Platte River Recovery Implementation Program

2010

Interior least tern and Piping plover Monitoring and Research Report for the Central Platte River, Nebraska.

Prepared for:
Governance Committee

Prepared by:
Executive Director's Office

FINAL – 11 May, 2011

Platte River Recovery Implementation Program

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PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

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We would also like to acknowledge the privately-owned sand and gravel mining companies who allowed us access to their property to monitor and collect data on interior least tern and piping plover activities. These companies included Broadfoot Sand and Gravel Corporation, Deweese Sand and Gravel Inc., Hooker Brothers Sand and Gravel, Island Landhandlers Inc., and Lilley Sand and Gravel Inc.

PREFACE

This is a preliminary report of the Platte River Recovery Implementation Program's (Program) monitoring and research efforts for interior least terns and piping plovers during 2010. The report was prepared to inform Program partners, licensing agencies, and the general public of our activities and to provide a summary of results to fulfill the requirements of the Program's state (Nebraska Master Permit #1014) and federal (TE183430-0) monitoring permits. ***Data analyses are not final and should be treated as such when citing information, data, or analyses found in this document.***

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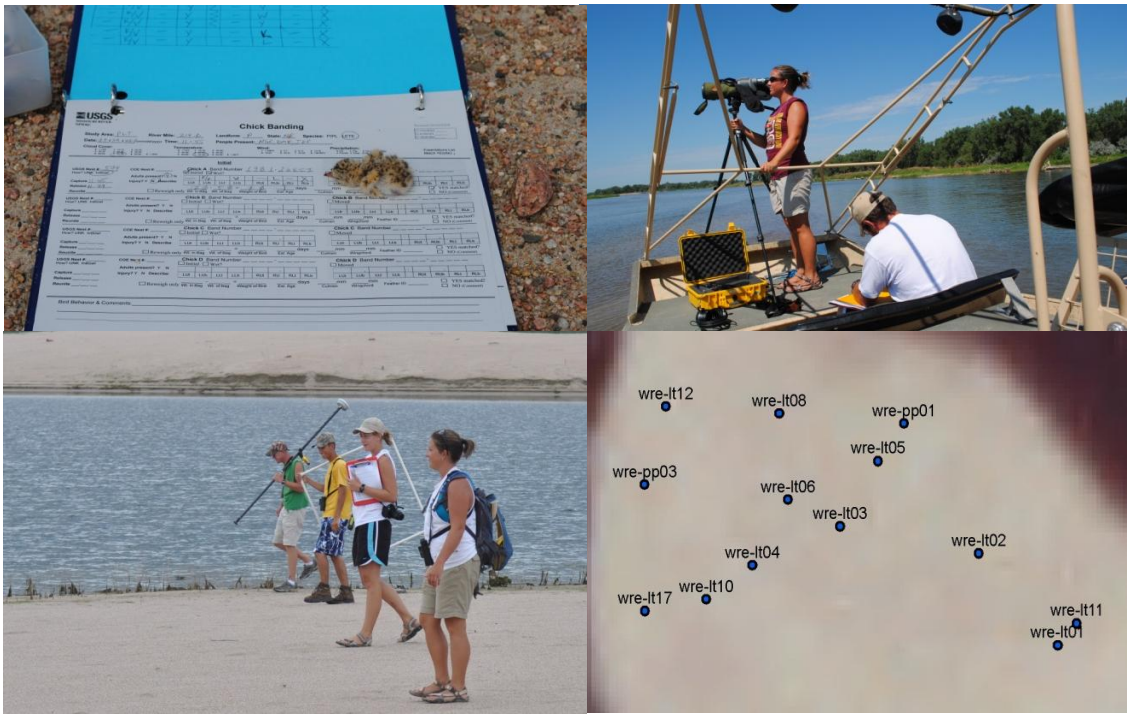


2010 EXECUTIVE SUMMARY

The scientific purposes of monitoring and research under the Program's Adaptive Management Plan are to assess target species' response to management actions on the central Platte River and to reduce uncertainty related to the interaction of physical processes and habitat availability and use. The "Big Questions" provided below is a condensed version of critical uncertainties related to interior least terns and piping plovers that form the basis for testing the Flow-Sediment-Mechanical (FSM) and Mechanical Creation and Maintenance (MCM) management strategies.

Big Questions Related to Program Management Actions for Terns and Plovers

What was learned about tern and plover habitat within Program associated habitats?

- Interior least terns and piping plovers have nested on constructed or managed riverine sandbars and at sandpit sites every year since the Program was initiated in 2007; however, only piping plovers nested on river islands during 2010 which we believe was because of high-flows and subsequent vegetation emergence.
- We found 76% of interior least tern nests were > 400 feet from the nearest predator perch, 83% were 50 feet from the nearest waterline, 91% were 1.5 feet above the nearest waterline, and 61% had nest furniture during 2010 (ES-1).
- Of the piping plover nests observed at sandpit sites, 73% were >400 feet from the nearest predator perch, 73% were 50 feet from the nearest waterline, 91% were 1.5 feet above the nearest waterline, and 60% had nest furniture during 2010. Similarly, 90% of the piping plover nests observed at riverine sites were >400 feet from the nearest predator perch, 40% were 50 feet from the nearest waterline, 70% were 1.5 feet above the nearest waterline, and 60% had nest furniture during 2010.
- We found positive correlations between nesting area size and number of piping plover nests and between the ratio of bare-sand to surface water area and number of piping plover nests at riverine and sandpit sites; however, we plan to evaluate these relationships further to see if the relationships exist over time.

a) *How did availability of habitat change during the First Increment?*

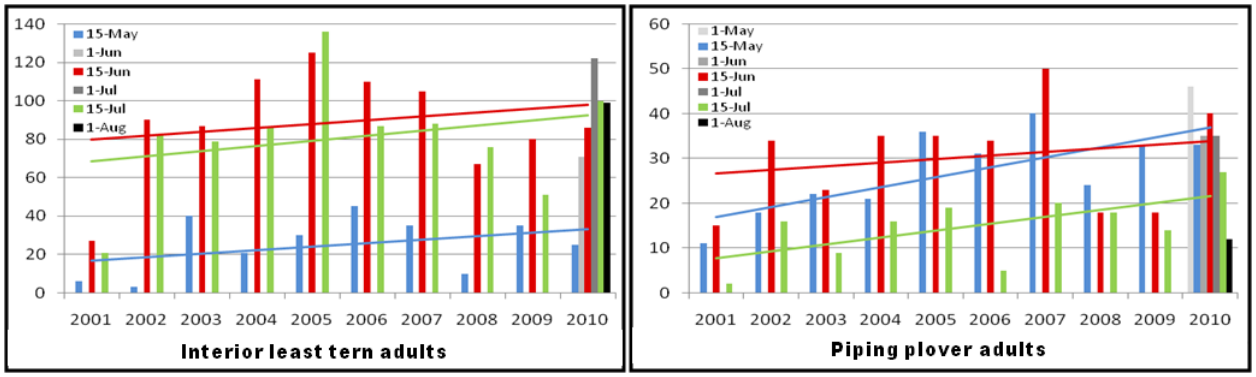
- Detailed analyses of the amount and annual change in habitat availability within Program Associated Habitats since inception of the Program will be conducted during 2011. Until these analyses are conducted, we cannot accurately depict the amount, annual changes in, and distribution of habitat present during the 2007-2010 timeframe; however, the amount and suitability of nesting habitat going into the 2010 nesting season was enhanced by Program and its partner's actions such as vegetation removal, vegetation control, and land acquisition.
- The Program acquired the Dyer and Newark Properties, signed a management agreement with Broadfoot Kearney South, and enhanced nesting habitat on the Cottonwood Ranch Property prior to the 2010 nesting season.
- Four unmanaged sandpit sites, monitored for several years, were determined to be unsuitable for nesting interior least terns and piping plovers during 2010.
- Due to extended natural high-flows and ineffective vegetation control at several sites during 2010, availability and suitability of nesting habitat declined throughout the nesting season as a result of vegetation emergence, an abnormally high decrease in bare-sand area exposed, and island erosion.

ES-1. Average site- and nest-level habitat measures collected at interior least tern and piping plover nesting sites in 2010.

	Site-level				Interior least terns								Piping plovers							
Site Name	Habitat Type	15 June Nesting-area Size (ac)	15 June % Bare Sand	15 June Sandpit-pond or River-channel Area (Ac)	# of Nests with Habitat Data	Elevation Above Water (ft)	Nearest waterline (ft)	Wetted Width of Channel (ft)	Narrowest Channel Width (ft)	% Vegetative Cover (1-yd^2 Area)	Nearest predator perch (ft)	# Nests with Nest Furniture	# of Nests with Habitat Data	Elevation Above Water (ft)	Nearest waterline (ft)	Wetted Width of Channel (ft)	Narrowest Channel Width (ft)	% Vegetative Cover (1-yd^2 Area)	Nearest predator perch (ft)	# Nests with Nest Furniture
Lexington Pit	SP	14	>75	39	21	7.4	119	----	----	<1	417	10	6	6.5	137	----	----	<1	441	3
Dyer Pit	SP	20	50-75	56	0	----	----	----	----	----	----	----	1	6.3	120	----	----	<1	1342	1
Blue Hole	SP	25	>75	56	21	6.1	130	----	----	<1	508	13	7	7.7	159	----	----	<1	487	6
Johnson Pit	SP	5	>75	32	4	4.6	69	----	----	<1	243	4	3	5.4	75	----	----	<1	339	2
Broadfoot South	SP	14	>75	74	3	5.0	44	----	----	<1	883	2	2	4.7	53	----	----	<1	749	2
Wild Rose Ranch East	SP	3	>75	13	17	2.2	53	----	----	<1	662	11	3	1.0	30	----	----	1	649	3
Sandpit Summary	**SP**	**81**	**>75**	**270**	**66**	**5.1**	**99**	**----**	**----**	**<1**	**662**	**40**	**22**	**5.8**	**112**	**----**	**----**	**<1**	**539**	**17**
Younkin Tract	RI	1	>75	67	0	----	----	----	----	----	----	----	1	1.5	15	1065	216	<1	870	1
Dinan Tract	RI	2	>75	40	0	----	----	----	----	----	----	----	2	2.0	17	926	302	<1	683	0
Dippel Tract	RI	5	50-75	87	0	----	----	----	----	----	----	----	5	2.1	50	1452	158	<1	967	2
Alda Farms	RI	1	50-75	81	0	----	----	----	----	----	----	----	1	3.9	75	1479	456	<1	552	0
Mormon Island	RI	1	>75	70	0	----	----	----	----	----	----	----	1	0.7	54	845	232	1-5	579	0
River Island Summary	**RI**	**10**	**75**	**345**	**0**	**----**	**----**	**----**	**----**	**----**	**----**	**----**	**10**	**2.1**	**46**	**1250**	**230**	**<1**	**814**	**3**
Summary for All Sites	**All**	**91**	**>75**	**615**	**66**	**5.1**	**99**	**----**	**----**	**<1**	**662**	**40**	**32**	**4.6**	**90**	**1250**	**230**	**<1**	**627**	**20**

b) *How do interior least terns and piping plovers use the habitat (nesting, foraging, loafing)?*

- A maximum of 122 adult interior least terns (61 pair; ES-2) were observed while conducting early-July semi-monthly river and sandpit surveys when there were a combined total of 47 active nests (33) and broods (14) present at sandpit sites within Program associated habitats (no interior least tern nests observed on river islands during 2010).
- We observed a maximum of 46 adult piping plovers (23 pair; ES-2) during early-May surveys; however, a few of these adults probably nested on another river system as we typically observed 34 – 36 adults (17 – 18 pair) during subsequent surveys. The maximum number of active piping plover nests and broods observed during any single survey period (mid-June) was 17 which included 11 nests and 6 broods.
- We observed 76 interior least tern and 22 piping plover nests at managed sandpit sites and 13 piping plover nests on constructed and managed river islands during the 2010 nesting season.
- During semi-monthly surveys, >65% of adult interior least tern and >83% of adult piping plover observations were at sandpits or river islands managed for their reproduction. Behavioral states at all sites included foraging, forage delivery, courtship, preening, loafing, and flying. Additional behavioral states at managed sandbars and sandpit sites included breeding, nest-bowl preparation, nesting, and brood rearing.
- Although interior least terns foraged in sandpit ponds and piping plovers foraged along sandpit-pond waterlines, most foraging by adult and fledgling interior least terns and piping plovers was observed at riverine sites.
- Interior least tern and piping plover chicks reared at sandpit sites typically were observed foraging on or near managed riverine habitat shortly after fledging; >60% of all fledgling observations occurred on or near managed river islands.

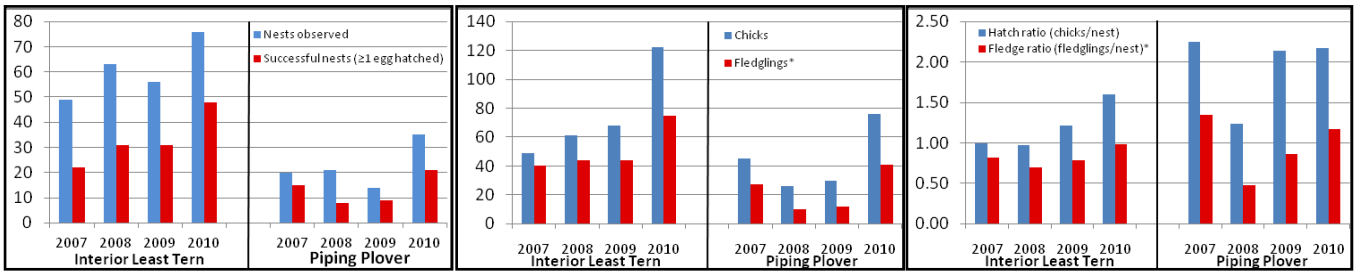


ES-2. Trends (lines) in numbers (boxplots) of adult interior least terns and piping plovers observed during mid-month and semi-monthly river and sandpit surveys within Program Associated Habitats.

c) <u>How does an increase in habitat availability relate to productivity?</u>

- Trends in the number of interior least tern and piping plover adults observed during mid-month and semi-monthly surveys of Program associated habitats show an increase since 2001; however, adult numbers declined during the mid-2000s, but were as high or higher during 2010 than they have been since 2001 (ES-2).
- We observed as many or more interior least tern and piping plover nests, successful nests, chicks, chicks/nest, fledglings, and fledglings/nest during 2010 than since the Program began in 2007 (ES-3; ES-4).

ES-3. Number of initiated and successful nests (left), chicks and fledglings (middle), and nest-based hatch and fledge ratios (right) for interior least terns and piping plovers observed at river island and sandpit sites within Program Associated Habitats.



- Daily, incubation-, and brood-rearing period survival rates for interior least tern and piping plover nests and chicks remained high during 2010 despite the near season-long high flows that claimed at least 3 nests and broods and inundated or eroded potential habitat, vegetation establishment that limited nesting opportunities on river islands, and a mid-June rain event that claimed several nests and broods on sand pits (ES-4).
- 2010 was the first year interior least tern or piping plover nests were observed on Program owned and managed sites with suitable nesting habitat (Cottonwood Ranch, Dyer, Broadfoot Kearney South, and Newark Sandpit) and we observed:
  - <u>Dyer Sandpit</u>: 1 piping plover nest that fledged 3 chicks,
  - <u>Broadfoot Kearney South Sandpit</u>: 2 piping plover nests that hatched 7 chicks, but we failed to observe any fledglings; however, we did observe adult piping plovers entering and leaving a vegetated area on the peninsula, presumably tending to chicks, for 7-10 days after the 2 broods were last observed at 20-days of age, and
  - <u>Broadfoot Kearney South Sandpit</u>: 11 interior least tern nests, 5 of which hatched 14 chicks and produced 12 fledglings; however, 8 of the 11 nests were on 2 islands we could not monitor effectively due to access limitations so actual numbers were likely higher.

ES-4. Reproductive success for interior least terns and piping plovers at sandpit and river island sites within Program Associated Habitats.

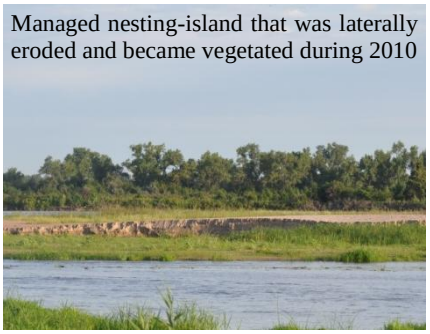
Reproductive Parameter *	Interior least tern				Piping plover			
	2007	2008	2009	2010	2007	2008	2009	2010
Total Nests Observed	49	63	56	76	20	21	14	35
Successful Nests	22	31	31	48	15	8	9	21
Apparent Nest Success	0.45	0.49	0.55	0.63	0.75	0.38	0.64	0.60
Daily Nest Survival Rate	0.97	0.98	0.99	0.98	0.99	0.98	0.99	0.98
Incubation-period Survival Rate	0.55	0.61	0.73	0.64	0.71	0.58	0.67	0.54
Chicks Observed	49	61	68	122	45	26	30	76
Hatch Ratio (Chicks/Nest)	1.00	0.97	1.21	1.61	2.25	1.24	2.14	2.17
Chicks (15 Days old)	40	44	44	76	27	10	12	50
Fledglings (21/28 Days old)	-----	-----	-----	75	-----	-----	-----	41
Historic Fledge Ratio(15 Days old)	0.82	0.70	0.79	1.00	1.35	0.48	0.86	1.43
Fledge ratio (21/28 Days old)	-----	-----	-----	0.99	-----	-----	-----	1.17
Daily Brood Survival Rate	-----	0.98	0.98	0.98	-----	0.94	0.98	0.99
Brooding-period Survival Rate	-----	0.75	0.79	0.72	-----	0.42	0.79	0.70

What was learned about using flow to create and maintain interior least tern, piping plover, and whooping crane habitat through implementation of the FSM management strategy?

a) *How much will long-term implementation of an FSM strategy cost?*

b) *Did flow create and maintain riverine habitat for all three species?*

- The Program did not implement the FSM management strategy (short duration high flow, sediment balance, and mechanical channel preparation); however, a natural high-flow event with equivalent flow magnitudes (7,000–8,000cfs) over an extended period (14 days) passed through the central Platte River during 2010.
- In the absence of sediment augmentation, the high-flows laterally eroded and redistributed suitable nesting islands within the channel which resulted in point-bars and smaller, lower elevation sandbar islands that were less suitable for nesting after flows receded.
- We observed a decrease in habitat availability and suitability related to river flows throughout the 2010 nesting season in the form of decreased suitable bare-sand area exposed, island erosion, and vegetation emergence.


Managed nesting-island that was laterally eroded and became vegetated during 2010

c) *Did species' use or productivity increase as a result of this habitat?*

- We fledged more piping plovers on the Platte River in 2010 than any other year since Progam inception (and the most since 2001); however, the near season-long high flow event was responsible for the loss of at least 3 piping plover nests.
- For the first time since the Program was initiated, we observed no interior least tern nests on river islands during 2010. Potential reasons for the lack of nesting are reduced habitat availability (inundation and lateral erosion) and reduced suitability (vegetation emergence) from early June through the end of the nesting season.

What was learned about using mechanical actions to create and maintain interior least tern, piping plover, and whooping crane habitat through implementation of the MCM management strategy?

a) How much will long-term implementation of a MCM strategy cost?

b) Did we mechanically create and maintain river and off-channel habitat for all three species?

- The Program and partners effectively created suitable on- and off-channel nesting habitat prior to the 2010 nesting season; however, most mechanically created and managed on-channel habitat was not effectively maintained and was lost during the nesting season.
- Though mechanically created and managed riverine and sandpit nesting habitat was available early in the nesting season (May/early June), elevated water levels through June and July resulted in habitat inundation and erosion during the high-flow event and vegetation encroachment as the season progressed. Mechanically created islands were not maintained as suitable habitat throughout the nesting season.
- Prior to inundation, mechanically created river islands that were managed with pre-emergent herbicides became heavily vegetated.

c) Did species' use or productivity increase as a result of this habitat?

- Interior least tern and piping plover reproductive success occurred at mechanically created and maintained on- and off-channel habitat during 2010 (see Big Question 1 above).

How do central Platte interior least tern, piping plover, and whooping crane populations relate to overall population recovery objectives?

- Through banding efforts conducted during 2009 and observations made during 2010, we observed fidelity and migration/winter-ground survival rates of at least 50% (5 of 10 returned) and 9% (3 of 25 returned) for adult and juvenile piping plovers banded on the central Platte River, respectively. One piping plover banded as a chick on the Platte River during 2009 was observed on the Loup River during 2010; therefore, we know at least 12% (4 of 25) of the piping plovers banded on the central Platte as chicks during 2009 survived migration and over-wintering.


plover chicks and eggs

- During 2010, we observed 1.28 interior least tern fledglings/pair and 1.86 piping plover fledglings/pair which is believed to be a high enough reproductive rate to sustain and even grow the population of interior least terns and piping plovers on the central Platte River.

What uncertainties exist at the end of the First Increment? How might we address those uncertainties in the Second Increment?

- To date, we have obtained no information on interior least tern survival and fidelity because interior least terns banded on the central Platte will not return to nest until 2011 or 2012.
- We collected a limited amount of information on factors that influence interior least tern and piping plover nest-site selection and survival during 2010; however, more information at a larger scale is needed to fully evaluate these relationships.
- Though we are unaware of any interior least terns or piping plovers banded within Program Associated Habitats in 2009 that nested on another river system during 2010, more time and additional banding efforts in the future will allow us to determine if fidelity or migration and winter survival rates have limited population growth rates on the central Platte River or if habitat is limiting. We did, however, observe an adult interior least tern during 2009 that nested and was banded on the central Platte that lost its nest and re-nested on the Missouri River later in the season.

INTRODUCTION

The Platte River Recovery Implementation Program (Program or PRRIP) was initiated on 1 January, 2007 as a result of a cooperative agreement negotiating process that started in 1997 between the states of Colorado, Wyoming, and Nebraska; the U.S. Department of the Interior (DOI); waters users; and conservation groups. The Program is intended to address issues related to the Endangered Species Act and loss of habitat in the Platte River between Lexington and Chapman, Nebraska by managing certain land and water resources following principles of adaptive management to provide benefits for 4 "target species": the endangered whooping crane (*Grus americana*), interior least tern (*Sternula antillarum*), and pallid sturgeon (*Scaphirhynchus albus)*; and the threatened piping plover (*Charadrius melodus*). The Program is led by a Governance Committee (GC) that is assisted by several standing advisory committees as well as an Executive Director (ED) and staff.

The Program has 3 main elements:

- Increasing stream flows in the central Platte River during relevant time periods through re-timing and water conservation or supply projects. The first increment objective is to re-time and improve flows in the central Platte River to reduce shortages to target flows by an average of 130,000 – 150,000 acre-feet per year at Grand Island.
- Enhancing, restoring, and protecting habitat lands for the target species. The first increment objective is to protect, restore, and maintain 10,000 acres of habitat.
- Accommodating certain new water-related activities.

In 2010, the Program's Technical Advisory Committee (TAC) agreed to revise its interior least tern and piping plover protocol to: 1) increase the window for conducting interior least tern and piping plover surveys at all sites (from 15 May – 15 July to 1 May – 1 August); 2) increase the frequency of surveys at potential nesting areas (from monthly to semi-monthly); 3) clarify or further define terms within the original Monitoring Protocol; and 4) allow for on-site collection of habitat parameters believed to influence reproductive success of interior least terns and piping plovers within Program Associated Habitats. Changes to the monitoring protocol that has been implemented by Program partners since 2001 should not impact our ability to make year-to-year comparisons of the distribution and reproductive success of interior least terns and piping plovers in the central Platte River valley. The revised protocol included monitoring interior least tern and piping plover presence and nesting on midstream-river sandbars and sand and gravel mines along the central Platte River between Lexington and Chapman, Nebraska. The Program also concluded a 2-year Foraging Habits study under a contract with United States Geologic Survey Northern Prairie Wildlife Research Center (USGS-NPWRC) and initiated a pilot-year nest-site selection research study during 2010 to learn more about habitat parameters that influence nest placement and nest and brood survival within Program Associated Habitats. Monitoring and research during 2010 was a collaborative effort between personnel of Headwaters Corporation (Program staff), Nebraska Public Power District (NPPD), United States Fish and Wildlife Service-Grand Island Field Office (USFWS-GI), Central Platte Natural Resources District (CPNRD), and USGS-NPWRC. Past analyses and data are reported in annual reports produced by West, Incorporated (2001-2007) and ED Office staff (2008-2009). Interior least tern and piping plover activity and reproductive success during 2010 are summarized in this report.

