

Platte River Recovery Implementation Program

2025 Central Platte River Piping Plover and Interior Least Tern Monitoring and Research Protocol



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Technical Advisory Committee
Governance Committee

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TABLE OF ABBREVIATIONS

Abbreviation	Definition
ac	Acres
AHR	Associated Habitat Reach
AMP	Adaptive Management Plan
BPE	Breeding Pair Estimate
cfs	Cubic feet per second
CNPPID	Central Nebraska Public Power and Irrigation District
CPNRD	Central Platte Natural Resources District
Cooperative Agreement	Cooperative Agreement for Platte River Research and Other Efforts Relating to Endangered Species Habitats
DSR	Daily survival rate
EDO	Executive Director’s Office
ESA	Endangered Species Act
ft	Feet or foot
GC	Governance Committee
GIS	Geographic Information System software
GPS	Global Positioning System
J-2	Johnson Hydropower Return
LiDAR	Light Detection and Ranging
MCA	Moving Complex Approach
mi	Mile or miles
NGPC	Nebraska Game and Parks Commission
NPPD	Nebraska Public Power District
OCSW	Off-channel sand and water
PRRIP or Program	Platte River Recovery Implementation Program
SDM	Structured Decision Making
sec	Second
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

2025 Central Platte River Piping Plover and Interior Least Tern Monitoring and Research Protocol

INTRODUCTION

The northern Great Plains population of piping plovers (*Charadrius melodus*) was listed as threatened on 10 January 1986 (50 Federal Register 50726) by the United States Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA). The northern Great Plains piping plover (hereafter plover) remains listed as threatened due to concerns over the species' viability given impacts of predation and habitat loss on survival and productivity ([USFWS 2020](#)). The interior least tern (*Sternula antillarum*) was listed as endangered under the ESA on 27 June 1985 (50 Federal Register 21784). The USFWS removed the interior least tern from ESA protective status on 12 February 2021 (86 Federal Register 2564); however, the interior least tern (hereafter tern) remains protected under the Migratory Bird Treaty Act and the Nebraska Non-Game and Endangered Species Conservation Act (Nebraska Rev. Statute §37-801-811).

In 1997, the Department of the Interior and the States of Nebraska, Colorado, and Wyoming adopted the “Cooperative Agreement for Platte River Research and Other Efforts Relating to Endangered Species Habitats” (Cooperative Agreement). The Platte River provides key habitat for plovers and terns with both species nesting on manufactured sand and gravel pits adjacent to the active river channel and on unvegetated sandbars in the river channel ([Sidle and Kirsch 1993](#), [Kirsch 1996](#), [Farnsworth et al. 2017](#), [Farrell et al. 2018](#), [Jorgensen et al. 2021](#)). The Platte River Recovery Implementation Program (PRRIP or Program) is responsible for implementing certain aspects of plover and tern recovery plans along the central Platte River ([PRRIP 2021b](#)) and manages land and water to attain specific management objectives.

MANAGEMENT OBJECTIVES

The management objective for plovers and terns as defined in the Program's First Increment Adaptive Management Plan (AMP; [PRRIP 2021b](#)) is to improve their productivity along the central Platte River through:

- (1) increasing the number of fledged chicks,
- (2) reducing adult mortality.

Increasing the number of fledged chicks may be done through increasing the number of breeding pairs and/or increasing fledge ratios, the latter of which is related to nest loss and chick mortality due to predation, weather, flooding, and inadequate forage. Reducing adult mortality may primarily be accomplished by reducing predation, although severe weather may affect adult survival. The Program uses the number of nesting pairs and number of chicks fledged per nest or breeding pair (i.e., fledge ratio) as indicators for monitoring the status of plovers and terns. Though not required for ESA compliance, in 2021 the Program's Governance Committee (GC) directed

Executive Director’s Office (EDO) staff to continue monitoring terns following the same protocol as it did prior to federal delisting ([PRRIP 2021a](#)).

EXTENSION “BIG QUESTIONS” (EBQS)

The Program’s First Increment Extension Science Plan, written in 2022, identified two Extension “Big Questions” related specifically to plover productivity and the role of predation ([PRRIP 2022](#)).

EBQ #8 – How much of an effect does predation have on plover productivity?

- Use data on nest and brood predation to quantify the impact of predation
- Identify predator species responsible for losses
- Determine whether losses are incurred during incubation or brood rearing
- Utilize population viability models to predict what effect decreases in fledge ratios due to predation may mean in terms of future breeding pairs on the central Platte River

EBQ #9 – How effective is Program management at mitigating losses of plover productivity due to predation?

- Collect data on the efficacy of trapping, fencing, and/or predator deterrent lighting at reducing nest and brood failure due to predation
- Develop predator management alternatives based upon learning through remote camera/video monitoring
- Evaluate the necessity for additional predator management based on plover response to predation over time

PURPOSE

In 2001, the Cooperative Agreement coordinated a standardized protocol for monitoring reproductive success and reproductive habitat parameters of plovers and terns on the central Platte River from Lexington to Chapman, Nebraska. The standardized protocol was implemented by CNPPID, CPNRD, NPPD, and USFWS during 2001-2006 (<https://platteriverprogram.org/program-library>; Target Species: piping plover, interior least tern; Keywords: protocol implementation, [Year of Study]). In 2007, the Program assumed this responsibility and Program staff, contracted personnel, and cooperators have since implemented the monitoring protocol. The protocol was revised prior to the 2010 nesting season ([PRRIP 2010](#)), prior to the 2017 nesting season ([PRRIP 2017](#)), and the current version prior to the 2025 nesting season to reflect changes in habitat management, learning regarding species biology, habitat availability and use, as well as effectiveness and efficiency of monitoring methods.

The current monitoring protocol is intended to provide standard implementation guidance for collecting plover and tern data necessary to assess progress toward meeting plover and tern management objectives and evaluate learning related to the Extension Big Questions. This protocol outlines the Program’s monitoring efforts for plovers and terns including: (1) observing use and nest productivity on riverine in-channel sandbars and created or rehabilitated off-channel sand and water (OCSW) nesting sites along the central Platte River between Lexington and

Chapman, Nebraska, and (2) identifying and documenting factors that influence nest site selection and nest and brood success. It is understood that regardless of survey methods, not all plovers and terns are certain of being detected during the breeding season and therefore full implementation of this or any other protocol will not represent complete use of the central Platte River valley. The monitoring protocol describes the conceptual design, study methods, and procedures that are used annually during the nesting season (May through August) to gather repeatable information on plovers and terns 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 Nebraska Public Power District (NPPD).

