

# Platte River Recovery Implementation Program:

## 2024 Whooping Crane Monitoring Protocol Migrational Habitat Use in the Central Platte River Valley

Prepared for:  
PRRIP Technical Advisory and Governance Committees  
Approval Date: 10 September 2024



Prepared by:  
Malinda Henry<sup>1</sup> and Jason Bruggeman  
Platte River Recovery Implementation Program  
Executive Director's Office  
4111 4<sup>th</sup> Avenue, Suite 6  
Kearney, NE 68845  
<sup>1</sup> henrym@headwaterscorp.com

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**Prepared by:**

Malinda Henry ([henrym@headwaterscorp.com](mailto:henrym@headwaterscorp.com)) and Jason Bruggeman

Platte River Recovery Implementation Program

Executive Director's Office

4111 4<sup>th</sup> Avenue

Suite 6

Kearney, Nebraska 68845

**Suggested citation:**

Platte River Recovery Implementation Program (PRRIP). 2024. Platte River Recovery Implementation Program: 2024 Whooping Crane Monitoring Protocol. Migrational Habitat Use in the Central Platte River Valley.

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## TABLE OF ABBREVIATIONS

Abbreviation	Definition
<b>AHR</b>	Associated Habitat Reach
<b>AMP</b>	Adaptive Management Plan
<b>AWB</b>	Aransas-Wood Buffalo
<b>cfs</b>	Cubic feet per second
<b>CSRT</b>	Chapman secondary return transect
<b>E</b>	East
<b>EBQ</b>	Extension Big Question
<b>EDO</b>	Executive Director's Office
<b>ESRT</b>	Elm Creek secondary return transect
<b>FA</b>	Fall
<b>FAA</b>	Federal Aviation Administration
<b>ft</b>	Feet or foot
<b>GC</b>	Governance Committee
<b>GIS</b>	Geographic information system
<b>GPS</b>	Global positioning system
<b>ID</b>	Identification number or code
<b>mph</b>	Miles per hour
<b>NE</b>	Nebraska
<b>NF</b>	Nearest forest
<b>NGPC</b>	Nebraska Game and Parks Commission
<b>PRRIP or Program</b>	Platte River Recovery Implementation Program
<b>PWRTE</b>	Primary wetland return transect east
<b>PWRTW</b>	Primary wetland return transect west
<b>QA/QC</b>	Quality assurance/quality control
<b>SP</b>	Spring
<b>TAC</b>	Technical Advisory Committee
<b>UOCW</b>	Unobstructed channel width
<b>USFWS</b>	United States Fish and Wildlife Service
<b>USGS</b>	United States Geological Survey
<b>UTM</b>	Universal Transverse Mercator
<b>VR</b>	Vibration reduction
<b>W</b>	West
<b>WC</b>	Whooping crane, <i>Grus americana</i>
<b>WSRT</b>	Wood River secondary return transect
<b>OSE</b>	East river transect
<b>OSW</b>	West river transect



## PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

### 2024 Whooping Crane Monitoring Protocol

#### Migration Habitat Use in the Central Platte River Valley

## INTRODUCTION

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, Nebraska. 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. The Extension Science Plan includes several protocols for monitoring target species, habitat, and physical processes as well as plans for data analysis and synthesis to better understand interrelationships and provide information for evaluating species response to management actions. This document serves as the whooping crane monitoring protocol for the Program.

Information collected during the implementation of this monitoring protocol is being used to evaluate the biological response of whooping cranes to the land and water management activities of the Program. Several critical scientific and technical uncertainties about physical processes and the response of the target species 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 ([PRRIP 2022](#)). These uncertainties are captured in statements of broad management hypotheses in Table 1 on pages 8 and 9 of the Extension Science Plan. As a means of better linking science learning to Program decision-making, those uncertainties comprise a set of "Extension Big Questions." The Extension Science Plan provides a template linking specific hypotheses and performance measures to management objectives and overall Program goals ([PRRIP 2022](#)).

**Three Extension "Big Questions" (EBQs)** in the Extension Science Plan directly relate to measuring whooping crane response to Program management ([PRRIP 2022](#)):

- **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?

The specific management objective for the whooping crane and indicators related to that objective, as noted in the 2006 First Increment Adaptive Management Plan, remain the same throughout the First Increment Extension.

- **Management Objective** – Contribute to the survival of whooping cranes during migration.
- **Indicators:**
  1. Increase the area of suitable roosting and foraging habitat.
  2. Increase the number of crane use days during spring and fall.
  3. Increase the proportion of the Aransas-Wood Buffalo (AWB) population that stops on the AHR during spring and fall.



To assess progress toward this objective and gather information to reduce remaining uncertainties about whooping cranes during the Extension, several finer-scale priority management hypotheses were developed by Program participants to receive focused attention. For whooping cranes, those priority management hypotheses are:

- EBQ #4 Management Hypothesis: Probability of WC stopping within the AHR is a function of discharge.
- EBQ #5 Management Hypothesis: Length of WC stopover within the AHR is a function of discharge.
- EBQ #6 Management Hypothesis: WC use of the AHR in the spring is greater than during the fall due to higher flows during the spring.

## PURPOSE

This monitoring protocol is intended to provide standard implementation guidance for collecting whooping crane use and associated habitat attribute data necessary to test priority whooping crane hypotheses, assess progress toward meeting the whooping crane management objective, and evaluate learning related to the whooping crane Extension Big Questions. This protocol is used by the Program to gather information on whooping crane habitat use and to provide an index of whooping crane abundance in the study area. It is understood that regardless of survey method, not all whooping cranes are certain of being detected during migration and therefore full implementation of this or any other protocol will not represent complete whooping crane use of the central Platte River valley. The monitoring protocol describes the conceptual design, study methods, and procedures that are used annually during spring and fall to gather repeatable information on whooping crane stopovers in the central Platte River valley, Nebraska. The protocol outlines information that the Program's Executive Director's Office (EDO) staff collect in the field, as well as data collected by the United States Fish and Wildlife Service (USFWS) and state agencies. The protocol also describes the procedures to be used for collecting data to address the following specific objectives:

1. Detect and confirm whooping crane stopovers in the Program's AHR ([Figure 1](#)). Systematic, targeted, aerial surveys of the river channel and wetlands within the study area are conducted daily and the data are used to evaluate changes in the number and distribution of stopovers within the study area over time, in addition to the number of individual whooping cranes that stop within the AHR.
2. Identify and describe habitat utilized by whooping cranes during stopovers in the AHR ([Figure 1](#)). During systematic aerial surveys, observers record the date, time, and location of each unique whooping crane group observed. From the aircraft, observers take photographs of whooping crane use locations that provide spatial points of reference for pinpointing use locations on a map. This information is combined with the Program's aerial imagery of the AHR to characterize habitat attributes used by whooping cranes. See the [Assessing Habitat and Flow Metrics](#) section for more details.

## DESIGN CONSIDERATIONS AND SPECIFICATIONS

### Study Area

The study area for monitoring whooping crane stopovers and migrational habitat use consists of the Program's AHR. The AHR encompasses the Platte River from the junction of U.S. Highway 283 and Interstate 80 near Lexington, Nebraska (40°44'08.15" N; 99°44'37.31" W) extending east to Chapman, Nebraska (40°59'07.06" N; 98°08'40.40" W) ([Figure 1](#)). The AHR includes a 3.5-mile buffer to the north and south of the Platte River ([Figure 1](#)).

