Platte River Recovery Implementation Program

2011

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

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Platte River Recovery Implementation Program

2011 Interior Least Tern and Piping Plover Monitoring and Research Report for the Central Platte River, Nebraska

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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, 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 2011. 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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2011 STATE OF THE PLATTE 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.



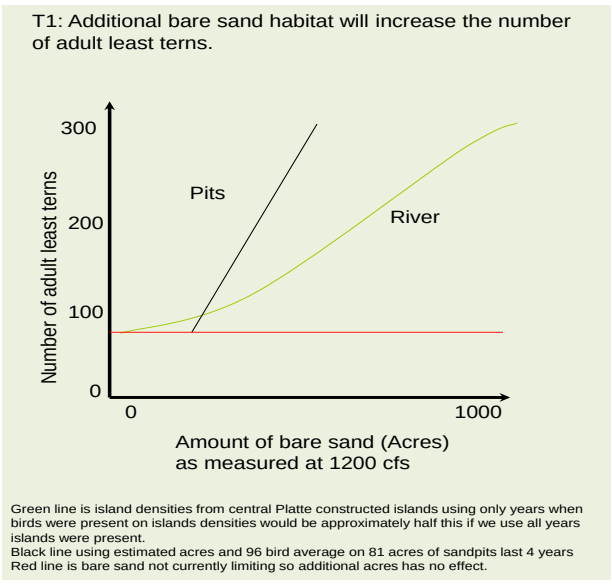
Monitoring Protocol: PRRIP Tern and Plover Monitoring Protocol
Monitoring Entity: EDO lead; USGS, CPNRD, NPPD, FWS personnel
Dates of Field Activity: May 2011 through August 2011
Numbers of Years of Implementation: Five (2007-2011)
Analysis Entity: ED Office

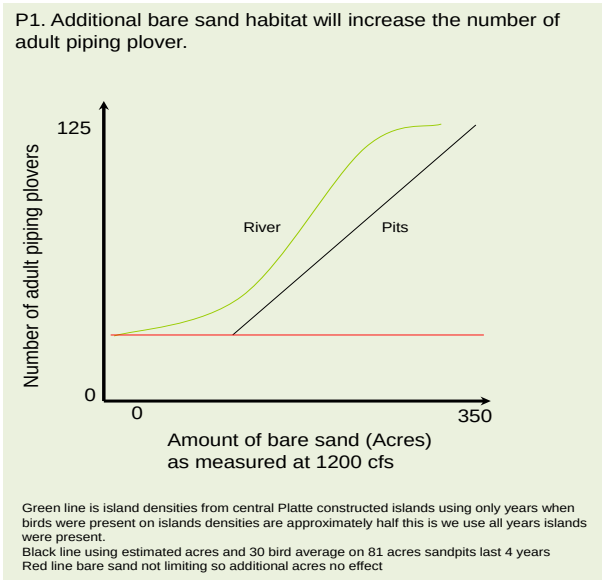
Relevant Big Question(s)

#1 – Do terns and plovers use Program habitat complexes and/or habitat meeting Program minimum criteria in proportions greater than their availability?

#3 – What is the relationship between availability of riverine nesting habitat meeting Program minimum criteria and tern and plover use and productivity?

Relevant Tier 1 Hypotheses from AMP





ES Figure 1. Hypothesized responses of terns and plovers to in- and off-channel habitat availability within the Program Associated Habitat Area.

2011 Summary of Activities

- Seven of twelve sandpit sites monitored for tern and plover productivity were actively managed during 2011. The Program created a 40-acre off-channel nesting area (50/50 sand/water ratio) at Cottonwood Ranch, increased the suitable nesting area at Newark sandpit by ~10 acres, and removed vegetation from ~30 acres of nesting habitat at Broadfoot South and Dyer sandpits prior to the 2011 nesting season. A pre-emergent herbicide was applied to the nesting areas at Lexington, Dyer, Blue Hole, Johnson, Cottonwood Ranch, Broadfoot South, and Newark sandpits and the nesting areas were protected from predators with electrified fencing and trapping.
- Tern and plover monitoring and research conducted during 2011 was a collaborative effort between personnel of Headwaters Corporation, Nebraska Public Power District, United States Fish and Wildlife Service-Grand Island Field Office, Central Platte Natural Resources District, and USGS-Northern Prairie Wildlife Research Center. We conducted surveys of the Program Associated Habitat area (Platte River and sandpits within 3.5 miles of the Platte River between Lexington and Chapman, NE) to document tern and plover habitat use and productivity on or about the first and fifteenth of May, June, and July and the first of August. Sandpit sites with active nests or broods were surveyed from within (grid searches) and outside the nesting colony twice per week. We documented numbers of tern and plover adults, nests, chicks, and fledglings observed as well as habitat characteristics believed to influence tern and plover use and productivity during each survey. In addition, we banded tern and plover adults and chicks to allow us to quantify dispersal, colonization, and renesting events.

2011 Results

Terns and Plovers

- All least tern and piping plover nesting occurred on sandpit sites during 2011 (ES Table 1).
- Least tern use of the river for foraging remained fairly high during early June and August when many adults were initiating nests and tending to fledglings, respectively, despite the season-long natural high flow event that inundated or laterally eroded nearly all riverine nesting habitat.
- We observed a season high 57 least tern pair within the Program Associated Habitats during the 15-July survey when there were 19 active nests and 16 active broods at sandpit sites (ES Table 1).
- We observed 90 interior least tern nests, 125 chicks, and 96 fledglings which equates to a fledge ratio of 1.07 fledglings/nest or 1.68 fledglings/pair during 2011 (ES Figure 2).
- River use by piping plovers declined sharply after May 15 which likely was the result of the near-complete loss of sandbar foraging and nesting habitat within the Program Associated Habitat Area.
- We documented 25 pair of piping plovers during the 1-July survey when there were 5 active nest and 8 broods present; however, we observed 22 active nests and broods during the 1-June survey when we only observed 22 pair with the Program Associated Habitats (ES Table 1).
- We observed 34 piping plover nests, 88 chicks, and 46 fledglings and an overall fledge ratio of 1.35 fledglings/nest or 1.84 fledglings/pair during 2011 (ES Figure 2).

ES Table 1. Numbers of interior least tern and piping plover adults, nests, chicks, broods, and fledglings observed within Program Associated Habitats during semi-monthly river and sandpit surveys, 2011.

Survey	Interior least tern					Piping plover				
	Adults	Nests	Chicks	Broods	Fledglings	Adults	Nests	Chicks	Broods	Fledglings
1 May	0	0	0	0	0	35	5	0	0	0
15 May	18	0	0	0	0	45	15	0	0	0
1 Jun	93	4	0	0	0	45	21	3	1	0
15 Jun	101	32	0	0	0	48	8	26	12	0
1 Jul	99	30	11	5	0	51	5	21	8	18
15 Jul	114	19	32	16	12	26	4	13	5	17
1-Aug	94	3	26	13	53	5	0	5	2	11

Habitat

- The natural high-flow event during 2011 inundated or laterally eroded away most in-channel bare sand habitat.
- Two consecutive season-long natural high flow events resulted in a net loss of in-channel nesting habitat meeting the Program's minimum habitat criteria. During mid-June, there was approximately 6 acres of sandbar habitat exposed that met the Program's minimum habitat criteria.
- Program management actions between the 2010 and 2011 nesting seasons increased or improved approximately 50 acres of off-channel nesting habitat.

Aerial images of constructed and managed tern and plover nesting sites available for nesting 15 June, 2011.

Performance Measures and Benchmarks

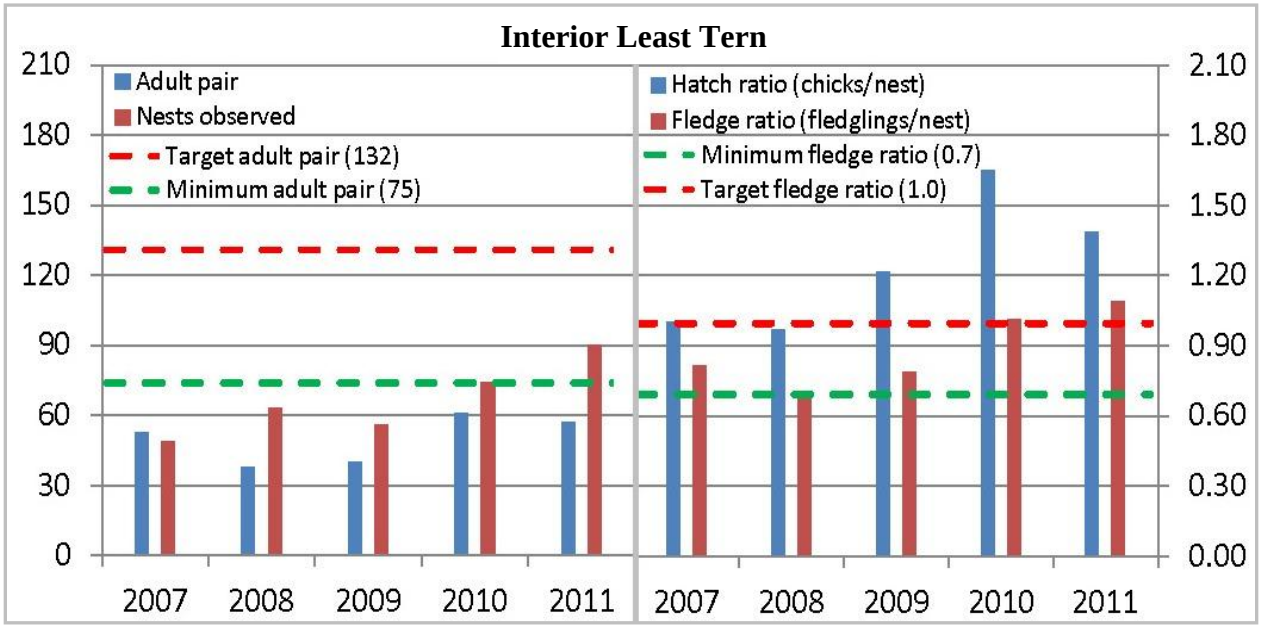
ES Table 2. Program defined least tern and piping plover habitat and productivity Performance Measures and Preliminary Minimum and Target Benchmarks. Preliminary Minimum and Target Benchmarks are based on various Program documents and will be finalized during 2012.

Performance Measure	Benchmarks		2011
	Minimum	Target	
Acres of in-channel bare sand	150	640	154
Acres of sandbars meeting MHC	90	384	4.7
Acres of off-channel habitat meeting MHC	80	200	181
Tern nesting pairs	75	126	61
Tern nesting pairs/acre of in- & off-channel habitat meeting MHC	0.67/acre	1.00/acre	0.15
Increase in proportion of terns observed on the river during mid-month surveys (i.e. 10%-25% increase over 2001-2006 average)	10%	25%	24%
Tern fledge ratio (fledglings/nest : fledglings/pair)	0.70	1.00	1.07 : 1.68
Plover nesting pairs	32	64	25
Plover nesting pairs/acre of in- & off-channel habitat meeting MHC	0.17/acre	0.20/acre	0.06
Increase in proportion of plovers observed on the river during mid-month surveys (i.e. 10%-25% increase over 2001-2006 average)	10%	25%	–48%
Plover fledge ratio (fledglings/nest : fledglings/pair)	1.17	1.75	1.35 : 1.84

Comparative Results and Trends

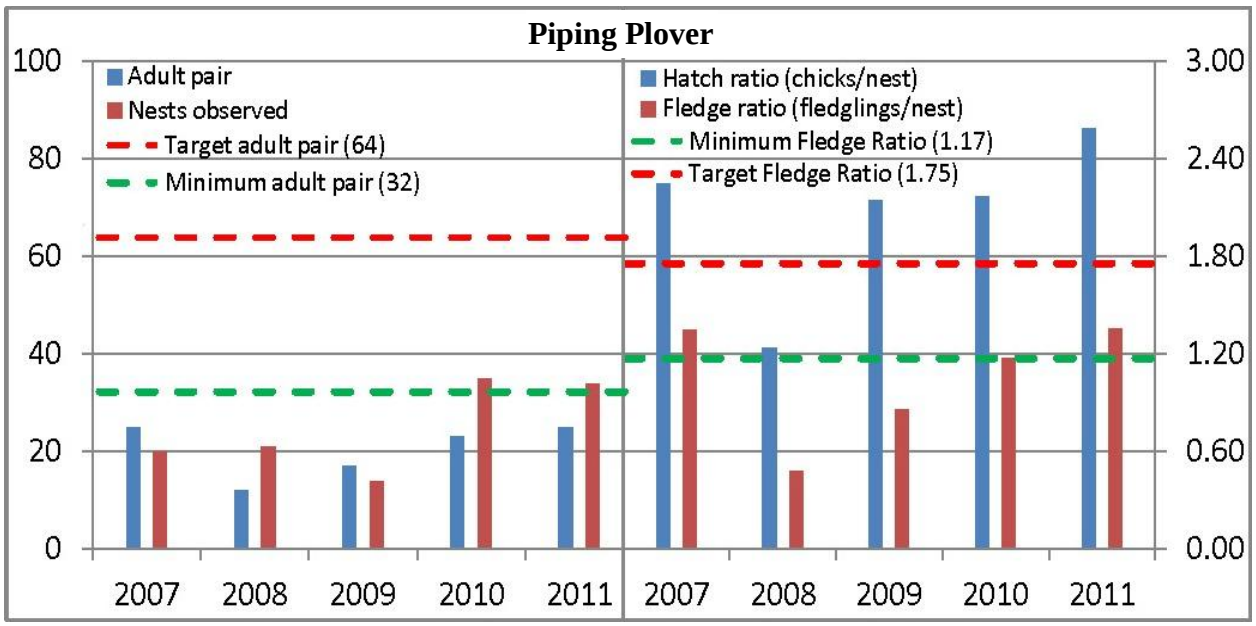
Terns and Plovers

- The number of adult least tern pair observed during system-wide surveys of Program Associated Habitats (ES Figure 2) has not met the Program's Target or Minimum Performance Benchmarks (ES Table 2); however, recent counts have increased despite unfavorable riverine nesting conditions (ES Figure 2).
- The number of least tern nests observed within the Program Associated Habitats has increased steadily since 2007(ES Figure 2). We observed 84% more least tern nests during 2011 than 2007.
- Least tern fledge ratios (ES Figure 2) have met or exceeded the Program's Preliminary Minimum Performance Benchmark of 0.70 fledglings/nest (ES Table 2) since 2007 and have met or exceeded the Program's Preliminary Performance Benchmark Target of 1.00 fledglings/nest the past 2 years.



ES Figure 2. Numbers of interior least tern pair and nests (left) and the hatch and fledge ratios (right) observed within Program Associated Habitats, 2007 – 2011. Dashed lines represent Program-defined preliminary minimum and target Performance Benchmarks. Final Performance Benchmarks will be established during 2012.

- The number of adult piping plover pair observed during system-wide surveys of Program Associated Habitats (ES Figure 3) has not met the Program's Preliminary Target Performance Benchmark (ES Table 2); however, recent counts have exceeded the Program's Preliminary Minimum Performance Benchmark despite unfavorable nesting conditions on the river (ES Figure 3).
- The number of piping plover nests observed within the Program Associated Habitats has increased steadily since 2007 (ES Figure 3). We observed 70% more piping plover nests during 2011 than 2007.
- Piping plover fledge ratios (ES Figure 3) have met or exceeded the Program's Preliminary Minimum Performance Benchmark of 1.17 fledglings/nest the past 2 years (ES Table 2); however, fledge ratios have not met the Program's Preliminary Performance Benchmark Target of 1.75 fledglings/nest since the Program was initiated.

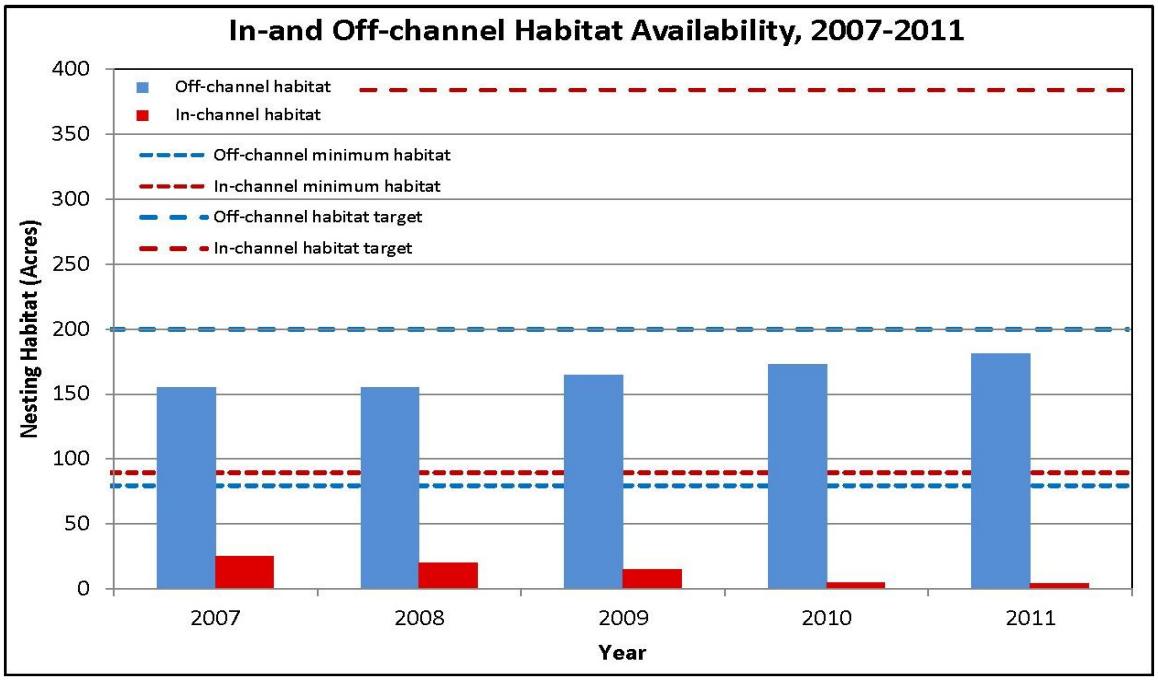


ES Figure 3. Numbers of piping plover pair and nests (left) and the hatch and fledge ratios (right) observed within Program Associated Habitats, 2007 – 2011. Dashed lines represent preliminary Minimum and Target Performance Benchmarks for plover pairs and fledge ratios. Final Performance Benchmarks will be established during 2012.

