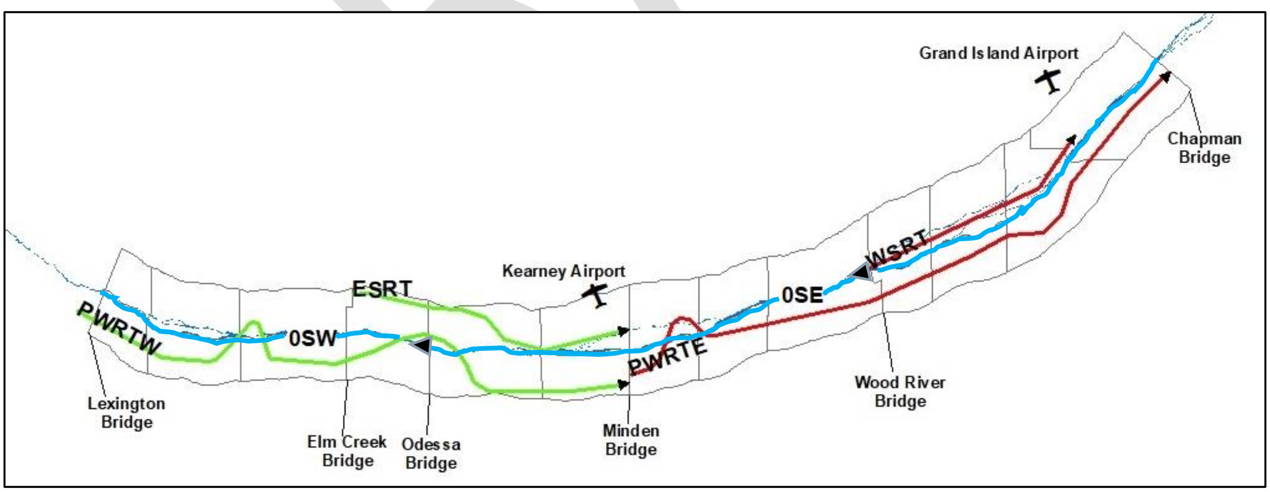

Figure 2. Route 2 east and west flight transects. Black and grey triangles indicate starting points. River channel transect shown in blue (0SW,0SE). West primary wetland return transect (PWRTW) and secondary return transect (ESRT) are shown as green lines. East primary wetland return transect (PWRTE) and secondary return transect (WRST) are shown as red lines.

Observations and data collection

At the beginning of each transect and at turn around points, the aerial crews relayed their position via mobile phone to the nearby ground crews so they could stay in relative proximity. The aerial observers utilized binoculars for sighting and a Canon Rebel T6s 760D camera for photo documentation. If an aerial crew spotted potential whooping crane(s), aerial photographs were taken of them along with the surrounding area to later confirm the identity and location. If additional observations for confirmation were needed, aerial crew contacted the nearest ground observer via mobile phone, who then positioned themselves to make a positive identification of the crane(s) without disturbing them. The U.S. Fish and Wildlife Service (USFWS) were notified of daily survey results following the completion of both flights.

In addition to systematic flights, the aerial and ground crews also confirmed and reported opportunistic sightings. Immediately after receiving a report, either a plane was deployed from the nearest airport and/or ground personnel surveyed the area until the crane(s) were located and confirmed, or sufficient search time was allocated to confirm the cranes had left and/or were not present in the immediate area.

Aerial and ground crews used photographs and data sheets to document their observations of whooping crane groups, documenting numbers and age category of individuals, location, habitat type, time, and date of observation. A crane group was defined as one or more whooping cranes observed at one location. Each crane group was given a unique crane group ID (e.g., 2022FA01 = year-season-number) at sighting and was re-labeled as a new group and given a new crane group ID the next day if it was observed again. Aerial flight logs and ground search data sheets were used to document time and mileage devoted to searching for and identifying whooping cranes. Universal Transverse Mercator (UTM) coordinates within UTM Zone 14N were determined for each crane group utilizing satellite imagery with a Geographic Information System (GIS) in conjunction with observation photos and location descriptions from datasheets. Use sites were given a numerical value at the time of sighting if the crane group was observed in a riverine, lacustrine, or palustrine environment. Crane groups sighted outside of these environments were not assigned a use site number, but rather the location's appropriate land cover classification was recorded or denominated as "AIR" if the group was sighted while in flight. All data were later transcribed from the completed data sheets directly to the PRRIP species database. Data were then subjected to Quality Assurance/Quality Control (QA/QC) checks by the EDO to ensure accuracy.

Results

Whooping Crane Observations and Associated Habitat Metrics

Confirmed whooping crane sightings

PRRIP monitoring identified 6 individual whooping cranes within 3 unique groups through 5 systematic and opportunistic observations, including second observations of the same group on the same day. Details of each observation can be found in Appendix A.

USFWS/PRRIP data comparison

Table 1 provides a comparison of PRRIP monitoring results and USFWS whooping crane public sighting database (provided by Matt Rabbe – USFWS whooping crane lead) for the fall 2022 migration. The table includes PRRIP icons associated with each unique crane group, PRRIP/USFWS identification (ID) numbers assigned to the respective groups, the date(s) the group was observed, the number of individuals in the group (adults and juveniles), and crane use days for each group. The difference in group ID numbers is due to the USFWS data operating on an "initial sighting" basis of identification, whereas PRRIP assigns a new crane group ID number each day a group is observed.

Table 1 crane use days are calculated for PRRIP observations by multiplying the number of individual cranes in each group by the number of days the group was present, plus one day per crane if the initial observation is made before noon. This is because each crane observed during early morning PRRIP aerial surveys is assumed to have been present the evening prior to the morning of the first observation. Since public sightings occur throughout the day, an additional day per crane is added to USFWS public sightings only for observations made before noon. On the rare occasion that PRRIP's initial observation of a group occurs in the evening (e.g. opportunistic flight or ground surveys to get a final count for the day while the cranes are on the river in the case of a morning flight cancelation), an additional use day is not added for the day prior to this observation. PRRIP crane use days includes observations made within the designated systematic survey period and any extensions of that survey period due to continued observed crane presence within the AHR as per the Program's monitoring protocol. PRRIP crane use days includes days when crane groups are not observed by PRRIP if they fall between PRRIP observations of that group, assuming the group did not leave and return and that it is the same group. Unique groups are typically individually identifiable by their arrival date, location, and group composition. PRRIP coordinates with USFWS to determine unique groups. USFWS data are not used to calculate PRRIP crane use days, such that groups not observed by PRRIP and dates that groups were observed by USFWS prior to or after PRRIP observations are not included in the calculation of PRRIP crane use days.

Table 1. Comparison of PRRIP and USFWS whooping crane (WC) sightings including: PRRIP group icon, PRRIP and USFWS group identification (ID), dates present, number and age category (adults (Ad) : juveniles (Juv)) of individuals, and crane use days.

PRRIP						**USFWS**				
Unique Group Icon	**Group ID**	**Dates Present**	**Use Days = (Days Present x Cranes) + 1 day per crane on first day observed**			**Group ID**	**Dates Present**	**Use Days = (Days Present x Cranes) + 1 day per crane on first day observed**		
			# of WC Ad:Juv	**Days Present**	**Use Days**			**# of WC Ad:Juv**	**Days Present**	**Use Days**
	2022FA01	10/31	1:0	1	2	22B-12	10/31	1:0	1	2
	2022FA02	11/15	2:0	1	4	22B-55	11/15	2:0	1	4
	2022FA03	11/15	2:1	1	6	22B-54	11/15	2:1	1	6
Totals			**5:1**		**12**	**Totals**		**5:1**		**12**

There were no instances this fall where USFWS reported a crane group in the AHR that was not observed by PRRIP and therefore PRRIP and USFWS data sets agree on number of cranes and crane use days. They calculated a total of 12 crane use days during the 2022 fall survey period (Table 1). Since 2007, crane use days for fall migration have ranged from 8 - 522 days (average 82.13 days). To determine whether fall crane use days demonstrate a long-term trend (either increasing or decreasing over time), we computed a non-parametric Spearman's rank correlation to assess the relationship between fall crane use days and year from 2007-2022. This non-parametric test is more appropriate given the large amount of annual variability in fall crane use days that leads to poor fit of a linear regression model. There was no significant correlation of fall crane use days with year (r(14) = 0.39, p-value = 0.14)) at an alpha level of 0.05 (Fig. 3), indicating no significant long-term trend.

Proportion of population

According to the most recent survey conducted by the USFWS during the winter of 2021-2022, the AWB migratory whooping crane population was estimated to be 543 birds (95% CI: 426.5 – 781.8; USFWS 2022). The 6 individuals (5:1) observed by PRRIP during both systematic and opportunistic monitoring efforts in the fall 2022 season constitute approximately 1.10% of the estimated migratory population. This proportion will be updated when the 2022-2023 USFWS winter survey results are published.

PRRIP observed whooping crane use of the central Platte River during fall surveys of the AHR has varied from year to year (Fig. 3). Since the initiation of PRRIP monitoring efforts in 2007, the estimated proportion of the AWB population observed on the central Platte River through implementation of the PRRIP monitoring protocol in the fall has ranged from 0.99% - 16.21% (average 4.71%). To determine whether the proportion of the AWB population using the AHR in the fall demonstrates a long-term trend (either increasing or decreasing over time), we computed a non-parametric Spearman's rank correlation to assess the relationship between fall proportion and year from 2007-2022. There was no significant correlation of fall proportion with year (r(13) = 0.071, p-value = 0.80)) at an alpha level of 0.05 (Fig. 3), indicating no significant long-term trend. This analysis will be redone when the USFWS winter survey results are published.

