Least Tern and Piping Plover Monitoring Protocol Implementation Report for 2004

Prepared for:
Technical Committee

Prepared by:
Executive Director's Office

January 16, 2006

INTRODUCTION

The Cooperative Agreement's Technical Committee agreed to implement the protocol for "Monitoring Reproductive Success and Reproductive Habitat Parameters of Least Terns and Piping Plovers in the Central Platte River valley" (Tern and Plover Monitoring Protocol) dated May 1, 2002 in 2004 for the purpose of documenting the reproductive efforts of least terns and piping plovers. Existing cooperator staff and equipment was used to conduct the fieldwork. The Executive Director's office (EDO) was tasked to compile data and write the report. This report summarizes the data collected in the 2004 season.

METHODS

Surveys of the central Platte River were conducted in 2004 to locate active nests and individual birds (component 1 of the protocol design). Surveys were conducted of all channels wider than 75m that could safely be navigated. Two airboats were used during the survey. Personnel from the Grand Island Field Office, U.S. Fish and Wildlife Service (USFWS) conducted the river survey from Chapman upstream to the Kearney Canal headgates (near Elm Creek) on May 17, 18 and 24. No surveys of this section of river were conducted in June or July due to low water conditions. Nebraska Public Power District (NPPD), Central Nebraska Public Power and Irrigation District (Central), and Central Platte Natural Resources District (CPNRD) personnel conducted the river survey from the Kearney Canal headgates upstream to Lexington on May 28, and June 21. No surveys of this section of river were conducted in July due to low water conditions. The lengths of river surveyed for each of the surveys are in Table 1. The daily average in-stream (provisional) flows and stage levels for the Overton, Kearney and Grand Island gages during the river surveys are in Table 2 and during the months of May, June and July are in Figures 1-6.

Sandpits and islands constructed for tern and plover reproductive habitat were surveyed either two or three times to locate active nests and individual birds (component 2 of the protocol). NPPD personnel surveyed 6 sandpits and 4 constructed islands from the Lexington bridge to the Odessa bridge. CPNRD personnel surveyed 10 sandpits from ~1 mile West of the Kearney bridge to the Chapman bridge. Several small pits between the Kearney bridge and the Odessa bridge as well as the Leach owned pit just East of the Minden bridge were not surveyed because permission to access was not obtained.

With the exception of two sites (see below), nests located during the river survey, or sandpit and constructed island survey were monitored throughout the nesting period. Nests were

visited every 3 days until the nest failed or until the nestlings fledged. Nest level habitat characteristics were measured at nests after the birds had left the colony area. Colony level characteristics will be measured in a geographic information system using the spatially referenced 2004 color photographs during a future analysis. Access to two pits owned by Broadfoot Sand and Gravel in the Kearney area was granted to conduct the three monthly surveys to locate nests, though access was not granted to monitor nests every three days.

The data were entered into the Program's Microsoft Access database. The database 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.

RESULTS

Survey Results

River surveys required 4 days to complete in May. Surveys were only conducted for one day in June, from the Kearney Canal headgates to Lexington. There were 0 least tern nests and 0 piping plover nests detected during the river surveys. The most birds detected during one river survey period in 2004 were 26 least tern adults and 5 piping plover adults (Table 3). Counts of birds detected during the river survey were not adjusted to account for the birds assumed to be reproducing at the nearby sandpits. The locations of each river survey observation and the distance to the closest known nesting colony are in Tables 4 and 5.

Sixteen sandpits and four constructed islands were surveyed during the May survey. Fifteen sandpits and four constructed islands were surveyed during the June survey. Twelve sandpits and one constructed island were surveyed during the July survey. There were 54 least tern and 19 piping plover nests located on sandpits in 2004. No nests were observed on constructed islands in 2004. The number of adults, nests, chicks and fledglings detected on the site visit nearest to May 15, June 15, and July 15 were summed across the sites surveyed (Table 6). The most birds detected during one of these surveys to sandpits and constructed islands were 111 least tern adults, 35 piping plover adults, 41 least tern juveniles, and 5 piping plover juveniles.

Least tern and/or piping plover nests were located at 7 of the 20 sandpits/constructed islands surveyed (Table 7; Figures 7 and 8). Five of these sites were visited every three days while nests were active.

There were 54 least tern nests located in 2004; 20 nests at Blue Hole, 2 nests at Broadfoot-Kearney South Pit, 4 nests at Broadfoot-Newark Pit, 5 nests at Bruner-Shelton Pit, 8 nests at Johnson Pit, and 15 nests at Lexington Pit (Table 8). Thirty of the 48 nests monitored successfully fledged at least 1 least tern for a total of 60 least tern fledglings.