Habitat

- The amount of in-channel habitat meeting Program minimum habitat criteria has never met the Program's preliminary Minimum or Target Performance Benchmarks (ES Table 2). Season-long high-flow events the past 2 years have resulted in the loss of suitable nesting habitat for terns and plovers (ES Figure 4). Final Performance Benchmarks will be established during 2012.
- Management actions taken by the Program and its partners have resulted in a net increase in the availability of off-channel habitat within the Associated Habitat Area (ES Figure 4). The amount of off-channel habitat meeting Program minimum habitat criteria has exceeded the Program's preliminary Minimum Performance Benchmark since 2007, but to date has not met the preliminary Target Benchmark (ES Table 2).

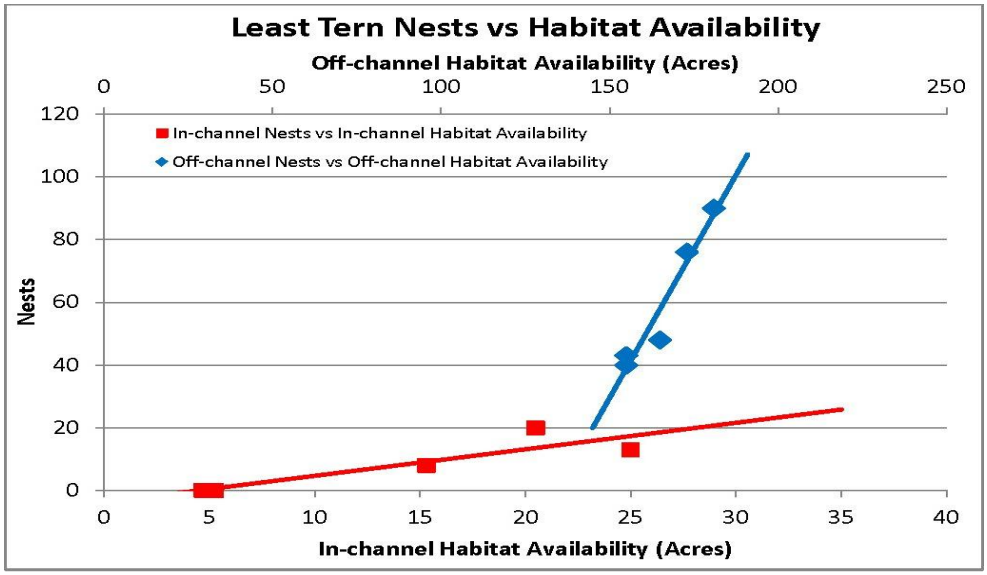
Managed in-channel nesting habitat that was eroded away by season-long high flow events during 2010 and 2011.



ES Figure 4. In- and off-channel habitat availability, 2007-2011. Dashed lines represent preliminary minimum and target performance benchmarks for in-and off-channel habitat availability. In- and off-channel habitat acreages are estimates based on initial habitat availability assessment results and will be updated and Final Performance Benchmarks for the Program will be established during 2012.

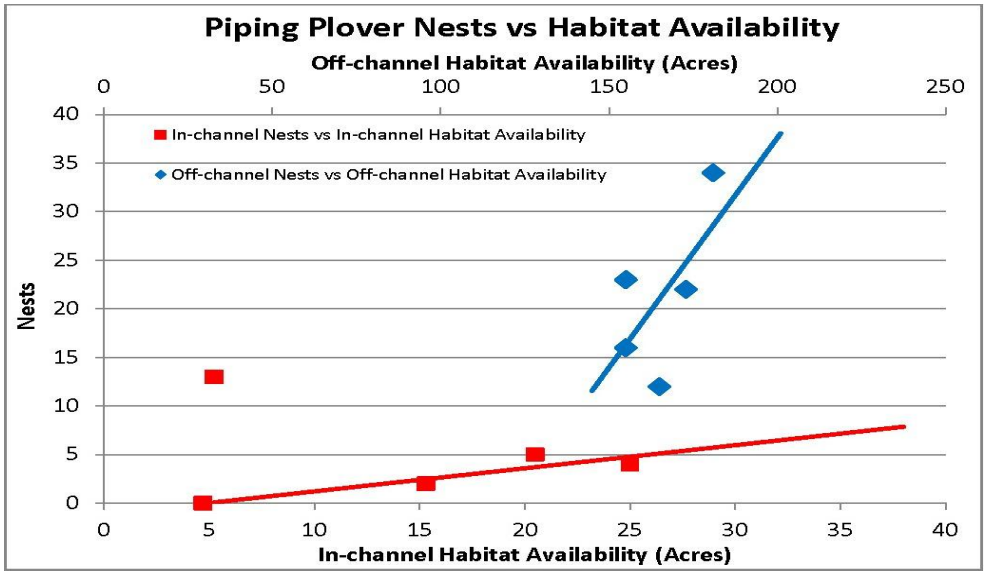
Tier 1 Hypotheses and Big Questions

- We observed a positive relationship between in- and off-channel habitat availability and numbers of least tern nests observed on each habitat type (ES Figure 5). In-channel habitat availability, however, has declined since 2007 and we observed no tern nests on river islands during 2010 or 2011.



ES Figure 5. Relationship between availability of in- and off-channel habitat meeting Program minimum habitat criteria and number of least tern nests observed on each habitat type, 2007-2011. Habitat acreages are preliminary estimates based on initial habitat availability assessment results and will be updated in 2012.

- We observed a negative relationship between in-channel habitat availability and numbers of piping plover nests, 2007-2011; however, the relationship was skewed by the loss of habitat following nest initiation during 2010. Removing 2010 data from the analysis resulted in a positive relationship as described by Program hypothesis P1 (ES Figure 6).
- In-channel habitat availability has declined since 2007 and we observed no piping plover nests on river islands during 2011.



ES Figure 6. Relationship between availability of in- and off-channel habitat meeting Program minimum habitat criteria and number of piping plover nests observed on each habitat type, 2007-2011. Habitat acreages are preliminary estimates based on initial habitat availability assessment results and will be updated in 2012. The in-channel trend excludes 2010 data when habitat availability was high during May, but decreased rapidly when a natural high flow event inundated or eroded away most suitable in-channel nesting habitat.

Conclusions

- What are general takeaway messages from 2011?
    - 2011 productivity remained high despite the season-long high-flow event that inundated most riverine habitat.
    - Habitat enhancement work at off-channel sites the past 2 years resulted in a better distribution of terns and plovers throughout the Program Associated Habitat Area.
- Any implications to management actions based on 2011 data?
    - Going into the 2012 nesting season, the Program plans to create sandbar habitat to test the hypothesized relationships presented in Hypotheses T1, P1, and TP1. There were ≤6 acres of in-channel habitat meeting the Program's minimum habitat criteria available for nesting the past 2 years due to the prolonged natural high-flow events.
    - Management actions taken at off-channel sites the past few years have resulted in a net increase in habitat availability and may have helped distribute nesting across a wider stretch of river.
- What do 2011 and 2007-2011 data say about Big Questions and Tier 1 hypotheses?
    - There appears to be a positive relationship between in- and off-channel habitat availability and tern and plover use; however, to test hypotheses T1 and P1 the Program needs to increase habitat availability to better establish these relationships.

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 interior least tern and piping plover monitoring protocol was revised to: 1) increase the window for conducting 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 use and productivity on midstream-river sandbars and sand and gravel mines along the central Platte River between Lexington and Chapman, Nebraska. The Program concluded a 2-year Foraging Habits study under a contract with United States Geologic Survey Northern Prairie Wildlife Research Center (USGS-NPWRC) in 2010 and in 2011 the study plan was amended and included 3 objectives: 1) quantify dispersal of adults between units of nesting habitat on the Central Platte River among years; 2) quantify colonization rate of newly constructed or managed nesting habitat by local versus immigrant adults; and 3) quantify frequency and location of renesting attempts by adults with failed nests. As such, banding and resighting least tern and piping plover adults and chicks continued for a third consecutive year on the central Platte River (2009-2011). Monitoring and research during 2011 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 (2008-2010). Interior least tern and piping plover activity and reproductive success during 2011 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.

2011 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 region has been dependent upon construction or management efforts.

April to late-May daily flows were 2,000–3,000cfs higher during 2011 than average flows from the previous 10-years; however, snow melt from the mountains of Wyoming and Colorado and local rainfall resulted in a pulse-flow magnitude, natural high flow event on the Platte River throughout the habitat reach late-May through early July (Figure 2). Mean daily flows exceeding 7,000cfs, topping out at 10,300cfs (USGS gage at Grand Island), occurred 25 May and didn't subside until 8 July. Much of the mechanically created and managed riverine nesting habitat remaining from the 2010 nesting season was inundated and/or eroded away by the prolonged high flow event which, for the second consecutive year, limited nesting opportunities on the river. The season-long high flow event may also have negatively influenced least tern and piping plover use of the river for foraging as we observed fewer least tern and piping plover adults while conducting river surveys during 2011 than we did during 2010.

Sandbar in the central Platte River prior to the high-flow event that inundated this and other potentially suitable in-channel habitat for tern and plover nesting. Image captured 16 May, 2011 near Bluehole Sandpit.

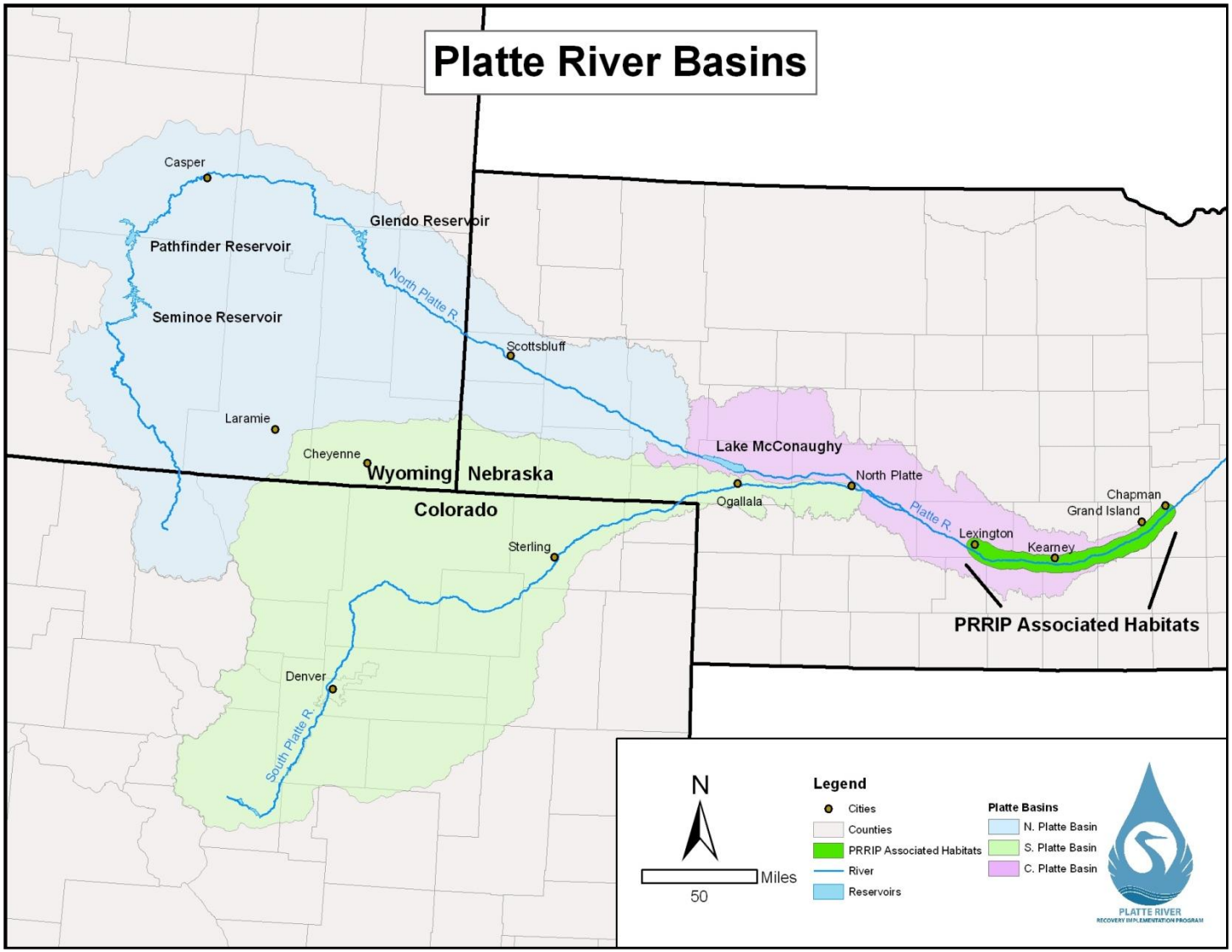


Figure 1. Platte River Basins extending from Colorado and Wyoming through Nebraska. The study area for our interior least tern and piping plover monitoring and research efforts was the PRRIP associated habitats region of the Platte River located between Lexington and Chapman, Nebraska.

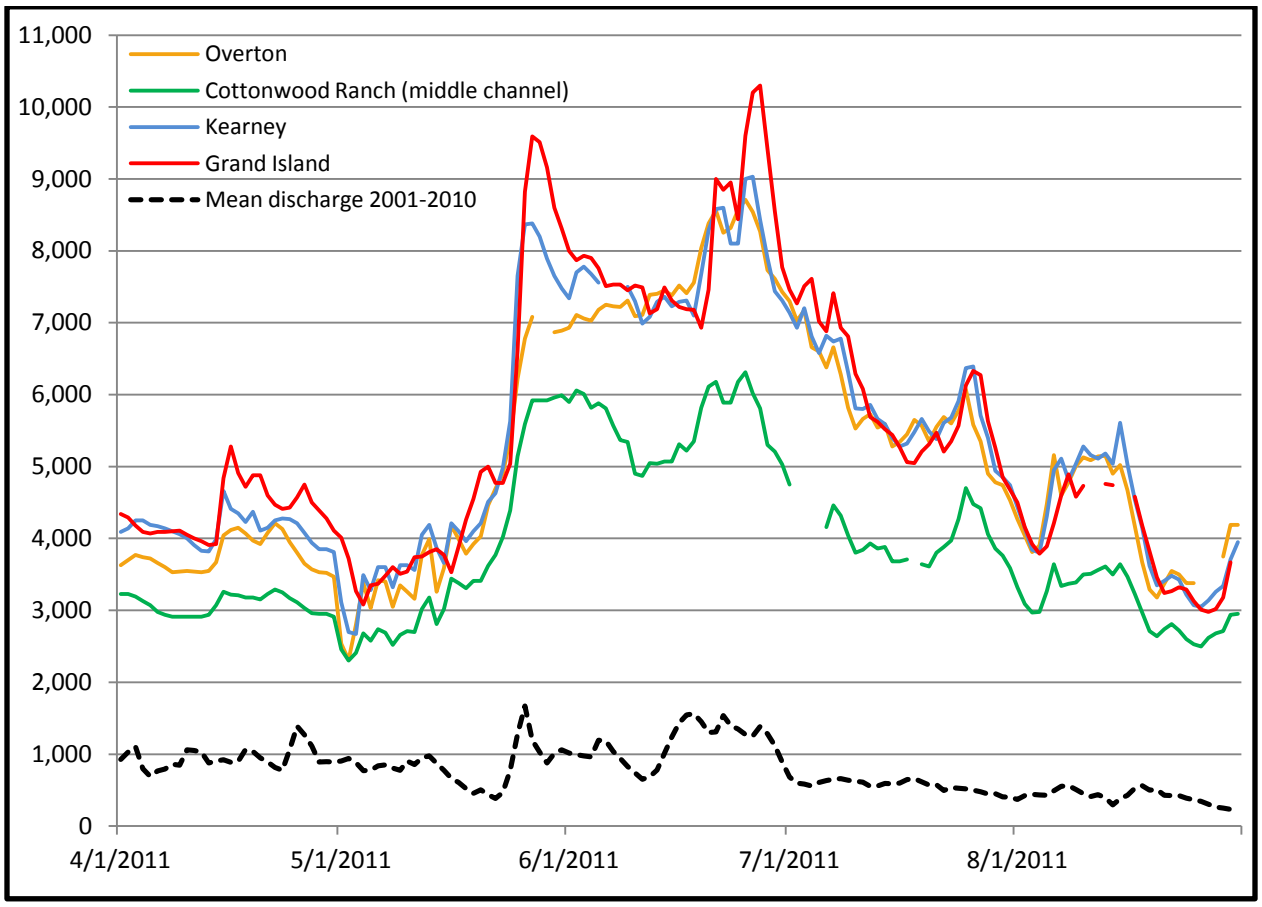


Figure 2. Mean daily discharge (ft^3/second; cfs) at Overton (USGS gage 06768000), Cottonwood Ranch near Overton (USGS gage 06768035), Kearney (USGS gage 06770200), and Grand Island, Nebraska (USGS gage 06770500), 1 April – 31 August, 2011 and mean daily discharge at Kearney (USGS gage 06770200) 1 April – 31 August, 2001–2011. See Figure 4 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.