### Project Design

This protocol only collects information on whooping cranes using the AHR in the central Platte River valley during the spring and fall migrations. Therefore, any inference from results is restricted to whooping cranes stopping over in the AHR and not the entire whooping crane population during migration. In addition, any



use of multiple observations per crane group to determine habitat use attributes results in non-independent measures of habitat metrics (i.e., pseudoreplication) unless accounted for using appropriate analytical methods. Finally, because every whooping crane may not be detected using systematic surveys (i.e., detection probability <1), a lack of detection does not necessarily denote absence of whooping cranes at a location. This protocol does not account for detection probability or provide methods for correcting numbers of whooping cranes observed for detection probability.

Whooping crane stopovers are documented using systematic aerial surveys, ground crews, drones, and opportunistic sightings (see Methods section). Crane groups detected with systematic aerial surveys comprise a probability-based sample and use of data from these groups affords inference to the entire AHR. Systematic aerial transects that survey riverine habitat cover the study area from east to west with equal effort. Inferences from analyses of riverine survey data are applicable to all Platte River channels in the AHR. Systematic aerial transects used on return survey routes cover the off-channel portion of the study area most likely to be used by whooping crane groups at or near sunrise. Targeted wetlands and all landcover within ½ mile on both sides of the return transect are surveyed under this protocol. Inferences from analyses of return survey data are applicable to a ½ mile buffer on both sides of return transects.

Crane groups detected opportunistically using ground crews, drones, or aerial observations (i.e., an observation made while not on a systematic aerial transect route) compromise a non-probability-based sample. Inference from analyses of opportunistic locations contain biases associated with unequal sampling effort that cannot be accounted for and therefore may not represent actual crane use of the entire study area.

### **Spring and Fall Monitoring Periods**

Aerial surveys of the study area are conducted each spring and fall. Monitoring periods have been adjusted over the years to generally encompass the 5<sup>th</sup> and 95<sup>th</sup> percentile of initial observation dates of whooping cranes in Nebraska to account for shifts in the timing of whooping crane migration ([Appendix A, Tables A1-A2](#)). Currently, the monitoring period start and end dates are determined as follows. The EDO will use the USFWS whooping crane public sighting database for Nebraska to calculate the 2.5<sup>th</sup> and 97.5<sup>th</sup> percentiles of the initial dates of whooping crane group observations in 10-year rolling periods on an annual basis based on the most recent 10 years of available data ([Appendix A](#)). Beginning in 2024, the monitoring period dates are March 5 through April 19 for spring, and October 15 through November 18 for fall. The 10-year period appears to be sufficiently long to not be overly influenced by annual variability in whooping crane migratory behavior. Use of the broader 2.5<sup>th</sup> and 97.5<sup>th</sup> percentile dates encompasses the 5<sup>th</sup> and 95<sup>th</sup> percentiles of dates of group observations and provides a buffer to continue including the 5<sup>th</sup> and 95<sup>th</sup> percentiles should the timing and duration of migration shift over time. This protocol collects data during a period when the majority of whooping cranes have migrated through Nebraska over the previous 10 years, but does not intend to survey during the entire period of the migration. Therefore, the monitoring period start and end dates are not initiated earlier in times of an earlier onset of migration or extended during times of a later migration.

If flights are cancelled due to weather or mechanical issues for the last few days of the regular monitoring period, the project leader, in coordination with the USFWS Whooping Crane Migration Tracking Coordinator (Tracking Coordinator), will consider any additional information available to make a decision to stop monitoring. If previously observed crane groups have not left the study area by the end of the regular monitoring period, surveys dates will be extended beyond the established period end date to complete stay length and habitat use data collection. New groups that may arrive while implementing the extended monitoring protocol will be observed through the full duration of their stopover. If observed crane groups remain on the AHR beyond the established period end date, then surveys will be stopped using the following rules. For the spring survey, flights will be discontinued if no whooping cranes have been sighted in the central Platte River valley for two days, and there are no recent (within two days) reports of whooping cranes in the Central Flyway south of the Platte River. For the fall survey, flights will be discontinued if no whooping cranes have been sighted in the central Platte River valley for two days, and there are no recent (two days) reports of whooping cranes in the Central Flyway north of the Platte River. Due to the



potential for cancelled flights due to weather, flights without detection of whooping cranes do not need to occur on two consecutive days to end the extended monitoring season. In this instance, the project leader will consider any additional information available to confirm whooping cranes have left the study area. The project leader is responsible for managing these surveys and remains in contact with the Tracking Coordinator to obtain reports of whooping crane presence in the Central Flyway. That information is then used to determine whether to continue aerial surveys.

In the instance that one or two crane groups remain within the study area more than seven days beyond the established period end date, then the project leader may discuss options with the USFWS to employ alternative monitoring methods throughout the remainder of the group's stay on the AHR. The most useful alternative monitoring method would be the use of drone surveys conducted within ten miles of the group's previous locations (see [Methods](#) section). Another alternative would be the use of ground crew surveys conducted within ten miles of the group's previous locations (see [Methods](#) section). Although use of a drone and/or ground crews is not comparable to obtaining a location with a systematic aerial survey, these alternative survey methods to be used in the case of extended whooping crane stays beyond the regularly surveyed monitoring period would document whether the group was still present to inform stay length analyses and opportunistic locations.

## DEFINITIONS

**Crane Group** – one or more cranes observed in a migrating unit at a stopover location or while flying. The group may consist of an individual crane, a family unit (two adults and  $\geq$ one juvenile), or a flock ( $\geq$ three adults). The age composition (adults; juveniles) of crane groups should be recorded whenever possible.

**Crane Group Identification (ID)** – Crane groups are assigned a new PRRIP crane group ID each day they are observed (e.g., 2022FA01, 2022FA02, 2022FA03, ...) based on the year, season (spring [SP]; fall [FA]), and group number that is generated consecutively for each group observed.

**Sighting** – the observation of a crane group in the study area. Separated into an Opportunistic or Systematic sighting, and a Confirmed, Probable, or Unconfirmed sighting (defined below).

***Opportunistic Sighting*** – Observation of a crane group made outside of scheduled systematic aerial surveys of established transects. Any observations made aerially that are off systematic flight transects or outside of the scheduled morning flight hours are considered opportunistic. Opportunistic sightings include observations made by ground crew or drone surveys to independently confirm or deny unconfirmed crane groups located outside of systematic flight transects. Observations made by ground crew or drone surveys to independently search for known (prior reports, telemetry, etc.) crane groups when flights are cancelled are also recorded as opportunistic. Opportunistic sightings also include observations made as a result of public, telemetry, etc. reports.

***Systematic Sighting*** – Observation of a crane group made during a scheduled systematic aerial survey along established transects as well as confirmations of systematic aerial sightings made by ground crew at the same location reported by the aerial survey. Observations made during systematically conducted flights along established transects outside the established monitoring period (see [Spring and Fall Monitoring Periods section](#)) as a result of extended monitoring efforts due to continued whooping crane presence within the AHR are also considered systematic observations.