STUDY AREA

Our study area encompassed the PRRIP "associated habitats" region of the central Platte River between Lexington and Chapman, Nebraska (~90 river miles, Figure 1) as well as sandpit complexes within this reach of river. In the central Platte River system, interior least tern and piping plover habitat was located at both on- and off-river sites. River habitat included midstream sandbars used for nesting and the river itself was used for foraging. Off-river habitat included spoil piles of sparsely- or non-vegetated sand and associated sandpit lakes at sand and gravel mines. Interior least terns nested on managed sandpit spoil piles and foraged in sandpit lakes or the river while piping plovers nested on managed sandpit spoil piles and river islands and foraged on low elevation river islands and along the waterline of sandpit ponds.

2010 RIVER CONDITIONS

The amount of low-elevation sandbars present within the PRRIP associated habitats region of the central Platte River is variable and dependent on seasonal and daily fluctuations in river flow. The size and distribution of non-vegetated, high-elevation sandbars characteristic of interior least tern and piping plover nesting sites within the PRRIP Associated Habitat region is dependent upon construction or management efforts; however, nesting has occurred on lower islands built by the river (Central Platte River interior least tern and piping plover surveys, 2007 – summary of results).

April to mid-June daily flows were only slightly higher during 2010 than average flows from the previous 9-years; however, snow melt from the mountains of Wyoming and Colorado and local rainfall resulted in a natural high flow event on the Platte River throughout the habitat reach mid-June through early July (Figure 2). Mean daily flows exceeding 6,000cfs and topping out at 8,170cfs (USGS gage at Kearney) occurred during the last two weeks of June and subsided the first week of July. Much (~75%) of the mechanically created and managed riverine nesting habitat present early in the 2010 nesting season was inundated and/or eroded away by the prolonged high flow event and vegetation quickly established itself on the remaining sandbar-island habitat which limited nesting opportunities on the river. Increased river stage, however, may have positively influenced piping plover chick survival as more piping plover fledgelings were produced on river islands during 2010 than all previous years of the Program combined.

Managed nesting habitat at a Platte River Whooping Crane Trust property (Alda Farms) near Alda, Nebraska. The image was captured after high flows subsided and when a brood of 4 piping plover chicks were present.

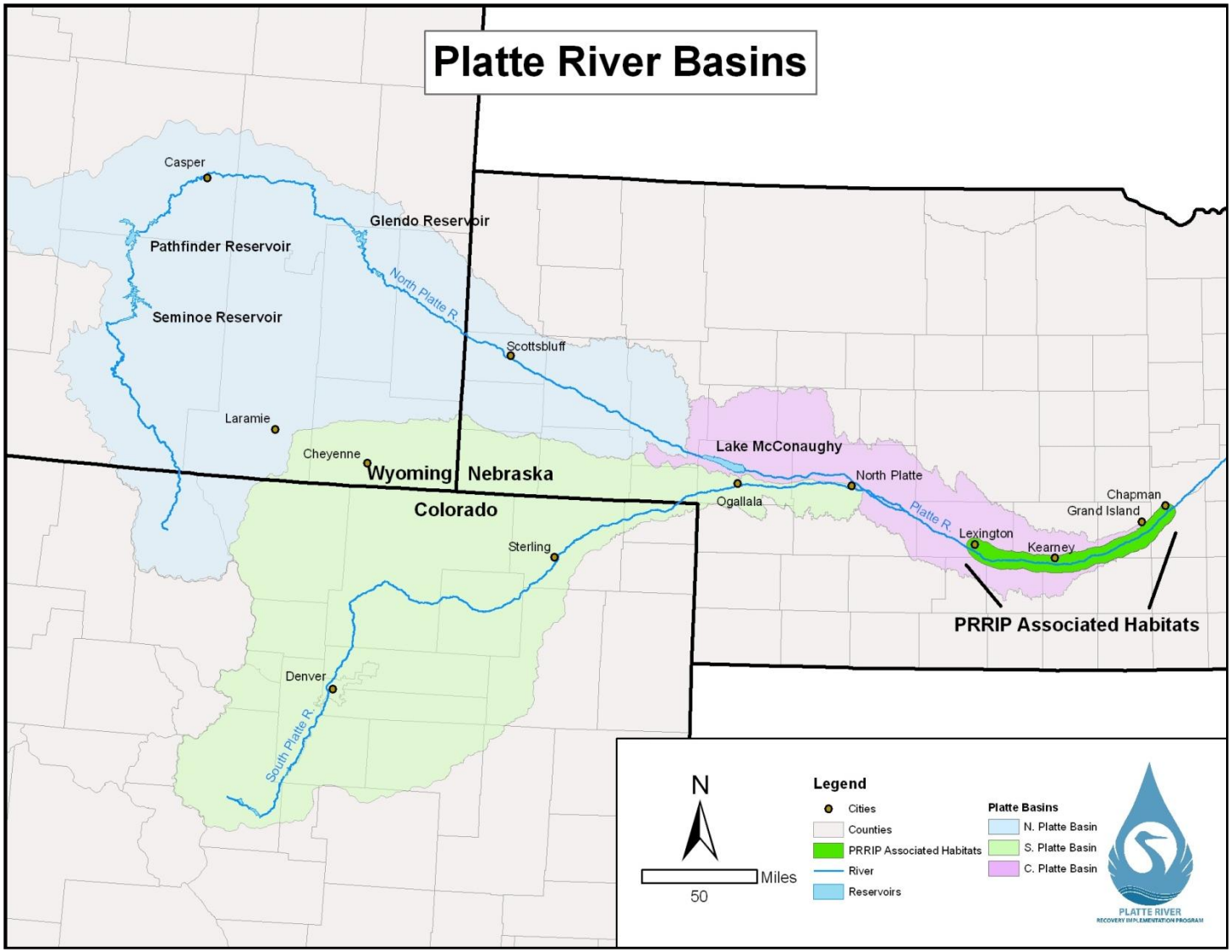


Figure 1. Platte River Basins extending from Colorado and Wyoming through Nebraska. The study area for our interior least tern and piping plover monitoring and research efforts was the PRRIP associated habitats region of the Platte River located between Lexington and Chapman, Nebraska.

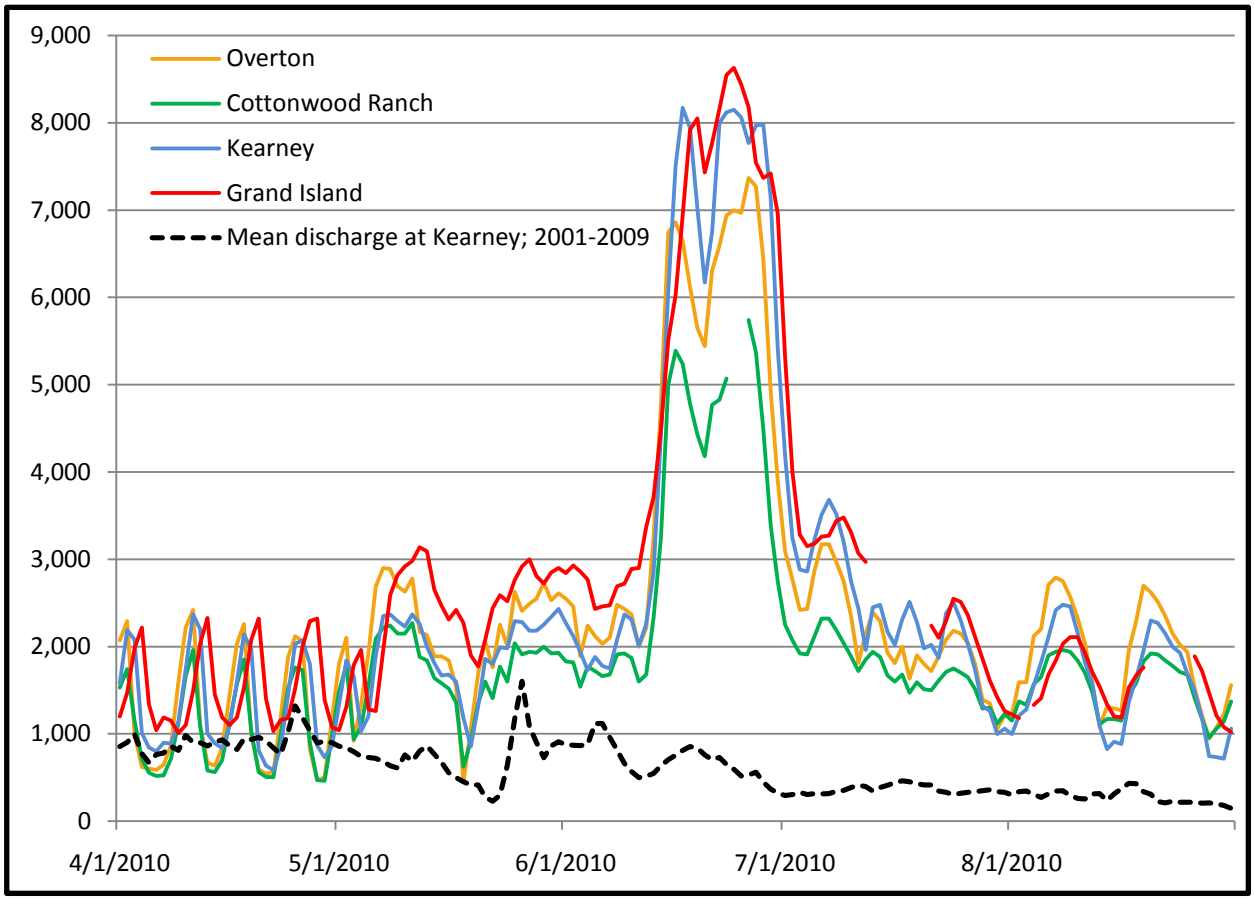


Figure 2. Mean daily discharge (ft^3/second; cfs) at Overton (USGS gage 06768000), Cottonwood Ranch near Overton (USGS gage 06768035), Kearney (USGS gage 06770200), and Grand Island, Nebraska (USGS gage 06770500), 1 April – 31 August, 2010 and average mean daily discharge at Kearney (USGS gage 06770200) 1 April – 31 August, 2001 – 2010. See Figure 3 for the location of gage stations within our study area. Data available at: waterdata.usgs.gov/ne/nwis/current/?type=flowandgroup_key=NONEandsearch_site_no_station_nm=platte%20river.

Image of managed, interior least tern and piping plover nesting habitat at a Rowe Sanctuary property (Younkin Tract) located downstream of the HWY 10 – Platte River Bridge near Minden, Nebraska. The image was captured after the 2010 high flows subsided and 3 weeks after a piping plover nest hatched 2 chicks that eventually fledged.

MANAGEMENT

Management actions designed to increase nesting habitat (bare sand) and productivity of interior least terns and piping plovers within Program associated habitats were taken at on- and off-river sites during fall 2009 and spring 2010. Management activities were site specific and included: mechanical actions to remove vegetative cover (disking, tree removal, mowing, and burning); chemical application to eradicate or prevent emergence of vegetation (spring or fall herbicide application); and predator control (fencing and trapping).

SANDPIT SITES:

Seven of the 12 sandpits monitored during 2010 were actively managed (see specific management activities below) to increase interior least tern and piping plover reproduction. Five of these sandpits were not mined for sand and gravel during 2010 and the other two, Blue Hole and Broadfoot South sandpits, were mined; however, nesting occurred in areas away from sand and gravel mining activities. The five sandpit sites not managed for interior least terns and piping plover reproduction were actively mined during 2010.

Lexington Sandpit – A contact herbicide was applied to kill existing vegetation primarily along the waterline fall 2009. A pre-emergent herbicide was applied, the woven-wire predator fences with offset electric wires along the west side of the nesting areas were maintained, and predator trapping occurred during 2010. No sand and gravel mining occurred during 2010.

Dyer Sandpit – Vegetation was burned and mechanically removed, the nesting area was drug smooth and had a contact herbicide applied, and a temporary 4-foot tall electrified predator fence was installed across the south end of each peninsula spring 2010. No sand and gravel mining occurred during 2010.

Blue Hole Sandpit – A contact herbicide was applied to kill existing vegetation primarily along the waterline fall 2009. A pre-emergent herbicide was applied, the existing permanent predator fence was maintained, a temporary 4-foot tall electrified predator fence was installed along the southwest edge of the peninsula, and predator trapping occurred during 2010. Sand and gravel mining occurred northeast of the primary nesting peninsula during 2010.

Johnson Sandpit – A contact herbicide was applied to kill existing vegetation primarily along the waterline fall 2009. A pre-emergent herbicide was applied, the woven-wire predator fence with offset electric wires along the west side of the nesting area was maintained, and predator trapping occurred during 2010. No sand and gravel mining occurred during 2010.

Broadfoot-Kearney South Sandpit – A pre-emergent herbicide was applied to the nesting area and a temporary 4-foot tall electrified predator fence was installed across the east end of the peninsula. Sand and gravel mining occurred northwest of the primary peninsula during 2010.

Broadfoot-Newark West Sandpit – Vegetation was mechanically removed, the nesting area was drug smooth and had a pre-emergent herbicide applied, and a temporary 4-foot tall electrified predator fence was installed across the south end of the peninsula. No sand and gravel mining occurred at the west sandpit; however, the east sandpit was actively mined, but not monitored for interior least terns and piping plovers during 2010.

Trust-Wild Rose East Sandpit – Both islands were disked fall 2009 and a pre-emergent herbicide was applied to the nesting areas. No sand and gravel mining or predator control measures occurred during 2010.

Deweese-Alda, Island Landhandlers, and Lilley-Wood River Sandpits – Sand and gravel mining occurred, but no management activities were applied during 2010.

Hooker Brothers-GI South and GI West – No sand and gravel mining or management activities.

RIVERINE SITES:

Several years of prolonged drought (2003 – 2006) and low flows within the study area (Figure 2) resulted in the establishment of herbaceous and woody vegetation on many river islands. The Program and Program partners conducted many habitat construction and enhancement projects in an effort to increase nesting habitat and improve reproductive success of interior least terns and piping plovers within Program associated habitats during 2008 and 2009. Management activities conducted during fall 2009 and spring 2010 were largely to maintain the suitability of riverine nesting habitat; information on 15 sites containing multiple islands that were managed or had riverine habitat constructed in the past and that were monitored during 2010 is described below.

Lexington Island – A pre-emergent herbicide was applied to the nesting areas spring 2010.

Overton Island – A pre-emergent herbicide was applied to the nesting areas spring 2010. Two heavily vegetated river islands in this area had trees and vegetation removed prior to the 2010 nesting season; however, this work was not intended to increase the amount of nesting habitat.

Cottonwood Ranch Site – A heavily vegetated 14-acre island was cleared and split into 3 suitable nesting islands during fall 2009; no pre-emergent herbicide was applied.

Elm Creek Island Site – No management activities applied.

Bartels/Johns Tract – No management activities applied.

Wyoming Property – No management activities applied.

Younkin Tract – Two new islands were applied management in the fall of 2009 and all islands at this tract were disked and graded in the fall of 2009. A pre-emergent herbicide was applied to nesting areas spring 2010.

Dinan Tract – Islands on this tract were disked and graded in the fall of 2009. A pre-emergent herbicide was applied to nesting areas spring 2010.

Triplett Trail Tract – A pre-emergent herbicide was applied to nesting areas spring 2010.

Dippel Tract – The two nesting islands were disked and graded in the fall of 2009. A pre-emergent herbicide was applied to nesting areas spring 2010.

Uridil Property – Vegetation was mechanically removed from the islands and clean sand was placed on top and the islands were graded with a dozer. A pre-emergent herbicide was applied to nesting areas spring 2010.

Dahm Property – No management activities applied.

Alda Farms Site – The nesting island was disked in the fall of 2009. A pre-emergent herbicide was applied to nesting areas spring 2010.

Wild Rose East Site – A pre-emergent herbicide was applied to nesting areas spring 2010.

Mormon Island Site – Islands at this site were disked, bladed with a dozer to remove vegetation and then graded. A pre-emergent herbicide was applied to nesting areas spring 2010.

MONITORING

In 1997, the DOI 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 interior least terns and piping plovers in the central Platte River from Lexington to Chapman, Nebraska. The standardized protocol was implemented by CNPPID, CPNRD, NPPD, and USFWS-GI during 2001−2006. In 2007, the Program assumed responsibilities of the protocol; Program staff and cooperators have since implemented and revised it slightly prior to the 2010 nesting season.

SEMI-MONTHLY RIVER AND SANDPIT SURVEYS:

METHODS

We conducted 7 semi-monthly surveys (1 and 15 May, June, and July and 1 August) of all bare sand on the central Platte River between Chapman and Lexington, Nebraska (river surveys) and all sandpits within Program Associated Habitats that met the Program's minimum habitat criteria (sandpit surveys) to locate active nests and individual birds during 2010. We included summaries of the total number of adults, nests, chicks, and fledglings observed during river surveys (2001-2010), sandpit surveys (2010), and a combination of river and sandpit surveys (semi-monthly survey totals) to provide 7 snap-shots of the numbers observed within Program Associated Habitats during the 2010 nesting season. We also provided a summary of adults, nests, chicks, and fledglings observed at suitable sandpit and constructed or managed river island nesting habitat (sandpit-island surveys) during semi-monthly (2010) and mid-month surveys (2001-2009) to provide an estimate of the number of birds observed at suitable nesting areas through time. Additional sandpits sites were observed during each of the nesting seasons, but were determined to be unsuitable nesting habitat for interior least terns and piping plovers and thus were not monitored. All counts of adults, nests, chicks, and fledglings reported represent minimums present as we did not enter colony sites to search vegetated areas during these surveys.

Semi-monthly River Surveys – We used airboats or canoes to survey all channels wider than 75yds between Lexington and Chapman, NE that could be safely navigated and documented all observations of interior least tern and piping plover adults, nests, chicks, and fledglings located within this reach of river. Personnel from NPPD conducted semi-monthly surveys of riverine habitat between the Lexington Bridge and J2 Return (Lexington Island) on 3 May; 14 May; 3 June; 15 June; 29 June; and 15 July. ED Office staff and technicians conducted semi-monthly river surveys between the J2 Return and the Alda bridge on 3 – 6 May; 17 – 18 May; 31 May – 1 June; 14 – 16 June; 28 – 29 June; 15 July; and 28 and 30 July. Personnel from the USFWS-GI or ED Office staff and technicians conducted river surveys between the Alda and Chapman Bridges on 3 May; 17 May; 2 – 3 June; 14 and 16 June; 29 June; 15 – 16 July; and 1 August. Due to high flows, canoes were used to conduct the early-July river surveys between the Dyer property and the Chapman Bridge; an airboat was used to survey between the J2 Return and the Dyer property on 29 June.

Semi-monthly Sandpit Surveys – We conducted semi-monthly surveys at 12 sandpit sites to count individual birds and locate active interior least tern and piping plover nests. Semi-monthly sandpit surveys were conducted on 3 – 4 May; 14 and 17 – 18 May; 28 and 31 May – 1 June; 14 – 18 June; 28 June – 1 July; 13 – 16 July; and 29 – 30 July and 2 – 4 August during 2010. Personnel from CPNRD, Headwaters Corporation, and NPPD participated in semi-monthly sandpit surveys.

Semi-monthly Survey Totals – In order to get an estimate of the minimum number of interior least tern and piping plover adults, nests, chicks, and fledglings within the Program area throughout the 2010 nesting season, we summed the numbers detected anywhere on the river and at sandpit sites during semi-monthly surveys nearest to 1 and 15 May, June, and July and 1 August.

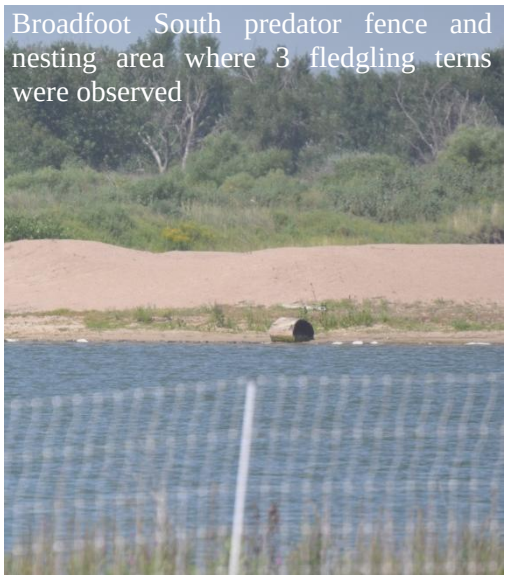
Semi-monthly Sandpit-Island Surveys – In order to get an estimate of the minimum number of interior least tern and piping plover adults, nests, chicks, and fledglings present at Program or Program-partner enhanced nesting habitat meeting the Program's Minimum Habitat Criteria throughout the nesting season, we summed the numbers detected at sandpit sites and constructed or managed river islands during semi-monthly surveys nearest to 1 and 15 May, June, and July and 1 August, 2010 or mid-month surveys nearest to 15 May, June, and July, 2001 – 2009.

RESULTS

Semi-monthly River Surveys – Each of the 7 semi-monthly river surveys between Lexington and Chapman, Nebraska required 2 – 4 days to complete and spanned a maximum of 4 days during 2010. We observed similar numbers of interior least tern adults and slightly more piping plover adults on the river during survey periods that coincided with past mid-month surveys (Table 1). We observed the most interior least tern and piping plover adults on the river during surveys outside the timeframe when past river surveys were conducted. We observed the most adult interior least terns (66) and piping plover (31) during the early-August and early-May surveys, respectively (Table 1). We observed 0 interior least tern nests and 9 of the 10 confirmed piping plover nests on river islands during the 2010 river surveys. One piping plover nest at the Alda Farms site was presumably present but not observed during 2 consecutive river surveys (early- and mid-July); however, we observed 4 chicks that were 3-5 days old at this site during the early-August river survey. We also observed a piping plover brood (4 chicks) at Dippel tract during the early-July canoe river survey and a piping plover brood (2 chicks) at the Younkin site during the early-August river survey (Table 1; Figure 3; see Table 5 for site names). All interior least tern and piping plover fledglings observed on the river during semi-monthly river surveys were either known (banded) or were presumed (near areas with sandpits that fledged chicks) to be associated with sandpit nests.

Observation taken from the Program's airboat

Semi-monthly Sandpit Surveys – Each of the 7 semi-monthly sandpit surveys required 2 – 5 days to complete and spanned a maximum of 7 days during 2010. All interior least tern and piping plover adults, nests, and chicks observed at sandpits during 2010 were on sites where management activities occurred prior to the 2010 nesting season. We observed 72 interior least tern nests and 21 piping plover nests during our semi-monthly sandpit surveys in 2010. We observed the most adult interior least terns (90) and active interior least tern nests (33) during the early-July sandpit survey; however, we observed more active nests and broods (36) during the mid-July survey of sandpit sites when there were 16 nests and 20 broods (26 chicks and 19 fledglings; Table 2). We observed the most piping plover adults (27) during the mid-June sandpit survey and observed the most active piping plover nests (9) at sandpit sites during both the mid-May and early-June sandpit surveys. We observed 13 active nests and broods during both the mid-June and the early-July sandpit surveys when there were 7 nests and 6 broods (18 chicks) and 5 nests and 8 broods (16 chicks and 5 fledglings) at sandpit sites, respectively (Table 2). Observations of adults, nests, and chicks at Broadfoot – South sandpit, however, were hindered because nesting occurred on 2 islands we could not access so observations were made from one direction at a distance of about 200 yards.



Broadfoot South predator fence and nesting area where 3 fledgling terns were observed

Table 1. Number of interior least tern and piping plover adults, nests, chicks, and fledglings observed during semi-monthly or mid-month (bold font) airboat surveys on the Platte River between Lexington and Chapman, Nebraska, 2001–2010. Observations were collected from outside the nesting areas; actual numbers were likely higher.

	Interior least tern				Piping plover			
Survey	Adults	Nests	Chicks	Fledglings	Adults	Nests	Chicks	Fledglings
1 May-10	0	0	0	0	31	0	0	0
15 May-10	**25**	**0**	**0**	**0**	**16**	**2**	**0**	**0**
1 Jun-10	38	0	0	0	17	4	0	0
15 Jun-10	**19**	**0**	**0**	**0**	**13**	**4**	**0**	**0**
1 Jul-10	32	0	0	0	10	2	4	0
15 Jul-10	**34**	**0**	**0**	**4**	**14**	**1**	**0**	**9**
1-Aug-10	66	0	0	24	6	1	6	9
15 May-09	**22**	**0**	**0**	**0**	**7**	**1**	**0**	**0**
15 Jun-09	**27**	**2**	**0**	**0**	**1**	**0**	**0**	**0**
15 Jul-09	**23**	**5**	**0**	**1**	**5**	**0**	**0**	**6**
15 May-08	**30**	**0**	**0**	**0**	**7**	**3**	**0**	**0**
15 Jun-08*	**19**	**8**	**0**	**0**	**7**	**2**	**0**	**0**
15 Jul-08*	**21**	**2**	**0**	**0**	**3**	**0**	**2**	**1**
15 May-07	**26**	**0**	**0**	**0**	**7**	**0**	**0**	**0**
15 Jun-07	**41**	**11**	**0**	**0**	**10**	**2**	**3**	**0**
15 Jul-07	**23**	**1**	**0**	**0**	**6**	**1**	**2**	**0**
15 May-06	**16**	**0**	**0**	**0**	**10**	**0**	**0**	**0**
15 Jun-06	**3**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
15 May-05	**18**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
15 Jun-05	**27**	**0**	**0**	**0**	**10**	**0**	**0**	**0**
15 Jul-05	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
15 May-04	**26**	**0**	**0**	**0**	**5**	**0**	**0**	**0**
15 Jun-04	**6**	**0**	**0**	**0**	**3**	**0**	**0**	**0**
15 May-03	**28**	**0**	**0**	**0**	**10**	**0**	**0**	**0**
15 Jun-03	**17**	**0**	**0**	**0**	**9**	**0**	**0**	**0**
15 May-02	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
15 Jun-02	**18**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
15 Jul-02	**31**	**0**	**0**	**7**	**5**	**0**	**0**	**5**
15 May-01	**16**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
15 Jun-01	**23**	**0**	**0**	**0**	**5**	**0**	**0**	**0**
15 Jul-01	**16**	**0**	**0**	**5**	**17**	**0**	**0**	**12**

* Total counts during these 2 surveys include observations of interior least terns and piping plovers at constructed or managed islands only; data sheets for other observations were lost.

