Platte River
Recovery Implementation Program:

IMPLEMENTATION OF THE WHOOPING CRANE MONITORING PROTOCOL
2022 SPRING REPORT

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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 spring 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*. Spring migration monitoring took place from March 6th through April 29th, 2022. During the 55-day monitoring period, surveys were conducted using systematic flight transects along the Platte River from Chapman to Lexington, NE. Of the 110 scheduled flights typical of a 55-day spring monitoring season, 79 (71.8%) were completed. Systematic and opportunistic sightings resulted in the observation of 33 individual whooping cranes, 6.08% of the estimated Aransas – Wood Buffalo (AWB) migratory whooping crane population. Streamflow in the Platte River ranged from 69-2,590 cfs (cubic feet per second) during the monitoring period. Instantaneous discharge at the nearest gaging station at the time crane groups were observed, ranged from 107 cfs – 2,320 cfs. Unobstructed channel width at whooping crane use sites averaged 748 feet and distance to nearest forest averaged 537 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, 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:

EBQ #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.

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 these whooping crane hypotheses, evaluate learning related to the whooping crane Extension 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 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 spring 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 spring 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). 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 spring monitoring period is a 55-day season occurring from March 6th to April 29th. The PRRIP EDO conducted spring 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.

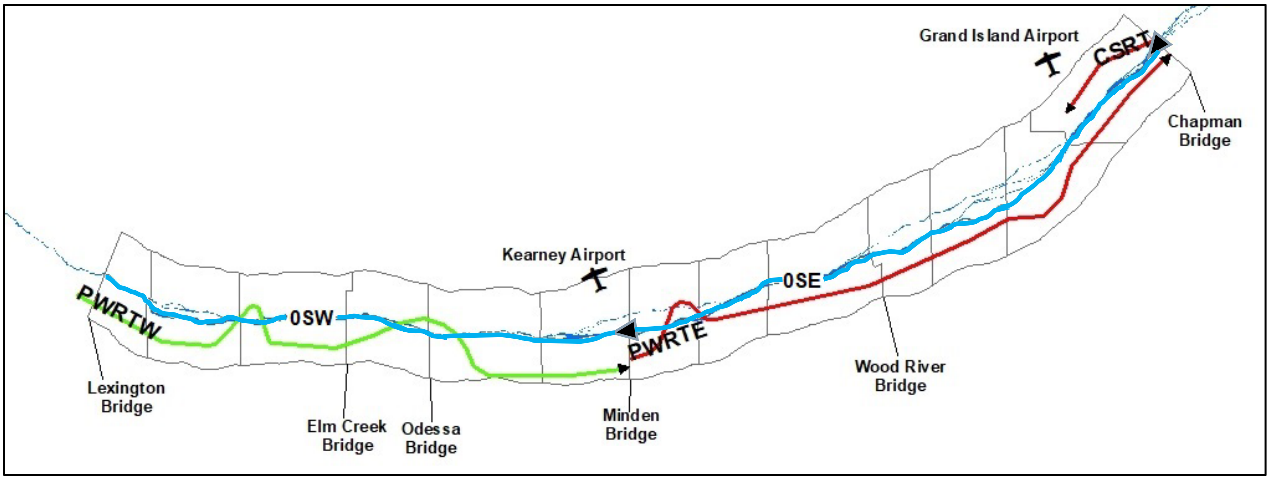

Figure 1. Route 1 east and west flight transects. Black and grey triangles indicate starting points. River channel transect shown in blue (0SW,0SE). West primary wetland return transect (PWRTW) is shown as a green line. East primary wetland return transect (PWRTE) and secondary return transect (CRST)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

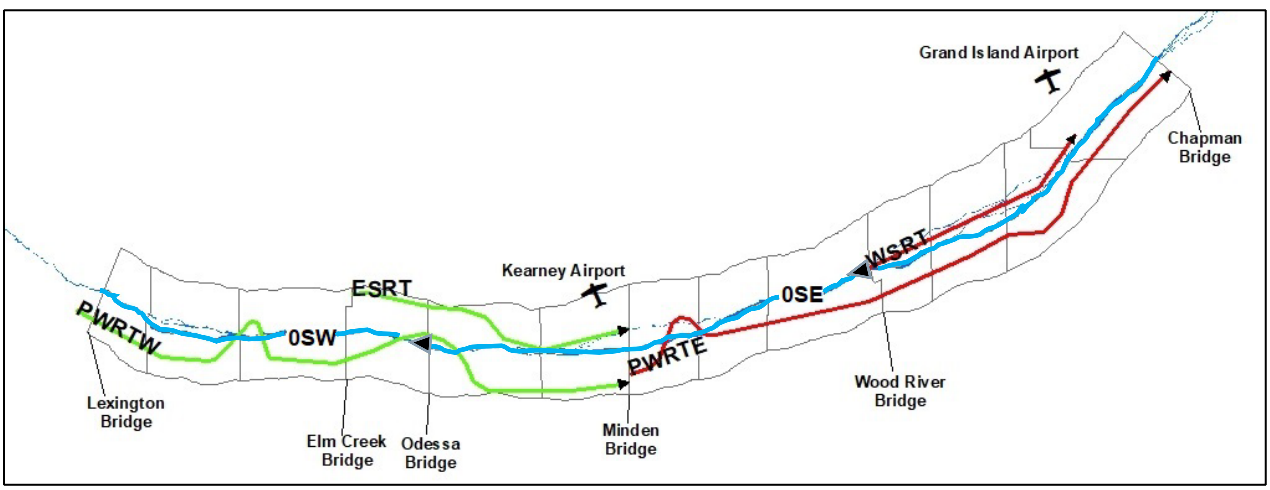

Figure 2. Route 2 east and west flight transects. Black and grey triangles indicate starting points. River channel transect shown in blue (0SW,0SE). West primary wetland return transect (PWRTW) and secondary return transect (ESRT) are shown as green lines. East primary wetland return transect (PWRTE) 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., 2022SP01 = 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 33 individual whooping cranes within 18 unique groups through 63 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 spring 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, and crane use days for each group. The difference in 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. 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 prior to 11:59 a.m. Unique groups are typically individually identifiable by their arrival date, location, and group composition. PRRIP coordinates with USFWS to determine unique groups.

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

PRRIP						USFWS				
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
Not Observed						22A-01	2/28-3/1	4:0	2	12
	2022SP01,02	3/14-3/15	0:1	2	3	22A-03	3/13-3/15	0:1	3	3[a]
	2022SP06,07,09, 13,20,30,37,39,40, 41,43,44,45,47,48, 49,50	3/14-4/9	1:0	27	28	22A-11	3/14-4/9	1:0	27	28
	2022SP03, 10	3/16-3/18	0:1	3	4	22A-04	3/16-3/18	0:1	3	4
	2022SP04,08,17, 18,24,26,27,29,32, 36,38	3/17-3/28	4:2	12	78	22A-10	3/17-3/28	4:2	12	78
	2022SP05,11, 16,21	3/17-3/21	4:0	5	24	22A-09	3/16-3/21	4:0	6	24[a]
	2022SP12,14	3/19-3/20	1:0	2	3	22A-17	3/19-3/20	1:0	2	3
Not Observed						22A-18	3/20	1:0	1	2
	2022SP15	3/20	3:0	1	6	22A-15	3/20	3:0	1	6
	2022SP19	3/21	1:0	1	2	22A-14	3/21	1:0	1	2
	2022SP22	3/21	1:0	1	2	22A-16	3/20-3/21	1:0	2	3
	2022SP23	3/21	1:0	1	2	22A-19	3/21	1:0	1	2
	2022SP25	3/22	1:0	1	2	22A-20	3/22	1:0	1	2
	2022SP28,33	3/24-3/26	1:0	3	4	22A-24	3/24-3/27	1:0	4	5
	2022SP31,35	3/25-3/26	1:0	2	3	22A-26	3/25-3/27	1:0	3	4
Not Observed						22A-29	3/26	7:0	1	7[a]
	2022SP34	3/26	1:0	1	2	22A-25	3/24-3/27	1:0	4	4[a]
Not Observed						22A-35	3/29	2:0	1	2[a]
	2022SP42	4/1	4:0	1	8	22A-40	4/1	4:0	1	8
	2022SP46	4/5	1:0	1	2	22A-49	4/5	1:0	1	2
	2022SP51	4/14	2:0	1	4	22A-63	4/14	2:0	1	4
	2022SP52,53, 54,55,56	4/15-4/19	2:0	5	12	22A-65	4/15-4/19	2:0	5	12
Totals			**29:4**		**189**	**Totals**		**43:4**		**217**

[a]One day per crane was not added to the crane use days for this group due to the first observation of the crane group occurring after 11:59 AM.

There were four instances (22A-01, 22A-18, 22A-29, and 22A-35) where USFWS reported a crane group that was not observed by PRRIP. Group 22A-01 was observed prior to the start date of PRRIP monitoring. Group 22A-18 and 22A-29 were either missed or got off the river prior to the arrival of the aerial survey plane. Group 22A-35 was present on 3/29, a day when both PRRIP flights were cancelled due to weather. These additional four groups that the USFWS recorded consisted of 14 individuals that added 23 days to the USFWS total crane use days. Additionally, there were six instances when groups were reported arriving earlier and/or staying longer by the USFWS than what PRRIP observed, accounting for another five additional crane use days to the USFWS total. Discrepancies among datasets occur when crane groups arrive and are reported to USFWS later in the day after systematic transects have been flown, crane groups leaving the river prior to the survey plane arriving, observers not seeing the group, and/or flights being cancelled for weather.

Overall, PRRIP calculated a total of 189 crane use days during the 2022 spring survey period (Table 1). Since 2007, crane use days for spring migration has ranged from 7 - 492 days (average 102.3 days). Linear regression analysis of the spring crane use day data from 2007 – 2022 demonstrated no significant long-term trend in crane use days through time (y intercept = -19192.45, slope coefficient = 9.578, $r^2 = 0.151$, p-value = 0.137) at an alpha level of 0.05 (Fig. 3).

Proportion of population

According to the most recent survey conducted by the U.S. Fish and Wildlife Service during the winter of 2021-2022, the Aransas – Wood Buffalo (AWB) migratory whooping crane population was estimated to be 543 birds (95% CI: 426.5 – 781.8; USFWS 2022). The 33 individuals (29:4) observed by PRRIP during both systematic and opportunistic monitoring efforts in the spring 2022 season constitute approximately 6.08% of the estimated migratory population.

PRRIP observed whooping crane use of the central Platte River during spring 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 spring has ranged from 0.39% - 23.37% (average 6.64%). Linear regression analysis of the spring proportion data from 2007 – 2022 demonstrated no significant long-term trend (y intercept = -6.873, slope coefficient = 0.003, $r^2 =$ 0.055, p-value = 0.398) at an alpha level of 0.05.

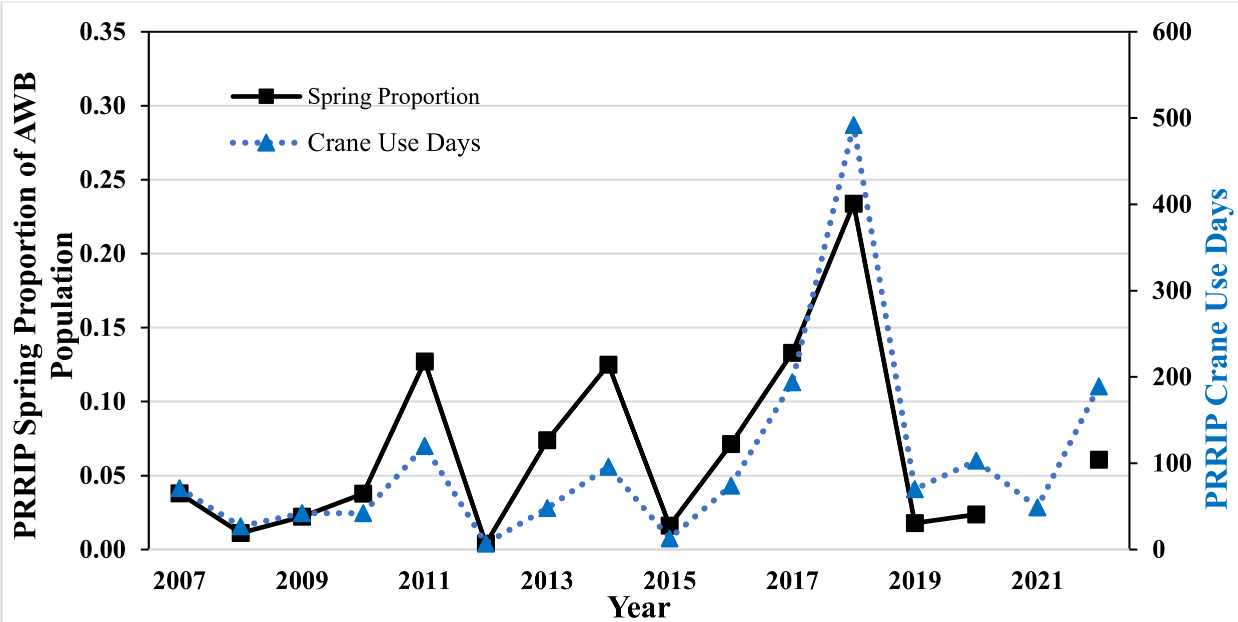

Figure 3. Annual proportion of the estimated Aransas-Wood Buffalo (AWB) whooping crane population (black squares) and number of crane use days (blue triangles) observed during PRRIP aerial systematic and opportunistic spring migration surveys from 2007-2022. Lack of a 2020-2021 winter survey of the AWB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

Streamflow and unobstructed channel width at whooping crane use locations

During the spring 2022 whooping crane migration monitoring period, Platte River flow in the AHR ranged from a low of 69 cubic feet per second (cfs) at Kearney on 4/29/22 (USGS 2022c) to a high of 2,590 cfs at Grand Island on 3/12/22 (USGS 2022d). Instantaneous discharge at the nearest gaging station at the time crane groups were observed, ranged from 107 cfs – 2,320 cfs (Table 2).