There were 19 piping plover nests located in 2004; 5 nests at Blue Hole, 3 nests at Broadfoot-Kearney South Pit, 3 nests at Broadfoot-Newark Pit, 3 nests at Johnson Pit, 1 nest at Paulsen's Lexington Pit, and 4 nests at Lexington Pit (Table 9). Eight of the 13 nests monitored successfully fledged at least 1 piping plover for a total of 23 piping plover fledglings. In addition, 2 piping plover fledglings were documented from 1 fledged nest at the Broadfoot-Newark site, although the nests were not monitored every 3 days.

The numbers of piping plover and least tern individuals and nests documented at the Broadfoot-Kearney South Pit and the Broadfoot-Newark Pit represent minimums present. Surveys to determine exact counts of birds were hindered by the number of birds present, the size of the area and the availability of hiding cover for fledglings.

Reproductive Parameters

Reproductive parameters listed in the protocol were estimated with the data collected in 2004. Formulas for reproductive habitat calculations are located in the protocol. The reproductive parameters calculated for this report were based only on the nests monitored in 2004.

Total Nests Initiated

The total nests initiated are the number of nests detected during the site surveys. There were 54 least tern and 19 piping plover nest initiations documented in 2004. There were 48 least tern nest and 13 piping plover nests monitored until the nest failed or the fledglings departed the colony (Tables 10 and 11).

Nest-based Hatching Success

Nest-based hatching success was estimated to be 1.50 for least terns (72 eggs/48 nests) and 2.62 for piping plovers (34 eggs/13 nests) monitored in 2004. This estimate is calculated as the number of hatched eggs divided by the number of nests initiated. The number of eggs that hatched was estimated as the maximum of number of chicks initially observed or number of chicks 15 days old (fledged by protocol definition).

Nesting Loss

Nesting loss was estimated to be 0.31 for least terns (15 nests lost/48 nests) and 0.31 for piping plovers (4 nests lost/13 nests) monitored in 2004. This estimate is calculated as the number of unsuccessful nests divided by the number of nests initiated. A nest is defined as unsuccessful if no eggs hatch.

Nesting Success

Nesting success was estimated to be 0.69 for least terns (33 successful nests/48 nests) and 0.69 for piping plovers (9 successful nests/13 nests) monitored in 2004. This estimate is calculated as the number of successful nests divided by the number of nests initiated. A nest is successful if at least one chick is observed initially or one 15 day old chick is observed.

Number of Pairs

Number of pairs was estimated to be 38 for least terns and 12 for piping plovers at sites monitored in 2004 for reproductive success (every 3 days). This estimate is calculated as the maximum number of nests and number of broods detected during one survey. An alternative estimate is one-half of the number of adults detected during one survey. Using this method, the number of pairs was estimated to be 35 for least terns and 13.5 for piping plovers for sites monitored in 2004.

The number of pairs estimated as the maximum number of nests and number of broods detected during one survey was 49 for least terns and 17 for piping plovers at all sites visited in 2004. The alternative estimate, one-half of the number of adults detected during one survey, was

58.5 for least terns and 25.5 for piping plovers for all sites visited in 2004. These estimates include sites visited during the monthly surveys but not monitored for reproductive success.

Nest-based Fledgling Success

Nest-based fledgling success was estimated to be 1.25 for least terns (60 fledglings/48 nests) and 1.77 for piping plovers (23 fledglings/13 nests) monitored in 2004. This estimate is calculated as the number of fledglings divided by the number of nests initiated. The number of fledglings for each nest was estimated as the maximum of the number of chicks 15 days old or observed flying.

Pair-based Fledgling Success

Pair-based fledgling success for 2004 was estimated to be 1.58 for least terns (60 fledglings/38 pair) and 1.92 for piping plovers (23 fledglings/12 pair) using the first estimate of pairs above and 1.71 for least terns (60 fledglings/35 pair) and 1.70 for piping plovers (23 fledglings/13.5 pair) using the second estimate of pairs above. This estimate is calculated as the number of fledglings divided by the number of pairs.

Mayfield Daily Survival Rate

Mayfield daily nest survival rate was estimated to be 0.9834 (95% CI: 0.9749, 0.9919) for least terns (1-(15 nests/903 days)) and 0.9837 (95% CI: 0.9675, 1.0000) for piping plovers (1-(4 nests/245 days)) monitored in 2004 (Tables 12 and 13). This estimate is calculated as one minus the quantity: number of nest failures divided by the number of days nests were monitored (exposure days).

Trend Detection

Trends of reproductive parameters through time were not estimated with the data. As the monitoring data is accumulated throughout the Program's first increment, these analyses will be possible.