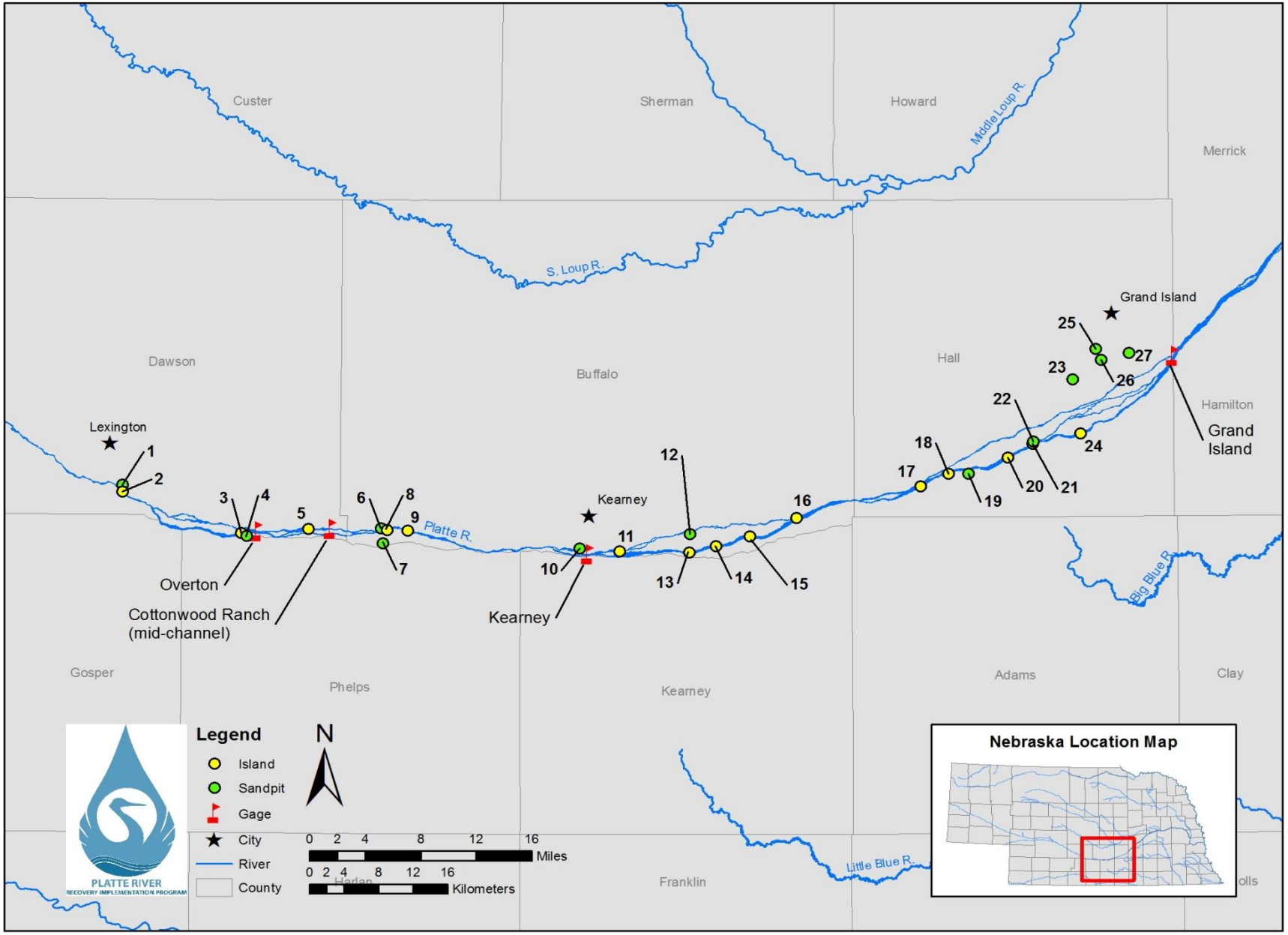


Figure 3. Study area including sandpits and river island sites monitored for interior least tern and piping plover nesting and foraging activities during 2010. Names of sites are located in Table 5.

Table 2. Number of interior least tern and piping plover adults, nests, chicks, and fledglings observed at sandpits designated as suitable nesting habitat during semi-monthly sandpit surveys, 2010. Observations were collected from outside the nesting areas; actual numbers present were likely higher.

	Interior least tern					Piping plover			
Survey	Sites	Adults	Nests	Chicks	Fledglings	Adults	Nests	Chicks	Fledglings
1 May-10	12	0	0	0	0	15	1	0	0
15 May-10	12	0	0	0	0	17	9	0	0
1 Jun-10	12	33	7	0	0	18	9	8	0
15 Jun-10	11	67	29	2	0	27	7	18	0
1 Jul-10	12	90	33	24	0	25	5	16	5
15 Jul-10	12	66	16	26	19	13	4	4	3
1-Aug-10	12	33	3	14	16	6	1	9	0

Semi-monthly Survey Totals – Semi-monthly sandpit and river survey totals included observations of adults, nests, chicks, and fledglings observed during the 7 semi-monthly sandpit and river surveys and represent an estimate of the numbers present within Program Associated Habitats during the 2010 nesting season. These surveys required 3 – 7 days (usually 4 – 5) to complete and spanned a maximum of 8 days (usually 4 – 5). We observed 72 interior least tern and 30 piping plover nests during these surveys in 2010. The most interior least tern adults (122) and active nests (33) were observed during the early-July survey when we also observed 14 broods; however, the most broods (23) and fledglings (38) were observed during the Mid-July and early-August surveys, respectively (Table 3). We observed the most piping plover adults (46) and active nests (13) during the early-May surveys and early-June surveys, respectively. The most active piping plover nests and broods combined (17) were observed during the mid-June survey and the most fledglings observed during a single survey period, mid-July, was 12 (Table 3).

Table 3. Number of interior least tern and piping plover adults, nests, chicks, and fledglings observed within Program Associated Habitats during semi-monthly river and sandpit surveys, 2010. Observations were collected from outside the nesting areas; actual numbers present were likely higher.

	Interior least tern					Piping plover				
Survey	Adults	Nests	Chicks	Broods	Fledglings	Adults	Nests	Chicks	Broods	Fledglings
1 May-10	0	0	0	0	0	46	1	0	0	0
15 May-10	25	0	0	0	0	33	11	0	0	0
1 Jun-10	71	7	0	0	0	35	13	8	3	0
15 Jun-10	86	29	2	1	0	40	11	18	6	0
1 Jul-10	122	33	24	14	0	35	7	20	9	5
15 Jul-10	100	16	26	23	23	27	5	4	9	12
1-Aug-10	99	3	14	19	38	12	2	15	10	9

Semi-monthly Sandpit-Island Surveys – Sandpit-island survey totals only include observations of adults, nests, chicks, and fledglings observed at sandpit sites and riverine sites with constructed or managed islands during semi-monthly (2010) or mid-month (2001-2009) sandpit and river island surveys. During 2010, we monitored 12 sandpits and 15 riverine sites that, as defined by the Program, had suitable nesting habitat and observed 72 interior least tern and 30 piping plover nests (Table 4; Figure 3; see Table 5 for site names). We observed the most adult interior least terns (109) during early-July sandpit survey and the most piping plovers (41) at riverine sites with constructed or managed islands during the early-May river survey.

Table 4. Number of interior least tern and piping plover adults, nests, chicks, and fledglings observed at sandpits and constructed or managed islands on the Platte River between Chapman and Lexington, Nebraska during semi-monthly or mid-month (bold font) surveys, 2001 – 2010. Observations were collected from outside the nesting areas; actual numbers of adults, nests, chicks, and fledglings present were likely higher.

	Interior least tern					Piping plover			
Survey	**Sites**	**Adults**	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Nests**	**Chicks**	**Fledglings**
1 May-10	27	0	0	0	0	41	1	0	0
15 May-10	**27**	**23**	**0**	**0**	**0**	**31**	**11**	**0**	**0**
1 Jun-10	27	49	7	0	0	35	13	8	0
15 Jun-10	**26**	**83**	**29**	**2**	**0**	**40**	**11**	**18**	**0**
1 Jul-10	27	109	33	24	0	34	7	20	5
15 Jul-10	**27**	**74**	**16**	**26**	**19**	**23**	**5**	**4**	**6**
1-Aug-10	26	64	3	14	29	10	2	15	7
15 May-09	**27**	**35**	**0**	**0**	**0**	**33**	**8**	**0**	**0**
15 Jun-09	**26**	**80**	**24**	**0**	**0**	**18**	**2**	**6**	**0**
15 Jul-09	**25**	**51**	**7**	**12**	**12**	**14**	**0**	**6**	**10**
15 May-08	**26**	**10**	**0**	**0**	**0**	**24**	**11**	**0**	**0**
15 Jun-08	**25**	**67**	**28**	**0**	**0**	**18**	**5**	**2**	**0**
15 Jul-08	**24**	**76**	**12**	**9**	**10**	**18**	**0**	**8**	**0**
15 May-07	**20**	**35**	**0**	**0**	**0**	**40**	**16**	**0**	**0**
15 Jun-07	**21**	**105**	**39**	**0**	**0**	**50**	**4**	**22**	**0**
15 Jul-07	**20**	**88**	**6**	**17**	**21**	**20**	**2**	**4**	**9**
15 May-06	**18**	**45**	**0**	**0**	**0**	**31**	**15**	**0**	**0**
15 Jun-06	**18**	**110**	**35**	**0**	**0**	**34**	**3**	**17**	**11**
15 Jul-06	**17**	**87**	**13**	**2**	**36**	**5**	**1**	**0**	**9**
15 May-05	**19**	**30**	**0**	**0**	**0**	**36**	**14**	**0**	**0**
15 Jun-05	**19**	**125**	**40**	**10**	**0**	**35**	**3**	**22**	**9**
15 Jul-05	**15**	**136**	**21**	**8**	**20**	**19**	**2**	**7**	**7**
15 May-04	**20**	**21**	**0**	**0**	**0**	**21**	**12**	**0**	**0**
15 Jun-04	**19**	**111**	**39**	**8**	**0**	**35**	**5**	**15**	**2**
15 Jul-04	**13**	**86**	**7**	**20**	**41**	**16**	**0**	**4**	**5**
15 May-03	**20**	**40**	**0**	**0**	**0**	**22**	**10**	**0**	**0**
15 Jun-03	**20**	**87**	**46**	**0**	**0**	**23**	**6**	**23**	**0**
15 Jul-03	**17**	**79**	**15**	**16**	**33**	**9**	**1**	**0**	**6**
15 May-02	**22**	**3**	**0**	**0**	**0**	**18**	**4**	**0**	**0**
15 Jun-02	**22**	**90**	**41**	**3**	**0**	**34**	**7**	**22**	**2**
15 Jul-02	**22**	**82**	**9**	**22**	**29**	**16**	**0**	**0**	**5**
15 May-01	**23**	**6**	**0**	**0**	**0**	**11**	**3**	**0**	**0**
15 Jun-01	**23**	**27**	**14**	**0**	**0**	**15**	**1**	**20**	**0**
15 Jul-01	**23**	**21**	**0**	**15**	**14**	**2**	**1**	**0**	**1**

SUMMARY: The trends in the number of adult interior least terns observed during mid-month airboat surveys on the central Platte River, though variable, have increased during the 2001–2010 timeframe (Figure 4). Similarly, the number of piping plovers observed during the May and June mid-month river surveys increased steadily from 2001 to 2010. There has been a decline in the trend in numbers observed during the mid-July river survey; however, the 2010 mid-July counts were as high as ever despite unfavorable nesting conditions on the river. It is also important to note that river conditions (low or no flow) precluded many June and July surveys between 2003 and 2006 and that all June and July river surveys conducted during this period, excluding the June 2005 survey, only occurred upstream of the Kearney Canal Headgates. Counts of birds detected during river surveys are not adjusted to account for the presence of birds at nearby sandpits and, as mentioned above, all counts of adults, nests, chicks, and fledglings reported represent minimums present as we did not enter colony sites to search vegetated areas.

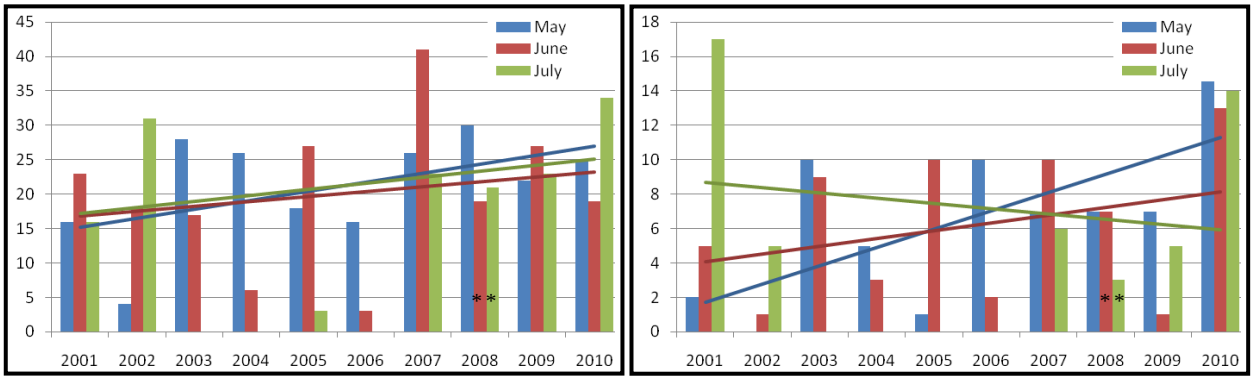


Figure 4. Trends (lines) in the number (boxplots) of adult interior least terns (left) and piping plovers (right) observed during mid-month airboat surveys on the Platte River between Chapman and Lexington, Nebraska, 2001 – 2010 (Table 1). * indicates minimum numbers; two river surveys below Kearney diversion include observations of interior least terns and piping plovers at managed or constructed islands only; data for other observations were lost. All June and July river surveys during 2003, 2004, and 2006 and the July 2005 survey below the Kearney Diversion were impossible due to low flows so areas covered are not the same across surveys.


Tern fledgling on sandbar

The trend in number of adult interior least terns and piping plovers observed during mid-month surveys of sandpits and constructed or managed river island sites shows an increase from 2001 to 2010; however, the number of adult interior least terns observed during mid-month surveys declined after 2005, but have recently increased (Figure 5). We observed the most adult interior least terns and piping plovers during the early-July and early-May sandpit-island surveys. During each semi-monthly survey, >65% of adult interior least tern and >83% of adult piping plover observations were at sandpits or managed or constructed river island sites. No interior least tern nests were observed on riverine habitat during 2010 which was likely due to a lack of available habitat during the peak June nesting timeframe caused by high flows and then vegetation emergence once the flows receded. Over twice as many piping plover nests were observed at sandpits than at river island sites during the 2010 sandpit-island surveys. Interior least tern and piping plover chicks reared at sandpit sites typically were observed foraging on or near managed riverine habitat shortly after fledging; >60% of all fledgling observations occurred on sites managed for these species.


Plover fledgling on sandbar

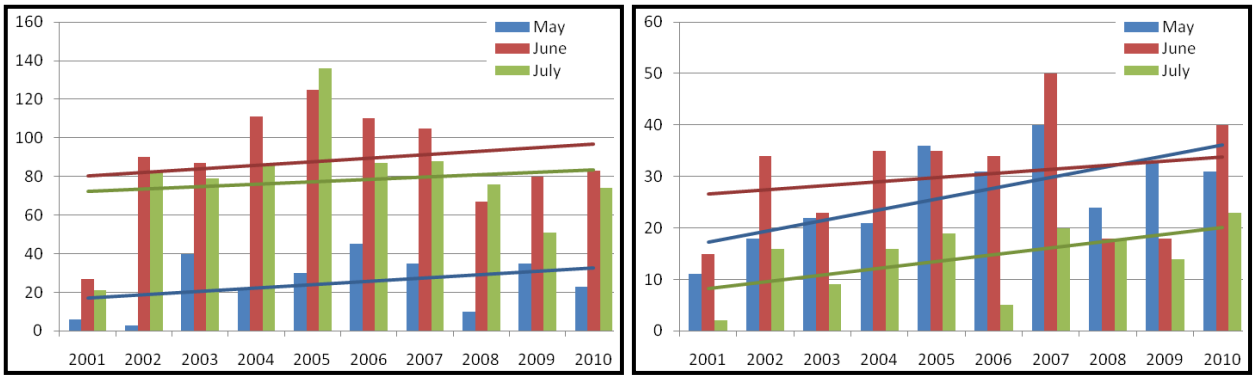


Figure 5. Trends (lines) in the number (boxplots) of adult interior least terns (left) and piping plovers (right) observed during surveys of sandpits and constructed or managed river islands on the Platte River between Chapman and Lexington, Nebraska, 2001 – 2010 (Table 3; Figure 3; see Table 5 for site names and site-specific counts). Observations were collected from outside the nesting areas; actual numbers present were likely higher.

A maximum of 122 adult interior least terns (61 pair) were observed while conducting the early-July semi-monthly river and sandpit surveys when there were a combined total of 47 active nests and broods present within Program Associated Habitats. We observed a maximum of 46 adult piping plovers (23 pair) during the early-May surveys; however, a few of these adults probably nested on another river system as we typically observed 34 – 36 adults (17 – 18 pair) during subsequent surveys. The maximum number of active piping plover nests and broods observed during any single survey period (mid-June) was 17 which included 11 nests, 6 broods, and 40 adults.


Plover pair


Snowy plover

We observed 2 adult snowy plovers foraging with adult piping plovers near the Dahm and Dinan Tracts during the early-May river survey and an adult snowy plover was observed foraging on the Cottonwood Ranch Islands during the mid-May river survey (Figure 3, see Table 5 for site names); however, no snowy plover nests were observed during 2010. We also observed a fledgling Forster's tern during the river survey conducted on 28 June, 2010 which is believed to be uncommonly early for a fledgling of this species to be migrating.


Forster's tern fledgling

NEST AND CHICK MONITORING

METHODS: In addition to semi-monthly surveys, we monitored all sites with active nests or broods on a semiweekly basis throughout the nesting season. We attempted to observe nests and chicks twice/week until the nest or chicks failed or the chicks fledged. We conducted independent surveys of adults, nests, chicks, and fledglings from both outside and within the nesting area, and attempted to conduct these surveys during the same day. Program staff and partners monitored nesting sites from outside the nesting colonies and Program staff and USGS field crews conducted nest and brood searches from within the nesting colonies during 2010. Observations of adults, nests, chicks, and fledglings collected from outside and inside the nesting area were documented on separate data sheets; final counts reported represent maximum numbers counted by either method of observation during each site visit.


Interior least tern chicks and egg

We recorded date, temperature, observation start and stop times, and the number of interior least tern and piping plover adults, nests, broods, chicks, and fledglings present during each semiweekly site visit. During the initial observation of each nest we counted the number of eggs present, estimated nest-initiation date, took a photograph of the nest, and collected habitat measures believed to influence nest placement and productivity (measured vegetation height, canopy cover, and distance to vegetation ≥6 inches tall within a 1-yd^2 area centered on the nest; classified bare-sand area of nesting sites; documented presence/absence of nest furniture; determined distances to predator perch and nearest waterline; measured channel widths on each side of islands at riverine sites; and used a GIS and LiDAR data (± 6 inch vertical accuracy) to determine elevation of each nest above the waterline, nesting area size, and surface area of the water surrounding observed nesting sites). We recorded maximum vegetation height and percent canopy cover within a 1-yd^2 area centered on each nest and classified percent bare-sand area at the nesting site during subsequent observations of each nest. When chicks or fledglings were observed, we estimated the date of hatching or fledging based on current and previous chick observations. We determined the amount of nesting habitat available at each site using a GIS to delineate exposed bare-sand areas present within CIR imagery captured 18 June, 2010 when flows at Kearney and Grand Island were near 8,000cfs. We also used a GIS to determine the wetted channel area surrounding riverine sites by calculating the surface area of water extending bank to bank and from the upstream to downstream end of suitable nesting habitat at each site.

Outside Monitoring – Outside surveys were performed using binoculars and/or spotting scopes at a distance great enough to not cause disturbance to nesting birds (usually >165 ft, but closer or farther as terrain dictates) and for at least 1/2 hour. Observations were conducted from multiple locations to provide as complete of coverage of the site as possible. From outside the nesting colony, nests and chicks were often found by locating and observing adult birds.

Outside monitoring

Inside Monitoring – A systematic grid-search pattern was used to conduct inside surveys (Figure 6). To initiate this search method, investigators formed a straight line on the edge of and parallel to the side of a sandbar or sandpit pond (pictured to the right). Investigators were evenly spaced and the spacing was adjusted to ensure all nests and chicks were detected; the distance between individuals did not exceed 5 yards. For example, when visibility was low due to vegetation or because the substrate was similar in size and shape to the eggs, then the distance between technicians was decreased.

Inside monitoring / grid searching

We calculated daily and incubation-period nest survival rates using Program MARK (Version 5.1). We included nests located at sandpit and riverine sites that were monitored by personnel from CPNRD, Headwaters Corporation, NPPD, and USGS-NPWRC during 2010 to determine survival rates. Nest success was defined as any nest that hatched ≥1 chick. We considered the incubation period for interior least terns and piping plovers to be 21 and 28 days, respectively, from when nests were determined to have been initiated. When the fate of a nest was unknown, we assign a failed status to the nest if the date of determination was <21 days (interior least tern) or <28 days (piping plover) after the date nest was determined to have been initiated. For example, if a site with no nests present was surveyed on 8 May; surveyed again on 15 May when a piping plover nest was first observed; was monitored again on 18 and 21 May and we found the nest to be active and intact; but on 24 May we observed no eggs in or adults on the nest, we assigned a "failed" status to the nest as the nest likely did not hatch. If, however, this nest, with

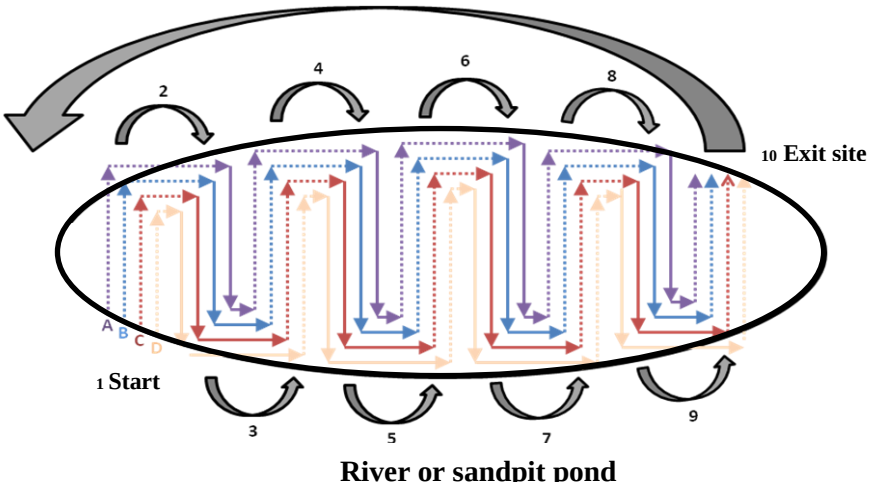


Figure 6. Systematic grid-search pattern used to locate nests and broods while conducting inside surveys of suitable nesting sites

an unknown fate, was known to be active on 10 June (26 days after initial observation) and was last observed on 14 June (30 days after initial observation), we censored the nest at 26 days and assigned a "success" status to the nest. Our assumption was that, on average, we discarded survived and failed intervals in the same proportion that they existed in the data. We also used Program MARK to determine daily and brooding-period survival rates for broods and chicks. We included broods and chicks located at sandpit and riverine sites that were monitored by personnel from CPNRD, Headwaters Corporation, NPPD, and USGS-NPWRC during 2010 to determine survival rates. As the exact date of hatching was occasionally unknown, we considered the brooding period for interior least tern and piping plover chicks to be 21 and 28 days from the date we first observed nestlings, respectively. A successful brood was defined as any brood with ≥1 chick that survived 21 days (interior least terns) or 28 days (piping plovers). Similar to nest survival methods, when the fate of a brood was unknown, we assign a failed status to a brood if the date of fate determination was <21 or 28 days after we first observed interior least tern or piping plover chicks, respectively and a success status to the brood otherwise. Broods not observed alive were discarded from the analyses.