Exposed sandbar in the central Platte River after peak high-flows began to subside. Image captured 16 July, 2011 near Bluehole Sandpit.

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 2010 and spring 2011. Management activities were site specific and included: mechanical actions to improve nesting conditions and remove vegetative cover (disking, paddle-scraper, packing, 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 off-channel sites monitored during 2011 were actively managed (see specific management activities below) to increase interior least tern and piping plover reproduction. Four of these 7 sandpits were not mined for sand and gravel during 2011 and the other three (Blue Hole, Broadfoot South, and Newark sandpits) were mined; however, nesting occurred in areas away from sand and gravel mining activities. Two of the five sandpit sites not managed for interior least terns and piping plover reproduction during 2011were actively mined.

Lexington Sandpit – A contact herbicide was applied to kill existing vegetation primarily along the waterline fall 2010. A pre-emergent herbicide was applied, the woven-wire predator fence with offset electric wires along the west side of the nesting areas was maintained, and predator trapping occurred during 2011. No sand and gravel mining occurred during 2011.

Dyer Sandpit – Vegetation was mechanically removed with a paddle-scraper (pictured below), the nesting area was packed with roller-packers, and nest furniture (i.e., small twigs and branches) was placed during fall 2010. A pre-emergent herbicide was applied, a permanent 4-foot tall woven wire predator fence with offset electric wires was installed across the south end of each peninsula, 4 least tern decoys were placed on the east peninsula, and predator trapping occurred during 2011. No sand and gravel mining occurred during 2011.

Cottonwood Ranch* OCSW *(Off-channel Sand and Water) – A 40-acre off-channel nesting area (20 acres of water and 20 acres of bare sand) was constructed with hydraulic scrapers and box scrapers and nest furniture (i.e., small twigs and branches) was placed during fall/winter 2010. A pre-emergent herbicide was applied, a temporary 4-foot tall electrified predator fence was installed across the land bridge, and 4 least tern decoys were placed on the east end of the peninsula during 2011. No sand and gravel mining occurred.

Blue Hole Sandpit – A contact herbicide was applied to kill existing vegetation primarily along the waterline fall 2010. 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 2011. Sand and gravel mining occurred northeast of the primary nesting peninsula during 2011.

Johnson Sandpit – A contact herbicide was applied to kill existing vegetation primarily along the waterline fall 2010. 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 2011. No sand and gravel mining occurred during 2011.

Broadfoot South Sandpit – A contact herbicide was applied and vegetation was mechanically removed with a paddle-scraper and nest furniture (i.e., small twigs and branches) was placed during fall 2010. A land-bridge was built to allow access to one of the 2 islands and a better view of the other island located northwest of the primary peninsula. A pre-emergent herbicide was applied to the nesting area, a temporary 4-foot tall electrified predator fence was installed across the east end of the peninsula, and #110 conibear traps were used late in the season in an effort to capture mink during 2011. Sand and gravel mining occurred northwest of the primary peninsula during 2011.

Newark Sandpit – The nesting area was expanded by 10 acres by adding an additional peninsula with backhoes, skid-steer loaders, and paddle scrapers (pictured left) and clearing vegetation from the south portion of the existing nesting area during fall/winter 2010. The nesting areas had a pre-emergent herbicide applied, a temporary 4-foot tall electrified predator fence was installed across the land bridges to the peninsulas, and predator trapping occurred during 2011. No sand and gravel mining occurred at the west sandpit; however, the east sandpit was actively mined and an island was periodically monitored during 2011 though it did not meet Program minimum habitat design criteria.

Wild Rose Ranch East Sandpit – Island disking occurred during fall 2010, but no pre-emergent herbicide was applied spring 2011. No sand and gravel mining occurred during 2011.

Deweese-Alda and Lilley-Wood River Sandpits – Sand and gravel mining occurred, but no management activities were applied during 2011.

Hooker Brothers South and West – No management or sand and gravel mining during 2011.

RIVERINE SITES:

The Program and Program partners implemented many habitat construction and enhancement projects prior to the 2011 nesting season in an effort to increase in-channel nesting habitat and improve reproductive success of interior least terns and piping plovers within Program associated habitats. Prolonged high flow events the past 2 years, however, resulted in inundation and erosion of nearly all managed in-channel nesting sites and the establishment of herbaceous and woody vegetation on remaining portions of most of these islands. In-channel management activities between the 2010 and 2011 nesting seasons were hindered by high flows so no in-channel habitat was constructed or managed. Three sites with past constructed and managed riverine habitat, however, remained exposed and available during 2011 and aerial images are shown below.

Aerial images of Lexington, Elm Creek, and Cottonwood Ranch Islands that were constructed and managed for interior least tern and piping plover nesting and exposed and available during 2011. Images captured 15 June, 2011.

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, contracted personnel, and cooperators have since implemented it. The protocol was revised prior to 2010.

SEMI-MONTHLY RIVER AND SANDPIT SURVEYS:

METHODS

We conducted 7 semi-monthly surveys (1 and 15 May, June, and July and 1 August) of 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 2011. We included summaries of the total number of adults, nests, chicks, and fledglings observed during river surveys, sandpit surveys, and a combination of river and sandpit surveys (semi-monthly survey totals) to provide 7 snap-shots of the numbers observed during the 2011 nesting season. We also provided a summary of adults, nests, chicks, and fledglings observed at Program defined suitable sandpit and river-island nesting habitat (sandpit-island surveys) during semi-monthly surveys to provide an estimate of the number of birds observed at. Additional sandpits sites were observed prior to or during the 1 May survey period, 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 during semi-monthly surveys represent minimums present.

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 the Overton Bridge (Lexington Island) on 12 May, 2 June, 21 July, and an additional survey was conducted on 26 May; Lexington Island was reported to be inundated much of the nesting season. ED Office staff, technicians, and USGS personnel conducted semi-monthly river surveys between the J2 Return and the Alda Bridge on 2–3 May; 16 and 18–20 May; 31 May; 13 June; 29 June; 15–16 July; and 2 August. Personnel from the USFWS-GI or ED Office staff and technicians conducted river surveys between the Alda and Chapman Bridges on 3 May; 16 May; 31 May; 13–14 June; 29 June; 14 July; and 2 August. Due to high flows, canoes were used to conduct river surveys between the Dyer property and the Chapman Bridge and an airboat was used to survey between the J2 Return and the Dyer property during both May river surveys and the mid-July river survey.

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 2–4 and 6 May; 16–17 and 20 May; 31 May – 3 June and 6 and 9 June; 13–15 and 17 June; 27–28 June and 1 July; 12–15 and 19 July; and 29 July–3 August during 2011. ED Office staff and technicians and personnel from USGS, CPNRD, 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 2011 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 – We summed the number of interior least tern and piping plover adults, nests, chicks, and fledglings 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, 2011 to get an estimate of the minimum numbers present at Program or Program-partner enhanced nesting habitat meeting Program minimum habitat criteria during the nesting season.

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 5 days during the mid-May survey and 1–2 days for all other surveys during 2011. We typically observed fewer interior least tern and piping plover adults on the river during 2011 than 2010 (Table 1; Figure 3). Similar to 2010, 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 tern (45) and piping plover adults (10) during the early-June and early-May surveys, respectively (Table 1). We didn't observe any interior least tern or piping plover nests on river islands during 2011. 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.

Table 1. Number of interior least tern and piping plover adults, nests, chicks, and fledglings observed during semi-monthly airboat or canoe surveys of the Platte River between Lexington and Chapman, Nebraska, 2011.

	Interior least tern				Piping plover			
Survey	Adults	Nests	Chicks	Fledglings	Adults	Nests	Chicks	Fledglings
1 May-11	0	0	0	0	10	0	0	0
15 May-11	14	0	0	0	8	0	0	0
1 Jun-11	45	0	0	0	1	0	0	0
15 Jun-11	27	0	0	0	1	0	0	0
1 Jul-11	15	0	0	0	6	0	0	2
15 Jul-11	33	0	0	1	4	0	0	4
1-Aug-11	44	0	0	37	2	0	0	7

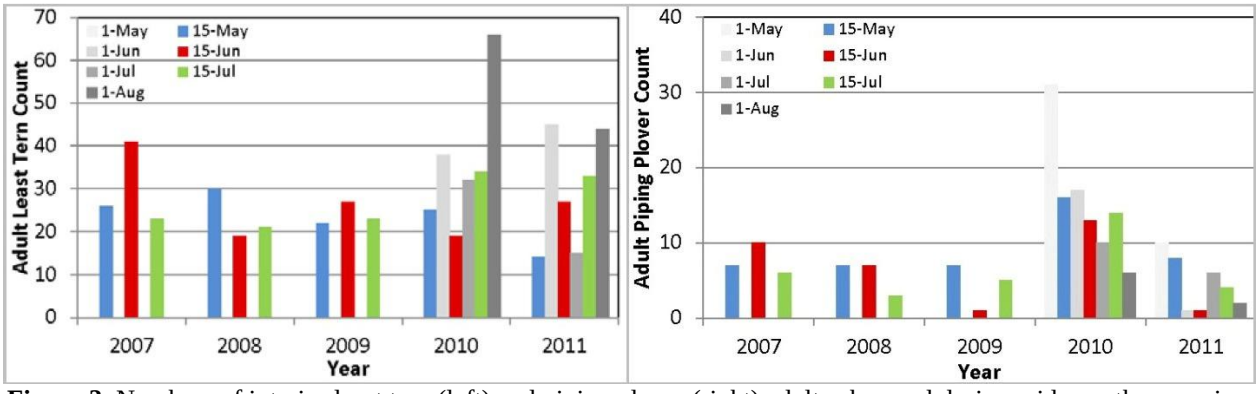


Figure 3. Numbers of interior least tern (left) and piping plover (right) adults observed during mid-month or semi-monthly airboat or canoe surveys of the Platte River between Lexington and Chapman, Nebraska, 2007-2011.

Semi-monthly Sandpit Surveys – Each of the 7 semi-monthly sandpit surveys required 3–6 days to complete and generally spanned 5–6 days with a maximum span of 10 days during 2011. Other than the 3 interior least tern nests at the Deweese-Alda sandpit, all interior least tern and piping plover adults, nests, and chicks observed during 2011 were on sandpit sites where management activities occurred prior to the 2011 nesting season. We observed the most adult interior least terns (86) and active interior least tern nests (32) during the early-July and mid-June sandpit surveys, respectively (Table 2). We observed the most active interior least tern nests and broods (35) during the early-July and mid-July surveys of sandpit sites when there were 30 nests and 5 broods of chicks and 19 nests, 16 broods of chicks, and 12 fledglings observed, respectively. We observed the most piping plover adults (47) during the mid-June sandpit survey and observed the most active piping plover nests and broods at sandpit sites during the early-June sandpit surveys when there were 21 active nests and 1 brood of 3 chicks (Table 2). Observations of adults, nests, chicks, and fledglings at Broadfoot South sandpit during 2011 likely more accurately reflect actual numbers present than past counts (2001–2010) due to increased access which allowed us a better view of all nesting habitat on the site.

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, 2011.

	Interior least tern					Piping plover			
Survey	Sites	Adults	Nests	Chicks	Fledglings	Adults	Nests	Chicks	Fledglings
1 May-11	12	0	0	0	0	25	5	0	0
15 May-11	12	4	0	0	0	37	15	0	0
1 Jun-11	12	45	4	0	0	44	21	1	0
15 Jun-11	12	74	32	0	0	47	8	12	0
1 Jul-11	12	86	30	11	0	45	5	8	16
15 Jul-11	12	83	19	32	12	22	4	5	13
1-Aug-11	12	51	3	26	16	3	0	2	4

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 2011 nesting season. These surveys required 3–6 days (usually 4) to complete and spanned a maximum of 10 days (typically 5–6). The most active interior least tern nests (32) were observed during the mid-June survey when we observed 101 adults; however, we observed the most adults (116) during the mid July survey when there were 19 active nests, 16 broods, and 13 fledglings present (Table 3). We also observed 35 active interior least tern broods and nests (combined) during the early-July survey when there were no fledglings observed. The most interior least tern broods (16) and fledglings (53) were observed during the Mid-July and early-August surveys, respectively (Table 3). We observed the most piping plover adults (51) and active nests (21) during the early-July and early-June surveys, respectively. The most active piping plover nests and broods combined (22) were observed during the early-June survey and the most piping plover fledglings observed during a single survey period, early-July, was 18 (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, 2011.

Survey	Interior least tern					Piping plover				
	Adults	Nests	Chicks	Broods	Fledglings	Adults	Nests	Chicks	Broods	Fledglings
1 May-11	0	0	0	0	0	35	5	0	0	0
15 May-11	18	0	0	0	0	45	15	0	0	0
1 Jun-11	90	4	0	0	0	45	21	3	1	0
15 Jun-11	101	32	0	0	0	48	8	26	12	0
1 Jul-11	101	30	11	5	0	51	5	21	8	18
15 Jul-11	116	19	32	16	13	26	4	13	5	17
1-Aug-11	95	3	26	13	53	5	0	5	2	11

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 sandpit and river island surveys. During 2011, we monitored 12 sandpits and 3 constructed or managed riverine sites that, as defined by the Program, had suitable nesting habitat (Figure 4; see Table 5 for site names. We observed the most adult interior least terns (86) during early-July and the most adult piping plovers (47) at sandpits and riverine sites with constructed or managed islands during the mid-June and early-July surveys (Table 4).

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 surveys, 2011.

Survey	Interior least tern					Piping plover			
	Sites	Adults	Nests	Chicks	Fledglings	Adults	Nests	Chicks	Fledglings
1 May-11	15	0	0	0	0	35	5	0	0
15 May-11	15	6	0	0	0	43	15	0	0
1 Jun-11	15	52	4	0	0	44	21	3	0
15 Jun-11	15	76	32	0	0	47	8	26	0
1 Jul-11	15	86	30	11	0	47	5	21	16
15 Jul-11	15	83	19	32	12	22	4	13	13
1-Aug-11	15	51	3	26	16	3	0	5	4

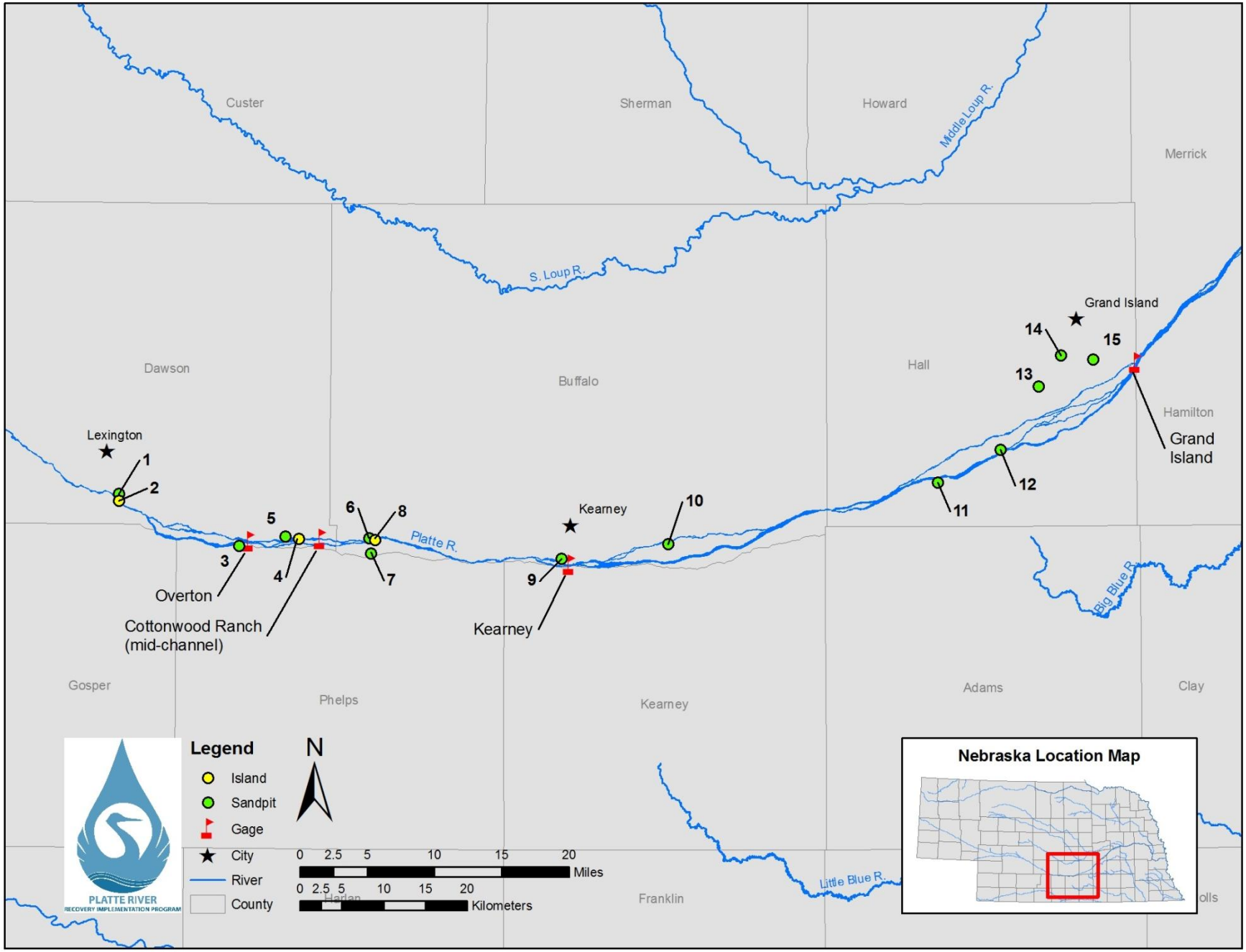


Figure 4. Study area including sandpits and constructed or managed river island sites monitored for interior least tern and piping plover nesting and foraging activities during 2011. Names of sites are located in Table 5.