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

Unique Group Icon	Crane Group ID	# of Cranes Adults:Juv	Use Site #	Date	Gaging station[a]	Discharge (cfs)
	2022SP01	0:1	1	3/14/22	Grand Island	702
	2022SP02	0:1	1	3/15/22	Grand Island	797
	2022SP06	1:0	5	3/14/22	Grand Island	702
	2022SP07	1:0	6	3/17/22	Grand Island	926
	2022SP09	1:0	7	3/18/22	Grand Island	813
	2022SP13	1:0	5	3/20/22	Grand Island	1,500
	2022SP20	1:0	13	3/21/22	Grand Island	1,550
	2022SP30	1:0	17	3/25/22	Grand Island	605
	2022SP37	1:0	24	3/27/22	Grand Island	420
	2022SP39	1:0	26	3/28/22	Grand Island	383
	2022SP40	1:0	28	3/31/22	Grand Island	2,310
	2022SP41	1:0	29	4/1/22	Grand Island	1,340
	2022SP44	1:0	30	4/3/22	Grand Island	578
	2022SP03	0:1	2	3/16/22	Grand Island	1,210
	2022SP10	0:1	8	3/18/22	Grand Island	794
	2022SP04	4:2	3	3/17/22	Kearney	523
	2022SP18	4:2	12	3/21/22	Cottonwood	1,210
	2022SP29	4:2	19	3/25/22	Cottonwood	267
	2022SP32	4:2	31	3/26/22	Cottonwood	251
	2022SP36	4:2	23	3/27/22	Cottonwood	724
	2022SP38	4:2	25	3/28/22	Cottonwood	1,130
	2022SP05	4:0	4	3/17/22	Kearney	523
	2022SP16	4:0	11	3/20/22	Kearney	1,650
	2022SP14	1:0	9	3/20/22	Grand Island	1,480
	2022SP15	3:0	10	3/20/22	Kearney	1,650
	2022SP22	1:0	14	3/21/22	Kearney	1,610
	2022SP23	1:0	15	3/21/22	Kearney	1,570
	2022SP28	1:0	16	3/24/22	Grand Island	892
	2022SP33	1:0	20	3/26/22	Grand Island	515
	2022SP31	1:0	18	3/25/22	Grand Island	637
	2022SP35	1:0	22	3/26/22	Grand Island	515
	2022SP34	1:0	21	3/26/22	Grand Island	515
	2022SP46	1:0	36	4/5/22	Kearney	2,320
	2022SP51	2:0	32	4/14/22	Grand Island	1,710
	2022SP52	2:0	33	4/15/22	Kearney	154
	2022SP53	2:0	34	4/16/22	Kearney	107
	2022SP56	2:0	35	4/19/22	Kearney	116

[a]Gaging Stations: Cottonwood Ranch – Elm Creek (USGS 2022b), Kearney (USGS 2022c), and Grand Island (USGS 2022d).

Figs. 4-7 display discharge during the spring 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.

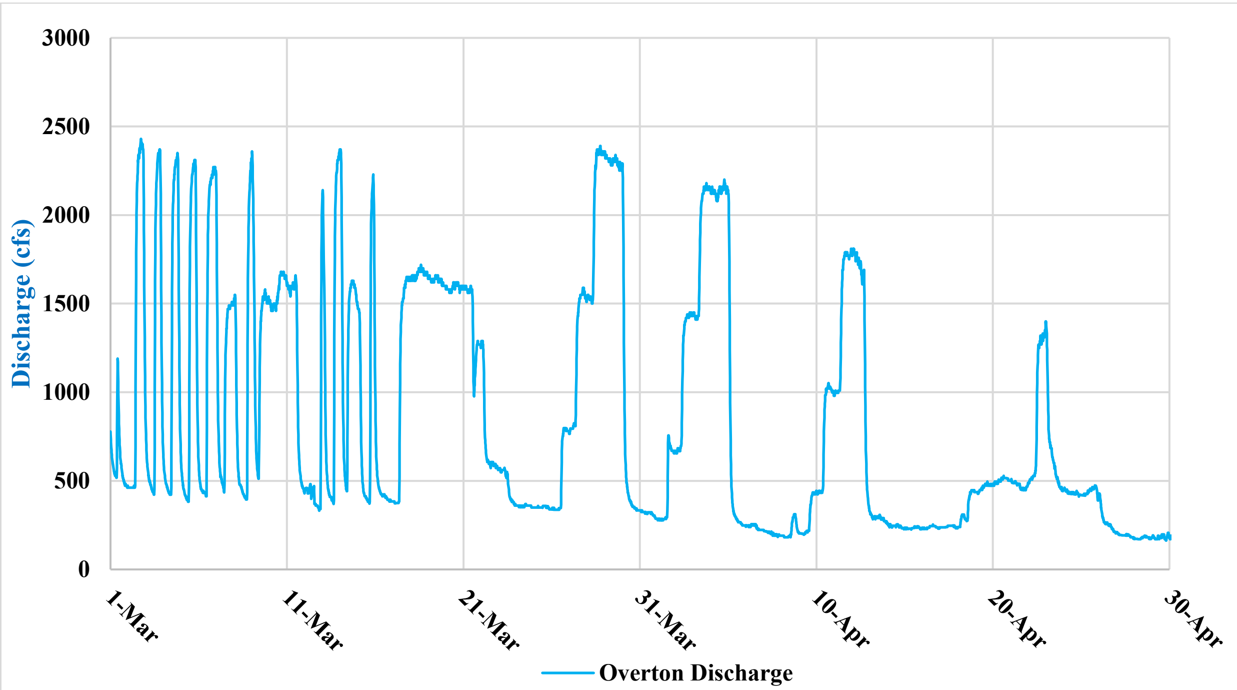

Figure 4. Discharge (blue line) at the Overton gage from 3/1 – 4/30 (USGS 2022a). No whooping cranes were observed either on or off-channel at locations for which the Overton gage was the closest gaging station.

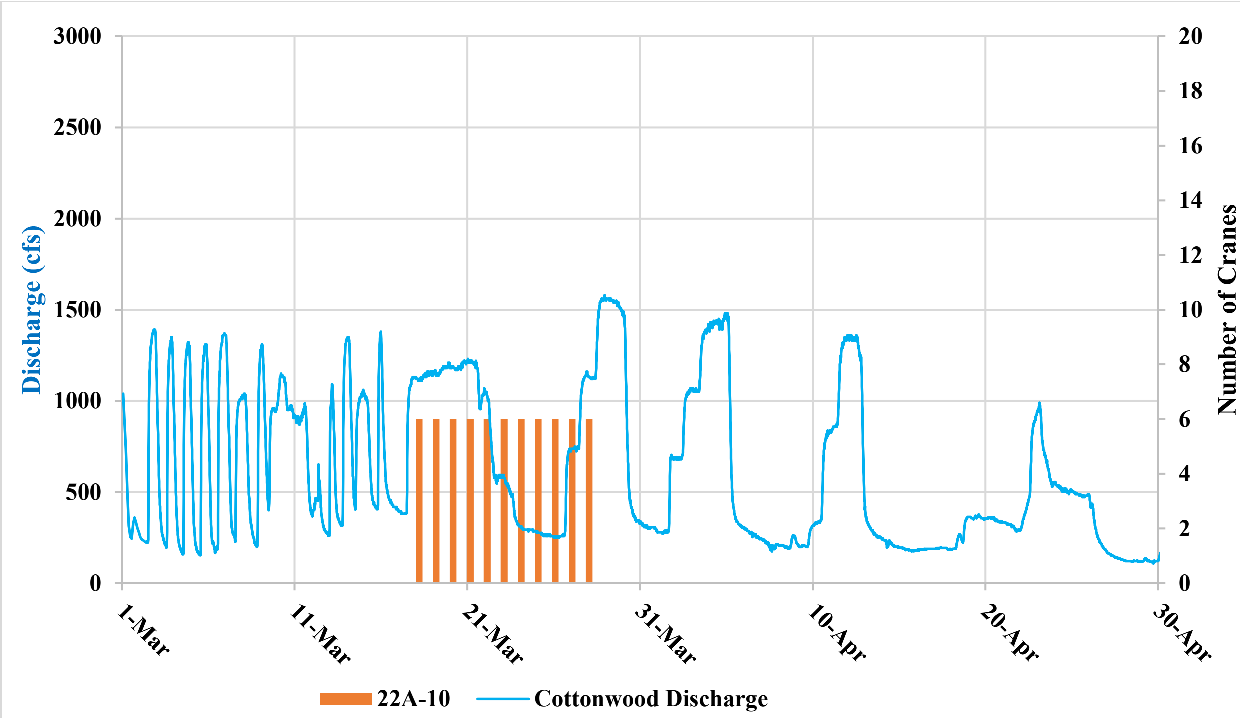

Figure 5. Discharge (blue line) at the Cottonwood gage from 3/1– 4/30 (USGS 2022b) and numbers of whooping cranes from each group (USFWS 22A-10 in colored bar) observed on the indicated dates either on- or off-channel at locations for which Cottonwood was the nearest gaging station.

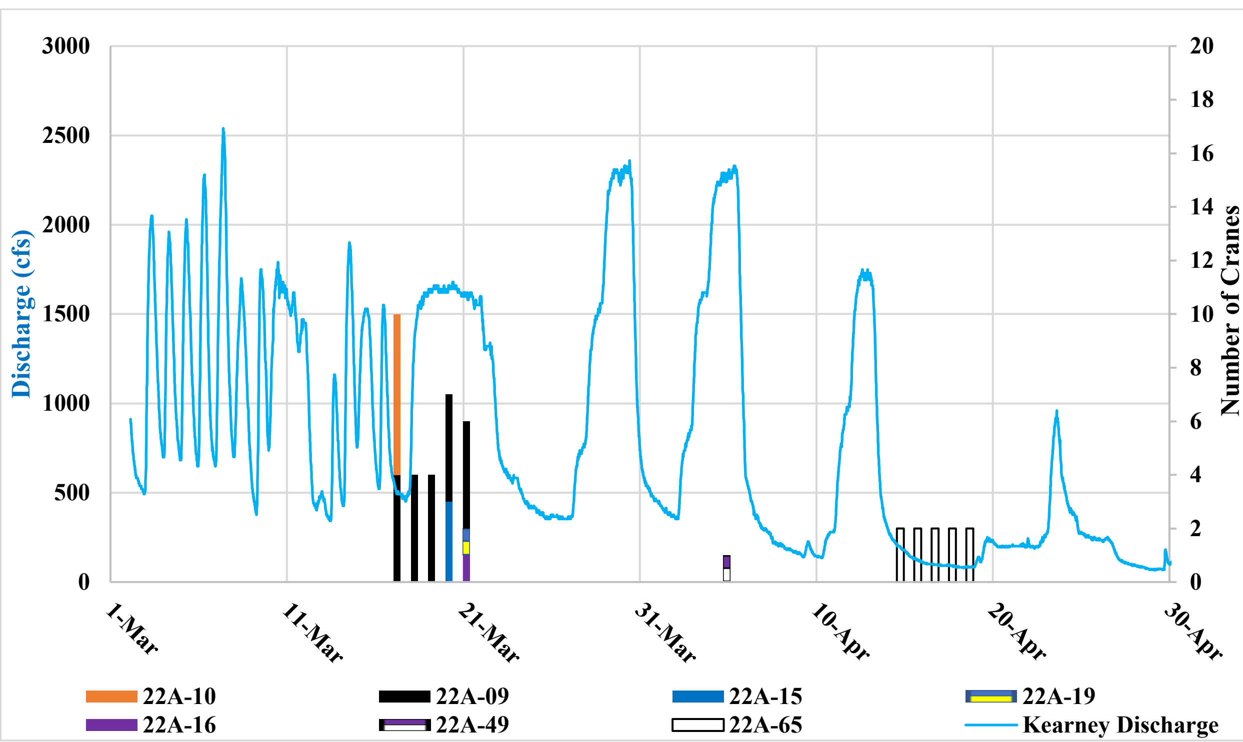

Figure 6. Discharge (blue line) at the Kearney gage from 3/1– 4/30 (USGS 2022c) and numbers of whooping cranes from each group (USFWS 22A-10, 22A-09, 22A-15, 22A-19, 22A-16, 22A-49, and 22A-65 in colored bars) observed on the indicated dates either on- or off-channel at locations for which Kearney was the nearest gaging station.

