Platte River Recovery Implementation Program

2008 – 2009

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

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

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

PREFACE

This is a preliminary report of the Platte River Recovery Implementation Program's monitoring and research efforts for interior least terns and piping plovers during 2008 and 2009. The report was prepared to inform Program partners, licensing agencies, and the general public of our activities and to provide a preliminary summary of results to fulfill the requirements of state (Nebraska Master Permit #1014) and federal (TE183430-0) Program monitoring permits. ***Data analyses are not final and should be treated as such when citing information, data, or analyses found in this document.***

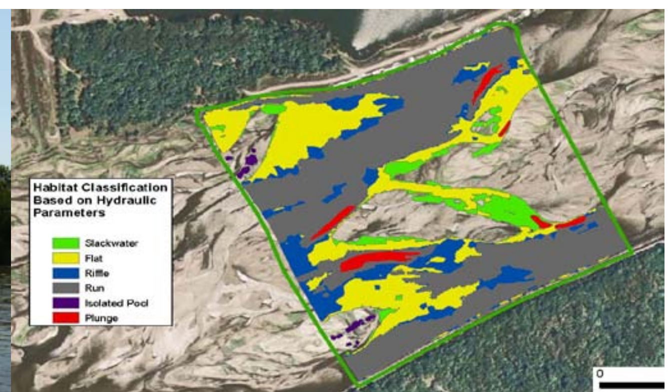
The report contains 4 sections: Introduction, Management, Monitoring, and Research.

Introduction: This section provides details of the study area and summarizes conditions during the 2008 and 2009 nesting seasons.

Management: This section describes on- and off-river land management practices used to facilitate nesting and actions taken to protect interior least tern and piping plover colonies and nests from predation and disturbance.

Monitoring: This section presents data collected annually and includes the number of interior least tern and piping plover nests, adults, chicks, and fledglings observed along the central Platte River during 2008 and 2009. These data are collected and summarized in a form that allows comparison across the entire range of each species and includes annual survey results.

Research: This section contains information about the methods and research related efforts that began during 2009. The results of 2009 research efforts will be reported in 2010.



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 2007, the Program's Technical Advisory Committee (TAC) agreed to implement a protocol to monitor the distribution and reproductive success of interior least terns and piping plovers in the central Platte River valley for the purpose of documenting reproductive efforts of these species. Monitoring has been 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), Central Nebraska Public Power and Irrigation District (CNPPID), and the United States Geologic Survey Northern Prairie Wildlife Research Center (USGS-NPWRC). Our protocol included monitoring interior least tern and piping plover presence and nesting on midstream-river sandbars and sand and gravel mines along the central Platte River between Lexington and Chapman, Nebraska. Interior least tern and piping plover activity and reproductive success during 2008 and 2009 are summarized in this report.

The Program's monitoring protocol was implemented by Program partners during 2001−2007. Analyses and data were reported in annual reports produced by West, Incorporated. Data were entered into the Program's Microsoft Access database which contains 11 data tables. Three tables contain information about the river survey, 4 tables document the nest monitoring, 1 table documents the nest habitat, 1 table lists the names and phone numbers for observers cited in the data tables and 1 table documents all the sandpit and constructed islands considered for the survey. The database also contains 4 data entry forms corresponding to the 4 datasheets. Raw data sheets are housed at the EDO.

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 and piping plovers nested on the expanses of sandy beach and foraged at sandpit lakes or on the river.

2008 – 2009 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 activity within the PRRIP Associated Habitat region is fairly predictable and dependent upon construction or management efforts; however, nesting by both species has occurred on lower islands built by the river (Central Platte River least tern and piping plover surveys, 2007 – summary of results).

Flows were unremarkable from April through the middle of May in 2008; however, above-average rainfall occurred across the region on 23 and 24 May, 2008 in south central Nebraska. The greatest amount of rainfall occurred along the Platte River valley between Gothenburg and Cozad, Nebraska with depths totaling 6–7 inches (2009, PRRIP – Data Analysis Summary Report for May 2008 Natural High Flow Event; hereafter 2009, HFE Report). The 23 and 24 May rainfall event was preceded by several lesser events producing a 1 May – 1 July precipitation total of 10–12 inches near the west end of the PRRIP associated habitats region (Figure 2); average May precipitation in this area is <4 inches (2009, HFE Report). Rainfall events of this magnitude in central Nebraska exceeded a 100-year return period and resulted in a natural high flow event on the Platte River throughout the habitat reach (Figure 3). The crest of the high flow event exceeded National Weather Service (NWS) flood stage levels (Flood stage level at Overton, Kearney, and Grand Island USGS gage stations were 7.0 ft, 6.0 ft, and 6.5 ft, respectively) and produced moderate flooding throughout the area. Peak high flows occurred during the last week of May and were subsiding the first week of June, but subsequent local-rain events resulted in regional pulses within the eastern reaches of the study area during June and July (Figure 3). River levels subsided enough in mid to late June that sandbar habitat for nesting interior least terns and piping plovers was available from the latter half of June onward. A time-series of photographs at a Program property near Kearney, Nebraska supplement the USGS-gage station flow data (Figures 6 and 7). River flows were unremarkable during 2009; peak flows were <4,000 cfs (Figure 4). As vegetative cover and nesting habitat present within the banks of the Platte River during 2008 and 2009 were influenced by flows during previous years, we included a figure showing river flows during the nesting seasons of 2003–2007. During June and July of 2003, 2004, and 2006, the average discharge in the Platte River at the USGS gage station located near Kearney was 46 cfs (range = 1 − 659 cfs; Figure 5). Average discharge recorded at the same gage station during June and July, 2008 and 2009 was 954 cfs (range = 138 – 4130; Figures 3 and 4).

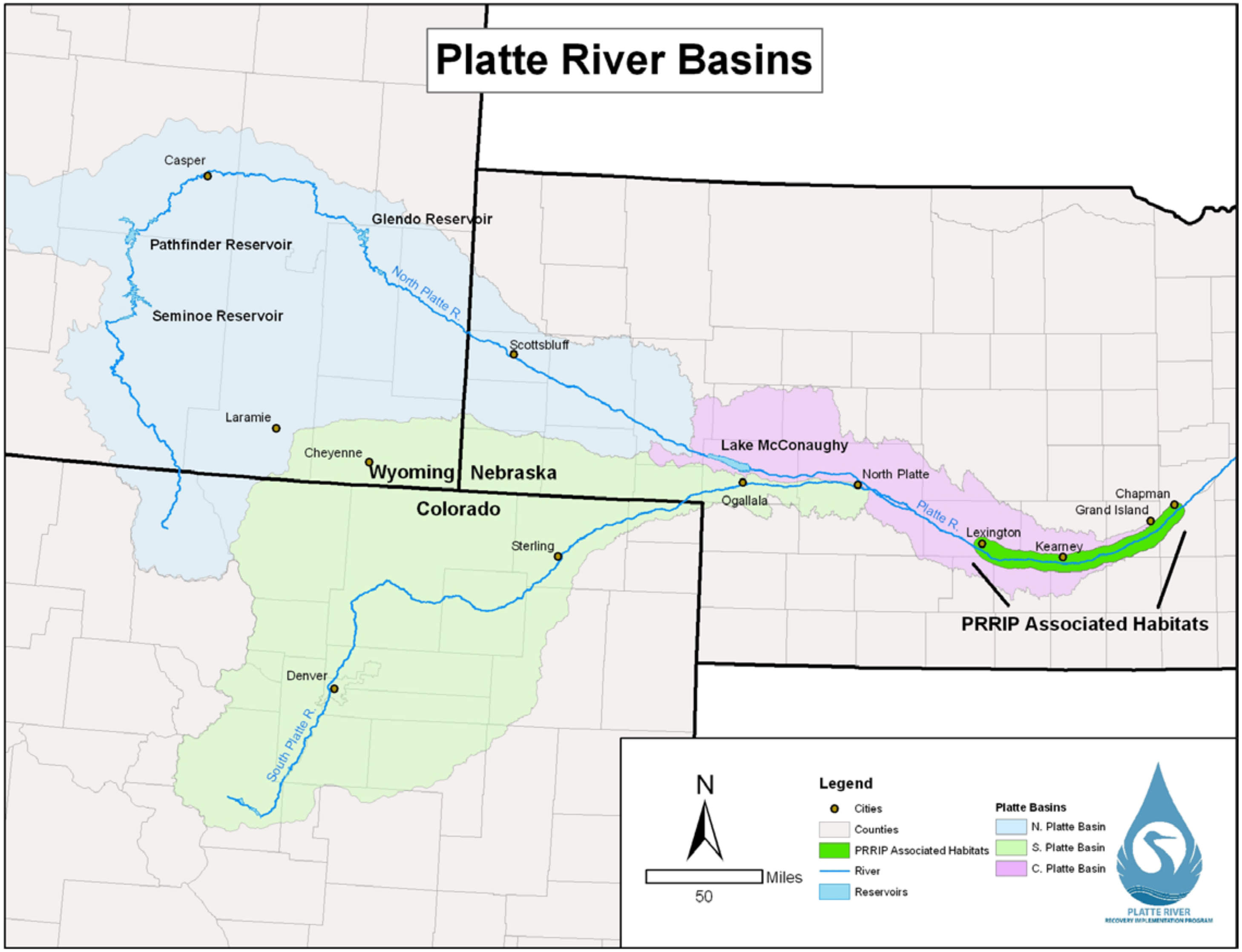


Figure 1. Platte River Basins extending from Colorado and Wyoming through Nebraska. The study area for our interior least tern and piping plover monitoring and research efforts was the PRRIP associated habitats region of the Platte River located between Lexington and Chapman, Nebraska.

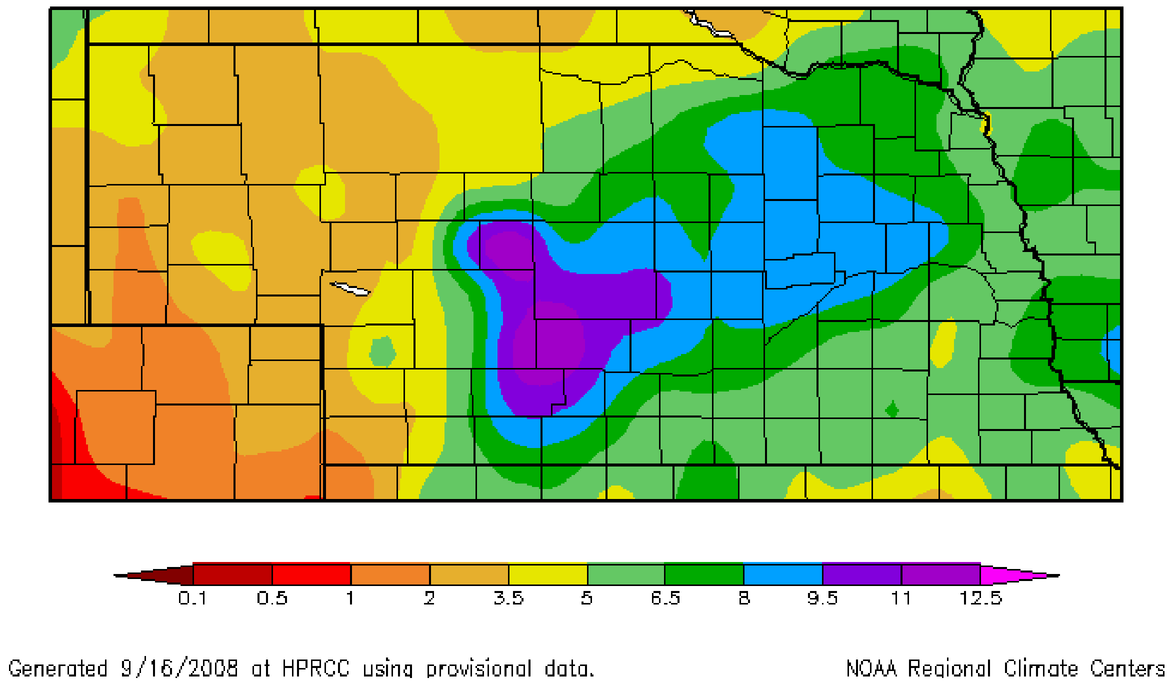


Figure 2. Nebraska precipitation in inches 1 May – 1 July, 2008. Image courtesy of High Plains Regional Climate Center, University of Nebraska-Lincoln.

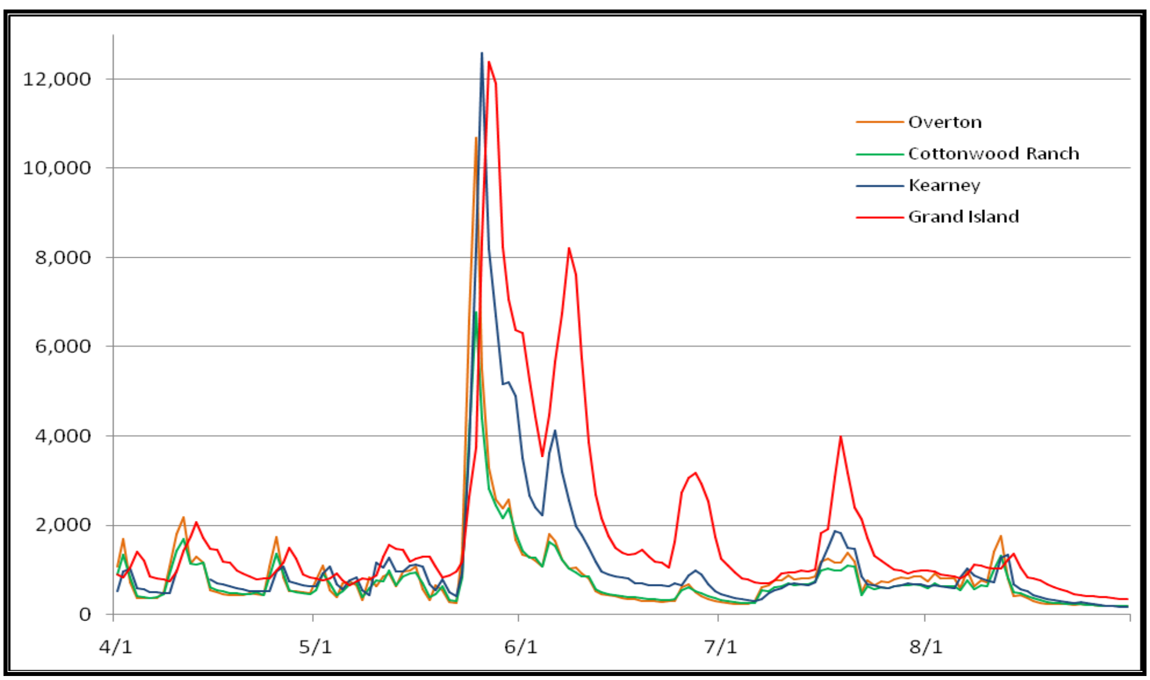


Figure 3. Mean daily discharge (ft^3/second; cfs) at Overton (USGS gage 06768000), Cottonwood Ranch near Overton (USGS gage 06768035), Kearney (USGS gage 06770200), and Grand Island, Nebraska (USGS gage 06770500), 1 April – 31 August, 2008 (Flood stage discharge levels at Kearney and Grand Island USGS gage stations were ~10,500 cfs, and ~11,200 cfs, respectively; information from other sites is unavailable). Available at: http://waterdata.usgs.gov/ne/nwis/current/?type=flow&group_key=NONE&search_site_no_station_nm=platte%20river. See Figure 8 for the location of gage stations within our study area.