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 2001–2011 timeframe (Figure 5). Similarly, the trend in numbers of adult piping plovers observed during the May and June mid-month river surveys has increased since 2001; however, numbers of piping plovers observed during 2011 river surveys were similar to 2009 which was much lower than 2010 (Figure 5). There was a 71% decline in the number of piping plover adults observed during the mid-July river survey from 2010 to 2011; however, much of that decline can likely be attributed to unfavorable nesting conditions and a lack of exposed sand on the river. It is also important to note that river conditions (low or no flow) precluded several 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.

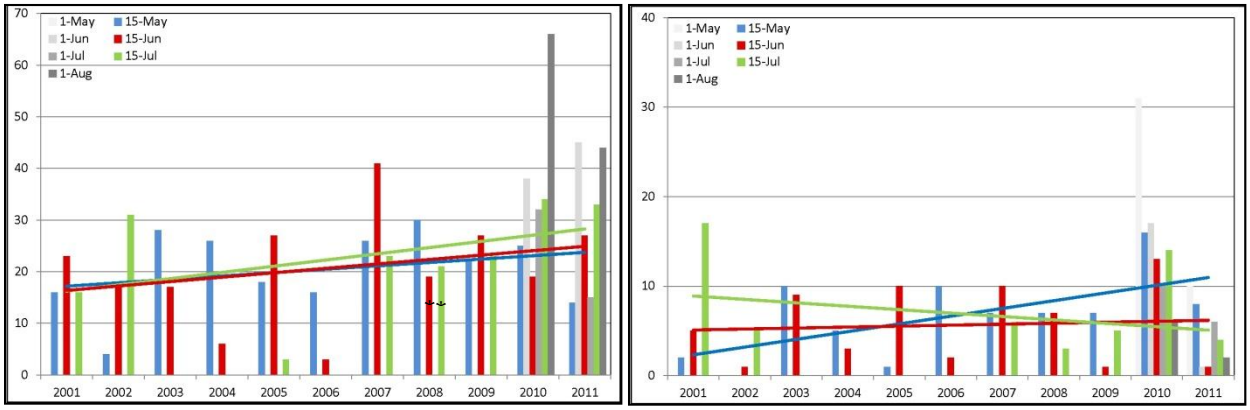


Figure 5. Trends (lines) in the number (boxplots) of adult interior least terns (left) and piping plovers (right) observed during mid-month and semi-monthly airboat surveys on the Platte River between Chapman and Lexington, Nebraska, 2001–2011. * indicates minimum numbers; two river surveys below Kearney 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. Surveys were conducted using 2 canoes during 2011.

The trend in numbers of adult interior least terns and piping plovers observed during mid-month river and sandpits surveys has increased since 2001; however, the number of adult interior least terns and piping plovers observed during these surveys declined after 2005 and 2007, respectively, but have recently increased (Figure 6). In 2011, we observed the most adult interior least terns and piping plovers during the mid-July and early-July surveys, respectively. During semi-monthly survey, 66% of adult interior least tern and 87% of adult piping plover observations occurred at sandpits sites. No interior least tern or piping plover nests were observed on riverine habitat during 2011 which was likely due to a lack of available habitat during the nesting season caused by high flows and vegetation emergence on exposed sand. We observed high use of the river by interior least terns (78% in mid-May) prior to their peak nesting season as well as an increase in interior least tern and piping plover use of the river for foraging habitat after chicks fledged (after mid-July) which corresponds well with the timing of increasing and decreasing flows, respectively (Figure 2).

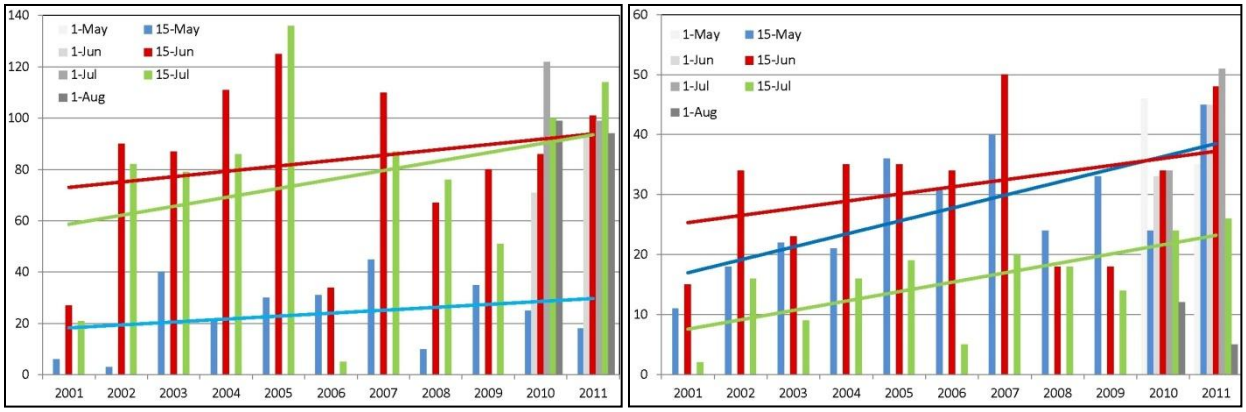


Figure 6. Trends (lines) in the number (boxplots) of adult interior least terns (left) and piping plovers (right) observed during surveys of sandpits and the Platte River between Chapman and Lexington, Nebraska, 2001–2011.

A maximum of 116 adult interior least terns (58 pair) were observed while conducting the mid-July semi-monthly river and sandpit surveys when there were a combined total of 35 active nests and broods present within Program Associated Habitats. We observed a maximum of 51 adult piping plovers (25 pair) during the early-July survey when there were 5 active nests, 8 broods of chicks and 18 fledglings observed. The maximum number of active piping plover nests and broods observed during any single survey period (early-June) was 22 which included 21 nests, 1 brood, and a total of 45 adults. We didn't observe any snowy plovers during 2011.


Piping plover on a nest

NEST AND CHICK MONITORING

METHODS: In addition to semi-monthly surveys, we monitored all sites with active nests or broods on a semi-weekly 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 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 technicians, USGS field crews, and Program partners monitored nesting sites from outside the nesting colonies and Program staff and technicians and USGS field crews conducted nest and brood searches from within the nesting colonies during 2011. 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.


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 semi-weekly 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; and used a GIS 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 15 June, 2011 when flows at Overton, Kearney, and Grand Island were >7,200cfs.

In addition to monitoring, we placed 4 decoys near the east end of Cottonwood Ranch OCSW and 4 decoys on the east peninsula at Dyer sandpit to attract interior least terns to nest at sites that were recently constructed and managed and where nesting had not previously occurred.

Outside Monitoring – Outside surveys were performed from the ground or boats 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 dictated), 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 located by observing adult birds.

Outside monitoring

Inside Monitoring – A systematic grid-search pattern was used to conduct inside surveys (Figure 7). To initiate this search method, investigators formed a straight line on the edge of and parallel to the side of the 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 10 yards unless chicks were detected at which point the spacing was widened to allow the chicks to pass between observers to prevent driving chicks out of their natal territory. 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 or 'grid searching'

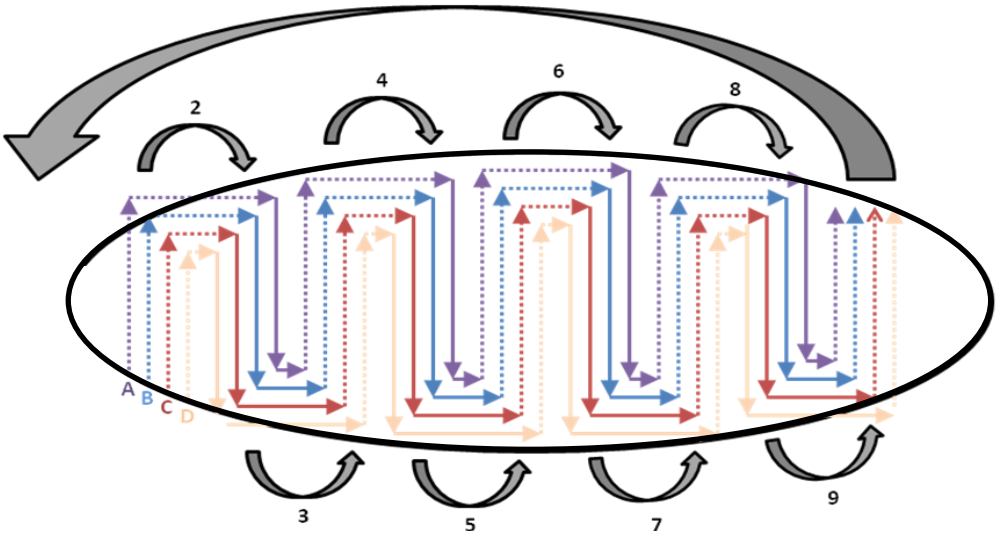


Figure 7. Systematic grid-search pattern used to locate nests and broods while conducting inside surveys of sandpit sites.

We calculated daily and incubation-period nest survival rates using Program MARK (Version 5.1). We included nests located at sandpit sites that were monitored during 2011 by ED Office staff and technicians, USGS-NPWRC field crews, and personnel from CPNRD and NPPD 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 the date of determination (date first observed inactive) was <21 days (interior least tern) or <28 days (piping plover) after the date nest was initiated and we failed to observe chicks of appropriate age near the nest bowl. For example, if a piping plover nest, observed to be active and intact 12 days after it was initiated was found to be empty (no eggs) 16 days after it was initiated with no sign of chicks of appropriate age in the area, we censored the nest at 14 days (midpoint of the 2 observation periods) and assigned a "failed" status to the nest as it likely did not hatch within 16 days of initiation. If, however, a piping plover nest with an unknown fate was last observed to be active 25 days after it was initiated, but 29 days after it was initiated we observed an empty nest bowl and no sign of chicks of appropriate age in the area, we censored the nest at 27 days (midpoint of the 2 observation periods) 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 that were monitored by ED Office staff and technicians, USGS-NPWRC field crews, and personnel from CPNRD and NPPD during 2011 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 was observed fledged or 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 censored the data at the midpoint of when the brood was last observed active and first documented as an "unknown" status and 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.

We also calculated Mayfield estimates of daily and incubation-period or brooding-period survival rates for all interior least tern and piping plover nests and broods 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:

Least tern chick and eggs

$SE_S = ([S\text{-}S^2]/E_S)^{1/2}$ 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 tern remains

Mortality: We observed a potential research-related mortality during 2011 when a crew approached a 1.3-acre sandpit island to band interior least tern chicks when they noticed a previously banded piping plover chick flee into the water and get consumed by what was believed to be a large-mouth bass. The incident was immediately reported to the USFWS-Grand Island Field Office. Five additional interior least tern chicks and 6 piping plover chicks were found dead and collected during 2011. Another piping plover chick was found dead, but was too decomposed to collect. The legs from 2 interior least tern chicks were found and it is presumed the chicks were predated. Observed deaths of chicks were attributed to weather (8/15), predation (3/15), or unknown causes (4/15). Predation (avian, raccoon, fox, mink, etc.) was the leading cause of nest failure and accounted for 10 interior least tern and 2 piping plover nest- and several

Live trap used at Newark & Dyer

1. Mink were suspected for the loss of several least tern nests and chicks at Broadfoot South late in the nesting season during 2011. Thirteen interior least tern nests at Newark sandpit were lost to predation (7) or unknown causes (6) between June 14 and July 1; however, nest losses were reduced once EDO staff and field crews used live traps (pictured left) to remove 10 raccoon and 2 red fox from the site. Six nests were abandoned during 2011; 3 of which were partially predated prior to nest abandonment, 2 had fractured eggs likely attributable to weather events, and 1 was a 1-egg nest. Sixteen interior least tern and 3 piping plover nest failures were attributed to unknown causes, flooding claimed 1 nest, and the fate of 7 nests was unknown. We observed 1 abnormal egg (pictured right) in a scrape at Newark sandpit during 2011, but we were not able to determine whether it was a interior least tern or piping plover egg; it was collected and submitted to US Fish and Wildlife Service for testing.

Abnormal egg observed at Newark

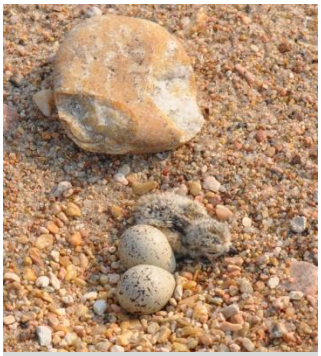
Least Terns: Interior least tern nests were observed and monitored at 8 of the 12 sandpits and none of the riverine sites we surveyed during 2011 (Table 5, Figure 8). All counts of adults, nests, chicks, and fledglings reported in Table 5 represent the maximum number observed from inside and outside the nesting colony during all surveys. The first observation of interior least tern nests occurred on 31 May, 2011 and the last nest initiated was observed on 19 July, 2011.

Tern chick and eggs

The first observation of an interior least tern chick occurred on 31 May, 2011 and the last nest known to hatch did so on 8 August, 2011. At least 1 egg from 58% (52/90) of interior least tern nests hatched which resulted in 125 chicks and an overall nest-success rate of 1.39 chicks/nest during 2011 (Table 6). Average daily survival rate of interior least tern nests at sandpits was 0.97 (range = 0.79–1.00) with differences observed between sites during 2011 [$\chi^2(1, N = 83) = 31.32$; $p = <0.01$; Appendix 1]; the average

survival rate over the 21-day incubation period was 0.58 (range = 0.01–1.00; Appendix 1). We observed the first interior least tern fledgling on 9 July, 2011 and the last known interior least tern chick to fledge did so on 29 August, 2011. Apparent fledge success at all sites monitored was 1.09 fledglings/nest (98 fledglings/90 nests) or 1.69 fledglings/pair (98 fledglings/58 pair; Table 6) with all nests occurring on sandpit sites during 2011. Average daily survival rates for all interior least tern broods during 2011 was 0.99 (range = 0.97–1.00; Appendix 2); average brooding-period survival rate was 0.89 (range = 0.07–1.00).

Interior least tern decoys placed at Dyer sandpit and Cottonwood Ranch OCSW didn't appear to positively influence nesting birds as no interior least terns nested at Cottonwood Ranch and 4 of the 5 nests at Dyer sandpit were on the peninsula without decoys.


Piping plover chick and eggs

Piping Plovers: Piping plover nests were observed at 6 of 12 sandpits and no river sites we surveyed that had managed or constructed islands during 2011 (Table 5; Figure 8). The first observation of a piping plover nest was made on 3 May, 2011 and the last nest initiated was observed on 28 June, 2011. The first observation of a piping plover chick occurred on 29 May, 2011 and the last successful nest we observed hatched on 12 July, 2011. At least 1 egg from 79% (27/34) of piping plover nests hatched which resulted in 88 chicks and an overall nest-success rate of 2.59 chicks/nest during 2011 (Table 7); all nests and chicks observed were at sandpit sites. Piping plover daily nest survival rate was 0.99 (range = 0.98–1.00; Appendix 3) during 2011; average incubation-period survival rate was 0.77 (range = 0.52–1.00). We first observed a piping plover fledgling on 28 June, 2011 and the last known piping plover chick to fledge did so on 8 August, 2011. We observed an apparent nest-based fledging rate of 1.35 (46 fledglings/34 nests) and a pair-based fledging rate of 1.84 (46 fledglings/25 pair) at all sites monitored during 2011 (Table 7). We observed an average daily survival rate of 0.99 (range = 0.92–1.00) for piping plover broods during 2011; the 28-day brooding period survival rate was 0.73 (range = 0.08–1.00; Appendix 4).

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 2011. See the Management Section of this report for a detailed description of management actions taken at each site. Site #'s correspond with Figure 4.