Before-After Program Analysis

A before-after analysis of reproductive parameters was not estimated for this year of monitoring data. As the monitoring data is accumulated throughout the Program's first increment, these analyses will be possible.

Nest-level Habitat Characteristics

Nest characteristics were visually estimated at 11 of the least tern and 6 piping plover nests located in 2004 (Tables 14 and 15).

Distance to Nearest Bank

There were no least tern nests or piping plover nests monitored in the river channel in 2004.

Nest Elevation

The nest elevation averaged 1.43 meters (95% CI: 1.34, 1.53) over the 11 least tern nests visually estimated on sandpits and 1.48 meters (95% CI: 1.08, 1.88) over the 6 piping plover nests visually estimated on sandpits.

Nest Management

The owner/operators were notified of the location of the five nests located at the Bruner-Shelton pit.

Vegetation Composition

The average cover visually estimated within the 1 m^2 area over the 11 least tern nests was 0.45% grass, 5.91% forb, and 0% woody. The average cover estimated within the 1 m^2 area over the 6 piping plover nests was 0.33% grass, 0.17% forb, and 0% woody. The average cover estimated within the 5 m^2 area over the 11 least tern nests was 0.45% grass, 9.55% forb, and 0% woody. The average cover estimated within the 5 m^2 area over the 6 piping plover nests was 0.33% grass, 2.50% forb, and 0% woody.

Vegetation Density

The average density of stems visually estimated within the 1 m^2 area over the 11 least tern nests was 0.73 stems of grass per m^2, 1.73 stems of forb per m^2, and 0 stems of woody per m^2. The average density estimated within the 1 m^2 area over the 6 piping plover nests was 0.33 stems of grass per m^2, 0.17 stems of forb per m^2, and 0 stems of woody per m^2. The average density estimated within the 5 m^2 area over the 11 least tern nests was 0.91 stems of grass per 5 m^2, 21.18 stems of forb per 5 m^2, and 0 stems of woody per 5 m^2. The average density estimated within the 5 m^2 area over the 6 piping plover nests was 1.00 stem of grass per 5 m^2, 19.17 stems of forb per 5 m^2, and 0 stems of woody per 5 m^2.

Vegetation Height

The average height of stems visually estimated within the 1 m^2 area over the 11 least tern nests was 0.09 meters. The average height estimated within the 1 m^2 area over the 6 piping plover nests was 0.08 meters. The average height estimated within the 5 m^2 area over the 11 least tern nests was 0.10 meters. The average height estimated within the 5 m^2 area over the 6 piping plover nests was 0.08 meters.

Colony-level Habitat Characteristics

Nesting colony characteristics were measured at the 7 pits with active nests in 2004 (Table 16).

Colony management

Three of the pits with active least tern or piping plover nests were managed for nesting activities through the use of electric predator fences, predator trapping by USDA from late May to August and pre-emergent herbicide application in March. One pit received herbicide treatment. The three other pits received no management for nesting activities.

Adjacent Land Use

Six of the pits with active least tern or piping plover nests were adjacent to active sandpits in 2004.

Bare Sand Area

This colony habitat characteristic was not estimated for any colonies in 2004.

Pond Size

Pond size will be calculated with the most recent photos during a GIS analysis of the data.

Distance from Colony to River

Distance from the colony to the river will be calculated with the most recent photos during a GIS analysis of the data.

Sandbar/Island Height

There were no least tern nests or piping plover nests monitored in the river channel in 2004.

Channel Width

There were no least tern nests or piping plover nests monitored in the river channel in 2004.

Habitat Associations with Reproductive Parameters

Nest level associations use the nest as the sample size and assume the nests are independent. Correlations between each of the nest habitat characteristics and the number of eggs hatched, an indicator of nest success, and the number of chicks fledged were calculated by species (Tables 17 and 18). Positive correlations indicate an increase in the habitat parameter associated with an increase in the reproductive parameter. Negative correlations indicate a decrease in the habitat parameter associated with a decrease in the reproductive parameter.

Colony level associations use the colony as the sample size and assume the colonies are independent. Correlations between each of the colony habitat characteristics and the reproductive parameters will be estimated during a GIS analysis of the data

INCIDENTAL OBSERVATIONS

There were no incidental observations of least terns or piping plovers reported in the study area for 2004.

IMPLEMENTATION COSTS

There were 52 people-days worked to implement the protocol during the 2004 implementation (Table 19). Each cooperator contributed their time under existing budgets, and no credit was given against the Cooperative Agreement. The estimate is lower than would be expected if a private contractor implemented the protocol because not all the pits were surveyed, and some surveyors were able to monitor nests on the way to or from other job responsibilities in the area.

TABLES

Table 1. Length of river surveyed in 2004 based on river miles.