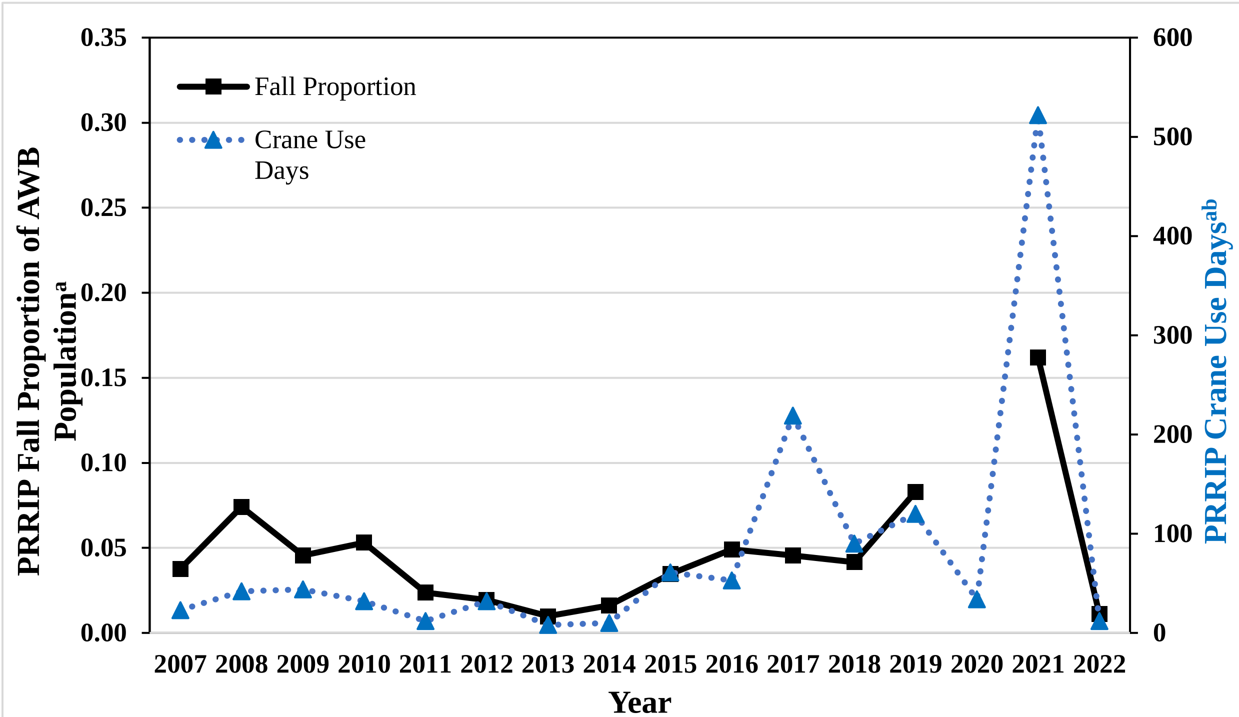

Figure 3. Annual proportion of the estimated AWB whooping crane population (black squares) and number of crane use days (blue triangles) observed during PRRIP aerial systematic and opportunistic fall migration surveys from 2007-2022. Lack of a 2020-2021 USFWS winter survey of the AWB population prevents calculation of proportion of AWB population using the AHR for Fall 2020.

[a]Current figure reflects inclusion of PRRIP observations from the 2013 winter survey of the AHR that were previously excluded though they fall within the current PRRIP monitoring period or during an extension of that period due to continued crane presence as per PRRIP's monitoring protocol, adding a single WC observed over three crane use days to the Fall 2012 data point for both proportion of the population and crane use days.

[b]Crane use days have been retrospectively recalculated to reflect current protocol (see above) for calculation of crane use days in an effort to make these data comparable over the long term from 2007-2022. Crane use days presented in previous reports have used varying protocols for calculation of this metric over time (e.g., adding a day prior to initial observation or a day following an evening observation, or not; including days for which crane groups were not observed if they fall between observation dates, or not; inclusion of observation days outside of the survey period; or not; inclusion of observations not made or confirmed by PRRIP, or not; etc.).

Streamflow and unobstructed channel width at whooping crane use locations

During the fall 2022 whooping crane migration monitoring period, Platte River flow in the AHR ranged from a low of 21.9 cubic feet per second (cfs) at Grand Island on 10/18/22 (USGS 2022d) to a high of 1,860 cfs at Overton on 11/10/22 (USGS 2022a). Instantaneous discharge at the nearest gaging station at the time crane group 22B-12 / 2022FA01 was observed was 128 cfs. The gage at Grand Island was affected by ice on 11/15 when crane groups 22B-55 / 2022FA02 and 22B-54 / 2022FA03 were present (Table 2). Discharge data are provisional and will be updated when approved by USGS.

Table 2. In-channel crane group use sites and associated streamflow discharge (cfs) from nearest gaging station and time of observation.

Unique Group Icon	USFWS Group ID	PRRIP Group ID	# of Cranes Adults:Juv	Use Site #	Date	Gaging station[a]	Discharge (cfs)
	22B-12	2022FA01	1:0	1	10/31/22	Kearney	128
	22B-55	2022FA02	2:0	2	11/15/22	Grand Island	ICE
	22B-54	2022FA03	2:1	3	11/15/22	Grand Island	ICE

[a]Gaging Stations: Kearney (USGS 2022c) and Grand Island (USGS 2022d). Discharge data are provisional and will be updated when approved by USGS.

Figs. 4-7 display discharge during the fall 2022 monitoring period at USGS river gages located at Overton (USGS 2022a), Cottonwood Ranch (USGS 2022b), Kearney (USGS 2022c), and Grand Island (USGS 2022d). The daily number of cranes observed for each crane group are displayed in stacked bars.

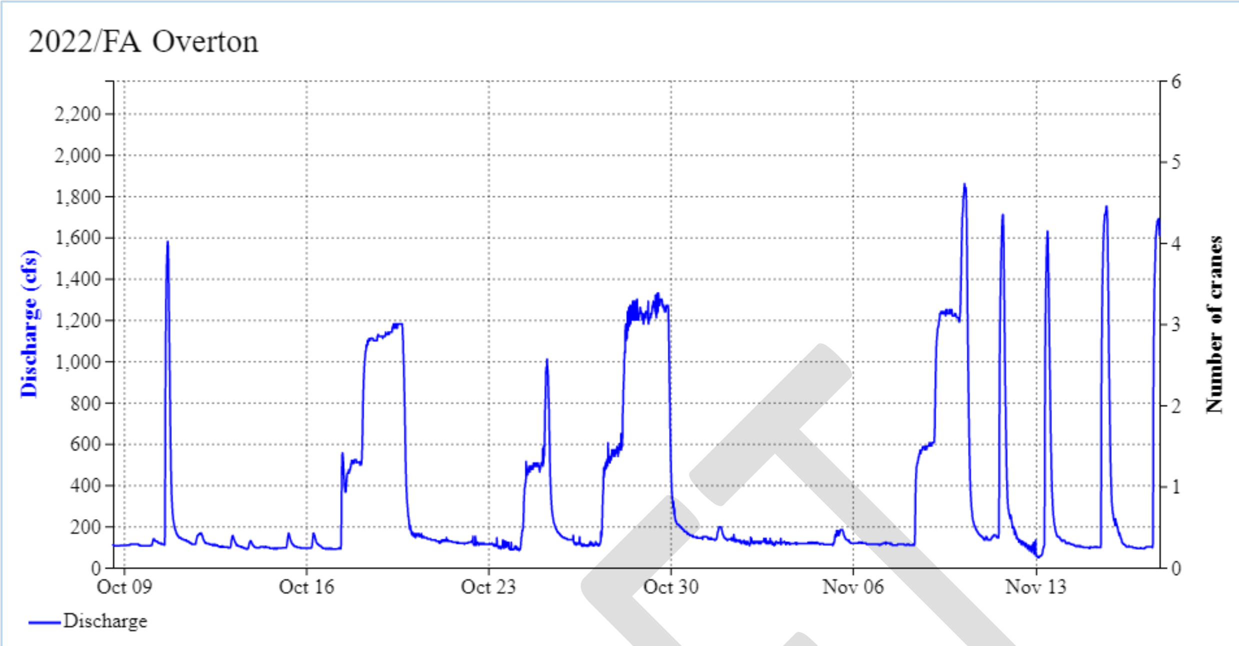

Figure 4. Discharge (blue line) at the Overton gage from 10/9 – 11/18 (USGS 2022a). No whooping cranes were observed either on or off-channel at locations for which the Overton gage was the closest gaging station. Discharge data are provisional until USGS updates with corrections.

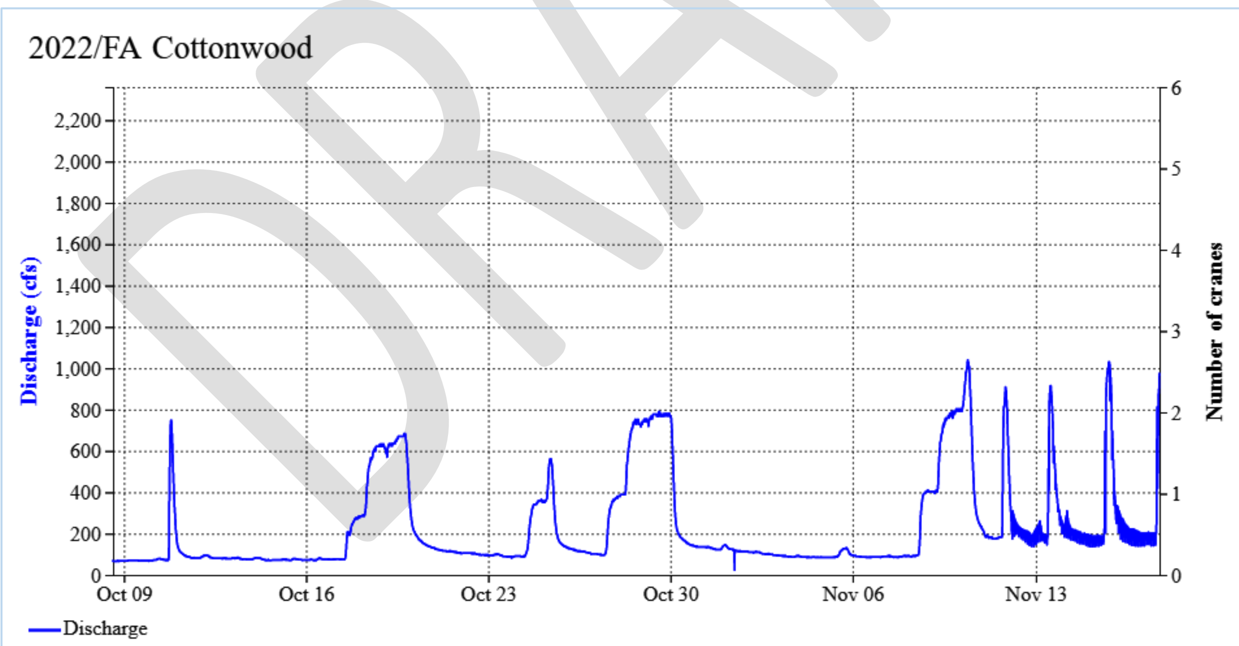

Figure 5. Discharge (blue line) at the Cottonwood gage from 10/9– 11/18 (USGS 2022b). No whooping cranes were observed either on or off-channel at locations for which the Overton gage was the closest gaging station. Discharge data are provisional until USGS updates with corrections.