***Confirmed Sighting*** – Observation made by a State or Federal biologist or officer or by other known qualified observer (trained ornithologist or birder with experience identifying of whooping cranes). A photograph may also be used to confirm a sighting. Aerial survey crew members with previous aerial whooping crane observations may confirm a crane group during the survey.

***Probable Sighting*** – No confirmation made by State or Federal biologist or officer or by other known qualified observer, yet details of the sighting seem to identify the birds as whooping cranes. To be classified as a probable sighting all of the following factors must be met: (1) location of sighting is within normal migration corridor and is an appropriate site for whooping cranes; (2) date of sighting is



within usual period of migration; (3) accurate physical description provided; (4) number of birds is reasonable; (5) behavior of the birds does not eliminate whooping cranes; and (6) good probability that the observer would provide a reliable report.

*Unconfirmed Sighting* – Sighting details meet some, but not all, of the six factors listed for a probable sighting.

Stopover – A documented Use Location by a crane group during spring or fall migration.

Suitable Habitat – relates to the Program’s established minimum habitat criteria for whooping cranes (see [PRRIP Draft Whooping Crane Minimum Habitat Criteria \[Updated 8-1-12\]](#)).

Use Location – A location of a crane group that occurs in any landcover class within the study area. A single crane group may, and likely will have more than one use location per day and will be assigned an alphabetical use *Location ID* each time the crane group is observed at a new location that day (e.g., A, B, C, etc...) with the A denoting the original location at which the group was observed.

Use Site – A location of a crane group within a landcover class containing water (wetted channel, open water, pit/pond/lake, etc.) in the study area. Use sites are a special type of use location in that they only occur in a landcover class containing water. Use sites are assigned a *Use Site ID* (e.g., 01, 02, ...) and a *Location ID* (e.g., A, B, ...). A single crane group may have more than one use site per day.

## METHODS

### Detecting and Locating Whooping Crane Stopovers

Whooping crane stopovers in the AHR along the central Platte River during the spring and fall migrations are determined using multiple methods: systematic aerial surveys, ground crew surveys, drone surveys, and opportunistically obtained locations. Telemetry data are not actively used to locate whooping crane groups through this monitoring protocol, but observations of telemetered cranes may occur in the PRRIP dataset if those individuals are also observed either during systematic aerial monitoring or during opportunistic ground or drone surveys. The Program’s Technical Advisory Committee (TAC) may choose to implement each protocol component as necessary to obtain needed information, such as changing the survey effort based on results of past surveys.

#### *Systematic Aerial Surveys*

Daily aerial surveys are conducted along the central Platte River valley between Lexington and Chapman, Nebraska to detect whooping crane use-site locations (e.g., roost locations) in the study area. The design of the aerial surveys is intended to maximize opportunities to observe whooping crane use sites throughout the study area. Daily flights are conducted in the early morning when whooping cranes are most likely to be at or near their roost location. Daily flights take place over the main river channel (river transects) and upland areas with a higher density of wetlands within the study area (return transects; [Figure 2](#) and [Figure 3](#)). The “main river channel” is defined as the widest channel when all channels have flowing water. It is recognized that this protocol only samples river channels and a ½ mile area on both sides of the targeted wetland return transects and does not sample other areas of the study area. River transects are flown from east to west and return transects are flown west to east.

Two Cessna 172 or similar aircrafts are flown at a speed of 100 mph, as safety allows. One plane flies the area between Chapman and the Nebraska Highway 10 (Minden) Bridge (the east leg, 0SE in [Figure 2](#) and [Figure 3](#)). The second plane flies the area between the Minden Bridge and the Lexington Bridge (the west leg, [Figure 2](#) and [Figure 3](#)). Two observers and the pilot are in each plane. Surveys are scheduled to begin one-half hour before sunrise unless weather during this time prevents beginning the survey. All attempts should be made to begin the survey one half-hour before sunrise, but if the survey cannot begin during this time period, the survey start time may be extended up to two hours after sunrise. Surveys may be cancelled the night before or the morning of the survey due to unsafe weather conditions (e.g., rain, snow, fog, high winds). Cancelled flights are entered into the database with an explanation of why the flight was cancelled.



All aerial surveys are flown such that the flight direction when flying the river transect is away from the rising sun in the east. To help address the concern that one end of the river transect is always flown early and the other late, there are two alternating routes for each leg (east and west) of the study area. For the eastern leg, the first route flight begins at Chapman, flies the river west to Minden (0SE), then flies the primary wetland return transect (PWRTE) back to Chapman, and flies the secondary wetland return transect (CSRT) back to the Burlington Northern railroad near Grand Island ([Figure 2](#)). On the second route, the flight begins at the Wood River Bridge, flies the river transect (0SE) west to Minden, flies the primary wetland return transect (PWRTE) back to Chapman, flies the rest of the river transect (0SE) from Chapman to Wood River, and finishes up on the secondary wetland return transect (WSRT) between Wood River and HWY 281 near Grand Island ([Figure 3](#)). For the western leg, the first route flight begins at Minden, flies the river (0SW) west to Lexington, and then flies the primary wetland return transect (PWRTW) back to Minden ([Figure 2](#)). On the second route, the flight begins at the Odessa Bridge, flies the river transect (0SW) west to Lexington, flies the primary wetland return transect (PWRTW) back to HWY 10 south of the Minden Bridge, flies the rest of the river transect (0SW) from Minden to Odessa, and then flies the secondary wetland return transect (ESRT) from Elm Creek back to HWY 10 north of the Minden Bridge ([Figure 3](#)). The alternating route pattern will continue through the monitoring period. Aerial observers in each plane complete an aerial survey log datasheet ([Appendix B](#); [Figures B1](#) and [B2](#)).

During the river transect, observers are situated such that the main channel(s) can be clearly viewed by both observers looking out the passenger side of the plane. This necessitates that the plane fly just south of the main channel. An exception to this rule occurs west of the Overton Bridge when the plane flies over Jeffery Island and observers position themselves to observe both the north and south channel of the Platte River. On the return transect, observers look out different sides of the plane so that they can survey ½-mile on each side of the targeted wetland return transect. This design provides a systematic aerial survey to locate whooping crane groups within the channel as well as outside the channel within the targeted wetland survey area. If additional wetlands are created or are identified, the Program’s TAC may choose to alter the return transects to sample these areas and indices of use (e.g., number whooping cranes/flight mile) may need to be adjusted to account for change in area surveyed. Again, it is recognized that this sampling scheme over-samples the river and targeted wetland areas compared to upland areas not covered by the return transects. Aerial observers are not notified of whooping crane locations or presence before or during the survey as this would bias detection.

All transects are flown at 750 ft altitude unless Federal Aviation Administrations (FAA) regulation or snow goose migration dictate a higher altitude (e.g., a minimum of 1,000 ft altitude when flying over towns and cities). The 750 ft altitude for transects is selected for safety reasons. Extremely large numbers of migratory waterfowl are present in the central Platte River valley each spring so flights may be flown at 2,000 ft altitude when the safety of the flight crew is at risk. The 2,000 ft altitude allows pilots to fly over airborne waterfowl to decrease the chance of collision. If suspected whooping crane(s) are seen, the plane is encouraged to circle to an altitude of 500 ft (when safety allows) to provide a better viewing opportunity of the suspected whooping crane(s). Each plane has a global position system (GPS) unit to aid in flight-path orientation and documentation of miles flown during surveys to measure survey efforts.