We calculated Mayfield estimates of daily and incubation-period or brooding-period survival rates for all interior least tern and piping plover nests, broods, and chicks because only Mayfield estimates were reported in the past (2001 – 2007). We calculated Mayfield estimates of daily nest survival (S) using: $S = 1 - N_f / E_S$, where N_f is the number of nests that failed and E_S is exposure days or number of days that elapsed between when the nest was first observed and when it was observed to have hatched or failed; losses occurring between visits were assumed to have occurred at the midpoint between visits. We calculated incubation-period survival rates for nests by raising the daily survival rate to the 21st or 28th power for interior least tern and piping plover nests, respectively. For example, if the daily survival rate for interior least tern nests was 0.97, the incubation-period survival rate would be approximately 0.5275 (0.97^{21}). The same process was used to obtain estimates of daily and brooding-period survival rates for interior least tern and piping plover broods and chicks. We calculated standard errors (SE_S) and 95% confidence intervals (CI_{95}) for survival estimates using: SE_S = ([S-


plover chicks and eggs

$S^2]/E_S)^{1/2}$ where E_S was the total number of exposure days used to calculate S and $CI_{95} = S \pm 1.96(SE_S)$. 95% confidence intervals for the corresponding Mayfield incubation-period and brood-rearing period estimates were calculated by raising the confidence limits for S to the power of 21 or 28 for interior least terns and piping plovers, respectively.

RESULTS:


Avian predated adult plover

Mortality: We observed no research-related mortality during 2010. We did, however, observe the remains of what appeared to be an avian predated adult piping plover at the Dippel Tract (pictured to the right) and at the Dinan Tract during 2010. Seven interior least tern chicks and 3 piping plover chicks were found dead and collected during 2010; all deaths were attributed to weather or unknown causes. We also found the remains of an adult interior least tern believed to have died in 2009 and was recovered in 2010. We had 1 banding-related injury on 15 May where an adult piping plover was injured while being released from the hands of an experienced bander; the incident was reported to USFWS. The injured piping plover was last observed tending its nest on 17 May, lost its nest to unknown causes prior to 21 May, and was last detected via telemetry on 6 August, 2010. Predation (bobcat, avian, raccoon, fox, etc.) was the leading cause of nest failure and accounted for 7 interior least tern and 3 piping plover nest failures during 2010. Four interior least tern nests and several chicks are believed to have been predated by a bobcat (track pictured to the left) and another nest was abandoned at the Blue Hole sandpit site between 5 and 15 July 2010 which coincided with the timing of when the sand mining operation temporarily shut down mining operations to relocate equipment. Three interior least tern and 3 piping plover nest failures were attributed to weather events (flooding, hail, inundation) and 5 interior least tern nests and 2 piping plover nests were abandoned during 2010; nest abandonment along the central Platte River was rarely documented in the past. One abandoned piping plover nest, however, was incubated by an adult that was also incubating another nest during the same observation period. Unknown causes accounted for 6 interior least tern and 4 piping plover nest failures during 2010.

Bobcat track

Least Terns: Interior least tern nests were observed and monitored at 5 of the 12 sandpits and none of the riverine sites we surveyed during 2010 (Table 5, Figure 7). All counts of adults, nests, chicks, and fledglings reported in Table 5 represent the maximum number observed from inside and outside the nesting colony during all surveys. The first observation of interior least tern nests occurred on 31 May, 2010 and the last nest initiated was observed on 27 July, 2010. The first observation of an interior least tern chick occurred on 16 June, 2010 and the last nest known to hatch did so on 2 August, 2010. At least 1 egg from 63% (48/76) of interior least tern nests hatched which resulted in 122 chicks and an overall nest-success rate of 1.61 chicks/nest during 2010 (Table 6). Average daily survival rate of interior least tern nests at sandpits was 0.98 (range = 0.93 – 0.99) with no difference observed between sites during 2010 [$\chi^2(1, N = 68) = 7.74$; $p = 0.10$; Appendix 1]; the average survival rate over the 21-day incubation period was 0.64 (range = 0.24 – 0.79; Appendix 1). We observed the first interior least tern fledgling on 9 July, 2010 and the last known interior least tern chick to fledge did so on 20 August, 2010. Apparent fledge success at

Tern chick and eggs

all sites monitored was 0.99 fledglings/nest (75 fledglings/76 nests) or 1.25 fledglings/pair (75 fledglings/61 pair; Table 6) with all nests occurring on sandpit sites during 2010. Average daily survival rates for all interior least tern broods during 2010 was 0.98 (range = 0.92 – 1.00; Appendix 2); average brooding-period survival rate was 0.72 (range = 0.17 – 1.00). Average daily survival rates for individual interior least tern chicks during 2010 was 0.97 (range = 0.89 – 1.00; Appendix 3); average brooding-period chick survival rate was 0.57 (range = 0.09 – 1.00).


Plover chicks and eggs

Piping Plovers: Piping plover nests were observed at 6 of 12 sandpits and 5 of 15 riverine sites we surveyed that had managed or constructed islands during 2010 (Table 5; Figure 7). The first observation of a piping plover nest was made on 3 May, 2010 and the last nest initiated was observed on 9 July, 2010. The first observation of a piping plover chick occurred on 23 May, 2010 and the last successful nest we observed hatched on 9 August, 2010. At least 1 egg from 60% (21/35) of piping plover nests hatched which resulted in 76 chicks and an overall nest-success rate of 2.17 chicks/nest during 2010 (Table 6). We observed 13 chicks (1.00 chicks/nest) on managed or constructed islands and 63 chicks (2.86 chicks/nest) at sandpits. Piping plover apparent nest success was lower at managed and constructed river islands than at sandpits. Only 31% (4/13) of piping plover nests located on river islands hatched ≥1 chick while 77% (17/22) of piping plover nests at sandpits hatched ≥1 chick (Table 5). Piping plover daily nest survival rates at sandpit sites was 0.99 (range = 0.97 – 1.00; Appendix 4) during 2010; incubation-period survival rates was 0.76 (range = 0.45 – 1.00). The average daily survival rate for piping plover nests at river island sites during 2010 was 0.94 (range = 0.01 – 0.97; Appendix 5). The average incubation-period survival rate for piping plover nests during 2010 was 0.15 (range = 0.00 – 0.42). The average daily and incubation-period survival rates for piping plover nests was higher at sandpit sites than at river island sites [$\chi^2(1, N=34) = 12.22$; $p<0.001$; Appendix 6]; however, a nest that was not observed until after it hatched was excluded from the analysis. We first observed a piping plover fledgling on 19 June, 2010 and the last known piping plover chick to fledge was observed on 16 August, 2010. We observed an apparent nest-based fledging rate of 1.17 (41 fledglings/35 nests) and a pair-based fledging rate of 1.78 (41 fledglings/23 pair) at all sites monitored during 2010 (Table 6). We observed an apparent nest-based fledging success rate of 0.77 piping plover fledglings/nest (10/13) at managed or constructed islands and 1.41 (31/22) piping plover fledglings/nest at sandpits during 2010. We observed an average daily survival rate of 0.99 (range = 0.95 – 1.00) for piping plover broods located at sandpits during 2010; the 28-day brooding period survival rate was 0.69 (range = 0.24 – 1.00; Appendix 7). Average daily survival rate for piping plover broods located at river-island sites during 2010 was 0.99 (range = 0.97 – 1.00); the 28-day brooding period survival rate was 0.71 (range = 0.41 – 1.00; Appendix 8). The average daily survival rate for piping plover broods at sandpit and the riverine sites during 2010 was similar [$\chi^2(1, N = 21) = 0.004$; $p=0.95$; Appendix 9]. The average daily survival rate for piping plover chicks at sandpit sites was 0.98 (range = 0.92 – 0.99) during 2010; the 28-day brooding period survival rate for piping plover chicks at sandpit sites was 0.50 (range = 0.30 – 0.71; Appendix 10). We observed an average daily survival rate of 0.99 (range = 0.98 – 1.00) for piping plover chicks located at river-island sites during 2010; the 28-day brooding period survival rate for piping plover chicks at riverine sites was 0.73 (range = 0.49 – 1.00; Appendix 11). Average daily survival rates for piping plover chicks at sandpit and riverine sites were similar [$\chi^2(1, N = 75) = 2.06$; $p=0.15$; Appendix 12].

Table 5. Site-specific numbers of adults, nests, chicks, and fledglings observed while monitoring sandpits and constructed or managed river islands for interior least tern and piping plover reproduction during 2010. See the Management Section of this report for a detailed description of management actions taken at each site. Site #'s correspond with Figure 3.

						Interior least tern							Piping plover						
Site #	Site Name	Habitat Type [A]	Management [A]	Surveys	Survey Time (hr)	Adults (Cum) [A]	Adults (Max) [A]	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-21 Days	Fledglings	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-28 Days	Fledglings
1	Lexington Pit	SP	HPFT	58	76	755	29	21	16	41	30	30	196	10	6	3	11	9	8
2	Lexington Island	RI	P	7	3	7	2	0	0	0	0	0	0	0	0	0	0	0	0
3	Overton Island	RI	RP [B]	8	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0
4	Dyer Pit	SP	RCGPF	24	14	1	1	0	0	0	0	0	29	4	1	1	4	3	3
5	Cottonwood Ranch	RI	RG [C]	7	3	11	7	0	0	0	0	0	12	10	0	0	0	0	0
6	Blue Hole	SP	HPFT	50	60	471	25	22	12	31	2	2	257	15	7	6	24	16	13
7	Johnson Pit	SP	HPFT	59	33	85	9	5 [D]	1	2	2	2	90	4	3	2	6	2	2
8	Elm Creek Island	RI	N	14	5	6	3	0	0	0	0	0	15	6	0	0	0	0	0
9	Bartels/Johns Tract	RI	N	16	19	30	5	0	0	0	0	0	2	2	0	0	0	0	0
10	Broadfoot – Kearney South	SP	PF	36	30	212	20	11 [E]	5	14	12	12	68	6	2	2	7	4	0
11	Wyoming Property	RI	N	7	2	8	4	0	0	0	0	0	0	0	0	0	0	0	0
12	Broadfoot –Newark	SP	RGPF	23	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Younkin Tract	RI	RDGP	46	29	27	8	0	0	0	0	0	64	4	2 [D]	1	2	2	2
14	Dinan Tract	RI	DGP	32	18	14	3	0	0	0	0	0	57	6	3 [D]	0	0	0	0
15	Triplett Trail Tract	RI	P	7	1	4	1	0	0	0	0	0	1	1	0	0	0	0	0
16	Dippel Tract	RI	DGP	28	19	28	6	0	0	0	0	0	112	8	5	2	7	4	4
17	Uridil Property	RI	RGP	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Dahm Property	RI	U	7	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
19	Lilley – Wood River	SP	N	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Alda Farms	RI	DP	19	9	15	5	0	0	0	0	0	22	3	2 [F]	1 [F]	4 [F]	4 [F]	4 [F]
21	Wild Rose Ranch	RI	P	7	4	16	7	0	0	0	0	0	7	7	0	0	0	0	0
22	Wild Rose Ranch – East Pit	SP	P	25	9	354	30	17	14	28	28	28	89	6	3	3	11	6	5
23	DeWeese – Alda	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Mormon Island	RI	RDGP	10	6	12	4	0	0	0	0	0	6	3	1	0	0	0	0
25	Hooker Brothers – GI West	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Island Landhandlers – GI	SP	N	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Hooker Brothers – GI South	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[A] Habitat types include sandpits (SP) and river islands (RI). Management actions applied to each site could include: mowed (M), burned (B), disked (D), graded (G), tree/vegetation removal (R), or herbicide (H) during fall 2009; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2010; no management (N); or unknown (U). Adult counts represent cumulative number of adult interior least terns and piping plovers observed during all surveys (Cum) and the maximum number adults observed during any single survey (Max).

[B] Trees and vegetation were from 2 vegetated islands in this area prior to the 2010 nesting season; however, these were not intended to be nesting islands.

[C] A heavily vegetated 14-acre island was cleared and split into 3 nesting islands during fall 2009; however, no pre-emergent herbicide was applied.

[D] Includes a nest documented from outside the nesting area observed to be without eggs during inside surveys.

[E] Includes 8 nests located on 2 small islands located northwest of the main peninsula that we could not access.

[F] Includes a nest that was not observed while active, but was observed after it hatched 4 chicks.

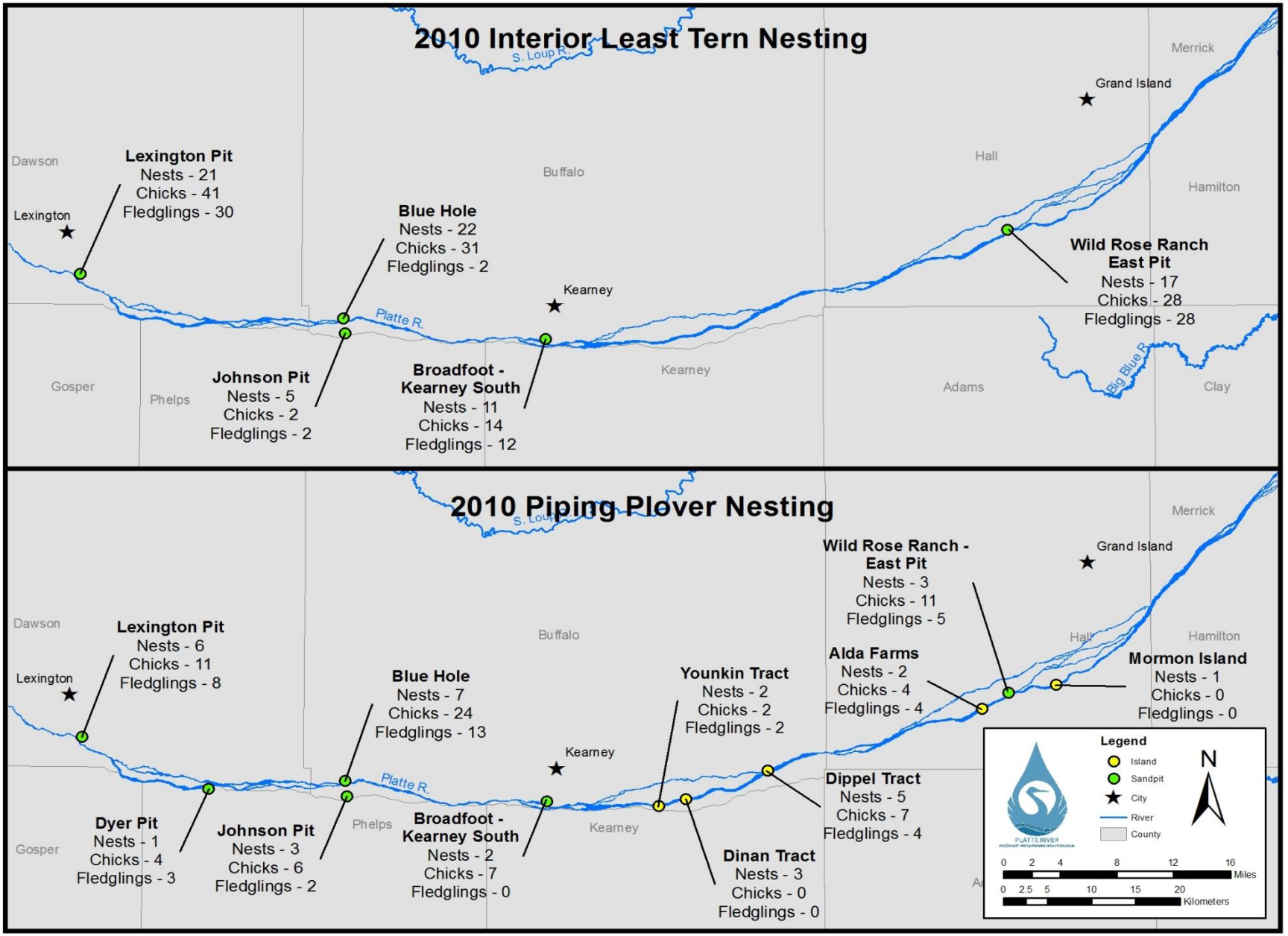


Figure 7. Distribution and numbers of interior least tern and piping plover nests, chicks, and fledglings observed within Program associated habitats during 2010 surveys of sandpits and managed, constructed, or naturally occurring river islands.

Table 6. Summary of interior least tern and piping plover reproductive success at sandpits and river island sites on the central Platte River of Nebraska, 2007 – 2010. Site-specific details on nest and chick success during 2010 are provided in Table 5. Habitat- and site-specific details of daily and incubation- and brooding-period survival rates during 2010 are provided in Appendices 1 – 12 (Program Mark estimates) and 13 – 24 (Mayfield estimates).

	Interior least tern				Piping plover			
Reproductive Parameter	**2007**	**2008**	**2009**	**2010**	**2007**	**2008**	**2009**	**2010**
Total Nests Observed	49	63	56	76[a]	20	21	14	35[b]
Successful Nests (≥1 egg hatched)	22	31	31	48[a]	15	8	9	21[b]
Apparent Nest Success	0.45	0.49	0.55	0.63[a]	0.75	0.38	0.64	0.60[b]
Daily Nest Survival Rate (All sites)	0.97	0.98	0.99	0.98[c]	0.99	0.98	0.99	0.98[d]
Incubation-period Survival Rate (All sites)	0.55	0.61	0.73	0.64[c]	0.71	0.58	0.67	0.54[d]
Chicks Observed	49	61	68	122	45	26	30	76
Hatch Ratio (Chicks/Nest)	1.00	0.97	1.21	1.61[a]	2.25	1.24	2.14	2.17[b]
Chicks (15D)	40	44	44	76	27	10	12	50
Fledglings (21/28D)	-----[e]	-----	-----	75	-----	-----	-----	41
Historic Fledge Ratio (15D Chicks/Nest)	0.82	0.70	0.79	1.00[a]	1.35	0.48	0.86	1.43[b]
Fledge ratio (21/28D Chicks/Nest)	-----	-----	-----	0.99[a]	-----	-----	-----	1.17[b]
Pair-based Fledge Ratio (15D Chicks/Pair)	0.76	1.16	1.10	1.25[a]	1.08	0.83	0.73	2.17[b]
Pair-based Fledge Ratio (21/28D Chicks/Pair)	-----	-----	-----	1.23[a]	-----	-----	-----	1.78[b]
Daily Brood Survival Rate (All sites)	-----	0.98	0.98	0.98[cf]	-----	0.94	0.98	0.99[f]
Brooding-period Survival Rate (All sites)	-----	0.75	0.79	0.72[cf]	-----	0.42	0.79	0.70[f]

[a] Includes 2 nests documented from outside the nesting area observed to be without eggs during inside surveys and 8 nests located on 2 small islands located northwest of the main peninsula at Broadfoot – Kearney South that we could not access.

[b] Includes 2 nests documented from outside the nesting area observed to be without eggs during inside surveys and 1 nest at Alda Farms that was not observed while active, but was observed after it hatched 4 chicks.

[c] Excludes 8 nests located on 2 small islands located northwest of the main peninsula at Broadfoot – Kearney South that we could not access.

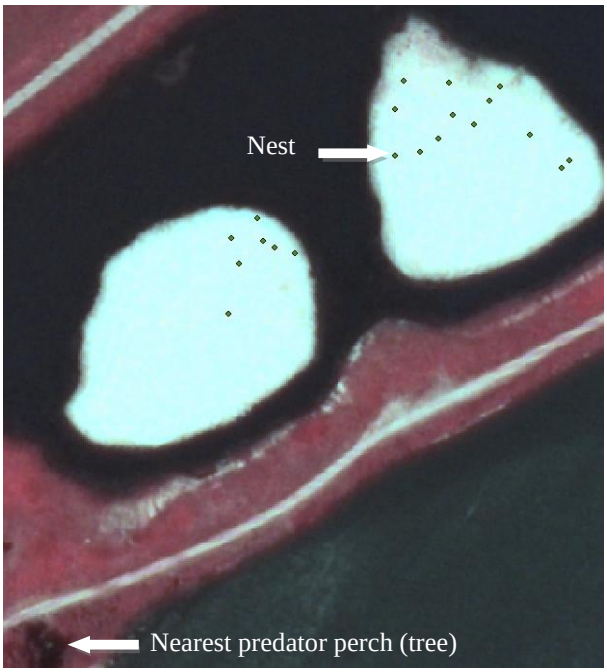
[d] Excludes 1 nest at Alda Farms that was not observed while active, but was after it hatched 4 chicks.

[e] "-----" indicates these data were not reported.

[f] Brood survival rates are not comparable to past data because 15 day old tern and plover chicks were considered fledged during 2007 – 2009 and in 2010 we began to use 21 and 28 days for the fledge age for tern and plover chicks, respectively.

Habitat Measures

Least Tern: We recorded habitat conditions for 66 interior least tern nests at 5 sandpit sites during 2010 (Table 7; see Appendix 27 for habitat conditions at individual interior least tern nests). We found little correlation (r = 0.40) between nesting area size and the number of interior least tern nests present at sandpit sites (Table 7). We observed no relationship between the number of interior least tern nests observed and the ratio of bare-sand to surface water area across sites (r = 0.11). On average, interior least terns nested 5.4 feet above the waterline at sandpit sites (average range across sites = 2.2 – 7.4 feet) and average nest elevations were 28 – 50% lower (closer to the waterline elevation) than the highest nests at each site (Table 7). Interior least terns nested at least 2.4 feet above the elevation of the waterline (range of minimum nest elevations across sites = 2.4 – 3.5 feet above the waterline) at all sites excluding Wild Rose East Sandpit. Though elevations up to 6.0 feet above waterline were available at Wild Rose East Sandpit, 59% of interior least tern nests were <2.4 feet above the waterline elevation (range = 0.3 – 4.4 feet above waterline; Table 7). Interior least terns, on average, nested 99 feet (range = 12 – 286) from the edge of the waterline at sandpit sites during 2010. Of the 66 interior least tern nests observed during 2010, 85% (56) were positioned >50 feet from the edge waterline and 8 of the 10 nests that were <50 feet from the waterline were located at Wild Rose East Sandpit which had a smaller nesting area than other sandpit sites (Table 7). Average distance between interior least tern nests and the nearest predator perch was 520 feet (range = 220 – 117 feet). The only apparent avoidance of predator perches we were able to visually observe occurred at Wild Rose East Sandpit where interior least terns and piping plovers both nested on the east, northeast sides of the 2 nesting islands present (pictured above left). Of the 66 interior least tern nests observed during 2010, 61% (40) had nest furniture present and 60% (24) of these nests hatched successfully while 81% (21) of the 26 nests without nest furniture hatched successfully. Though it appears as though interior least tern nests without nest furniture were more successful than those with nest furniture, nest furniture such as herbaceous litter present at several nests when initiated was washed or blown away during heavy rain events and subsequently some of these nests failed. Nest furniture present at interior least tern nests (pictured above right) during 2010 included tree bark and small branches, 9-guage wire, river rock, 1”×4” board, and dead vegetation.