						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	69	83	351	16	10[B]	7	16	12	10[C]	268	10	6[B]	5	14	5	3
2	Lexington Island	RI	N	4	3	2	2	0	0	0	0	0	1	1	0	0	0	0	0
3	Dyer Pit	SP	RGHPFT	51	44	144	12	5	2	5	3	2	108	5	2	2	6	3	0
4	Cottonwood Ranch Island	RI	N	7	2	2	2	0	0	0	0	0	3	2	0	0	0	0	0
5	Cottonwood Ranch OCSW	SP	GPFT	21	10	1	1	0	0	0	0	0	9	2	0	0	0	0	0
6	Blue Hole	SP	HPFT	90	144	918	33	24	18	47	40	39	732	18	11	10	36	32	28
7	Johnson Pit	SP	HPFT	53	30	26	6	1	0	0	0	0	79	4	2	1	3	3	3
8	Elm Creek Island	RI	N	7	1	14	12	0	0	0	0	0	3	3	0	0	0	0	0
9	Broadfoot South	SP	RHPFT	76	77	621	23	20[D]	8	17	13	12	432	13	9[DE]	6	19	11	6
10	Newark	SP	GRHPFT	70	55	360	13	19	6	15	9	9	92	4	0	0	0	0	0
11	Lilley – Wood River	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Wild Rose Ranch East Pit	SP	D	31	26	246	14	8	8	18	17	17	125	8	4	3	10	7	6
13	Deweese – Alda	SP	N	22	14	91	10	3	3	7	7	7	1	1	0	0	0	0	0
14	Hooker Brothers – GI West	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Hooker Brothers – GI South	SP	N	7	4	7	6	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 2010; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2011; 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 3 nests (1 interior least tern and 2 piping plovers) that were not surrounded by electrified fence and water. One plover nest hatched 1 chick that was last observed when it was17 days old.

[C] Count excludes 2 chicks documented as fledged from outside the colony that were known to have been predated (legs with metal band found) prior to reaching the fledging age of 21 days.

[D] Includes 6 nests (5 interior least tern and 1 piping plover) that were surrounded by water; however, we could not access the islands to monitor the nests. The plover nest hatched 3 chicks that were last observed when they were 6 days old. One interior least tern nest hatched 1 chick that was only observed during 1 survey.

[E] Includes 2 piping plover nests that were not surrounded by water or fence; both nests failed.

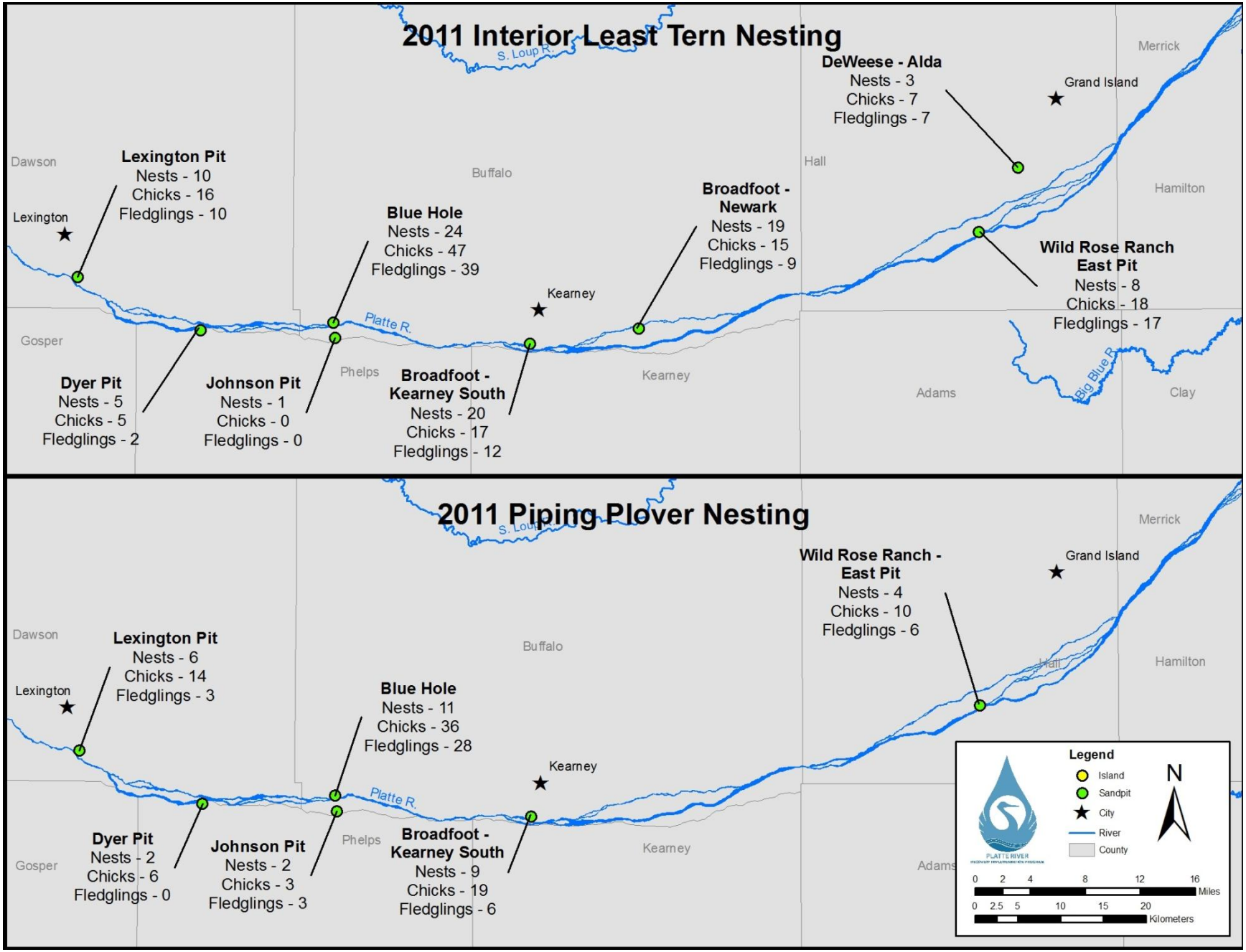


Figure 8. Distribution and numbers of interior least tern and piping plover nests, chicks, and fledglings observed within Program associated habitats during 2011 surveys of sandpits and managed, constructed, or naturally occurring river islands.

Table 6. Summary of interior least tern reproductive success at sandpits and river island sites on the central Platte River of Nebraska, 2007–2011. Site-specific details on numbers of adults, nest, chicks, and fledglings observed during 2011 are provided in Table 5. Habitat- and site-specific details of daily and incubation- and brooding-period survival rates during 2011 are provided in Appendices 1–2 (Program Mark estimates) and 5–6 (Mayfield estimates).

Reproductive Parameter	Interior least tern				
	2007	2008	2009	2010	2011
Total Nests Observed	49	63	56	76[A]	90[A]
Successful Nests (≥1 egg hatched)	22	31	31	48[A]	52[A]
Apparent Nest Success	0.45	0.49	0.55	0.63[A]	0.57[A]
Daily Nest Survival Rate (All sites)	0.97	0.98	0.99	0.98[B]	0.97[B]
Incubation-period Survival Rate (All sites)	0.55	0.61	0.73	0.64[B]	0.58[B]
Chicks Observed	49	61	68	122[A]	125[A]
Hatch Ratio (Chicks/Nest)	1.00	0.97	1.21	1.61[A]	1.39[A]
Chicks (15D)	40	44	44	76[A]	101[A]
Fledglings (21D)	-----[C]	-----	-----	75[A]	96[A]
Historic Fledge Ratio (15D Chicks/Nest)	0.82	0.70	0.79	1.00[A]	1.12[A]
Fledge ratio (21D Chicks/Nest)	-----	-----	-----	0.99[A]	1.07[A]
Pair-based Fledge Ratio (15D Chicks/Pair)	0.76	1.16	1.10	1.25[A]	1.77[A]
Pair-based Fledge Ratio (21D Chicks/Pair)	-----	-----	-----	1.23[A]	1.68[A]
Daily Brood Survival Rate (All sites)	-----	0.98	0.98	0.98[BD]	0.99[BD]
Brooding-period Survival Rate (All sites)	-----	0.75	0.79	0.72[BD]	0.89[BD]

[A] Includes 8 nests during 2010 and 5 nests during 2011 that were located on 2 small islands located northwest of the main peninsula at Broadfoot South that we could not access and 1 nest at Lexington sandpit that was located outside the protected nesting area.

[B] Excludes the 13 nests during 2010 and 2011 that were located on 2 small islands located northwest of the main peninsula at Broadfoot South that we could not access.

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

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

Table 7. Summary of piping plover reproductive success at sandpits and river island sites on the central Platte River of Nebraska, 2007–2011. Site-specific details on numbers of adults, nest, chicks, and fledglings observed during 2011 are provided in Table 5. Habitat- and site-specific details of daily and incubation- and brooding-period survival rates during 2011 are provided in Appendices 3–4 (Program Mark estimates) and 7–8 (Mayfield estimates).

Reproductive Parameter	Piping plover				
	2007	2008	2009	2010	2011
Total Nests Observed	20	21	14	35[A]	34[B]
Successful Nests (≥1 egg hatched)	15	8	9	21[A]	27[B]
Apparent Nest Success	0.75	0.38	0.64	0.60[A]	0.79[B]
Daily Nest Survival Rate (All sites)	0.99	0.98	0.99	0.98[C]	0.99[C]
Incubation-period Survival Rate (All sites)	0.71	0.58	0.67	0.54[C]	0.77[C]
Chicks Observed	45	26	30	76[A]	88[B]
Hatch Ratio (Chicks/Nest)	2.25	1.24	2.14	2.17[A]	2.59[B]
Chicks (15D)	27	10	12	50[A]	61[B]
Fledglings (28D)	-----[D]	-----	-----	41[A]	46[B]
Historic Fledge Ratio (15D Chicks/Nest)	1.35	0.48	0.86	1.43[A]	1.79[B]
Fledge ratio (28D Chicks/Nest)	-----	-----	-----	1.17[A]	1.35[B]
Pair-based Fledge Ratio (15D Chicks/Pair)	1.08	0.83	0.73	2.17[A]	2.44[B]
Pair-based Fledge Ratio (28D Chicks/Pair)	-----	-----	-----	1.78[A]	1.84[B]
Daily Brood Survival Rate (All sites)	-----	0.94	0.98	0.99[F]	0.99[EF]
Brooding-period Survival Rate (All sites)	-----	0.42	0.79	0.70[F]	0.73[EF]

[A] Includes 2 nests documented from outside the nesting colony 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.

[B] Includes 1 nest located on a small island located northwest of the main peninsula at Broadfoot South that we could not access and 2 nests at Broadfoot South and 1 nest at Lexington sandpit that were located outside the protected nesting areas.

[C] Excludes 1 nest at Alda Farms during 2010 that was not observed while active, but was after it hatched 4 chicks and 1 nest located on a small island located northwest of the main peninsula at Broadfoot South that we could not access during 2011.

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

[E] Excludes 1 nest located on a small island located northwest of the main peninsula at Broadfoot South that we could not access.

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

Habitat Measures

Least Tern: We measured habitat conditions at 85 interior least tern nests at 8 sandpit sites during 2011 (Table 8; see Appendix 9 for habitat metrics collected at individual interior least tern nests). We found a moderate correlation (r = 0.54) between nesting area size and the number of interior least tern nests present at sandpit sites (Table 8). We observed no relationship between numbers of interior least tern nests observed and the ratio of bare-sand to surface water area across sites (r = 0.08). Excluding Newark where LiDAR data is currently not available and Johnson Sandpit where only 1 interior least tern nest was observed, on average interior least terns nested 5.3 feet above the waterline at sandpit sites (range of average across sites = 2.2–10.0 feet) and average nest elevations were 16–41% lower (closer to the waterline elevation) than the highest nests at each site (Table 8). Interior least terns nested at least 1.1 feet above the elevation of the waterline (range of minimum nest elevations across sites = 1.1–7.2 feet above the waterline) at all sites. On average, interior least terns nested 110 feet (range = 9–288 feet) from the edge of the waterline at sandpit sites during 2011. Similar to 2010, 87% (74) of the 85 interior least tern nests that we could obtain access to during 2011 were positioned >50 feet from the edge waterline (Table 8). Average distance between interior least tern nests and the nearest predator perch was 623 feet (range = 123–1245 feet). Of the 85 accessible interior least tern nests observed during 2011, 45% (39) had nest furniture present and 64% of nests with a known fate with and without nest furniture hatched successfully (23/36 and 29/45), respectively. Of the 85 interior least tern nests we collected habitat measures at, 82 were place in a sandy substrate (0.125-2.0 mm), 2 were in small gravel (2-10 mm), and 1 was placed in large gravel or cobble (>10 mm). Nest furniture present at interior least tern nests during 2011 included tree bark and small branches, wire, river rock, 1”×4” board, and dead vegetation.

Piping Plover: We recorded habitat conditions at 34 piping plover nests distributed across 6 sandpit sites during 2011 (Table 9; see Appendix 10 for habitat conditions at individual piping plover nests). Similar to interior least terns, nesting area size and the number of piping plover nests present at all sites was marginally correlated (r = 0.58; Table 9). We observed no relationship between the ratio of bare-sand to surface water area and the number of piping plover nests present at sandpit sites (r = -0.17). On average, piping plovers nested 4.5 feet above the waterline at sandpit sites (range in averages across sites = 1.8–6.8 feet) and average nest elevations were 7–46% lower than the highest nests at each site (Table 9). Piping plovers nested >1.4 feet above the waterline elevation at all sites excluding Wild Rose East Sandpit (range of minimum nest elevations across sites = 1.4–6.3 feet above the waterline). At Wild Rose East Sandpit, 1 piping plover nest was 0.7 feet above the waterline elevation (range = 0.7–3.4 feet) though opportunities to nest at elevations 6 feet above the waterline existed (Table 9). Piping plover nests at sandpit sites, on average, were placed 98 feet (range = 6–277 feet) from the edge of the waterline during 2011. Of the 34 piping plover nests observed at sandpit sites during 2011, 74% (25) were positioned >50 feet from the edge waterline (Table 9; Appendix 10). Average distance between piping plover nests and the nearest predator perch at all sites was 556 feet (range = 141–969 feet; (Table 9). Eighteen (78%) of the 34 piping plover nests we observed during 2011 had nest furniture and 78% (14) of these nests hatched successfully. Similarly, 13 (81%) of the 16 piping plover nests without nest furniture also hatched successfully. Of the 34

Piping plover nest with nest furniture

piping plover nests we collected habitat measures at, 28 were place in a sandy substrate (0.125-2.0 mm), 5 were in small gravel (2-10 mm), and 1 was placed in large gravel or cobble (>10 mm). Similar to interior least terns, nest furniture present at piping plover nests during 2011 included tree bark and small branches, 9-guage wire, river rock, 1"×4" board, and dead vegetation.

Inside-Outside Monitoring – Inside and outside counts were obtained at 7 sandpit sites during 2011; however, inside and outside counts at 4 of the sites were conducted by the same observers (Table 10; see Appendix 11 and 12 for outside and inside counts at all sites, respectively). At the 3 sandpit sites monitored by separate observers from outside and inside the colonies, from inside (grid searching) the nesting areas we documented 4 interior least tern nests and 1 piping plovers nest that were not observed from outside the colony. 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. Two of the nests that were only observed from outside the nesting colony hatched and produced 2 fledglings; none of the nests only observed from inside the nesting colony hatched.

Adult and Chick Band Observations – As part of Program-funded research conducted by USGS field crews, 16 adult and 35 juvenile interior least terns were banded during 2009, 7 adult and 74 juvenile interior least terns were banded during 2010, and 4 adult and 98 juvenile interior least terns were banded during 2011. Eleven adult and 25 juvenile piping plovers were banded during 2009, 13 adult and 64 juvenile piping plovers were banded during 2010, and 2 adult and 68 juvenile piping plovers were banded during 2011. After 3 years of banding on the central Platte, we have 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. We have observed several adult piping plovers return to nest at the site where they were banded (and at other sites); however, all banded chicks observed to date that returned to nest have nested at non-natal sites. On multiple occasions, we have observed tern and plover fledglings at non-natal sites late in the nesting season, which may be an indication that fledglings begin selecting nesting habitat for the subsequent year prior to departing for the winter grounds. For example, a piping plover banded as an adult at Blue Hole sandpit in 2009 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 and 2011. The mate of this particular bird, originally banded on Johnson sandpit, was observed to re-nest during 2011 prior to chicks from its first nest reaching fledging age. A piping plover, banded as an adult at Dinan Islands in 2009, nested at Broadfoot Kearney South sandpit and a piping plover, banded as an adult at Dippel islands in 2010, nested at Wild Rose East Sandpit; both during 2011. A piping plover, banded on the Lower Platte River, was observed nesting at Blue Hole during 2011. A piping plover adult, banded on Lake Sakakwea, was observed at Dyer sandpit early in the nesting season; however, this bird apparently moved north to nest as it was never observed on the central Platte again. We observed 2 confirmed and possibly 3 adult piping plovers that were banded on the Gulf Coast during the fall 2010 that nested at the Broadfoot Kearney South sandpit during 2011. 2011 marked the first year we expected to observe interior least terns, banded as chicks on the central Platte River in 2009, return to nest; however, re-sighting events were fairly limited. We did, however, observe an interior least tern, banded as an adult in 2010, return to nest at the same site during 2011.

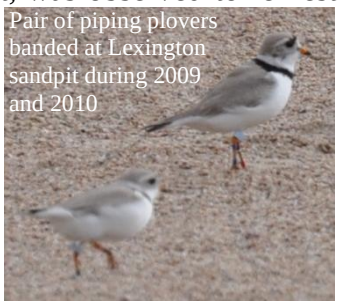

Pair of piping plovers banded at Lexington sandpit during 2009 and 2010

Table 8. Average site- and nest-level habitat measures collected at confirmed (eggs observed in a scrape) interior least tern nest sites during 2011. Habitat measures for individual nests can be found in Appendix 9.