STUDY AREA AND SPECIES HABITAT USE

Our study area encompasses the Program's Associated Habitat Reach (AHR) segment of the central Platte River between Lexington and Chapman, Nebraska (~90 river mi) and OCSW sites within 3.5 mi of the river in this reach. River or on-channel habitat includes naturally formed or constructed midstream sandbars used for nesting and the open river channel used for foraging (see [Appendix A. Definition of Riverine Habitat](#)). The number of low-elevation sandbars present within the PRRIP AHR of the central Platte River has been variable and dependent on seasonal and daily fluctuations in river flow. The size and distribution of non-vegetated, high-elevation sandbars characteristic of plover and tern nesting sites within the region has been dependent upon construction and vegetation management efforts.

OCSW habitat includes spoil piles of sparsely- or non-vegetated sand at sand and gravel mines and constructed nesting sites (see [Appendix A. Definition of OCSW Habitat](#)). Migratory plovers typically arrive in early May and nest on OCSW habitat or constructed on-channel islands. Adults forage on low elevation river sandbars or along the waterline of OCSW habitat, though they are more reliant on OCSW shorelines while nesting ([Sherfy et al. 2012](#)). Chicks forage along OCSW waterlines until fledging when they are often observed foraging on the river channel. Migratory terns typically arrive later in May and nest on OCSW habitat or constructed on-channel islands. Terns forage at both the sand and water site and on the river channel, though they rely more on the river channel for foraging ([Sherfy et al. 2012](#)). Fledged terns at OCSW habitat along the AHR have been observed beginning to learn to forage in the water surrounding the nesting area, then are later often observed on the river channel.

RIVER CONDITIONS

River conditions during the breeding season and at each river survey date are obtained from the USGS WaterWatch site ([USGS 2025d](#)). Mean daily discharge (ft³/second; cfs) for each segment is recorded for the closest respective gage along the central Platte River in Nebraska at the Overton bridge, USGS gage 0676800 ([USGS 2025a](#)); Kearney bridge, USGS gage 06770200 ([USGS 2025b](#)); and Grand Island bridge, USGS gage 6770500 ([USGS 2025c](#)). Discharge data from the USGS Kearney, Nebraska gage are also downloaded and used to compare the current year's mean daily discharge to the median daily discharge (2001-present).

MANAGEMENT

The Program undertakes management actions designed to increase the amount of nesting habitat (bare sand), improve foraging habitat, and increase productivity of plovers and terns at on- and off-channel sites.

ON-CHANNEL MECHANICAL HABITAT CREATION AND MAINTENANCE

Constructed on-channel habitat availability was variable and somewhat limited during the First Increment of the Program and no additional on-channel habitat has been added during the First Increment Extension. Approximately 24 ac of constructed on-channel habitat were present in the AHR in 2007 as the result of efforts by other conservation organizations. That habitat was subsequently lost over the course of several years due to erosion during high flow events. Since 2007, on-channel habitat construction by other conservation organizations has been very limited. The Program constructed on-channel habitat between 2012 and 2014 as an adaptive management experiment to compare plover and tern nesting and productivity between on- and off-channel habitat. That habitat eroded shortly after construction. As a result of a structured decision-making process that integrated information on habitat construction, longevity, use, and productivity across both on- and off-channel sites, the Program shifted to prioritize the creation, rehabilitation, and maintenance of OCWS sites. As an alternative to large-scale on-channel habitat construction, the Program opted for a moving complex approach (MCA) whereby the Program manages and maintains approximately 10 ac of on-channel nesting habitat within the AHR annually. The MCA nesting habitat is cleared, disked, and sprayed to prevent revegetation, but not graded to increase height. It is anticipated that MCA areas will erode over the course of one to several years, during which time, the Program works to clear another MCA area in a different complex to take its place. Additional on-channel maintenance includes herbicide application and disking at targeted Program-managed properties.

OFF-CHANNEL MECHANICAL HABITAT CREATION AND MAINTENANCE

Approximately 48 ac of managed off-channel nesting habitat were present in the AHR at the beginning of the Program's First Increment in 2009. The Program began acquiring and restoring off-channel sites in 2009 and monitoring at these sites began in 2010. Total monitored off-channel habitat in the AHR increased to ~250 ac by 2021 as the Program constructed and restored potential nesting habitat. Area of potential nesting habitat across the AHR has remained fairly consistent since 2021 except for small annual differences in water level and vegetation. Any changes to this acreage are quantified and described in annual monitoring reports. Management activities at OCSW sites are site specific and include: disking, chemical application to kill or prevent emergence of vegetation (fall and/or spring herbicide application), and basic predator control.

PREDATOR MANAGEMENT

The Program implements several long-term management strategies to reduce the risk of predation at Program-managed OCSW sites during their construction and/or rehabilitation. We select off-channel nesting sites with peninsulas surrounded by water to manage and provide a ≥ 100 ft water deterrent to terrestrial predators. We install permanent and temporary electrified woven wire fences across the land entrance to each nesting area. We position non-electrified fence-panel wings on the ends of the electrified fence and extend them between three and seven ft in the water to deter terrestrial predators from swimming from the mainland to the nesting peninsula. To reduce the potential for avian predation, we remove all trees within a ≥ 492 ft radius of the nesting site and place avian spikes on all potential perches that cannot be removed. Finally, we trap and remove terrestrial predators from around the periphery of the site on an annual basis prior to and during the nesting season.

Terrestrial Mammal Trapping

The Program hires an independent contractor to conduct terrestrial mammal trapping and lethal removal at Program-owned OCSW nesting sites. NPPD also hires an independent contractor to perform the same service at NPPD-owned OCSW sites. Contractors are required to have the appropriate licenses for commercial trapping and lethal removal. Traps deployed include live cage traps, dog proof leg-hold traps, leg-hold/foot-hold traps (jaw traps), and body-hold snares. Firearms are used when deemed necessary. Trappers record the date on which each trap was deployed, GPS coordinates, trap type, trap identification number, and OCSW site. Daily trapping logs are kept to record the date and time of trap checks, trap type, number of traps checked, number of empty closed traps, number of traps closed with caught animal, and number of traps set to be checked the next day. When a terrestrial mammal is captured, trappers identify the species, the trap in which it is captured, location, time, and date, and then lethally remove the mammal from the site.

We calculate trapping effort at each site as the number of trap days, which is the total number of days each trap is open summed over all traps at each site. Because visits to traps may not always be conducted daily and because traps may have closed between visits, we determine the number of trap days when the trap closed between visits as one-half of the number of days since the trap was last checked. We do not include firearm usage in trapping effort. We use the total number of mammals captured in traps at the site divided by the total number of trap days to calculate the number of captures per unit effort (i.e., trap days). Animals removed through use of a firearm are counted toward total number of captures but are not included in the calculation of captures per trap day.

MONITORING

Monitoring consists of three main components: (1) monthly river surveys, (2) semi-monthly OCSW surveys, and (3) semi-weekly nest and chick monitoring. The central Platte River and OCSW sites spanning the Associated Habitat Reach (AHR) are monitored for plover and tern adults, nests, broods, and fledglings from outside the nesting area as described below. Plover and tern nests or chicks observed during any survey are monitored semi-weekly to evaluate their status.