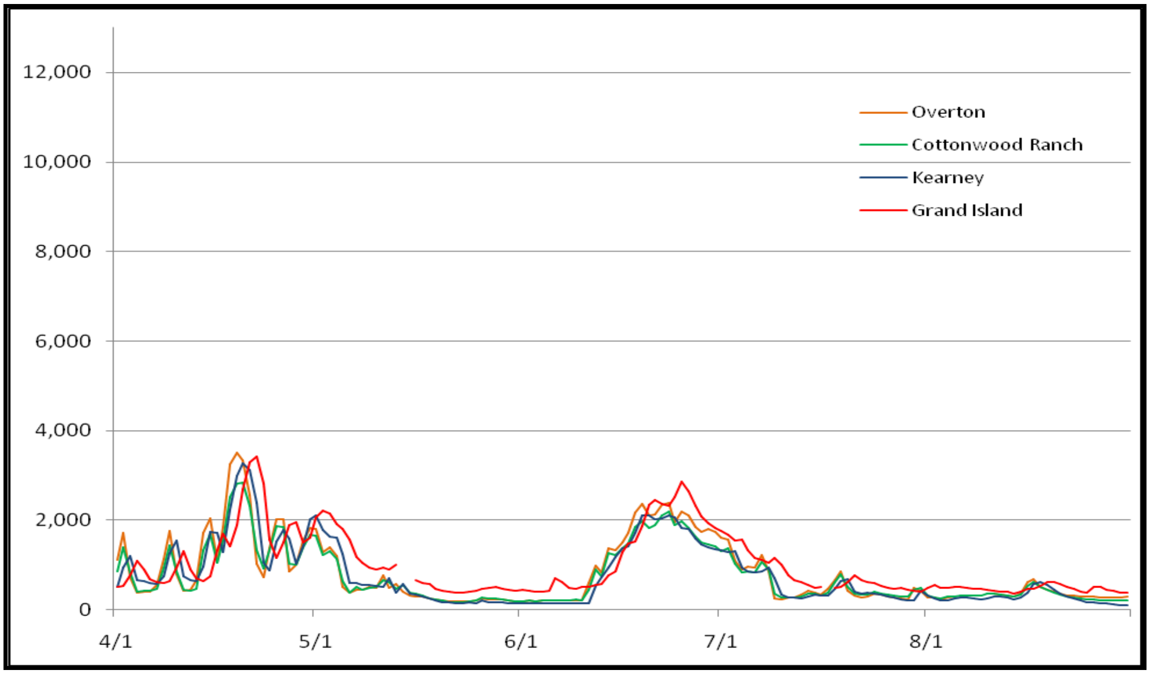


Figure 4. Mean daily discharge (ft^3/second; cfs) at Overton (USGS gage 06768000), Cottonwood Ranch near Overton (USGS gage 06768035), Kearney (USGS gage 06770200), and Grand Island, Nebraska (USGS gage 06770500), 1 April – 31 August, 2009 (Flood stage discharge levels at Kearney and Grand Island USGS gage stations were ~10,500 cfs, and ~11,200 cfs, respectively; information from other sites is unavailable). Available at: http://waterdata.usgs.gov/ne/nwis/current/?type=flow&group_key=NONE&search_site_no_station_nm=platte%20river. See Figure 8 for the location of gage stations within our study area.

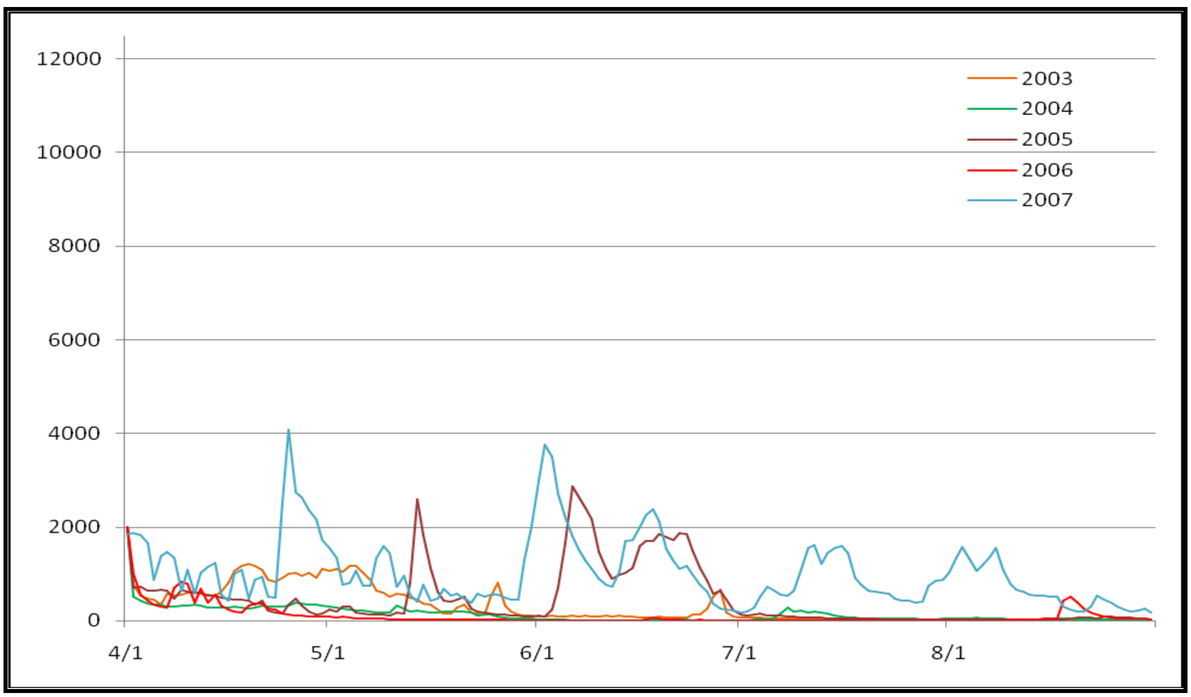


Figure 5. Mean daily discharge (ft^3/second; cfs) at Kearney, Nebraska (USGS gage 06770200) 1 April – 31 August, 2003−2007 (Flood stage discharge levels at Kearney USGS gage station was ~10,500 cfs). Available at: http://waterdata.usgs.gov/ne/nwis/current/?type=flow&group_key=NONE&search_site_no_station_nm=platte%20river. See Figure 8 for the location of gage stations within our study area.

5 May, 2008 – 650 cfs

27 May, 2008 – 7,770 cfs

16 June, 2008 – 870 cfs

Figure 6. Images of managed interior least tern and piping plover habitat at Program property located near Kearney, Nebraska. Images were captured before (top), during (middle), and after (bottom) the high-flow event that occurred during the end of May, 2008.

2 May, 2008

27 May, 2008

16 June, 2008

Figure 7. Images of managed interior least tern and piping plover habitat at Program property located near Kearney, Nebraska. Images were captured before (top), during (middle), and after (bottom) the high-flow event that occurred during the end of May, 2008.

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 2008 and 2009. Management activities were site and year specific and included: mechanical actions to remove vegetative cover (disking, tree removal, mowing, and burning); chemical application to eradicate or prevent emergence of vegetation (spring or fall herbicide application); and predator control (fencing and trapping). It is important to note that management activities, outlined in this report, are incomplete because information had not yet been compiled or was not available while compiling this report.

SANDPIT SITES:

Eleven of the 15 sandpits monitored for interior least tern and piping plover reproduction during 2008 and 2009 were actively being mined. Three sandpits located between Kearney and Lexington, Nebraska had management actions applied to improve habitat conditions for nesting birds. Two of these sites, Lexington and Johnson sandpits, were not mined during 2008 or 2009 and the third, Blue Hole sandpit, was actively mined, however, nesting occurred in areas away from mining activities. The waterlines of the Lexington sandpit, Blue Hole sandpit, and Johnson sandpit were chemically treated with an herbicide to kill existing vegetation during fall 2007. During the spring of 2008 and 2009, a pre-emergent herbicide was applied to nesting areas, existing predator fences were repaired, and predators were trapped and removed from these 3 sites. Trees were also removed at the Lexington sandpit to increase the buffer area around the sandpit during fall 2008. The 2 islands on the Wild Rose Ranch – East Pit, located between Kearney and Grand Island, Nebraska were disked during fall 2008 and a pre-emergent herbicide was applied to both nesting areas during spring 2009; this sandpit was not actively mined during either year. The Hooker Brothers – GI East Pit, located near Grand Island, Nebraska, was not mined during 2008 or 2009; however, the site was used for storage and mining products were transported off site each year.

RIVER ISLAND SITES:

Several years of prolonged drought (2003–2006) and low flows within the study area (Figure 5) resulted in the establishment of herbaceous and woody vegetation on many river islands. The Program and Program partners conducted many enhancement projects on existing river islands in an effort to increase nesting and improve reproductive success of interior least terns and piping plovers within Program associated habitats during 2008 and 2009; information on 15 managed or previously constructed riverine sites containing multiple islands is described below. Program partners also constructed several river islands between Kearney and Grand Island, Nebraska; however, information on the number and exact locations of these islands was not available and thus is not included in this report.

Lexington Island Site – Stands of Phragmites or common reed (*Phragmites australis*) were sprayed with an herbicide fall 2007 and trees were removed to increase the buffer area around this site fall 2008. A pre-emergent herbicide was applied to the nesting areas spring 2008 and 2009.

Overton Island Site – The buffer area and old channels were mowed fall 2007 and an herbicide was applied to vegetation in the old river beds fall 2008. A pre-emergent herbicide was applied to nesting areas spring 2008 and 2009.

Cottonwood Ranch Site **–** River channels were disked fall 2007 and 2008 and a pre-emergent herbicide was applied to the nesting areas spring 2008 and 2009.

Elm Creek Island Site **–** Stands of phragmites were sprayed fall 2007 and channels were disked fall 2007 and 2008. A pre-emergent herbicide was applied to nesting areas spring 2008 and 2009. Areas treated with a pre-emergent herbicide spring 2008 were mowed and burned fall 2008.

Wyoming Property Site − Pre-emergent herbicide applied to nesting areas spring 2008.

Dinan Tract Site **–** The nesting areas were disked and re-graded with dozers fall 2008; a pre-emergent herbicide was applied to nesting areas spring 2008 and 2009.

Triplett Trail Site **–** Pre-emergent herbicide applied to nesting areas spring 2008 and 2009.

Dippel Tract Site **–** The channels and nesting areas were disked fall 2008 and a pre-emergent herbicide was applied to nesting areas spring 2008 and 2009.

Uridil Site **–** Trees along the bank line of the river were removed to increase the buffer area and the channels and nesting areas were disked fall 2008. A pre-emergent herbicide was applied to nesting areas spring 2009.

Dahm Property Site – A pre-emergent herbicide was applied to nesting areas spring 2008. An off-channel slough restoration project occurred fall 2008; however, these activities were not related to interior least tern and piping plover reproduction.

Alda Farms Site **–** Channels and nesting areas were disked fall 2008. A pre-emergent herbicide was applied to nesting areas and a small chicken-wire predator fence was constructed at the site spring 2009.

Wild Rose Ranch Site **–** River island was lightly disked fall 2008 and a pre-emergent herbicide was applied to the nesting areas spring 2008 and 2009.

Mormon Island Site **–** Vegetation was removed from the river island with dozers and the island was back bladed spring 2009; a pre-emergent herbicide was also applied to the nesting areas spring 2009.

Rowe Sanctuary, Younkin, and Bartel's-John's Tract Sites **–** Management such as disking, grading, water-washing, or pre-emergent herbicides were applied at these sites fall 2008 or spring 2008 and 2009; however they were not monitored weekly as other sites.

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 standardized protocol; Program staff and cooperators have since implemented it.

<u>MID-MONTH RIVER AND SANDPIT SURVEYS:</u>

METHODS: We conducted 3 surveys of the central Platte River between Chapman and Lexington, Nebraska (river surveys) to locate active nests and individual birds (Component 1 of the protocol design) during 2008 and 2009. We used 2 airboats to survey all channels wider than 75yds that could be safely navigated and documented all observations of interior least tern and piping plover adults, nests, chicks, and fledglings located anywhere within this reach of river. Personnel from the USFWS-GI conducted river surveys between Chapman, Nebraska and the Kearney Canal headgate (near Elm Creek, Nebraska) on 19–21 May; 17–19 June; and 21–23 July during 2008. Personnel from the USFWS-GI and Headwaters Corporation conducted surveys in this reach on 19, 28, and 29 May; 16–18 June; and 20–22 July during 2009. Personnel from NPPD, CNPPID, and CPNRD conducted river surveys between Kearney Canal headgates and Lexington on 23 May, 12 June, and 15 July, 2008 and on 14 May, 16 June, and 10 July, 2009.

We also conducted mid-month surveys at 15 sandpits and 12 or 13 riverine sites containing constructed or managed islands (sandpit-island surveys) during 2008 and 2009 to count individual birds and locate active interior least tern and piping plover nests (Figure 8; see Table 3 for site names). The number of adults, nests, chicks and fledglings detected on the site visit nearest to 15 May, 15 June, and 15 July were summed across the sites surveyed. Personnel from CNPPID, CPNRD, Headwaters Corporation, NPPD, USGS-NPWRC, and USFWS-GI conducted sandpit-island surveys. Additional sandpits and riverine sites were observed during the nesting season, but we determined the habitat was unsuitable for nesting interior least terns and piping plovers.

RESULTS: The Chapman – the Kearney Canal headgate river surveys required 3 days to complete during May, June, and July 2008 and 2009. It is important to note that all counts of adults, nests, chicks, and fledglings reported represent minimums present as we did not enter colony sites to search vegetated areas. We observed 10 interior least tern nests and 5 piping plover nests during 2008 and 7 interior least tern nests and 1 piping plover nest during 2009. We detected 1 piping plover brood (3 chicks) at the Dinan site during the 2008 river surveys (2 coyotes were chased off the nesting island during the observation) and 2 piping plover broods (6 chicks) near Blue Hole during 2009 (Table 1; Figure 8; see Table 3 for site names). We observed an interior least tern chick at the Dinan tract (Figure 8) during the July, 2009 river survey. Although interior least tern chicks have been documented and observed to fledge at river island sites in the past, this was the first observation of an interior least tern chick during any mid-month river survey in over 9 years. The most birds were observed on the river during the May surveys in 2008 and 2009. We observed 30 interior least tern and 7 piping plover adults during the May, 2008 survey and 22 interior least tern and 7 piping plover adults during the May, 2009 survey (Table 1).

We surveyed 15 sandpits and 12 riverine sites with managed or constructed islands during the 2008 sandpit-island surveys. We surveyed an additional riverine site, Mormon Island, during sandpit-island surveys in 2009. We observed 30 interior least tern and 11 piping plover nests located on sandpits during sandpit-island surveys in 2008 and 24 interior least tern and 9 piping plover nests located on sandpits during these surveys in 2009. Observations at one of the sandpits (Broadfoot Sand and Gravel – South), however, were collected from a distance due to access limitations; our ability to determine exact counts of birds, nests, chicks, and fledglings were hindered by the large number present at the site, the size of the area, and the availability of hiding cover. We observed the most interior least terns during July, 2008 and 2009 sandpit-island surveys; 76, 9, and 10 interior least tern adults, chicks, and fledglings, respectively, in 2008 and 51, 12, and 12 interior least tern adults, chicks, and fledglings, respectively, in 2009 (Table 2). We also observed the most piping plovers during July, 2008 and 2009 sandpit-island surveys; 18 and 8 piping plover adults and chicks, respectively, in 2008 and 14, 6, and 10 piping plover adults, chicks, and fledglings, respectively, in 2009 (Table 2).