Survey	From	To	River Miles
May 2004	Chapman	Kearney Diversion	72.3
May 2004	Kearney Diversion	J2 Return	17.3
		Total	89.6
June 2004	Kearney Diversion	J2 Return	17.3
		Total	17.3
July 2004			0
		Total	0

Table 2. Daily average discharge (cfs) and stage (feet) at Overton, Nebraska (USGS Gage No. 06768000), Kearney, Nebraska (USGS Gage No. 06770200) and Grand Island, Nebraska (USGS Gage No. 06770500) during river survey dates.

	Overton		Kearney		Grand Island	
Date	Discharge	Stage	Discharge	Stage	Discharge	Stage
5/17/2004	139	0.74	192	2.20	177	3.14
5/18/2004	133	0.72	203	2.22	189	3.16
5/24/2004	102	0.63	120	2.00	122	3.04
5/28/2004	99	0.62	42	1.67	75	2.92
6/21/2004	141	0.78	19	1.55	33	2.80

Table 3. The number of adults, nests, chicks, and fledgling least terns and piping plovers observed during each monthly airboat survey of the river, 2001-2004.

	Least Tern				Piping Plover			
Survey	# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
May 2004	26	0	0	0	5	0	0	0
June 2004	6	0	0	0	3	0	0	0
May 2003	28	0	0	0	10	0	0	0
June 2003	17	0	0	0	9	0	0	0
May 2002	4	0	0	0	0	0	0	0
June 2002	18	0	0	0	1	0	0	0
July 2002	31	0	0	7	5	0	0	5
May 2001	16	0	0	0	2	0	0	0
June 2001	23	0	0	0	5	0	0	0
July 2001	16	0	0	5	17	0	0	12

Table 4. Locations of least terns observed during the river survey. The distance to nearest constructed island or sandpit with nesting least terns was estimated as the strait-line distance using the location reported for each site.

Date	UTM x	UTM y	# Adults	# Juveniles	Activity	Distance to Closest Known Nesting Area (miles)
5/24/04			1	0		
5/24/04			2	0	diving	
5/24/04	470853	4504089	4	0	foraging & loafing	1.32
5/24/04	472727	4503581	2	0	foraging	2.50
5/24/04	485132	4501460	2	0	foraging	4.68
5/24/04	503772	4503496	1	0	foraging	0.23
5/24/04	505894	4501265	2	0	foraging	1.75
5/24/04	514963	4503928	2	0		5.51
5/24/04	522388	4507264	1	0		1.37
5/28/04	461736	4503890	3	0	foraging	4.35
5/28/04	468755	4503732	6	0	foraging	0.19
6/21/04	461736	4503894	2	0	flying	4.35
6/21/04	468747	4503732	4	0	foraging	0.19

Table 5. Locations of piping plovers observed during the river survey. The distance to nearest constructed island or sandpit with nesting piping plovers was estimated as the strait-line distance using the location reported for each site.

Date	UTM x	UTM y	# Adults	# Juveniles	Activity	Distance to Closest Known Nesting Area (miles)
5/24/04	471205	4503848	2	0	foraging	1.54
5/28/04	468755	4503732	2	0	foraging	0.19
5/28/04	470231	4504132	1	0	foraging	0.93
6/21/04	468402	4503626	3	0	foraging	0.33

Table 6. The number of adults, nests, chicks, and fledgling least terns and piping plovers observed during each monthly survey at sand pits and constructed islands, 2001-2004.

Survey	# Sites	Least Tern				Piping Plover			
		# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
May 2004	20	21	0	0	0	21	12	0	0
June 2004	19	111	39	8	0	35	5	15	2
July 2004	13	86	7	20	41	16	0	4	5
May 2003	20	40	0	0	0	22	10	0	0
June 2003	20	87	46	0	0	23	6	23	0
July 2003	17	79	15	16	33	9	1	0	6
May 2002	22	3	0	0	0	18	4	0	0
June 2002	22	90	41	3	0	34	7	22	2
July 2002	22	82	9	22	29	16	0	0	5
May 2001	23	6	0	0	0	11	3	0	0
June 2001	23	27	14	0	0	15	1	20	0
July 2001	23	21	0	15	14	2	1	0	1

Table 7. Sandpits and constructed islands monitored for least tern and piping plover reproduction in 2004. Number of adults, pairs, and nests is the maximum observed on one day for all the surveys at the site.