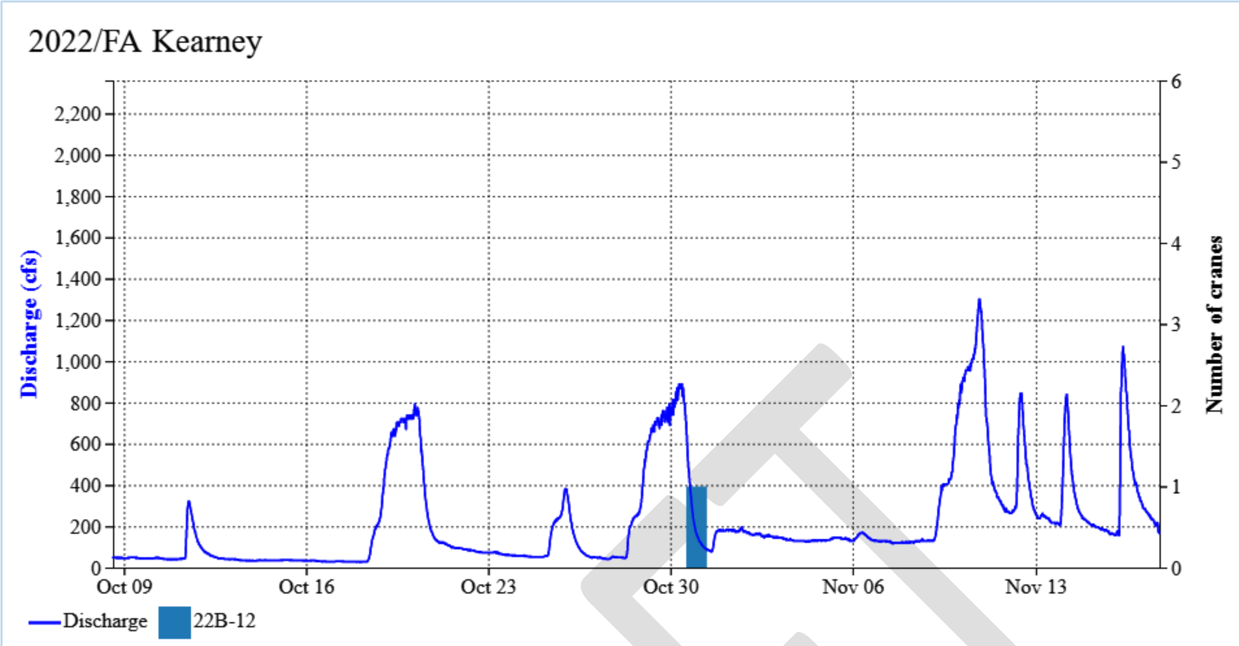

Figure 6. Discharge (blue line) at the Kearney gage from 10/9 – 11/18 (USGS 2022c) and numbers of whooping cranes from each group (USFWS 22B-12 / PRRIP 2022FA01 in colored bars) observed on the indicated dates either on- or off-channel at locations for which Kearney was the nearest gaging station. Discharge data are provisional until USGS updates with corrections.

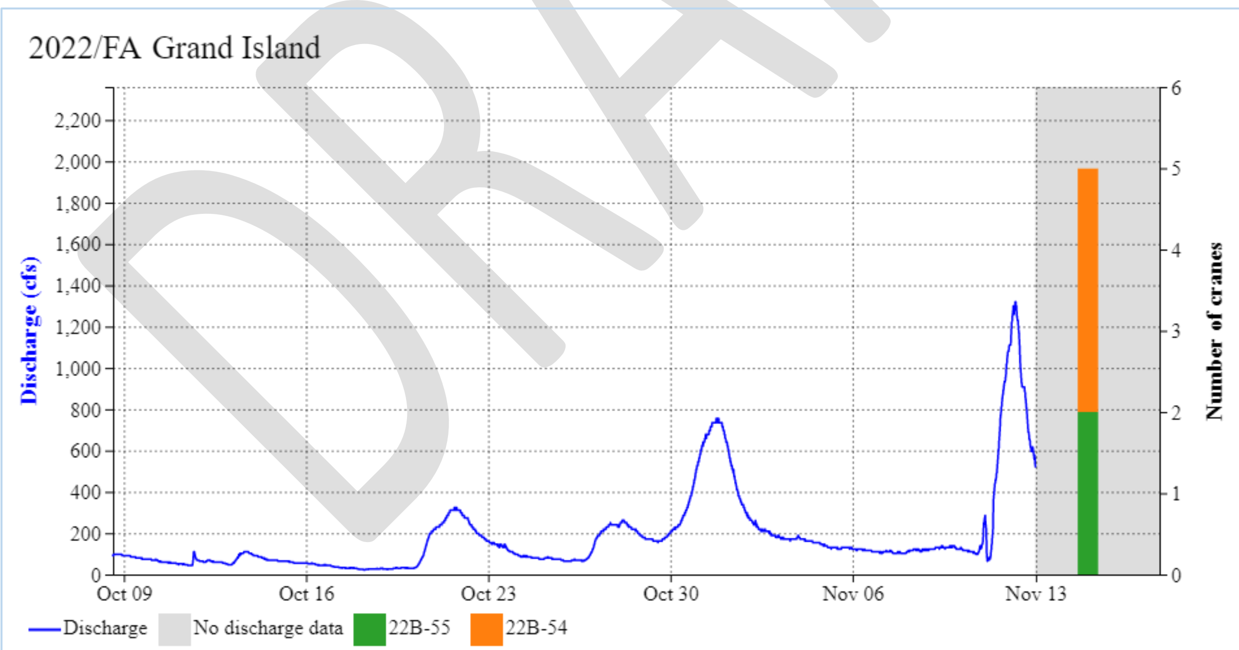

Figure 7. Discharge (blue line) at the Grand Island gage from 10/9 – 11/18 (USGS 2022d) and numbers of whooping cranes from each group (USFWS 22B-55 / PRRIP 2022FA02 and 22B-54 / PRRIP 2022FA03 in colored bars) observed on the indicated dates either on- or off-channel at locations for which Grand Island was the nearest gaging station. Gage ice affected from 11/13-11/18 (grey shading). Discharge data are provisional until USGS updates with corrections.

Unobstructed channel width (width of channel unobstructed by dense vegetation) and nearest forest (distance to nearest riparian forest) have both been found to be important predictors of whooping crane use of the Platte River (Baasch *et al*. 2019). Fall 2022 aerial imagery was used to measure unobstructed channel width and distance to nearest forest from each in-channel use site. Unobstructed channel widths at riverine use sites ranged from 151 – 854 feet (average = 614 feet) (Table 3). Nearest forest ranged from 451 – 700 feet (average = 570 feet).

Table 3. Unobstructed channel width and nearest forest at each in-channel crane use location.

Unique Group Icon	USFWS Group ID	PRRIP Crane Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Unobstructed Channel Width (ft)	Nearest Forest (ft)
	22B-12	2022FA01	1	505705	4501198	151	559
	22B-55	2022FA02	2	539779	4511626	837	451
	22B-54	2022FA03	3	543738	4513828	854	700
					Average:	**614**	**570**

Figures 8-10 provide maps of crane group use locations in relation to PRRIP and other conservation lands. Figures 11-13 provide photographs of whooping crane groups observed during systematic and opportunistic monitoring.

Monitoring Effort and Detection Probabilities

Systematic effort

A total of 3 whooping crane observations, resulting in the documentation of 3 unique crane groups containing 6 individuals, were made while conducting systematic aerial monitoring (Appendix A). Of the 76 regularly scheduled flights, there were 67 instances when crews were able to depart the airport, of which 66 were completed, resulting in completion of 86.8% of scheduled flights (Table 4). Nine flights were cancelled, and one flight was initiated, but not completed during this regular season. However, this season was extended three days resulting in 5 additional systematic flights being completed (2 east; 3 west) to make a total of 71 completed flights for the fall 2022 season (35 east and 36 west). There were two days that both east and west transects were completed by a single plane flying the entire river from Chapman to Lexington and then the primary return transects back.

Considering the river channel and off-channel primary/secondary return transects individually, 184 (88%) of the 209 scheduled systematic transects within our original October 9th through November 15th survey period were completed (Table 6). Within the one incomplete flight, there was only one transect initiated but not completed when the weather turned poor mid-survey. The transects that were not initiated prior to ending the survey were recorded as cancelled along with all transects that were scheduled when the plane did not depart the airport. Twenty-four regular season transects were cancelled. Over the extended survey period from October 9th through

November 18th, 197 (88%) out of 225 total scheduled systematic transects were completed, 1 incomplete, and 27 cancelled.

Table 4. Systematic flight completion rates.

	East	**West**	**Totals**
Regularly Scheduled			
Systematic Completed	33	33	66
Cancelled/Incomplete	5	5	10
Scheduled Season Total	38	38	76
% Regularly Scheduled Completed	**86.8%**	**86.8%**	**86.8%**
Additionally Flown			
Systematic Completed	2	3	5
Cancelled/Incomplete	1	0	1
Additional Total	3	3	6
% Additional Completed	**66.7%**	**100%**	**83.3%**
OVERALL % COMPLETED	**85.4%**	**87.8%**	**86.6%**

Opportunistic effort

All observations made outside of the systematic aerial transects were considered opportunistic. Two opportunistic observations were recorded this season (Appendix A). For one of the two crane groups, the opportunistic observation made by ground crews added to information about the crane group that was also observed in the systematic aerial surveys. The other opportunistic observation was an aerial observation made at 7:04 a.m. while in route to the start of the systematic transect at Wood River bridge (22B-55 / 2022FA02). The same crane group was observed again at 8:11 a.m. in the same location when the plane returned following the east half of the 0SE systematic transect.

Ground crews conducted four searches on three different days. Only one crane group was found which added a “B” location to crane group 22B-12 / 2022FA01 B (Table 5). Table 5 shows the effort made by ground crews. The “miles driven” column indicates the total miles driven in the effort to locate a potential crane group, starting from the location of the last reported sighting or known location based on previous days’ observations, then continuing until the crane group or white object was located and identified or a reasonable amount of effort was put forth.

Table 5. Ground search effort for whooping cranes (WC) in response to an information source: aerial sighting by plane (plane), found based upon previous known locations (known), or sighting with no prior knowledge of whooping crane presence in the area (no information). Sighting resulted from effort by aerial and ground crew working together (both) or ground crew sighting alone (ground). Efforts that resulted in no WC found, are recorded as None.

Unique Group Icon	USFWS Group ID	PRRIP Group ID	Date	Source	WC Confirmed Ad:Juv	Miles Driven	Aerial/Ground Effort
	22B-12	2022FA01 B	10/31	Plane	1:0	1	Both
			11/10	Plane	None	42	Both
			11/10	Plane	None	18	Both
			11/17	Plane	None	24	Both
					TOTAL:	**85**	

Table 6. Systematic and opportunistic monitoring effort including transect completions, hours, and mileage and resulting whooping crane (WC) sightings.