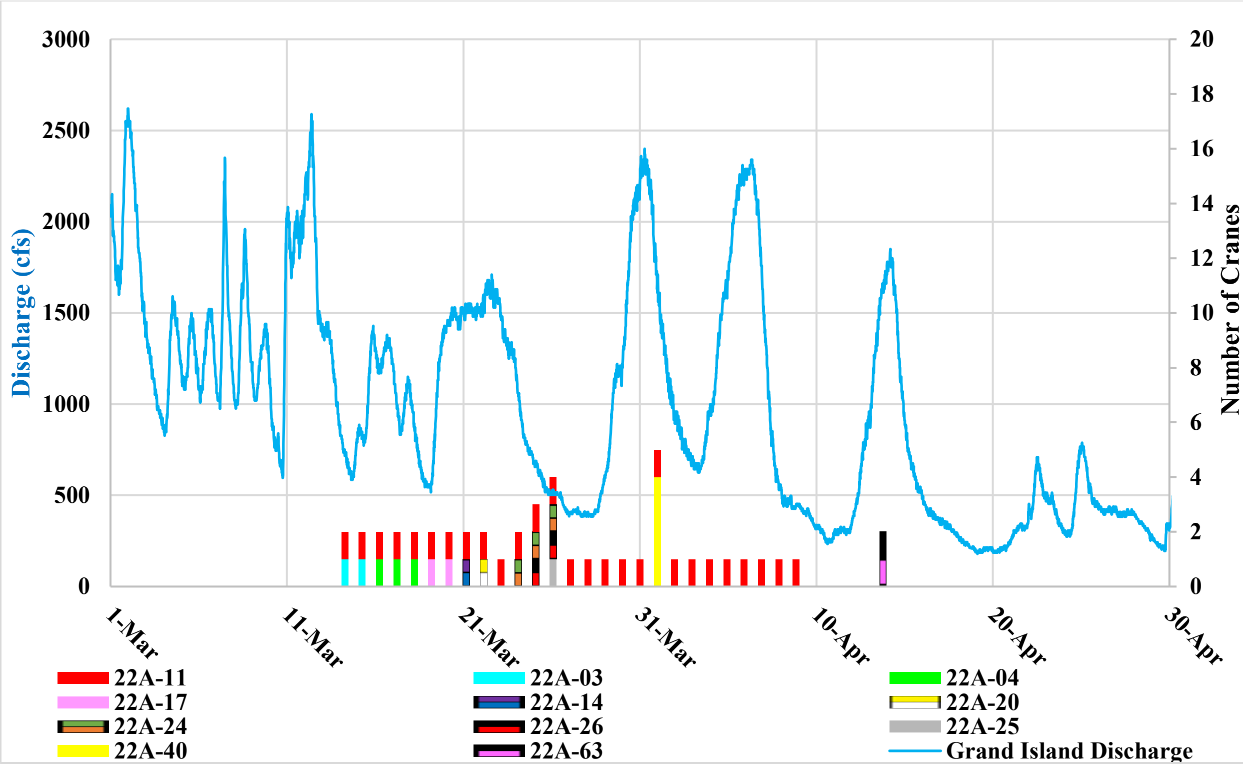

Figure 7. Discharge (blue line) at the Grand Island gage from 3/1 – 4/30 (USGS 2022d) and numbers of whooping cranes from each group (USFWS 22A-11, 22A-03, 22A-04, 22A-17, 22A-14, 22A-20, 22A-24, 22A-26, 22A-25, 22A-40 and 22A-63 in colored bars) observed on the indicated dates either on- or off-channel at locations for which Grand Island was the nearest gaging station.

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 2021 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 257 – 1,201 feet (average = 748 feet) (Table 3). Nearest forest ranged from 61 – 1,660 feet (average = 537 feet).

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

Unique Group Icon	Crane Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Unobstructed Channel Width (ft)	Nearest Forest (ft)
	2022SP01	1	539638	4511504	803	402
	2022SP02	1	539638	4511504	803	402
	2022SP06	5	562167	4527057	988	547
	2022SP07	6	561849	4526913	1,060	368
	2022SP09	7	562243	4527031	988	456
	2022SP13	5	562167	4527057	988	547
	2022SP20	13	562342	4527111	451	1,166
	2022SP30	17	561386	4525883	558	176
	2022SP37	24	559862	4523371	571	187
	2022SP39	26	559627	4523447	558	341
	2022SP40	28	560451	4524512	1,021	499
	2022SP41	29	554310	4518089	501	311
	2022SP44	30	554643	4518447	374	279
	2022SP03	2	544709	4514533	1,201	1,660
	2022SP10	8	547931	4515204	661	506
	2022SP04	3	480759	4501035	530	243
	2022SP18	12	471947	4503743	833	161
	2022SP29	19	471982	4503584	930	716
	2022SP32	31	472301	4503499	875	738
	2022SP36	23	472252	4503532	875	679
	2022SP38	25	473173	4503370	954	657
	2022SP05	4	506057	4501457	808	1402
	2022SP16	11	506872	4501842	938	351
	2022SP14	9	554235	4517974	395	174
	2022SP15	10	522747	4507360	501	204
	2022SP22	14	511678	4502968	711	610
	2022SP23	15	508993	4502050	460	642
	2022SP28	16	531113	4509124	1,022	593
	2022SP33	20	538644	4511293	1,017	436
	2022SP31	18	547584	4515338	257	61
	2022SP35	22	543775	4513937	820	730
	2022SP34	21	545128	4514670	826	403
	2022SP46	36	507229	4501818	710	513
	2022SP51	32	548604	4515257	517	855
	2022SP52	33	520343	4506780	740	402
	2022SP53	34	516774	4505042	798	644
	2022SP56	35	517138	4505356	617	795
				Average:	**748**	**537**

Figures 8-26 provide maps of crane group use locations in relation to PRRIP and other conservation lands. Figures 27-43 provide photographs of whooping crane groups observed during systematic and opportunistic monitoring.

Monitoring Effort and Detection Probabilities

Systematic effort

A total of 43 whooping crane observations resulting in the documentation of 16 unique crane groups containing 31 individuals were made while conducting systematic aerial monitoring (Appendix A). Of the 110 regularly scheduled flights, there were 84 instances when crews were able to depart the airport, of which 79 were completed, resulting in completion of 71.8% of scheduled flights (Table 4). Twenty-six flights were cancelled, and five flights were initiated, but not completed. One day 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, 218 (72.2%) of the 302 scheduled systematic transects were completed. Within the five incomplete flights, there were seven transects initiated but not completed when the weather turned poor mid-survey. The transects that were not initiated prior to ending the survey are recorded as cancelled along with all transects that are scheduled when the plane does not depart the airport. Seventy-seven transects were cancelled. (Table 6).

Table 4. Systematic flight completion rates.

	East	**West**	**Totals**
Regularly Scheduled			
Systematic Completed	40	39	79
Cancelled/Incomplete	15	16	31
Scheduled Season Total	55	55	110
OVERALL % COMPLETED	**72.7%**	**70.9%**	**71.8%**

Opportunistic effort

All observations made outside of the systematic aerial transects were considered opportunistic. Twenty opportunistic observations were recorded for eight crane groups this season (Appendix A). For six of the eight crane groups, these opportunistic observations added to information about crane groups that were also observed in the systematic aerial surveys. However, opportunistic ground observations did pick up an additional two crane groups (2022SP19 and 2022SP25), that were not detected during any systematic survey, bringing the total number of whooping cranes observed for the spring 2022 season over both systematic and opportunistic efforts up to 33 individuals and 18 unique crane groups.

Of those 20 opportunistic observations, one (2022SP55) was an aerial observation made while in route from the airport to the systematic transect. Nineteen were opportunistic observations made from the ground for which 13 were made by ground crews independently without the aid of aerial support (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 has been 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	Date	Source	WC Confirmed Ad:Juv	Miles Driven	Aerial/Ground Effort
N/A	3/9	Plane	None	21	Both
N/A	3/14	Plane	None	33	Both
N/A	3/14	Plane	None	25	Both
	3/14	Plane	0:1	12	Both
N/A	3/15	Known	None	29	Ground
	3/17	Plane	4:2	1	Both
	3/18	Known	4:2	3	Ground
N/A	3/19	Known	None	25	Ground
	3/19	No Info	1:0	1	Ground
N/A	3/20	Known	None	28	Ground
	3/21	Known	1:0	2	Ground
	3/21	Known	4:2	5	Both
N/A	3/22	Known	None	30	Ground
	3/22	Known	4:2	5	Ground
	3/22	No Info	1:0	1	Ground
N/A	3/23	Known	None	96	Ground
N/A	3/23	Known	None	151	Ground
N/A	3/23	Known	None	85	Ground
N/A	3/23	Known	None	37	Ground
N/A	3/23	Known	None	10	Ground
	3/23	Known	4:2	1	Ground
	3/27	Known	4:2	2	Both
N/A	3/30	Known	None	128	Ground
N/A	3/30	Known	None	32	Ground
	3/31	Plane	1:0	1	Both
	4/2	Known	1:0	60	Ground
	4/4	Known	1:0	1	Ground
	4/6	Known	1:0	10	Ground
N/A	4/6	Known	None	15	Ground
	4/7	Known	1:0	1	Ground

Unique Group Icon	Date	Source	WC Confirmed Ad:Juv	Miles Driven	Aerial/Ground Effort
	4/8	Known	1:0	15	Ground
	4/9	Known	1:0	1	Ground
	4/14	Plane	2:0	20	Both
	4/17	Known	2:0	1	Ground
			Total:	**888**	

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]	41	79	5	26	110	41:20:00	8,831
		Off Channel	PWRTE, PWRTW[c]	2	80	2	28	110	38:43:00	
			WSRT, CSRT, ESRT[d]	0	59	0	23	82	10:56:00	
Opportunistic		Flight[e]		1						
		Ground[f]		19					33:36:00	888
		TOTALS		63	218	7	77	302	124:35:00	9,719

[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]Opportunistic-Flight: includes observations made while in route to systematic transects or deviations from the systematic transects.
[f]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 seven of the ten decoy sets placed in a wetted channel (70.0%) and three of the ten decoy sets placed at off-channel locations (30.0%) (Table 7).

Table 7. Observation efficiency trials using whooping crane decoys.

Date Placed	Date Tested	UTMx	UTMy	# of Decoys	Habitat Type	Detected
3/15	3/16	516350	4505043	1	Channel	NO
3/15	3/16	500753	4501293	1	Lowland Grass	NO
3/16	3/17	516704	4505347	2	Lowland Grass	NO
3/16	3/17	499937	4501204	2	Lowland Grass	NO
3/19	3/20	461586	4504012	3	Lowland Grass	NO
3/20	3/21	459717	4503830	1	Lowland Grass	NO
3/23	3/24	461077	4503971	1	Channel	YES
3/23	3/24	447720	4504172	3	Lowland Grass	YES
3/24	3/25	447852	4504657	2	Channel	YES
3/24	3/25	458679	4503676	2	Channel	NO
3/25	3/26	446842	4504789	1	Channel	YES
3/30	3/31	534364	4510572	1	Channel	YES
3/30	3/31	550694	4517201	2	Lowland Grass	NO
3/31	4/1	549110	4515348	2	Channel	YES
3/31	4/1	534588	4510512	1	Lowland Grass	YES
4/11	4/13	533759	4510375	1	Channel	NO
4/11	4/13	510730	4503130	2	Lowland Grass	NO
4/14	4/15	511109	4502851	3	Lowland Grass	YES
4/20	4/21	561717	4526847	2	Channel	YES
4/27	4/28	456978	4502936	2	Channel	YES

Comparatively, observation efficiency in the spring of 2022 was above the average of 64% since 2011 for channel decoys and above the average of 22% since 2013 for off-channel decoys. Observation efficiency will likely continue to be above historic averages prior to 2020 when only single decoys were placed. In 2020, decoy placements were adjusted to groups of 1-3 decoys per set to better replicate whooping crane detectability.