The aerial survey crew uses binoculars for sighting whooping cranes, and all whooping crane groups as well as their general locations are photographed using a digital camera (Canon Rebel T6s 760D) with an 18 mm × 105 mm Vibration Reduction (VR) zoom lens or similar setup approved by the Program. All observations are recorded on the aerial observation datasheet ([Appendix B](#); [Figure B3](#)) making note of the number of birds, age category of individuals (adults; juveniles), general location, habitat type, and time and date of the observation. After the flight is completed, Universal Transverse Mercator (UTM) coordinates for the crane group location are determined by the project leader using satellite imagery in Geographic Information Systems (GIS) in conjunction with observation photos and location descriptions from the datasheets. Deviations from return transect flight paths may be implemented (and documented on the datasheet) to relocate or confirm crane groups in the area; however, river transects should be completed without interruption. If the crane group cannot be confirmed from the air, the observers in the plane contact and direct a ground crew member to the location to confirm the sighting.



### *Ground Crew Surveys*

The project leader deploys at least one person on the ground in a motorized vehicle daily to confirm sightings that cannot be verified from the air via photographs or require additional positive identification. The ground crew observer positions himself or herself near the center of the assigned aircraft transects to be able to make a quick response in aiding in confirmations. When the ground crew observer(s) are notified of a confirmation that is needed, they begin recording miles and search time once they arrive at the location described. Once the crane group(s) are positively confirmed or a reasonable amount of effort (30 minutes to two hours) has been devoted to confirming the birds from the ground, monitoring is complete for the day and the ground crew observer completes a ground search log datasheet ([Appendix B](#); [Figure B4](#)). Observations made by the ground crew to confirm a previous aerial sighting along a systematic transect are recorded as systematic observations when the observation is made at the location initially recorded by the aerial observer. Observations made by the ground crew while confirming a previous aerial sighting that are made at a new location are recorded as opportunistic.

Ground crew may also be deployed if there are known (from prior observations, public or telemetry reports, etc.) whooping crane group(s) in the study area and the aerial flight is cancelled. All ground monitoring is conducted from public roads unless the project leader acquires permission to enter a property and can safely do so without disturbing the whooping crane(s). All ground crew observations that are not a confirmation of the same location recorded by systematic aerial observation are recorded as opportunistic because there are no established systematic driving routes.

### *Drone Surveys*

Whooping crane groups are not often easily visible from the ground during Ground Crew Surveys due to the terrain and habitat type surrounding the river. Rather than risking disturbance of the cranes or attempting to acquire access to private land with better visibility of the river channel, the project leader may decide to deploy a drone following FAA regulations to assist in confirmations of crane groups. The project leader may also utilize a drone to confirm presence or absence of crane groups observed the previous day when systematic aerial flights are cancelled. If flights are cancelled for multiple days at the end of the regular monitoring period following the sighting of one or more crane groups, a drone may be used to confirm presence or absence of crane groups without requiring additional systematic flights. If the Program receives information on early arrival of individuals prior to the monitoring period, the project leader may decide to deploy a drone opportunistically to confirm the sighting and gather information on group composition and stay length. In the event the monitoring period is extended seven days beyond the scheduled 97.5<sup>th</sup> percentile end date due to the presence of one or two crane group(s), the project leader may get permission from USFWS to utilize a drone instead of continuing systematic aerial flights to monitor the remaining crane group(s).

The drone pilot must hold a current remote pilot certificate through the FAA. The drone should be flown at a minimum of 350 ft but a maximum of 400 ft (the maximum altitude allowed by FAA) along the south side of the river to optimize the direction of light and prevent flying over the top a crane group that may result in disturbance. To minimize disturbance, the pilot shall not hover or linger in the area once the targeted crane group is confirmed. All lights on the drone will be turned off to minimize disturbance. The FAA requires drone lights to be turned on for nighttime flights, so drone usage will be limited to the hours between sunrise and sunset (daylight hours). Use of the drone during daylight hours improves visibility of the drone by the pilot and improves detectability of whooping cranes through drone imagery. To prevent flushing of whooping cranes prior to occurrence, video footage will be recorded by the drone and observed by the pilot while in use to monitor any behavioral cues of alarm or disturbance in response to the drone, such as looking up and visually following the drone. If these behaviors occur, the drone will be immediately withdrawn from the area. USFWS will be notified of any instances of behavior cues suggesting potential disturbance or alarm and be provided video footage upon request to inform the need for modifications to this protocol. The drone should not be flown within five miles of an airport or prior to the systematic aerial survey that may increase the risk of an aircraft and drone collision. Any observations made by drone will be recorded as opportunistic-aerial observations.



### *Opportunistically Obtained Locations*

All observations made outside of the scheduled systematic aerial survey along established transects are recorded as opportunistic. Systematic aerial riverine transect routes should not be deviated from when possible, but when observations occur off the established transect or because of a flight deviation, the observations are to be recorded as opportunistic. Situations may also arise when flights are initiated that do not follow the systematic protocol (e.g., evening flights). All observations made during these flights are recorded as opportunistic. Observations made by ground crew or drone surveys to independently confirm or deny unconfirmed crane groups located outside of systematic flight transects or to independently search for known (prior reports, telemetry, etc.) crane groups when flights are cancelled are also recorded as opportunistic.

### **Use of Additional Sources of Information**

#### *Telemetry Location Data*

Telemetry location data from the Whooping Crane Tracking Partnership is not given to the Program until well after whooping cranes have departed the study area. Therefore, telemetry tracking methods are not actively used to observe crane groups. However, in the event observations occur as a direct result of telemetry intelligence, those observations are treated as opportunistic locations. The telemetry data are used by the Program as an additional source of information for analyses related to EBQs ([PRRIP 2022](#)).

#### *Public Sightings*

The quality and timing of public sighting reports are highly variable. For example, several reports of a single group may be made by different individuals. Sightings may be reported after the group has left the area. Snow geese, white (leucistic) sandhill cranes, pelicans, or egrets may be reported as whooping cranes. To document the validity of a sighting in a timely manner, email and phone contact information is broadly shared and used to relay reports of possible whooping crane sightings to the USFWS. Contact information is publicized online and at local areas frequented by birders, USFWS offices, and Nebraska Game and Parks Commission (NGPC) offices. The USFWS Whooping Crane Migration Tracking Coordinator (Tracking Coordinator) receives the information and determines if the report is able to be confirmed. The project leader managing these surveys is notified of public whooping crane reports via email chain with USFWS and various other conservation organizations in the Platte valley. If USFWS is unable to confirm the report, the project leader attempts to assist USFWS in confirming any “probable” and “unconfirmed” sightings reported to be in the study area through the results of the scheduled systematic surveys. However, aerial crews conducting systematic aerial survey observers are not notified of such reports as this would bias detection probabilities. Likewise, the project leader uses the same email chain to notify USFWS and other conservation organizations in the Platte Valley of daily survey results.