			Flight Transects	WC Group Sightings[a]	Completed	Incomplete	Cancelled	Total Scheduled	Hours	Miles
Systematic	Scheduled Flights	On Channel	0SE, 0SW[b]	3	67	0	9	76	33:03:00	7,229
		Off Channel	PWRTE, PWRTW[c]	0	67	0	9	76	29:36:00	
			WSRT, CSRT, ESRT[d]	0	50	1	6	57	8:58:00	
	Additional Flights[e]	On-Channel	0SE, 0SW[b]	0	5	0	1	6	2:32:00	525
		Off-Channel	PWRTE, PWRTW[c]	0	5	0	1	6	2:02:00	
			WSRT, CSRT, ESRT[d]	0	3	0	1	4	0:21:00	
Opportunistic		Flight[f]		1						
		Ground[g]		1					3:06:00	85
		TOTALS		5	197	1	27	225	79:38:00	7,839

[a]See Appendix A for crane group sighting details.
[b]Primary Transect (Riverine), (East – 0SE, West – 0SW) (Figs. 1-2)
[c]Primary Return transect, (East – PWRTE, West – PWRTW) (Figs. 1-2)
[d]Secondary Return transect, (East – WSRT and CSRT, West – ESRT) (Figs. 1-2)
[e]Systematic-Additional: includes the three days of systematic monitoring effort added at the end of the monitoring season from November 16-18 to collect data on whooping cranes remaining within the reach.
[f]Opportunistic-Flight: includes observations made while in route to systematic transects or deviations from the systematic transects.
[g]Opportunistic-Ground: includes efforts made by motorized vehicle outside of systematic flight transects to confirm or deny unconfirmed crane groups or to independently search for previous day groups when flights were cancelled.

Detection probability trials

A total of 20 whooping crane decoy sets (1-3 decoys per set) were placed by the EDO in 20 unique locations along the aerial transects to evaluate ability of aerial observers to detect potential whooping cranes. Ten decoy sets were placed at randomly selected locations within the channel and ten decoy sets were placed at randomly selected locations along off-channel conservation lands within 500 feet of the channel. Flight crews spotted six of the ten decoy sets placed in a wetted channel (60%) and two of the ten decoy sets placed at off-channel locations (20%) (Table 7).

Table 7. Observation efficiency trials using whooping crane decoys.

Date Placed	Date Tested	UTMx	UTMy	# of Decoys	Habitat Type	Detected
10/14	10/15	517067	4505448	2	Grassland - Lowland	No
10/17	10/18	489924	4500917	2	Grassland - Lowland	Yes
10/18	10/19	537669	4511564	1	Grassland - Lowland	No
10/25	10/26	500076	4501230	1	Grassland - Lowland	No
10/26	10/27	500295	4501128	3	Wetted Channel	Yes
10/27	10/29	545189	4514732	2	Wetted Channel	No
10/28	10/29	459471	4503885	2	Grassland - Lowland	No
10/31	11/1	442962	4505762	2	Grassland - Lowland	No
11/1	11/2	444125	4504418	2	Grassland - Lowland	No
11/1	11/2	564328	4529480	1	Wetted Channel	Yes
11/2	11/3	496864	4501123	1	Wetted Channel	Yes
11/2	11/3	512963	4502791	1	Wetted Channel	Yes
11/3	11/5	566830	4532731	2	Grassland - Lowland	Yes
11/4	11/5	516961	4505440	2	Grassland - Lowland	No
11/7	11/9	509639	4502649	3	Grassland - Lowland	No
11/7	11/10	467685	4503716	1	Wetted Channel	No
11/9	11/11	511606	4503134	2	Wetted Channel	Yes
11/10	11/11	467207	4503425	1	Wetted Channel	Yes
11/11	11/13	508346	4501900	3	Wetted Channel	No
11/14	11/15	471214	4503971	2	Wetted Channel	No

Comparatively, observation efficiency in the fall of 2022 was below the average of 74% from 2007-2021 for channel decoys and right at the average of 21% from 2013-2021 for off-channel decoys. In 2020, decoy placements were adjusted to groups of 1-3 decoys per set to better replicate whooping crane detectability.

Incidental take

The USFWS in its 2006 Biological Opinion (USFWS 2006) and 2018 Supplemental Biological Opinion (USFWS 2018) on the Program developed an incidental take statement addressing incidental take for whooping cranes associated with monitoring and research as well as land management and habitat restoration conducted in the Platte River basin covered by the Program.

Such take includes harm caused by harassment of individuals, and effects to fitness of adults resulting in loss of productivity. Six instances of take in the form of harassment of whooping cranes is exempted during the First Increment and 13-year Extension of the Program. The total amount of take that would remove an individual from the migrating population (i.e. lethal or crippling) exempted is one whooping crane during the First Increment and 13-year Extension of the Program. The USFWS requires documentation of any human activity that occurred in the proximity of whooping cranes that could constitute "take" as defined by the Endangered Species Act (i.e., "…*to harass, harm, pursue, hunt, shoot, wound, kill, capture, or collect, or attempt to engage in any such conduct"*). Because harassment interrupts essential feeding or sheltering behaviors, the definition includes disturbance of whooping cranes sufficient to result in cranes taking flight. Since the Program's initiation in 2007, the Program has not observed take (lethal, crippling, harm, harassment, etc.) of any whooping cranes due to monitoring or research activities or due to habitat restoration and land management activities.

During the fall 2022 monitoring period, PRRIP documented no instances of take as defined above. Specifically:

- *Lethal or crippling take*

  There were no observations of crippling or lethal take of whooping cranes this season resulting from the monitoring conducted by PRRIP.
- *Harassment*

  PRRIP staff did not observe or engage in any activity that could be construed as harassment as defined by USFWS.
- *Public disturbance*

  PRRIP staff did not observe any incident of public disturbance of whooping cranes.

Past research synthesis

In addition to implementation of the Program's monitoring protocol, directed research has been conducted by the Program since 2007 to provide data to evaluate the Program's management objectives and priority hypotheses. Design and implementation of research activities was guided by the Program's EDO and Technical Advisory Committee (TAC), reviewed by the Program's Independent Scientific Advisory Committee (ISAC) and ultimately approved by the Program's Governance Committee (GC). Whooping crane monitoring and research conducted along the central Platte River were designed and implemented to provide information on an array of topics relevant to species management, including:

- Methods for monitoring whooping cranes and using detection data for drawing conclusions
- Whooping crane use of the central Platte River and the Great Plains migratory corridor
- Identification and characterization of riverine use sites
- Identification and characterization of diurnal use sites
- Whooping crane habitat selection analyses
- Management of river hydrology and morphology for whooping crane habitat
- Whooping crane use of off-channel palustrine wetlands

Links to these studies and other research relevant to the Program's objectives for whooping cranes can be found in Appendix B.

Supplements

QA/QC of database was performed by PRRIP EDO staff.
Original datasheets – Retained at PRRIP EDO office.

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United States Geological Survey (USGS). 2022b. United States Geological Survey National Water Information System: Web Interface. USGS 06768035 Platte River, Cottonwood Ranch near Elm Creek, Nebr. https://waterdata.usgs.gov/monitoring-location/06768035/#parameterCode=00065&period=P7D

United States Geological Survey (USGS). 2022c. United States Geological Survey National Water Information System: Web Interface. USGS 06770200 Platte River near Kearney, Nebr. https://waterdata.usgs.gov/monitoring-location/06770200/#parameterCode=00065&period=P7D

United States Geological Survey (USGS). 2022d. United States Geological Survey National Water Information System: Web Interface. USGS 06770500 Platte River near Grand Island, Nebr. https://waterdata.usgs.gov/monitoring-location/06770500/#parameterCode=00065&period=P7D

Figures

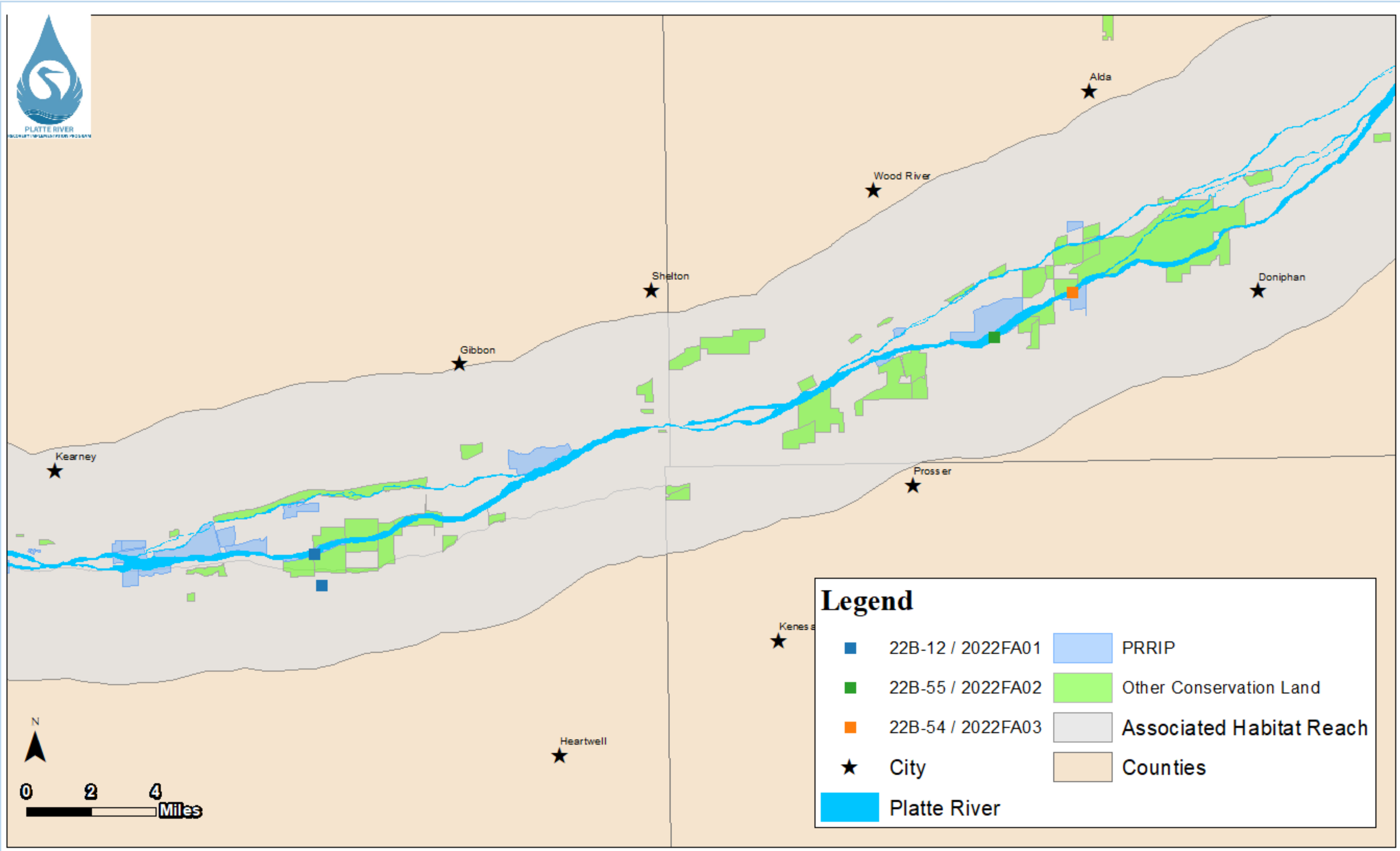

Figure 8. Distribution of whooping crane group observations within the AHR during the 2022 fall survey. Refer to Figures 9-13 for greater detail.