Incidental take

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. During the 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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Figures

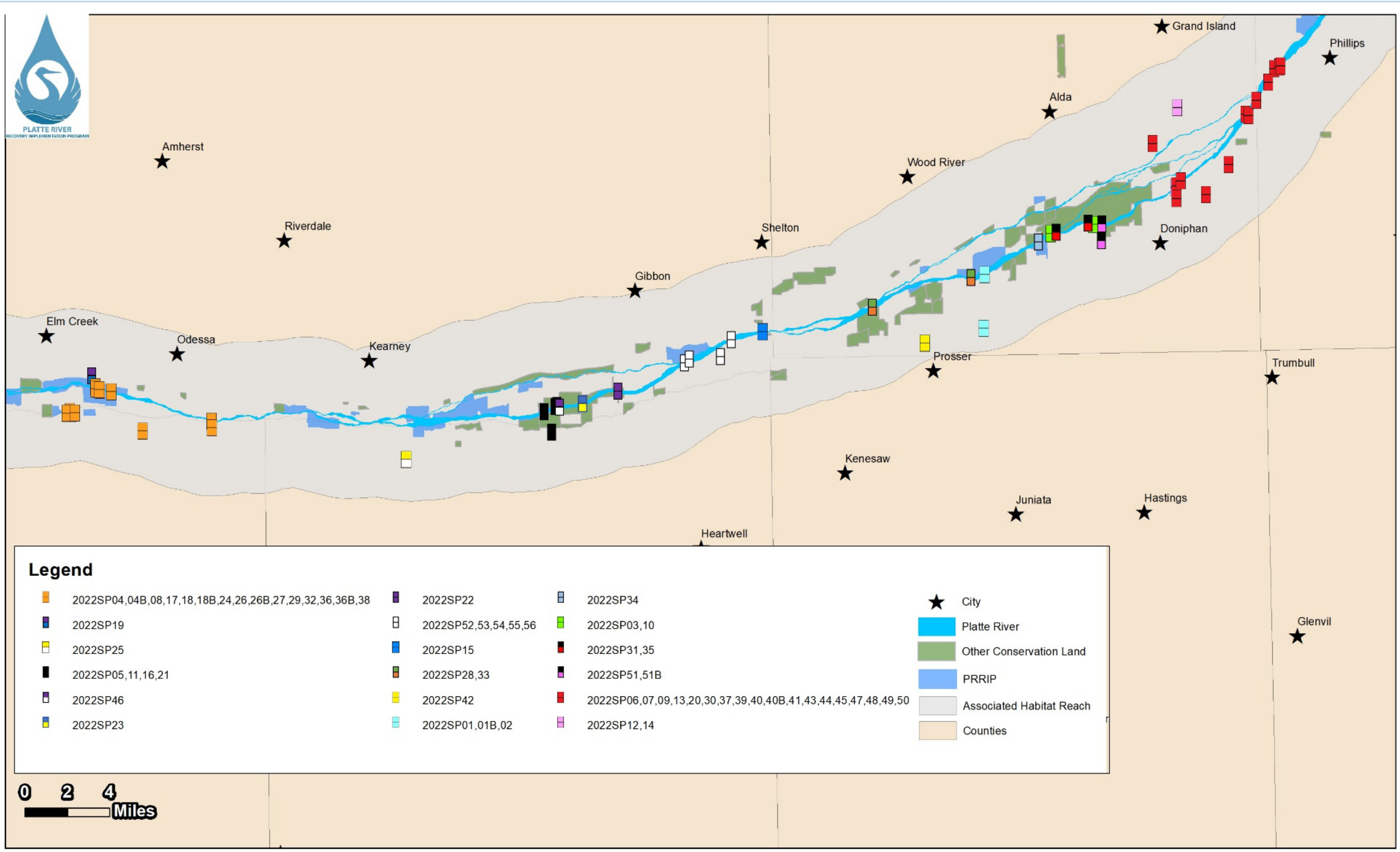

Figure 8. Distribution of whooping crane group observations within the AHR during the 2022 spring survey.

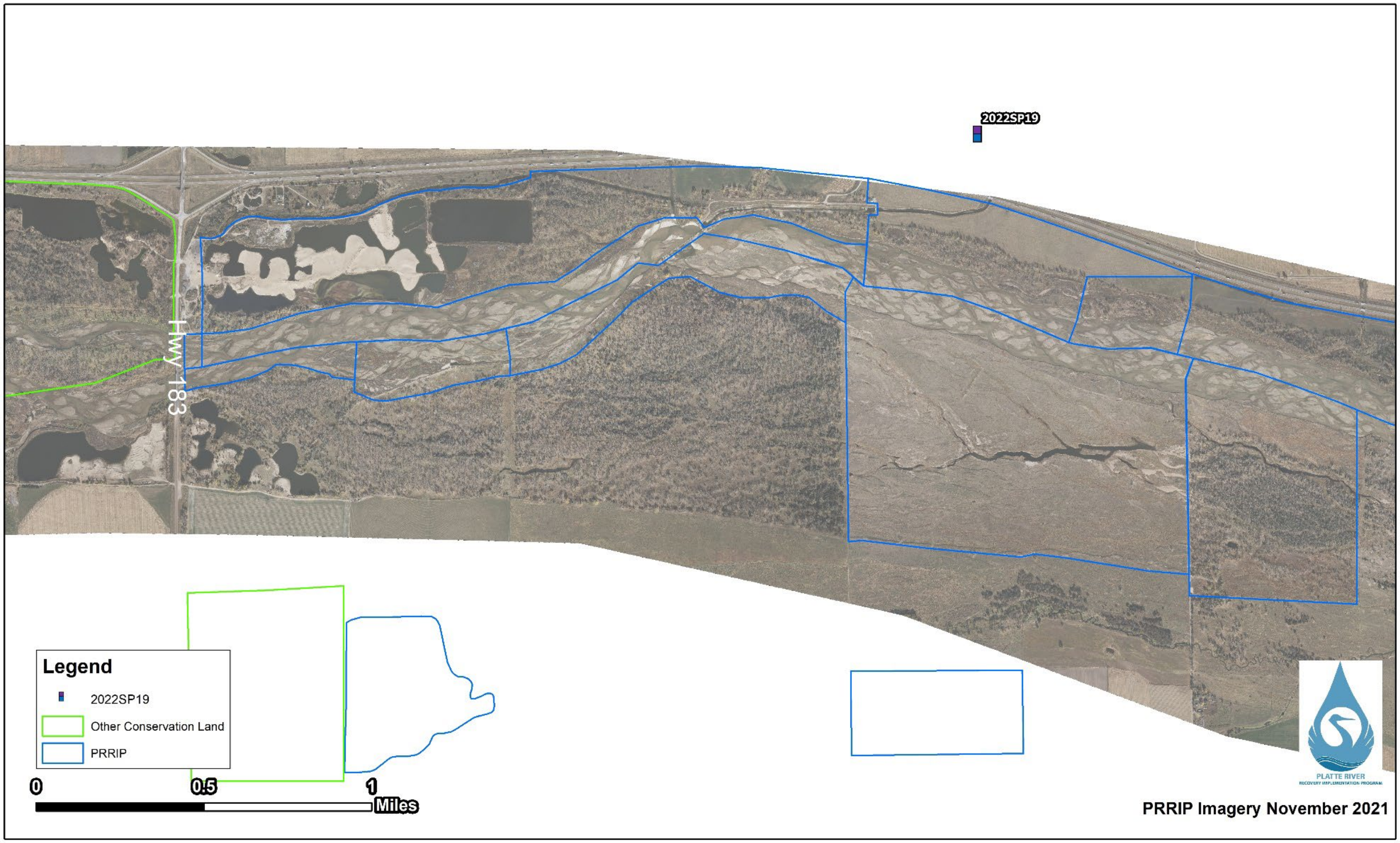

Figure 9. Elm Creek Complex. Whooping crane group 2022SP19 observed on 3/21/22 southeast of Elm Creek, NE.

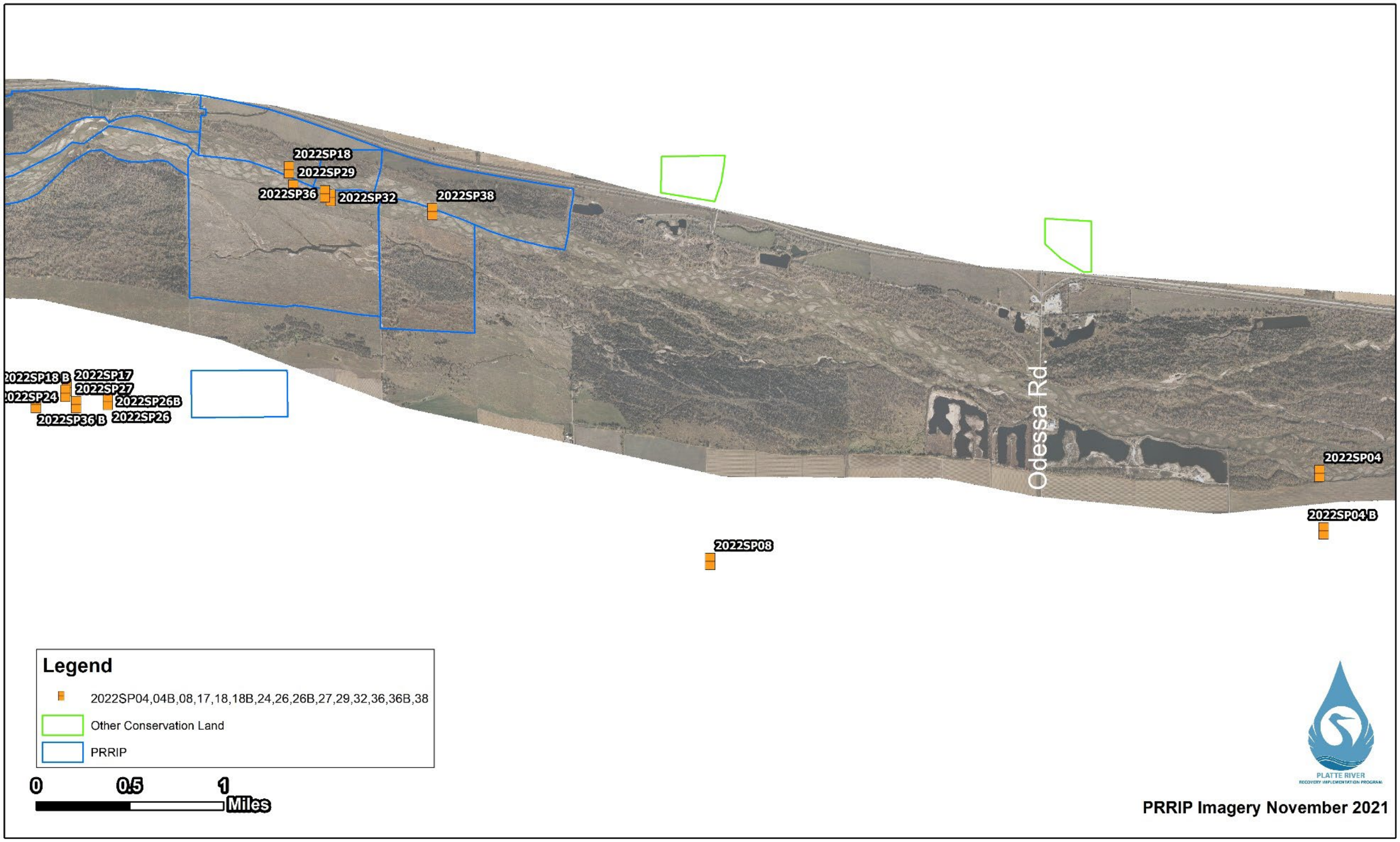

Figure 10. Elm Creek Complex. Whooping crane group 2022SP04, 04B, 08, 17, 18, 18B, 24, 26, 26B, 27, 29, 32, 36, 36B, and 38 observed on 3/17/22 – 3/28/22 (including use sites 3, 12, 19, 23, 25, and 31) south of Odessa, NE.

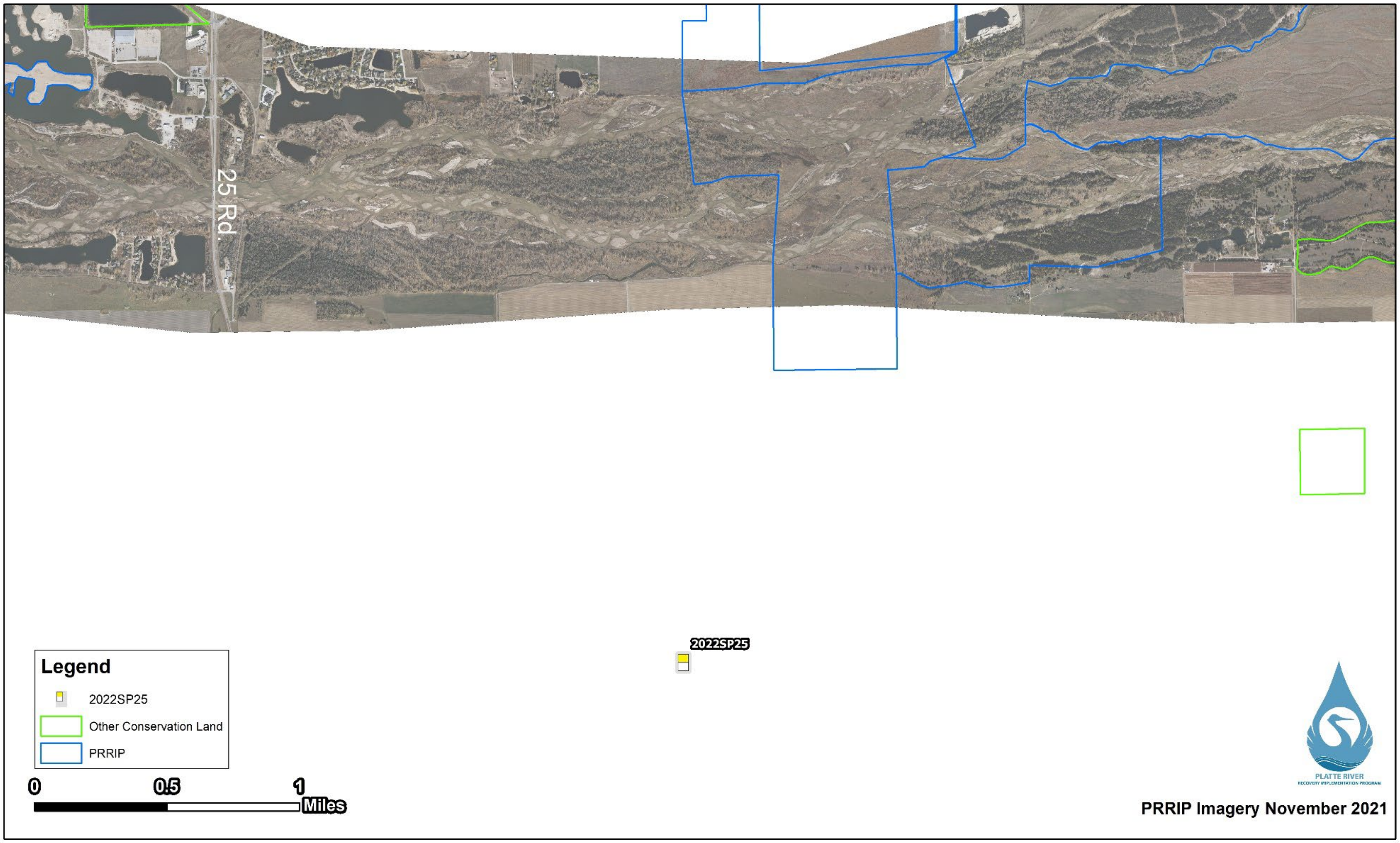

Figure 11. Fort Kearny Complex. Whooping crane group 2022SP25 observed on 3/22/22 south of Kearney, NE.