Site	Site type	# Surveys	UTM x	UTM y	Least Tern			Piping Plover			Site management
					# adults	# pairs	# nests	# adults	# pairs	# nests	
Blue Hole	sandpit	44	468736	4504032	28	16	13	9	5	3	electric fence, predator trapping by USDA late May-August, pre-emergent herbicide application
Lexington Pit	sandpit	38	438763	4509268	22	12	12	12	4	4	electric fence, predator trapping by USDA late May-August, pre-emergent herbicide application
Johnson Pit	sandpit	33	468881	4502069	12	6	6	5	2	2	electric fence, predator trapping by USDA late May-August, pre-emergent herbicide application
Bruner-Shelton	sandpit	20	521924	4509427	8	4	4	2	0	0	none
Paulsen's Lexington Pit	sandpit	15	434039	5409125	0	0	0	1	1	1	none
Cottonwood Ranch	constructed island	11	460254	4503961	4	0	0	0	0	0	pre-emergent herbicide application
Overton Island	constructed island	10	452604	4503365	0	0	0	0	0	0	pre-emergent herbicide application
Elm Creek Island	constructed island	9	469434	4503790	0	0	0	1	0	0	pre-emergent herbicide application
Lexington Island	constructed island	8			0	0	0	0	0	0	pre-emergent herbicide application
Broadfoot-Kearney South	sandpit	3	492659	4501284	29	5	2	17	3	2	none
Lilley-Wood River	sandpit	3	536428	4509875	2	0	0	0	0	0	none
Broadfoot-Newark	sandpit	3	504135	4503466	12	6	4	4	2	2	none
Central Sand &Gravel -GI	sandpit	3	555873	4527165	0	0	0	0	0	0	none
Hooker Bros -GI South	sandpit	3	555613	4525340	0	0	0	0	0	0	none
Hooker Bros - GI West	sandpit	3	551433	4526439	0	0	0	0	0	0	none
Island Landhandlers- GI	sandpit	3	552343	4524639	0	0	0	0	0	0	none
Deweese-Alda	sandpit	3	548759	4521648	0	0	0	0	0	0	none
TF Odessa	sandpit	2	479147	4501179	0	0	0	0	0	0	pre-emergent herbicide application
OSG Overton Pit	sandpit	2			0	0	0	0	0	0	pre-emergent herbicide application
Knight-Chapman	sandpit	1	565680	4537371	0	0	0	0	0	0	none

Table 8. Least tern nests located in the Cooperative Agreement study area in 2004. Nests at all sites except the Broadfoot-Kearney S. and Broadfoot-Newark sites were monitored every three days.

Site	Nest #	First Date Observed	# Eggs	Date Hatched	# Chicks Initially Observed	# Chicks Fledged	Date Fledged	Final Status	Nest Management
Blue Hole	5	5/26/04		6/19/04	3	3		Fledged	
Blue Hole	6	5/28/04		6/20/04	3	3		Fledged	
Blue Hole	7	5/28/04		6/20/04	2	2		Fledged	
Blue Hole	8	6/1/04		6/22/04	3	3		Fledged	
Blue Hole	9	6/1/04		6/23/04	3	3		Fledged	
Blue Hole	10	6/1/04		6/26/04	2	1		Fledged	
Blue Hole	11	6/1/04		6/22/04	2	2		Fledged	
Blue Hole	12	6/7/04		6/28/04	2	2		Fledged	
Blue Hole	13	6/7/04		6/28/04	2	2		Fledged	
Blue Hole	14	6/9/04		6/30/04	2	1		Fledged	
Blue Hole	16	6/14/04		7/1/04	2	1		Fledged	
Blue Hole	17	6/14/04		7/1/04	2	2		Fledged	
Blue Hole	18	6/14/04						Failed- Unknown	
Blue Hole	19	6/20/04		6/30/04	2	2		Fledged	
Blue Hole	20	6/22/04		7/10/04	2	2		Fledged	
Blue Hole	21	6/24/04		7/13/04	2	1		Fledged	
Blue Hole	22	6/30/04		7/16/04	2	1		Fledged	
Blue Hole	23	6/30/04						Failed- Unknown	
Blue Hole	24	7/20/04	2	7/23/04	2			Failed- Unknown	
Blue Hole	25	8/2/04		8/10/04	2	2		Fledged	
Broadfoot-Kearney S.	1	6/23/04	3	6/22/04		2		Unknown Outcome	
Broadfoot-Kearney S.	2	6/23/04	2	6/22/04		1		Unknown Outcome	
Broadfoot-Newark	1	6/23/04						Unknown Outcome	
Broadfoot-Newark	2	6/23/04						Unknown Outcome	
Broadfoot-Newark	3	6/23/04						Unknown Outcome	
Broadfoot-Newark	4	6/23/04						Unknown Outcome	