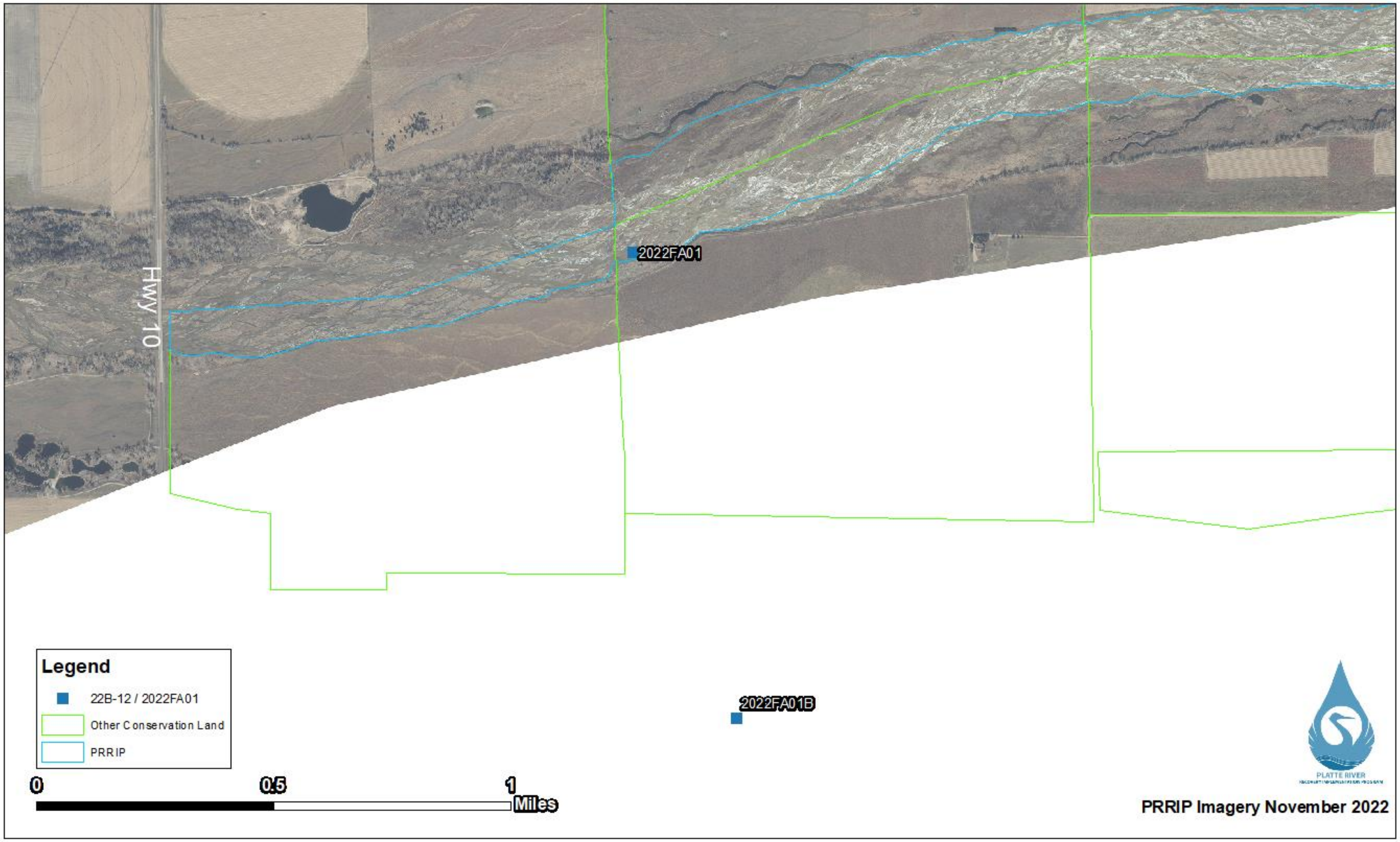

Figure 9. Rowe-Younkin Complex. USFWS crane group 22B-12 / PRRIP crane groups 2022FA01 and 2022FA01 B observed on 10/31/22 (including use site 1) north of Minden, NE.

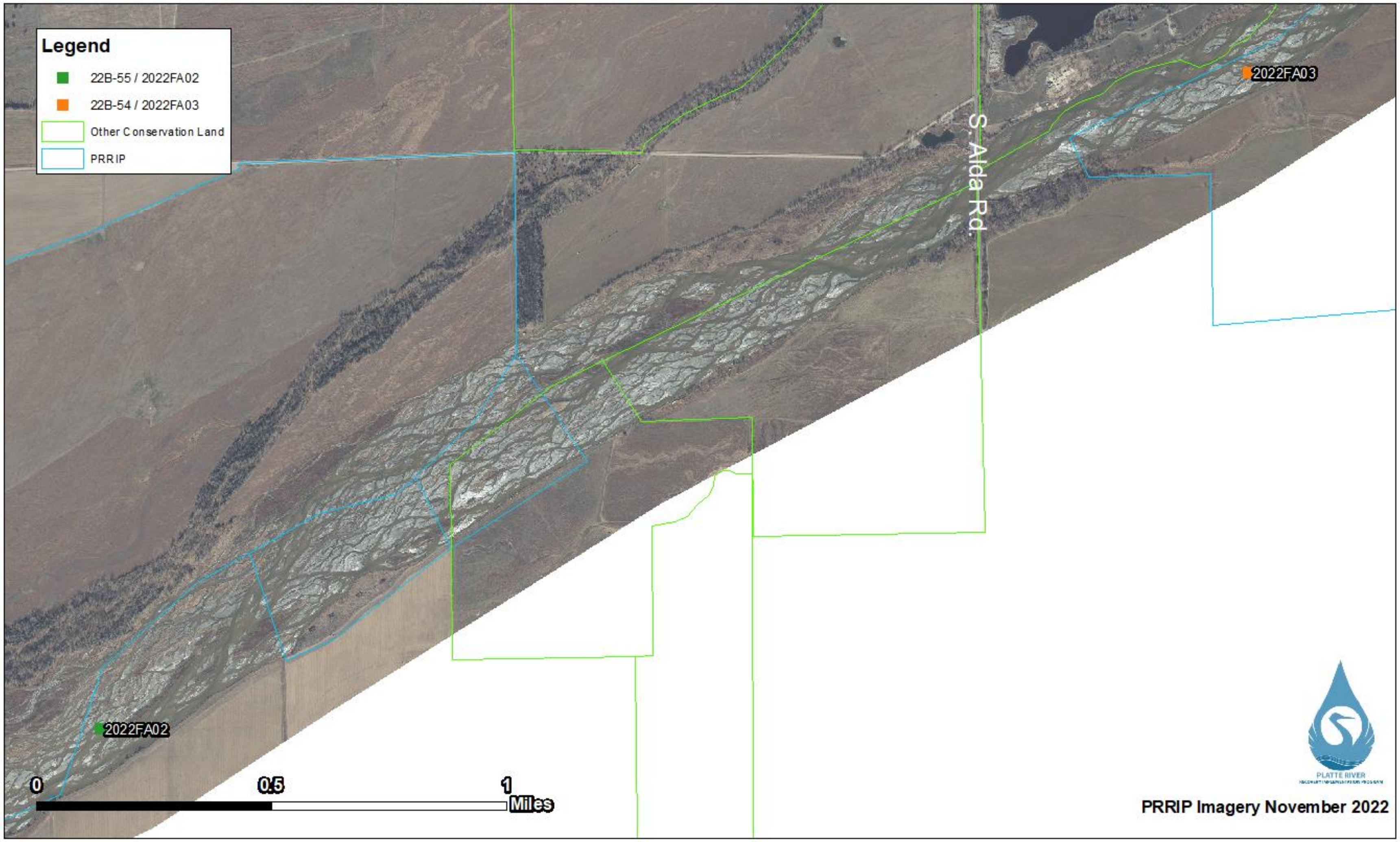

Figure 10. Shoemaker Island. USFWS crane group 22B-55 / PRRIP crane group 2022FA02 and USFWS crane group 22B-54 / PRRIP crane group 2022FA03 observed on 11/15/22 (including use sites 2 - 3) south of Alda, NE. 22B-55 / 2022FA02 was observed twice at the same location within approximately one hour, thus only one location appears here.

Figure 11. Photo taken during a systematic observation of USFWS crane group 22B-12 / PRRIP crane group 2022FA01 on 10/31/22 at use site 1 in the main channel of the Platte River (see Fig. 9 above for location).

Figure 12. Photo taken during a systematic observation of USFWS crane group 22B-55 / PRRIP crane group 2022FA02 on 11/15/22 at use site 2 in the main channel of the Platte River (see Fig. 10 above for location).

Figure 13. Photo taken during a systematic observation of USFWS crane group 22B-54 / PRRIP crane group 2022FA03 on 11/15/22 at use site 3 in the main channel of the Platte River (see Fig. 10 above for location).

Appendix A

Crane group observations

Letters are placed following PRRIP crane group ID’s when more than one observation of a crane group is made in the same day. Use site numbers refer to riverine, lacustrine, or palustrine locations where crane groups were observed. Crane groups sighted outside of these environments were not assigned a use site number, but rather the location’s appropriate land cover classification or denominated as “AIR” if the group was sighted while in flight. Sys – systematic observation. Opp – opportunistic observation.

Table A. Data for crane group **22B-12**.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	PRRIP Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	10/31/22	1:0	2022FA01	1	505705	4501198	Sys-Flight
			2022FA01 B	Corn	506036	4499612	Opp-Ground

Table B. Data for crane group **22B-55**.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	PRRIP Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	11/15/22	2:0	2022FA02	2	539779	4511626	Opp-Flight[a]
							Sys-Flight

[a]Opportunistic flight observation was made at 7:04 a.m. as plane approached the systematic transect. Crane group was then observed a second time at 8:11 a.m. at the same location while monitoring along the systematic transect. Both observations recorded in the database, but second observation did not receive a B location as it is not an independent locational data point.