Interior least tern nest with nest furniture

Piping Plover: We recorded habitat conditions at 32 piping plover nests distributed across 6 sandpit and 5 riverine sites during 2010 (Table 8; see Appendix 28 for habitat conditions at individual piping plover nests). Nesting area size and the number of piping plover nests present at all sites was marginally correlated (r = 0.51), was essentially uncorrelated for sandpit sites (r = 0.34), and was positively correlated for riverine sites (r = 0.71; Table 8). A positive correlation between nesting area and numbers of nests indicates number of nests present increases as the amount of riverine nesting habitat increased; however, with a relatively small number of sites (5) and a narrow range of sizes (range = 1 – 4 acres/site), it would be advisable to further evaluate this and other relationships in the upcoming years. We also observed a positive relationship between the ratio of bare-sand to surface water area and the number of piping plover nests present at sandpit (r = 0.60), riverine (r = 0.75), and all sites (r = 0.60). Higher ratios between the amount of suitable nesting habitat and the amount of surface water surrounding each site appears to result in more piping plover nests. On average, piping plovers nested 5.8 feet above the waterline at sandpit sites (range across sites = 1.0 – 7.7 feet) and average nest elevations were 13 – 50% lower than the highest nests at each site (Table 8). Piping plover nests observed on river islands during 2010 were, on average, 2.1 feet above the elevation of the waterline when initiated (range = 0.7 – 3.9); however, 2 of these nests were inundated by the high-flow event and 2 nests at the Dippel Tract narrowly escaped inundation by <1 inch (nest pictured left) when peak flows of 8,320cfs, measured at Kearney, passed through. Piping plovers nested >2.8 feet above the waterline elevation at all sites excluding Wild Rose East Sandpit (range of minimum nest elevations across sites = 2.8 – 4.8 feet above the waterline). At Wild Rose East Sandpit, 100% of piping nests were <2.8 feet above the waterline elevation (range = 0.3 – 2.0 feet) though opportunities to nest at elevations 4 – 6 feet above the waterline existed (Table 8). Piping plover nests at sandpit sites, on average, were placed 112 feet (range = 16 – 207) from the edge of the waterline during 2010. Of the 22 piping plover nests observed at sandpit sites during 2010, 77% (17) were positioned >50 feet from the edge waterline and 3 of the 5 nests <50 feet from the waterline were located at Wild Rose East Sandpit which had a smaller nesting area than other sandpit sites (Table 8; Appendix 28). Of the 10 piping plover nests observed at riverine sites during 2010, 50% (5) were positioned >50 feet from the edge waterline. Average distance between piping plover nests and the nearest predator perch at all sites was 627 feet (range = 357 – 1,322 feet); on average, distance to predator perch was greater at riverine than at sandpit sites (Table 8). Twenty (63%) of the 32 piping plover nests observed during 2010 had nest furniture and similar to interior least terns 60% (12) of these nests hatched successfully. Similarly, 7 (58%) of the 12 piping plover nests without nest furniture also hatched successfully. Similar to interior least terns, nest furniture present at piping plover nests during 2010 included tree bark and small branches, 9-guage wire, river rock, 1”×4” board, and dead vegetation.

Piping plover nest with nest furniture

Table 7. Average site- and nest-level habitat measures collected at confirmed (eggs observed in a scrape) interior least tern nest sites during 2010. Habitat measures for individual nests can be found in Appendix 27.

Site Name	Habitat Type	# of Nests with Habitat Data	15 June Site-level Nesting Area Size (Ac)	15 June % Bare-Sand	15 June Sandpit-pond Area (Ac)	Elevation above Water (Ft)			Nearest Waterline (Ft)			Nearest Predator Perch (Ft)			Nest Furniture			
						Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	# Nests Hatched with	# Nests Hatched without	# Nests Failed with	# Nests Failed without
Lexington Pit	SP	21	14	>75	39	2.6	7.4	14.5	53	119	199	243	417	582	9	7	1	4
Blue Hole	SP	21	25	>75	56	2.4	6.1	10.8	39	130	286	359	508	713	5	7	8	1
Johnson Pit	SP	4	5	>75	32	3.5	4.6	6.8	52	69	79	220	243	296	1	0	3	0
Broadfoot – Kearney	SP	3	14	>75	74	3.0	5.0	6.9	27	44	55	689	883	1117	1	1	1	0
Wild Rose Ranch – East	SP	17	3	>75	13	0.3	2.2	4.4	12	53	94	440	662	810	8	6	3	0
Summary for All Sites	**ALL**	**66**	**61**	**>75**	**214**	**0.3**	**5.1**	**14.5**	**12**	**99**	**286**	**220**	**520**	**1117**	**24**	**21**	**16**	**5**

Table 8. Average site- and nest-level habitat measures collected at confirmed (eggs observed in a scrape) piping plover nest sites during 2010. Habitat measures for individual nests can be found in Appendix 28.

Site Name	Habitat Type	# of Nests with Habitat Data	15 June Site-level Nesting Area Size (Ac)	15 June % Bare-Sand	15 June Sandpit-pond or River-channel Area (Ac)	Elevation above Water (Ft)			Nearest Waterline (Ft)			Nearest Predator Perch (Ft)			Nest Furniture			
						Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	# Nests Hatched with	# Nests Hatched without	# Nests Failed with	# Nests Failed without
Lexington Pit	SP	6	14	>75	39	4.2	6.5	8.4	99	137	207	291	441	572	3	2	0	1
Dyer Pit	SP	1	20	50-75	56	6.3	6.3	6.3	120	120	120	1342	1342	1342	0	0	1	0
Blue Hole	SP	7	25	>75	56	2.8	7.7	12.5	44	159	229	393	487	579	3	1	3	0
Johnson Pit	SP	3	5	>75	32	4.8	5.4	6.2	40	75	130	286	339	370	0	1	2	0
Broadfoot – Kearney	SP	2	14	>75	74	3.0	4.7	6.3	33	53	72	669	749	828	0	0	2	0
Wild Rose Ranch – East	SP	3	3	>75	13	0.3	1.0	2.0	16	30	38	435	649	813	3	0	0	0
Sandpit Summary	**SP**	**22**	**81**	**>75**	**270**	**0.3**	**5.8**	**12.5**	**16**	**112**	**229**	**286**	**539**	**1342**	**9**	**4**	**8**	**1**
Younkin Tract	RI	1	1	>75	67	1.5	1.5	1.5	15	15	15	870	870	870	1	0	0	0
Dinan Tract	RI	2	1	>75	40	1.7	2.0	2.3	2	17	31	528	683	837	0	0	0	2
Dippel Tract	RI	5	4	50-75	87	1.3	2.1	2.8	30	50	72	357	967	1322	2	2	0	1
Alda Farms	RI	1	3	50-75	81	3.9	3.9	3.9	75	75	75	552	552	552	0	1	0	0
Mormon Island	RI	1	1	>75	70	0.7	0.7	0.7	54	54	54	579	579	579	0	0	0	1
River Island Summary	**RI**	**10**	**10**	**~75**	**345**	**0.7**	**2.1**	**3.9**	**2**	**46**	**75**	**357**	**814**	**1322**	**3**	**3**	**0**	**4**
Summary for All Sites	**ALL**	**32**	**91**	**>75**	**615**	**0.3**	**4.6**	**12.5**	**2**	**90**	**229**	**286**	**627**	**1342**	**12**	**7**	**8**	**5**

Inside-Outside Monitoring – Independent, double-observer counts were obtained at 6 sandpit and 5 riverine sites during 2010 (Table 9; see Appendix 25 and 26 for outside and inside counts at all, respectively). At the 6 sandpit sites monitored from outside and inside the colonies, from inside (grid searching) the nesting areas we: 1) documented 6 (14%) more confirmed (eggs observed in scrape) interior least tern nests and 2 (12%) more piping plovers nests; 2) on average, documented interior least tern nests 1-2 days earlier (range = 15 to -8 days) and observed piping plover nests 2-3 days earlier (range = 7 to -8 days); 3) observed 8 (35%) more successful interior least tern nests; 4) observed 28 (57%) more interior least tern chicks and 9 (21%) more piping plover chicks <5 days old; 5) only observed 8 (22%) of the interior least tern chicks and 27 (79%) of the piping plover chicks that were >5 days old; and 6) only observed 3 (8%) of the interior least tern fledglings and 12 (50%) of the piping plover fledglings as compared to outside counts (Table 9). From outside sandpit nesting colonies, we documented several more interior least tern and piping plover adults, chicks >5 days old, and fledglings than we did from within the nesting area; however we also documented 2 potential false positive interior least tern nests (adult on scrape without eggs observed) and 2 potential false positive piping plover nests from outside the nesting area.

Information collected at the 5 river sites monitored from outside and inside the nesting colony indicates from inside the nesting colonies we documented: 1) 2 (33%) more piping plover nests; 2) 1 (50%) more successful nest; 3) 7 (350%) more chicks <5 days old; 4) 2 (50%) more chicks >5 days old; and 5) 4 (200%) more fledglings than from outside the nesting areas (Table 9). We also documented 2 potential false-positive piping plover nests from outside the colony where an adult piping plover was observed sitting on a scrape that contained no eggs when we entered to collect habitat data following outside surveys. Though we did observe 6 of 8 piping plover nests from outside the nesting colony in areas where both monitoring techniques were used, only 3 nests were ever observed from the bank line where monitoring typically occurred (vegetation and topography inhibited our ability to observe nests from outside the colony even after being marked with a paint stir-stick); 3 nests were only viewed on 1 or 2 occasions when we conducted semi-monthly airboat surveys. At a site where only outside monitoring was performed (Alda Farms), we failed to ever observe a nest that hatched and fledged 4 chicks though presumably the site was monitored twice from all sides via an airboat while the nest was active. Furthermore, we were only able to observe any of the piping plover chicks at Alda Farms during 2 of 7 site visits conducted while the brood was active because the brood presumably was always foraging along heavily vegetated bank line (pictured right); we observed adults entering and leaving this area during several outside surveys and assume the chicks were foraging here as they were when we entered the site on 3 occasions and observed them. We did, however, observe the 4 fledglings from outside the nesting area (Table 5).

False-positive piping plover nest an adult was observed on during 3 outside surveys that spanned 6 days

Alda Farms nesting habitat with vegetated bankline where piping plover chicks were observed during inside surveys.

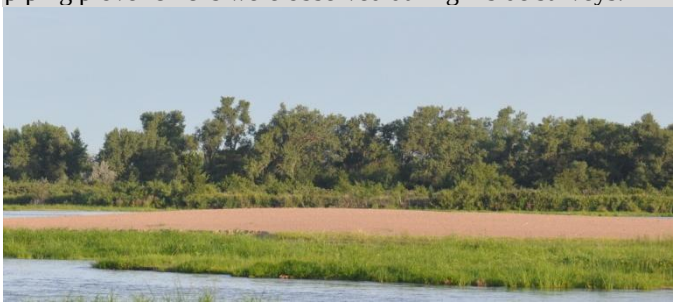


Table 9. Site-specific number of adults, nests, chicks, and fledglings observed while conducting outside (top) and inside (bottom) surveys for interior least tern and piping plover reproduction at sandpits and constructed or managed river islands during 2010. Only sites where both outside and inside monitoring occurred during 2010 are included in this table; site #'s correspond with Figure 3. See Appendices 25 and 26 for separate outside and inside counts, respectively, at all sites monitored during 2010.

						Interior least tern							Piping plover						
Site #	Site Name	Habitat Type [A]	Management [A]	Surveys	Survey Time (hr)	Adults (Cum) [A]	Adults (Max) [A]	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-21 Days	Fledglings	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-28 Days	Fledglings
1	Lexington Pit	SP	HPFT	36	50	482	29	19	15	32	30	30	91	7	5	3	9	9	8
4	Dyer Pit	SP	RCGPF	17	11	1	1	0	0	0	0	0	20	4	1	1	4	3	3
6	Blue Hole	SP	HPFT	29	29	271	25	19 [B]	5	10	2	2	137	15	6	6	18	16	11
7	Johnson Pit	SP	HPFT	39	24	50	8	4 [B]	1	2	2	2	46	4	3	2	5	2	2
8	Elm Creek Island	RI	N	7	3	4	3	0	0	0	0	0	9	6	0	0	0	0	0
9	Bartels/Johns Tract	RI	N	7	6	20	5	0	0	0	0	0	2	2	0	0	0	0	0
10	Broadfoot – Kearney South	SP	PF	22	19	179	20	3 [C]	2	5	3	3	43	20	2	2	7	4	0
12	Broadfoot –Newark	SP	RGPF	13	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Younkin Tract	RI	RDGP	27	20	23	8	0	0	0	0	0	39	3	2 [B]	1	2	2	2
14	Dinan Tract	RI	DGP	18	12	12	3	0	0	0	0	0	42	6	3 [B]	0	0	0	0
16	Dippel Tract	RI	DGP	18	12	17	6	0	0	0	0	0	61	8	3	1	0	2	0
1	Lexington Pit	SP	HPFT	22	26	273	29	21	16	41	4	0	105	10	6	3	11	8	5
4	Dyer Pit	SP	RCGPF	7	3	0	0	0	0	0	0	0	9	2	1	1	4	3	0
6	Blue Hole	SP	HPFT	21	31	200	22	21	12	29	1	0	120	10	7	6	24	10	7
7	Johnson Pit	SP	HPFT	20	9	35	9	4	1	2	0	0	44	4	3	2	6	2	0
8	Elm Creek Island	RI	N	7	7	2	2	0	0	0	0	0	6	4	0	0	0	0	0
9	Bartels/Johns Tract	RI	N	9	13	10	3	0	0	0	0	0	0	0	0	0	0	0	0
10	Broadfoot – Kearney South	SP	PF	14	11	33	7	3 [C]	2	5	3	3	43	20	2	2	7	4	0
12	Broadfoot –Newark	SP	RGPF	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Younkin Tract	RI	RDGP	19	9	4	4	0	0	0	0	0	25	4	1	1	2	2	2
14	Dinan Tract	RI	DGP	14	6	2	2	0	0	0	0	0	15	5	2	0	0	0	0
16	Dippel Tract	RI	DGP	10	8	11	6	0	0	0	0	0	51	8	5	2	7	4	4

[A] Habitat types include sandpits (SP) and river islands (RI). Management actions applied to each site could include: mowed (M), burned (B), disked (D), graded (G), tree/vegetation removal (R), or herbicide (H) during fall 2009; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2010; no management (N); or unknown (U). Adult counts represent cumulative number of adult interior least terns and piping plovers observed during all surveys (Cum) and the maximum number adults observed during any single survey (Max).

[B] Includes a nest documented from outside the nesting area observed to be without eggs during inside surveys.

[C] Excludes 8 nests located on 2 small islands located northwest of the main peninsula that we could not access to monitor from inside the colony.

Adult and Chick Band Observations – As part of the USGS Foraging Habits study, 16 adult and 35 juvenile interior least terns were banded during 2009 and 7 adult and 74 juvenile interior least terns were banded during 2010. Eleven adult and 25 juvenile piping plovers were banded during 2009 and 13 adult and 64 juvenile piping plovers were banded during 2010. The first year after banding occurred on the central Platte, we compiled valuable information on site and habitat (sandpit or riverine) fidelity and philopatry, wintering grounds for central Platte River piping plovers, survival and recruitment, re-nesting events, and disturbance. For example, an adult piping plover that nested and was banded within Program Associated Habitat during 2009 was later observed nesting on the Missouri River after its nest on the central Platte failed. A piping plover banded as an adult within Program Associated Habitat in 2009 (Blue Hole Sandpit) was documented on the wintering grounds at Matagorda Beach, Matagorda Texas in November, 2009 and returned to nest at Blue Hole Sandpit again during 2010. Another adult piping plover, banded within Program Associated Habitat as a chick in 2009 (unknown location), was observed on the Loup River during May, 2010. We observed 5 of 10 piping plover adults and 3 of 25 piping plover chicks that were banded in 2009 nesting within Program Associated Habitats during 2010. A piping plover that was banded as an adult on a river island at the Dinan Tract in 2009 was observed nesting on a constructed river island near Mormon Island during 2010 and one of its offspring, banded as a chick in 2009, nested at Alda Farms Island during 2010. We observed 3 adult piping plovers banded at Blue Hole Sandpit as adults during 2009 nested at Blue Hole again during 2010. A piping plover banded as an adult at Lexington Sandpit in 2009 nested at Lexington Sandpit again during 2010; we were able to capture and band its mate during 2010 also (pair pictured to the right). A piping plover banded as a chick at Blue Hole in 2009 was observed nesting at Lexington Sandpit during 2010. A piping plover banded within Program Associated Habitat as a chick in 2009 (unknown location) was observed nesting at Johnson Sandpit during 2010. We observed an adult piping plover banded on the Missouri River (2005 – 2010) nesting on a river island at the Dippel tract during 2010. We also documented a re-nesting event where a piping plover presumably nested on a river island at the Dippel Tract around 17 May, 2010 and fledged 4 chicks and then re-nested at the Wild Rose East Sandpit at the Trust on about 8 July, 2010 where the second nest hatched 9 August and the chicks were last observed 16 August, 2010. Though we cannot be 100% certain the piping plover was banded at Dippel (incomplete band combination, blurry photograph, etc), we can be certain the adult was banded on 1 of 3 nests on the central Platte river during 2010 given it had a B/W split band over a Yellow band on the lower left leg as observed in the field and are fairly certain it nested at Dippel given what appears to be a Red band over an Orange band on the lower right leg (blurry photograph). The 2 other less likely possibilities, given an accurate record of the band combination on lower left leg, include: it nested successfully and fledged 2 chicks at Blue Hole Sandpit and then later re-nested at the Trust Sandpit; or it nested at Broadfoot South Sandpit where we last observed chicks at 20 days of age and then re-nested at the Trust Sandpit. Regardless of what the full band combination was, due to banding we were able to document a re-nesting event where the piping plover successfully nested, reared fledglings or 20-day-old chicks, and then re-nested at a different site during 2010. Although 2010 was too soon to observe interior least tern chicks banded on the Platte River in 2009, we did document an adult interior least tern on the Platte River during 2010 that USGS personnel believe was radio-marked and banded on the Missouri River during 2006 or 2007.


Pair of piping plovers banded at Lexington sandpit during 2009 and 2010

Information collected during 2010 indicates nest success was higher for nests associated with a banded adult interior least terns and piping plovers than it was for those of unbanded adults. The

USGS banded 7 adult interior least terns on nests that were incubated at least 7 days and 6 (86%) hatched successfully during 2010. We observed an additional 53 interior least tern nests that were incubated by unbanded adults at least 7 days and of these nests only 39 (74%) hatched successfully. USGS also banded 13 adult piping plovers on nests that were incubated at least 7 days and 12 (92%) hatched successfully during 2010; 1 of 2 (50%) at river sites and 11 of 11 (100%) successful at sandpit sites. We observed an additional 14 piping plover nests that were incubated by unbanded adults at least 7 days of which 8 (57%) hatched successfully; 2 of 4 (50%) at river sites and 6 of 9 (67%) successful at sandpit sites.

SUMMARY:

The number of interior least tern nests, successful nests, chicks, chicks/nest, fledglings, and fledglings/nest were higher during 2010 than they have been since the Program began in 2007 (Table 6; Figures 8 – 10). Daily and incubation-period survival rates for interior least tern nests remained fairly high during 2010 despite what appears to be a decline in brooding-period survival rates from 2008 and 2009. The difference in survival rates between 2010 and the previous years was due to the Program changing the fledging age from 15 days (2007 – 2009) to 21 days for interior least tern chicks. The number of interior least tern nests, chicks, and fledglings observed may have been higher but near season-long high flows (Figure 2) and vegetation establishment (pictured left) reduced nesting opportunities on river islands and a mid-June weather event claimed several nests through flooding and hail damage on sand pits. Although nesting islands were available west of Kearney, Nebraska piping plovers only nested on river islands east of this point and 2010 was the first year piping plovers and interior least terns nested at a sandpit site east of Kearney since the Program began in 2007.

The number of initiated and successful piping plover nests observed were >60% and >40% higher during 2010 than 2007 – 2009, respectively (Table 6; Figure 8); however, 2 nests documented during 2010 were never confirmed to have had eggs. We observed >30 more chicks and >20 more piping plover fledglings in 2010 that we did during 2007 – 2009 (Table 6; Figure 9). Piping plover apparent nest success (chicks/nest) during 2010 was higher than 2008, but was similar or slightly lower than 2007 and 2009 numbers (Figure 10). We observed an 85 – 500% increase in the number of chicks that survived to 15-days of age in 2010 as compared to 2007 – 2009; however, the historic fledge ratio was only 6% higher and the observed fledge ratio was 13% lower during 2010 than it was during 2007 due to changing the fledging age for piping plover chicks from 15 to 28 days prior to the 2010 nesting season (Table 6; Figure 10). Similar to 2008 and 2009, the daily nest survival rate for piping plover nests was higher at sandpit sites than river island sites. Unlike 2008 and 2009 where piping plover brood survival rates were higher at sandpit sites than river-island sites, the average daily brood and chick survival rates were similar at sandpit and river-island sites during 2010. We found positive correlations between nesting area size and numbers of piping plover nests at river island and sandpit sites. We also found positive correlations between between the ratio of bare-sand to surface water area and number of riverine piping plover nests at river island and sandpit sites. We plan to evaluate these relationships further to see if the effect size changes over time. We found 76% of interior least tern nests and 90% of piping plover nests at sandpits and 73% of piping plover nest at river sites were >400 feet from the nearest predator perch. Eighty-three percent of all interior least tern nests were >50 feet from the nearest waterline and 91% were 1.5 feet above the waterline when initiated. Similarly, 73% of all piping plover nests at sandpits and 40% of piping plover nests on river islands were >50 feet from the nearest waterline when initiated. Ninety-one percent of


Banded piping plover near its nest at the Dippel Tract

piping plover nests at sandpits and 70% of piping plover nests on river islands were 1.5 feet above the waterline when initiated. Sixty-one percent of all interior least tern and 60% of all piping plover nests had nest furniture during 2010.

2010 was the first year that interior least tern or piping plover nests were observed on Program owned or managed sites with suitable nesting habitat and we observed:

- Dyer Sandpit: 1 piping plover nest that fledged 3 chicks
- Broadfoot – Kearney South Sandpit: 2 piping plover nests that hatched 7 chicks, but we failed to observe any fledglings; however, we did observe adult piping plovers entering and leaving a heavily vegetated area on the peninsula, presumably tending to chicks, for 7-10 days after the 2 broods were last observed
- Broadfoot – Kearney South Sandpit: 11 interior least tern nests, 5 of which hatched 14 chicks that resulted in 12 fledglings; however, 8 of these nests were on 2 islands we could not monitor effectively due to access limitations so actual numbers were likely higher

Though nesting occurred at Broadfoot – Kearney South in the past, vegetation emergence the past several years resulted in a sharp decline in the number of nests, chicks, and fledglings reported. Numbers of piping plover and interior least tern nests, chicks, and fledglings reported at the Broadfoot – Kearney South sandpit in Table 5 represent minimums present; access limited our ability to monitor 2 islands where several interior least tern nests occurred during 2010.

Collecting data within the colony appears to result in a more accurate depiction of nest initiation, nest success, and number of chicks hatched and outside monitoring appears to result in higher fledgling and adult counts; however, counting adults, chicks, and fledglings was not a primary objective of the Foraging Habits Study (i.e., counts within the colony). During 2010, we failed to observe a piping plover nest at a site where only outside monitoring occurred and recorded 4 false-positive piping plover nests during outside surveys. Due to large discrepancies in adult, chick, and fledgling counts, at this point we plan to modify the methods used to count adults, chicks, and fledglings while within nesting colonies during 2011 to help address issues related to disturbance and detectability. If similar findings are observed in 2011, counts collected from inside and outside the nesting colony will be used to further assess differences in detectability between the 2 techniques, to determine if the additional level of disturbance associated with monitoring within the colony appears to negatively impact reproductive success, and to develop an 'adjustment factor' so outside and inside monitoring numbers are comparable if the Program takes a research-based approach to learn about factors that affect interior least tern and piping plover reproductive success on the central Platte River.

Though banding has only occurred on the central Platte River for 2 years, efforts to date have provided a lot of information with little evidence that interior least tern and piping plover adults or nests have been negatively impacted. We did, however, have 1 incident in the 2 years of banding where an adult piping plover was inadvertently injured while being released from the hand of an experienced bander. Though we never observed the injured piping plover after it lost its nest at the Dinan Tract around 20 May, 2010, this bird was monitored via telemetry throughout the nesting season and was last detected by USGS telemetry equipment on 6 August, 2010. We expect interior least tern chicks banded within Program Associated Habitats to return to nest the next couple of years and anticipate we will learn a great deal more about how interior least terns interact with riverine and sandpit habitats along the central Platte River as well. We will continue to obtain data from banding that was conducted the past 2 years which will be used to help guide Program management activities.