### **Crane Group Numbering**

A new *Crane Group ID* is assigned for each day a crane group is observed in the study area by the survey crew. Multiple observations of the same crane group on the same day, as noted on the data sheet in terms of general location and group composition, receive the same *Crane Group ID* and an alphabetical use *Location ID* each time the crane group is observed at a new location that day (e.g., A, B, C, etc...) with the “A” denoting the original location at which the group was observed. In contrast, the USFWS assigns each crane group a single group identifier for the entire stopover along the AHR. Thus, the USFWS crane group ID serves as a single unique crane group identifier. Program Crane Group IDs have a USFWS crane group identification number associated with them to identify individual crane groups that use the study area for multiple days. USFWS crane group identification numbers for confirmed sightings are included in the Program database and linked to the Program crane group numbers. This will assist in future cross-referencing between unique whooping crane groups in the USFWS and Program databases.

The *Use Site ID* variable connects locations used by each crane group. The *Use Site ID* is a sequential number (beginning with 01) assigned by the project leader and is recorded on the datasheets with the



corresponding *Crane Group ID*, *Location ID* and *Time*. *Use Site ID*'s are numerical and only assigned to locations associated with riverine, wetland, pits/ponds or other wetted locations. *Location ID*'s are alphabetical and assigned to all landcover class locations including those with *Use Site ID*'s.

## **Data Collection from State and Federal Agencies**

Information on all confirmed and probable sightings made by the Program are forwarded to the USFWS Nebraska field office by the project leader. If in doubt, PRRIP survey crews consult with the Tracking Coordinator and collaboratively work together to form consensus on confirming PRRIP detected uniquely identified crane groups. Incidental observations reported to the monitoring crew from inside or outside the study area are also forwarded to the USFWS Nebraska field office, Tracking Coordinator. Thus, the USFWS Public Sightings Database includes Program observations in addition to those made by and/or reported to state and federal agencies. The Program's monitoring reports contains a summary of all whooping crane sightings within the AHR, those made by the Program, and those obtained from the USFWS, Grand Island Field Office.

## **ANALYSIS AND REPORTING**

### **Stopover Metrics and Indices of Use**

Annual indices of spring and fall whooping crane use of the AHR (i.e., stopover metrics) have been and will continue to be calculated using information obtained by this protocol. Based on the number of individual cranes observed during the monitoring period, the proportion of the migratory AWB population that stops on the AHR will be calculated for both spring and fall. The proportion is calculated by dividing the total number of unique individual whooping cranes observed through combined systematic and opportunistic monitoring efforts by the estimated size of the AWB population from the most recent winter surveys performed by USFWS at Aransas to estimate the proportion of the AWB population that stopped on the AHR.

The number of crane use days, which is related to the number of cranes per group and the number of days that the group remains on the AHR, will also be calculated for spring and fall. The number of crane use days for each whooping crane group observed is calculated by multiplying the number of individual cranes in each group by the number of days the group was present, and adding one day per whooping crane observed, if the initial observation is made before noon. One day was added per whooping crane observed because it was assumed the birds were present and roosting on or near the river the evening prior to the morning of the 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 cancellation), 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 on the AHR per the Program's monitoring protocol. PRRIP crane use days includes days when crane groups are not observed by PRRIP if dates of no observations are between consecutive PRRIP observations of that group. This assumes 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. 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. The total number of crane use days for a migration season was calculated by summing the number of crane use days across all whooping crane groups observed.

Indices of use will document the number of cranes and crane groups observed per spring and fall monitoring periods using Program habitat complexes, Program habitat defined and evaluated as highly suitable, and areas deemed as less suitable for whooping cranes by existing Program standards. If the protocol is implemented in a consistent manner, a change in these stopover metrics and indices over time will provide



an estimate of changes in the frequency of use of the study area, Program habitat complexes, as well as Program-defined highly suitable and less suitable habitat.

### **Stopover Metrics Adjusted for 5<sup>th</sup> and 95<sup>th</sup> Percentile Dates**

The project leader will use the USFWS whooping crane public sighting database for Nebraska to determine the initial dates of whooping crane group observations during the most recent 10-year period of available data for both the spring and fall migration. The project leader will use Program R ([R Core Team 2022](#)) to calculate the 5<sup>th</sup> and 95<sup>th</sup> percentiles of initial dates of group observations for spring and fall for the 10-year period ([Appendix C](#)). The project leader will calculate adjusted stopover metrics as the total number of individual whooping cranes observed and total number of crane use days within the dates corresponding to the 5<sup>th</sup> and 95<sup>th</sup> percentiles of initial dates of group observations for the 10-year period. The adjusted metrics will be provided in the spring and fall whooping crane monitoring reports.

### **Assessing Habitat and Flow Metrics**

Using riverine group location data, the project leader will use GIS and aerial imagery to determine two habitat metrics related to whooping crane roost site suitability in the river channel ([Baasch et al. 2019](#)). First, the project leader will calculate the unobstructed channel width (UOCW) at the whooping crane location, which is defined as the width of the channel clear of tall, dense vegetation ([Baasch et al. 2019](#)). Second, the project leader will calculate the distance in any direction from the whooping crane location to the nearest riparian forest (NF; [Baasch et al. 2019](#)).

Four United States Geological Survey (USGS) gaging stations located on the Platte River spanning the AHR provide information on instantaneous river discharge at 15-minute intervals over the monitoring period. Using the location and time of each riverine group observation, the project leader will determine the instantaneous discharge (cubic feet per second [cfs]) at the gaging station closest to the group at the time of the observation to the nearest 15 minutes. In addition, hydrographs will be generated for each of the four USGS gages to document river discharge during the migration period. Corresponding numbers of whooping cranes from each group observed at either on- or off-channel locations near the gage will be depicted in relation to the hydrographs. This information is used to understand flow conditions during the stopover.

### **Analysis Methods**

Information collected through this protocol is used to evaluate changes in the distribution of use and habitat characteristics for whooping crane use-sites in the study area. As such, the Program performs basic data analysis and reports findings that include explanatory as well as graphical representations of their findings on a migration-season basis. The Program may examine whether trends over time occur such as an increase or decrease in use, increase or decrease in the proportion of population stopping in the study area, and increase or decrease in the number of crane use days. This protocol is designed to provide information on crane groups with an estimated probability of inclusion in the sample regardless of location in the study area.

### **Quality Assurance/Quality Control**

Quality Assurance/Quality Control (QA/QC) measures are implemented at all stages of the study, including field data collection, data entry, data analysis, and report preparation. Observers are trained and tested in the methods used and, on their ability to identify whooping cranes. Data forms will be completed daily. At the end of each survey day, each observer is responsible for inspecting his or her data forms for completeness, accuracy, and legibility. The project leader reviews data forms to ensure completeness and legibility, and corrects the forms as needed. Any changes made to the data forms are initialized by the person making the change.

To help train observers that are conducting the aerial surveys, there are whooping crane decoys placed in the river channel for each observer's first seasonal flight to allow observers the opportunity to see a



“whooping crane” from the air at the speed and altitude of the surveys. Twenty decoy sets are also placed throughout the duration of the season. Each set contains one, two, or three decoys. Ten decoy sets are to be placed in random riverine locations on private, Program, governmental or non-governmental organizations’ lands in which Program personnel (EDO staff, partners, etc.) have permission to access. Another ten decoy sets are to be placed within 500 ft of the river on conservation lands in which Program personnel have permission to access. Aerial crews are not aware of the presence of the decoys during the flight, but the coordinating ground crews are notified of the locations prior to the start of the survey. If the aerial crew observes a decoy(s), the location of the sighting is relayed to the ground crew for confirmation of the decoy location. Decoy observations are recorded on the aerial observation datasheet.