Table 1. Number of adults, nests, chicks, and fledgling interior least terns and piping plovers observed during mid-month airboat surveys on the Platte River between Chapman and Lexington, Nebraska, 2001–2009.

	Interior Least Tern				Piping Plover			
Survey	**Adults**	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Nests**	**Chicks**	**Fledglings**
May-09	22	0	0	0	7	1	0	0
Jun-09	27	2	0	0	1	0	0	0
Jul-09	23	5	0	1	5	0	0	6
May-08	30	0	0	0	7	3	0	0
Jun-08*	19	8	0	0	7	2	0	0
Jul-08*	21	2	0	0	3	0	2	1
May-07	26	0	0	0	7	0	0	0
Jun-07	41	11	0	0	10	2	3	0
Jul-07	23	1	0	0	6	1	2	0
May-06	16	0	0	0	10	0	0	0
Jun-06	3	0	0	0	2	0	0	0
May-05	18	0	0	0	1	0	0	0
Jun-05	27	0	0	0	10	0	0	0
Jul-05	3	0	0	0	0	0	0	2
May-04	26	0	0	0	5	0	0	0
Jun-04	6	0	0	0	3	0	0	0
May-03	28	0	0	0	10	0	0	0
Jun-03	17	0	0	0	9	0	0	0
May-02	4	0	0	0	0	0	0	0
Jun-02	18	0	0	0	1	0	0	0
Jul-02	31	0	0	7	5	0	0	5
May-01	16	0	0	0	2	0	0	0
Jun-01	23	0	0	0	5	0	0	0
Jul-01	16	0	0	5	17	0	0	12

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

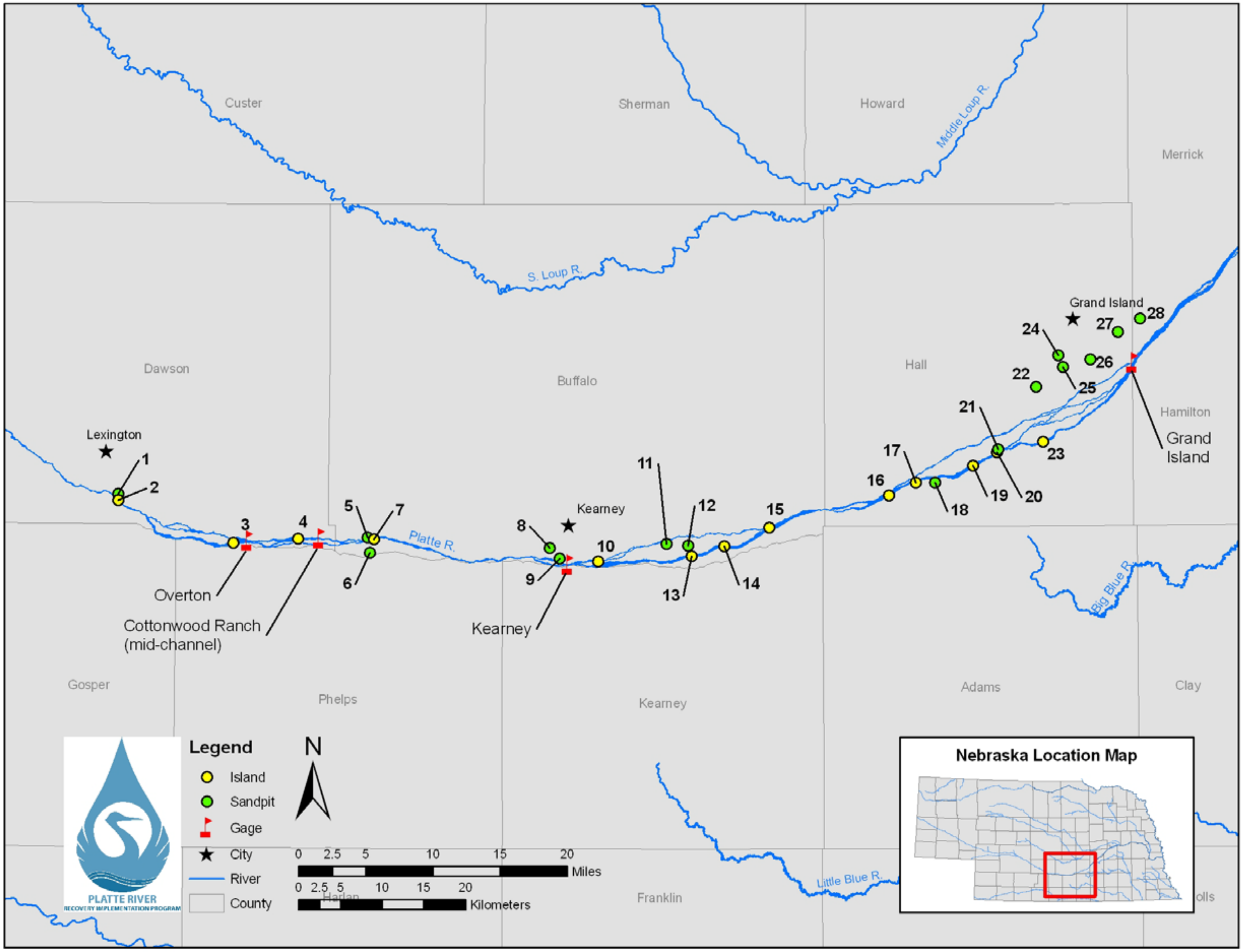


Figure 8. Study area including sandpits and river island sites monitored for interior least tern and piping plover nesting and foraging activities during 2008 and 2009. Names of sites are located in Table 3.

Table 2. Number of adults, nests, chicks, and fledgling interior least terns and piping plovers observed during mid-month surveys of sandpits and managed or constructed islands on the Platte River between Chapman and Lexington, Nebraska, 2001–2009. Observations at Broadfoot Sand and Gravel − South were collected from a distance, due to access limitations; actual number of birds present within Program associated habitats was likely higher.

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

SUMMARY: The trend in number of adult birds observed during May and June mid-month airboat river surveys, though highly variable, increased during the 2001–2009 timeframe; however, July numbers have declined (Figure 9). It is important to note, however, that river conditions (low or no flow) precluded many June and July surveys between 2003 and 2006 and that all June and July river surveys conducted during this period, excluding the June 2005 survey, only occurred upstream of the Kearney Canal Headgates. Counts of birds detected during river surveys are not adjusted to account for the presence of birds at nearby sandpits and, as mentioned above, all counts of adults, nests, chicks, and fledglings reported represent minimums present as we did not enter colony sites to search vegetated areas.

We observed 1 adult snowy plover at the Dinan site during the May, 2008 river survey and 1 adult snowy plover was observed foraging at Mormon Island and 2 adult snowy plovers foraging with an adult piping plover near the Triplett Trail site during the June, 2009 river survey (Figure 8, see Table 3 for site names). No snowy plover nests were observed while conducting river surveys during 2008 or 2009. A pair of snowy plovers and a nest, however, was observed at the Dinan Tract site during weekly site surveys in 2008 and 2009; snowy plover chicks fledged at the Dinan Tract site during 2009. Two snowy plover nests were also observed at the Dinan Tract site in 2007; one fledged young.

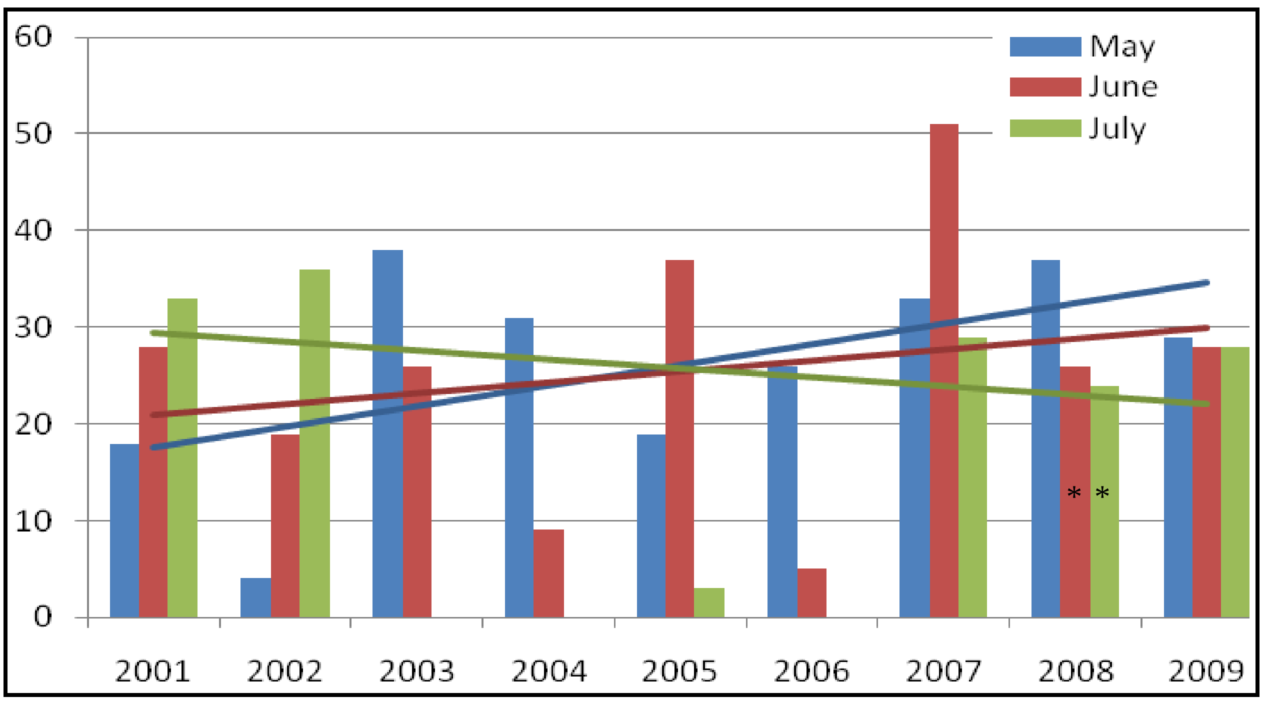


Figure 9. Trends (lines) in the number (boxplots) of adult interior least terns and piping plovers observed during mid-month airboat surveys on the Platte River between Chapman and Lexington, Nebraska, 2001–2009 (Table 1). * indicates minimum numbers; two river surveys below Kearney diversion include observations of interior least terns and piping plovers at managed or constructed islands only; data for other interior least tern and piping plover 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 during some years (Figure 5), so the areas covered are not the same across surveys.

The trend in number of interior least tern and piping plover adults observed during mid-month sandpit-island surveys increased from 2001 to 2009; however, the number of adults observed during June and July sandpit-island surveys declined steadily since 2005 (Figure 10). Some of this decline could be attributed to access limitations at Broadfoot Sand and Gravel – South. Our ability to determine exact counts of birds was hindered by the large number present at the site, the size of the area, and the availability of hiding cover. During 2008 and 2009 sandpit-island surveys combined, we observed over 3-times the number of interior least tern and piping plover nests at sandpits than we did at river island sites. More interior least tern and piping plover adults, chicks, and fledglings were also observed at sandpits than river islands during 2008 and 2009 mid-month sandpit-island surveys.

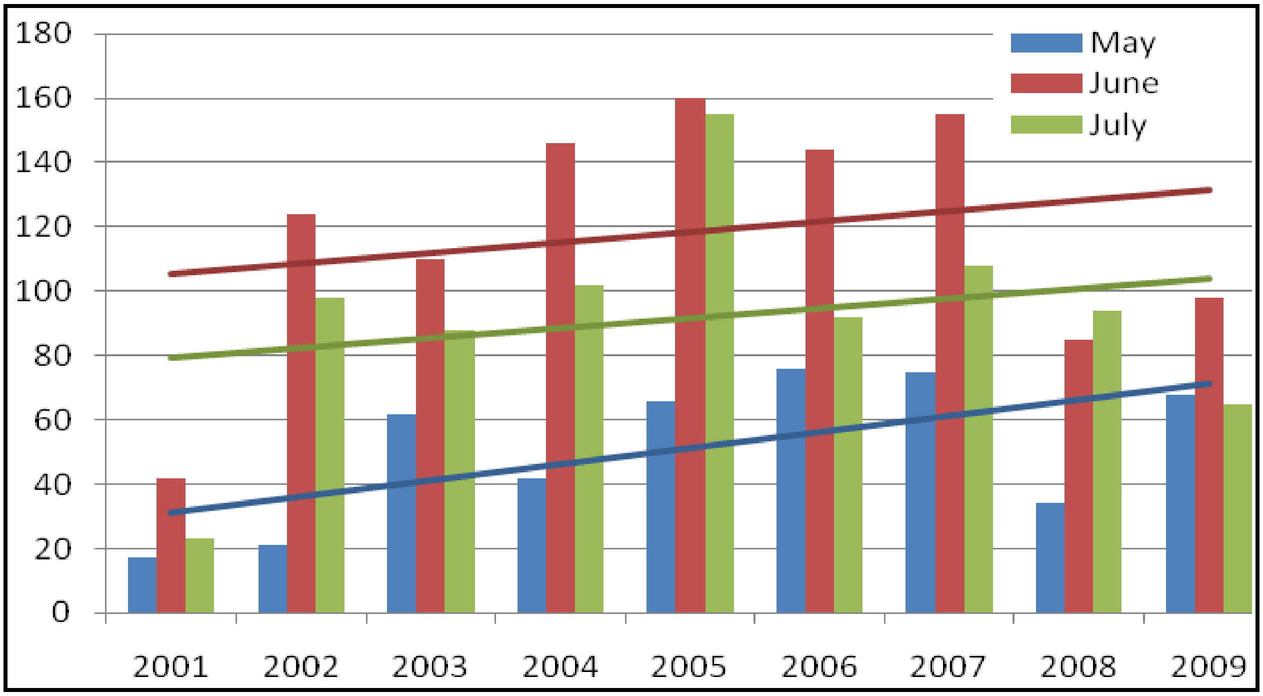


Figure 10. Trends (lines) in the number (boxplots) of interior least tern and piping plover adults observed during surveys of sandpits and managed or constructed islands on the Platte River between Chapman and Lexington, Nebraska, 2001–2009 (Table 2; Figure 8). Observations at Broadfoot Sand and Gravel − South were collected from a distance due to access limitations; actual number of birds present in Program associated habitats was likely higher.

Interior least terns observed through a spotting scope

NEST AND CHICK MONITORING

METHODS: We monitored sandpit and sites with managed or constructed river islands for nesting activity on a weekly basis throughout the nesting period. We attempted to observe nests and chicks every 3 days until the nest failed or chicks fledged. Observations were made from a distance in an attempt not to disturb nesting birds; most often, nests were found by observing adult birds sitting on nests incubating eggs. We recorded date, temperature, observation start and stop times, and the number of interior least tern and piping plover active nests, broods, chicks, and fledglings present during each 3-day site visit. We also counted the number of eggs present during the initial observation of each nest and estimated the date of nest-initiation. When chicks or fledglings were observed, we estimated the date of hatching or fledging (sustained flight) based on current and previous chick observations. After interior least terns and piping plovers left the colony area, we recorded habitat characteristics at nesting sites including: % vegetative cover, vegetative height, and stem counts within 1 m^2 and 5 m^2 of the nest; nest elevation; and distance to water. We were granted only limited access to two sandpits owned by Broadfoot Sand and Gravel in the Kearney area (Broadfoot Newark and Broadfoot Kearney South) to conduct the 3 monthly surveys to count adult birds and document nesting, though access was not granted to monitor nests, chicks, and fledglings every three days.