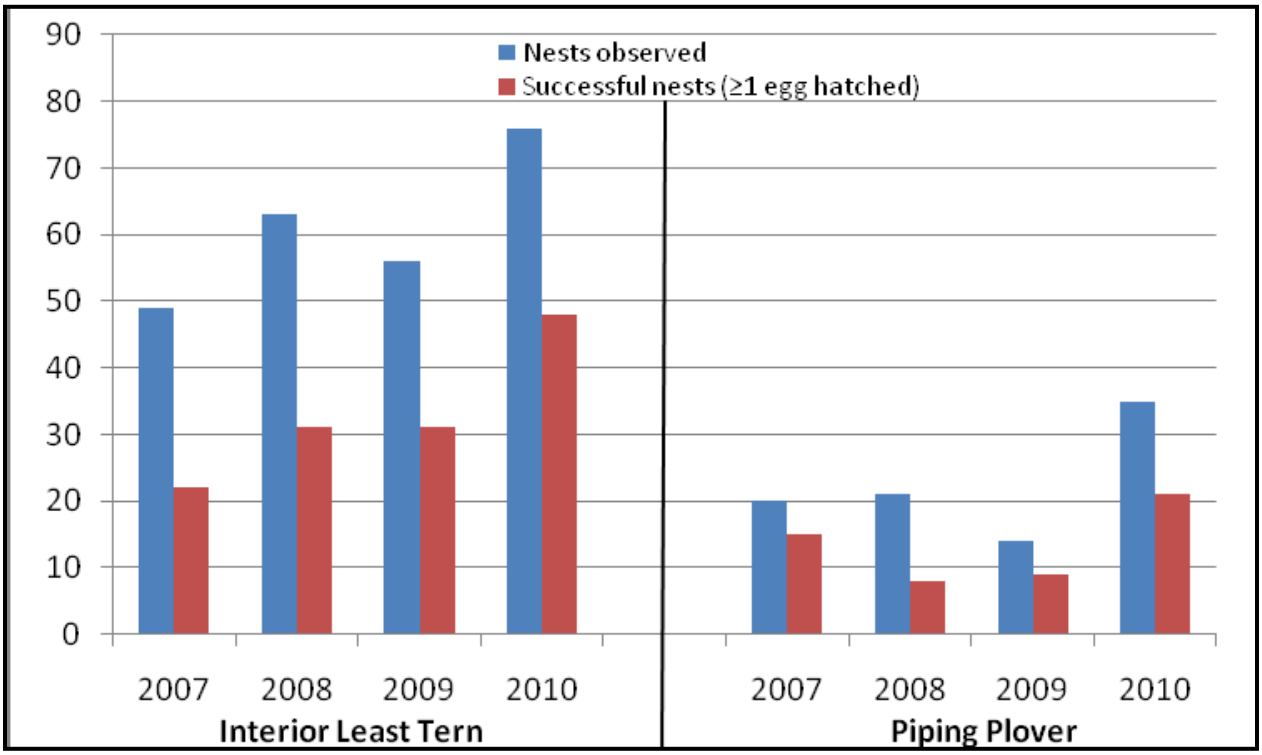


Figure 8. Number of initiated and successful interior least tern and piping plover nests observed at monitored river island and sandpit sites within Program associated habitats, 2007 – 2010.

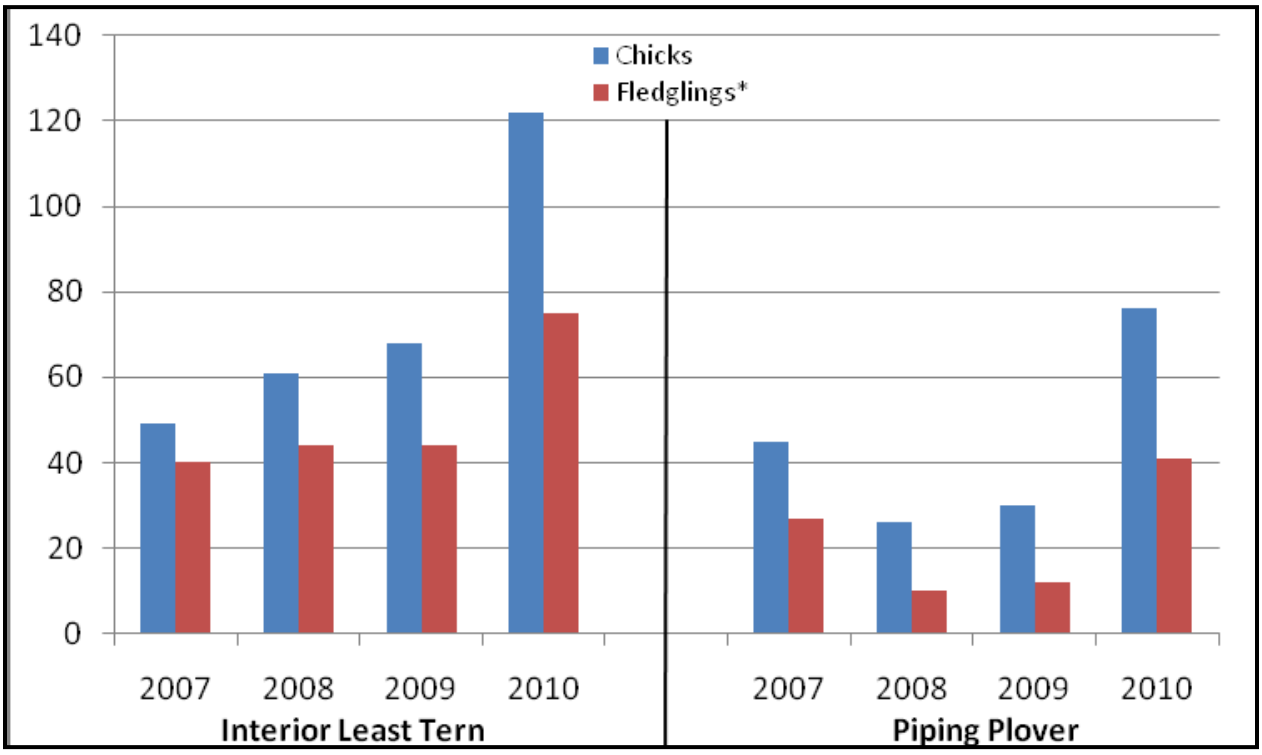


Figure 9. Number of interior least tern and piping plover chicks and fledglings observed at monitored river island and sandpit sites within Program associated habitats, 2007 – 2010.

* The Program's fledging age for chicks was changed from 15 days during 2007 – 2009 to 21 and 28 days for interior least tern and piping plover chicks, respectively in 2010. Historic (2007-2009), 15-Day fledgling counts for interior least terns and piping plovers during 2010 were 76 and 50, respectively.

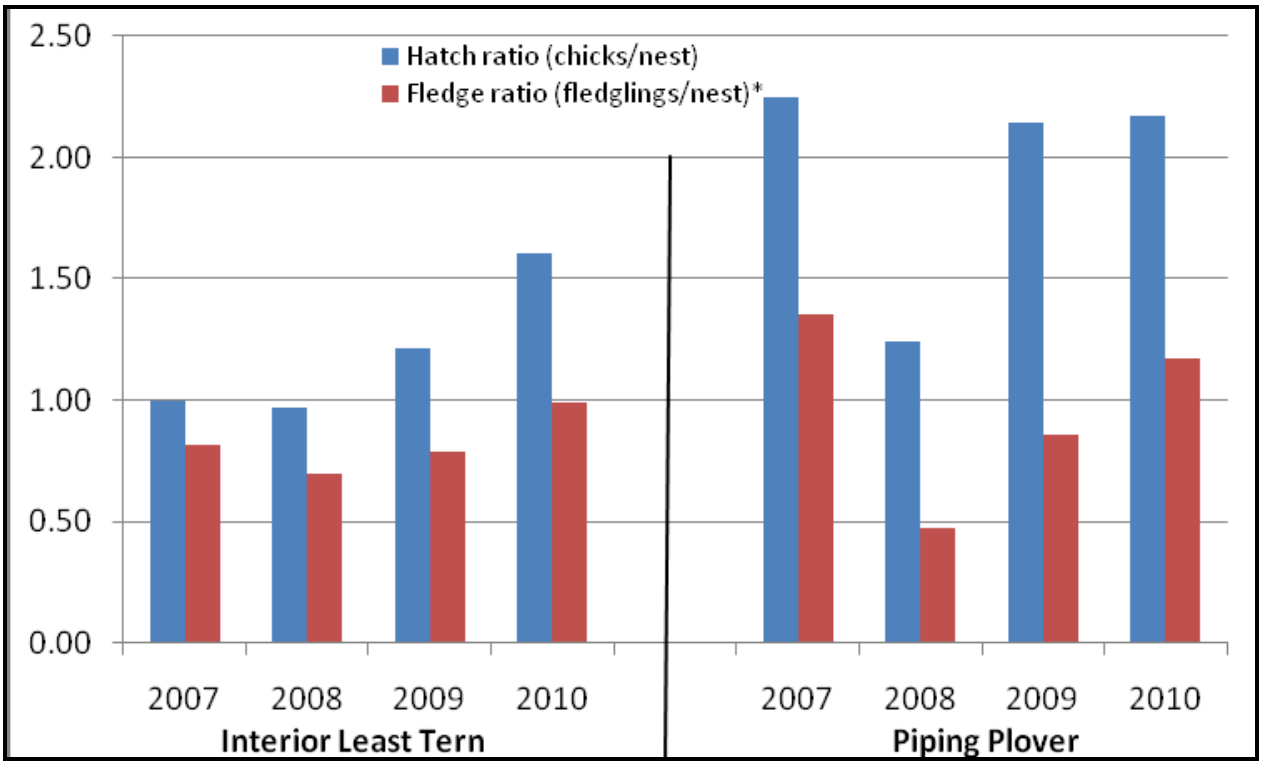


Figure 10. Nest-based hatch and fledge ratios for interior least tern and piping plover nests observed at monitored river island and sandpit sites within Program associated habitats, 2007 – 2010.

* The Program's fledging age for chicks was changed from 15 days during 2007 – 2009 to 21 and 28 days for interior least tern and piping plover chicks, respectively in 2010. Historic (2007 – 2009), 15-day fledge ratios for interior least terns and piping plovers were 1.00 and 1.43 during 2010, respectively.

RESEARCH

In addition to implementation of the Program's surveillance monitoring protocol, conservation monitoring and directed research will be conducted during the course of the Program's First Increment to provide data to evaluate the Program's management objectives and priority hypotheses. Over the next several years, activities will include research on interior least tern and piping plover nest-site selection and comparisons of use and reproductive success on riverine versus off-channel sand and water habitat. Design and implementation of this research will be guided by the ED Office, the TAC, and Program partners and will be reviewed by the Program's Independent Scientific Advisory Committee (ISAC). Future editions of this report will include a brief summary of all interior least tern and piping plover research conducted by the Program and a description of where to find summaries of findings.

FORAGING HABITS STUDY

The first directed research project related to interior least terns and piping plovers on the central Platte River began in 2009 with the implementation of the Foraging Habits Study. A contract to conduct this study over two field seasons (2009 − 2010) was awarded to the USGS-NPWRC. The research was jointly funded by the Program and the USGS-NPWRC. This section provides a summary of activities conducted for the foraging habits study in 2009 and 2010; details about their findings can be found in the Final Research Report to be generated by the USGS-NPWRC in early 2011. This research was designed to quantify various measures of foraging habitat used

by interior least terns and piping plovers at sandpits and river-island sandbars with a goal of addressing 4 specific objectives that collectively contribute to the understanding of foraging habits of adult interior least terns and piping plovers within Program associated habitats:

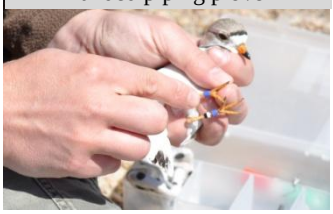
1. **Movements**
   Quantify frequency and distance of movements away from nesting colonies for least interior least terns and piping plovers nesting in sandpit and riverine sandbar habitats.
2. **Time Allocation**
   Quantify time allocation to foraging and foraging success rate for adult least interior least terns and piping plovers in sandpit and riverine habitats.
3. **Foraging Habitat**
   Quantify features of foraging habitats used by adult least interior least terns and piping plovers during nesting and brood rearing at sandpit and riverine habitats.
4. **Productivity**
   Evaluate linkages between indices of productivity and measures of foraging effort for adult least interior least terns and piping plovers nesting at sandpit and riverine sandbar habitats.

ADULT CAPTURE, BANDING, AND RADIO TELEMETRY

Adult interior least terns and piping plovers were trapped and banded so that they were uniquely identifiable. Techniques outlined in this section support all 4 objectives outlined above. Interior least tern and piping plover adults were trapped on nests using hoop nets ≥1 week after nest initiation and prior to pipping. Observers were positioned in blinds to quickly process captured adults and to abort trapping attempts if the adult was disrupted from its nest for ≥20 minutes. Prior to trap deployment, eggs from targeted nests were exchanged with artificial eggs to reduce potential risk of injury and were immediately replaced upon termination of the trapping effort. Once captured, adults were moved to a nearby area away from the colony and weighed, banded, fitted with a radio transmitter (not all adults), and released to the colony area within 10 minutes of capture and were observed to ensure resumption of normal behaviors (e.g., incubation and foraging).

Adult tern in D-loop trap

Banded piping plover



Interior least tern and piping plover adults were also fitted with radio transmitters primarily in support of objective 1, but also to provide information in support of objectives 2 – 4. For interior least terns, we used leg-band mounted transmitters secured to the aluminum leg band with nylon thread. The leg band transmitter package was fitted on the upper leg, and was the only metal band applied to radio-marked interior least terns. For piping plovers, we used glue-on transmitters attached to the intrascapular region of the bird. All radio-marked birds were released adjacent to the colony within 10 minutes of capture and were observed to ensure resumption of normal behaviors (e.g., incubation and foraging). Automated dataloggers with data collection computers programmed to scan all deployed frequencies every 5 – 10 minutes were used to document presence/absence of radio-marked birds which we used to develop estimates of trip frequency and duration by pairs and colonies. Hand-held antennas were used to locate birds during behavioral observations.

Radio-telemetered plover

CHICK CAPTURE AND BANDING

Interior least tern and piping plover chicks were also banded so they were uniquely identifiable. Banding and re-sighting data was collected in support of objective 4 outlined above. We attempted to band all interior least tern and piping plover chicks at all sandpits and river islands surveyed. We visited nests of interior least terns and piping plovers on or near the day of hatch so that chicks could be captured by hand in or near the nest bowl and banded; handling time was ≤2 minutes. Capture and banding occurred every 2 – 3 days during productivity assessments. We recaptured interior least tern chicks at ~15 days of age and applied stainless steel leg bands and ensured retention of plastic leg bands. Each site was re-visited 2 – 3 times/week between banding and fledging to re-sight banded birds. Band combinations of piping plover chicks were obtained by visually scanning brood-rearing areas from a distance to minimize bird disturbance. Due to the sedentary behavior and posture of interior least tern chicks, occasionally re-sightings required us to pick chicks up to read color band combinations. We visually scanned areas where interior least tern chicks were previously located and conducted searches on foot to locate and capture banded chicks; handling time was <5 minutes per re-sighting.

Banded interior least tern chick

BEHAVIORAL OBSERVATIONS

Behavioral observations were conducted in support of objective 2 and provided information on locations where sampling was needed for objective 3. We observed behaviors of interior least terns and piping plovers to identify the proportion of time spent foraging, estimate the rates of foraging behaviors and habitats used for foraging piping plovers, and determine success rates of foraging interior least terns. Behavioral observation sessions occurred during 4-hr intervals (0600 – 1000, 1200 – 1600, and 1700 – 2100h). We systematically allocated sessions to ensure we observed each interior least tern and piping plover pair at least 1 time during each interval every two weeks. Observers entered the blind or observation location using an approach that minimized disturbance to foraging interior least terns and piping plovers. A scan sampling technique was used to monitor interior least terns and focal sampling technique was used for piping plovers. We observed and recorded state behaviors on 5-minute-intervals. At the beginning of interval, observers spent 5 seconds assessing the state of each bird. If foraging behaviors were observed during the bird-specific 5 second scan, we coded the state as foraging; otherwise we recorded the dominant behavior during the 5-second interval. Behavior states were classified into 1 of 9 categories including: foraging, transport or food delivery, active parental care, stationary parental care, locomotion, active stationary (e.g., preen, bathe, courtship, copulation), inactive or resting, out of view (in area, but view was obstructed), and left observation area. Classification of state behaviors was species specific.

Interior least terns: Observation sessions for interior least tern colonies spanned 1 – 3 hours depending on the number of interior least tern pairs that were visible. Observers conducted scan sampling techniques on 5 minute intervals; recording the number of adult interior least terns visible that were engaged in each behavioral state. We randomly selected a foraging adult and documented behaviors including hover, unsuccessful plunge, successful plunge, plunge of unknown success, eating prey, in the area

Adult tern

but out of view, adult left the area, and forage delivered to an adult, chick, or unknown recipient. When observing forage delivery behaviors, we watched the whole colony and documented all deliveries of forage to chicks or other adults and recorded the location of foraging and the recipient of forage. If the adult left the area or stopped foraging for ≥30 seconds, we selected and observed another foraging adult.

Piping plovers: Two people were used to monitor the position and behavior of piping plover adults and broods. Behavioral observations of piping plovers were focused on individual adults, pairs, or adults with broods (hereafter focal unit). We allocated 3, 1-hour sessions per day for behavioral sampling so that up to 3 focal units could be sampled per day of field work. We recorded behavioral states and habitat characteristics for each individual within the focal group on 5-minute-intervals. Each individual (adult and chick) was observed for 5 seconds to determine the dominant behavioral state, with behaviors being linked to marked individuals when possible. In the interim time between all focal observation intervals, we randomly selected an adult or chick and recorded all pecks and gleans made during a 3-minute interval. We randomly selected a new adult or chick, alternating between adults and chicks, for each subsequent peck-recording interval.


Banded fledgling plover

FORAGING HABITAT EVALUATION

Forage Fish Sampling: Foraging habitat data was collected to quantify features of habitats used by foraging interior least terns and piping plovers primarily in support of objective 3. We conducted forage fish sampling with Mini-Missouri River trawls to describe fish abundance, species, and size, and aquatic habitats where interior least terns foraged in relation to available sites.

*River Sampling***:** We collected a GPS location, water temperature, turbidity, depth, flow, benthic substrate (sand, clay/silt/organic, or gravel), and habitat class (main channel, secondary channel, braided/dendritic channel). We then placed a 50-m float line 2 m from the sample point (perpendicular to the current) to guide the direction and distance of the sampling path. We began trawls at the sampling point and 2 people space 3 m apart towed it downstream parallel to the float line at a speed that was slightly faster than the river current. Once completed, the trawl mouth was held out of the water and we processed the sample at a nearby sandbar or shoreline not currently used by interior least terns or piping plovers. All captured fish were identified to species, measured, and released as quickly as possible. We used fish identification guides and taxonomic keys to identify fish to species. When large samples of fish were caught, we placed fish in a bucket of river water prior to handling to reduce the chance of mortality.

*Sandpit Sampling***:** When on sandpit ponds, we used a canoe to navigate to sampling locations. Similar to river sampling, we collected a GPS location and data on water temperature, turbidity, depth, and benthic substrate and deployed the floating trawl and towed it 50 yards through the pond. We identified and handled fish as outlined for river samples.

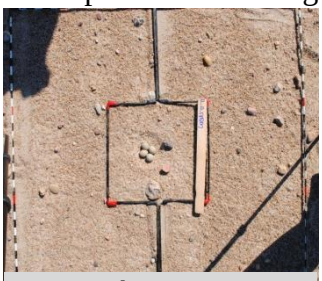
Forage fish sampling in sandpit pond

Invertebrate Sampling: We conducted invertebrate sampling to describe the invertebrate taxa, abundance, and terrestrial habitats where piping plovers foraged in relation to available sites. Sampling occurred at brood-specific foraging locations and two random locations selected within 75 m of the foraging location at the end of each 1-hour behavior session, if foraging was observed. Once at the sampling location, we collected the GPS location, distance to nearest semi-permanent water source, landform, substrate moisture, vegetative cover, visual coverage estimates for vegetation of each class, mean height of vegetation, maximum height of vegetation, visual coverage estimates for each substrate size class, and visual coverage estimate for each debris class. If sampling points were within 100 m of an active interior least tern or piping plover nest or brood, we chose another location. We sampled invertebrates using 4, paint stir-stick insect traps coated with Tanglefoot®; 2 placed horizontally and 2 vertically within a 1-m^2 exclosure. The handle of the sticks were labeled with study area, site, brood/nest number, point type (i.e., foraging or random location), stick number, date, and time set. We retrieved the traps after 2 – 3 hours and recorded the end time. We limited disturbance to interior least tern and piping plover adults and chicks to 10 minutes during setup and tear down of traps. We identified and counted invertebrates on the sticky sticks immediately outside study area. Invertebrates <3 mm were counted, but not identified. Invertebrates 3 mm or greater were counted and identified to order (all) and to family if in the Diptera order. When invertebrates could not be counted and identified on the collection day, we froze sticky sticks for later identification.


Invertebrate sampling

NEST-SITE SELECTION STUDY

We evaluated habitat characteristics associated with interior least tern and piping plover nest-site selection and reproductive success at two spatial scales: 1) the macro-habitat scale (landscape-level selection), which included features of the landscape at all observed and potential breeding habitat within the focal areas of the study; and 2) the micro-habitat scale (within-site nest placement), which included habitat characteristics within 1 yd^2 of the nest and at random locations distributed across the river island or sandpit site containing the nest. Macro-habitat scale data was collected to determine factors that influence landscape level nest-site selection and brood survival, whereas micro-habitat scale data was used to determine factors that influenced within-site placement of nests. This section describes methods used to evaluate research parameters related to nest-site selection and nest and brood survival for interior least terns and piping plovers; details about our findings can be found in the Final Research Report to be generated by Program staff by mid 2011. The objectives of this pilot study were to:


Plover nest

1) Quantify parameters associated with interior least tern and piping plover nest initiation and nest and brood survival at 2 areas containing riverine and sandpit nesting habitat;
2) Refine methodology and evaluate the logistics of implementing such a study within all Program associated habitats; and
3) Determine if conducting an intensive study, such as this, appears to impact interior least tern and piping plover nest and brood survival rates.

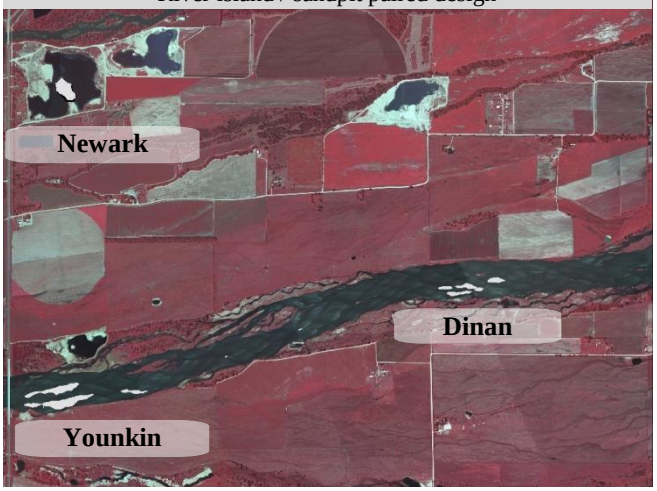
The long-term objectives include analyzing data as it relates to performance and decision criteria for Program hypotheses outlined in the Program's Adaptive Management Plan (listed below) and to evaluate the influence the Programs Flow-Sediment-Mechanical and Mechanical Creation and Maintenance strategies have on habitat availability, nest-site selection, and reproductive success of interior least terns and piping plovers within Program Associated Habitats.

- T1 and P1 – Additional bare sand habitat will result in an increase in the number of adult interior least terns and piping plovers in the study area.
- TP1 – Interaction of river and sandpit habitat.
- TP5 – Use of riverine islands by interior least terns and piping plovers will increase as the active channel width increases.

FOCAL AREAS

The 2010 nest-site selection research consisted of 2 focal areas along the Platte River; each area encompassed a 3-mile stretch of river and an associated off-channel sandpit. The focal area west of Kearney included the Elm Creek river-island complex and Blue Hole sandpit site; this focal area started at the Elm Creek (HWY 183) Bridge and stretched downstream to the east edge of the Bartels/Johns Tract. The focal area east of Kearney (image right) included the Younkin and Dinan Tracts and the recently purchased and enhanced Newark sandpit site; this focal area started at the Minden (HWY 10) Bridge and included a stretch of river downstream to the Rowe Sanctuary boat ramp. We chose these areas because only off-channel nesting has occurred west of Kearney and has occurred at the Blue Hole sandpit each year and only on-channel nesting has occurred east of Kearney and has occurred at the Dinan Tract each year since the Program was initiated in 2007.

River island / sandpit paired design



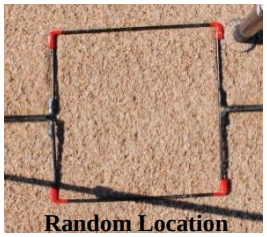
METHODS

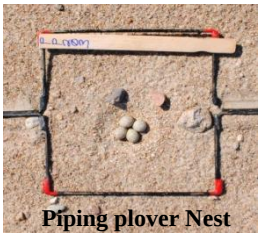
Site visits were conducted on a weekly basis between 1 May and 1 August; standardized field methods were used during each visit to a nesting area. We recorded: date; time of arrival, entry into colony, and departure; weather conditions (temperature, cloud cover, wind speed and direction, and precipitation); number of interior least tern and piping plover adults, nests, and chicks present in the area; and the band combination of interior least terns or piping plovers observed. Upon arrival during all site visits, we visually scanned potential nesting areas with binoculars or spotting scopes to determine how many interior least tern and piping plover adults, nests, chicks, and fledglings were present; these counts were used for outside survey counts outlined in the Program's Monitoring Protocol. Following visual scans, we entered the site and again counted nests, adults, chicks, and fledglings present and collected habitat measurements; these counts represented inside survey counts described in the monitoring protocol. No more than 2 visits per week were made to any nest or brood; activity within the colony area was limited to 20 minutes per observation period.