Data collected will be used to evaluate trends in plover and tern habitat use and reproductive parameters, assess progress toward meeting plover and tern management objectives, and evaluate learning related to the impacts of predation and the Program's ability to mitigate those impact (EBQ #8 and #9).

MONTHLY RIVER SURVEYS

EDO biologists use an airboat to conduct monthly river surveys from May through August on the central Platte River spanning the AHR to count plover and tern adults, breeding pairs, nests, chicks, and fledglings. Exact survey dates are based upon the evaluation of peak plover nesting over the most recent 10-year period. Active river channels >225 ft (75 yards) wide that can safely be navigated between the J-2 Return, located east of Lexington, and the Chapman bridge, located south of Chapman, Nebraska, are included in the survey. Preference is given to surveying the main channel or channels managed for target species where multiple channels meeting these criteria exist. River surveys typically take two days to complete and are conducted between 0700 and 1600 with designated time slots in the morning, midday, and afternoon. For the survey, the river is divided into six sections based on boat ramp access and limited by bridges that are too low for the airboat to navigate under. The three west river sections are completed on the first day of the survey and the three east river sections are completed on the second day of the survey. The order in which the three sections are monitored is alternated over the four monthly surveys to provide a snapshot of use of each section during the morning, midday, and early afternoon. During the morning or early afternoon time periods, surveys are conducted in an upstream or downstream direction so observers are facing away from direct sunlight to maximize visibility. When possible, driving through suitable habitat before the survey begins is avoided to minimize disturbance to the birds. If a plover or tern nest is found, the nest is monitored following the semi-weekly nest and brood monitoring protocol.

- Modification to protocol under conditions of low discharge (below 200 cfs) or high discharge (above 3,500 cfs) – Low discharge (below 200 cfs) severely reduces or eliminates riverine habitat and limits access to the river via airboat. High discharge (above 3,500 cfs) makes it difficult or impossible to safely travel under bridges with an airboat in order to monitor sections of the river without boat ramp access. Under either condition, monthly river surveys may be restricted. If nesting has been documented on the river during the current nesting season, Program staff puts forth their best effort to get to those areas to survey. If no nesting has been documented on the river during the current nesting season, an airboat is used only where the river can safely be navigated. In areas that cannot be safely navigated by an airboat, Program staff implements point count surveys. There is an increased likelihood of plover and tern use of the river at river sections adjacent to OCSW nesting sites on Program and conservation lands where surveys indicate continued presence of plovers and/or terns. Therefore, point count surveys are conducted from the bank of Program property and conservation lands and from bridges as appropriate to check for plover and/or tern use of the river. Program staff do not attempt to access private property.

SEMI-MONTHLY OCSW SURVEYS

EDO and NPPD biologists conduct semi-monthly (1 and 15 of May, June, and July; and 1 August) surveys at Program-owned or partnered OCSW sites along the AHR to count plover and tern adults, breeding pairs, nests, chicks, and fledglings. EDO conducted surveys are usually conducted on the same date across multiple sites over the entire AHR or within a day. Each survey consists of ≥ 30 min of observation from outside the site using binoculars and/or spotting scopes at a distance that does not cause disturbance to the plovers and terns (usually > 165 ft, but occasionally closer as terrain dictates). Biologists make observations from multiple vantage points to allow observation of as much of the site as possible. Monitoring techniques from outside the site include scanning shorelines for plover and tern adults, fledglings, or chicks; systematically scanning the interior of the site for plover and tern adults, fledglings, or chicks; and listening for plover and tern calls.

SEMI-WEEKLY NEST AND CHICK MONITORING

In addition to monthly surveys of the river and semi-monthly surveys of all OCSW sites, EDO and NPPD biologists monitor any OCSW or river site with active nests or broods on a semi-weekly basis throughout the nesting season. Upon location of an active nest, biologists monitor from outside the nesting area to observe nests and/or chicks twice per week until the nest or brood fail, or the chicks fledge. Biologists record site and nest/brood specific data including: date, location of the nest, observation start and stop times, and the number of plover and tern adults, nests, broods, chicks, and fledglings present.

Like semi-monthly OCSW surveys, semi-weekly nest and chick monitoring consists of ≥ 30 minutes of observation using binoculars and/or spotting scopes at a distance that does not cause disturbance to nesting birds (usually > 165 ft, but occasionally closer as terrain dictates). Biologists make observations from multiple vantage points to allow observation of as much of the site as possible. Monitoring techniques from outside the site include scanning shorelines for plover and tern adults, fledglings, or chicks; systematically scanning the interior of the site for plover and tern adults, fledglings, or chicks; and listening for plover and tern calls.

Biologists often locate nests and chicks by first observing adult birds. If an adult plover or tern is seen sitting on the sand, the location is estimated on a map of the site. The second time an adult is seen sitting in the same location, the location is considered an active nest and the estimated initiation date is determined to be the midpoint between the first date the bird was seen sitting and the previous date the site was surveyed when the bird was not seen sitting. The estimated hatch date and estimated fledge date are autogenerated by the Program's species database based on the estimated initiation date. Estimated hatch date is 28 days for plovers and 21 days for terns after the estimated initiation date.

Once the first chick has hatched, nest monitoring transitions to brood monitoring, though as mentioned, the fate of any remaining eggs will be recorded. Chicks are assigned to a nest/brood on hatch. This is primarily done based upon location and timing. If chicks are in or around the nest bowl (within 5-7 ft.) or within the adults' territory (territory varies by species, site, and terrain)

they are assigned to that nest/brood. Adult behavior such as foraging, territorial displays and calls, and chick calls can help to determine approximate territory. Upon hatch, the territory for plovers can include the nearest stretch of shoreline as plover chicks move to the shoreline within one to two days of hatch. Terns typically remain in or around the nest bowl for three to five days before moving down to the shoreline during the day. Broods can also be assigned to a nest using other context data as well, such as matching the date the brood was first observed and approximate age of the chicks with the estimated hatch date of the nest. Observers take into account the presence or absence of other nests of the same species, their current status, and estimated hatch dates. When biologists observe chicks still in the nest bowl, the observed hatch date is determined to be the date the chicks are first seen. If chicks are first seen away from the nest bowl, the observed hatch date is determined to be the midpoint between the date the chicks are seen and the previous date the site was surveyed.