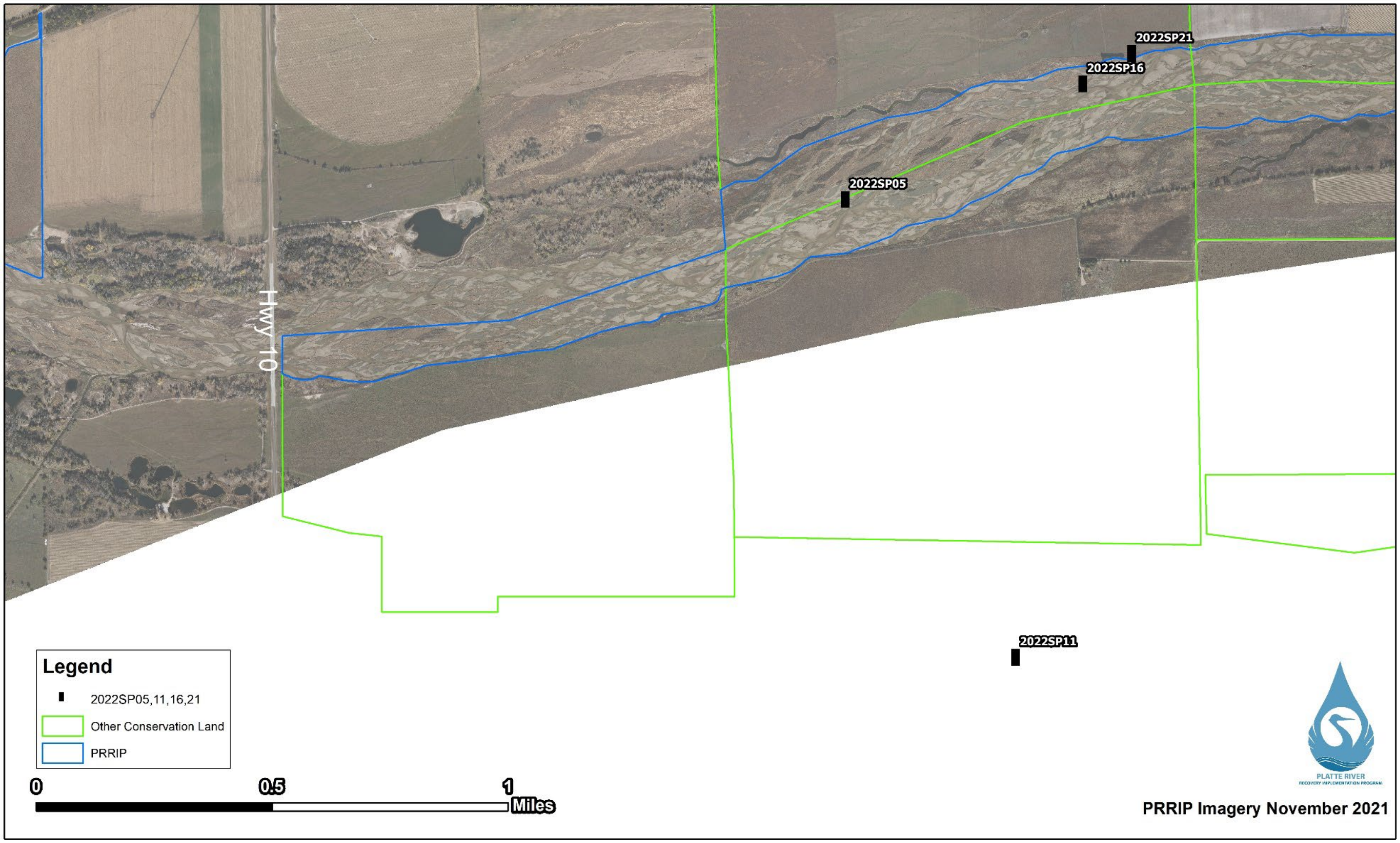

Figure 12. Rowe. Whooping crane group 2022SP05, 11, 16, and 21 observed on 3/17/22 – 3/21/22 (including use sites 4 and 11) north of Minden, NE.

Figure 13. Rowe. Whooping crane group 2022SP46 observed on 4/5/22 (including use site 36) north of Minden, NE.

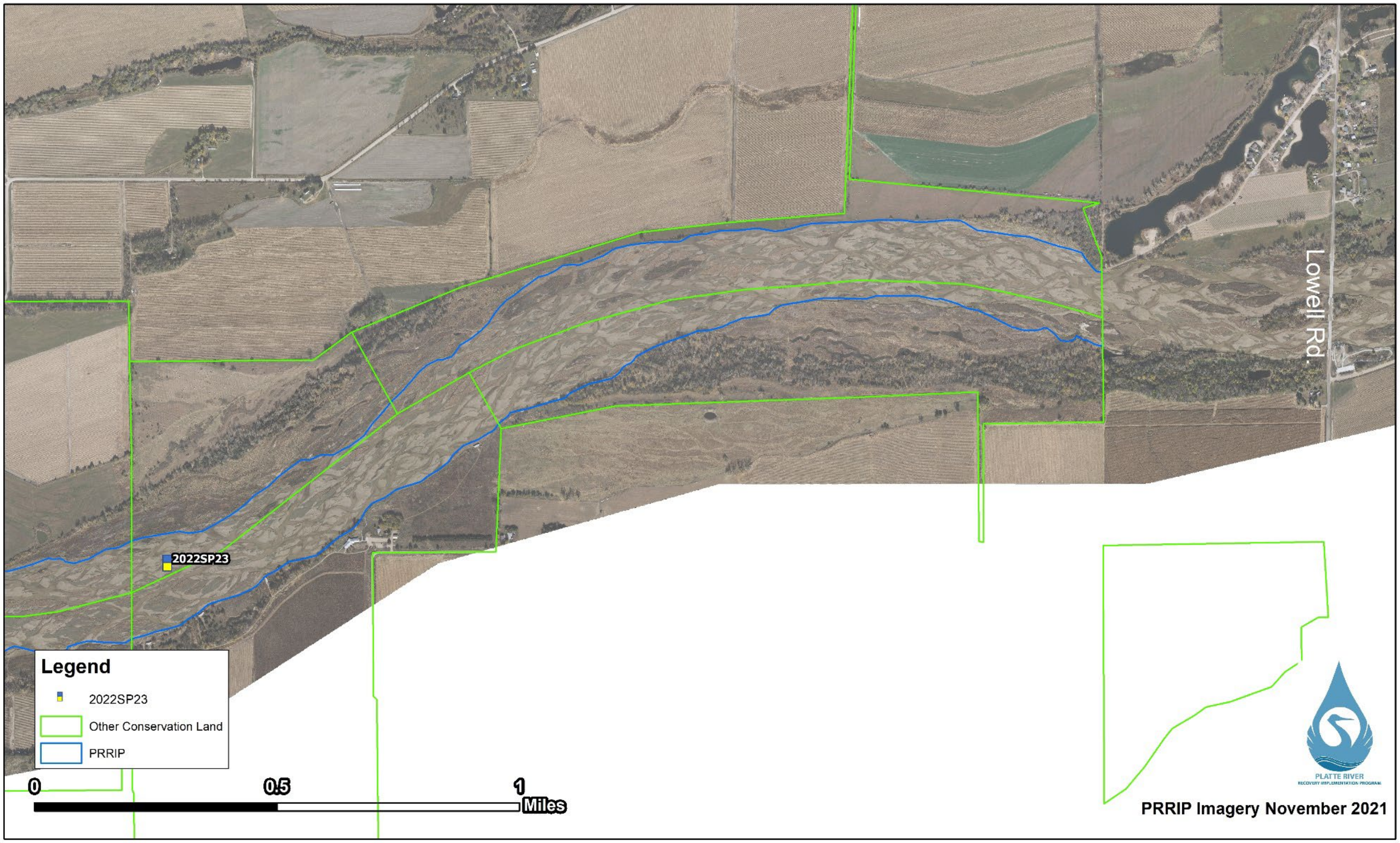

Figure 14. Rowe. Whooping crane group 2022SP23 observed on 3/21/22 (including use site 15) south of Gibbon, NE.

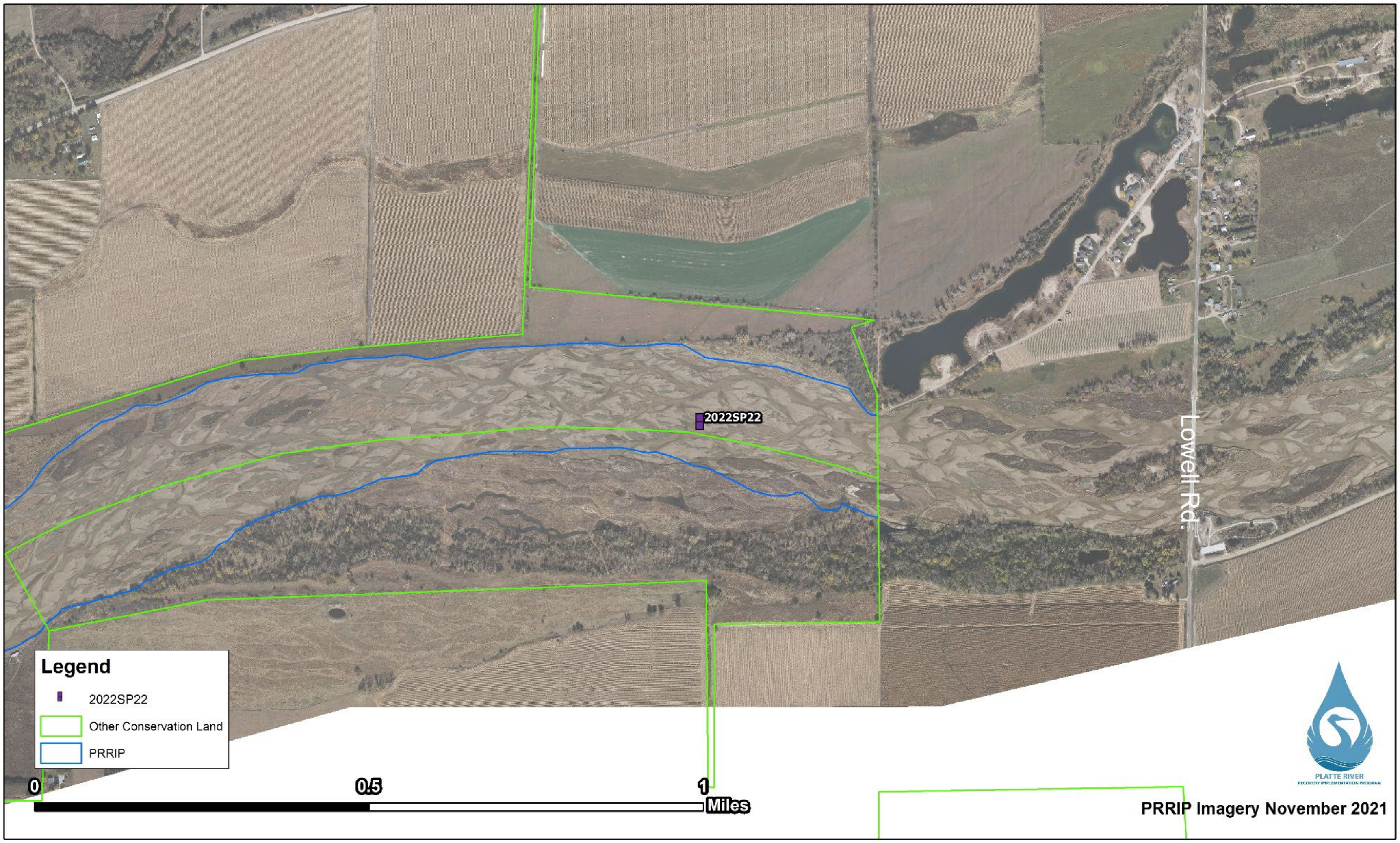

Figure 15. Rowe. Whooping crane group 2022SP22 observed on 3/21/22 (including use site 14) south of Gibbon, NE.