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	10	13	>75	41	2.8	4.6	7.9	39	79	150	177	417	648	5	2	2	1
Dyer	SP	5	19	>75	24	6.3	7.7	9.2	75	140	198	834	908	1062	0	2	2	0
Blue Hole	SP	24	25	>75	54	2.1	6.3	9.5	18	156	288	390	556	741	11	7	1	4
Johnson Pit	SP	1	9	>75	51	1.6	1.6	1.6	48	48	48	234	234	234	0	0	1	0
Broadfoot South	SP	15	16	>75	80	3.3	4.3	5.7	48	90	138	123	648	1245	4	4	1	4
Newark	SP	19	8	>75	46	NA	NA	NA	9	93	207	372	748	1179	2	4	6	7
Wild Rose Ranch East	SP	8	3	50-75	12	1.1	2.2	3.4	54	68	87	456	658	801	1	7	0	0
Deweese – Alda	SP	3	3	>75	53	7.2	10.0	12.5	111	143	201	411	469	582	0	3	0	0
Summary for All Sites	**ALL**	**85**	**96**	**>75**	**361**	**1.1**	**5.3**	**12.5**	**9**	**110**	**288**	**123**	**622**	**1245**	**23**	**29**	**13**	**16**

Table 9. Average site- and nest-level habitat measures collected at confirmed (eggs observed in a scrape) piping plover nest sites during 2011. Habitat measures for individual nests can be found in Appendix 10.

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	6	13	>75	41	4.4	6.1	9.7	39	102	162	174	464	612	1	4	1	0
Dyer Pit	SP	2	19	>75	24	6.3	6.8	7.4	48	57	66	633	743	852	1	1	0	0
Blue Hole	SP	11	25	>75	54	1.4	5.1	8.9	81	143	270	408	577	810	6	4	1	0
Johnson Pit	SP	2	9	>75	51	2.0	3.1	4.2	66	83	99	351	506	660	0	1	0	1
Broadfoot South	SP	9	16	>75	80	1.8	3.8	5.6	6	69	135	141	543	969	3	3	1	2
Wild Rose Ranch East	SP	4	3	50-75	12	0.7	1.8	3.4	12	59	96	378	595	786	3	0	1	0
Summary for All Sites	**ALL**	**34**	**85**	**>75**	**262**	**0.7**	**4.5**	**9.7**	**6**	**98**	**270**	**141**	**556**	**969**	**14**	**13**	**4**	**3**

Table 10. 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 sandpit sites during 2011. Only sites where both outside and inside monitoring occurred during 2011 are included in this table; site #'s correspond with Figure 4. See Appendices 9 and 10 for separate outside and inside counts, respectively, at all sites monitored during 2011.

						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	29	32	151	16	10	6	13	12	11[C]	106	9	6	5	12	5	3
3	Dyer Pit[D]	SP	RGHPFT	23	14	78	12	5	2	5	3	2	48	4	2	2	6	3	0
5	Cottonwood Ranch OCSW[D]	SP	GPFT	12	5	1	1	0	0	0	0	0	4	2	0	0	0	0	0
6	Blue Hole[E]	SP	HPFT	41	69	539	33	21	18	43	34	33	309	18	10	10	35	29	27
7	Johnson Pit	SP	HPFT	35	20	11	4	0	0	0	0	0	47	4	2	1	3	3	2
9	Broadfoot South[DE]	SP	RHPFT	34	33	346	23	20	8	17	13	12	205	13	9	6	19	11	6
10	Newark[D]	SP	GRHPFT	32	16	164	12	19	6	15	9	9	36	3	0	0	0	0	0
1	Lexington Pit	SP	HPFT	40	51	200	15	10	7	15	9	5	161	10	6	5	14	5	3
3	Dyer Pit[D]	SP	RGHPFT	28	30	66	6	5	2	5	3	2	58	5	2	2	6	3	0
5	Cottonwood Ranch OCSW[D]	SP	GPFT	9	5	0	0	0	0	0	0	0	4	1	0	0	0	0	0
6	Blue Hole[E]	SP	HPFT	49	75	379	22	20	16	35	24	17	346	16	11	10	34	27	17
7	Johnson Pit	SP	HPFT	18	10	15	6	1	0	0	0	0	30	4	2	1	3	3	3
9	Broadfoot South[DE]	SP	RHPFT	42	44	275	15	15	7	16	13	12	219	12	9	6	19	11	6
10	Newark[D]	SP	GRHPFT	38	39	196	13	19	6	15	9	9	54	4	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 2010; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2011; 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] Based on observations from within the colony, the fate of 2 nests and the chick and fledgling associated with one of the nests were assigned to the wrong nest from outside the colony; second nest failed.

[C] Count includes 2 chicks documented as fledged from outside the colony that were known to have been predated (legs with metal band found) prior to reaching the fledging age of 21 days.

[D] Sites where double observer counts were conducted by the same field observers (i.e., counts are not independent) and chicks and fledglings were not associated with individual nests from outside the colony; i.e., inside and outside chick and fledgling counts are the same except for at Broadfoot South.

[E] Outside counts include 5 least tern nests located on the non-access islands where inside surveys could not be conducted; inside counts exclude these nests.

[F] Based on observations from outside the colony, observers from within the colony missed 4 least tern nests; 2 of which hatched 6 chicks and fledged 5. Counts of eggs in each of these nests were not obtained. Based on observations from within the colony, the outside observer missed 3 interior least tern nests and 1 piping plover nest; none of these nests hatched. In total, there were 24 least tern nests and 11 piping plover nests at Blue Hole sandpit during 2011.

SUMMARY:

The number of interior least tern nests, successful nests, chicks, chicks/nest, fledglings, and fledglings/nest were higher during 2011 than they have been since the Program began in 2007 (Table 6; Figures 8–10). Daily incubation-period survival rates and brooding-period survival rates for interior least tern nests and chicks were also higher during 2011 than the previous 3 years despite the fact the Program changed the fledging age from 15 days (2007–2009) to 21 days for interior least tern chicks.

We observed a similar number piping plover nests during 2011 as we did during 2010; however, we observed more successful nests, chicks, and 15-day-old chicks (2007-2009 fledging age) during 2011 than we had since 2007 (Table 7; Figures 9-10). We observed 12 more chicks and 5 more piping plover fledglings (28-day-old chicks) in 2011 than we did during 2010 which was the previous high for the Program (Table 7; Figure 10). Seventy-nine percent of piping plover nests were successful (hatched ≥1 chick) during 2011 which was also a record for the Program (Figure 11). We observed a 49–500% increase in the number of chicks that survived to 15-days of age in 2011 as compared to 2007–2010; however, the historic fledge ratio (chicks/nest) was only 33% higher and the observed fledge ratio was the same during 2011 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 7; Figure 11). Similar to 2010, we found a positive correlation (r = 0.58) between nesting area size and numbers of piping plover nests at sandpit sites during 2011; however, we observed little correlation (r = -0.17) between the ratio of bare-sand to surface water area and number of piping plover nests at sandpit sites. Eighty-seven percent of all interior least tern nests were >50 feet from the nearest waterline, 96% were >200 feet from the nearest predator perch, and 95% were 1.5 feet above the waterline when initiated. Similarly, 74% of all piping plover nests at sandpit sites were >50 feet from the nearest waterline, ninety-four percent of piping plover nests were 1.5 feet above the waterline when initiated, and 94% were >200 feet from the nearest predator perch. Forty-four percent of all interior least tern and 53% of all piping plover nests had nest furniture during 2011.


Banded piping plover adult and chick at Lexington sandpit

2011 was the second consecutive 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: 5 interior least tern nests, 2 of which hatched and resulted in 5 chicks and 2 fledglings;
- Dyer Sandpit: 2 piping plover nests that both hatched which resulted in 6 chicks and 0 fledglings;
- Broadfoot South Sandpit: 20 interior least tern nests, 5 of which hatched and resulted in 17 chicks and 12 fledglings; however, 5 of these nests were on 2 islands we could not monitor effectively due to access limitations so actual numbers were likely higher;
- Broadfoot South Sandpit: 9 piping plover nests, 6 of which hatched and resulted in 19 chicks and 6 fledglings; however, 1 of these nests was on an island we could not monitor effectively due to access limitations so actual numbers may have been higher; and
- Newark Sandpit: 19 interior least tern nests, 6 of which hatched and resulted in 15 chicks and 9 fledglings.

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, counts during 2011 were much more similar than 2010 counts. During 2011, outside monitoring personnel failed to observe 1 piping plover nest and 4 interior least tern nests; however, inside monitoring failed to observe 4 interior least tern nests as well so overall nest counts from monitoring inside and outside the nesting colonies were similar. We plan to further modify the methods used to count adults, chicks, and fledglings while within nesting colonies during 2012 and will have more sites independent observers collect the counts to help address issues related to disturbance and detectability.

Though banding has only occurred on the central Platte River for 3 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 3 years of banding where an adult piping plover was inadvertently injured while being released from the hand of an experienced bander and 1 incident where a piping plover chick was observed in a sandpit pond, presumably trying to avoid researchers that was consumed by what was believed to be a large-mouth bass. 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 3 years which will be used to help guide Program management activities.

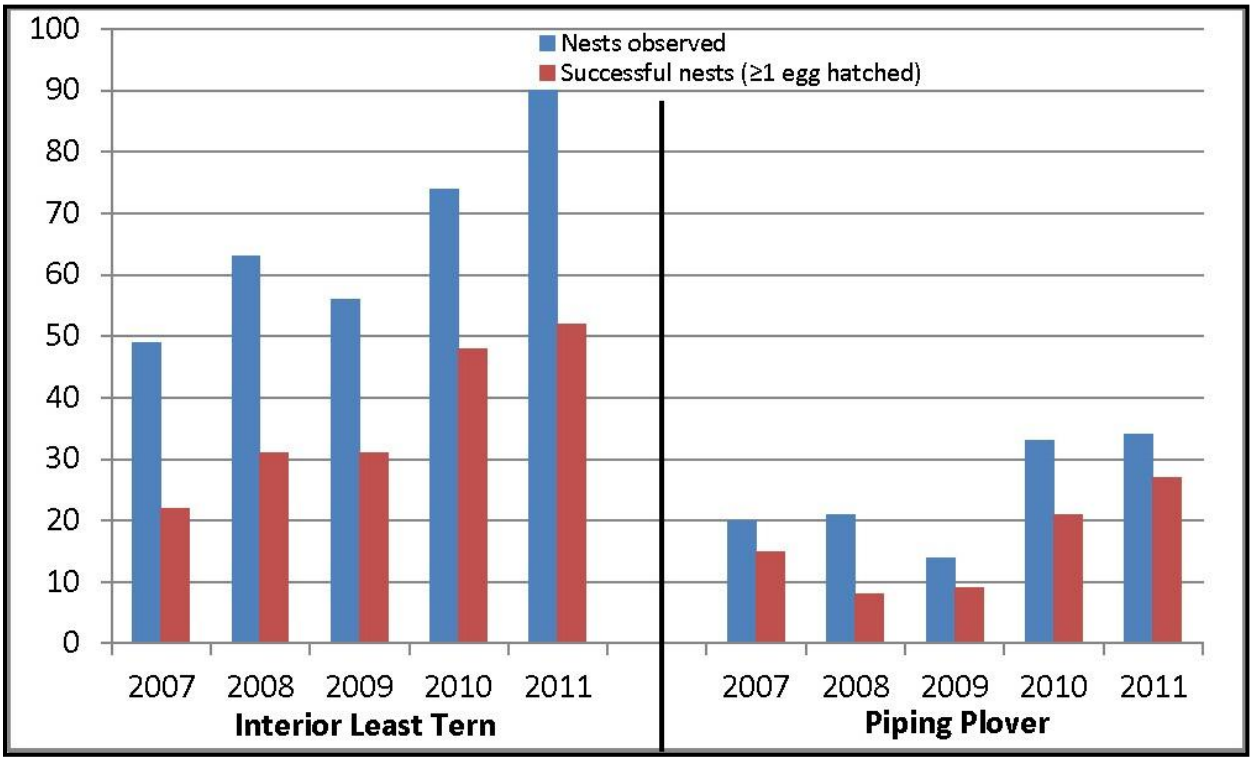


Figure 9. Number of initiated and successful interior least tern and piping plover nests observed at monitored river island and sandpit sites within Program associated habitats, 2007–2011.

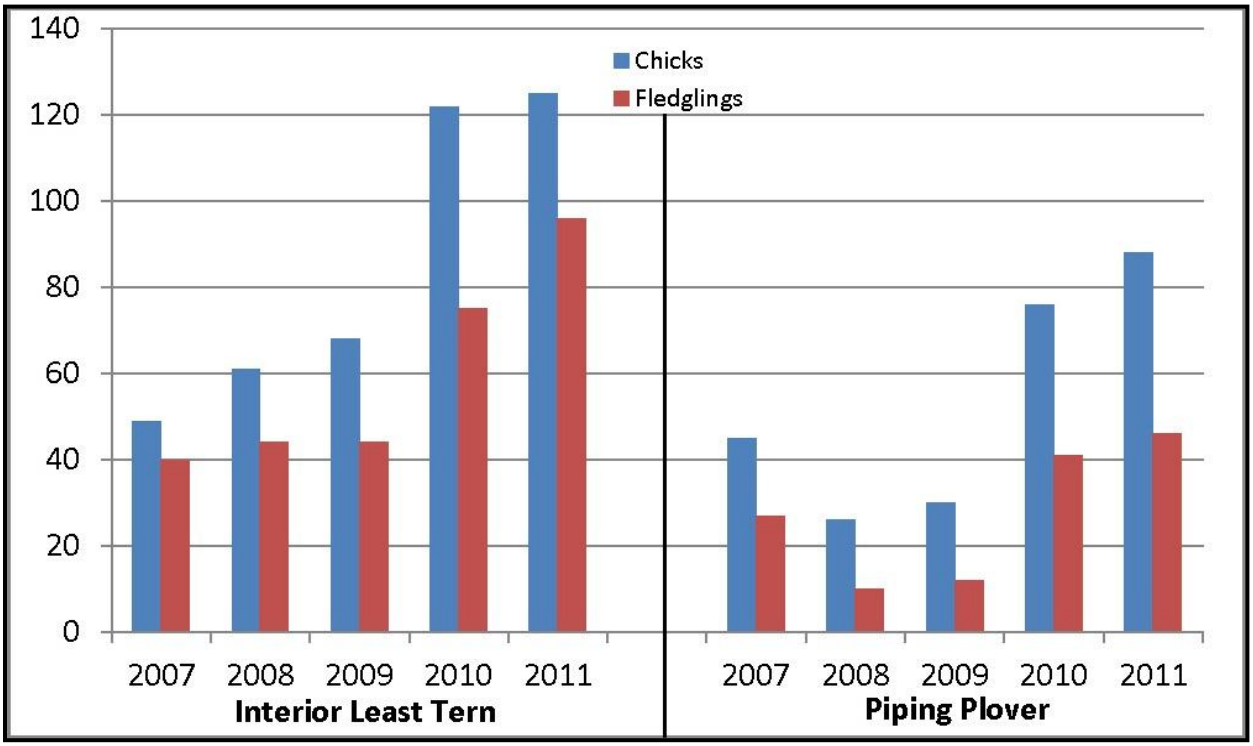


Figure 10. Number of interior least tern and piping plover chicks and fledglings observed at monitored river island and sandpit sites within Program associated habitats, 2007–2011. The 2010 and 2011 15-day fledgling counts for interior least terns were 76 and and 101, respectively and were 50 and 61for piping plovers, respectively.