The Program’s species database will be used to store, retrieve, and organize field observations. Data are entered into the Program’s database by the project leader or qualified technicians. These files are compared to the raw data forms and checked for errors. Irregular codes detected or any ambiguous data are discussed with the observer and study team leader to clarify and document changes. After data are keyed and verified, the project leader or QA/QC technician checks data forms against the final computer file and any problems identified will be traced back to raw data forms, observer(s), and data-entry personnel to be corrected, with all corrections being documented. All field data collection forms and electronic data files will be retained for ready reference.

## Report Format

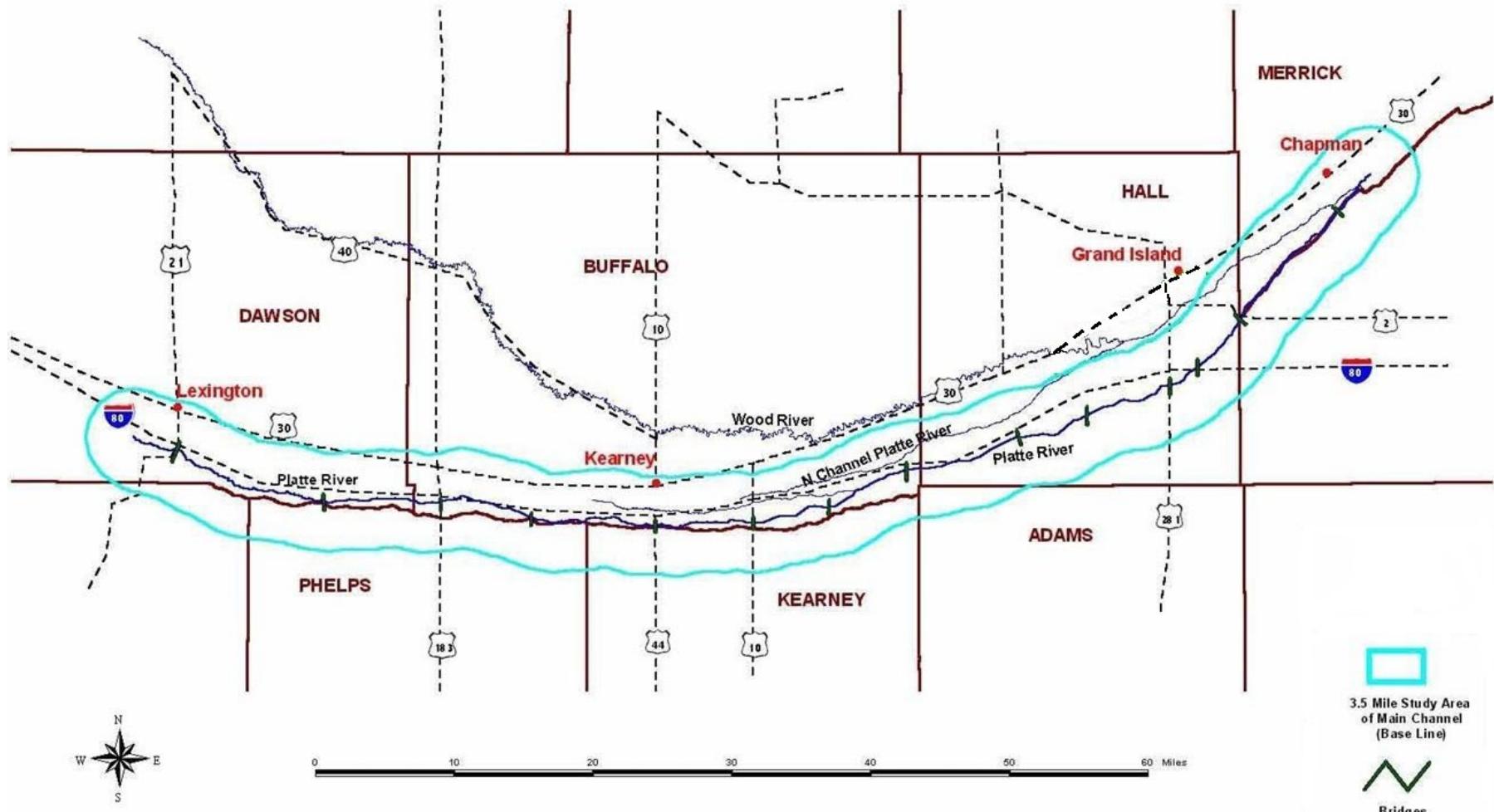
Data on whooping crane habitat use is compiled, summarized, and incorporated within the larger Program database following each migration season. Draft and final reports that summarize findings and describe methods, analyses (including descriptive statistics of whooping crane use), results, and any conclusions are provided to the TAC and Governance Committee (GC) for their review, revision, and final approval.

## REFERENCES

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>

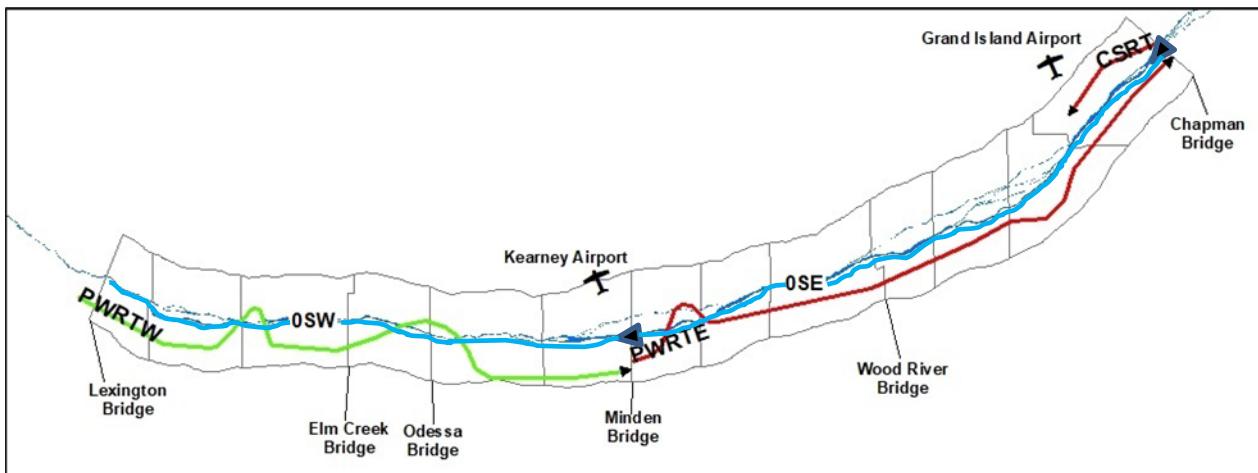
Platte River Recovery Implementation Program (PRRIP) 2022. First Increment Extension Science Plan.  
<https://platteriverprogram.org/document/prrip-extension-science-plan>

R Core Team. 2022. R: a language and environment for statistical computing. R Foundation for Statistic Computing, Vienna, Austria. Version 4.2.2. <https://www.R-project.org/>