We used Program MARK (Version 5.1) to calculate daily and incubation-period nest survival rates. We included nests located at sandpit and riverine sites that were monitored by personnel from CNPPID, CPNRD, Headwaters Corporation, NPPD, and USFWS-GI during 2008 and 2009 to determine survival rates. We included observations of nests made by personnel from USGS-NPWRC in the 2009 analyses. Nest success was defined as any nest that hatched ≥1 chick. As the exact date of nest initiation was unknown on many occasions, we considered the incubation period for interior least terns and piping plovers to be 21 and 28 days, respectively, from when we first observed the nests. When the fate of a nest was unknown, we assign a failed status to the nest if the date of determination was <21 days (interior least tern) or <28 days (piping plover) after the date nest was first observed. For example, if a site with no nests present was surveyed on 8 May; surveyed again on 15 May when a piping plover nest was first observed; was monitored again on 18 and 21 May and we found the nest to be active and intact; but on 24 May we observed no eggs in or adults on the nest, we assigned a "failed" status to the nest as the nest likely did not hatch. If, however, this nest, with an unknown fate, was known to be active on 10 June (26 days after initial observation) and was last observed on 14 June (30 days after initial observation), we censored the nest at 26 days and assigned a "success" status to the nest. Our assumption was that, on average, we discarded survived and failed intervals in the same proportion that they existed in the data. Nests only observed to be active on 1 site visit were discarded from analyses.

We also used Program MARK to calculate daily and brooding-period survival rates. We included broods monitored at sandpits and riverine sites during 2008 and 2009 to determine survival rates. As the exact date of nest hatching was occasionally unknown, we considered the brooding period for interior least terns and piping plovers to be 15 days from the date we first observed nestlings. A successful brood was defined as any brood with ≥1 chick that survived 15 days after the initial observation of nestling chicks. Similar to nest survival methods, when the fate of a brood was unknown, we assign a failed status to a brood if the date of fate determination was <15 days after we first observed nestlings and a success status to a brood when the date of fate determination was >15 after nestlings were first observed. Broods only observed to be active on 1 site visit were discarded from analyses.

RESULTS: We observed 1 research-related mortality incident during 2008 and 2009 combined. This mortality was a result of a piping plover chick being stepped on during a systematic chick search at Lexington sandpit during 2009; the incident was reported to USFWS. Four interior least tern chicks at Blue Hole and 2 piping plover adults (1 at Blue Hole and 1 at Lexington sandpit) were also found dead during the 2009 breeding season. Three of the interior least tern chicks likely died of predation as body parts were missing from chicks when observed; the fourth chick died of unknown causes. The adult piping plover found dead at Blue Hole died of unknown causes while the other adult likely collided with a power line located ~200 yards from the Lexington sandpit. One interior least tern nest and 2 piping plover nests at Lexington sandpit and 2 piping plover nests at Blue Hole sandpit were abandoned during 2009; nest abandonment along the central Platte River is rarely observed.

Interior least tern nests were observed and monitored at 4 of the 15 sandpits we surveyed and 4 of the 12 riverine sites with managed or constructed islands we surveyed during 2008 (Table 3, Figure 11). As with river and river-sandpit surveys, all counts of adults, nests, chicks, and fledglings reported represent minimums present as we did not enter colony sites while monitoring nests and broods. The first observation of an interior least tern nest occurred on 26 May, 2008 and the last observed nest was initiated on 25 July, 2008. At least 1 egg from 49% (31/63) of interior least tern nests hatched which resulted in 61 chicks and an overall nest-success rate of 0.97 chicks/nest during 2008 (Table 5). The first observation of an interior least tern chick occurred on 18 June, 2008 and the last nest known to hatch did so on 15 August, 2008. Nest-success was lower at managed and constructed river islands than at sandpits. We observed 40% (8/20) of interior least tern nests located on river islands hatched ≥1 chick while 53% (23/43) of interior least tern nests at sandpits hatched ≥1 chick. We observed 16 chicks (0.80 chicks/nest) on managed or constructed islands and 45 chicks (1.05 chicks/nest) at sandpits. Average daily survival rate interior least tern nests at sandpits was 0.99 (range = 0.90–0.99) with no difference observed between sites during 2008; average incubation-period survival rate = 0.73 (range = 0.11–0.84; Appendix 1). We observed an average daily survival rate of 0.95 (range = 0.67–0.98) for nests located on managed or constructed river islands during 2008; average incubation-period survival rate = 0.35 (range = 0.00–0.61; Appendix 2). The survival rate of nests at the Dippel site was higher than other sites (Appendix 2). Daily and incubation period survival rates for interior least tern nests was lower at river sites than sandpits [$\chi^2(1, N=53) = 6.28$; $P<0.01$; Appendix 3]. We observed the first interior least tern fledgling on 15 July, 2008 and the last known interior least tern chick to fledge did so on 9 August, 2008. The fledging rate at all sites monitored during 2008 was 0.70 (44 fledglings/63 nests; Table 5). We observed a nest-based fledging success rate of 0.45 (9/20) interior least tern fledglings/nest at managed or constructed islands and 0.81 (35/43) interior least tern fledglings/nest at sandpits during 2008. Daily survival rates for interior least tern broods at sandpits was 0.99 (range = 0.98–0.99); brooding-period survival rate = 0.80 (range = 0.73–0.89; Appendix 4). We observed a daily brood survival rate of 0.97 at our only river site containing a brood during 2008, Dippel; brooding-period survival rate = 0.63 (Appendix 5). Interior least tern brood survival rates between sandpit and river island sites during 2008 were similar [$\chi^2(1, N=28) = 0.84$; $P=0.36$; Appendix 6].

Piping plover nests were observed at 4 of 15 sandpits surveyed and 3 of 12 riverine sites we surveyed that had managed or constructed islands during 2008 (Table 3; Figure 11). The first observation of a piping plover nest was made on 5 May, 2008 and the last observed nest was initiated on 27 June, 2008. At least 1 egg from 38% (8/21) of piping plover nests hatched which resulted in 26 chicks and an overall nest-success rate of 1.24 chicks/nest during 2008 (Table 5). We observed 3 chicks (0.60 chicks/nest) on managed or constructed islands and 23 chicks (1.44 chicks/nest) at sandpits. The first observation of a piping plover chick occurred on 29 May, 2008 and the last successful nest we observed hatched on 15 July, 2008. Piping plover nest-success was lower at managed and constructed river islands than at sandpits. Only 20% (1/5) of piping plover nests located on river islands hatched ≥1 chick while 44% (7/16) of piping plover nests at sandpits hatched ≥1 chick (Table 3). Piping plover daily nest survival rates at sandpits was 0.98 (range = 0.95–0.99) during 2008; incubation-period survival rates = 0.65 (range = 0.26–0.80; Appendix 7). Daily survival rates for piping plover nests at river islands during 2008 was 0.95 (range = 0.89–0.96); incubation period survival rate = 0.23 (range = 0.4–0.34; Appendix 8). Piping plover daily and incubation period nest survival rates were higher at sandpits than at river sites [$\chi^2(1, N=18) = 4.32$; $P=0.04$; Appendix 9]. We first observed a fledgling piping plover on 20 June, 2008 and the last known piping plover chick to fledge was observed on 11 August, 2008. We observed a nest-based fledging rate of 0.48 (10 fledglings/21 nests) at all sites monitored during 2008 (Table 5). We observed a nest-based fledging success rate of 0.60 piping plover fledglings/nest (3/5) at managed or constructed islands and 0.44 (7/16) piping plover fledglings/nest at sandpits during 2008. We observed an average piping plover daily survival rate of 0.93 (range= 0.90–0.94) for broods located at sandpits during 2008; brooding-period survival rate = 0.33 (range = 0.21–0.42; Appendix 10). We only observed 1 piping plover brood at managed or constructed islands during 2008 and it survived (Appendix 11). Piping plover daily and brooding-period survival rates during 2008 were similar between sandpits and the river site [$\chi^2(1, N=8) = 1.96$; $P=0.16$; Appendix 12].

We observed and monitored interior least tern nests at 4 of the 15 sandpit sites we surveyed and 3 of the 13 riverine sites we surveyed that had managed or constructed islands during 2009 (Table 4; Figure 12). The first known interior least tern nest was initiated on 25 May, 2009 and the last observed nest was initiated on 10 July, 2009. At least 1 egg from 55% (31/56) of interior least tern nests hatched which resulted in 68 chicks and an overall nest-success rate of 1.21 chicks/nest during 2009 (Table 5). The first observation of an interior least tern chick occurred on 17 June, 2009 and the last nest known to hatch did so on 1 August, 2009. Unlike 2008, interior least tern nest-success was lower at sandpits than managed or constructed river islands during 2009. We observed 75% (6/8) of interior least tern nests located on river islands hatched ≥1 chick while 52% (25/48) of interior least tern nests at sandpits hatched ≥1 chick. During 2009, we observed 11 chicks (1.38 chicks/nest) on managed or constructed islands and 57 chicks (1.19 chicks/nest) at sandpits. The 5 nests 'observed' at the Mormon Island site, however, were only observed after they had hatched so they were not included in analyses of daily survival. We observed an average daily survival rate of 0.99 (range = 0.98–0.99) for sandpit nests with no difference observed between sites; average incubation-period survival rate = 0.77 (range = 0.63–0.88; Appendix 13). We observed an average daily survival rate of 0.84 (range = 0.77–1.00) for nests located on managed or constructed river islands; average incubation-period survival rate = 0.03 (range = 0.00–1.00; Appendix 14). Survival rates for interior least tern nests was lower at river sites than sandpits [$\chi^2(1, N=49) = 6.38$; $P=0.01$; Appendix 15]. We observed an interior least tern fledgling for the first time on 9 July, 2009 and the last known interior least tern chick to fledge was observed on 17 August, 2009. We observed a fledging rate of 0.79 (44 fledglings/56 nests) at all sites monitored during 2009 (Table 5). Similar to 2008, we observed a nest-based fledging success rate of 0.38 interior least tern fledglings/nest (3/8) at managed or constructed islands and 0.85 interior least tern fledglings/nest (41/48) at sandpits during 2009 (Table 4). Daily survival rates for interior least tern broods at sandpits was 0.99 (range = 0.95–0.99); brooding-period survival rate = 0.84 (range = 0.48–0.91; Appendix 16). We observed a daily brood survival rate of 0.96 at our only monitored river site with an interior least tern brood during 2009, Mormon Islands; brooding-period survival rate = 0.63 (Appendix 17). Interior least tern brood survival rates at sandpit and river island sites during 2009 were similar [$\chi^2(1, N=30) = 1.74$; $P=0.19$; Appendix 18].

We observed piping plover nests at 3 of 15 sandpits we surveyed and 1 of 13 riverine sites we surveyed that had managed or constructed islands during 2009 (Table 4; Figure 12). The first observation of a piping plover nest occurred on 4 May, 2009 and the last observed nest was initiated on 3 June, 2009. At least 1 egg from 64% (9/14) of piping plover nests hatched which resulted in 30 chicks and a nest-success rate of 2.14 chicks/nest during 2009 (Table 5). The first observation of a piping plover chick occurred on 1 June, 2009 and the last successful nest we observed hatched on 21 June, 2009. We observed 50% (1/2) of piping plover nests located on river islands hatched ≥1 chick while 67% (8/12) of piping plover nests at sandpits hatched ≥1 chick. Three chicks (1.50 chicks/nest) successfully hatched on managed or constructed islands and 27 chicks (2.25 chicks/nest) hatched successfully at sandpits. We observed a daily nest survival rate of 0.98 (range = 0.98–1.00) for piping plover nests located on sandpits; incubation period nest survival rate = 0.61 (range = 0.55–1.00; Appendix 19). We observed a daily survival rate of 0.96 for 2 nests located Dinan river islands; incubation-period survival rate = 0.35 (Appendix 20). Piping plover nest survival was similar between sandpits and managed or constructed river islands [$\chi^2(1, N=14) = 0.40$; $P=0.53$; Appendix 21]. The first fledgling piping plover was observed on 24 June, 2009 and we last observed a fledged piping plover chick on 9 July, 2009. We observed a fledging rate of 0.86 (12 fledglings/14 nests) at all sites monitored during 2009 (Table 4). We observed a nest-based fledging success rate of 0.50 piping plover fledglings/nest (1/2) at managed or constructed islands and 0.92 piping plover fledglings/nest (11/12) at sandpits during 2009. The 2009 Piping plover daily brood survival rate for broods located on sandpits was 0.98 (range= 0.96–1.00); brooding-period brood survival rate = 0.77 (range = 0.55–1.00; Appendix 22). The piping plover brood observed at the Dinan, river site during 2009 fledged 1 chick (Appendix 23). Piping plover brood survival rates at sandpits and the river site were similar during 2009 [$\chi^2(1, N=9) = 0.49$; $P=0.48$; Appendix 24].


Piping plover eggs and chicks located on a river island at Dinan Tract site.

Table 3. Site-specific number 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 2008. See the Management Section of this report for a detailed description of management actions taken at each site. Site #'s correspond with Figure 8.

						Interior Least Tern						Piping Plover					
Site #	Site Name	Habitat Type	Management	Surveys	Survey Time (hr)	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks	Fledglings	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks	Fledglings
1	Lexington Pit	SP	HPFT	36	53	416	26	20	11	25	19	124	8	6	0	0	0
2	Lexington Island	RI	HP	7	4	0	0	0	0	0	0	3	3	0	0	0	0
3	Overton Island	RI	MP	5	4	0	0	0	0	0	0	0	0	0	0	0	0
4	Cottonwood Ranch	RI	DP	8	5	2	1	0	0	0	0	0	0	0	0	0	0
5	Blue Hole	SP	HPFT	42	54	407	26	14	10	18	16	91	9	4	4	14	6
6	Johnson Pit	SP	HPFT	34	24	15	2	1	0	0	0	56	4	3	3	9	1
7	Elm Creek Island	RI	HDPFT	8	6	2	1	0	0	0	0	2	1	0	0	0	0
8	Broadfoot – Turkey Creek	SP	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Broadfoot – Kearney South	SP	N	3	4	44	26	8	2	2	0	20	8	3	0	0	0
10	Wyoming Property	RI	P	11	6	14	4	0	0	0	0	0	0	0	0	0	0
11	Broadfoot –Newark	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
12	Mid-Nebraska Aggregate – Minden	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
13	Dinan Tract	RI	P	32	27	62	11	2	0	0	0	58	4	3	1	3	3
14	Triplett Trail	RI	P	20	12	41	9	2	0	0	0	15	3	1	0	0	0
15	Dippel Tract	RI	P	31	40	273	18	12	8	16	9	10	2	1	0	0	0
16	Uridil	RI	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Dahm Property	RI	P	8	2	0	0	0	0	0	0	0	0	0	0	0	0
18	Lilley – Wood River	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
19	Alda Farms	RI	N	14	9	26	8	4	0	0	0	2	1	0	0	0	0
20	Wild Rose Ranch	RI	P	17	8	4	2	0	0	0	0	1	1	0	0	0	0
21	Wild Rose Ranch – East Pit	SP	P	17	8	9	6	0	0	0	0	1	1	0	0	0	0
22	DeWeese – Alda	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
23	Mormon Island	RI	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Hooker Brothers – GI West	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
25	Island Landhandlers – GI	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
26	Hooker Brothers – GI South	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
27	Central Sand & Gravel – GI	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
28	Hooker Brothers – GI East	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0

* 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 removal (R), or herbicide (H) during fall 2007; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2008; no management (N); or unknown (U). Adult counts represent cumulative number of adult terns and plovers observed during all surveys (Cum) and the maximum number adults observed during any single survey (Max).