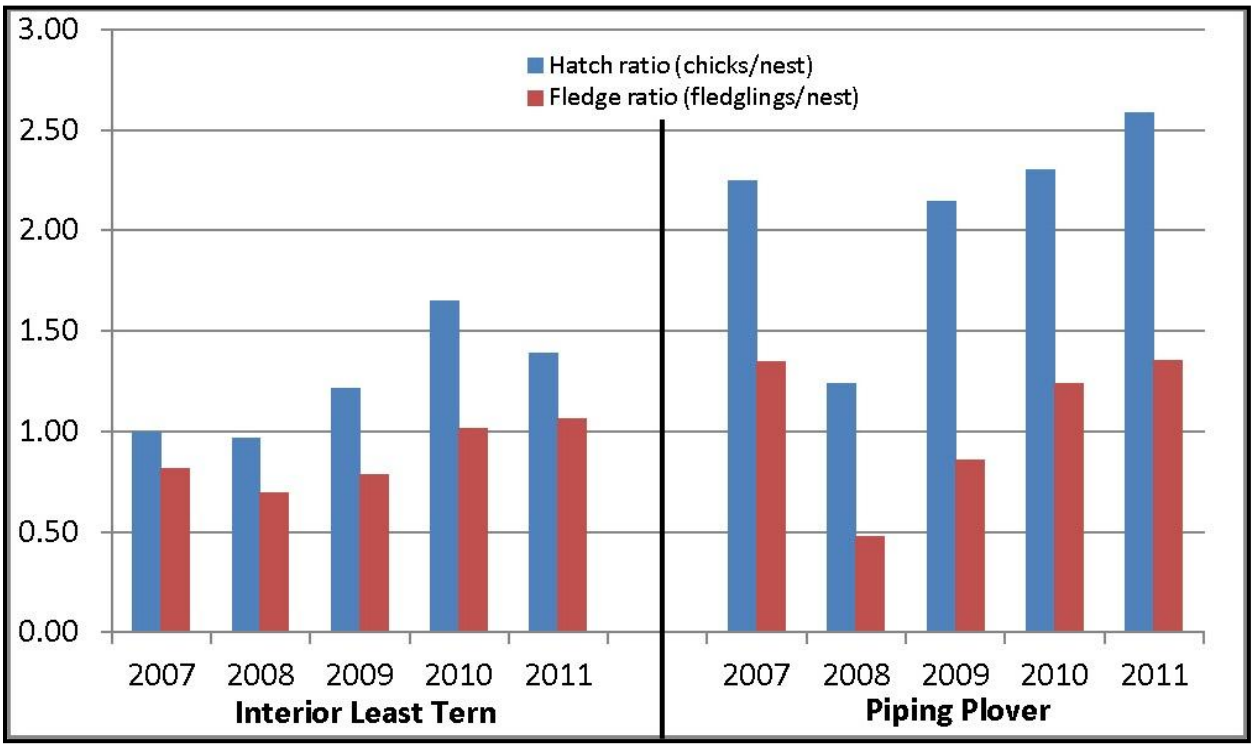


Figure 11. Nest-based hatch and fledge ratios for interior least tern and piping plover nests observed at monitored river island and sandpit sites within Program associated habitats, 2007–2011. Historic (2007–2009), 15-day fledge ratios for interior least terns were 1.00 and 1.12 during 2010 and 2011, respectively and were 1.43 and 1.79 for piping plovers, respectively.

* 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 since 2010.

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, habitat colonization, dispersal rates, re-nesting events, 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).

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. Final results of the Foraging Habits Study can be found in the Program Library at the following link:

http://www.platteriverprogram.org/PubsAndData/ProgramLibrary/Foraging%20Habits%20Study.pdf

HABITAT COLONIZATION STUDY

In 2011, the Program and USGS entered into an agreement for USGS to conduct a study to evaluate Habitat Colonization and Productivity of Least Terns and Piping Plovers Nesting on Central Platte River Sandpits and Sandbars. This study will address 3 specific objectives that will contribute to understanding of habitat use by least terns and piping plovers in the CPRV:

1. **Dispersal**
   Quantify dispersal of adults between units of nesting habitat on the Central Platte River among years.
2. **Colonization**
   Quantify colonization rate of newly constructed or managed nesting habitat by local vs. immigrant adults.
3. **Renesting**
   Quantify frequency and location of renesting attempts by adults with failed nests.

The research is jointly funded by the Program and the USGS-NPWRC. Details about findings of this research can be found in the Final Research Report to be generated by the USGS-NPWRC in early 2014.

HABITAT SELECTION STUDY

The EDO plans to use nest location and habitat data collected through 2012 to evaluate interior least tern and piping plover habitat selection on the Central Platte River. Results of this evaluation will be available in 2013.

APPENDICES

Program Mark Survival Estimates

Appendix 1. Daily and incubation-period survival rates for interior least tern nests monitored on sandpits during 2011. 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	10	3	178	0.9822	0.0102	0.9463	0.9943	0.6863	0.3599	0.8949
Dyer	4	2	74	0.9716	0.0198	0.8933	0.9929	0.5460	0.1592	0.8842
Blue Hole	24[1]	6	452	0.9861	0.0056	0.9694	0.9937	0.7449	0.5369	0.8803
Johnson	1	1	6	0.7937	0.1871	0.2907	0.9731	0.0078	0.0000	0.9929
Broadfoot[2]	15	7	230	0.9679	0.0119	0.9342	0.9846	0.5042	0.2675	0.7390
Newark	19	13	161	0.9115	0.0235	0.8533	0.9480	0.1429	0.0461	0.3654
Wild Rose[3]	7	0	154	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
DeWeese[4]	3	0	64	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	83	32	1319	0.9744	0.0045	0.9640	0.9818	0.5798	0.4681	0.6839

[1] Includes 4 interior least tern nests documented from outside the nesting area not observed during inside surveys as well as 4 nests observed from inside the nesting area not observed during outside surveys.

[2] 'Broadfoot' represents interior least tern nests present and monitored on the main peninsula at Broadfoot South and excludes 5 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 first observed after it hatched.

[4] 'DeWeese' represents interior least tern nests at DeWeese-Alda Sandpit.

Appendix 2. Daily and brooding-period survival rates for interior least tern broods (1 or more chicks) monitored on sandpits during 2011. 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	7	1	122	0.9913	0.0086	0.9411	0.9988	0.8331	0.3689	0.9771
Dyer	2	1	34	0.9692	0.0303	0.8113	0.9957	0.5187	0.0692	0.9398
Blue Hole	18	0	355	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	7	1	140	0.9925	0.0075	0.9488	0.9989	0.8539	0.4127	0.9799
Newark	6	2	96	0.9779	0.0155	0.9159	0.9945	0.6253	0.2271	0.9046
Wild Rose[2]	8	0	172	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
DeWeese[3]	3	0	66	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	51	5	985	0.9947	0.0024	0.9872	0.9978	0.8936	0.7688	0.9550

[1] 'Broadfoot' represents interior least tern broods present and monitored on the main peninsula at Broadfoot South and excludes broods 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.

[3] 'DeWeese' represents interior least tern broods at DeWeese-Alda Sandpit.

Appendix 3. Daily and incubation-period survival rates for piping plover nests monitored on sandpits during 2011. 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[1]	6	1	144	0.9928	0.0072	0.9506	0.9990	0.8163	0.3376	0.9749
Dyer	2	0	57	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Blue Hole	11	1	287	0.9964	0.0036	0.9748	0.9995	0.9035	0.5439	0.9866
Johnson	2	1	45	0.9767	0.0230	0.8524	0.9967	0.5173	0.0687	0.9397
Broadfoot[2]	8	3	162	0.9807	0.0110	0.9419	0.9938	0.5794	0.2408	0.8568
Wild Rose[3]	4	1	79	0.9867	0.0132	0.9114	0.9981	0.6867	0.1727	0.9584
All Sites	33	8	774	0.9906	0.0035	0.9804	0.9955	0.7673	0.5866	0.8846

[1] Includes 1 piping plover nest located outside the fenced nesting areas that failed.

[2] 'Broadfoot' represents piping plover nests present and monitored on the main peninsula at Broadfoot South and excludes 1 nest located on 2 small islands located northwest of the main peninsula that we could not access.

[3] 'Wild Rose' represents piping plover nests at Wild Rose Ranch East Pit.

Appendix 4. Daily and brooding-period survival rates for piping plover broods (1 or more chicks) monitored on sandpits during 2011. 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	5	3	118	0.9737	0.0150	0.9215	0.9915	0.4735	0.1527	0.8178
Blue Hole	10	0	281	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Johnson	1	0	29	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Dyer	2	2	25	0.9154	0.0577	0.7152	0.9790	0.0841	0.0021	0.8008
Broadfoot[1]	5	1	123	0.9916	0.0084	0.9426	0.9988	0.7887	0.2923	0.9712
Wild Rose[2]	3	1	76	0.9863	0.0136	0.9091	0.9981	0.6796	0.1664	0.9575
All Sites	26	7	652	0.9889	0.0042	0.9768	0.9947	0.7307	0.5338	0.8655

[1] 'Broadfoot' represents piping plover broods present and monitored on the main peninsula at Broadfoot South and excludes 1 brood located on a small island located northwest of the main peninsula that we could not access.

[2] 'Wild Rose' represents piping plover broods at Wild Rose Ranch East Pit.

Mayfield Survival Estimates

Appendix 5. Mayfield estimates of daily and incubation-period survival rates for interior least tern nests monitored on sandpits during 2011. 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	10	3	178	0.9831	0.0096	0.9642	1.0021	0.6998	0.4654	1.0441
Dyer	4	2	74	0.9730	0.0189	0.9360	1.0099	0.5625	0.2495	1.2304
Blue Hole	24[1]	6	452	0.9867	0.0054	0.9762	0.9973	0.7553	0.6027	0.9443
Johnson	1	1	6	0.8333	0.1521	0.5351	1.1315	0.0217	0.0000	13.3983
Broadfoot[2]	15	7	230	0.9696	0.0113	0.9474	0.9918	0.5225	0.3213	0.8406
Newark	19	13	161	0.9193	0.0215	0.8772	0.9613	0.1707	0.0638	0.4369
Wild Rose[3]	7	0	154	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
DeWeese[4]	3	0	64	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	83	32	1319	0.9757	0.0042	0.9674	0.9840	0.5970	0.4990	0.7133

[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 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 6. Mayfield estimates of daily and brooding-period survival rates for interior least tern broods monitored on sandpits during 2011. 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 Lower	Daily Brood Survival Rate 95% CI Upper	Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI Lower	Brooding Period Survival Rate 95% CI Upper
Lexington	7	1	122	0.9918	0.0082	0.9758	1.0078	0.8413	0.5979	1.1773
Dyer	2	1	34	0.9706	0.0290	0.9138	1.0274	0.5342	0.1506	1.7635
Blue Hole	18	0	355	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Broadfoot[1]	7	1	140	0.9929	0.0071	0.9789	1.0068	0.8602	0.6391	1.1531
Newark	6	2	96	0.9792	0.0146	0.9506	1.0077	0.6427	0.3451	1.1757
Wild Rose[2]	8	0	172	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
DeWeese[3]	3	0	66	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	51	5	985	0.9949	0.0023	0.9905	0.9994	0.8986	0.8181	0.9867

[1] 'Broadfoot' represents interior least tern broods present and monitored on the main peninsula at Broadfoot South and excludes broods 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.

[3] 'DeWeese' represents interior least tern broods at DeWeese-Alda Sandpit.

Appendix 7. Mayfield estimates of daily and incubation-period survival rates for piping plover nests monitored on sandpits during 2011. 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 Lower	Daily Nest Survival Rate 95% CI Upper	Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI Lower	Incubation Period Nest Survival Rate 95% CI Upper
Lexington[1]	6	1	144	0.9931	0.0069	0.9750	1.0066	0.8227	0.5598	1.2029
Dyer	2	0	57	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Blue Hole	11	1	287	0.9965	0.0035	0.9897	1.0033	0.9069	0.7483	1.0976
Johnson	2	1	45	0.9778	0.0220	0.9347	1.0208	0.5330	0.1510	1.7819
Broadfoot[2]	8	3	162	0.9815	0.0106	0.9607	1.0022	0.5925	0.3256	1.0647
Wild Rose[3]	4	1	79	0.9873	0.0126	0.9627	1.0120	0.7000	0.3448	1.3963
All Sites	33	8	774	0.9897	0.0036	0.9825	0.9968	0.7476	0.6106	0.9139

[1] Includes 1 piping plover nest located outside the fenced nesting areas that failed.

[2] 'Broadfoot' represents piping plover nests present and monitored on the main peninsula at Broadfoot South and excludes 1 nest located on 2 small islands located northwest of the main peninsula that we could not access.

[3] 'Wild Rose' represents piping plover nests at Wild Rose Ranch East Pit.

Appendix 8. Mayfield estimates of daily and brooding-period survival rates for piping plover broods monitored on sandpits during 2011. 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	5	3	118	0.9746	0.0145	0.9462	1.0030	0.4862	0.2124	1.0868
Blue Hole	10	0	281	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Johnson	1	0	29	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Dyer	2	2	25	0.9200	0.0543	0.8173	1.0263	0.0968	0.0031	2.0713
Broadfoot[1]	5	1	123	0.9919	0.0081	0.9760	1.0077	0.7957	0.5065	1.2410
Wild Rose[2]	3	1	76	0.9868	0.0131	0.9612	1.0125	0.6901	0.3304	1.4145
All Sites	26	7	652	0.9893	0.0040	0.9814	0.9972	0.7392	0.5903	0.9238

[1] 'Broadfoot' represents piping plover broods present and monitored on the main peninsula at Broadfoot South and excludes 1 brood located on a small island located northwest of the main peninsula that we could not access.

[2] 'Wild Rose' represents piping plover broods at Wild Rose Ranch East Pit.

Appendix 9. Habitat measures collected at confirmed (eggs observed in a scrape) interior least tern nests we observed and could access during 2011.

		Site Measures				Nest Measures						1yd² Area Nest Measures				Nest
Nest ID	Site Name	Habitat Type	15 June % Bare-Sand	Nesting Area Size (Ac)	Sandpit Pond Size (Ac)	Nest Management	Nest Furniture	Elevation above Water (Ft)	Distance to nearest Waterline (Ft)	Distance to nearest Predator Perch (Ft)	Distance to nearest non-suitable habitat (FT)	%Vegetative Cover	Maximum Vegetation Height (In)	Distance to nearest Vegetation >6" (In)	Substrate	Fate
LT135	Lexington Pit	SP	>75	13	41	None	No	6.4	53	534	293	0	0	None		Hatched
LT137	Lexington Pit	SP	>75	13	41	None	Yes	4.2	39	273	273	0	0	None		Hatched
LT138	Lexington Pit	SP	>75	13	41	None	Yes	2.8	57	369	387	0	0	None		Hatched
LT139	Lexington Pit	SP	>75	13	41	None	Yes	5.2	42	321	267	0	0	None		Failed
LT140	Lexington Pit	SP	>75	13	41	None	Yes	3.2	150	456	390	0	0	None		Failed
LT141	Lexington Pit	SP	>75	13	41	None	Yes	5.4	126	648	471	0	0	None		Hatched
LT142	Lexington Pit	SP	>75	13	41	None	No	7.9	90	450	150	0	0	None		Hatched
LT143	Lexington Pit	SP	>75	13	41	None	Yes	3.8	99	537	537	0	0	None		Hatched
LT144	Lexington Pit	SP	>75	13	41	None	Yes	3.4	66	405	171	0	0	None		Hatched
LT145	Lexington Pit	SP	>75	13	41	None	No	3.9	66	177	129	0	0	None		Failed
LT239	Blue Hole Pit	SP	>75	25	54	None	Yes	7.7	105	675	348	0	0	None		Hatched
LT241	Blue Hole Pit	SP	>75	25	54	None	Yes	9.5	63	411	372	0	0	None		Hatched
LT242	Blue Hole Pit	SP	>75	25	54	None	No	3.8	219	594	198	0	0	None		Hatched
LT243	Blue Hole Pit	SP	>75	25	54	None	Yes	3.9	255	495	303	0	0	None		Hatched
LT244	Blue Hole Pit	SP	>75	25	54	None	No	4.4	87	390	507	0	0	None		Failed
LT245	Blue Hole Pit	SP	>75	25	54	None	No	6.7	132	588	543	0	0	None		Hatched
LT246	Blue Hole Pit	SP	>75	25	54	None	No	6.7	237	696	579	0	0	None		Hatched
LT247	Blue Hole Pit	SP	>75	25	54	None	Yes	5.8	48	516	414	0	0	None		Hatched
LT248	Blue Hole Pit	SP	>75	25	54	None	Yes	6.7	135	582	525	0	0	None		Hatched
LT249	Blue Hole Pit	SP	>75	25	54	None	Yes	4.9	72	585	579	0	0	None		Failed
LT250	Blue Hole Pit	SP	>75	25	54	None	Yes	6.4	219	414	117	0	0	None		Hatched
LT251	Blue Hole Pit	SP	>75	25	54	None	Yes	7.9	132	600	588	0	0	None		Hatched
LT252	Blue Hole Pit	SP	>75	25	54	None	Yes	7.3	228	621	600	0	0	None		Hatched
LT254	Blue Hole Pit	SP	>75	25	54	None	No	5.8	60	510	441	0	0	None		Hatched
LT255	Blue Hole Pit	SP	>75	25	54	None	Yes	5.7	270	522	258	0	0	None		Hatched
LT256	Blue Hole Pit	SP	>75	25	54	None	Yes	2.1	45	552	507	0	0	None		Hatched
LT257	Blue Hole Pit	SP	>75	25	54	None	No	8.7	288	498	546	0	0	None		Failed
LT258	Blue Hole Pit	SP	>75	25	54	None	Yes	2.2	192	741	321	0	0	None		UNK
LT259	Blue Hole Pit	SP	>75	25	54	None	No	7.7	162	666	600	0	0	None		Hatched
LT260	Blue Hole Pit	SP	>75	25	54	None	Yes	6.3	18	528	480	0	0	None		Hatched
LT261	Blue Hole Pit	SP	>75	25	54	None	No	8.5	159	480	474	0	0	None		Hatched
LT262	Blue Hole Pit	SP	>75	25	54	None	No	9.2	231	600	555	0	0	None		Failed
LT263	Blue Hole Pit	SP	>75	25	54	None	No	7.7	222	603	555	0	0	None		Failed
LT264	Blue Hole Pit	SP	>75	25	54	None	No	5.7	159	480	474	0	0	None		Hatched

Appendix 9 (Continued)