Bruner-Shelton	1	6/8/04	4	6/24/04	3	3	7/9/04	Fledged	
Bruner-Shelton	2	6/8/04	4					Failed- Predated	
Bruner-Shelton	3	6/8/04		6/27/04	2	2	7/12/04	Fledged	
Bruner-Shelton	4	6/11/04		6/23/04	2	2	7/9/04	Fledged	
Bruner-Shelton	5	6/22/04		7/18/04	2	2	8/6/04	Fledged	
Johnson Pit	3	5/26/04						Failed- Other	
Johnson Pit	4	5/26/04						Failed- Predated	
Johnson Pit	5	6/1/04		6/22/04	1			Failed- Other	
Johnson Pit	6	6/3/04						Failed- Unknown	
Johnson Pit	7	6/7/04		6/27/04	2			Failed- Predated	
Johnson Pit	8	6/7/04		6/29/04				Failed- Other	
Johnson Pit	11	5/26/04						Failed- Predated	
Johnson Pit	12	6/22/04						Failed- Predated	
Lexington Pit	5	6/1/04		6/24/04	2	2		Fledged	
Lexington Pit	6	6/1/04						Failed- Other	
Lexington Pit	7	6/7/04		6/29/04	3	3		Fledged	
Lexington Pit	8	6/7/04		6/29/04	3	2		Fledged	
Lexington Pit	9	6/7/04		6/27/04	3	3		Fledged	
Lexington Pit	10	6/9/04						Failed- Unknown	
Lexington Pit	11	6/14/04		7/3/04	2	2		Fledged	
Lexington Pit	12	6/14/04		7/3/04	2	2		Fledged	
Lexington Pit	13	6/14/04		7/1/04	2	1		Fledged	
Lexington Pit	15	6/16/04						Failed- Other	
Lexington Pit	16	6/16/04		7/10/04	1	1		Fledged	
Lexington Pit	17	6/22/04						Failed- Other	
Lexington Pit	18	6/30/04		7/23/04	2	2		Fledged	
Lexington Pit	19	7/13/04	1					Failed- Abandoned	
Lexington Pit	20	7/13/04	1					Failed- Abandoned	

Table 9. Piping plover nests located in the Cooperative Agreement study area in 2004. Nests at all sites except the Broadfoot-Kearney S. and Broadfoot-Newark sites were monitored every three days.

Site	Nest #	First Date Observed	# Eggs	Date Hatched	# Chicks Initially Observed	# Chicks Fledged	Date Fledged	Final Status	Nest Management
Blue Hole	1	5/10/04	4	5/29/04	4	3		Fledged	
Blue Hole	2	5/12/04	4	5/28/04	4	4		Fledged	
Blue Hole	3	5/12/04						Failed- Unknown	
Blue Hole	4	5/26/04		5/31/04	4	3		Fledged	
Blue Hole	15	6/14/04		6/30/04	3	3		Fledged	
Broadfoot-Kearney S.	1	5/19/04	4					Unknown Outcome	
Broadfoot-Kearney S.	2	5/19/04						Unknown Outcome	
Broadfoot-Kearney S.	3	6/23/04	2					Unknown Outcome	
Broadfoot-Newark	1	5/19/04	4					Unknown Outcome	
Broadfoot-Newark	2	5/19/04	4			2		Fledged	
Broadfoot-Newark	3	6/23/04	3					Unknown Outcome	
Johnson Pit	1	5/7/04	4	5/27/04	4	2		Fledged	
Johnson Pit	2	5/10/04	4	6/4/04	4			Failed- Unknown	
Johnson Pit	10	6/20/04						Failed- Predated	
Lexington Pit	1	5/5/04		5/29/04	4	2		Fledged	
Lexington Pit	2	5/7/04		6/7/04	3	2		Fledged	
Lexington Pit	3	5/17/04		5/31/04	4	4		Fledged	
Lexington Pit	4	5/17/04						Failed- Unknown	
Paulsen's Lexington Pit	1	5/17/04						Unknown Outcome	

Table 10. Least tern reproductive parameter estimates for the 2004 nesting season. These estimates are based on nests monitored.

Site	# Pairs[1]	# Pairs[2]	# Nests Initiated	# Chicks Initially Observed	# Successful Nests	# Unsuccessful Nests	# Eggs Hatched	# Fledglings	Nest-based Hatch Success	Nesting Loss	Nesting Success	Nest-based Fledging Success	Pair-based[1] Fledging Success	Pair-based[2] Fledging Success
Blue Hole	16	14	20	40	18	2	40	33	2.00	0.10	0.90	1.65	2.06	2.36
Bruner-Shelton	4	4	5	9	4	1	9	9	1.80	0.20	0.80	1.80	2.25	2.25
Johnson Pit	6	6	8	3	2	6	3	0	0.38	0.75	0.25	0.00	0.00	0.00
Lexington Pit	12	11	15	20	9	6	20	18	1.33	0.40	0.60	1.20	1.50	1.64
All sites	38	35	48	72	33	15	72	60	1.5	0.31	0.69	1.25	1.58	1.71

1. Pair defined as the maximum number of nests and number of broods detected during one survey.
2. Pair defined as one-half of the maximum number of adults detected during one survey.