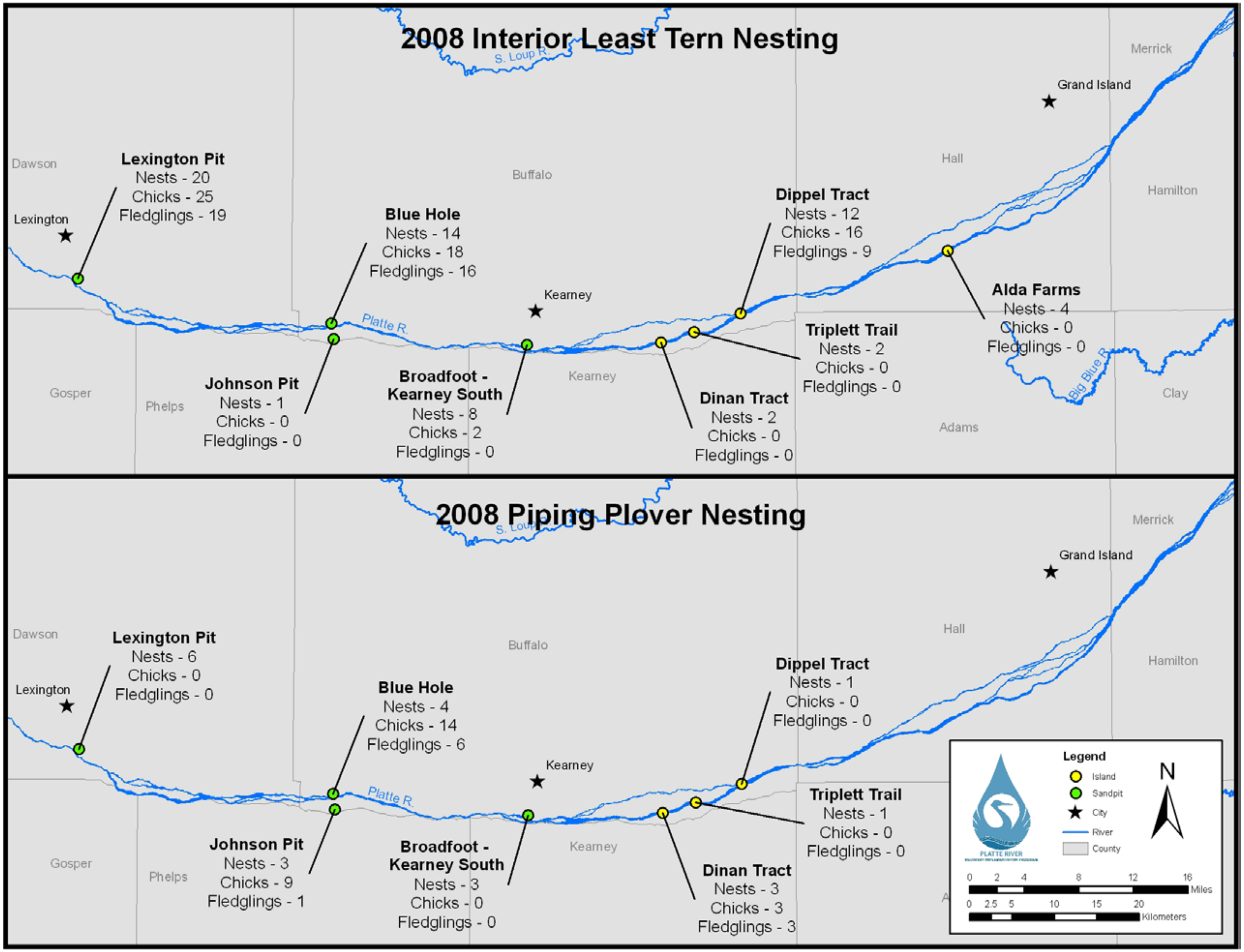


Figure 11. Distribution and numbers of interior least tern and piping plover nests, chicks, and fledglings observed within Program associated habitats during 2008 surveys of sandpits and constructed or managed river islands.

Table 4. Site-specific number 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 2009. See the Management Section of this report for a detailed description of management actions taken at each site. Site #'s correspond with Figure 8.

						Interior Least Tern						Piping Plover					
Site #	Site Name	Habitat Type	Management	Surveys	Survey Time (hr)	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks	Fledglings	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks	Fledglings
1	Lexington Pit *	SP	RPFT	74	176	258	22	18	10	27	18	92	6	5	3	9	5
2	Lexington Island *	RI	RP	10	4	1	1	0	0	0	0	0	0	0	0	0	0
3	Overton Island	RI	HP	8	3	2	2	0	0	0	0	2	2	0	0	0	0
4	Cottonwood Ranch *	RI	DP	9	6	7	4	0	0	0	0	2	2	0	0	0	0
5	Blue Hole *	SP	PFT	83	168	318	22	22	12	25	21	98	6	5	3	10	6
6	Johnson Pit *	SP	PFT	41	51	93	8	6	2	5	2	49	4	2	2	8	0
7	Elm Creek Island	RI	MBDP	10	5	3	2	0	0	0	0	5	4	0	0	0	0
8	Broadfoot – Turkey Creek	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
9	Broadfoot – Kearney South	SP	N	3	4	27	22	2	0	0	0	24	14	0	0	0	0
10	Wyoming Property *	RI	N	4	3	2	2	0	0	0	0	2	2	0	0	0	0
11	Broadfoot – Newark	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
12	Mid-Nebraska Aggregate – Minden	SP	N	2	1	0	0	0	0	0	0	0	0	0	0	0	0
13	Dinan Tract *	RI	DGP	30	32	14	5	1	1	2	0	12	2	2	1	3	1
14	Triplett Trail *	RI	P	14	3	0	0	0	0	0	0	1	1	0	0	0	0
15	Dippel Tract	RI	DP	24	27	20	9	2	0	0	0	0	0	0	0	0	0
16	Uridil	RI	DRP	9	6	3	2	0	0	0	0	0	0	0	0	0	0
17	Dahm Property	RI	N	9	5	0	0	0	0	0	0	0	0	0	0	0	0
18	Lilley – Wood River	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
19	Alda Farms	RI	DPF	9	8	4	2	0	0	0	0	2	2	0	0	0	0
20	Wild Rose Ranch	RI	DP	3	1	1	1	0	0	0	0	0	0	0	0	0	0
21	Wild Rose Ranch – East Pit	SP	DP	8	7	5	3	0	0	0	0	0	0	0	0	0	0
22	DeWeese – Alda	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
23	Mormon Islands	RI	PG	18	21	73	10	5	5	9	4	3	2	0	0	0	0
24	Hooker Brothers – GI West	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
25	Island Landhandlers – GI	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
26	Hooker Brothers – GI South	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
27	Central Sand & Gravel – GI	SP	N	1	1	0	0	0	0	0	0	0	0	0	0	0	0
28	Hooker Brothers – GI East	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0

* Sites marked with an * indicate personnel from USGS-NPWRC contributed data to the counts (See Appendices 25 and 26 for separate counts). Habitat types include sandpits (SP) and river islands (RI). Management actions applied to each site include: mowed (M), burned (B), disked (D), graded (G), tree removal (R), or herbicide (H) during fall 2008; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2009; no management (N); or unknown (U). Adult counts are cumulative number of adult birds observed during all surveys (Cum) and maximum number adults observed during any survey (Max).

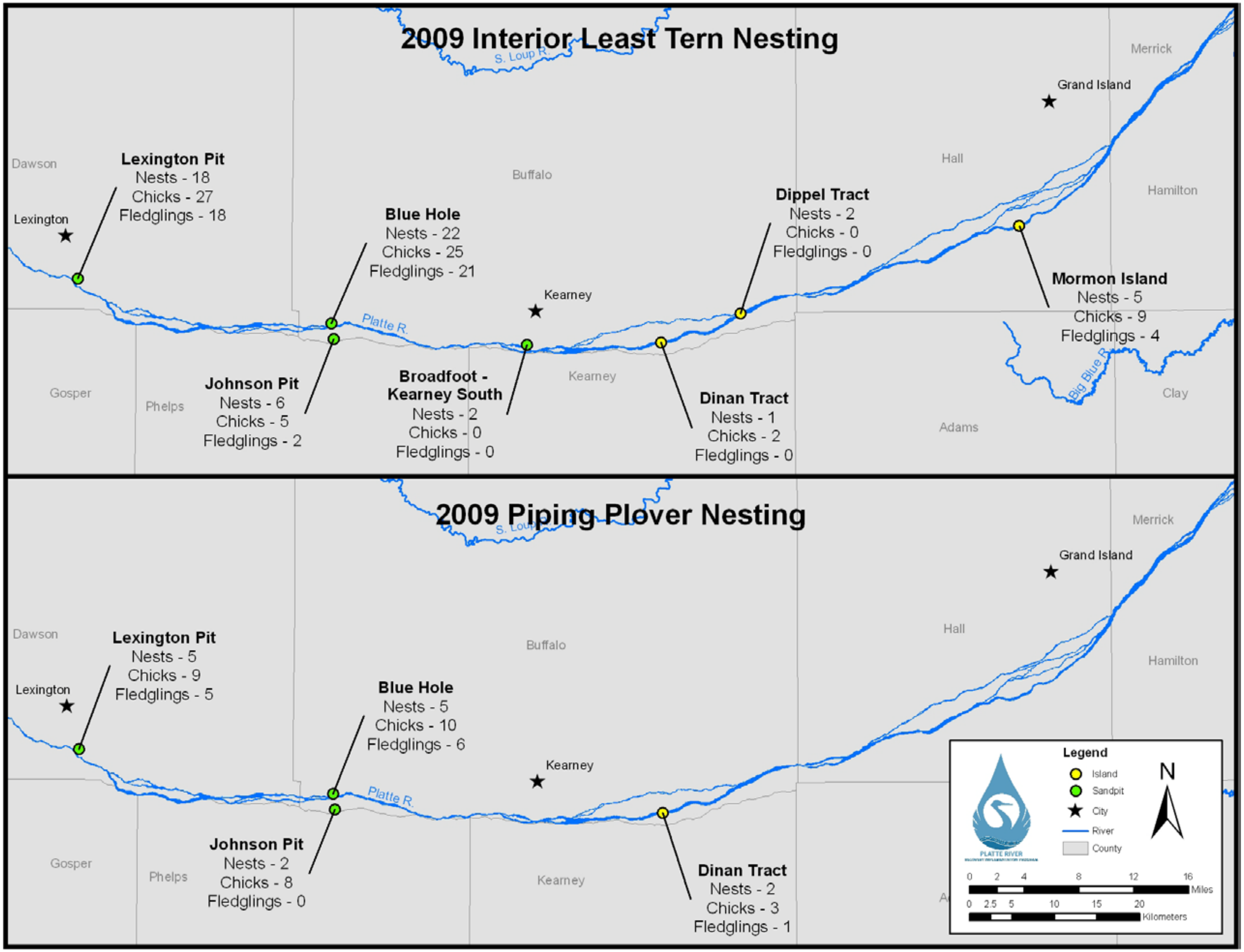


Figure 12. Distribution and numbers of interior least tern and piping plover nests, chicks, and fledglings observed within Program associated habitats during 2009 surveys of sandpits and constructed or managed river islands.

SUMMARY: The number of nests, successful nests, chicks, and fledgling interior least terns was higher during 2008 and 2009 than 2007 (Table 5; Figures 11 and 12). The number of interior least tern chicks/nest initiated during 2008 was lower than 2007 and 2009 (Figure 15), but we attribute that to the partial loss of nests (damage to some eggs) associated with the 2008 May rain event. The nest-based fledge ratio for interior least terns was 17% and 4% lower during 2008 and 2009, respectively, than 2007 (Figure 15); however, we did observe a slight increase in the total number of interior least tern fledglings during 2008 and 2009 (Figure 14). Daily, incubation-period, and brooding-period survival rates for interior least terns increased steadily from 2007–2009 and tended to be higher at sandpits than river-island sites.

The number of piping plover nests initiated during 2007 and 2008 were similar; however, the number of successful nests was nearly 50% lower during 2008 (Table 5; Figure 13). We also observed a 37% decline in the proportion of chicks that fledged from 2007 to 2008. The 23–24 May, 2008 rain event can likely be attributed to the decreases we observed in the number of piping plover nests initiated and the reproductive success of nest during 2008, as several nests were reported to have been flooded or damaged by hail. The number of piping plover nests initiated during 2009 was lower than 2007 or 2008 (Figure 13), but the proportion of nests that hatched ≥1 chick during 2009 was only slightly lower than 2007 and was much higher than 2008. The number of chicks/nest initiated during 2009 was slightly lower than 2007; however the fledge ratio was much lower during 2009 than 2007 (Figure 15). Similar to interior least terns, piping plover nest and brood survival rates tended to be higher at sandpits than river-island sites, which could indicate sandpits may be the most critical habitat currently available for maintaining viable populations of these birds along the central Platte River.

The numbers of piping plover and interior least tern nests, chicks, and fledglings documented at the Broadfoot – Kearney South sandpit represent minimums present during 2008 and 2009 (Tables 3 and 4, respectively). Surveys to determine exact counts of birds were hindered by the large number of birds present at the site, size of the area, availability of hiding cover for fledglings and adults, and limited access to the sandpit. Interior least tern and piping plover success rates (chicks and fledglings/nest) were likely affected by the limited access and visibility, especially during 2008 when we observed 8 interior least tern nests and 8 piping plover nests, but only observed 2 chicks and no fledglings of either species at this site. It was interesting to note that all interior least tern and piping plover sandpit nests observed during 2008 and 2009 were located between Kearney and Lexington, Nebraska while all river island nesting occurred between Grand Island and Kearney, Nebraska (Figures 11 and 12).

Piping plover on a nest at Blue Hole sandpit

Table 5. Summary of interior least tern and piping plover reproductive success at sandpits and river island sites on the central Platte River of Nebraska, 2007–2009. Site-specific details on nest and chick success during 2008 and 2009 are provided in Tables 3 and 4, respectively. Habitat-and site-specific details of daily and incubation- and brooding-period survival rates during 2008 and 2009 are provided in Appendices 1–24.