Table C. Data for crane group **22B-54**.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	PRRIP Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	11/15/22	2:1	2022FA03	3	543738	4513828	Sys-Flight

Appendix B

Past research synthesis

Published	Study Topic	Document Title	Summary	Principal Findings	Citation
2022	Habitat use	Whooping crane (*Grus americana*) use patterns in relation to an ecotope classification in the central Platte River Valley, Nebraska, USA	Evaluation of ecotope-based landcover at 400 m and 1000m spatial scales to predict WC use of the central Platte River.	Integrated both landcover classification and hydrological factors into a finer scale ecotope data layer. USFWS public sighting WC use locations were characterized utilizing this ecotope data layer with a 400 m and a 1000 m buffer around each locational data point. Generalized linear mixed-effects models were used to assess the effects of ecotope composition, flooding frequency, and wetland status on the probability of whooping crane use. Ecotopes at the 1000 m scale explained nearly 40% of the variation in WC use. WC were present more frequently in wetland portions of both agriculture fields and grassland communities, and less likely to use upland portions of these landcover types. Use was positively associated with proximity to the main channel of the Platte River. The probability of WC use was predicted to decrease as the proportion of developed landcover increased and distance to nearest road decreased.	Baasch DM, Caven AJ, Jorgensen JG, Grosse R, Rabbe M, Varner DM, LaGrange T. 2022 Whooping Crane (*Grus americana*) use patterns in relation to an ecotope classification in the Central Platte River Valley, Nebraska, USA. https://ace-eco.org/vol17/iss2/art35/
2022	Power line collision mitigation	Mitigating avian collisions with power lines through illumination with ultraviolet light.	Tested effectiveness of two avian collision avoidance systems (ACASs) at reducing collisions of large-bodied avian species. Whooping cranes were not documented as part of this study.	ACAS illumination and environmental variables were important predictors of avian collisions with power lines. ACAS illumination reduced collisions at focal power line by 88%. Collisions were more likely at moderate wind speeds.	Baasch DM, Hegg AM, Dwyer JF, Caven AJ, Taddicken WE, Worley CA, Medaries AH, Wagner CG, Dunbar PG, Mittman ND. 2022 Mitigating avian collisions with power lines through illumination with ultraviolet light. Avian Conservation and Ecology 17(2):9. https://doi.org/10.5751/ACE-02217-170209

Published	Study Topic	Document Title	Summary	Principal Findings	Citation
2022	Wintering habitat use	Whooping and sandhill cranes visit upland ponds proportional to migration phenology on the Texas coast	Evaluated whooping and sandhill crane use of constructed freshwater ponds as alternative water sources during drought on wintering grounds.	Used camera traps to estimate visits/month of 7 constructed ponds over 3 winters with drought conditions. Used generalized linear mixed-effects models to evaluate the effect of pond type, pond salinity, distance to saltmarsh, bay salinity, tide levels, rainfall, time of year, and migration phenology on the probability of pond use each month. Examined daily activity patterns of crane use at ponds. The best fitting models (both at the pond and broader scale) suggested more whooping crane group visits occurred in January when most whooping cranes were on the wintering grounds. More whooping cranes visited ponds on the mainland than on Matagorda Island. Whooping cranes were not observed at ponds prior to sunrise and infrequently after sunset, thus upland ponds were visited by whooping cranes diurnally.	Butler MJ, Metzger KL, Sanspree CR, Cain JW, Harris GM. 2022. Whooping and sandhill cranes visit upland ponds proportional to migration phenology on the Texas coast. Wildlife Society Bulletin 46(3): e1290. https://doi.org/10.1002/wsb.1290
2022	Wintering habitat use	Space use and site fidelity of wintering whooping cranes on the Texas Gulf Coast	Evaluation of AWB whooping crane winter home ranges through time and in relation to age, sex, reproductive status, and drought.	Used telemetry data from 57 individual telemetered whooping cranes from 2009-2017 and autocorrelated kernel density estimation (AKDE) to explore variation in home range size in relation to age, sex, reproductive status, and drought. Examined overlap in and distance between home range centroids through time to examine site fidelity. Estimated 95% AKDE mean as 30.1 km^2. Home range estimates did not differ for groups with vs. without juveniles. Sub-adult male home ranges were similar in size to those of family groups. Home ranges of sub-adult females were approximately double that of family groups. Home ranges increased in size during drought on the wintering grounds. From one year to the next, home range site fidelity averaged 68% overlap, but as the number of years increased between home ranges of an individual adult whooping crane, they overlapped less. Fidelity to juvenile winter home range declined with age through the 4th winter, but the limited data available beyond the 4th winter suggested that older individuals may return to within 2 km of their juvenile home range.	Butler MJ, Stewart DR, Harris GM, Bidwell MT, Pearse AT. 2022. Space use and site fidelity of wintering whooping cranes on the Texas Gulf Coast. Journal of Wildlife Management 86(5): e22226. https://doi.org/10.1002/jwmg.22226

Published	Study Topic	Document Title	Summary	Principal Findings	Citation
2022	Stopover duration	Whooping crane stay length in relation to stopover site characteristics	Examined the relationship between habitat characteristics and stopover duration during whooping crane migration.	Quantified habitat characteristics at 605 use locations from 449 stopover sites obtained through telemetry from 58 individual whooping cranes. Performed random forest regression to estimate importance of landcover variables for predicting stopover stay length. Mean stopover duration was 3.1 days. Over half of the stopover sites assessed for habitat characteristics were used only a single day or less. Landscape level variables explained 43% of variation in stay length, whereas site level variables explained 9%. Stay length increased with latitude, proportion of land cover as open-water slough with emergent vegetation, proportion of landcover as alfalfa, and longitude. At the site level, wetted width combined over all wetland classes, landcover of nearest shoreline, distance to terrestrial bank from a wetland use location, and wetland class were better predictors of variability in stay length. Stay length increased with wetted width at riverine sites but decreased with wetted width at lacustrine and palustrine sites.	Caven AJ, Pearse AT, Brandt DA, Harner MJ, Wright GD, Baasch DM, Brinley Buckley EM, Metzger KL, Rabbe MR, Lacy AE. 2022. Whooping crane stay length in relation to stopover site characteristics. Proceedings of the North American Crane Workshop 15:6-33. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1387&context=nacwgproc
2022	Habitat use	Balancing future renewable energy infrastructure siting and associated habitat loss for migrating whooping cranes	Evaluation of functional migratory habitat across the Great Plains relative to renewable energy infrastructure, human development and disturbance, and drought.	Used locational data from 57 individual telemetered whooping cranes from 20101-2016 in the US Great Plains to assess habitat selection and avoidance of disturbance (including renewable energy infrastructure) during migration relative to drought conditions. Land use within 800 m were the best predictors of WC use. Zones of influence distances were determined for disturbance variables. Relationships between WC use and predictor variables were compared under drought and non-drought conditions. An optimization analysis was performed to select potential sites for new wind energy development that minimize habitat loss for whooping cranes while maximizing wind energy potential.	Ellis KS, Pearse AT, Brandt DA, Bidwell MT, Harrell W, Butler MJ, Post van der Burg M. Balancing future renewable energy infrastructure siting and associated habitat loss for migrating whooping cranes. Frontiers in Ecology and Evolution 10:931260. https://doi.org/10.3389/fevo.2022.931260

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2022	Wintering habitat	Spatial and temporal predictions of whooping crane (*Grus americana*) habitat along the US Gulf Coast	Study mapping the historical spatial transformation of whooping crane habitat in and around Aransas National Wildlife Refuge.	Used exploratory spatial data analysis to document areas used by whooping cranes and how this space use has changed over time from 1990-2009. Developed a time series of ecological niche models to identify environmental factors (biotic and abiotic) correlated with crane habitat use and how importance has changed over time. Utilized multitemporal models to forecast areas along the US Gulf Coast that may provide additional wintering habitat for an expanding whooping crane population and where habitat may be lost due to rising sea levels predicted with climate change.	Golden KE, Hemingway BL, Frazier AE, Scholtz R, Harrell W, Davis CA, Fuhlendorf SD. 2022. Spatial and temporal predictions of whooping crane (*Grus americana*) habitat along the US Gulf Coast. Conservation Science and Practice 4(6): e12696. https//doi.org/10.1111/csp2.12696
2022	Agricultural land cover as habitat	Winners and losers of land use change: A systematic review of interactions between the world's crane species (*Gruidae*) and the agricultural sector	Meta-analysis of published literature on crane use of agricultural landcover and importance of agricultural crops in the diet of cranes to evaluate the bilateral effects of land use change.	Reviewed 135 articles describing 285 crane-agriculture interactions. Agricultural crops are an important dietary component for the majority of crane species with corn and wheat making the largest proportional contribution to the crane diet). Crane use of cropland as foraging habitat was identified in one-third of studies reviewed, but crop damage was identified in only ten percent of studies. Study identified two potential effects of increasing agricultural land cover: 1) habitat loss with negative effects on crane species dependent upon specific non-agricultural habitats and 2) superabundant food availability beneficial for opportunistic crane species able to utilize these resources.	Hemminger K, König H, Månsson J, Bellingrath-Kimura SD, Nilsson L. 2022. Winners and losers of land use change: A systematic review of interactions between the world's crane species (*Gruidae*) and the agricultural sector. Ecology and Evolution 12(3): e8719. https://doi.org.10.1002/ece3.8719
2022	Migratory habitat	The use of US Army Corp of Engineers reservoirs as stopover sites for the Aransas-Wood Buffalo population of whooping crane	Summary of AWB whooping crane use of USACE reservoirs as stopover sites.	Assessed AWB whooping crane stopover use of USACE reservoirs within the migratory corridor. Utilized WC stopover locations from USGS Telemetry Database from 2009-2018 together with USFWS Cooperative Whooping Crane Tracking Project database and USGS Biodiversity Information Serving Our Nation database to document significant stopover use of USACE reservoirs in both spring and fall migratory seasons. One reservoir was used as a wintering location in multiple years.	Jung JF, Fischer RA, McConnell C, Bates P. 2022. The use of US Army Corp of Engineers reservoirs as stopover sites for the Aransas-Wood Buffalo population of whooping crane. US Army Engineer Research and Development Center, Vicksburg, MS. https://apps.dtic.mil/sti/pdfs/AD1176388.pdf