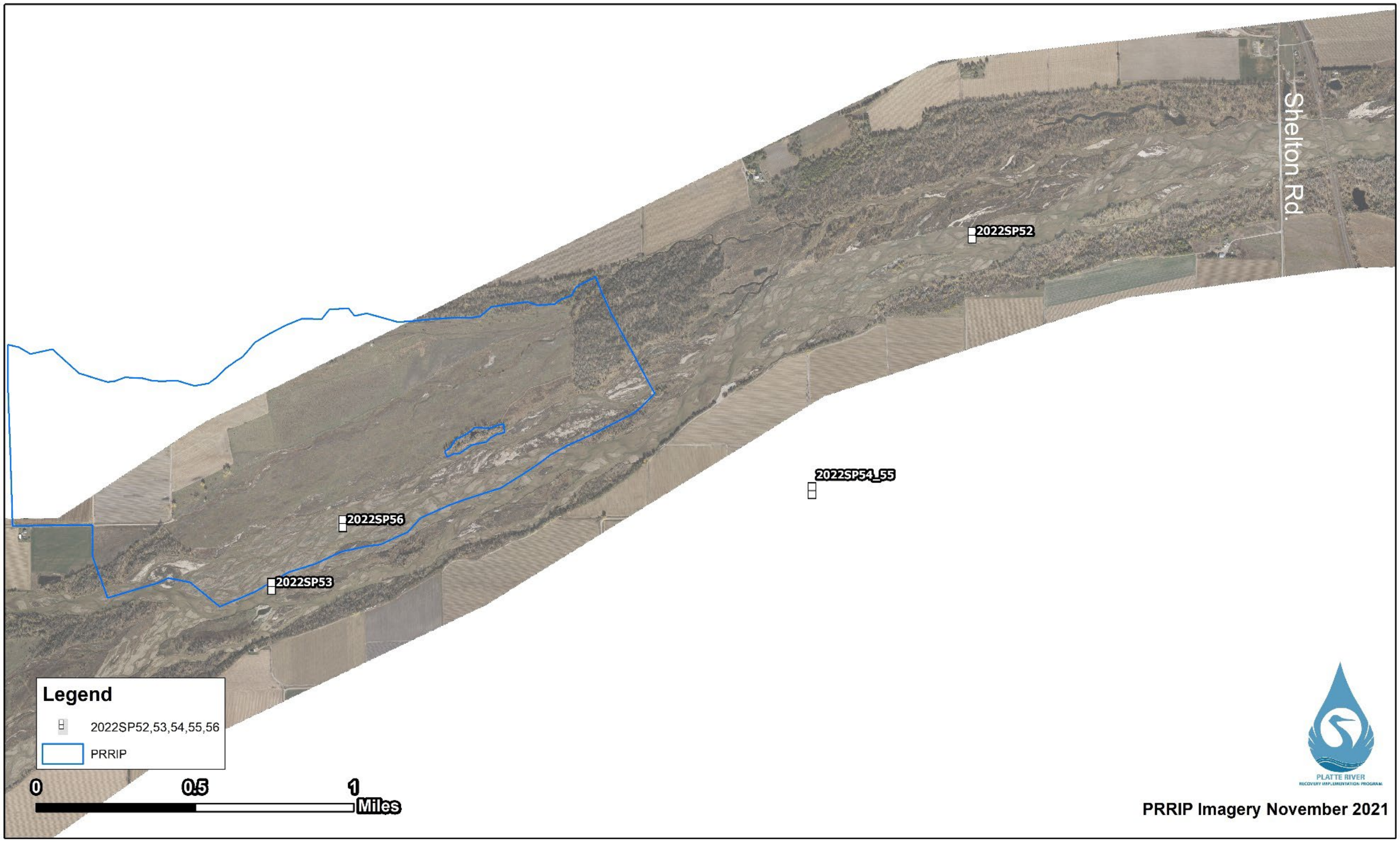

Figure 16. Clark Island Complex. Whooping crane group 2022SP52, 53, 54, 55, and 56 observed on 4/15/22 – 4/19/22 (including use site 33, 34, and 35) southeast of Gibbon, NE.

Figure 17. Shelton. Whooping crane groups 2022SP15 observed on 3/20/22 (including use site 10) south of Shelton, NE.

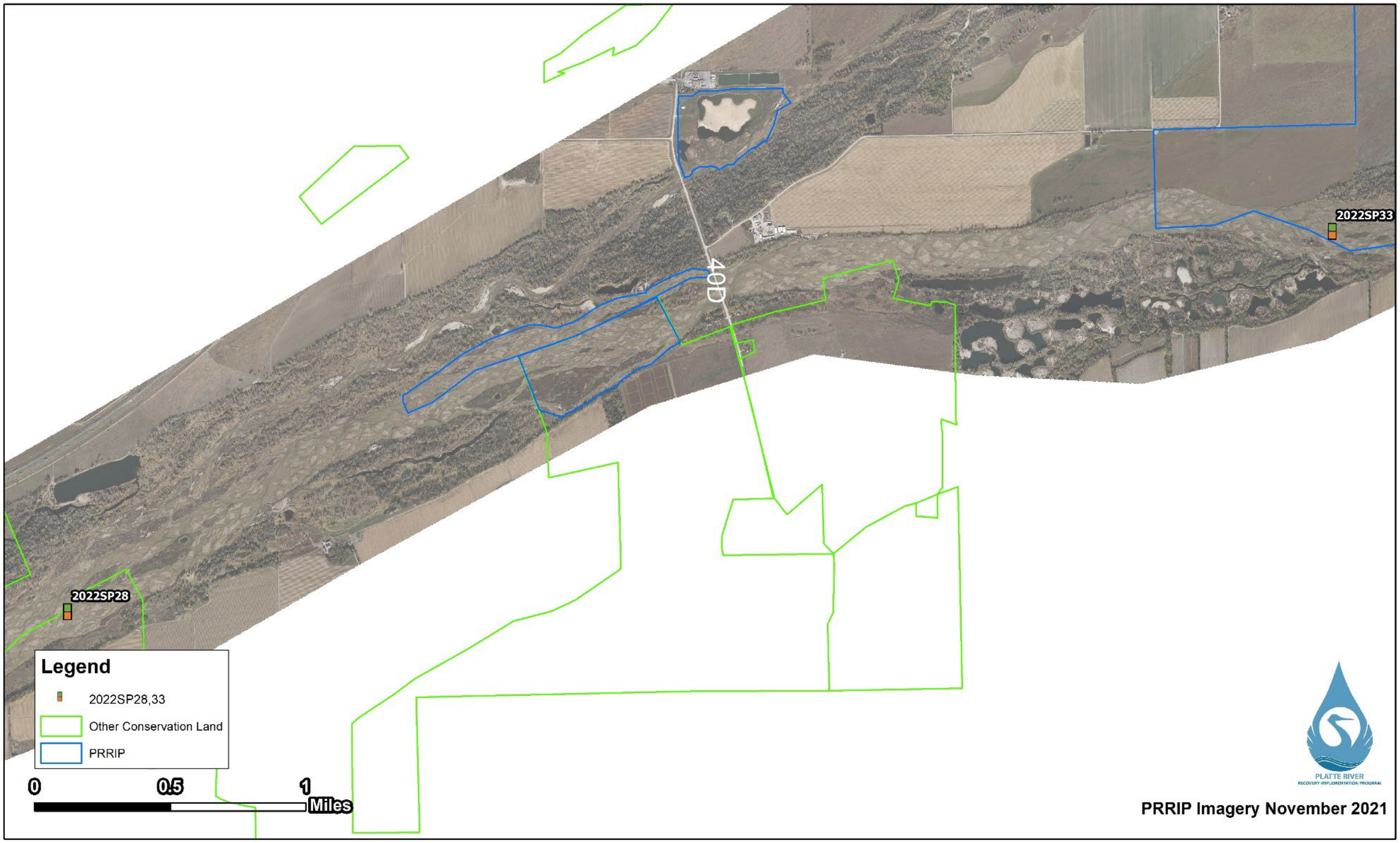

Figure 18. Shelton to Wood River plus Shoemaker Island Complex. Whooping crane group 2022SP28 and 33 observed on 3/24/22-3/26/22 (including use sites 16 and 20) south of Wood River, NE.

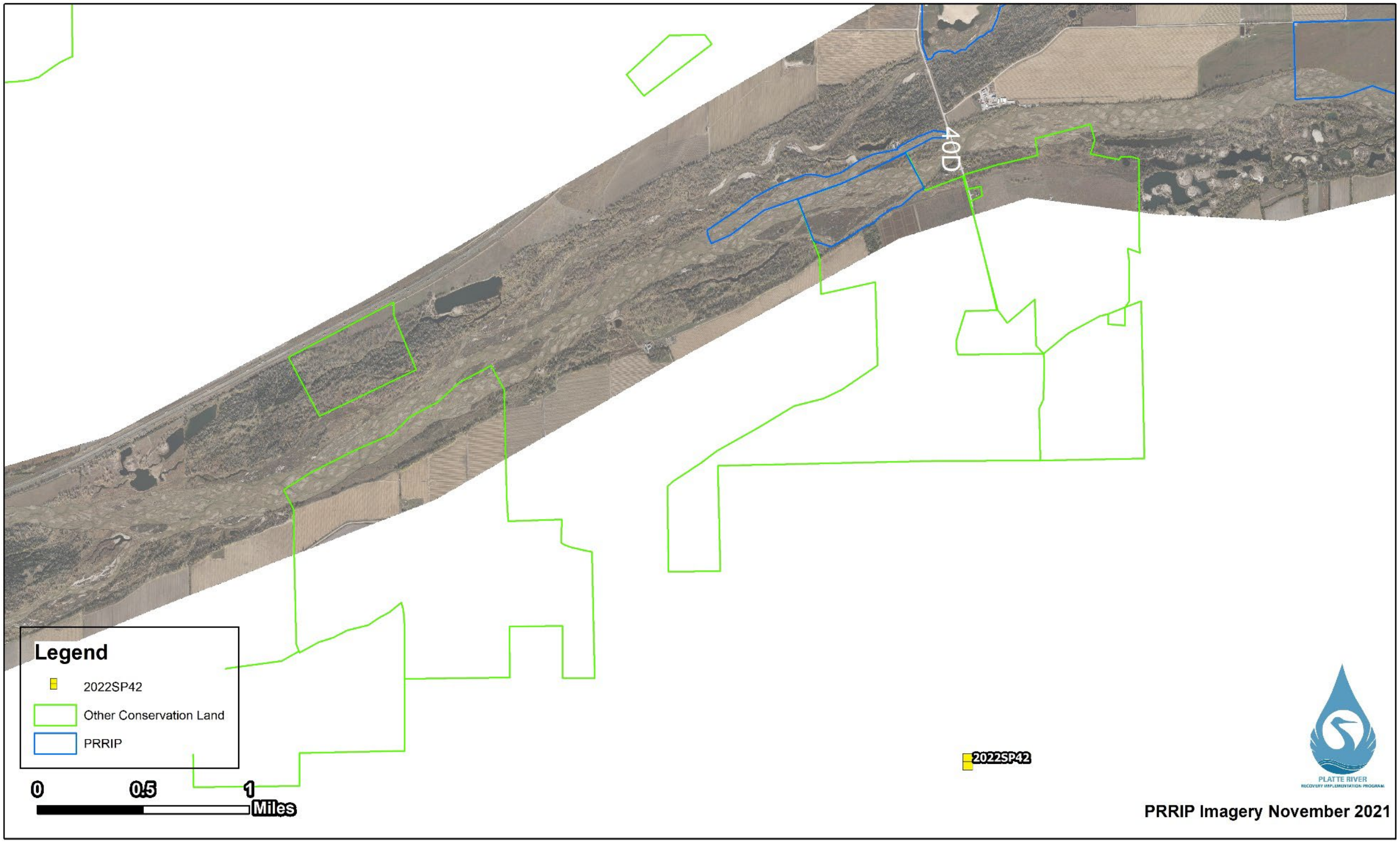

Figure 19. Shelton to Wood River plus Shoemaker Island Complex. Whooping crane group 2022SP42 observed in flight on 4/1/22 south of Wood River, NE.