Reproductive Parameter	Interior Least Tern			Piping Plover		
	2007	2008	2009	2007	2008	2009
Total Nests Observed	49	63	56	20	21	14
Successful Nests (≥1 egg hatched)	22	31	31	15	8	9
% Nest Success	0.45	0.49	0.55	0.75	0.38	0.64
Daily nest survival rate (All sites)	0.97	0.98	0.99	0.99	0.98	0.99
Incubation-period survival rate (All sites)	0.55	0.61	0.73	0.71	0.58	0.67
Chicks Observed	49	61	68	45	26	30
Hatch ratio (Chicks/Nest)	1.00	0.97	1.21	2.25	1.24	2.14
Fledglings	40	44	44	27	10	12
Fledge ratio (Fledglings/Nest)	0.82	0.70	0.79	1.35	0.48	0.86
Daily brood survival rate (All sites)	No Data	0.98	0.98	No Data	0.94	0.98
Brooding-period survival rate (All sites)*	No Data	0.75	0.79	No Data	0.42	0.79

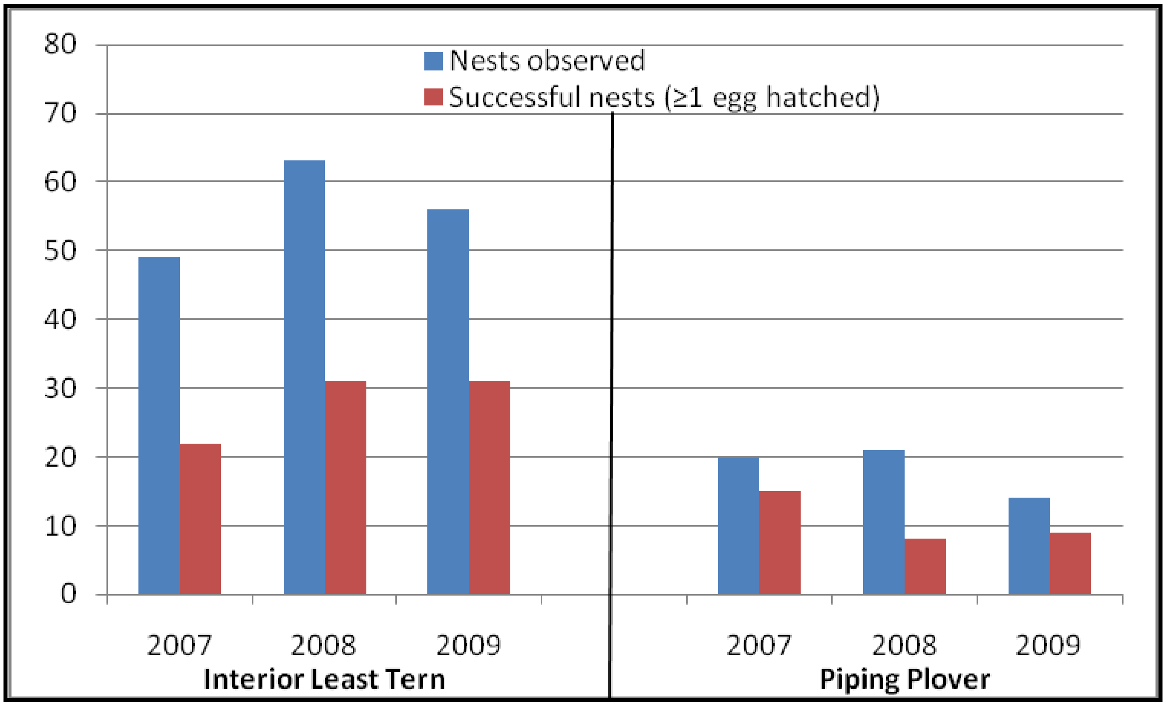


Figure 13. Number of initiated and successful interior least tern and piping plover nests observed at monitored river island and sandpit sites within Program associated habitats, 2007–2009.

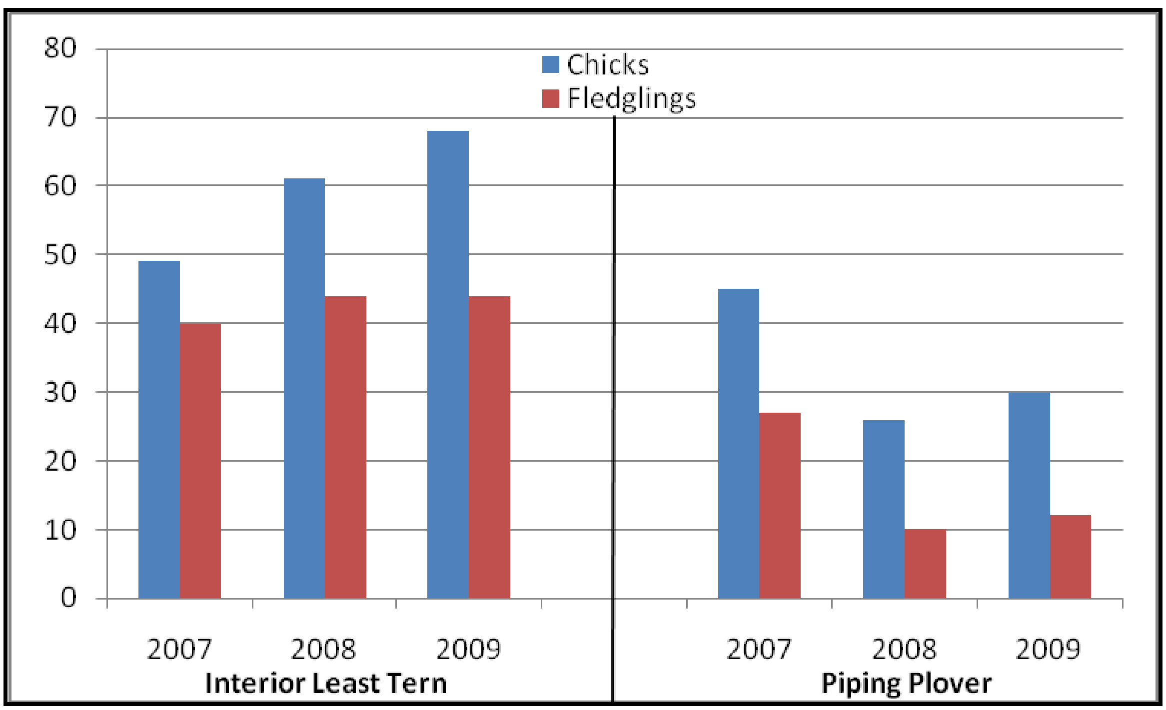


Figure 14. Number of interior least tern and piping plover chicks and fledglings observed at monitored river island and sandpit sites within Program associated habitats, 2007–2009.

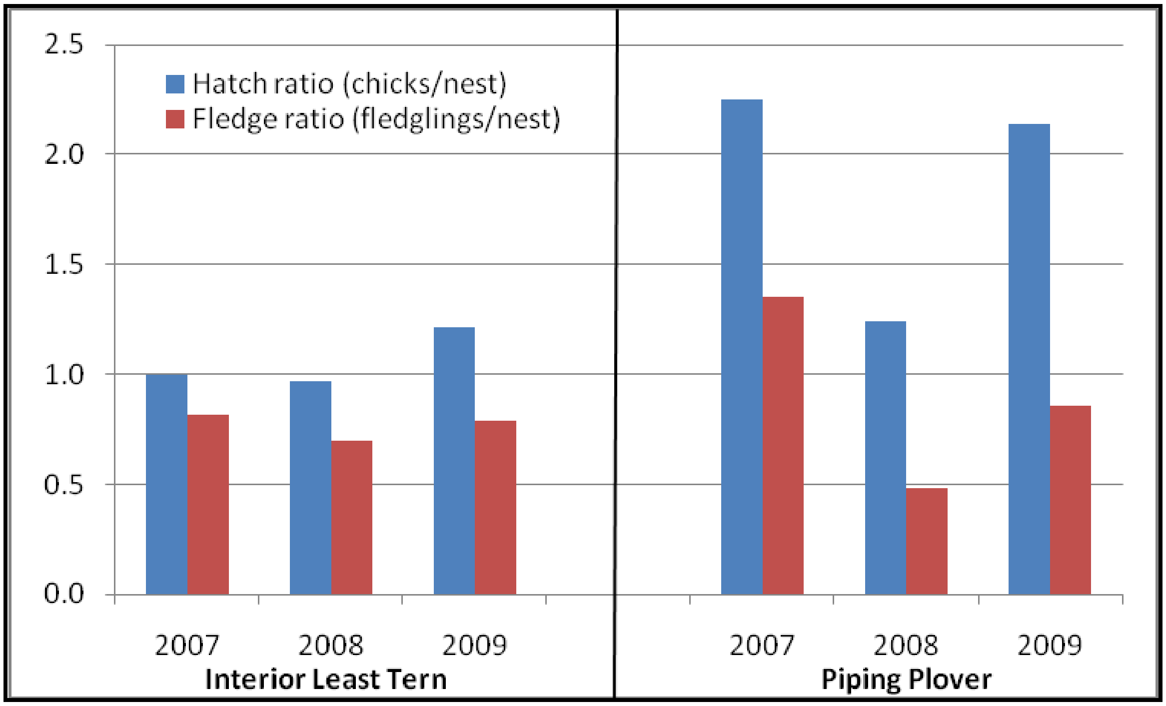


Figure 15. Nest-based hatch and fledge ratios for interior least tern and piping plover nests observed at monitored river island and sandpit sites within Program associated habitats, 2007–2009.

RESEARCH

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

The first directed research project related to interior least terns and piping plovers on the central Platte River began in 2009 with Year-One implementation of the Program's foraging habits study. A contract to conduct this study over two field seasons (2009−2010) was awarded to personnel from the USGS-NPWRC. The research is being jointly funded by the Program and the USGS-NPWRC. This section provides a summary of activities conducted for the foraging habits study in 2009; more details can be found in the Annual Research Report generated by the USGS-NPWRC. The range of dates for field work was 1 May – 31 July, 2009. This research was designed to quantify various measures of foraging habitat used by interior least terns and piping plovers at sandpits and river-island sandbars with a goal of addressing four specific objectives that collectively contribute to the understanding of foraging habits of adult interior least terns and piping plovers within Program associated habitats:

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

ADULT CAPTURE AND BANDING

Adult interior least terns and piping plovers were trapped and banded so that they were uniquely identifiable. Techniques outlined in this section support all 4 objectives outlined above. Interior least tern and piping plover adults were trapped on nests using wire mesh box traps, hoop nets, or potter-style fall traps. Trapping took place when air temperature was between 60°F and 90°F, wind was minimal, and there was no precipitation. Trapping occurred ≥1 week after nest initiation and prior to pipping. Observers were positioned in blinds to quickly process captured piping plovers and to abort trapping attempts if the adult was disrupted from its nest for ≥20 minutes. Prior to trap deployment, eggs from targeted nests were exchanged with artificial eggs to reduce potential risk of injury; real eggs were stored in small plastic container cushioned with synthetic batting and were immediately replaced upon termination of the trapping effort. Once captured, piping plovers were moved to a nearby area away from the colony, weighed with a Pesola-type spring scale, and the bill, culmen depth, and natural wing chord were measured with calipers or a wing rule. We also collected 20–30µl of blood (2-3 drops) or 6–10 contour feathers from the breast or back of the bird for laboratory sex determination.

Each adult least tern was banded with a stainless steel band, size 1A, on the lower leg and up to 3 plastic colored celluloid bands (XCL) on the upper leg (2 bands/leg), with exception of those receiving transmitters. Each adult plover was banded with a size 1A, numbered USGS aluminum band on the upper leg, a Darvic plastic short flag on the opposite upper leg, and up to 2 Darvic color bands on each of the lower legs. Birds were released adjacent to the colony within 10 minutes of capture, and observed to document resumption of normal behaviors (e.g., incubation and foraging). Although we attempted to band both individuals of each pair, capture of one individual from each nest was the primary goal.

CHICK CAPTURE AND BANDING

Interior least tern and piping plover chicks were banded so they were uniquely identifiable. Banding and re-sighting data was collected in support of objective 4 outlined above. We attempted to band all chicks at all successful interior least tern and piping plover nests at sandpits and river islands surveyed. We visited nests of interior least terns and piping plovers on or near the day of hatch so that chicks could be captured by hand in or near the nest bowl and banded. Interior least tern chicks were marked with 3 plastic color bands (1 above and below the joint on 1 leg, and 1 above the joint on the other leg); handling time was ≤2 minutes. We recaptured interior least tern chicks at ~15 days of age and applied stainless steel leg bands and ensured retention of plastic leg bands. Piping plover chicks were banded with one aluminum 1A band on the upper leg, a Darvic plastic short flag on the opposite upper leg, and up to 4 Darvic color bands on the lower legs (no more than 2 per leg segment). Capture and banding occurred every 2–3 days during productivity assessments.

Each site was re-visited 2–3 times between banding and fledging to re-sight banded birds. Band combinations of piping plover chicks were obtained by visually scanning brood-rearing areas from a distance to minimize bird disturbance. Due to the sedentary behavior and posture of interior least tern chicks, re-sightings required us to pick chicks up to read color band combinations. We visually scanned areas where interior least tern chicks were previously located and conducted searches on foot to locate and capture banded chicks; handling time was <5 minutes per re-sighting.

Banded piping plover chick

RADIO TELEMETRY

Interior least tern and piping plover adults were fitted with radio transmitters primarily in support of objective 1, but also provided information in support of objectives 2–4. We attempted to apply radio-transmitters to 16 interior least tern and 16 piping plover adults. Transmitters were placed on 1 bird per pair. For interior least terns, we used leg-band mounted transmitters, consisting of a <1.1g transmitter (Holohil BD-2) secured to a 1A aluminum leg band with nylon thread. The leg band transmitter package was fitted on the upper leg, and was the only metal band applied to radio-marked interior least terns. We placed 1–3 smears of an indelible Sharpie/Marks-a-Lot marker (black, brown, blue, green, or red) on radio-marked interior least terns under the wings, on the side of the breast, or near the vent to indicate nesting colony and facilitate relocation of individuals from colonies during behavioral observations. For piping plovers, we used ~1.2g, glue-on transmitters (Holohil BD-2G) attached with cyanoacrylate glue to the intrascapular region of the bird. All radio-marked birds were released adjacent to the colony within 10 minutes of capture and we observed the birds to document resumption of normal behaviors (e.g., incubation & foraging).

Automated dataloggers were used to document presence/absence of radio-marked birds. We used automated data collection computers (ATS R4500S Scientific Receiver/Datalogger connected to ≥1 Yagi antenna), which was programmed to scan all deployed frequencies every 5–10 minutes. All equipment (loggers, receivers, and antenna) was housed in blinds so they did not provide a perch for raptors or other birds. The dataloggers recorded the presence of radio-marked birds, which we correlated with direct behavioral observations and used to develop estimates of trip frequency and duration by pairs and colonies. Dataloggers and blinds were positioned strategically to provide meaningful records of bird-use of target habitats and to allow us access to the dataloggers 2–3 times/week without disturbing nesting or foraging birds. Hand-held Yagi antennas were used to locate birds in foraging areas during behavioral observations.

BEHAVIORAL OBSERVATIONS

Behavioral observations were conducted in support of objective 2 and provided information on locations where sampling was needed for objective 3. We observed the behaviors of interior least terns and piping plovers to identify the proportion of time spent foraging, estimate the rates of foraging behaviors and habitats used for foraging piping plovers, and determine success rates of foraging interior least terns. Behavioral observation sessions occurred during 4-hr intervals (0600–1000, 1200–1600, and 1700–2100h). We systematically allocated sessions to ensure we observed each interior least tern and piping plover pair at least 1 time during each interval every two weeks. The number of active nests and broods in the area were recorded for each species during each session. For colony sites, this was the number of known nests within the colony, not just the number visible from a behavior data collection location. For non-colony locations where foraging interior least terns or piping plovers were observed, we recorded zero known active nests and broods in the area to identify areas as off-colony foraging locations.