Fledging success is determined by observed/estimated hatch, approximate age and appearance of chicks, or observed flight if this occurs before the estimated fledge date. The estimated fledge date of a chick is 28 days for plovers and 21 days for terns after the estimated hatch date. Unless the actual hatch date is known, a buffer of 3-4 days is included to account for the fact that the estimated hatch date may not be the actual hatch date. The approximate age of chicks based on appearance is recorded on data sheets and can be considered if necessary. If a chick is seen flying before the estimated fledge date, the observed fledge date entered is the date the chick was seen flying. If a fledgling is observed during the survey following a chick's estimated fledge date, it is assumed the chick fledged on the estimated date and was observed flying after the fact, thus the observed fledge date is entered as being the same as the prior estimated date. Typically, chicks are not considered fledged until flight is observed or until they are observed on or after the estimated fledge date. However, if chicks were last observed within the 3–4-day buffer and there is no evidence of failure, then they are considered to have reached fledge age as it is assumed that they were likely capable of sustained flight and could be present on nearby habitat. Broods are considered fledged once one chick of the associated brood meets these requirements.

NEST AND BROOD FATING

When the nest or brood fail, biologists attempt to determine the cause of failure and assign a nest/brood failure fate as abandoned, flooded, predated, weather, or unknown as explained below. Unknown causes of nest/brood failure are assigned when loss stage was known, but there was not enough evidence to assign a specific fate. In order to fate a nest or brood, biologists look at all evidence available for a nest or brood (see [Appendix D: Nest and Brood Fating](#)).

Nest Fating

Successful Nest – A nest is considered successful if ≥ 1 egg hatches, chicks of an appropriate age are observed in the nest bowl or near the nest, or there is evidence of hatching (chick droppings, chick tracks, or piping fragments) at the nest. It is possible for ≥ 1 egg to hatch, resulting in a successful nest fate, while the remaining eggs have a different fate.

Failed Nest – If a nest is not successful, the fate of the entire nest is determined by the fate of the final egg remaining in a nest because the nest could still be successful if the final egg hatches. Therefore, each egg in a nest could have a different failed fate, but the final egg determines the fate of the nest.

Failed-Abandoned – A nest is considered failed-abandoned if the eggs are still present in the nest but the adults are no longer observed tending to the nest. A nest is considered abandoned if there are three or more survey visits without an adult sitting on the nest with no evidence of hatch or no chicks observed.

Failed-Flooded – A nest is considered failed-flooded if the nest is observed partially or completely inundated, if water level has surpassed the height at which the nest had previously resided and now the nest is washed away, or the nest is surrounded by debris or wrack from water levels rising then receding, which caused damage to the nest.

Failed-Predated – A nest is considered failed-predated if a predator is observed predating the nest. A failed predated fate is also assigned to a nest that is damaged or missing prior to estimated hatch date accompanied by predator signs at the nest (tracks, scat, digging, etc), yolk concretions, blood, and/or feathers observed near the nest bowl. A combination of less direct supporting evidence may also lead to a failed predated nest fate, including: predator breach of fence, predator digs, predator presence on nesting site as documented by tracks or scat, and documented predation events at nearby nests occurring over the same time period when the nest in question was damaged or went missing.

Failed-Weather – A nest is considered failed-weather if a weather event is observed damaging the nest or a major weather event occurred since the last observation (within three days) and the nest is damaged or missing such that the location of a known nest is now washed out or eggs are washed out due to rain, a nest has been damaged by hail, or the nest is damaged or missing the same day as another, nearby nest that failed-weather.

Failed-Unknown – A nest is failed-unknown if all eggs are damaged or missing more than three days before the nest's estimated hatch date and there is no evidence to support loss by predation, flooding, or weather. If a nest is damaged or missing after a known predation event and a known flooding/weather event occurred at the site but there is not enough evidence to assign failure to one cause or another, the nest is fated failed-unknown. Nests where adults tend to the nest for three or more survey visits past the estimated hatch date with no chicks of an appropriate age observed are also considered failed-unknown.

Unknown Outcome – An unknown outcome means it is unknown if the nest hatched or failed. A nest has an unknown outcome if the nest disappears within three days of the nest's estimated hatch date (28 days after initiation date for plovers, 21 days after initiation date for terns) without enough evidence to determine if it was successful or failed. If no chicks are observed within three days of the nest's estimated hatch date, the nest is also fated as an unknown outcome. The estimated hatch date is an estimate; therefore, the nest could hatch up to three days before or after the estimation. An unknown outcome nest can happen if the nest was known to have failed overall, but it is uncertain whether it had hatched before failing so the failure could not be assigned to either the

nest or brood stage. An unknown outcome fate can also be assigned in the rare case that it is completely unknown if the nest was successful or failed.

Brood Fating

Successful Brood (Fledged) – A brood is considered successful if a chick or chicks are observed at fledge age (28 days for plovers, 21 days for terns) or within four days of estimated fledge age, if there is observed flight of any length by chicks, or if unaccounted for fledglings of an appropriate age and quantity matches a known nest.

Failed Brood – If a brood is not successful, the fate of the entire brood is determined by the fate of the final chick because the brood could still be successful if the final chick fledges. Therefore, each chick in a brood could have a different failed fate, but the final chick determines the fate of the brood.

Failed-Predated – A brood is considered failed-predated if a predator is observed predating all chicks. A brood is failed due to predation if dead chick(s) are found with evidence of predation or blood and chick feathers are found. A combination of less direct supporting evidence can support a failed predated brood fate (but must accompany one piece of evidence above): predator breach of fence, predator digs, predator presence on nesting site as documented by tracks or scat, and documented predation events at nearby nests or broods occurring over the same time period when the brood in question went missing.

Failed-Weather – A brood is considered failed-weather if a weather event is observed killing all chicks. Broods may also be fated failed-weather if a weather event (usually hail) occurred since last visit (within three days) with other nests/chicks/adults fated failed due to weather on same site.

Failed-Unknown – A brood is considered failed-unknown if no chicks from a brood are observed for three straight visits and they were not seen within four days of their estimated fledge date, or if dead chick(s) are observed and the cause of death is unclear.

Unknown Outcome – If a nest is marked as unknown outcome, then the corresponding brood fate for this nest must also be considered unknown outcome. An unknown outcome brood can happen if the nest was known to have failed overall, but it is uncertain whether it had hatched before failing so the failure could not be assigned to either the nest or brood stage. An unknown outcome fate can also be assigned in the rare case that it is completely unknown if the brood was successful or failed. A brood has an unknown outcome if no chicks were observed for one or two straight survey visits (but not three), and the site was not visited again.

ANALYSES

HABITAT AVAILABILITY AND USE

Monitored on-channel nesting habitat along the AHR that is created, rehabilitated, or managed by the Program and other organizations and that fits the accepted Program habitat requirements (see [Appendix A. Definition of Available or Suitable Nesting Habitat, Riverine Habitat](#)) is delineated using aerial imagery and GIS, and area is calculated. OCSW suitable habitat acres (see [Appendix A. Definition of Available or Suitable Nesting Habitat, OCSW Habitat](#)) are also calculated using aerial imagery and GIS. The area of bare sand (i.e., less than 25% vegetative cover) at least 200 ft from any vegetation ≥ 5 ft tall is calculated at each site. Washouts, steep banks, and areas with high disturbance (frequent driving, walking, or human activity) are excluded.