Macro-habitat Scale Nest-site Selection: As nests were initiated throughout the breeding season, physical characteristics of all suitable river island and sandpit sites within the focal areas of this study were measured weekly between 1 May and 1 August. We visually classified vegetative canopy cover, maximum height of living or current-year vegetation, percent bare ground, presence of potential nest-site furniture, and the predominant substrate present at 5 randomly chosen 1-yd^2 areas within each river island and sandpit site. We also used a GIS or laser range finder (LRF) to measure channel width (riverine sites only) and the distance from the center of each island or sandpit site to the nearest non-suitable nesting habitat (excluding water), predator perch >10 feet tall, and suitable nesting habitat of the same and al ternate class (river or sandpit). Sites with nesting interior least terns or piping plovers were visited twice each week during the breeding season to collect micro-habitat scale data as outlined below; macro-habitat scale data was collected during 1 of these semi-weekly visits.

Site-specific Macro-habitat Measurements: At riverine sites, we used a GPS unit to measure water-line elevation and surface area of each sandbar island and to create a polygon shapefile of each island by walking the perimeter and marking waypoints every 2−3 seconds (~10-yard intervals). When the perimeter of a sandbar was irregular, we walked slower and collect more waypoints to provide a more accurate depiction of island size and shape. We used a LRF to measure the wetted width between river islands and both bank lines from the point on the island nearest the bank line in both directions (i.e., minimum wetted width). We determined site-specific flow rates (ft^3/sec) using data collected at the nearest upstream and downstream USGS-gage station from each site. At sandpit sites, we used a GPS unit to delineate the size and shape of sandpit islands, measure elevation at the waterline, and to create a polygon shapefile of the nesting area by walking the along the inner sandpit-island shoreline and marking waypoints every 2−3 seconds (~10-yard intervals). We also estimated % bare sand area at each sandpit site and the total nesting area size based on the total size of each site and percent of the area classified as bare sand.

Micro-habitat Scale Nest-site Selection and Nest Survival: When new nests were present, we collected a GPS location and marked each nest with a numbered nest marker, counted, floated (initial nest observation only), and determined the fate of eggs in each nest, documented the presence of adults tending each nest, and proceeded to collect measurements to be used in micro-habitat scale nest-site selection or incubation-period nest survival analyses. We generated 5 nest-specific random locations within the boundaries of the site during the initial visit of each nest. We used a digital camera to capture habitat characteristics (vegetative cover, substrate, distance to nearest living or current year vegetation >6 inches tall within a 1-yd^2 area, and the presence of nest furniture) present within a 1-yd^2 area centered on each nest and random location; data was recorded off-site to minimize time spent within the colony. We measured height of living vegetation, distance to water, predator perch >10 feet tall, non-suitable nesting habitat (excluding water), and nearest conspecific's and other species' nest located at the site, and the elevation above waterline for each nest and random location. At riverine sites, we measured active channel widths (width at 1,200cfs including land) and wetted width and determined time- and site-specific flow rates (ft3/sec) using data collected at the nearest upstream and downstream USGS-gage station. Throughout the nesting season, we recorded daily precipitation and maximum and minimum daily temperature; these data will be used in nest survival analyses.


Random Location


Piping plover Nest

Brood Survival: Physical characteristics present at each river island or sandpit site containing a brood were measured twice a week. Similar to other surveys, we conducted outside surveys prior to entering each site. Following outside surveys, we entered the site to conduct inside surveys and used a LRF to measure the wetted width between river islands and both bank lines. When broods were present, we generated and collected habitat measures at 5 random locations within the boundary of the brood site; the 5 random locations were common for all broods present. We used a digital camera to collect information on habitat characteristics present at each random location as outlined in the micro-habitat nest-site selection section above.

DATA ANALYSIS

We will use data collected during 2010 to assess the amount and quality of habitat available for nesting interior least terns and piping plovers by measuring the physical characteristics of all suitable river islands and sandpit sites, with and without nesting birds, within the focal areas of this study. Prior to analyzing the empirical data, we will develop the Program's Data Analysis Plan and explore ways in which management actions and parameter configurations might affect interior least tern and piping plover nest- and brood-site selection and survival. We will develop *a priori* sets of models that include various combinations of variables relative to the Program's priority hypotheses and management objectives for each analysis. We anticipate using Program R, or a similar program, to develop Bayesian random effects discrete-choice nest-site selection models and programs such as R or MARK to develop logistic-exposure nest- and brood-survival models. Results of these analyses will be used to improve methods used to collect data in the future, to increase our understanding of factors that influence interior least tern and piping plover macro-habitat scale nest-site selection, micro-habitat scale nest-site selection, and nest and brood survival within Program Associated Habitats, and to determine if methods employed appear to negatively impact nest and brood survival rates.

APPENDICES

Program Mark Survival Estimates

Appendix 1. Daily and incubation-period survival rates for interior least tern nests monitored on sandpits during 2010. Incubation-period nest survival rate = (daily nest survival rate)^{21}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	21	5	390	0.9872	0.0057	0.9697	0.9947	0.7637	0.5431	0.8978
Blue Hole	22[1]	10	339	0.9709	0.0091	0.9467	0.9843	0.5375	0.3358	0.7276
Johnson	5[1]	4	59	0.9342	0.0318	0.8372	0.9751	0.2396	0.0474	0.6659
Broadfoot[2]	3	1	45	0.9780	0.0217	0.8598	0.9969	0.6270	0.1263	0.9513
Wild Rose[3]	17	3	263	0.9887	0.0065	0.9654	0.9963	0.7870	0.5085	0.9295
All Sites	68	23	1095	0.9792	0.0043	0.9689	0.9861	0.6432	0.5210	0.7493

[1] Includes an interior least tern nest documented from outside the nesting area observed to be without eggs during inside survey and excludes broods found dead in bowl when first observed.

[2] 'Broadfoot' represents interior least tern nests present and monitored on the main peninsula at Broadfoot – Kearney South and excludes 8 nests located on 2 small islands located northwest of the main peninsula that we could not access.

[3] 'Wild Rose' represents interior least tern nests at Wild Rose Ranch – East Pit and excludes a successful nest that was never observed while active.

Appendix 2. Daily and brooding-period survival rates for interior least tern broods monitored on sandpits during 2010. Brooding-period brood survival rate = (daily brood survival rate)^{21}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	16	2	277	0.9931	0.0048	0.9730	0.9983	0.8654	0.5920	0.9661
Blue Hole	9	8	97	0.9201	0.0271	0.8482	0.9596	0.1741	0.0462	0.4783
Johnson	1	0	19	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	2	1	29	0.9661	0.0333	0.7950	0.9952	0.4846	0.0564	0.9367
Wild Rose[2]	14	0	255	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	43	11	676	0.9842	0.0047	0.9717	0.9912	0.7155	0.5564	0.8344

[1] 'Broadfoot' represents interior least tern broods present and monitored on the main peninsula at Broadfoot – Kearney South and excludes 3 broods of 9 chicks located on 2 small islands located northwest of the main peninsula that could not access.

[2] 'Wild Rose' represents interior least tern broods at Wild Rose Ranch – East Pit.

Appendix 3. Daily and brooding-period survival rates for interior least tern chicks monitored on sandpits during 2010. Brooding-period brood survival rate = (daily brood survival rate)^{21}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	41	14	585	0.9747	0.0065	0.9584	0.9847	0.5834	0.4211	0.7294
Blue Hole	22	20	168	0.8895	0.0240	0.8330	0.9285	0.0855	0.0270	0.2394
Johnson	2	0	38	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	5	2	79	0.9750	0.0175	0.9055	0.9937	0.5876	0.1926	0.8948
Wild Rose[2]	28	0	488	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	98	36	1358	0.9737	0.0043	0.9638	0.9810	0.5718	0.4658	0.6717

[1] 'Broadfoot' represents interior least tern broods present and monitored on the main peninsula at Broadfoot – Kearney South and excludes 3 broods of 9 chicks located on 2 small islands located northwest of the main peninsula that could not access.
[2] 'Wild Rose' represents interior least tern broods at Wild Rose Ranch – East Pit.

Appendix 4. Daily and incubation-period survival rates for piping plover nests monitored on sandpits during 2010. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	6	3	105	0.9717	0.0161	0.9158	0.9908	0.4473	0.1347	0.8188
Blue Hole	7	1	168	0.9940	0.0059	0.9590	0.9991	0.8461	0.3955	0.9495
Johnson	3	1	66	0.9848	0.0150	0.9002	0.9979	0.6521	0.1442	0.9495
Dyer	1	0	28	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	2	0	56	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Wild Rose[2]	3	0	84	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	22	5	506	0.9902	0.0044	0.9766	0.9959	0.7581	0.5346	0.8953

[1] 'Broadfoot' represents piping plover nests at Broadfoot – Kearney South.
[2] 'Wild Rose' represents piping plover nests at Wild Rose Ranch – East Pit.

Appendix 5. Daily and incubation-period survival rates for piping plover nests monitored on constructed or managed river islands during 2010. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Younkin[1]	2	1	32	0.9692	0.0303	0.8113	0.9957	0.4167	0.0363	0.9312
Dinan[1]	3	3	15	0.8087	0.1004	0.5423	0.9379	0.0026	0.0000	0.7090
Dippel	5	3	76	0.9612	0.0220	0.8864	0.9875	0.3303	0.0704	0.7626
AldaFarms[2]	1	1	2	0.0051	53.9217	0.0000	1.0000	0.0000	0.0000	1.0000
Mormon[3]	1	1	10	0.9036	0.0922	0.5406	0.9868	0.0585	0.0002	0.9597
All Sites	12	9	135	0.9350	0.0210	0.8796	0.9659	0.1523	0.0403	0.4346

[1] Includes a piping plover nest documented from outside the nesting area observed to be without eggs during inside surveys.
[2] Excludes a piping plover nest that was successful, but not observed while active.
[3] 'Mormon' represents piping plover nests present and monitored at constructed and managed islands near Mormon Island.

Appendix 6. Daily and incubation-period survival rates for piping plover nests monitored at sandpits and on constructed or managed river islands during 2010. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	22	5	506	0.9902	0.0044	0.9766	0.9959	0.7581	0.5346	0.8953
River Islands	12[1]	9	135	0.9350	0.0210	0.8796	0.9659	0.1523	0.0403	0.4346
All Sites	34	16	641	0.9784	0.0057	0.9638	0.9871	0.5418	0.3698	0.7044

[1] Includes 2 piping plover nests documented from outside the nesting areas that were observed to be without eggs during inside surveys and excludes a successful piping plover nest that was never observed while active.

Appendix 7. Daily and brooding-period survival rates for piping plover broods monitored on sandpits during 2010. Brooding-period survival rate = (daily brood survival rate)^{28}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	3	0	80	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Blue Hole	6	1	141	0.9929	0.0071	0.9514	0.9990	0.8193	0.3430	0.9752
Johnson	2	1	37	0.9730	0.0267	0.8314	0.9962	0.4641	0.0496	0.9349
Dyer	1	0	27	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	2	2	39	0.9500	0.0345	0.8209	0.9875	0.2378	0.0224	0.8096
Wild Rose[2]	3	1	59	0.9830	0.0168	0.8891	0.9976	0.6193	0.1211	0.9505
All Sites	17	4	382	0.9870	0.0058	0.9691	0.9946	0.6928	0.4417	0.8654

[1] 'Broadfoot' represents piping plover nests at Broadfoot – Kearney South.
[2] 'Wild Rose' represents piping plover nests at Wild Rose Ranch – East Pit.

Appendix 8. Daily and brooding-period survival rates for piping plover broods monitored on constructed or managed river islands during 2010. Brooding-period brood survival rate = (daily brood survival rate)^{28}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Younkin	1	0	26	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Dippel	2	1	32	0.9687	0.0308	0.8082	0.9956	0.4103	0.0347	0.9310
Alda Farms	1	0	24	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	4	1	82	0.9878	0.0121	0.9185	0.9983	0.7092	0.1939	0.9611

Appendix 9. Daily and brooding-period survival rates for piping plover broods monitored at sandpits and on constructed or managed river islands during 2010. Brooding-period brood survival rate = (daily brood survival rate)^{28}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	17	4	386	0.9870	0.0058	0.9691	0.9946	0.6928	0.4417	0.8654
River Islands	4	1	82	0.9878	0.0121	0.9185	0.9983	0.7092	0.1939	0.9611
All Sites	21	5	468	0.9871	0.0052	0.9716	0.9942	0.6956	0.4681	0.8558

Appendix 10. Daily and brooding-period survival rates for piping plover chicks monitored on sandpits during 2010. Brooding-period survival rate = (daily brood survival rate)^{28}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	11	3	241	0.9876	0.0071	0.9624	0.9960	0.7057	0.3856	0.9016
Blue Hole	24	9	498	0.9821	0.0059	0.9659	0.9906	0.6025	0.3973	0.7771
Johnson	6	4	94	0.9581	0.0205	0.8936	0.9842	0.3015	0.0743	0.6990
Dyer	4	1	86	0.9884	0.0116	0.9220	0.9984	0.7206	0.2056	0.9626
Broadfoot[1]	7	7	90	0.9245	0.0275	0.8499	0.9636	0.1111	0.0196	0.4390
Wild Rose[2]	10	5	171	0.9711	0.0127	0.9325	0.9879	0.4402	0.1785	0.7400
All Sites	62	29	1178	0.9756	0.0045	0.9652	0.9830	0.5017	0.3782	0.6250

[1] 'Broadfoot' represents piping plover nests present and monitored on the main peninsula at Broadfoot – Kearney South.
[2] 'Wild Rose' represents piping plover nests at Wild Rose Ranch – East Pit.

Appendix 11. Daily and brooding-period survival rates for piping plover chicks monitored on constructed or managed river islands during 2010. Brooding-period chick survival rate = (daily brood survival rate)^{28}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Younkin	2	0	52	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Dippel	7	3	119	0.9750	0.0143	0.9252	0.9919	0.4917	0.2017	0.8247
Alda Farms	4	0	96	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	13	3	259	0.9888	0.0064	0.9659	0.9964	0.7296	0.4190	0.9099

Appendix 12. Daily and brooding-period survival rates for piping plover chicks monitored at sandpits and on constructed or managed river islands during 2010. Brooding-period chick survival rate = (daily brood survival rate)^{28}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	62	29	1178	0.9756	0.0045	0.9652	0.9830	0.5017	0.3782	0.6250
River Islands	13	3	267	0.9888	0.0064	0.9659	0.9964	0.7296	0.4190	0.9099
All Sites	75	32	1445	0.9781	0.0038	0.9692	0.9845	0.5376	0.4220	0.6493

Mayfield Survival Estimates

Appendix 13. Mayfield estimates of daily and incubation-period survival rates for interior least tern nests monitored on sandpits during 2010. Incubation-period nest survival rate = (daily nest survival rate)[21].

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	21	5	390	0.9872	0.0057	0.9760	0.9983	0.7624	0.6002	0.9658
Blue Hole	22[1]	10	339	0.9705	0.0092	0.9524	0.9885	0.5327	0.3593	0.7843
Johnson	5[1]	4	59	0.9322	0.0327	0.8681	0.9964	0.2289	0.0512	0.9261
Broadfoot[2]	3	1	45	0.9778	0.0220	0.9347	1.0208	0.6238	0.2422	1.5423
Wild Rose[3]	17	3	263	0.9794	0.0065	0.9758	1.0014	0.7859	0.5973	1.0304
All Sites	68	23	1095	0.9794	0.0042	0.9711	0.9877	0.6463	0.5403	0.7719

[1] Includes an interior least tern nest documented from outside the nesting area observed to be without eggs during inside survey and excludes broods found dead in bowl when first observed.

[2] 'Broadfoot' represents interior least tern nests present and monitored on the main peninsula at Broadfoot – Kearney South and excludes 8 nests located on 2 small islands located northwest of the main peninsula that we could not access.

[3] 'Wild Rose' represents interior least tern nests at Wild Rose Ranch – East Pit and excludes a successful nest that was never observed while active.

Appendix 14. Mayfield estimates of daily and brooding-period survival rates for interior least tern broods monitored on sandpits during 2010. Brooding-period brood survival rate = (daily brood survival rate)[21].

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	16	2	277	0.9892	0.0062	0.9769	1.0014	0.7953	0.6127	1.0290
Blue Hole	9	8	97	0.9171	0.0281	0.8621	0.9721	0.1625	0.0443	0.5521
Johnson	1	0	19	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	2	1	29	0.9655	0.0339	0.8991	1.0319	0.4786	0.1072	1.9348
Wild Rose[2]	14	0	255	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	43	11	676	0.9822	0.0051	0.9723	0.9922	0.6865	0.5543	0.8484

[1] 'Broadfoot' represents interior least tern broods present and monitored on the main peninsula at Broadfoot – Kearney South and excludes 3 broods of 9 chicks located on 2 small islands located northwest of the main peninsula that could not access.

[2] 'Wild Rose' represents interior least tern broods at Wild Rose Ranch – East Pit.

Appendix 15. Mayfield estimates of daily and brooding-period survival rates for interior least tern chicks monitored on sandpits during 2010. Brooding-period brood survival rate = (daily brood survival rate)^{21}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	41	14	585	0.9744	0.0065	0.9616	0.9872	0.5796	0.4389	0.7624
Blue Hole	22	20	168	0.8810	0.0250	0.8320	0.9299	0.0698	0.0210	0.2175
Johnson	2	0	38	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	5	2	79	0.9747	0.0177	0.9400	1.0093	0.5836	0.2730	1.2152
Wild Rose[2]	28	0	488	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	98	36	1358	0.9728	0.0044	0.9641	0.9814	0.5598	0.4640	0.6744

[1] 'Broadfoot' represents interior least tern broods present and monitored on the main peninsula at Broadfoot – Kearney South and excludes 3 broods of 9 chicks located on 2 small islands located northwest of the main peninsula that could not access.
[2] 'Wild Rose' represents interior least tern broods at Wild Rose Ranch – East Pit.

Appendix 16. Mayfield estimates of daily and incubation-period survival rates for piping plover nests monitored on sandpits during 2010. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	6	3	105	0.9713	0.0163	0.9393	1.0033	0.4424	0.1731	1.0969
Blue Hole	7	1	168	0.9940	0.0060	0.9824	1.0057	0.8456	0.6076	1.1724
Johnson	3	1	66	0.9847	0.0152	0.9550	1.0144	0.6500	0.2758	1.4934
Dyer	1	0	28	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	2	0	56	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Wild Rose[2]	3	0	84	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	22	5	506	0.9901	0.0044	0.9815	0.9987	0.7570	0.5925	0.9652

[1] 'Broadfoot' represents piping plover nests at Broadfoot – Kearney South.
[2] 'Wild Rose' represents piping plover nests at Wild Rose Ranch – East Pit.

Appendix 17. Mayfield estimates of daily and incubation-period survival rates for piping plover nests monitored on constructed or managed river islands during 2010. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Younkin[1]	2	1	32	0.9688	0.0308	0.9085	1.0290	0.5134	0.1332	1.8240
Dinan[1]	3	3	15	0.7931	0.1064	0.5846	1.0016	0.0077	0.0000	1.0343
Dippel	5	3	76	0.9605	0.0223	0.9167	1.0043	0.4292	0.1612	1.0944
AldaFarms[2]	1	1	2	0.5000	0.3536	-0.1930	1.1930	0.0000	0.0000	40.6611
Mormon[3]	1	1	10	0.9000	0.0949	0.7141	1.0859	0.1094	0.0008	5.6486
All Sites	12	9	135	0.9331	0.0215	0.8909	0.9753	0.2335	0.0883	0.5916

[1] Includes a piping plover nest documented from outside the nesting area observed to be without eggs during inside surveys.
[2] Excludes a piping plover nest that was successful, but not observed while active.
[3] 'Mormon' represents piping plover nests present and monitored at constructed and managed islands near Mormon Island.

Appendix 18. Mayfield estimates of daily and incubation-period survival rates for piping plover nests monitored at sandpits and on constructed or managed river islands during 2010. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	22	5	506	0.9901	0.0044	0.9815	0.9987	0.7570	0.5925	0.9652
River Islands	12[1]	9	135	0.9331	0.0215	0.8909	0.9753	0.2335	0.0883	0.5916
All Sites	34	16	641	0.9782	0.0058	0.9668	0.9895	0.5388	0.3890	0.7436

[1] Includes 2 piping plover nests documented from outside the nesting areas that were observed to be without eggs during inside surveys and excludes a successful piping plover nest that was never observed while active.

Appendix 19. Mayfield estimates of daily and brooding-period survival rates for piping plover broods monitored on sandpits during 2010. Brooding-period survival rate = (daily brood survival rate)^{28}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	3	0	80	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Blue Hole	6	1	141	0.9929	0.0071	0.9790	1.0068	0.8187	0.5517	1.2084
Johnson	2	1	37	0.9726	0.0270	0.9196	1.0256	0.4594	0.0958	2.0273
Dyer	1	0	27	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	2	2	39	0.9487	0.0353	0.8795	1.0179	0.2290	0.0274	1.6454
Wild Rose[2]	3	1	59	0.9829	0.0169	0.9497	1.0161	0.6171	0.2357	1.5649
All Sites	17	4	382	0.9869	0.0058	0.9755	0.9983	0.6911	0.4990	0.9536

[1] 'Broadfoot' represents piping plover nests at Broadfoot – Kearney South.
[2] 'Wild Rose' represents piping plover nests at Wild Rose Ranch – East Pit.

Appendix 20. Mayfield estimates of daily and brooding-period survival rates for piping plover broods monitored on constructed or managed river islands during 2010. Brooding-period brood survival rate = (daily brood survival rate)^{28}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Younkin	1	0	26	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Dippel	2	1	32	0.9683	0.0312	0.9070	1.0295	0.4052	0.0651	2.2558
Alda Farms	1	0	24	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	4	1	82	0.9877	0.0122	0.9638	1.0116	0.7077	0.3565	1.3824

Appendix 21. Mayfield estimates of daily and brooding-period survival rates for piping plover broods monitored at sandpits and on constructed or managed river islands during 2010. Brooding-period brood survival rate = (daily brood survival rate)^{28}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	17	4	386	0.9869	0.0058	0.9755	0.9983	0.6911	0.4990	0.9536
River Islands	4	1	82	0.9877	0.0122	0.9638	1.0116	0.7077	0.3565	1.3824
All Sites	21	5	468	0.9871	0.0052	0.9768	0.9973	0.6946	0.5181	0.9284

Appendix 22. Mayfield estimates of daily and brooding-period survival rates for piping plover chicks monitored on sandpits during 2010. Brooding-period survival rate = (daily brood survival rate)^{28}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	11	3	241	0.9876	0.0071	0.9736	1.0016	0.7042	0.4721	1.0443
Blue Hole	24	9	498	0.9819	0.0060	0.9702	0.9936	0.5998	0.4286	0.8360
Johnson	6	4	94	0.9572	0.0209	0.9162	0.9982	0.2940	0.0862	0.9518
Dyer	4	1	86	0.9883	0.0116	0.9655	1.0111	0.7193	0.3743	1.3619
Broadfoot[1]	7	7	90	0.9218	0.0284	0.8662	0.9774	0.1023	0.0179	0.5275
Wild Rose[2]	10	5	171	0.9708	0.0129	0.9455	0.9960	0.4356	0.2083	0.8942
All Sites	62	29	1178	0.9754	0.0045	0.9652	0.9842	0.4976	0.3855	0.6408

[1] 'Broadfoot' represents piping plover nests present and monitored on the main peninsula at Broadfoot – Kearney South.
[2] 'Wild Rose' represents piping plover nests at Wild Rose Ranch – East Pit.

Appendix 23. Mayfield estimates of daily and brooding-period survival rates for piping plover chicks monitored on constructed or managed river islands during 2010. Brooding-period chick survival rate = (daily brood survival rate)^{28}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Younkin	2	0	52	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Dippel	7	3	119	0.9747	0.0144	0.9464	1.0030	0.4877	0.2138	1.0865
Alda Farms	4	0	96	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	13	3	267	0.9863	0.0079	0.9708	1.0017	0.6790	0.4367	1.0487

Appendix 24. Mayfield estimates of daily and brooding-period survival rates for piping plover chicks monitored at sandpits and on constructed or managed river islands during 2010. Brooding-period chick survival rate = (daily brood survival rate)^{28}.

Site	# Chicks	# Chicks Lost	Exposure Days	Daily Chick Survival Rate	Daily Chick Survival SE	Daily Chick Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	62	29	1178	0.9754	0.0045	0.9652	0.9842	0.4976	0.3855	0.6408
River Islands	13	3	267	0.9863	0.0079	0.9708	1.0017	0.6790	0.4367	1.0487
All Sites	75	32	1445	0.9771	0.0040	0.9692	0.9849	0.5227	0.4170	0.6538

Appendix 25. Site-specific number of adults, nests, chicks, and fledglings observed while conducting outside surveys for interior least tern and piping plover reproduction at sandpits and constructed or managed river islands during 2010. Site #'s correspond with Figure 3.