Observers entered the blind or observation location using an approach that minimized disturbance to foraging interior least interior least terns and piping plovers. Once positioned to view the birds, observers waited 5 minutes to ensure their presence no longer disturbed the birds and began collecting data. A scan sampling technique was used to monitor interior least terns and focal sampling for piping plovers. We observed and recorded state behaviors on a 5-minute-interval. At the beginning of each 5-minute-interval, observers spent 5 seconds assessing the state of each bird. If any foraging behaviors were observed during the bird specific 5-second scan, we coded the state as foraging, even if the foraging behavior was very brief; otherwise we recorded the dominant behavior during the 5-second interval. We classified behavior states into 1 of 9 categories including: foraging, transport or food delivery, active parental care, stationary parental care, locomotion, active stationary (e.g., preen, bathe, courtship, copulation), inactive or resting, out of view (in area, but view was obstructed), and left observation area. Classification of state behaviors was species specific. When piping plovers moved out of view during focal bird sampling sessions, the observer quickly repositioned to view the bird, waited 5 minutes, and data collection commenced.

INTERIOR LEAST TERNS: Behavioral observations were conducted at two main types of locations within a nesting colony (sandbar or sandpit) and on non-colony riverine or sandpit sites that were used by interior least terns. Colony nesting sites were static and non-colony riverine or sandpit sites were identified by traveling the river looking for aggregations of interior least terns and by examining data from telemetry data-loggers located outside colonies. Observation sessions for interior least tern colonies spanned 1–3 hours depending on the number of interior least tern pairs that were visible. If there was only one pair/nest visible from a given location, we observed the pair/nest for 1 hour. If other interior least tern pairs could be observed from a location, we added 1 hour to the session for each additional pair visible (up to 3 hours).

Observers conducted scan sampling techniques on 5 minute intervals; recording the number of adult interior least terns visible that were engaged in each behavioral state. The interim time between each scan was used differently depending on whether the observation was conducted at a colony or non-colony site. At non-colony sites during the interim time, we selected a visible foraging adult and recorded the number of all occurrence (AO) behaviors for the randomly selected adult and ignored AO behaviors by any other adults in the area. If the selected adult left the area (with or without a prey item) or stopped foraging for ≥30 seconds, we selected and observed another foraging adult and record when the new adult was selected. We recorded AO behaviors at non-colony sites including: hovering, non-successful plunge, successful plunge, plunge of unknown success, eating prey, in area but out of view, left area with prey in bill, and left area. At colony sites during the interim time, we alternated between observing adults for forage delivery and observing foraging behavior of adults. When we were unable to observe potential foraging locations or it was apparent that no visible foraging occurred, we only recorded forage delivery observations during all interim periods. When observing forage delivery behaviors, we watched the whole colony and documented all deliveries of forage to chicks or other adults and recorded the location of foraging and the recipient of forage. We used techniques outlined for non-colony sites when we observed adult foraging behavior at colony sites during the interim periods. We randomly selected a foraging adult and documented behaviors including hover, unsuccessful plunge, successful plunge, plunge of unknown success, eating prey, in the area but out of view, adult left the area, and forage delivered to an adult, chick, or unknown recipient. We also recorded the habitat class (sandpit, main river channel, secondary river channel, or braided-dendritic channel) associated with each behavior documented. If the adult left the area or stopped foraging for ≥30 seconds, we selected and observed another foraging adult and record when the new adult was selected. We mapped all locations where foraging was observed and if forage fish sampling occurred that day, we sampled at the most recent successful foraging location observed and at two random locations (see forage fish sampling).

PIPING PLOVERS: When available, 2 people were used to monitored the position and behavior of piping plover adults and accompanying brood (if applicable) at colony and non-colony sites. Our behavioral observations of piping plovers were focused on individual adults, pairs, or adults with broods (hereafter focal unit). Thus, observations were conducted from moveable blinds; relocated specifically to watch the targeted focal unit, regardless of location (i.e., river or sandpit). When possible, we used hand-held telemetry units to locate targeted adults, so observers were able position themselves for observation in a way that minimized disturbance. When marked birds were observed, we recorded the identification of the bird or recorded unknown adult or chick if the identity could not be determined. We allocated 3, 1-hour sessions per day for behavioral sampling so that up to 3 focal units could be sampled per day of field work. We recorded the dominant habitat class within the foraging area, landform (river shoreline, sandbar, or sandpit), moisture (dry or wet substrate), and vegetative cover [bare (<30%), sparse (31–50%), or vegetated (>50%)]. We recorded behavioral states and habitat classes for each individual within the focal group on 5-minute-intervals. Each individual (adult and chick) was observed for 5 seconds to determine the dominant behavioral state, with behaviors being linked to marked individuals when possible. If any foraging behavior was observed during the 5-second observation period, we classified the period as foraging and spot-mapped the location; otherwise, the dominant behavior class that occurred during the 5-second period was recorded. We mapped all locations where foraging was observed and if invertebrate forage sampling occurred that day, we sampled at the most recent successful foraging location observed and at two random locations (see invertebrate sampling). In the interim time between all focal observation intervals, we selected an adult or chick, at random, and recorded all pecks, including gleans, made by the piping plover during the 3-minute interval. We recorded when the individual went in and out of view. We randomly selected a new adult or chick, alternating between adults and chicks, for each subsequent peck-recording interval. We did not map foraging locations observed during peck-recording intervals.

FORAGING HABITAT EVALUATION

FORAGE FISH SAMPLING: Foraging habitat data was collected to quantify features of habitats used by foraging interior least terns and piping plovers primarily in support of objective 3. We conducted forage fish sampling to describe fish abundance, species, and size, and aquatic habitats where interior least terns foraged in relation to available sites. We collected samples with minnow traps on sandpit ponds and Mini-Missouri River trawls when on the river. Sampling occurred at successful interior least tern foraging locations and two random points selected within 75 m of the observed foraging location at the end of evening behavior session.

River Sampling: When collecting river samples, we always sampled the foraging location prior to random locations. Once at the observed foraging location, we collected a GPS location, water temperature, turbidity, depth, flow, benthic substrate (sand, clay/silt/organic, or gravel), and habitat class (main channel, secondary channel, braided/dendritic channel). We then placed a 50-m float line 2 m from the sample point (perpendicular to the current) to guide the direction and distance of the sampling path. We began trawls at the sampling point and 2 people space 3 m apart towed it downstream parallel to the float line at a speed that was slightly faster than the river current. If the trawl-net became inverted while collecting a sample, we discarded the sample, recorded the attempt, moved to the other side of the float line, and collected our sample. Once completed, the trawl mouth was held out of the water and we processed the sample at a nearby sandbar or shoreline not currently used by interior least terns or piping plovers. All captured fish were identified to species, measured, and released as quickly as possible. We used fish identification guides and taxonomic keys to identify fish to species. When large samples of fish were caught, we placed fish in a bucket of river water prior to handling to reduce the chance of mortality. Once we finished sampling at the foraging location, we used a two-column random number table to modify the Northing and Easting of GPS point collected at observed foraging site and generated random locations. We used a GPS unit to navigate to randomly generate locations and sampled the area as described for foraging locations. When randomly generated locations were not within the same habitat class as the foraging location, were unsafe to sample (e.g., excessive flows or depths > 1.5 m), or when sampling path overlapped a previously sampled path from that day, we recorded the unsuitable random location and selected the next randomly generated location from the table.

Sandpit Sampling: We used a canoe to navigate to observed-foraging locations when on sandpit ponds. In order to maintain our position on windy days, we deployed an anchor as far up-wind as possible and scoped the anchor line out until we reached the foraging location. Similar to river sampling, we collected a GPS location and data on water temperature, turbidity, depth, and benthic substrate. We deployed a minnow trap by driving the stake ends into the substrate ensuring the lead pointed toward the center of the pond when depths were <0.75 m or floated at the surface for locations with depths >0.75 m. When minnow traps were floated, we ensured they were secured with an anchor; line length was slightly longer than the depth of water to prevent trap from moving if the wind changed direction. We record time the trap was deployed and left traps in place for 24 hours. After 24 hours, we retrieve the traps, recorded the collection time, and processed samples as with river samples.

INVERTEBRATE SAMPLING: We conducted invertebrate sampling to describe the invertebrate taxa, abundance, and terrestrial habitats where piping plovers foraged in relation to available sites. Sampling occurred at brood-specific foraging locations and two random locations selected within 75 m of the foraging location at the end of each 1-hour behavior session, if foraging was observed. Invertebrate sampling occurred after behavioral observations during the morning interval (0600–1000 hours) and when there was minimal chance of rain and wind speeds were expected to be below 18 mph during the sampling period.

We collected habitat characteristics at each sample site prior to collecting the sample. Once at the observed foraging location, we collected the GPS location, distance to nearest semi-permanent water source, landform (river shoreline, sandbar, or sandpit), substrate moisture (dry or wet substrate), vegetative cover [bare (<30%), sparse (31–50%), vegetated (>50%)], visual coverage estimates for vegetation of each class (wetland herbaceous, terrestrial herbaceous, woody vegetation), mean height of vegetation, maximum height of vegetation, visual coverage estimates for each substrate size class (silt, sand, small pebble, gravel, cobble, and boulder), and visual coverage estimate for each debris class (terrestrial leaf litter, small debris, and large debris). Similar to forage fish sampling, we used a 2-column random number table to modify the GPS location of the observed foraging location and generated random points within 75 m of the forage location and within the same habitat classes (i.e., landform, moisture, and vegetation) as those of the foraging location. We navigated to random locations using a GPS and if we determined a random point was not within the same habitat classes as those of the forage location, we selected the next set of numbers from the table and recorded the GPS location of unsuitable points. When a foraging location was within a narrow linear habitat class, random point selection was constrained to the same habitat class by changing the distance from the forage sampling location (i.e., positive number we moved N or E; negative number we moved S or W). If the random point was within 100 m of an active interior least tern or piping plover nest or brood, we chose another location.

We conducted invertebrate sampling at foraging and 2 random locations using 4, paint stir-stick insect traps coated with Tanglefoot® (The Tanglefoot Company, Grand Rapids, MI), 2 placed horizontally and 2 vertically within a 1-m^2 exclosure (hereafter, sticky sticks). We covered 20 cm of one side of the 2-horizontal sticks and 20 cm of both sides of the 2 vertical the sticks with a thin film of Tanglefoot®. We drove the vertical sticks into the ground handle first with the wide side facing into the wind so that the start of the Tanglefoot® was even with the surface of the substrate. We placed the horizontal sticks flat on the substrate 10 cm away from the vertical stick with the sticky side up and perpendicular to the direction of the wind. The handle of the sticks were labeled with study area, site, brood/nest number, point type (i.e., foraging or random location), stick number, date, and time set. We constructed small exclosures around sticky sticks to keep piping plovers and other birds from being entangled during sampling. The exclosures were made of 0.25 m tall 1-cm^2 nylon mesh netting held up in the corners by four wooden stakes. We retrieved the traps after 2–3 hours and recorded the end time. We limited disturbance to interior least tern and piping plover adults and chicks to 10 minutes during setup and tear down of traps. We identified and counted invertebrates on the sticky sticks immediately outside study area. Invertebrates <3 mm were counted, but not identified. Invertebrates 3 mm or greater were counted and identified to order (all) and to family if in the Diptera order. If unknown invertebrates were encountered, we consulted reference materials for identification and when identification was still unresolved we preserved a voucher specimen in ethanol, named and labeled it (e.g., “unknown A”), and made sure all references in data used the same name; especially if the unknown taxa occurred in another sample. When invertebrates could not be counted and identified on the collection day, we froze sticky sticks for later identification.


Invertebrate sampling site

NEST AND PRODUCTIVITY RESEARCH

We surveyed of all sites 2–3 times/week to assess the distribution and breeding activities of adult interior least terns and piping plovers primarily in support of objective 4. We recorded nest-specific information including habitat class (sandpit, sandbar island, sandbar island complex, point beach, or beach line), GPS location, management activities that occurred at the site, species, number of eggs, and we estimated nest initiation, hatch date, and incubation stage (determined by floating eggs). We also recorded habitat data including vegetative structure within 1-m^2 of the nest (% cover, vegetative height, and vegetative composition), nest-site and nest-cup substrate (silt, sand, small pebble, gravel, cobble, and boulder), and nest site furniture present near the site (driftwood, shrubs, bones, boulders, etc.). We collected habitat data as soon as possible after the nest was found, if not on the initial visit. During initial and subsequent nest observations, we recorded date and time of visit, status and fate of nest (normal, destroyed, eggs missing, hatched etc.), number of whole and pipped eggs, risk of inundation, nest manipulation (elevated nest), number of chicks in bowl, adult status (present or absent), and weather conditions. Once nests hatched, we documented the number of hatched and un-hatched eggs and the observed clutch size and attempted to band all chicks present.

We recorded a GPS location every time chicks were observed, regardless of whether chicks were captured or not. We recorded the site, species, date, time, weather conditions (cloud cover, temperature, wind, and precipitation), and bird behavior for each chick encounter. Anytime a chick was captured and banded and when bands were manipulated, we weighed the chick prior to band application or manipulation. If a chick of a piping plover brood was recaptured, the entire known brood was recaptured and weighed. We recorded the site, species, date, time, weather conditions (cloud cover, temperature, wind, and precipitation), bird behavior, nest identification number, adult presence, capture, release, and reunite times, band related injuries, chick age, culmen and wing-chord lengths, and collected a feather sample during each banding event.

APPENDICES

Appendix 1. Daily and incubation-period survival rates for interior least tern nests monitored on sandpits during 2008. 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	20	6	364	0.9832	0.0068	0.9630	0.9924	0.7001	0.4741	0.8581
Blue Hole	14	2	254	0.9919	0.0057	0.9683	0.9980	0.8433	0.5439	0.9605
Johnson	1	1	10	0.9000	0.0949	0.5328	0.9861	0.1094	0.0009	0.9413
All Sites	35	9	628	0.9853	0.0048	0.9721	0.9924	0.7333	0.5626	0.8547

Appendix 2. Daily and incubation-period survival rates for interior least tern nests monitored on managed or constructed river islands during 2008. 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
Dinan	2	2	12	0.7937	0.1323	0.4413	0.9493	0.0078	0.0000	0.8879
Dippel	12	4	174	0.9765	0.0116	0.9391	0.9912	0.6073	0.3081	0.8430
Triplett	2	2	6	0.6667	0.1925	0.2681	0.9161	0.0002	0.0000	0.9669
Alda Farms	2	2	20	0.8879	0.0750	0.6438	0.9720	0.0824	0.0020	0.7990
All Sites	18	10	212	0.9510	0.0151	0.9114	0.9735	0.3485	0.1639	0.5933

Appendix 3. Daily and incubation-period survival rates for interior least tern nests monitored at sandpits and on managed or constructed river islands during 2008. 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
Sandpits	35	9	628	0.9853	0.0049	0.9721	0.9924	0.7333	0.5626	0.8547
River Islands	18	10	212	0.9510	0.0151	0.9114	0.9735	0.3485	0.1639	0.5933
All Sites	53	19	840	0.9768	0.0053	0.9639	0.9851	0.6106	0.4700	0.7349

Appendix 4. Daily and brooding-period survival rates for interior least tern broods monitored on sandpits during 2008. Brooding-period survival rate = (daily brood survival rate)^{15}.