Biologists monitoring from outside of the nesting area estimate the location of all plover and tern nests in relation to colored cement blocks and other distinguishing site characteristics of known location. These points of reference are used in conjunction with GIS to place nests on a map and obtain GIS coordinates. If a nest is located while on the nesting site, the location is updated using GPS coordinates collected using a handheld GPS or cellular device. Habitat metrics associated with each nest, including elevation above water and distances to nearest waterline and predator perch are then collected off site using GIS. LiDAR imagery is used to develop digital elevation models to measure elevation of nests above water at each site. An RTK unit is used to collect four water surface elevations at each site during the semi-monthly OCSW surveys to document change through the season. These field-measured elevations are averaged to determine water surface elevation for each site. The difference between LiDAR-derived nest elevations and site-specific water surface elevations are calculated to arrive at nest elevations above waterline. The distance to the edge of the water is defined as the closest Euclidean distance to water from each nest. The distance to predator perches is defined as the Euclidean distance to the closest wooded area or object ≥ 10 ft tall that could be used by an avian or mammalian predator. This information is used for resource selection analyses to identify characteristics associated with nest site selection. Inter- and intraspecific associations are also analyzed by looking at the distances to the nearest plover and tern nest. GIS is used to identify the closest plover and tern nest, and only concurrently active nests are considered.

PRODUCTIVITY METRICS

Max Adult Count and Total Nests, Broods, Chicks, and Fledglings Observed

For each monthly river and semi-monthly OCSW site survey, we total the number of adults, breeding pairs, nests, chicks, and fledglings observed. These numbers provide snapshots of plover and tern relative abundance during each nesting season without accounting for detection probability. We use semi-weekly and semi-monthly survey data for OCSW sites with and without nests, respectively, to calculate the total number of plover and tern adults at all OCSW sites based on the maximum count of adults observed at each site on any one survey. We calculate the total number of nests as the total unique nests observed across all sites and brood count as the total number of successful nests (≥ 1 chick hatched) across all sites. We calculate the total number of chicks (< 15 days old) and fledglings (21 days old for terns; 28 days old for plovers) based on the

maximum number of chicks and fledglings that are associated with each unique nest and summed across all nests.

Breeding Pair Estimation (BPE)

We calculate plover and tern breeding pair estimates (BPE) for nesting observed on the river channel and at OCSW sites according to the methods described by Baasch et al. (2015). The Program's BPE was found to be the most appropriate estimator of breeding pairs based on our monitoring protocol and sampling effort (Baasch et al. 2015). We calculate plover and tern BPE by adding the number of active or recently failed nests (within the species-defined re-nest interval) to the number of active or recently failed or fledged broods (within the species-defined re-nest or post fledge interval, respectively) observed on a given date. We determine plover breeding pair counts by assuming: (1) plover nests do not hatch within 28 days of being initiated; (2) plovers do not re-nest within 5 days of losing a nest or brood or fledging chicks; (3) plover chicks fledge at 28 days of age (defined fledging age for 2010-current); (4) plover chicks that survive to 15 days of age (fledging age for 2007-2009) also fledge. We obtain tern breeding pair estimates by assuming: (1) tern nests do not hatch within 21 days of being initiated; (2) terns do not re-nest within five days of losing a nest or brood; (3) tern chicks fledge at 21 days of age (defined fledging age for 2010-current); (4) tern chicks that survive to 15 days of age (fledging age for 2007-2009) also fledge; and (5) terns do not re-nest after fledging chicks.

The Program reports peak BPE when numbers of plover and tern breeding pairs observed during a single observation period within the entire Program AHR first peak. Thus, peak breeding pair estimates are associated with a specific date. On- and off-channel BPE are calculated based upon the number of nests observed on the river channel or on OCSW sites, respectively. Thus on- and off-channel BPE represents the highest number of estimated breeding pairs across all on-channel river habitat during a single observation period, whereas off-channel BPE provides an estimate of the highest number of breeding pairs across all OCSW sites during a single observation period. We also calculate peaks in BPE for each OCSW site, which represents the highest number of estimated breeding pairs at a single site during a single observation period regardless of the date when breeding pairs peak over the entire AHR.

Apparent Nest Success and Fledge Ratios

Apparent nest success is calculated by taking the number of successful nests and dividing it by the total number of nests observed. Although this can be used to determine reproductive input and output, it is not always a true measure of reproductive success. Renesting and unknown outcomes of nests could create biases, therefore, the Program uses fledge ratios and survival rates to measure reproductive success of plovers and terns over time.

Fledge ratios are calculated by taking the total number of fledglings (28-day plover chicks or 21-day tern chicks) and dividing it by the respective BPE for the season. This equates to a ratio that can be compared to past years or across monitored sites.

SURVIVAL RATES

We separately estimate daily survival rates of plover and tern nests located on OCSW sites and on islands in the river channel. We define nest success as any nest that hatches ≥ 1 chick. We consider the incubation period for terns and plovers to be 21 and 28 days, respectively, from when nests were determined to have been initiated. When the fate of a nest is unknown, we assign a “failed” status to the nest if the date of determination (date first observed inactive) was < 21 days (tern) or < 28 days (plover) after the date the nest was initiated, and we failed to observe chicks of appropriate age near the nest bowl. For example, if a plover nest was observed to be active and intact 12 days after it was initiated, and then was found to be empty (no eggs) four days later (16 days after it was initiated) with no sign of chicks of appropriate age in the area, we fate the nest at 14 days (midpoint of the two observation periods) and assign a “failed” status to the nest as it likely did not hatch within 16 days of initiation. If, however, a plover nest with an unknown fate was last observed to be active 26 days after it was initiated, but then four days later (30 days after it was initiated) we observed an empty nest bowl with no sign of chicks of appropriate age in the area, we assign the fate of the nest on day 28 (midpoint of the two observation periods) as “successful”. Our assumption is that, on average, we discard survived and failed intervals in the same proportion they occur in the data.

We also separately estimate daily survival rates of plover and tern broods monitored each year. As the exact date of hatching is occasionally unknown, we consider the brooding period for tern and plover chicks to be 21 and 28 days from the date we first observed nestlings, respectively. A successful brood is defined as any brood with ≥ 1 chick that was observed fledged or that survived 21 days (terns) or 28 days (plovers). Like nest survival methods, when the fate of a brood is unknown, we assign the fate of the brood at the midpoint of when a brood was last observed active and first documented as an “unknown” status. We assign a failed status to a brood if the date of fate determination is < 21 or < 28 days after we first observed tern or plover chicks, respectively, and a successful status to the brood otherwise.