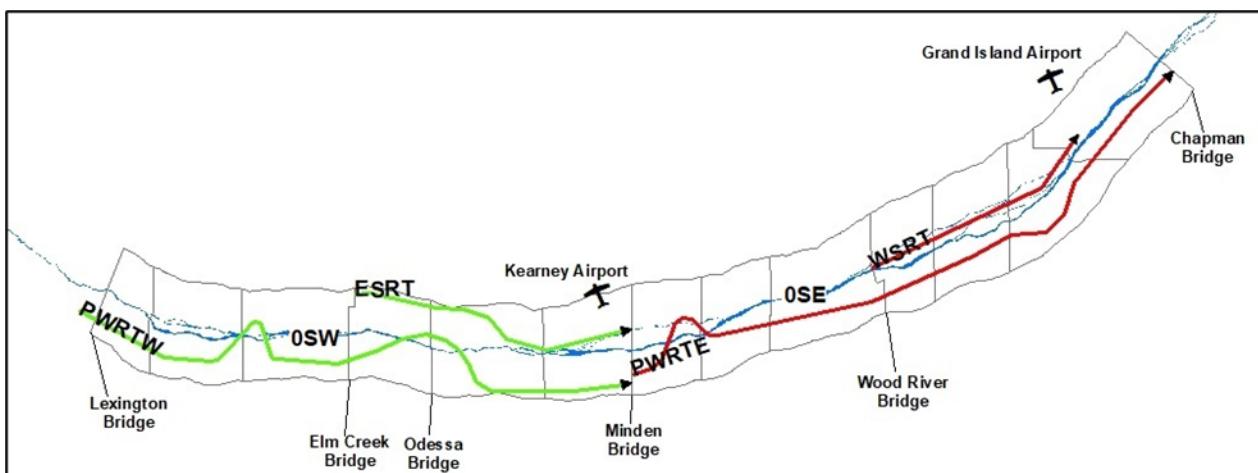


Maps and Analysis Prepared by Lynx Spatial Technologies Inc.

**Figure 1.** Platte River Recovery Implementation Program's Associated Habitat Reach encompassing the central Platte River valley in Nebraska.



**Figure 2.** East and west flight transects for Route 1 of whooping crane aerial surveys between Lexington, and Chapman, Nebraska. Black and grey triangles indicate starting points of flights. River channel transects (0SW; 0SE) are shown in blue. The west primary wetland return transect (PWRTW) is shown as a green line. The east primary wetland return (PWRTE) and secondary return transects (CSRT) are shown in red.



**Figure 3.** East and west flight transects for Route 2 of whooping crane aerial surveys between Lexington, Nebraska and Chapman, Nebraska. Black and grey triangles indicate starting points of flights. River channel transects (0SW; 0SE) are shown in blue. The west primary wetland return transect (PWRTW) and secondary return transect (ESRT) are shown as green lines. The east primary wetland return (PWRTE) and secondary return transects (WSRT) are shown as red lines.



**Appendix A. Tables of 5<sup>th</sup> and 95<sup>th</sup> percentiles of initial dates of whooping crane group observations during spring and fall in Nebraska for 10-year periods ranging from 1998–2007 to 2013–2022.**

**Table A1.** The 5<sup>th</sup> and 95<sup>th</sup> percentiles of initial dates of whooping crane group observations in Nebraska for 10-year periods ranging from 1998–2007 to 2013–2022. Percentiles were calculated using the USFWS whooping crane public sighting database for Nebraska during 1998–2022. For each period, the applicable survey year(s) for which the percentiles were used to adjust whooping crane metrics is provided. The established PRRIP monitoring period and earlier survey start dates during each survey year are also provided.

Period	Applicable survey year(s)	5 <sup>th</sup> percentile	95 <sup>th</sup> percentile	Survey start date	Monitoring period start date	Monitoring period end date
1998–2007	2007	8-Mar	20-Apr	22-Mar	21-Mar	29-Apr
1999–2008	2008	10-Mar	22-Apr	21-Mar	21-Mar	29-Apr
2000–2009	2009	10-Mar	4-May	22-Mar	21-Mar	29-Apr
2001–2010	2010	15-Mar	29-Apr	21-Mar	21-Mar	29-Apr
2002–2011	2011	14-Mar	24-Apr	21-Mar	21-Mar	29-Apr
2003–2012	2012	7-Mar	24-Apr	9-Mar	21-Mar	29-Apr
2004–2013	2013	7-Mar	19-Apr	11-Mar	21-Mar	29-Apr
2005–2014	2014	7-Mar	19-Apr	6-Mar	6-Mar	29-Apr
2006–2015	2015	7-Mar	18-Apr	6-Mar	6-Mar	29-Apr
2007–2016	2016	7-Mar	18-Apr	6-Mar	6-Mar	29-Apr
2008–2017	2017	7-Mar	17-Apr	6-Mar	6-Mar	29-Apr
2009–2018	2018	7-Mar	18-Apr	6-Mar	6-Mar	29-Apr
2010–2019	2019	8-Mar	17-Apr	6-Mar	6-Mar	29-Apr
2011–2020	2020	7-Mar	17-Apr	6-Mar	6-Mar	29-Apr
2012–2021	2021	7-Mar	17-Apr	6-Mar	6-Mar	29-Apr
2013–2022	2022	10-Mar	17-Apr	6-Mar	6-Mar	29-Apr
2014–2023	2023	10-Mar	17-Apr	6-Mar	6-Mar	29-Apr
2015–2024	2024	9-Mar	16-Apr	5-Mar	5-Mar	19-Apr



**Table A2.** The 5<sup>th</sup> and 95<sup>th</sup> percentiles of initial dates of fall whooping crane group observations in Nebraska for 10-year periods ranging from 1998–2007 to 2013–2022. Percentiles were calculated using the USFWS whooping crane public sighting database for Nebraska during 1998–2022. For each period, the applicable survey year(s) for which the percentiles were used to adjust whooping crane metrics is provided. The established PRRIP monitoring period and extended survey end date during each survey year are also provided.

Period	Applicable survey year(s)	5 <sup>th</sup> percentile	95 <sup>th</sup> percentile	Monitoring period start date	Monitoring period end date	Survey end date
1998–2007	2007	14-Oct	11-Nov	9-Oct	10-Nov	10-Nov
1999–2008	2008	13-Oct	5-Nov	9-Oct	10-Nov	10-Nov
2000–2009	2009	13-Oct	6-Nov	9-Oct	10-Nov	10-Nov
2001–2010	2010	13-Oct	5-Nov	9-Oct	10-Nov	10-Nov
2002–2011	2011	13-Oct	6-Nov	10-Oct	10-Nov	10-Nov
2003–2012	2012	14-Oct	10-Nov	9-Oct	10-Nov	16-Nov
2004–2013	2013	13-Oct	13-Nov	9-Oct	10-Nov	10-Nov
2005–2014	2014	15-Oct	14-Nov	9-Oct	10-Nov	12-Nov
2006–2015	2015	15-Oct	15-Nov	9-Oct	10-Nov	19-Nov
2007–2016	2016	15-Oct	16-Nov	9-Oct	10-Nov	20-Nov
2008–2017	2017	15-Oct	16-Nov	9-Oct	15-Nov	22-Nov
2009–2018	2018	16-Oct	16-Nov	9-Oct	15-Nov	15-Nov
2010–2019	2019	16-Oct	16-Nov	9-Oct	15-Nov	14-Nov
2011–2020	2020	16-Oct	16-Nov	9-Oct	15-Nov	15-Nov
2012–2021	2021	18-Oct	16-Nov	9-Oct	15-Nov	19-Nov
2013–2022	2022	17-Oct	16-Nov	9-Oct	15-Nov	18-Nov
2014–2023	2023	18-Oct	15-Nov	9-Oct	15-Nov	10-Jan-24
2015–2024	2024	TBD	TBD	15-Oct	18-Nov	TBD



**Appendix B.** Data sheets to be completed during whooping crane group observations and aerial and ground surveys. Data sheets are current as of the spring 2024 monitoring period.