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	11	3	149	0.9792	0.0119	0.9376	0.9933	0.7299	0.4193	0.9100
Blue Hole	9	1	128	0.9921	0.0079	0.9461	0.9989	0.8878	0.4972	0.9844
All Sites	20	4	277	0.9852	0.0073	0.9613	0.9944	0.8000	0.5727	0.9227

Appendix 5. Daily and brooding-period survival rates for interior least tern broods monitored on managed or constructed river islands during 2008. Brooding-period survival rate = (daily brood survival rate)^{15}.

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
Dippel	8	3	100	0.9700	0.0171	0.9111	0.9903	0.6333	0.2966	0.8761

Appendix 6. Daily and brooding-period survival rates for interior least tern broods monitored at sandpits and on managed or constructed river islands during 2008. Brooding-period survival rate = (daily brood survival rate)^{15}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	20	4	277	0.9852	0.0073	0.9613	0.9944	0.8000	0.5727	0.9227
River Islands	8	3	100	0.9700	0.0171	0.9111	0.9903	0.6333	0.2966	0.8761
All Sites	28	7	377	0.9811	0.0071	0.9609	0.9910	0.7514	0.5632	0.8763

Appendix 7. Daily and incubation-period survival rates for piping plover nests monitored on sandpits during 2008. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	6	3	120	0.9833	0.0068	0.9632	0.9925	0.6233	0.3774	0.8188
Blue Hole	4	0	91	0.9921	0.0056	0.9689	0.9980	0.8004	0.4607	0.9495
Johnson	3	0	77	0.9534	0.0322	0.8316	0.9883	0.2627	0.0280	0.8152
All Sites	13	3	288	0.9847	0.0048	0.9718	0.9918	0.6495	0.4635	0.7990

Appendix 8. Daily and incubation-period survival rates for piping plover nests monitored on managed or constructer river islands during 2008. 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
Dinan	3	2	54	0.9619	0.0264	0.8599	0.9905	0.3368	0.0496	0.8317
Dippel	1	1	10	0.8879	0.1061	0.4949	0.9846	0.0358	0.0000	0.9710
Tripplett	1	1	17	0.9412	0.0571	0.6797	0.9918	0.1831	0.0038	0.9295
All Sites	5	4	81	0.9490	0.0249	0.8718	0.9807	0.2309	0.0443	0.6605

Appendix 9. Daily and incubation-period survival rates for piping plover nests monitored at sandpits and on managed or constructer river islands during 2008. Incubation-period nest survival rate = (daily nest survival rate)^{28}.

Site	# Nests	# Nests Lost	Exposure Days	Daily Nest Survival Rate	Daily Nest Survival SE	Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Nest Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	13	3	228	0.9896	0.0060	0.9682	0.9966	0.7459	0.4430	0.9155
River Islands	5	4	81	0.9490	0.0249	0.8718	0.9807	0.2309	0.0443	0.6605
All Sites	18	7	309	0.9809	0.0072	0.9605	0.9909	0.5827	0.3487	0.7846

Appendix 10. Daily and brooding-period survival rates for piping plover broods monitored on sandpits during 2008. Brooding-period survival rate = (daily brood survival rate)^{15}.

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
Blue Hole	4	2	36	0.9444	0.0382	0.8033	0.9861	0.4243	0.0855	0.8531
Johnson	3	2	20	0.9000	0.0671	0.6762	0.9749	0.2059	0.0162	0.8037
All Sites	7	4	56	0.9286	0.0344	0.8246	0.9729	0.3290	0.0881	0.7133

Appendix 11. Daily and brooding-period survival rates for piping plover broods monitored on managed or constructed river islands during 2008. Brooding-period brood survival rate = (daily brood survival rate)^{15}.

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
Dinan	1	0	15	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Appendix 12. Daily and brooding-period survival rates for piping plover broods monitored at sandpits and on managed or constructed river islands during 2008. Brooding-period brood survival rate = (daily brood survival rate)^{15}.

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
Sandpits	7	4	56	0.9286	0.0344	0.8246	0.9729	0.3290	0.0881	0.7133
River Islands	1	0	15	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	8	4	71	0.9437	0.0274	0.8593	0.9787	0.4190	0.1426	0.7578

Appendix 13. Daily and incubation-period survival rates for interior least tern nests monitored on sandpits during 2009. 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	18	2	323	0.9937	0.0044	0.9752	0.9984	0.8759	0.6164	0.9687
Blue Hole	22	5	323	0.9843	0.0069	0.9630	0.9935	0.7180	0.4762	0.8770
Johnson	6	2	95	0.9782	0.0152	0.9171	0.9946	0.6301	0.2317	0.9058
All Sites	46	9	741	0.9877	0.0041	0.9765	0.9936	0.7705	0.6151	0.8758

Appendix 14. Daily and incubation-period survival rates for interior least tern nests monitored on managed or constructed river islands during 2009. 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
Dippel	2	2	11	0.7689	0.1466	0.3977	0.9437	0.0040	0.0000	0.9141
Dinan	1	0	4	1.0000	0.0000	1.0000	1.0000	1.0000	0.0000	1.0000
All Sites	3	2	15	0.8434	0.1027	0.5400	0.9611	0.0280	0.0002	0.8330

Appendix 15. Daily and incubation-period survival rates for interior least tern nests monitored at sandpits and on managed or constructed river islands during 2009. 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
Sandpits	46	9	741	0.9877	0.0041	0.9765	0.9936	0.7705	0.6151	0.8758
River Islands	3	2	15	0.8434	0.1027	0.5400	0.9611	0.0280	0.0002	0.8352
All Sites	49	11	756	0.9852	0.0044	0.9734	0.9918	0.7309	0.5770	0.8439

Appendix 16. Daily and brooding-period survival rates for interior least tern broods monitored on sandpits during 2009. Brooding-period survival rate = (daily brood survival rate)^{15}.

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	11	2	158	0.9870	0.0091	0.9495	0.9967	0.8219	0.5006	0.9550
Blue Hole	12	1	169	0.9941	0.0059	0.9592	0.9992	0.9148	0.5807	0.9881
Johnson	2	1	23	0.9522	0.0468	0.7266	0.9933	0.4793	0.0543	0.9366
All Sites	25	4	350	0.9884	0.0058	0.9694	0.9956	0.8390	0.6416	0.9382

Appendix 17. Daily and brooding-period survival rates for interior least tern broods monitored on managed or constructed river islands during 2009. Brooding-period survival rate = (daily brood survival rate)^{15}.

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
Mormon Isl.	5	2	50	0.9600	0.0277	0.8537	0.9900	0.5421	0.1565	0.8831

Appendix 18. Daily and brooding-period survival rates for interior least tern broods monitored at sandpits and on managed or constructed river islands during 2009. Brooding-period survival rate = (daily brood survival rate)^{15}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	25	4	350	0.9884	0.0058	0.9694	0.9956	0.8390	0.6416	0.9382
River Islands	5	2	50	0.9600	0.0277	0.8537	0.9900	0.5421	0.1565	0.8831
All Sites	30	6	400	0.9848	0.0062	0.9665	0.9931	0.7943	0.6119	0.9044

Appendix 19. Daily and incubation-period survival rates for piping plover nests monitored on sandpits during 2009. 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	5	2	112	0.9819	0.0127	0.9305	0.9955	0.5996	0.2031	0.8979
Blue Hole	5	2	96	0.9787	0.0149	0.9189	0.9947	0.5475	0.1605	0.8845
Johnson	2	0	25	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	12	9	233	0.9826	0.0086	0.9545	0.9934	0.6112	0.3124	0.8447

Appendix 20. Daily and incubation-period survival rates for piping plover nests monitored on managed or constructer river islands during 2009. 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
Dippel	2	1	28	0.9629	0.0364	0.7788	0.9948	0.3472	0.0217	0.9273

Appendix 21. Daily and incubation-period survival rates for piping plover nests monitored at sandpits and on managed or constructer river islands during 2009. 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
Sandpits	12	4	233	0.9886	0.0080	0.9557	0.9972	0.7345	0.3559	0.9327
River Islands	2	1	28	0.9629	0.0364	0.7788	0.9948	0.3606	0.0241	0.9279
All Sites	14	5	261	0.9852	0.0085	0.9552	0.9952	0.6690	0.3383	0.8887

Appendix 22. Daily and brooding-period survival rates for piping plover broods monitored on sandpits during 2009. Brooding-period survival rate = (daily brood survival rate)^{15}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Lexington	3	1	45	0.9770	0.0227	0.8539	0.9968	0.7053	0.2463	0.1900
Blue Hole	3	0	45	1.0000	0.0000	1.0000	1.0000	1.0000	0.0000	1.0000
Johnson	2	1	28	0.9614	0.0379	0.7710	0.9946	0.5543	0.3276	0.0846
All Sites	8	2	118	0.9825	0.0123	0.9328	0.9956	0.7676	0.1436	0.4055

Appendix 23. Daily and brooding-period survival rates for piping plover broods monitored on managed or constructed river islands during 2009. Brooding-period brood survival rate = (daily brood survival rate)^{15}.

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
Dinan	1	0	15	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Appendix 24. Daily and brooding-period survival rates for piping plover broods monitored at sandpits and on managed or constructed river islands during 2009. Brooding-period brood survival rate = (daily brood survival rate)^{15}.

Site	# Broods	# Broods Lost	Exposure Days	Daily Brood Survival Rate	Daily Brood Survival SE	Daily Brood Survival Rate 95% CI		Brooding Period Survival Rate	Brooding Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Sandpits	8	2	118	0.9825	0.0123	0.9328	0.9956	0.7676	0.4055	0.9412
River Islands	1	0	15	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
All Sites	9	2	133	0.9845	0.0108	0.9403	0.9961	0.7917	0.4454	0.9473

Appendix 25. Site-specific number of adults, nests, chicks, and fledglings observed by Program staff and partners while monitoring sandpits and constructed or managed river islands for interior least tern and piping plover reproduction during 2009. Site #'s correspond with Figure 8.

						Interior Least Tern						Piping Plover					
Site #	Site Name	Habitat Type	Management	Surveys	Survey Time (hr)	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks	Fledglings	Adults (Cum)	Adults (Max)	Nests	Nests hatched	Chicks	Fledglings
1	Lexington Pit	SP	RPFT	29	35	258	22	14	10	27	18	76	6	5	3	7	5
2	Lexington Island	RI	RP	9	3	1	1	0	0	0	0	0	0	0	0	0	0
3	Overton Island	RI	HP	8	3	2	2	0	0	0	0	2	2	0	0	0	0
4	Cottonwood Ranch	RI	DP	8	3	7	4	0	0	0	0	2	2	0	0	0	0
5	Blue Hole	SP	PFT	31	33	317	22	17	12	25	21	79	6	5	3	10	6
6	Johnson Pit	SP	PFT	24	23	93	8	6	2	5	2	45	4	2	2	8	0
7	Elm Creek Island	RI	MBDP	10	5	3	2	0	0	0	0	5	4	0	0	0	0
8	Broadfoot – Turkey Creek	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
9	Broadfoot – Kearney South	SP	N	3	4	27	22	2	0	0	0	24	14	0	0	0	0
10	Wyoming Property	RI	P	3	1	2	2	0	0	0	0	2	2	0	0	0	0
11	Broadfoot – Newark	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
12	Mid-Nebraska Aggregate – Minden	SP	N	2	1	0	0	0	0	0	0	0	0	0	0	0	0
13	Dinan Tract	RI	DGP	3	1	9	5	1	1	1	0	3	2	0	0	0	0
14	Triplett Trail	RI	P	3	1	0	0	0	0	0	0	1	1	0	0	0	0
15	Dippel Tract	RI	DP	3	1	17	9	0	0	0	0	0	0	0	0	0	0
16	Uridil	RI	DRP	9	6	3	2	0	0	0	0	0	0	0	0	0	0
17	Dahm Property	RI	N	9	5	0	0	0	0	0	0	0	0	0	0	0	0
18	Lilley – Wood River	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
19	Alda Farms	RI	DPF	9	8	4	2	0	0	0	0	2	2	0	0	0	0
20	Wild Rose Ranch	RI	DP	3	1	1	1	0	0	0	0	0	0	0	0	0	0
21	Wild Rose Ranch – East Pit	SP	DP	8	7	5	3	0	0	0	0	0	0	0	0	0	0
22	DeWeese – Alda	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
23	Mormon Islands	RI	PG	18	21	73	10	5	5	9	4	3	2	0	0	0	0
24	Hooker Brothers – GI West	SP	N	3	2	0	0	0	0	0	0	0	0	0	0	0	0
25	Island Landhandlers – GI	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
26	Hooker Brothers – GI South	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0
27	Central Sand & Gravel – GI	SP	N	1	1	0	0	0	0	0	0	0	0	0	0	0	0
28	Hooker Brothers – GI East	SP	N	3	1	0	0	0	0	0	0	0	0	0	0	0	0

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 removal (R), or herbicide (H) during fall 2008; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2009; no management (N); or unknown (U). Adult counts are cumulative number of adults observed during all surveys (Cum) and maximum number of adults observed during any single survey (Max).

Appendix 26. Site-specific number of adults, nests, chicks, and fledglings observed by USGS-NPWRC while monitoring sandpits and constructed or managed river islands for interior least tern and piping plover reproduction during 2009. Site #'s correspond with Figure 8.

						Interior Least Tern						Piping Plover					
Site #	**Site Name**	**Habitat Type**	**Management**	**Surveys**	**Survey Time (hr)**	**Adults (Cum)**	**Adults (Max)**	**Nests**	**Nests hatched**	**Chicks**	**Fledglings**	**Adults (Cum)**	**Adults (Max)**	**Nests**	**Nests hatched**	**Chicks**	**Fledglings**
1	Lexington Pit	SP	RPFT	45	141	-	-	18	9	15	2	-	-	5	1	9	4
2	Lexington Island	RI	RP	1	1	-	-	0	0	0	0	-	-	0	0	0	0
3	Overton Island	RI	HP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Cottonwood Ranch	RI	DP	1	3	-	-	0	0	0	0	-	-	0	0	0	0
5	Blue Hole	SP	PFT	52	135	-	-	22	12	16	0	-	-	5	2	8	2
6	Johnson Pit	SP	PFT	17	28	-	-	6	1	2	0	-	-	2	1	5	0
7	Elm Creek Island	RI	MBDP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Broadfoot – Turkey Creek	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Broadfoot – Kearney South	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Wyoming Property	RI	N	1	2	-	-	0	0	0	0	-	-	0	0	0	0
11	Broadfoot – Newark	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Mid-Nebraska Aggregate – Minden	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Dinan Tract	RI	DGP	27	31	-	-	1	1	2	0	-	-	2	1	3	1
14	Triplett Trail	RI	P	11	2	-	-	0	0	0	0	-	-	0	0	0	0
15	Dippel Tract	RI	DP	21	26	-	-	2	0	0	0	-	-	0	0	0	0
16	Uridil	RI	DRP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Dahm Property	RI	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Lilley – Wood River	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Alda Farms	RI	DPF	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Wild Rose Ranch	RI	DP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Wild Rose Ranch – East Pit	SP	DP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	DeWeese – Alda	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	Mormon Islands	RI	PG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Hooker Brothers – GI West	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Island Landhandlers – GI	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	Hooker Brothers – GI South	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	Central Sand & Gravel – GI	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	Hooker Brothers – GI East	SP	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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 removal (R), or herbicide (H) during fall 2008; pre-emergent herbicide (P), predator fencing (F), or predator trapping (T) during spring 2009; no management (N); or unknown (U). Adult counts are not included as counting adult birds was not an objective of USGS-NPWRC's research.