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2022	Migratory habitat	Differential shortstopping behavior in whooping cranes: habitat or social learning?	Characterizes shortstopping winter habitat utilized by the Eastern migratory population (EMP) to estimate the amount of potential shortstopping wintering habitat available to the Aransas Wood Buffalo population (AWBP) within the Great Plains migratory corridor. Tests habitat availability and social learning as potential drivers leading to the difference in wintering behavior between the EMP and the AWBP populations.	Based upon habitat characteristics of shortstopping sites used by the EMP, an estimated 31.4% of the AWBP migratory corridor is suitable for wintering, reducing the likelihood that insufficient habitat suitability limits shortstopping during fall migration by the AWBP. Limited interactions among adults and juveniles of the EMP may reduce social learning of and adherence to established migratory behavior, leaving room for experience with and uptake of novel migratory behaviors such as shortstopping.	Mendgen, P, Converse SJ, Pearse AT, Teitelbaum CS, Mueller, T. 2022. Differential shortstopping behavior in whooping cranes: habitat or social learning? Global Ecology and Conservation 41: e02365. https://doi.org/10.1016/j.gecco.2022.e02365
2021	Behavior	Whooping crane diurnal behavior and natural history during migration in the central Great Plains: Interim report – Fall 2020.	Used long-range photography/videography, spotting scopes, and binoculars to document whooping crane activity, response to aircraft, and response to potential predators via scan sampling.	Observed 10 whooping crane groups, including 27 individuals. Documented foraging, preening, loafing, social, and defensive behaviors over both on and off-channel environments. Foraging/drinking was the most common behavior observed. Loafing and preening occurred most often in open-water wetland land classes. Alert or defensive behaviors were most often observed in cornfields.	Baasch DM, Caven AJ, Krohn B. 2021. Whooping crane diurnal behavior and natural history during migration in the central Great Plains: Interim report – Fall 2020. Crane Trust, Wood River, NE. https://cranetrust.org/who-we-are/what-we-do/conservation/research/publications.html
2021	Diet and foraging behavior	Whooping crane (*Grus americana*) family consumes a diversity of aquatic vertebrates during fall migration stopover at the Platte River, Nebraska	Used long-range photography, videography, and behavioral scan sampling to document forage items consumed by whooping cranes.	During an 11-day stopover along the central Platte River during the fall of 2019 three adults- and one colt were observed. They consumed 16 individual vertebrates of at least 6 different species during the stopover. The research documented 7 channel catfish (*Ictalurus punctatus*), 5 ray-finned fish (Actinopterygii), 1 sunfish (Centrarchidae), 1 carp/minnow relative (Cypriniformes), 1 perch relative (Percidae), and 1 leopard frog relative (Lithobates sp.) consumed by whooping cranes.	Caven AJ, Koupal KD, Baasch DM, Brinley Buckley EM, Malzahn J, Forsberg ML, Lundgren M. 2021. Whooping crane (*Grus americana*) family consumes a diversity of aquatic vertebrates during fall migration stopover at the Platte River, Nebraska. Western North American Naturalist 81(4): 592-607. https://digitalcommons.unl.edu/natrespapers/1460/

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2021	Habitat selection	Migrating whooping cranes avoid wind-energy infrastructure when selecting stopover habitat	Used telemetry locations from 57 whooping cranes to detect potential avoidance of wind-energy infrastructure.	Examined how wind energy infrastructure may affect stopover locations. Used whooping crane ground locations and compared habitat characteristics within a buffer around each use and 19 available locations. Predictor variables included percentage wetland, percentage cropland, road density, distance from center of migratory corridor, and distance from energy tower. Zone of influence analysis demonstrated reduced probability of use of areas within 5 km of wind towers.	Pearse AT, Metzger KL, Brandt DA, Shaffer JA, Bidwell MT, Harrell W. 2021. Migrating whooping cranes avoid wind-energy infrastructure when selecting stopover habitat. Ecological Applications 31(5): e02324. https://doi.org.10.1002/eap.2324
2021	Habitat use	Disposition of non-complex palustrine wetlands	Used PRRIP whooping crane use locations from PRRIP monitoring and telemetry data from the whooping crane tracking partnership to assess use of the off-channel non-complex palustrine wetlands managed by the Program.	Whooping Cranes have not been documented to date using the non-complex palustrine wetlands managed by the Program.	PRRIP. 2021. Diposition of Non-Complex Palustrine Wetlands. https://platteriverprogram.org/system/files/2021-10/03-Palustrine%20Wetland%20Memo_0.pdf
2020	Migratory group sizes	Trends in the occurrence of large whooping crane groups during migration in the Great Plains, USA	Used public sighting database to examine trends in migrating whooping crane group sizes over time and space.	Whooping crane group size and the amount of variation in group size has increased over time and in relation to an increasing whooping crane population with the strongest trend observed in the increasing number of groups with 7-9 and ≥10 individuals. Large groups tended to occur within the 50% migratory corridor, at staging areas closer to the ends of the migratory corridor, and disproportionately on conservation-managed habitat.	Caven AJ, Rabbe M, Malzahn J, Lacy AE. 2020. Trends in the occurrence of large whooping crane groups during migration in the Great Plains, USA. Heliyon 6(4): E03549. https://doi.org/10.1016/j.heliyon.2020.e03549

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2020	Migratory habitat	Identifying, protecting, and managing stopover habitats for wild whooping cranes on U.S. Army Corps of Engineers lakes	Evaluation of USACE lakes within the AWB population migratory corridor as potential whooping crane habitat for management.	Thirty-four USACE lakes within the migratory corridor were evaluated using the following criteria: lake, pond, wetland ≥ 0.12 ha, with shallow area 12-25 cm deep for roosting, and gradual, sloping shorelines; little/no submerged/emergent vegetation in potential roost area; glide path clear of obstruction, no trees or tall, dense vegetation, open landscape with extensive horizontal visibility; and ≥ 275 m from human development/disturbance. Within the 34 lakes, 624 locations were identified as potential whooping crane stopover sites within North and South Dakota, Nebraska, Kansas, Oklahoma, and Texas with commitments to manage the identified habitat as resources allow.	McConnell, C. 2020. Identifying, protecting, and managing stopover habitats for wild whooping cranes on U.S. Army Corps of Engineers lakes. bioRxiv 12.30.424870. https://doi.org/10.1101/2020.12.30.424870
2020	Wintering habitat	Identifying sustainable winter habitat for whooping cranes	Predicting future wintering habitat quality and quantity under scenarios of sea level rise and urban development. Calculation of potential carrying capacity over wintering habitat.	Whooping cranes used salt marsh, areas >15 km from development, and < 2 km from estuarine water more frequently. Area of salt marsh changed over time with sea rise. One to three percent of suitable habitat was predicted to be lost to urbanization by 2100. Under the scenario of higher coastal urbanization over time, carrying capacity of wintering habitat for whooping cranes was predicted to initially increase with a 0.6 m rise in sea level, but decrease as sea level rose by 1-2 m through time.	Metzger KL, Lehnen SE, Sesnie SE, Butler MJ, Pearse AT, Harris G. 2020. Identifying sustainable winter habitat for whooping cranes. Journal for Nature Conservation 57. https://doi.org/10.1016/j.jnc.2020.125892
2020	Diet	A characterization of the diets of wild and reintroduced whooping cranes (*Grus americana*)	Inventoried proventriculus and ventriculus contents from dead birds to compare diet between Wisconsin-Florida (eastern migratory) population and the Aransas-Wood Buffalo population.	Wisconsin-Florida and Aransas-Wood Buffalo populations had similar dietary compositions, including benthic invertebrates, beetles, crabs/crayfish, vegetation, seeds, mollusks and unidentified vertebrates.	Neri H. 2020. A characterization of the diets of wild and reintroduced whooping cranes (*Grus americana*). MS Thesis, Department of Environmental Biology, Hood College, Frederick, MD. http://hdl.handle.net/11603/18389

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2020	Migration telemetry	Location data for whooping cranes of the Aransas-Wood Buffalo population, 2009-2018 (data set).	Telemetry tracking locational dataset for AWB migratory population of whooping cranes from 2009-2018.	Telemetry tracking locational dataset for AWB migratory population of whooping cranes from 2009-2018.	Pearse AT, Brandt DA, Baasch DM, Bidwell MT, Conkin JA, Harner MJ, Harrell W, Metzger KL. 2020. Location data for whooping cranes of the Aransas-Wood Buffalo population, 2009-2018 (data set). US Geological Survey. https://doi.org/10.5066/P9Y8KZJ9
2020	Migration strategy	Heterogeneity in migration strategies of whooping cranes	Used telemetry to assess variation in migration strategies among 58 whooping cranes and the variables associated with those differences.	Whooping cranes showed little consistency in stopover sites used among migration seasons. Timing of migration showed consistency among age classes and reproductive cycles. Time spent at stopover sites was positively associated with distances traveled and negatively associated with time spent at previous stopover sites.	Pearse AT, Metzger KL, Brandt DA, Bidwell MT, Harner MJ, Baasch DM, Harrell W. 2020. Heterogeneity in migration strategies of whooping cranes. The Condor 122(1): 1-15. https://academic.oup.com/condor/article/122/1/duz056/5700702
2019	Riverine habitat selection	Whooping crane use of riverine stopover sites	Analyzed habitat characteristics for riverine stopover sites in the Great Plains and on the Platte River using telemetry locations for the Great Plain analysis and both PRRIP systematic aerial monitoring and telemetry for the Platte River analysis.	This analysis found that whooping crane use on riverine sites was maximized at 200m for unobstructed channel width (656 ft. UOCW), 160m for nearest forest (524ft NF), and suggested managing for unforested corridor widths of 330m (1,082ft UFCW).	Baasch DM, Farrell PD, Howlin S, Pearse AT, Farnsworth JM, Smith CB. 2019. Whooping crane use of riverine stopover sites. PLoS ONE 14 (1): e0209612. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0209612

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2019	Diurnal habitat selection	Diurnal habitat selection of migrating whooping crane in the Great Plains	This study used telemetry marked whooping cranes to assess diurnal use of landcover types throughout the U.S. migration corridor.	Diurnal habitat selection by whooping cranes was found to be influenced by land-cover type and distance to roads. Avoidance of roads varied based on land cover type. At 200 m from any road, all water-based land-cover types (river, open water, and semipermanent wetlands) were estimated to be at least three times as likely and lowland grassland was more than twice as likely to be selected as diurnal use sites than other non-water-based land-cover types (upland grass, corn, wheat, and other agriculture). Corn and semipermanent wetlands were more than 3 times as likely to be selected for at 1 km compared to 200 m from any road, whereas open water and riverine were similarly selected at 1km and 200 m from any road. Semi-permanent wetland was the only water-based land-cover type that was influence by avoidance of roads and was almost 3 times as likely selected at 1 km compared to 200m.	Baasch DM, Farrell PD, Pearse AT, Brandt DA, Caven AJ, Harner MJ, Wright GD, Metzger KL. 2019. Diurnal habitat selection of migrating Whooping Crane in the Great Plains. Avian Conservation and Ecology 14(1):6. https://doi.org/10.5751/ACE-01317-140106
2019	Diet and foraging	Adult whooping crane (*Grus americana*) consumption of juvenile catfish (*Ictalurus punctatus*) during the avian spring migration in the Central Platte River Valley, Nebraska, USA.	First observation of whooping crane consumption of fish in the Platte River.	22 March 2018 observation and photo documentation of an adult whooping crane consuming five juvenile channel catfish.	Caven AJ, Malzahn J, Koupal KD, Brinley Buckley EM, Wiese JD. 2019. Adult whooping crane (*Grus americana*) consumption of juvenile catfish (*Ictalurus punctatus*) during the avian spring migration in the Central Platte River Valley, Nebraska, USA. Monographs of the Western North American Naturalist 11(2). https://scholarsarchive.byu.edu/mwnan/vol11/iss1/2/?utm_source=scholarsarchive.byu.edu%2Fmwnan%2Fvol11%2Fiss1%2F2&utm_medium=PDF&utm_campaign=PDFCoverPages