Table 11. Piping plover reproductive parameter estimates for the 2004 nesting season. These estimates are based on nests monitored.

Site	# Pairs[1]	# Pairs[2]	# Nests Initiated	# Chicks Initially Observed	# Successful Nests	# Unsuccessful Nests	# Eggs Hatched	# Fledglings	Nest-based Hatch Success	Nesting Loss	Nesting Success	Nest-based Fledging Success	Pair-based[1] Fledging Success	Pair-based[2] Fledging Success
Blue Hole	5	4.5	5	15	4	1	15	13	3.00	0.20	0.80	2.60	2.60	2.89
Johnson Pit	2	2.5	3	8	2	1	8	2	2.67	0.33	0.67	0.67	1.00	0.80
Lexington Pit	4	6	4	11	3	1	11	8	2.75	0.25	0.75	2.00	2.00	1.33
Paulsen's Lexington Pit	1	0.5	1	0	0	1	0	0	0	1	0	0	0	0
All sites	12	13.5	13	34	9	4	34	23	2.62	0.31	0.69	1.77	1.92	1.70

1. Pair defined as the maximum number of nests and number of broods detected during one survey.
2. Pair defined as one-half of the maximum number of adults detected during one survey.

Table 12. Mayfield daily nest survival rate and incubation survival rate for least terns in 2004. Incubation survival rate is the daily rate times itself for every day of incubation (21 times). These estimates are based on nests monitored.

Site	# Nests	# Nests Lost	Exposure Days	Mayfield Daily Nest Survival Rate	Mayfield Daily Nest Survival Rate Variance	Mayfield Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Blue Hole	20	2	369	0.9946	0.0000	0.9869	1.0022	0.8921	0.7587	1.0478
Bruner-Shelton	5	1	80	0.9875	0.0002	0.9627	1.0123	0.7679	0.4497	1.2938
Johnson Pit	8	6	185	0.9676	0.0002	0.9415	0.9936	0.5004	0.2821	0.8742
Lexington Pit	15	6	269	0.9777	0.0000	0.9597	0.9957	0.6227	0.4214	0.9135
All Sites	48	15	903	0.9834	0.0000	0.9749	0.9919	0.7034	0.5861	0.8429

Table 13. Mayfield daily nest survival rate and incubation survival rate for piping plovers in 2004. Incubation survival rate is the daily rate times itself for every day of incubation (28 times). These estimates are based on nests monitored.

Site	# Nests	# Nests Lost	Exposure Days	Mayfield Daily Nest Survival Rate	Mayfield Daily Nest Survival Rate Variance	Mayfield Daily Nest Survival Rate 95% CI		Incubation Period Survival Rate	Incubation Period Survival Rate 95% CI	
						Lower	Upper		Lower	Upper
Blue Hole	5	1	56	0.9821	0.0003	0.9467	1.0175	0.6038	0.2161	1.6271
Johnson Pit	3	1	68	0.9853	0.0002	0.9561	1.0145	0.6605	0.2845	1.4960
Lexington Pit	4	1	93	0.9892	0.0001	0.9679	1.0106	0.7388	0.4006	1.3448
Paulsen's Lexington Pit	1	1	28	0.9643	0.0012	0.8941	1.0344	0.3612	0.0436	2.5800
All Sites	13	4	245	0.9837	0.0000	0.9675	1.0000	0.6307	0.3963	0.9963

Table 14. Nest level habitat characteristics estimated at least tern nests in 2004 (estimations were not made at all nests as indicated by sample size).

Habitat Parameter	Site Type	Sample Size	Mean	95% CI		Minimum Value	Maximum Value
				Lower Bound	Upper Bound		
Nest Elevation	sandpit	11	1.43	1.34	1.53	1.25	1.75
Cover of Grass in 1 m2 area	sandpit	11	0.45	-0.44	1.35	0.00	5.00
Cover of Forb in 1 m2 area	sandpit	11	5.91	1.37	10.45	0.00	20.00
Cover of Woody in 1 m2 area	sandpit	11	0.00	0.00	0.00	0.00	0.00
Density of Grass in 1 m2 area	sandpit	11	0.73	-0.70	2.15	0.00	8.00
Density of Forb in 1 m2 area	sandpit	11	1.73	0.43	3.02	0.00	6.00
Density of Woody in 1 m2 area	sandpit	11	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 1 m2 a	sandpit	11	0.09	0.02	0.15	0.00	0.30
Cover of Grass in 5 m2 area	sandpit	11	0.45	-0.44	1.35	0.00	5.00
Cover of Forb in 5 m2 area	sandpit	11	9.55	4.19	14.91	0.00	30.00
Cover of Woody in 5 m2 area	sandpit	11	0.00	0.00	0.00	0.00	0.00
Density of Grass in 5 m2 area	sandpit	11	0.91	-0.87	2.69	0.00	10.00
Density of Forb in 5 m2 area	sandpit	11	21.18	3.53	38.84	0.00	100.00
Density of Woody in 5 m2 area	sandpit	11	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 5 m2 a	sandpit	11	0.10	0.05	0.16	0.00	0.30