We use mixed-effects nest fate logistic exposure models to estimate daily survival rates (DSRs) of plover nests and broods at OCSW sites ([Shaffer 2004](#)). We conduct separate analyses to estimate DSRs of tern nests and broods at OCSW sites. We develop three models for each of the four analyses. First, we estimate nest or brood survival as a constant (i.e., null model). Second, we evaluate whether nest or brood survival is different for nests at Program and non-Program managed sites (i.e., ownership model). Third, we evaluate whether nest or brood survival is different across sites (i.e., site model). We include site as a random effect in each model to account for a potential lack of independence of nest fates at each site. We use the *glmer* function in package *lme4* ([Bates et al. 2015](#)) in Program R ([R Core Team 2024](#)) to fit models and estimate coefficients. When models do not converge due to insufficient data, we default to a fixed effects model for estimates.

INCIDENTAL TAKE AND MORTALITY

In its 2006 Biological Opinion ([USFWS 2006](#)) and 2018 Supplemental Biological Opinion ([USFWS 2018](#)) on the Program, the USFWS developed an incidental take statement addressing

incidental take for plovers and terns associated with operation of existing and new water-related activities, and habitat alteration or monitoring conducted in the Platte River basin covered by the Program. Such take includes killing, harming, and harassing which could include the loss of habitat, individuals (adults, eggs, and/or chicks), and recruitment. In this incidental take statement, the USFWS described five types of losses reasonably foreseeable to occur as a result of the implementation of the Program and established allowable take under each category: (1) inundating flow; (2) inland lakes; (3) habitat restoration and management; (4) research and monitoring; (5) predation at OCSW nesting sites. Quantification of allowable take is also identified in the individual section 10(a)(1)(A) federal permits issued to researchers. The Service acknowledged “Acts of God” or “Acts of Nature” as beyond operational control of Program participants, with that type of take not included as incidental take. Any research-related incidental take is reported immediately to USFWS and the Nebraska Game and Parks Commission (NGPC). Annual monitoring reports include summaries of nest loss, brood loss, and adult mortalities with the cause of loss (i.e. fates) determined, when possible, from available monitoring information (see [Appendix D: Nest and Brood Fating](#)). Any take is reported annually and in conjunction with a summary of incidental take incurred by the Program since its inception in 2007.

DATA MANAGEMENT AND QUALITY ASSURANCE/QUALITY CONTROL

The Program’s species database is used to store, retrieve, and organize observational data from outside monitoring (see Appendix C. Datasheet Templates, Outside Monitoring: LTPP Daily Monitoring and LTPP Nest Monitoring). Data are first collected in the field on paper data sheets and then entered into the database by trained and qualified personnel. The database is housed through DJ Case as contracted by the Program EDO and backed up daily through external data centers. Data collected by trappers (see Appendix C. Datasheet Templates, Predator Trapping: Trap Location and Trapping Period, Daily Trapping, and Captures) are filled out on paper data sheets in the field and then later entered by Program staff into a Microsoft Excel spreadsheet. River survey data (see Appendix C. Datasheet Templates, River Survey) are collected using data sheets on digital notebooks and stored by online servers (Google Sheets) during the field season. Data are downloaded from these online servers weekly and stored along with trapping data and other files related to data analyses on a file server housed, maintained, and backed up nightly to an external server by Onset as contracted by the Program’s EDO. All paper data sheets and printed copies of annual monitoring reports are filed at the Program’s EDO.

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. Data forms are completed as surveys are completed and 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. Each observer is responsible for entering their data in the Program’s species database for long term storage. The Program’s species database has been developed and updated to detect potential errors or inconsistencies in data entry as data are being entered. Summaries of plover and tern monitoring data are generated by the Program species database and downloaded to be checked for consistency with paper data sheets weekly and at the end of the season by the observer. The project leader then reviews data from the

Program's species database for consistency in nest and brood chronology and fatting across data sources. The project leader also reviews trapping data to check for errors in data entry. Any necessary changes made to the data forms or database entries are accompanied by notes explaining the change and are initialed and dated by the person making the change. The Program's species database has been updated to directly produce tables and figures that summarize plover and tern monitoring data for annual reports to reduce errors and improve efficiency and repeatability.

REPORTING

Data on plover and tern habitat availability and use, productivity metrics, nest and brood survival, and incidental take and mortality are compiled, summarized, and incorporated within an annual monitoring and research report following each nesting season. Draft and final reports that describe implementation of annual management and monitoring methods, summarize annual results for plover and tern use and productivity (using tables, figures, and descriptive statistics), and provide general conclusions for the annual monitoring period are provided to the Technical Advisory Committee (TAC) and Governance Committee (GC) for their review, revision, and final approval.

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APPENDIX A. DEFINITIONS

Active Channel (riverine) – Channels >225 ft (75 yards) wide

Apparent Nest Success – Calculated by taking the number of successful nests and dividing it by the total number of nests observed in a nesting season

Available or Suitable Nesting Habitat – Nesting habitat will be classified as “available” or “suitable” if it is a river island or OCSW site with nesting plover or tern adults, or if it fits the following minimum habitat criteria as defined by the Program:

Riverine Habitat

- At least 50% water within a one quarter-mile river reach
- Within the same one quarter-mile reach of river, at least 1.5 ac of sand, 1.5 ft above 1,200 cfs reference stage, in minimum channel width of 400 ft
- Minimum buffer of island edge to bank of 50 ft
- Bare sand (i.e., less than 25% vegetative cover); existing vegetation less than 5 ft in height
- Edge of island at least 200 ft from any vegetation 5 ft or higher above the top elevation of the nesting island/bar

Off-Channel Sand and Water (OCSW) Habitat

- Sandpits within Program associated habitats along the river
- Per site, at least 1.5 ac of bare sand (i.e., less than 25% vegetative cover)
- Edge of bare sand at least 200 ft from any vegetation 5 ft or higher

Bare Sand – River island or OCSW site with <20% vegetative cover

Bare Sand Area – Total area with <25% vegetative cover at the colony site

% Bare Sand Area – Percent of the nesting area classified as bare sand (<25%, 25-50%, 50-75%, >75%)

BPE Peak Dates:

AHR BPE Peak Date – The Program reports peak BPE when numbers of plover and tern breeding pairs observed during a single observation period within the entire Program AHR first peaked. Thus, peak breeding pair estimates are associated with a specific date.

On- vs. Off-Channel BPE Peak Date – On- and off-channel BPE are calculated based upon the number of nests observed on the river channel or on OCSW sites, respectively. Thus, on- and off-channel BPE represents the highest number of estimated breeding pairs across all on-channel river habitat during a single observation period, whereas off-channel BPE provides an estimate of the highest number of breeding pairs across all OCSW sites during a single observation period.