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2018	Riverine habitat management	Investigating whooping crane habitat in relation to hydrology, channel morphology and a water-centric management strategy on the central Platte River, Nebraska	This study used annual aerial imagery to monitor effectiveness of sediment augmentation, mechanical/chemical vegetation clearing, channel consolidating, and short duration high flow releases to maintain suitable unobstructed channels for whooping cranes.	This study found 40-day mean peak discharge, wetted width of the channel, disking and herbicide application to be the best predictors of total unvegetated channel width (TUCW). Maximum unvegetated channel width (MUCW) was best explained by 40-day duration peak discharge and wetted width of the main channel. Disking and herbicide application were also included in the top model. Implementation of a short duration high flow release in a given year was predicted to increase TUCW by 0.0 – 6.7 m and MUOCW by 0.0 – 4.6 m depending on baseline river discharge at the time of the release.	Farnsworth JM, Baasch D, Farrell PD, Smith CB, Werbylo KL. 2018 Investigating whooping crane habitat in relation to hydrology, channel morphology and a water-centric management strategy on the central Platte River, Nebraska. Heliyon 4(10): E00851. https://doi.org/10.1016/j.heliyon.2018.e00851
2017	Riverine and diurnal use site selection	Correlates of whooping crane habitat selection and trends in use in the central Platte River	Using PRRIP systematic aerial monitoring data from 2001-2014, distance to nearest forest and unobstructed channel widths were important predictors of whooping crane use. However, distance to nearest obstruction was in the top five models. The proportion of population using the Platte River is increasing faster than the population during spring migration but not for fall. Neither spring nor fall migration has a significantly increasing trend.	Statistical modeling of habitat use indicated unobstructed channel width and nearest forest were the most important predictor variables for management purposes. Nearest obstruction was in all top five models but was not included in the management list as it cannot be managed for. Statistical modeling of diurnal habitat use indicated the full model for diurnal use containing all four covariates including nearest obstruction, nearest disturbance, proximity to roosting location, and land cover. Based upon PRRIP monitoring data from 2001- 2014, statistical modeling indicated a significant increase in the proportion of the Aransas-Wood Buffalo population of whooping crane using the Platte River in spring through time. However, the statistical modeling for fall use indicated a decreasing trend through time but was not statistically different than zero. These same trends for proportion of population were seen as well for crane use days for spring and fall migration, but neither were statistically different from zero.	Howlin S, Nasman K. 2017. Correlates of whooping crane habitat selection and trends in use in the central Platte River, Nebraska. https://platteriverprogram.org/sites/default/files/PubsAndData/ProgramLibrary/Correlates%20of%20Whooping%20Crane%20Habitat%20Selection%20and%20Trends%20in%20Use%20in%20the%20Central%20Platte%20River.pdf

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2017	Roost and diurnal use sites	Evaluation of nocturnal roost and diurnal sites used by whooping cranes in the Great Plains, United States	This document used telemetry marked whooping cranes to locate roost and diurnal use sites in the great plains. Characteristics of each site were measured to develop criteria to help identify habitat along the central Platte River for restoration, conservation, and management actions.	Whooping cranes were able to tolerate a wider range of habitat metrics in the larger portion of the migration corridor than defined by the Program's initial habitat criteria thresholds for the Platte River except for distance to nearest disturbance. Whooping cranes appeared to be more tolerant of disturbances on the Platte River than they were when analyzing the entire corridor.	Pearse AT, Harner MJ, Baasch DM, Wright GD, Caven AJ, Metzger KL. 2017. Evaluation of nocturnal roost and diurnal sites used by whooping cranes in the Great Plains, United States: U.S. Geological Survey Open-File Report 2016–1209, 29 p., https://pubs.usgs.gov/of/2016/1209/ofr20161209.pdf
2017	Habitat selection	PRRIP whooping crane habitat synthesis chapters	Used Program systematic monitoring along with telemetry datasets to identify riverine habitat for whooping cranes in the Great Plains and central Platte River.	Unable to establish a relationship between whooping crane use and river flow metrics or total channel width but identified unobstructed channel width and distance to nearest forest as good predictors of whooping crane use. Selection for unobstructed channel width was maximized around 650ft and unforested corridor width was maximized at 1,000 ft. Short-duration high-flow releases will not create or maintain favorable whooping crane riverine habitat in the central Platte River.	PRRIP. 2017. Whooping crane (*Grus americana*) habitat synthesis chapters. https://platteriverprogram.org/sites/default/files/PubsAndData/ProgramLibrary/PRRIP%20Whooping%20Crane%20Habitat%20Synthesis%20Chapters.pdf

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2015	Use site intensity throughout the migration corridor	Whooping crane stopover site use intensity within the Great Plains	Used five years data from 58 telemetry marked whooping cranes to analyze use site intensity throughout the migration corridor to identify landscapes important to whooping cranes during migration.	Twenty percent of the grid cells contained one or more stopovers. Thirty percent received only fall stopovers and 47% exclusively spring use. Twenty-three percent had use during both migration seasons. Lands with some type of protection covered approximately 10 percent of the migration corridor used by whooping cranes and approximately 27% of the core corridor. Based on the derived centerline of the migration corridor, 75% of stopover sites occurred within 59 km, 85% within 82 km, and 95% within 144 km of the centerline. Results were similar to those obtained from public sightings data (with known observational bias based upon location) supporting the idea that public sightings data may have value in large scale evaluation.	Pearse AT, Brandt DA, Harrell WC, Metzger KL, Baasch DM, Hefley TJ. 2015. Whooping crane stopover site use intensity within the Great Plains: U.S. Geological Survey Open-File Report 2015–1166, 12 p., https://pubs.er.usgs.gov/publication/ofr20151166
2014	Species distribution modeling	Correction of location errors for presence-only species distribution models	Analyzed sampling bias of whooping crane locations and the effects those errors had on species distribution models.	Whooping cranes avoid development within 100 and 250 m radius but are indifferent to development at 500 m. Species distribution models rely on accurate species locational data as well as accurate measurement of environmental covariates included in the model postulated to be important for species distribution. Errors in location data can lead to biased regression coefficients for species distribution modeling. Regression calibration can reduce this bias, but can increase variance surrounding parameter estimates, widening confidence intervals associated with variables predicting species distribution. Managers should consider whether there is enough location error (either random or systematic) to warrant correction in light of the increase in uncertainty around resulting parameter estimates. Recording accurate locations from the field will greatly increase the accuracy of models.	Hefley TJ, Baasch DM, Tyre AJ, Blankenship EE. 2014. Correction of location errors for presence-only species distribution models. Methods in Ecology and Evolution 5: 207-214. https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/2041-210X.12144

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2013	Population dynamics and recovery planning.	Influence of whooping crane population dynamics on its recovery and management	Modeled 73-year time series of WC abundance to estimate the probability of downlisting. Source for USFWS best estimates of AWB population 1938-2011 obtained through winter surveys.	AWB population experiences periodic population declines but is unlikely to go extinct if future conditions remain similar to those experienced in the past. Provides information for evaluating recovery timelines, habitat conservation targets, management triggers, and monitoring frequency.	Butler MJ, Harris G, Strobel BN. 2013. Influence of whooping crane population dynamics on its recovery and management. Biological Conservation 162: 89-99. https://www.sciencedirect.com/science/article/pii/S0006320713000980
2013	Species distribution modeling	Non-detection sampling bias in marked presence-only data	Used whooping crane data to develop a method that corrects for non-detection sampling bias when using presence-only locational data for species distribution modeling.	Developed a marked inhomogeneous Poisson point process species distribution model that accounted for non-detection and aggregation behavior. Correcting for non-detection sampling bias requires estimates of the probability of detection which must be obtained from auxiliary data, as presence-only data do not contain information about the detection mechanism. The number of detections required may be relatively small to result in adequate correction of non-detection sampling bias. Studies documenting the relationship between environmental features and a species' distribution of abundance must consider the grouping behavior of individuals.	Heffley TJ, Tyre AJ, Baasch DM, Blankenship EE. 2013. Non-detection sampling bias in marked presence-only data. Ecology and Evolution 3(16):5225-5236. https://onlinelibrary.wiley.com/doi/epdf/10.1002/ece3.887
2012-present	USFWS whooping crane survey results: winter 2012 - present	USFWS Whooping crane survey results: winter 2012 - present	Source for USFWS annual estimates of AWB population obtained through winter surveys 2012-present.	The USFWS estimated the abundance of whooping cranes in the AWB population for the winter of 2021–2022 as 543 whooping cranes (95% CI = 426.5–781.8; CV = 0.182) inhabiting the primary survey area. This estimate included at least 31 juveniles (95% CI = 20.2–50.8; CV = 0.255) and 196 adult pairs (95% CI = 153.4–282.9; CV = 0.182).	Butler MJ, Harrell W. Bradley SN, Sanspree CR, Moon JA 2012-2022. Whooping crane survey results: Winter 2012 – present. https://ecos.fws.gov/ServCat/Collection/Profile/1206

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2008	Summary of WC use of central Platte River from 2001-2006	Whooping crane migrational habitat use in the central Platte River during the Cooperative Agreement period, 2001-2006	Used data collected from systematic aerial surveys during the cooperative agreement to answer five objectives related to whooping crane use of the AHR.	During the cooperative agreement period, average predicted probability of detection for each survey ranged from 0.34 to 0.78. The average distance moved (straight line distance between two consecutive locations) across the 13 crane groups was 3.22 miles, ranging from 0.49 – 21.64 miles. There was no trend found in the index of WC use during this monitoring period. Feeding behaviors were the most common activity observed during crane group monitoring. The second most observed behavior was resting. WC selected channels with large unobstructed views with probability of use maximized when unobstructed width was 343 meters (1,125 ft). A flow dependent selection model indicated that wetted width at suitable depth increased the probability of WC use, maximizing probability of selection at a wetted width of 319 meters and proportion of channel at suitable depth or sand being 0.48.	Howlin S, Derby C, Strickland D. West, Inc. 2008. Whooping crane migrational habitat use in the central Platte River during the Cooperative Agreement period, 2001-2006. https://platteriverprogram.org/system/files/Internal%20Pubs%202/WEST%20Inc.%202008_WC%20Migrational%20Habitat%20Use%20%282001-2006%29.pdf
2001-present	Annual spring and fall whooping crane monitoring reports for the central Platte River	Platte River Recovery Implementation Program: implementation of the whooping crane monitoring protocol	Results from systematic aerial monitoring of the AHR on the central Platte River for spring and fall migration.	Results from systematic aerial monitoring of the AHR on the central Platte River for spring and fall migration.	Platte River Recovery Implementation Program (PRRIP). 2001-Present. https://platteriverprogram.org/program-library?field_document_category_ref_target_id=11&field_document_focus_area_ref_target_id=17&field_document_type_ref_target_id=All&field_document_species_ref_target_id=24&title=Monitoring+Report&items_per_page=20