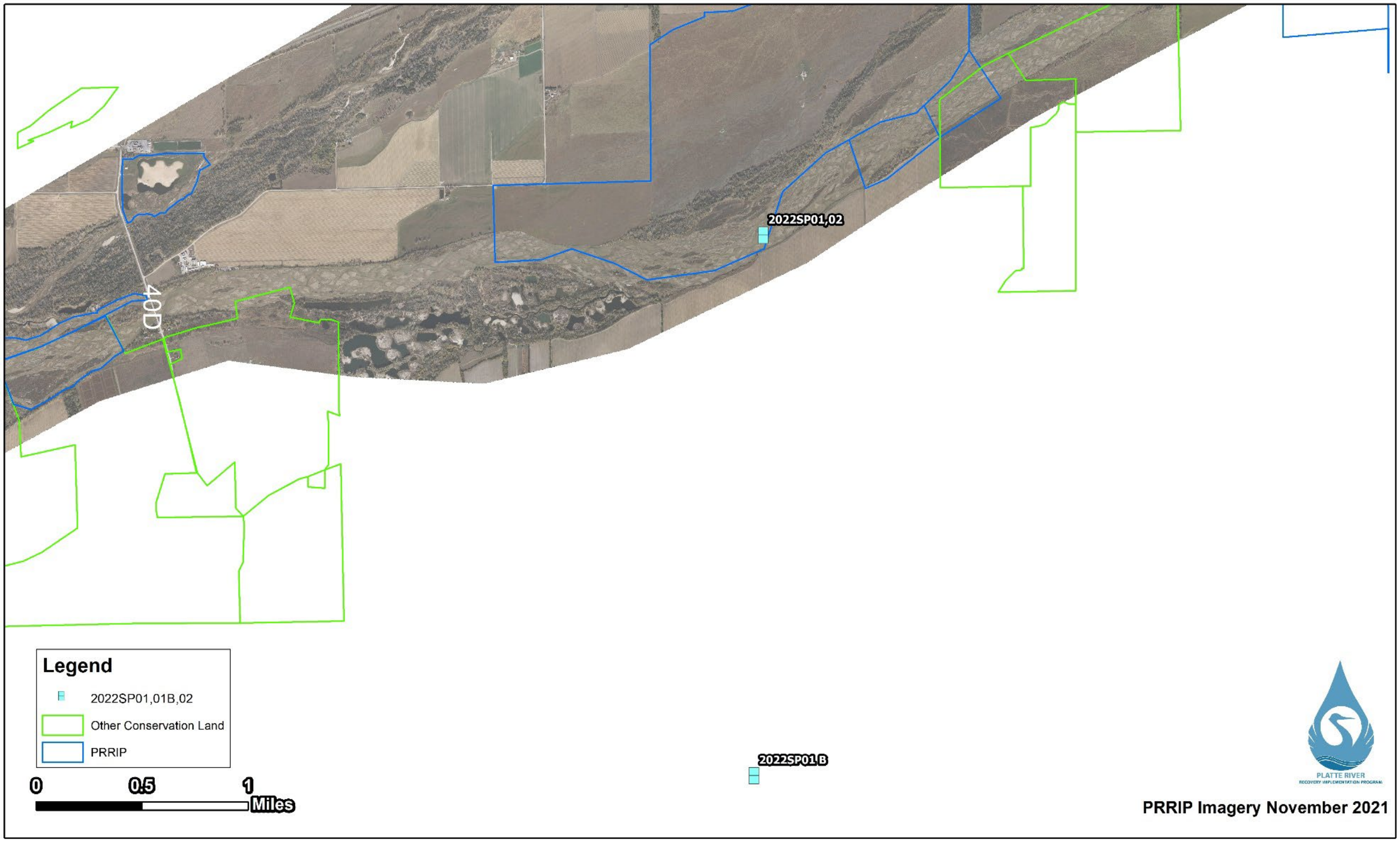

Figure 20. Shoemaker Island Complex. Whooping crane group 2022SP01, 01B, and 02 observed on 3/14/22-3/15/22 (including use site 1) south of Wood River, NE.

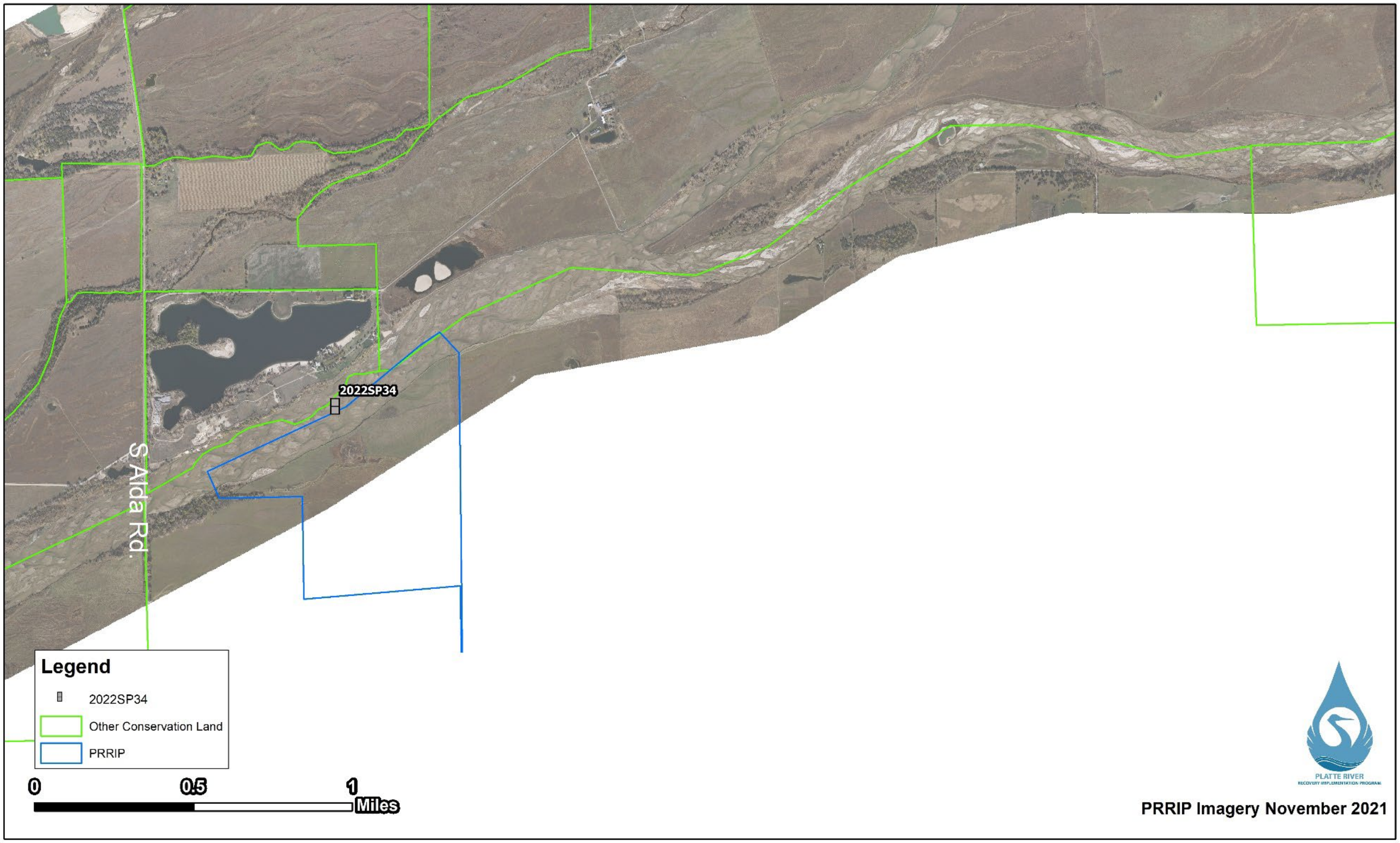

Figure 21. Alda to Grand Island. Whooping crane group 2022SP34 observed on 3/26/22 (including use site 21) south of Alda, NE.

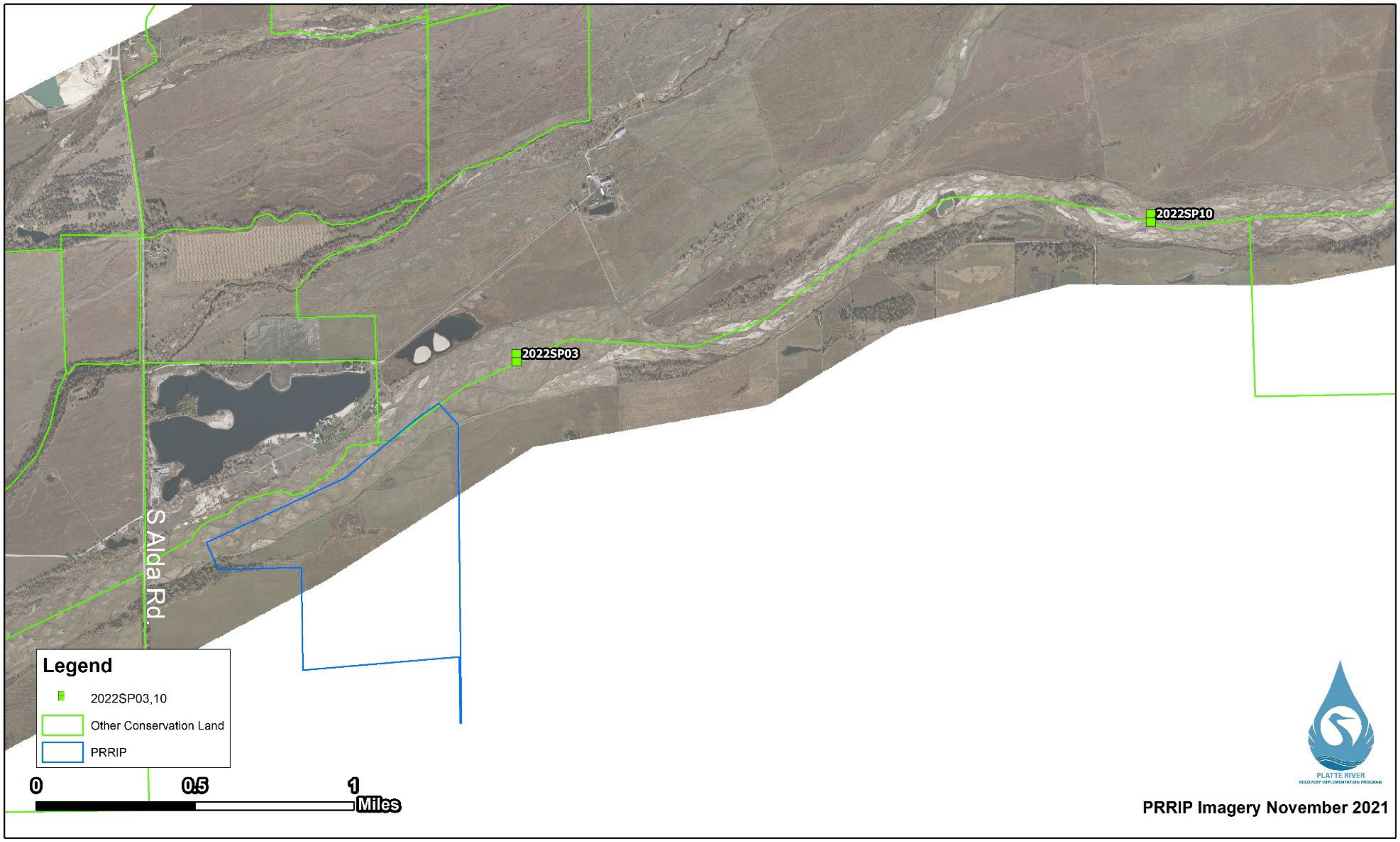

Figure 22. Alda to Grand Island. Whooping crane group 2022SP03 and 10 observed on 3/16/22 and 3/18/22 (including use sites 2 and 8) south of Alda, NE.

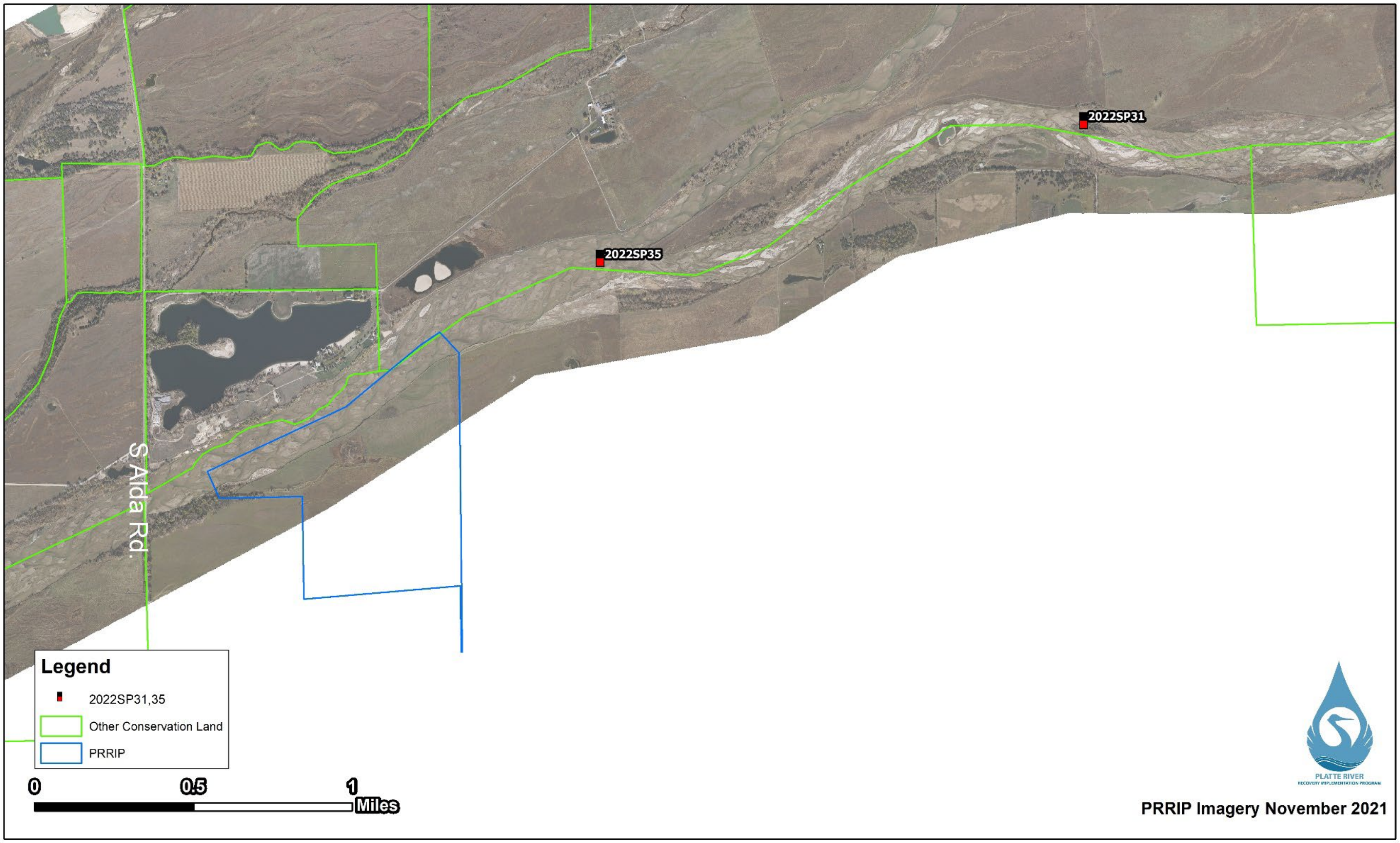

Figure 23. Alda to Grand Island. Whooping crane group 2022SP31 and 35 observed on 3/25/22 – 3/26/22 (including use sites 18 and 22) south of Alda, NE.