3/9/2024	6:19			Riverine	E to W	0	S	E	Chapman			NA	NA		
				Return	W to E	PWRTE	CSRT	E	Minden						
<b>Notes:</b>															
3/10/2024	7:12			Riverine	E to W	0	S	E	Wood River						
				Return	W to E	PWRTE	WSRT	E	Minden						
<b>Notes:</b>															
3/11/2024	7:16			Riverine	E to W	0	S	E	Chapman			NA	NA		
				Return	W to E	PWRTE	CSRT	E	Minden						
<b>Notes:</b>															
3/12/2024	7:08			Riverine	E to W	0	S	E	Wood River						
				Return	W to E	PWRTE	WSRT	E	Minden						
<b>Notes:</b>															
<p>The <u>RIVERINE</u> transect is always flown first and offset to the South so that both observers can view the main channel of the river.</p> <p>RETURN transects will be flown second in the order listed above. Primary wetland return transect (PWRTE) will be flown daily.</p> <p><b>When a possible crane group is observed: RECORD information on Observation Form and REPORT to ground crew.</b></p>															

**Figure B1.** Sample aerial survey log datasheet used during spring 2024 monitoring period for the east survey route.



3/9/2024	6:19			Riverine	E to W	0	S	W	Minden			NA	NA		
				Return	W to E	PWRTW	NA	W	Lexington			NA	NA		
<b>Notes:</b>															
3/10/2024	7:12			Riverine	E to W	0	S	W	Odessa						
				Return	W to E	PWRTW	ESRT	W	Lexington						
<b>Notes:</b>															
3/11/2024	7:16			Riverine	E to W	0	S	W	Minden			NA	NA		
				Return	W to E	PWRTW	NA	W	Lexington			NA	NA		
<b>Notes:</b>															
3/12/2024	7:08			Riverine	E to W	0	S	W	Odessa						
				Return	W to E	PWRTW	ESRT	W	Lexington						
<b>Notes:</b>															
<p>The <u>RIVERINE</u> transect is always flown first and offset to the South so that both observers can view the main channel of the river.</p> <p>RETURN transects will be flown second in the order listed above. Primary wetland return transect (PWRTW) will be flown daily and Elm Creek secondary return transect (ESRT) will be flown every other day when flights originate at Odessa.</p> <p><b>When a possible crane group is observed: RECORD information on Observation Form and REPORT to ground crew.</b></p>															

**Figure B2.** Sample aerial survey log datasheet used during spring 2024 monitoring period for the west survey route.



Observer(s)	Date (mm/dd/yy)	Obs. Time	Type of Obs. (circle one)	Air Transect		(circle one) WHCR Decoy Other	# of Cranes		Other Species Associated	
				0SE PWRTE WSRT CSRT OPP			Adult	Juv.		
				0SW PWRTW ESRT OPP						
<b>NVCS Vegetation (circle one. If Ag list type)</b>				Crane Group ID	Use Site ID	Location ID	UTMx		UTMy	
Wetted channel	Low land/grassland	Pit/pond/lake	Ag _____							
Notes:										Crane Group New to Area
										Y    N
Observer(s)	Date (mm/dd/yy)	Obs. Time	Type of Obs. (circle one)	Air Transect		(circle one) WHCR Decoy Other	# of Cranes		Other Species Associated	
				0SE PWRTE WSRT CSRT OPP			Adult	Juv.		
				0SW PWRTW ESRT OPP						
<b>NVCS Vegetation (circle one. If Ag list type)</b>				Crane Group ID	Use Site ID	Location ID	UTMx		UTMy	
Wetted channel	Low land/grassland	Pit/pond/lake	Ag _____							
Notes:										Crane Group New to Area
										Y    N
NVCS Ag types: Corn, Soybean, Wheat, Sorghum (Milo, Silage), Legume (Alfalfa). Other - briefly describe in notes (disked ground, summer fallow, farmstead, etc.)										
Confirmed WHCR should be assigned a Crane Group ID, Use Site ID, UTMx and UTMy by project leader.										
Only whooping cranes detected in riverine or palustrine wetland habitat will be assigned a Use Site ID										
Circle the transect that the white object was observed on as Riverine (East leg=0SE; West leg=0SW), primary wetland return transect (East leg = PWRTE; West leg = PWRTW), secondary return transect (Chapman = CSRT; Wood River = WSRT; Elm Creek = ESRT)										
<b>A ground search should be conducted for all crane groups that can't be confirmed from the air and a Ground Search form should be filled out.</b>										

**Figure B3.** Sample aerial observation log datasheet.



Date (mm/dd/yy)	Search Time		Miles Driven	Land cover River Wetland Grassland Pond/Lake Ag.	Observer(s)	Info Source	Object Found? Y    N	CRGP ID	Location ID
	Begin	End							
Sighting info:									
Notes:									
Date (mm/dd/yy)	Search Time		Miles Driven	Land cover River Wetland Grassland Pond/Lake Ag.	Observer(s)	Info Source	Object Found? Y    N	CRGP ID	Location ID
	Begin	End							
Sighting info:									
Notes:									
<b>Miles driven starts at the last known location of the crane group.</b> NVCS Ag types: Corn, Soybean, Wheat, Sorghum (Milo, Silage), Legume (Alfalfa). Other - briefly describe in notes (disked ground, summer fallow, farmstead, etc.) The protocol requires that the ground crew search for every probable sighting for a minimum of 2 hours. Confirmed WHCR will be assigned a Crane Group ID and Location ID (shaded areas) by project leader. <b>A ground search should be conducted for all crane groups that can't be confirmed from the air and an Observation Form should be filled out.</b> <b>Do NOT fill out if flight crew confirms whoopers w/o help.</b>									

Figure B4. Ground search effort log datasheet.



## Appendix C. R Code for Percentile Calculations

The following is sample R code for determining the 2.5<sup>th</sup>, 5<sup>th</sup>, 95<sup>th</sup>, and 97.5<sup>th</sup> percentiles of initial dates of group observations. The data were formatted using the Julian date of the initial date of group observation for the spring migration with data from the USFWS public sightings database for Nebraska during 2013–2022.

```
##Read in csv data file using specific computer path
data_spring_2013_2022=read.csv("C:/Users/bruggemanj/Documents/whooping_crane/reports/wc_usfws_
public_sightings_db_groups/spring/usfws_wc_spring_10yr_2013_2022_groups.csv",header=T)

##Calculate 2.5th and 97.5th percentile dates
quantile(data_spring_2013_2022$juliandate,0.025)
quantile(data_spring_2013_2022$juliandate,0.975)

##Calculate 5th and 95th percentile dates
quantile(data_spring_2013_2022$juliandate,0.05)
quantile(data_spring_2013_2022$juliandate,0.95)
```