		Site Measures				Nest Measures						1yd² Area Nest Measures				Nest
Nest ID	Site Name	Habitat Type	15 June % Bare-Sand	Nesting Area Size (Ac)	Sandpit Pond Size (Ac)	Nest Management	Nest Furniture	Elevation above Water (Ft)	Distance to nearest Waterline (Ft)	Distance to nearest Predator Perch (Ft)	Distance to nearest non-suitable habitat (FT)	%Vegetative Cover	Maximum Vegetation Height (In)	Distance to nearest Vegetation >6" (In)	Substrate	Fate
LT331	Johnson Pit	SP	>75	9	51	None	Yes	1.6	48	234	204	0	0	None		Failed
LT411	Dyer Pit	SP	>75	19	24	None	Yes	7.2	120	834	510	0	0	None		Failed
LT412	Dyer Pit	SP	>75	19	24	None	No	9.2	198	1062	330	0	0	None		Hatched
LT413	Dyer Pit	SP	>75	19	24	None	Yes	7.4	75	885	414	0	0	None		Failed
LT415	Dyer Pit	SP	>75	19	24	None	No	8.4	153	879	462	0	0	None		Hatched
LT416	Dyer Pit	SP	>75	19	24	None	No	6.3	153	879	462	0	0	None		UNK
LT537	Broadfoot South Pit	SP	>75	16	80	None	No	5.7	138	780	525	0	0	None		Hatched
LT538	Broadfoot South Pit	SP	>75	16	80	None	No	5.4	90	489	207	0	0	None		Hatched
LT539	Broadfoot South Pit	SP	>75	16	80	None	Yes	4.2	99	915	840	0	0	None		UNK
LT540	Broadfoot South Pit	SP	>75	16	80	None	No	5.0	90	639	96	0	0	None		Failed
LT541	Broadfoot South Pit	SP	>75	16	80	None	Yes	3.3	81	144	144	0	0	None		Hatched
LT542	Broadfoot South Pit	SP	>75	16	80	None	Yes	3.7	81	543	510	0	0	None		Hatched
LT543	Broadfoot South Pit	SP	>75	16	80	None	No	3.6	102	762	699	0	0	None		Failed
LT545	Broadfoot South Pit	SP	>75	16	80	None	Yes	5.4	111	870	768	0	0	None		UNK
LT546	Broadfoot South Pit	SP	>75	16	80	None	No	3.7	93	1245	450	0	0	None		Failed
LT547	Broadfoot South Pit	SP	>75	16	80	None	No	3.4	69	993	360	0	0	None		Hatched
LT548	Broadfoot South Pit	SP	>75	16	80	None	No	3.4	93	279	93	0	0	None		Hatched
LT549	Broadfoot South Pit	SP	>75	16	80	None	Yes	3.9	90	123	123	0	0	None		Hatched
LT550	Broadfoot South Pit	SP	>75	16	80	None	Yes	4.7	63	348	93	0	0	None		Hatched
LT551	Broadfoot South Pit	SP	>75	16	80	None	Yes	4.3	96	693	102	0	0	None		Failed
LT552	Broadfoot South Pit	SP	>75	16	80	None	No	4.9	43	891	225	0	0	None		Failed
LT-BF2	Broadfoot South Pit	SP	>75	16	80	None	No	2.4	45	NA	549	UNK	UNK	UNK		Hatched
LT-BF3	Broadfoot South Pit	SP	>75	16	80	None	UNK	1.7	21	NA	384	UNK	UNK	UNK		UNK
LT-BF4	Broadfoot South Pit	SP	>75	16	80	None	UNK	3.0	45	NA	555	UNK	UNK	UNK		UNK
LT-BF5	Broadfoot South Pit	SP	>75	16	80	None	No	2.8	60	NA	501	UNK	UNK	UNK		UNK
LT-BF6	Broadfoot South Pit	SP	>75	16	80	None	No	1.0	15	NA	630	UNK	UNK	UNK		Failed
LT701	Newark Pit	SP	>75	8	46	None	Yes	NA	174	690	300	0	0	None		Hatched
LT702	Newark Pit	SP	>75	8	46	None	No	NA	207	759	348	0	0	None		Failed
LT703	Newark Pit	SP	>75	8	46	None	No	NA	84	690	552	0	0	None		Failed
LT704	Newark Pit	SP	>75	8	46	None	No	NA	138	660	660	0	0	None		Failed
LT705	Newark Pit	SP	>75	8	46	None	No	NA	138	660	285	0	0	None		Failed
LT706	Newark Pit	SP	>75	8	46	None	Yes	NA	75	744	573	0	0	None		Failed
LT707	Newark Pit	SP	>75	8	46	None	Yes	NA	102	867	612	0	0	None		Failed
LT708	Newark Pit	SP	>75	8	46	None	Yes	NA	81	567	567	0	0	None		Failed

Appendix 9 (Continued)

		Site Measures				Nest Measures						1yd² Area Nest Measures				Nest
Nest ID	Site Name	Habitat Type	15 June % Bare-Sand	Nesting Area Size (Ac)	Sandpit Pond Size (Ac)	Nest Management	Nest Furniture	Elevation above Water (Ft)	Distance to nearest Waterline (Ft)	Distance to nearest Predator Perch (Ft)	Distance to nearest non-suitable habitat (FT)	%Vegetative Cover	Maximum Vegetation Height (In)	Distance to nearest Vegetation >6" (In)	Substrate	Fate
LT709	Newark Pit	SP	>75	8	46	None	Yes	NA	72	1179	789	0	0	None		Failed
LT710	Newark Pit	SP	>75	8	46	None	No	NA	120	1110	675	0	0	None		Hatched
LT711	Newark Pit	SP	>75	8	46	None	Yes	NA	102	372	540	0	0	None		Hatched
LT712	Newark Pit	SP	>75	8	46	None	Yes	NA	90	423	600	0	0	None		Failed
LT713	Newark Pit	SP	>75	8	46	None	Yes	NA	81	432	606	0	0	None		Failed
LT714	Newark Pit	SP	>75	8	46	None	No	NA	33	780	697	0	0	None		Failed
LT715	Newark Pit	SP	>75	8	46	None	No	NA	51	885	750	0	0	None		Hatched
LT716	Newark Pit	SP	>75	8	46	None	No	NA	48	840	624	0	0	None		Failed
LT717	Newark Pit	SP	>75	8	46	None	No	NA	132	1008	714	0	0	None		Failed
LT718	Newark Pit	SP	>75	8	46	None	No	NA	9	699	648	0	0	None		Hatched
LT719	Newark Pit	SP	>75	8	46	None	No	NA	36	852	636	0	0	None		Hatched
LT905	Wild Rose Ranch East Pit	SP	50-75	3	12	None	No	3.4	87	986	141	0	0	None		Hatched
LT906	Wild Rose Ranch East Pit	SP	50-75	3	12	None	No	1.1	54	795	174	1	3	None		Hatched
LT907	Wild Rose Ranch East Pit	SP	50-75	3	12	None	No	1.4	66	651	207	1	3	None		Hatched
LT908	Wild Rose Ranch East Pit	SP	50-75	3	12	None	No	2.7	63	564	192	0	0	None		Hatched
LT909	Wild Rose Ranch East Pit	SP	50-75	3	12	None	No	1.2	63	474	243	1	5	None		Hatched
LT901	Wild Rose Ranch East Pit	SP	50-75	3	12	None	No	2.2	60	801	90	1	5	None		Hatched
LT911	Wild Rose Ranch East Pit	SP	50-75	3	12	None	Yes	3.4	72	738	123	1	1	None		Hatched
LT912	Wild Rose Ranch East Pit	SP	50-75	3	12	None	No	2.5	75	456	303	1	1	None		Hatched
LT1	DeWeese-Alda Pit	SP	>75	3	53	None	No	7.2	111	414	318	0	0	None		Hatched
LT2	DeWeese-Alda Pit	SP	>75	3	53	None	No	12.5	201	411	261	0	0	None		Hatched
LT3	DeWeese-Alda Pit	SP	>75	3	53	None	No	10.4	117	582	414	0	0	None		Hatched

Appendix 10. Habitat measures collected at confirmed (eggs observed in a scrape) piping plover nests observed during 2011.

		Site Measures				Nest Measures						1yd² Area Nest Measures				Nest
Nest ID	Site Name	Habitat Type	15 June % Bare-Sand	Nesting Area Size (Ac)	Sandpit Pond Size (Ac)	Nest Management	Nest Furniture	Elevation above Water (Ft)	Distance to nearest Waterline (Ft)	Distance to nearest Predator Perch (Ft)	Distance to nearest non-suitable habitat (FT)	%Vegetative Cover	Maximum Vegetation Height (In)	Distance to nearest Vegetation >6" (In)	Substrate	Fate
PP130	Lexington Pit	SP	>75	13	41	None	No	6.2	113	345	113	0	0	None		Hatched
PP131	Lexington Pit	SP	>75	13	41	None	Yes	5.7	108	576	168	0	0	None		Hatched
PP132	Lexington Pit	SP	>75	13	41	None	No	4.4	39	600	36	0	0	None		Hatched
PP133	Lexington Pit	SP	>75	13	41	None	No	9.7	162	474	279	0	0	None		Failed
PP134	Lexington Pit	SP	>75	13	41	None	Yes	4.7	123	174	168	0	0	None		Failed
PP136	Lexington Pit	SP	>75	13	41	None	No	6.2	69	612	117	0	0	None		Hatched
PP230	Blue Hole Pit	SP	>75	25	54	None	No	3.1	96	525	510	0	0	None		Hatched
PP231	Blue Hole Pit	SP	>75	25	54	None	No	1.4	120	600	300	0	0	None		Hatched
PP232	Blue Hole Pit	SP	>75	25	54	None	Yes	7.6	270	498	270	0	0	None		Hatched
PP233	Blue Hole Pit	SP	>75	25	54	None	Yes	4.5	90	648	438	0	0	None		Failed
PP234	Blue Hole Pit	SP	>75	25	54	None	Yes	8.8	174	549	360	0	0	None		Hatched
PP235	Blue Hole Pit	SP	>75	25	54	None	Yes	7.1	210	480	480	0	0	None		Hatched
PP236	Blue Hole Pit	SP	>75	25	54	None	Yes	4.1	135	408	108	0	0	None		Hatched
PP237	Blue Hole Pit	SP	>75	25	54	None	No	8.9	204	639	657	0	0	None		Hatched
PP238	Blue Hole Pit	SP	>75	25	54	None	No	4.3	108	504	390	0	0	None		Failed
PP240	Blue Hole Pit	SP	>75	25	54	None	Yes	2.2	84	690	135	0	0	None		Hatched
PP253	Blue Hole Pit	SP	>75	25	54	None	Yes	3.8	81	810	198	0	0	None		Hatched
PP330	Johnson Pit	SP	>75	9	51	None	No	4.2	66	660	261	0	0	None		Hatched
PP332	Johnson Pit	SP	>75	9	51	None	No	2.0	99	351	123	0	0	None		Hatched
PP410	Dyer Pit	SP	>75	19	24	None	No	6.3	48	633	642	0	0	None		Failed
PP414	Dyer Pit	SP	>75	19	24	None	Yes	7.4	66	852	450	0	0	None		Hatched
PP530	Broadfoot South Pit	SP	>75	16	80	None	Yes	4.1	117	300	525	0	0	None		Hatched
PP531	Broadfoot South Pit	SP	>75	16	80	None	No	4.2	111	540	840	0	0	None		Hatched
PP532	Broadfoot South Pit	SP	>75	16	80	None	No	2.8	30	915	156	0	0	None		Hatched
PP533	Broadfoot South Pit	SP	>75	16	80	None	Yes	4.0	135	429	474	0	0	None		Hatched
PP534	Broadfoot South Pit	SP	>75	16	80	None	No	5.6	6	300	693	0	0	None		Hatched
PP535	Broadfoot South Pit	SP	>75	16	80	None	Yes	3.4	30	969	240	0	0	None		Failed
PP536	Broadfoot South Pit	SP	>75	16	80	None	Yes	3.4	48	141	48	0	0	None		UNK
PP544	Broadfoot South Pit	SP	>75	16	80	None	No	4.6	120	465	180	0	0	None		Hatched
PP-BF1	Broadfoot South Pit	SP	>75	16	80	None	No	1.8	21	NA	597	UNK	UNK	UNK		Hatched
PP901	Wild Rose Ranch East Pit	SP	50-75	3	12	None	Yes	3.4	93	378	117	0	0	None		Hatched
PP902	Wild Rose Ranch East Pit	SP	50-75	3	12	None	Yes	1.8	96	768	108	1	1	None		Failed
PP903	Wild Rose Ranch East Pit	SP	50-75	3	12	None	Yes	1.6	33	588	48	1	2	None		Failed
PP904	Wild Rose Ranch East Pit	SP	50-75	3	12	None	Yes	0.7	12	627	27	3	3	None		Hatched

Appendix 11. 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 2011. See the Management Section of this report for a detailed description of management actions taken at each site. Site #'s correspond with Figure 4.

						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[B]	SP	HPFT	29	32	151	16	10	7	13	12	11[C]	106	9	6	5	12	5	3
2	Lexington Island	RI	N	4	3	2	2	0	0	0	0	0	1	1	0	0	0	0	0
3	Dyer Pit[D]	SP	RGHPFT	23	14	78	12	5	2	5	3	2	48	4	2	2	6	3	0
4	Cottonwood Ranch Island	RI	N	7	2	2	2	0	0	0	0	0	3	2	0	0	0	0	0
5	Cottonwood Ranch OCSW	SP	GPFT	12	5	1	1	0	0	0	0	0	4	2	0	0	0	0	0
6	Blue Hole	SP	HPFT	41	69	539	33	20	17	43	34	33	309	18	10	10	35	29	27
7	Johnson Pit	SP	HPFT	35	20	11	4	0	0	0	0	0	47	4	2	1	3	3	2
8	Elm Creek Island	RI	N	7	1	14	12	0	0	0	0	0	3	3	0	0	0	0	0
9	Broadfoot South[DE]	SP	RHPFT	34	33	346	23	20	8	17	13	12	205	13	9[F]	6	19	11	6
10	Newark[D]	SP	GRHPFT	32	16	164	12	19	6	15	9	9	36	3	0	0	0	0	0
11	Lilley – Wood River	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Wild Rose Ranch East Pit[D]	SP	D	25	23	198	14	8	8	18	17	17	92	8	4	3	10	7	6
13	Deweese – Alda[D]	SP	N	20	13	77	10	3	3	7	7	7	1	1	0	0	0	0	0
14	Hooker Brothers – GI West	SP	N	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Hooker Brothers – GI South	SP	N	7	4	7	6	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 2010; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2011; 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 3 nests (1 interior least tern and 2 piping plovers) that were not surrounded by electrified fence and water. One plover nest hatched 1 chick that was last observed when it was17 days old.

[C] Count includes 2 chicks documented as fledged from outside the colony that were known to have been predated (legs with metal band found) prior to reaching the fledging age of 21 days; last observed at 17 days of age.

[D] Inside and outside counts were made by the same observers so counts are not independent and nest, chick, and fledgling counts are identical across survey methods.

[E] Includes 6 nests (5 interior least tern and 1 piping plover) that were surrounded by water; however, we could not access the islands to monitor the nests. The plover nest hatched 3 chicks that were last observed when they were 6 days old. One interior least tern nest hatched 1 chick that was only observed during 1 survey.

[F] Includes 2 piping plover nests that were not surrounded by water or fence; both nests failed.

Appendix 12. 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 2011. See the Management Section of this report for a detailed description of management actions taken at each site. Site #'s correspond with Figure 4.

						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[B]	SP	HPFT	40	51	200	15	10	7	15	9	5[C]	161	10	6	5	14	5	3
2	Lexington Island	RI	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Dyer Pit[D]	SP	RGHPFT	28	30	66	6	5	2	5	3	2	58	5	2	2	6	3	0
4	Cottonwood Ranch Island	RI	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Cottonwood Ranch OCSW	SP	GPFT	9	5	0	0	0	0	0	0	0	4	1	0	0	0	0	0
6	Blue Hole	SP	HPFT	49	75	379	22	20	16	35	24	17	346	16	11	10	34	27	17
7	Johnson Pit	SP	HPFT	18	10	15	6	1	0	0	0	0	30	4	2	1	3	3	3
8	Elm Creek Island	RI	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Broadfoot South[DE]	SP	RHPFT	42	44	275	15	20	8	17	13	12	219	12	9[F]	6	19	11	6
10	Newark[D]	SP	GRHPFT	38	39	196	13	19	6	15	9	9	54	4	0	0	0	0	0
11	Lilley – Wood River	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Wild Rose Ranch East Pit[D]	SP	D	6	3	29	6	8	8	18	17	17	29	6	4	3	10	7	6
13	Deweese – Alda[D]	SP	N	2	1	14	10	3	3	7	7	7	0	0	0	0	0	0	0
14	Hooker Brothers – GI West	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	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 2010; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2011; 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 3 nests (1 interior least tern and 2 piping plovers) that were not surrounded by electrified fence and water. One plover nest hatched 1 chick that was last observed when it was17 days old.

[C] Count excludes 2 chicks documented as fledged from outside the colony that were found to have been predated (legs with metal band found) prior to reaching the fledging age of 21 days.

[D] Inside and outside counts were made by the same observers so counts are not independent and nest, chick, and fledgling counts are identical across survey methods.

[E] Includes 6 nests (5 interior least tern and 1 piping plover) that were surrounded by water; however, we did not have access to the islands to monitor the nests. The plover nest hatched 3 chicks that were last observed when they were 6 days old. One interior least tern nest hatched 1 chick that was only observed during 1 survey.

[F] Includes 2 piping plover nests that were not surrounded by water or fence; both nests failed.