Site #	Site Name	Habitat Type [A]	Management [A]	Surveys	Survey Time (hr)	Interior least tern							Piping plover						
						Adults (Cum) [A]	Adults (Max) [A]	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-21 Days	Fledglings	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-28 Days	Fledglings
1	Lexington Pit	SP	HPFT	36	50	482	29	19	15	32	30	30	91	7	5	3	9	9	8
2	Lexington Island	RI	P	7	3	7	2	0	0	0	0	0	0	0	0	0	0	0	0
3	Overton Island	RI	RP [B]	8	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0
4	Dyer Pit	SP	RCGPF	17	11	1	1	0	0	0	0	0	20	4	1	1	4	3	3
5	Cottonwood Ranch	RI	RG [C]	7	3	11	7	0	0	0	0	0	12	10	0	0	0	0	0
6	Blue Hole	SP	HPFT	29	29	271	25	19 [D]	5	10	2	2	137	15	6	6	18	16	11
7	Johnson Pit	SP	HPFT	39	24	50	8	4 [D]	1	2	2	2	46	4	3	2	5	2	2
8	Elm Creek Island	RI	N	7	3	4	3	0	0	0	0	0	9	6	0	0	0	0	0
9	Bartels/Johns Tract	RI	N	7	6	20	5	0	0	0	0	0	2	2	0	0	0	0	0
10	Broadfoot – Kearney South	SP	PF	22	19	179	20	11 [E]	5	14	12	12	43	20	2	2	7	4	0
11	Wyoming Property	RI	N	7	2	8	4	0	0	0	0	0	0	0	0	0	0	0	0
12	Broadfoot –Newark	SP	RGPF	13	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Younkin Tract	RI	RDGP	27	20	23	8	0	0	0	0	0	39	3	2 [D]	1	2	2	2
14	Dinan Tract	RI	DGP	18	12	12	3	0	0	0	0	0	42	6	3 [D]	0	0	0	0
15	Triplett Trail Tract	RI	P	7	1	4	1	0	0	0	0	0	1	1	0	0	0	0	0
16	Dippel Tract	RI	DGP	18	12	17	6	0	0	0	0	0	61	8	3	1	0	2	0
17	Uridil Property	RI	RGP	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Dahm Property	RI	U	7	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
19	Lilley – Wood River	SP	N	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Alda Farms	RI	DP	16	8	14	5	0	0	0	0	0	18	3	1	1 [F]	4 [F]	4 [F]	4 [F]
21	Wild Rose Ranch	RI	P	7	4	16	7	0	0	0	0	0	7	7	0	0	0	0	0
22	Wild Rose Ranch – East Pit	SP	P	25	9	354	30	17	14	28	28	28	89	6	3	3	11	6	5
23	DeWeese – Alda	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Mormon Island	RI	RDGP	10	6	12	4	0	0	0	0	0	6	3	1	0	0	0	0
25	Hooker Brothers – GI West	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Island Landhandlers – GI	SP	N	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Hooker Brothers – GI South	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[A] Habitat types include sandpits (SP) and river islands (RI). Management actions applied to each site could include: mowed (M), burned (B), disked (D), graded (G), tree/vegetation removal (R), or herbicide (H) during fall 2009; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2010; no management (N); or unknown (U). Adult counts represent cumulative number of adult interior least terns and piping plovers observed during all surveys (Cum) and the maximum number adults observed during any single survey (Max).

[B] Trees and vegetation were from 2 vegetated islands in this area prior to the 2010 nesting season; however, these were not intended to be nesting islands.

[C] A heavily vegetated 14-acre island was cleared and split into 3 nesting islands during fall 2009; however, no pre-emergent herbicide was applied.

[D] Includes a nest documented from outside the nesting area observed to be without eggs during inside surveys.

[E] Includes 8 nests located on 2 small islands located northwest of the main peninsula that we could not access.

[F] Includes chicks and fledglings from a nest that was not observed while active, but was observed after it hatched 4 chicks.

Appendix 26. Site-specific number of adults, nests, chicks, and fledglings observed while conducting inside surveys for interior least tern and piping plover reproduction at sandpits and constructed or managed river islands during 2010. Site #'s correspond with Figure 3.

						Interior least tern							Piping plover						
Site #	Site Name	Habitat Type [A]	Management [A]	Surveys	Survey Time (hr)	Adults (Cum) [A]	Adults (Max) [A]	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-21 Days	Fledglings	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks 0-14 Days	Chicks 15-28 Days	Fledglings
1	Lexington Pit	SP	HPFT	22	26	273	29	21	16	41	4	0	105	10	6	3	11	8	5
2	Lexington Island	RI	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Overton Island	RI	RP [B]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Dyer Pit	SP	RCGPF	7	3	0	0	0	0	0	0	0	9	2	1	1	4	3	0
5	Cottonwood Ranch	RI	RG [C]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Blue Hole	SP	HPFT	21	31	200	22	21	12	29	1	0	120	10	7	6	24	10	7
7	Johnson Pit	SP	HPFT	20	9	35	9	4	1	2	0	0	44	4	3	2	6	2	0
8	Elm Creek Island	RI	N	7	7	2	2	0	0	0	0	0	6	4	0	0	0	0	0
9	Bartels/Johns Tract	RI	N	9	13	10	3	0	0	0	0	0	0	0	0	0	0	0	0
10	Broadfoot – Kearney South	SP	PF	14	11	33	7	11 [D]	5	14	12	12	68	6	2	2	7	4	0
11	Wyoming Property	RI	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Broadfoot –Newark	SP	RGPF	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Younkin Tract	RI	RDGP	19	9	4	4	0	0	0	0	0	25	4	1	1	2	2	2
14	Dinan Tract	RI	DGP	14	6	2	2	0	0	0	0	0	15	5	2	0	0	0	0
15	Triplett Trail Tract	RI	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Dippel Tract	RI	DGP	10	8	11	6	0	0	0	0	0	51	8	5	2	7	4	4
17	Uridil Property	RI	RGP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Dahm Property	RI	U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Lilley – Wood River	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Alda Farms	RI	DP	3	1	1	1	0	0	0	0	0	4	2	1	1 [E]	4 [E]	4 [E]	4 [E]
21	Wild Rose Ranch	RI	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Wild Rose Ranch – East Pit	SP	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	DeWeese – Alda	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Mormon Island	RI	RDGP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	Hooker Brothers – GI West	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Island Landhandlers – GI	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Hooker Brothers – GI South	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[A] Habitat types include sandpits (SP) and river islands (RI). Management actions applied to each site could include: mowed (M), burned (B), disked (D), graded (G), tree/vegetation removal (R), or herbicide (H) during fall 2009; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2010; no management (N); or unknown (U). Adult counts represent cumulative number of adult interior least terns and piping plovers observed during all surveys (Cum) and the maximum number adults observed during any single survey (Max).

[B] Trees and vegetation were from 2 vegetated islands in this area prior to the 2010 nesting season; however, these were not intended to be nesting islands.

[C] A heavily vegetated 14-acre island was cleared and split into 3 nesting islands during fall 2009; however, no pre-emergent herbicide was applied.

[D] Includes 8 nests located on 2 small islands located northwest of the main peninsula that we could not access.

[E] Includes chicks and fledglings from a nest that was not observed while active, but was observed after it hatched 4 chicks.

Appendix 27. Habitat measures collected at confirmed (eggs observed in a scrape) interior least tern nests we observed and could access during 2010.

Nest ID	Site Name	Habitat Type	15 June % Bare-Sand	Nest Management	Elevation above Water (Ft)	Channel / Sandpit-Pond Measures						Distance to:		1yd² Area Nest Measures				Nest
						Channel Width @ 1200cfs (Ft)	Nearest Bank @ 1200cfs (Ft)	Channel Width at Initiation (Ft)	Wetted Width South (Ft)	Wetted Width North (Ft)	Sandpit Pond Size	Nearest Waterline (Ft)	Nearest Predator Perch (Ft)	%Vegetative Cover	Max. Vegetation Height (In)	Distance to Vegetation >6" (In)	Nest Furniture	Fate
LT104	Lexington Pit	SP	>75	None	14.5	NA	NA	NA	NA	NA	39	178	491	<1	0	>25	No	Hatch
LT105	Lexington Pit	SP	>75	None	10.1	NA	NA	NA	NA	NA	39	113	478	<1	0	>25	No	Hatch
LT106	Lexington Pit	SP	>75	None	12.0	NA	NA	NA	NA	NA	39	136	489	<1	0	>25	No	Hatch
LT107	Lexington Pit	SP	>75	None	4.3	NA	NA	NA	NA	NA	39	81	243	<1	0	>25	Yes	Failed
LT108	Lexington Pit	SP	>75	None	3.5	NA	NA	NA	NA	NA	39	124	518	<1	0	>25	Yes	Hatch
LT109	Lexington Pit	SP	>75	None	3.9	NA	NA	NA	NA	NA	39	119	399	<1	0	>25	Yes	Hatch
LT110	Lexington Pit	SP	>75	None	4.6	NA	NA	NA	NA	NA	39	59	316	<1	0	>25	Yes	Hatch
LT113	Lexington Pit	SP	>75	None	7.1	NA	NA	NA	NA	NA	39	123	316	<1	0	>25	Yes	Hatch
LT114	Lexington Pit	SP	>75	None	2.6	NA	NA	NA	NA	NA	39	178	449	<1	0	>25	Yes	Hatch
LT115	Lexington Pit	SP	>75	None	8.0	NA	NA	NA	NA	NA	39	120	437	<1	0	>25	No	Hatch
LT116	Lexington Pit	SP	>75	None	3.3	NA	NA	NA	NA	NA	39	165	432	<1	0	>25	No	Failed
LT117	Lexington Pit	SP	>75	None	8.2	NA	NA	NA	NA	NA	39	53	252	<1	0	>25	No	Failed
LT118	Lexington Pit	SP	>75	None	9.0	NA	NA	NA	NA	NA	39	118	441	<1	0	>25	No	Hatch
LT120	Lexington Pit	SP	>75	None	11.7	NA	NA	NA	NA	NA	39	69	573	<1	0	>25	Yes	Hatch
LT121	Lexington Pit	SP	>75	None	9.9	NA	NA	NA	NA	NA	39	64	582	<1	0	>25	No	Hatch
LT122	Lexington Pit	SP	>75	None	5.7	NA	NA	NA	NA	NA	39	113	304	<1	0	>25	Yes	Hatch
LT123	Lexington Pit	SP	>75	None	12.0	NA	NA	NA	NA	NA	39	199	438	<1	0	>25	Yes	Hatch
LT124	Lexington Pit	SP	>75	None	4.3	NA	NA	NA	NA	NA	39	56	321	<1	0	>25	No	Failed
LT125	Lexington Pit	SP	>75	None	3.9	NA	NA	NA	NA	NA	39	108	385	<1	0	>25	Yes	Hatch
LT126	Lexington Pit	SP	>75	None	7.1	NA	NA	NA	NA	NA	39	159	438	<1	0	>25	No	Hatch
LT127	Lexington Pit	SP	>75	None	9.7	NA	NA	NA	NA	NA	39	154	447	<1	0	>25	No	Failed
LT208	Blue Hole Pit	SP	>75	None	2.4	NA	NA	NA	NA	NA	56	99	479	<1	0	>25	Yes	Hatch
LT209	Blue Hole Pit	SP	>75	None	3.8	NA	NA	NA	NA	NA	56	239	491	<1	0	>25	No	Hatch
LT210	Blue Hole Pit	SP	>75	None	6.3	NA	NA	NA	NA	NA	56	103	552	<1	0	>25	Yes	Hatch
LT211	Blue Hole Pit	SP	>75	None	5.7	NA	NA	NA	NA	NA	56	81	524	<1	0	>25	No	Hatch
LT212	Blue Hole Pit	SP	>75	None	3.2	NA	NA	NA	NA	NA	56	128	605	<1	0	>25	Yes	Hatch
LT213	Blue Hole Pit	SP	>75	None	6.1	NA	NA	NA	NA	NA	56	146	645	<1	0	>25	No	Hatch
LT214	Blue Hole Pit	SP	>75	None	3.4	NA	NA	NA	NA	NA	56	86	491	<1	0	>25	Yes	Hatch
LT215	Blue Hole Pit	SP	>75	None	3.0	NA	NA	NA	NA	NA	56	153	548	<1	0	>25	Yes	Failed
LT216	Blue Hole Pit	SP	>75	None	7.7	NA	NA	NA	NA	NA	56	202	447	<1	0	>25	No	Hatch
LT217	Blue Hole Pit	SP	>75	None	4.9	NA	NA	NA	NA	NA	56	86	470	<1	0	>25	No	Failed
LT218	Blue Hole Pit	SP	>75	None	9.7	NA	NA	NA	NA	NA	56	144	388	<1	0	>25	No	Hatch
LT219	Blue Hole Pit	SP	>75	None	6.6	NA	NA	NA	NA	NA	56	171	632	<1	0	>25	Yes	Hatch

Appendix 27 (Continued)

Nest ID	Site Name	Habitat Type	15 June % Bare-Sand	Nest Management	Elevation above Water (Ft)	Channel / Sandpit-Pond Measures: Channel Width @ 1200cfs (Ft)	Nearest Bank @ 1200cfs (Ft)	Channel Width at Initiation (Ft)	Wetted Width South (Ft)	Wetted Width North (Ft)	Sandpit Pond Size (Ac)	Distance to: Nearest Waterline (Ft)	Nearest Predator Perch (Ft)	1yd² Area Nest Measures: %Vegetative Cover	Max. Vegetation Height (In)	Distance to Vegetation >6" (In)	Nest Furniture	Nest Fate
LT220	Blue Hole Pit	SP	>75	None	7.2	NA	NA	NA	NA	NA	56	78	417	<1	0	>25	No	Hatch
LT221	Blue Hole Pit	SP	>75	None	9.9	NA	NA	NA	NA	NA	56	145	389	<1	0	>25	No	Hatch
LT222	Blue Hole Pit	SP	>75	None	7.5	NA	NA	NA	NA	NA	56	39	549	<1	0	>25	Yes	Failed
LT223	Blue Hole Pit	SP	>75	None	10.8	NA	NA	NA	NA	NA	56	150	713	<1	0	>25	Yes	Failed
LT224	Blue Hole Pit	SP	>75	None	9.5	NA	NA	NA	NA	NA	56	94	594	<1	0	>25	Yes	Failed
LT225	Blue Hole Pit	SP	>75	None	3.3	NA	NA	NA	NA	NA	56	286	537	<1	0	>25	Yes	Failed
LT226	Blue Hole Pit	SP	>75	None	3.7	NA	NA	NA	NA	NA	56	113	359	<1	0	>25	Yes	Failed
LT227	Blue Hole Pit	SP	>75	None	4.4	NA	NA	NA	NA	NA	56	142	388	<1	0	>25	Yes	Failed
LT228	Blue Hole Pit	SP	>75	None	8.6	NA	NA	NA	NA	NA	56	50	458	<1	0	>25	Yes	Failed
LT304	Johnson Pit	SP	>75	None	6.8	NA	NA	NA	NA	NA	32	79	296	<1	0	>25	Yes	Failed
LT305	Johnson Pit	SP	>75	None	3.8	NA	NA	NA	NA	NA	32	72	220	<1	0	>25	Yes	Failed
LT306	Johnson Pit	SP	>75	None	4.3	NA	NA	NA	NA	NA	32	73	233	<1	0	>25	Yes	Failed
LT307	Johnson Pit	SP	>75	None	3.5	NA	NA	NA	NA	NA	32	52	224	<1	0	>25	Yes	Hatch
LT503	Broadfoot – Kearney South	SP	>75	None	6.9	NA	NA	NA	NA	NA	74	51	939	<1	0	>25	No	Hatch
LT504	Broadfoot – Kearney South	SP	>75	None	5.2	NA	NA	NA	NA	NA	74	27	842	<1	0	>25	Yes	Hatch
LT505	Broadfoot – Kearney South	SP	>75	None	3.0	NA	NA	NA	NA	NA	74	51	1117	<1	0	>25	Yes	Failed
WRE-LT01	Wild Rose Ranch – East Pit	SP	>75	None	3.3	NA	NA	NA	NA	NA	13	54	783	<1	0	>25	No	Hatch
WRE-LT02	Wild Rose Ranch – East Pit	SP	>75	None	2.1	NA	NA	NA	NA	NA	13	58	786	<1	0	>25	Yes	Hatch
WRE-LT03	Wild Rose Ranch – East Pit	SP	>75	None	2.3	NA	NA	NA	NA	NA	13	86	744	<1	0	>25	Yes	Hatch
WRE-LT04	Wild Rose Ranch – East Pit	SP	>75	None	3.3	NA	NA	NA	NA	NA	13	76	726	<1	0	>25	Yes	Hatch
WRE-LT05	Wild Rose Ranch – East Pit	SP	>75	None	0.7	NA	NA	NA	NA	NA	13	56	783	<1	0	>25	No	Hatch
WRE-LT06	Wild Rose Ranch – East Pit	SP	>75	None	2.2	NA	NA	NA	NA	NA	13	79	747	<1	0	>25	Yes	Failed
WRE-LT07	Wild Rose Ranch – East Pit	SP	>75	None	2.5	NA	NA	NA	NA	NA	13	48	523	<1	0	>25	No	Hatch
WRE-LT08	Wild Rose Ranch – East Pit	SP	>75	None	0.5	NA	NA	NA	NA	NA	13	46	810	<1	1	>25	Yes	Hatch
WRE-LT09	Wild Rose Ranch – East Pit	SP	>75	None	1.3	NA	NA	NA	NA	NA	13	12	512	<1	0	>25	Yes	Hatch
WRE-LT10	Wild Rose Ranch – East Pit	SP	>75	None	3.0	NA	NA	NA	NA	NA	13	55	673	<1	1	>25	No	Hatch
WRE-LT11	Wild Rose Ranch – East Pit	SP	>75	None	2.4	NA	NA	NA	NA	NA	13	45	781	<1	0	>25	No	Hatch
WRE-LT12	Wild Rose Ranch – East Pit	SP	>75	None	0.3	NA	NA	NA	NA	NA	13	26	728	<1	1	>25	No	Hatch
WRE-LT13	Wild Rose Ranch – East Pit	SP	>75	None	0.6	NA	NA	NA	NA	NA	13	19	531	<1	1	>25	Yes	Hatch
WRE-LT14	Wild Rose Ranch – East Pit	SP	>75	None	4.2	NA	NA	NA	NA	NA	13	94	440	<1	1	>25	Yes	Hatch
WRE-LT15	Wild Rose Ranch – East Pit	SP	>75	None	2.2	NA	NA	NA	NA	NA	13	38	522	<1	1	>25	Yes	Hatch
WRE-LT16	Wild Rose Ranch – East Pit	SP	>75	None	4.4	NA	NA	NA	NA	NA	13	74	489	1-5	1	>25	Yes	Failed
WRE-LT17	Wild Rose Ranch – East Pit	SP	>75	None	1.4	NA	NA	NA	NA	NA	13	28	675	<1	1	>25	Yes	Failed

Appendix 28. Habitat measures collected at confirmed (eggs observed in a scrape) piping plover nests observed during 2010.

Nest ID	Site Name	Habitat Type	15 June % Bare-Sand	Nest Management	Elevation above Water (Ft)	Channel / Sandpit-Pond Measures						Distance to:		1yd² Area Nest Measures				Nest
						Channel Width @ 1200cfs (Ft)	Nearest Bank @ 1200cfs (Ft)	Channel Width at Initiation (Ft)	Wetted Width South (Ft)	Wetted Width North (Ft)	Sandpit Pond Size (Ac)	Nearest Waterline (Ft)	Nearest Predator Perch (Ft)	%Vegetative Cover	Max. Vegetation Height (In)	Distance to Vegetation >6" (In)	Nest Furniture	Fate
PP101	Lexington Pit	SP	>75	None	5.6	NA	NA	NA	NA	NA	39	117	436	<1	0	>25	Yes	Hatch
PP102	Lexington Pit	SP	>75	None	8.4	NA	NA	NA	NA	NA	39	123	339	<1	0	>25	Yes	Hatch
PP103	Lexington Pit	SP	>75	None	4.2	NA	NA	NA	NA	NA	39	124	499	<1	0	>25	Yes	Fail
PP111	Lexington Pit	SP	>75	None	6.8	NA	NA	NA	NA	NA	39	207	572	<1	0	>25	Yes	Fail
PP112	Lexington Pit	SP	>75	None	6.2	NA	NA	NA	NA	NA	39	99	291	<1	0	>25	Yes	Hatch
PP119	Lexington Pit	SP	>75	None	7.9	NA	NA	NA	NA	NA	39	149	506	<1	0	>25	No	Fail
PP401	Dyer Pit	SP	50-75	None	6.3	NA	NA	NA	NA	NA	56	120	1342	<1	0	>25	No	Hatch
PP201	Blue Hole	SP	>75	None	11.5	NA	NA	NA	NA	NA	56	159	530	<1	0	>25	Yes	Fail
PP202	Blue Hole	SP	>75	None	12.5	NA	NA	NA	NA	NA	56	115	428	<1	0	>25	Yes	Hatch
PP203	Blue Hole	SP	>75	None	2.8	NA	NA	NA	NA	NA	56	44	579	<1	0	>25	Yes	Hatch
PP204	Blue Hole	SP	>75	None	12.4	NA	NA	NA	NA	NA	56	139	393	<1	0	>25	Yes	Hatch
PP205	Blue Hole	SP	>75	None	4.2	NA	NA	NA	NA	NA	56	229	476	<1	0	>25	No	Hatch
PP206	Blue Hole	SP	>75	None	3.6	NA	NA	NA	NA	NA	56	213	428	<1	0	>25	No	Hatch
PP207	Blue Hole	SP	>75	None	7.1	NA	NA	NA	NA	NA	56	211	579	<1	0	>25	No	Hatch
PP301	Johnson Pit	SP	>75	None	5.3	NA	NA	NA	NA	NA	32	54	370	<1	0	>25	Yes	Fail
PP302	Johnson Pit	SP	>75	None	6.2	NA	NA	NA	NA	NA	32	130	286	<1	0	>25	No	Hatch
PP303	Johnson Pit	SP	>75	None	4.8	NA	NA	NA	NA	NA	32	40	361	<1	0	>25	No	Hatch
PP501	Broadfoot – Kearney South	SP	>75	None	3.0	NA	NA	NA	NA	NA	74	72	669	<1	0	>25	No	Hatch
PP502	Broadfoot – Kearney South	SP	>75	None	6.3	NA	NA	NA	NA	NA	74	33	828	<1	0	>25	No	Hatch
WRE-PP01	Wild Rose Ranch – East Pit	SP	>75	None	0.3	NA	NA	NA	NA	NA	13	38	813	1-5	1	>25	Yes	Hatch
WRE-PP02	Wild Rose Ranch – East Pit	SP	>75	None	2.0	NA	NA	NA	NA	NA	13	35	435	<1	1	>25	Yes	Hatch
WRE-PP03	Wild Rose Ranch – East Pit	SP	>75	None	0.8	NA	NA	NA	NA	NA	13	16	699	<1	0	>25	Yes	Hatch
Y-PP01	Younkin Tract	RI	>75	None	1.5	776	44	1065	216	780	NA	15	870	<1	4	>25	Yes	Hatch
PP602	Dinan Tract	RI	>75	None	1.7	888	363	1013	435	462	NA	31	528	<1	0	>25	No	Fail
D-PP02	Dinan Tract	RI	>75	None	2.3	835	70	839	168	663	NA	2	837	<1	0	>25	No	Fail
PP601	Dippel Tract	RI	>75	None	1.4	1253	86	1348	1053	65	NA	72	1032	<1	0	>25	Yes	Fail
PP603	Dippel Tract	RI	50-75	None	1.3	1503	352	1522	948	344	NA	50	357	<1	0	>25	Yes	Hatch
PP604	Dippel Tract	RI	50-75	None	2.8	1452	97	1529	1237	108	NA	51	1322	<1	0	>25	No	Fail
PP605	Dippel Tract	RI	50-75	None	2.0	1253	86	1387	1050	105	NA	30	990	<1	1	>25	Yes	Fail
PP606	Dippel Tract	RI	50-75	None	2.8	1425	63	1473	1102	167	NA	48	1132	<1	4	>25	Yes	Hatch
AF-PP01	Alda Farms	RI	50-75	None	3.9	1346	160	1479	456	687	NA	75	456	<1	0	>25	Yes	Fail
MI-PP01	Mormon Island	RI	>75	None	0.7	693	134	845	471	232	NA	54	579	1-5	3	>25	No	Fail