Figure 24. Alda to Grand Island. Whooping crane group 2022SP51 and 51B observed on 4/14/22 (including use site 32) southeast of Alda, NE.

Figure 25. Chapman Complex. Whooping crane group 2022SP06, 07, 09, 13, 20, 30, 37, 39, 40, 40B, 41, 43, 44, 45, 47, 48, 49, and 50 observed on 3/14/22 – 4/9/22 (including use sites 5, 6, 7, 13, 17, 24, 26, 28, 29, and 30) south and southeast of Grand Island, NE.

Figure 26. Chapman Complex. Whooping crane groups 2022SP12 and 14 observed on 3/19/22 – 3/20/22 (including use site 9) south of Alda, NE.

Figure 27. Photo taken during a systematic observation of crane group 2022SP17 on 3/20/22 south of the Platte River (see Fig. 10 above for location).

Figure 28. Photo taken during an opportunistic observation of crane group 2022SP25 south of the Platte River (see Fig. 11 above for location).

Figure 29. Photo taken during a systematic observation of crane group 2022SP05 on 3/17/22 at use site 4 in the main channel of the Platte River (see Fig. 12 above for location).

Figure 30. Photo taken during a systematic observation of crane group 2022SP46 on 4/5/22 at use site 36 in the main channel of the Platte River (see Fig. 13 above for location).

Figure 31. Photo taken during a systematic observation of crane group 2022SP23 on 3/21/22 at use site 15 in the main channel of the Platte River (see Fig. 14 above for location).

Figure 32. Photo taken during a systematic observation of crane group 2022SP22 on 3/21/22 on use site 14 in the main channel of the Platte River (see Fig. 15 above for location).

Figure 33. Photo taken during a systematic observation of crane group 2022SP52 on 4/15/22 at use site 33 in the main channel of the Platte River (see Fig. 16 above for location).

Figure 34. Photo taken during a systematic observation of crane group 2022SP15 on 3/20/22 at use site 10 in the main channel of the Platte River (see Fig. 17 above for location).

Figure 35. Photo taken during a systematic observation of crane group 2022SP33 on 3/26/22 at use site 20 in the main channel of the Platte River (see Fig. 18 above for location).

Figure 36. Photo taken during a systematic observation of crane group 2022SP42 on 4/1/22 south of the Platte River (see Fig. 19 above for location).

Figure 37. Photo taken during a systematic observation of crane group 2022SP02 on 3/15/22 at use site 1 in the main channel of the Platte River (see Fig. 20 above for location).

Figure 38. Photo taken during a systematic observation of crane group 2022SP34 on 3/26/22 at use site 21 in the main channel of the Platte River (see Fig. 21 above for location).

Figure 39. Photo taken during a systematic observation of crane group 2022SP03 on 3/16/22 at use site 2 in the main channel of the Platte River (see Fig. 22 above for location).

Figure 40. Photo taken during a systematic observation of crane group 2022SP31 on 3/25/22 at use site 18 in the main channel of the Platte River (see Fig. 23 above for location).

Figure 41. Photo taken during a systematic observation of crane group 2022SP51 on 4/14/22 at use site 32 in the main channel of the Platte River (see Fig. 24 above for location).

Figure 42. Photo taken during a systematic observation of crane group 2022SP37 on 3/27/22 at use site 24 in the main channel of the Platte River (see Fig. 25 above for location).

Figure 43. Photo taken during a systematic observation of crane group 2022SP14 on 3/20/22 on use site 9 in the main channel of the Platte River (see Fig. 26 above for location).

Appendix A

Crane group observations

Letters are placed following 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.

Table A. Data for crane group 22A-03.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/14/22	0:1	2022SP01	1	539638	4511504	Sys-Flight
			2022SP01B	Corn	539519	4507398	Opp-Ground
	3/15/22	0:1	2022SP02	1	539638	4511504	Sys-Flight

Table B. Data for crane group 22A-11.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/14/22	1:0	2022SP06	5	562167	4527057	Sys-Flight
	3/17/22	1:0	2022SP07	6	561849	4526913	Sys-Flight
	3/18/22	1:0	2022SP09	7	562243	4527031	Sys-Flight
	3/20/22	1:0	2022SP13	5	562167	4527057	Sys-Flight
	3/21/22	1:0	2022SP20	13	562342	4527111	Sys-Flight
	3/25/22	1:0	2022SP30	17	561386	4525883	Sys-Flight
	3/27/22	1:0	2022SP37	24	559862	4523371	Sys-Flight
	3/28/22	1:0	2022SP39	26	559627	4523447	Sys-Flight
	3/31/22	1:0	2022SP40	28	560451	4524512	Sys-Flight
			2022SP40B	Corn	558306	4519663	Opp-Ground
	4/1/22	1:0	2022SP41	29	554310	4518089	Sys-Flight
	4/2/22	1:0	2022SP43	Grass	554297	4517106	Opp-Ground
	4/3/22	1:0	2022SP44	30	554643	4518447	Sys-Flight
	4/4/22	1:0	2022SP45	Corn	556571	4517406	Opp-Ground
	4/6/22	1:0	2022SP47	Corn	552550	4521304	Opp-Ground
	4/7/22	1:0	2022SP48	Corn	552550	4521304	Opp-Ground
	4/8/22	1:0	2022SP49	Corn	552550	4521304	Opp-Ground
	4/9/22	1:0	2022SP50	Corn	552550	4521304	Opp-Ground

Table C. Data for crane group 22A-04.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/16/22	0:1	2022SP03	2	544709	4514533	Sys-Flight
	3/18/22	0:1	2022SP10	8	547931	4515204	Sys-Flight

Table D. Data for crane group 22A-10.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/17/22	4:2	2022SP04	3	480759	4501035	Sys-Flight
			2022SP04B	Beans	480789	4500542	Opp-Ground
	3/18/22	4:2	2022SP08	Corn	475520	4500340	Opp-Ground
	3/20/22	4:2	2022SP17	Corn	470018	4501897	Sys-Flight
	3/21/22	4:2	2022SP18	12	471947	4503743	Sys-Flight
			2022SP18B	Corn	470006	4501845	Opp-Ground
	3/22/22	4:2	2022SP24	Corn	470006	4501845	Opp-Ground
	3/23/22	4:2	2022SP26	Corn	470369	4501772	Opp-Ground
			2022SP26B	Corn	470369	4501772	Sys-Flight
	3/24/22	4:2	2022SP27	Corn	470098	4501748	Sys-Flight
	3/25/22	4:2	2022SP29	19	471982	4503584	Sys-Flight
	3/26/22	4:2	2022SP32	31	472301	4503499	Sys-Flight
	3/27/22	4:2	2022SP36	23	472252	4503532	Sys-Flight
			2022SP36B	Corn	469752	4501755	Opp-Ground
	3/28/22	4:2	2022SP38	25	473173	4503370	Sys-Flight

Table E. Data for crane group 22A-09.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/17/22	4:0	2022SP05	4	506057	4501457	Sys-Flight
	3/18/22	4:0	2022SP11	Corn	506620	4499890	Sys-Flight
	3/20/22	4:0	2022SP16	11	506872	4501842	Sys-Flight
	3/21/22	4:0	2022SP21	AIR	507040	4501944	Sys-Flight

Table F. Data for crane group 22A-17.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/19/22	1:0	2022SP12	Corn	554433	4524036	Opp-Ground
	3/20/22	1:0	2022SP14	9	554235	4517974	Sys-Flight

Table G. Data for crane group 22A-15.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/20/2022	3:0	2022SP15	10	522747	4507360	Sys-Flight

Table H. Data for crane group 22A-14.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/21/2022	1:0	2022SP19	Corn	471724	4504599	Opp-Ground

Table I. Data for crane group 22A-16.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/21/22	1:0	2022SP22	14	511678	4502968	Sys-Flight

Table J. Data for crane group 22A-19.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/21/22	1:0	2022SP23	15	508993	4502050	Sys-Flight

Table K. Data for crane group 22A-20.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/22/22	1:0	2022SP25	Beans	495540	4497942	Opp-Ground

Table L. Data for crane group 22A-24.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/24/22	1:0	2022SP28	16	531113	4509124	Sys-Flight
	3/26/22	1:0	2022SP33	20	538644	4511293	Sys-Flight

Table M. Data for crane group 22A-26.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/25/22	1:0	2022SP31	18	547584	4515338	Sys-Flight
	3/26/22	1:0	2022SP35	22	543775	4513937	Sys-Flight

Table N. Data for crane group 22A-25.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	3/26/22	1:0	2022SP34	21	545128	4514670	Sys-Flight

Table O. Data for crane group 22A-40.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	4/1/22	4:0	2022SP42	AIR	535050	4506322	Sys-Flight

Table P. Data for crane group 22A-49.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	4/5/22	1:0	2022SP46	36	507229	4501818	Sys-Flight

Table Q. Data for crane group 22A-63.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	4/14/22	2:0	2022SP51	32	548604	4515257	Sys-Flight
			2022SP51B	Corn	548560	4513989	Opp-Ground

Table R. Data for crane group 22A-65.

Unique Group Icon	Observation Dates	# of Cranes Adult:Juv	Group ID	Use Site #	Zone 14N UTMx	Zone 14N UTMy	Observation Type
	4/15/2022	2:0	2022SP52	33	520343	4506780	Sys-Flight
	4/16/2022	2:0	2022SP53	34	516774	4505042	Sys-Flight
	4/17/2022	2:0	2022SP54	Corn	519517	4505495	Opp-Ground
	4/18/2022	2:0	2022SP55	Corn	519517	4505495	Opp-Flight
	4/19/2022	2:0	2022SP56	35	517138	4505356	Sys-Flight

Appendix B

Past research synthesis

Published	Study Topic	Document Title	Summary	Principle Findings	Citation
2021	Whooping crane use of Non-Complex Palustrine Wetlands	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	Migration	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, and Harrell W. 2020. Heterogeneity in migration strategies of Whooping Cranes. https://academic.oup.com/condor/article/122/1/duz056/5700702
2019	Riverine stopover sites	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://doi.org/10.1371/journal.pone.0209612

Published	Study Topic	Document Title	Summary	Principle Findings	Citation
2019	Diurnal use sites	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 200m from any road, whereas open water and riverine were similarly selected at 1km and 200m 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, and 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
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. https://doi.org/10.1016/j.heliyon.2018.e00851

Published	Study Topic	Document Title	Summary	Principle Findings	Citation
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, and 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	Riverine stopover sites	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/document/prrip-whooping-crane-habitat-synthesis-chapters

Published	Study Topic	Document Title	Summary	Principle Findings	Citation
2017	Riverine and diurnal use sites	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. and Nasman K. 2017. Correlates of Whooping Crane Habitat Selection and Trends in Use in the Central Platte River, Nebraska.
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, and Hefley TJ. 2015. Whooping crane stopover site use intensity within the Great Plains: U.S. Geological Survey Open-File Report 2015–1166, 12 p., http://dx.doi.org/10.3133/ofr20151166.

Published	Study Topic	Document Title	Summary	Principle Findings	Citation
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, and Blankenship EE. 2014. Correction of location errors for presence-only species distribution models. https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/2041-210X.12144
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.	Hefley, TJ, Tyre AJ, Baasch DM, and Blankenship EE. 2013. Non-detection sampling bias in marked presence-only data. https://onlinelibrary.wiley.com/doi/epdf/10.1002/ece3.887

Published	Study Topic	Document Title	Summary	Principle Findings	Citation
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, and Strickland D. West, Inc. 2008. 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