Site BPE Peak Date – Peaks in BPE for each OCSW site represents the highest number of estimated breeding pairs at a single site during a single observation period regardless of the date when breeding pairs peaked over the entire AHR.

Breeding Pair Estimation – We calculate plover and tern breeding pair estimates (BPE) for nesting observed on the river channel and at OCSW sites according to the methods described by [Baasch et al. \(2015\)](#).

Brood – One or more chicks that hatched from a single nest

Brood-rearing Period – The brood-rearing period for plovers and terns will be considered 28- or 21-days post-hatch, respectively, unless more conclusive evidence of fledging is documented.

Channel Width (riverine) – Width of entire open-channel, including land, measured from the center of river islands in a direction perpendicular to river flow

Distance to Live Vegetation – Measured distance in inches from the center of a nest to living or current year vegetation within a 1-yd² area of the nest

Distance to Predator Perch – Distance to nearest predator perch ≥ 10 feet tall (i.e., tree, power-line pole, etc.) measured off-site using GIS

Distance to Water – Distance from each nest to the nearest water line measured using GIS

Fledge – A plover or tern chick will be considered fledged when it is 28 or 21 days old, respectively, when it is covered in unsheathed feathers, has a black eye stripe (terns), and has a short tail, or when sustained flight is observed.

Fledge Ratio – Calculated by taking the total number of fledglings (28-day plover chicks or 21-day tern chicks) and dividing it by the respective BPE for the season

Incubation Period – The incubation period for plovers and terns will be considered 28 and 21 days, respectively, from when the adult begins to incubate the eggs.

Nearest Bank (riverine) – Distance across water from each nest to the nearest bank measured off-site using GIS

Nest – A scrape in the sand, usually lined with pebbles, with eggs in it. Scrapes without eggs and randomly deposited non-incubated eggs(s) outside of a nest bowl will not be considered nests

Nest and Chick Monitoring Surveys – Any OCSW or river site with active nests or broods are surveyed on a semi-weekly basis throughout the nesting season. The surveys are from outside the nesting area and consist of ≥ 30 min of observation using binoculars and/or spotting scopes at a distance that does not cause disturbance to nesting birds. Biologists record numbers of adults, nests, chicks, and fledglings during each survey.

Nest Bowl – Nest cup (depression) including a 3-inch buffer area around the cup

Nest Elevation – Difference between the elevation of each nest and the water surface obtained off-site using LiDAR and GIS data.

Nest Initiation – A nest is initiated when it is constructed and at least one egg is laid.

Nesting Colony – Area encompassed by multiple nests within which disturbance to one nest results in a disturbance reaction by adults of other nests. In cases where only a single nest is present, the nest will serve as the “colony” for habitat measurements.

OCSW Surveys – Biologists conduct surveys at Program-owned or partnered OCSW sites along the AHR to count plover and tern adults, breeding pairs, nests, chicks, and fledglings. Surveys are conducted using spotting scopes and monitoring techniques from outside the nesting area.

Pond/Water Moat Size (OCSW site) – Size of pond/water moat, which is used as a predator barrier and for tern foraging, adjacent to OCSW sites. This parameter is measured using GIS.

Predator Management – The Program implements several basic, long-term management strategies (water deterrents, fencing, panel wings, tree removal, avian spikes on potential perches, terrestrial mammal trapping) to reduce the risk of predation at Program managed OCSW sites.

Terrestrial Mammal Trapping – A licensed trapper conducts terrestrial mammal trapping and lethal removal at nesting sites prior to and during the nesting season. Predator removal/trap types include live cage traps (cage traps), dog proof leg hold traps (dog proof traps), body hold snares (snares), as well as opportunistic firearm usage (firearm).

River Survey – Biologists use an airboat to conduct river surveys May through August on the central Platte River spanning the AHR to count plover and tern adults, breeding pairs, nests, chicks, and fledglings. Active river channels >225 ft wide that can safely be navigated between the J-2 Return, located east of Lexington, and the Chapman bridge, located west of Chapman, Nebraska, are included in the survey.

Site – A group of river islands within close proximity of each other and managed as a group or OCSW habitat surrounded by common water.

Site Management – Management activities applied to the site (i.e. disking, chemical application, and predator control) to increase the amount of nesting habitat, increase foraging habitat, and increase productivity of plovers and terns.

Site-specific water flow – Average daily discharge (ft³/sec) is obtained, as well as observation-period specific discharge data at three locations from the “WaterWatch: USGS Real-Time Water Data for Nebraska” website including Overton (USGS gage 06768000, [USGS 2022a](#)), Kearney (USGS gage 06770200, [USGS 2022b](#)), and Grand Island, Nebraska (USGS gage 06770500, [USGS 2022c](#)). The Program uses the location of each river island site with respect to the nearest upstream and downstream USGS gage to extrapolate flow data collected at the nearest upstream USGS gage

of the site to determine site- and observation-period-specific flow at the time habitat characteristics are measured.

Successful Brood – Plover or tern brood with ≥ 1 chick that fledges or survives 28 or 21 days after hatching, respectively.

Successful Nest – A nest is successful when at least one egg hatches.

Survival Rate – A statistical measure that indicates the proportion of nests or broods that survive to hatch or fledge

Total Nests Initiated – Total number of nests initiated whether successful or not. This total includes first nesting attempts as well as re-nesting attempts.

Vegetative Cover – Percent canopy cover within a 1-yd² area around the nest (<1%, 1-5%, 5-10%, 10-20%, >20%)

Vegetation Height – Maximum height of all vegetation in a 1-yd² area centered on the nest

Wetted Channel Widths (riverine) – Wetted width of the channel on each side of the nesting area measured with a laser-range finder or using GIS

APPENDIX B. MONITORING PROTOCOL REVISIONS OVER TIME

In 1997, the Department of the Interior and the States of Nebraska, Colorado, and Wyoming adopted the “Cooperative Agreement for Platte River Research and Other Efforts Relating to Endangered Species Habitats” (Cooperative Agreement). In 2001, the Cooperative Agreement coordinated a standardized protocol for monitoring reproductive success and reproductive habitat parameters of plovers and terns on the central Platte River from Lexington to Chapman, Nebraska. The standardized protocol was implemented by CNPPID, CPNRD, NPPD, and USFWS during 2001-2006 (<https://platteriverprogram.org/program-library>; Target Species: piping plover, interior least tern; Keywords: protocol implementation, [Year of Study]). In 2007, the Program assumed this responsibility and Program staff, contracted personnel, and cooperators have since implemented the monitoring protocol. The protocol was revised prior to the 2010 nesting season (PRRIP 2010), prior to the 2017 nesting season (PRRIP 2017), and the current version prior to the 2025 nesting season to reflect changes in habitat management, learning regarding species biology, habitat availability and use, as well as effectiveness and efficiency of monitoring methods.

Changes in monitoring protocols often affect the comparability of results over time. Most changes occurred in 2010 and include:

- The definition of fledging age changed from 15 days for both species to fledging ages of 21 days for terns and 28 days for plovers.
- River surveys increased from three monthly surveys between May and August in 2001-2009 to seven semi-monthly (1 and 15 of May, June, and July; and 1 August) surveys in 2010-2024.
- Both inside and outside monitoring was implemented at all off-channel sites during 2010-2016.
- The Program began building and restoring OCSW sites to increase the amount of stable available habitat.
- The Program gained access to sites that had been previously restricted and, therefore, were not included in reproductive calculations prior to 2010.

Major changes since the 2017 protocol include:

- Band re-sighting was discontinued.
- River surveys decreased from seven semi-monthly (1 and 15 of May, June, and July; and 1 August) surveys in 2010-2024 to four monthly surveys conducted May through August in 2025-present. Reduction in river survey frequency was due to lack of suitable on-channel nesting habitat and no documented on-channel nesting by either plovers or terns since 2016 (with the exception of a single on-channel plover nest in 2023 that failed within a week) on the central Platte River.

River Survey – The river survey datasheet is filled during each river survey. Data collected includes information on bridge segments surveyed, date/time of survey, and plover and tern observations.

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[illegible]

Comments

Outside Monitoring: LTPP Nest Monitoring – The LTPP nest monitoring datasheet is filled during each semi-weekly nest and chick monitoring survey. Data collected includes information on the site, nest, and the date/time of survey.

[illegible]

Comments:

Predator Trapping: Trap Location and Trapping Period – The trap location and trapping period datasheet is filled out at the beginning of the season when traps are installed and at the end of the season when traps are removed. Data collected includes information on the site, trap type, and when the trap was installed and removed.

PRRIP Trap Locations / Trapping Period

Year:

Site:

SITE	Trap ID (Waypoint)	Coord X (N)	Coord Y (W)	TRAP TYPE (CAGE TRAP, DOG PROOF TRAP OR LEG HOLD (SNARE))	DATE TRAP INSTALLED	DATE TRAP REMOVED	DAYS

Predator Trapping: Daily Trapping – The daily trapping datasheet is filled out when traps are checked. Data collected includes information on the site and the traps at each site.

PRRIP Daily Trapping Data Sheet

Year:

Site:

Site	Date	Trapper	Time arrived	Time left	# traps opened for capture day prior	# traps checked	# traps open/empty	# traps closed/empty	# traps closed/capture (data on capture sheet)	# traps set for next visit	Observations

Predator Trapping: Captures – The trap captures datasheet is filled out when a predator is captured in a trap. Data collected includes information on the site, trap, and predator.

PRRIP Capture Data Sheet

Year:

Site:

Site	Date	Trapper	Time	Trap ID (Waypoint)	Coord X (N)	Coord Y (W)	Trap Type (DPT, CT, LH (snare), firearm)	Species Caught	# individuals in trap	Observations

APPENDIX D. NEST AND BROOD FATING

Nest Fates – Criterion for fating a nest as successful, failed-abandoned, failed-flooded, failed-predated, failed-weather, failed-unknown, or unknown outcome.

Nest Fates						
Successful	Failed-Abandoned	Failed-Flooded	Failed-Predated	Failed-Weather	Failed-Unknown	Unknown Outcome
1. ≥ 1 egg hatches	1. Eggs are still present in the nest but the adults are no longer observed tending the nest for 3 or more survey visits	1. The nest is observed partially or completely inundated	1. Predator is observed predated the nest	1. Weather event is observed damaging nest	1. All eggs are damaged or missing more than 3 days before the nest's estimated hatch date and there is no evidence to support loss by predation, flooding, or weather	1. Nest disappears within 3 days of the nest's estimated hatch date (28 days after initiation date for plovers, 21 days after initiation date for terns) without enough evidence to determine if it was successful or failed
2. Chicks of an appropriate age are observed in the nest bowl or near the nest by the outside observer	2. Three or more survey visits without an adult sitting on the nest with no evidence of hatch or no chicks observed	2. The water level has surpassed the height at which the nest had previously resided and now the nest is washed away	2. Nest is damaged or missing prior to estimated hatch date accompanied by predator signs at the nest (tracks, scat, digging, etc), yolk concretions, blood, and/or feathers observed near the nest bowl	2. A major weather event occurred since the last observation (within 3 days) and the location of a known nest or eggs that were in the nest are now washed out due to rain	2. Nest is damaged or missing after both a known predation event and a known weather event occurred at the site but there is not enough evidence to claim failed-predated or failed-weather	2. No chicks observed within 3 days of the nest's estimated hatch date
3. Evidence of hatching at the nest: chick droppings, chick tracks, or piping fragments		3. Nest is surrounded by debris/wrack from water levels rising then receding which caused damage to the nest	3. A combination of less direct supporting evidence including: predator breach of fence, predator digs, predator presence on nesting site as documented by tracks or scat, and documented predation events at nearby nests occurring over the same time period when the nest in question was damaged or went missing	3. A major weather event occurred since the last observation (within 3 days) and nest is damaged by hail	3. Adults tend to the nest for 3 or more survey visits past the estimated hatch date with no chicks of an appropriate age observed	
				4. A major weather event occurred since the last observation (within 3 days) and nest is damaged or missing the same day as another, nearby nest that failed-weather		

Brood Fates – Criterion for fating chicks and broods as successful, failed-predated, failed-weather, failed-unknown, or unknown outcome.

Brood Fates				
Successful/Fledged	Failed-Predated	Failed-Weather	Failed-Unknown	Unknown Outcome
1. Chick or chicks are observed at fledge age (28 days for plovers, 21 days for terns) or within 4 days of estimated fledge date	1. Predator observed predating all chicks	1. Weather event (usually hail) is observed killing all chicks	1. No chicks from a brood are observed for 3 straight visits and they were not seen within 4 days of their estimated fledge date	1. If a nest is marked as unknown outcome, then the corresponding brood fate for this nest must also be considered unknown outcome.
2. Observed flight of any length by chicks	2. Dead chick(s) are found with additional evidence of predation, or blood and chick feathers are found	2. Weather event (usually hail) occurred since last visit (within 3 days) with other nests/chicks/adults fated failed due to weather on same site	2. Dead chick(s) observed and the cause of death is unclear	2. No chicks were observed for 1 or 2 straight visits (but not 3), and the site was not visited again
3. Unaccounted for fledglings of an appropriate age and quantity matches a known nest	3. A combination of less direct supporting evidence may also lead to a failed predated brood fate (but must accompany one piece of evidence above): predator breach of fence, predator digs, predator presence on nesting site as documented by tracks or scat, and documented predation events at nearby nests or broods occurring over the same time period when the brood in question went missing			