Table 15. Nest level habitat characteristics estimated at piping plover nests in 2004 (estimations were not made at all nests as indicated by sample size).

Habitat Parameter	Site Type	Sample Size	Mean	95% CI		Minimum Value	Maximum Value
				Lower Bound	Upper Bound		
Nest Elevation	sandpit	6	1.48	1.08	1.88	1.25	2.50
Cover of Grass in 1 m2 area	sandpit	6	0.33	-0.08	0.75	0.00	1.00
Cover of Forb in 1 m2 area	sandpit	6	0.17	-0.16	0.49	0.00	1.00
Cover of Woody in 1 m2 area	sandpit	6	0.00	0.00	0.00	0.00	0.00
Density of Grass in 1 m2 area	sandpit	6	0.33	-0.08	0.75	0.00	1.00
Density of Forb in 1 m2 area	sandpit	6	0.17	-0.16	0.49	0.00	1.00
Density of Woody in 1 m2 area	sandpit	6	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 1 m2 a	sandpit	6	0.08	-0.02	0.17	0.00	0.30
Cover of Grass in 5 m2 area	sandpit	6	0.33	-0.08	0.75	0.00	1.00
Cover of Forb in 5 m2 area	sandpit	6	2.50	-0.85	5.85	0.00	10.00
Cover of Woody in 5 m2 area	sandpit	6	0.00	0.00	0.00	0.00	0.00
Density of Grass in 5 m2 area	sandpit	6	1.00	-0.60	2.60	0.00	5.00
Density of Forb in 5 m2 area	sandpit	6	19.17	-12.88	51.21	0.00	100.00
Density of Woody in 5 m2 area	sandpit	6	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 5 m2 a	sandpit	6	0.08	-0.01	0.17	0.00	0.30

Table 16. Colony level habitat characteristics for each sandpit with least tern (LETE) or piping plover (PIPL) nests in 2004.

Site name	Nesting Species	Colony Management	Adjacent Land Use
Bruner-Shelton	LETE	none	active sandpit surrounded by grasslands/pasture
Broadfoot-Newark	LETE PIPL	none	active sandpit surrounded by riparian woodland, grassland, and residential
Broadfoot-Kearney South	LETE PIPL	none	active sandpit surrounded by river, commercial dev. and cultivated fields
Johnson Pit	LETE PIPL	predator fencing, predator trapping, herbicide, mowing, mechanical clearing	active pumping, agriculture
Lexington Pit	LETE PIPL	predator fencing, predator trapping, herbicide, mowing, mechanical clearing	active pumping, agriculture
Blue Hole	LETE PIPL	predator fencing, predator trapping, herbicide, mowing, mechanical clearing	active pumping, agriculture
Paulsen's Lexington Pit	PIPL	herbicide	

Table 17. Correlations between habitat parameters and reproductive parameters for the least tern nests monitored in 2004 (measurements were not done at all nests as indicated by sample size). Correlations cannot be calculated for habitat or reproductive parameters with constant values at all nests (indicated by missing values).

	# Eggs Hatched		Nest Success		# Young Fledged	
Habitat Parameter	n	Correlation	n	Correlation	n	Correlation
Nest Elevation	5	0.2500	5	0.6124	5	0.2500
Cover of Grass in 1 m2 area	5	.	5	.	5	.
Cover of Forb in 1 m2 area	5	0.4082	5	0.6875	5	0.4082
Cover of Woody in 1 m2 area	5	.	5	.	5	.
Density of Grass in 1 m2 area	5	.	5	.	5	.
Density of Forb in 1 m2 area	5	0.3980	5	0.6882	5	0.3980
Density of Woody in 1 m2 area	5	.	5	.	5	.
Height of Vegetation in 1 m2 area	5	0.9207	5	0.7845	5	0.9207
Cover of Grass in 5 m2 area	5	.	5	.	5	.
Cover of Forb in 5 m2 area	5	0.3411	5	0.6035	5	0.3411
Cover of Woody in 5 m2 area	5	.	5	.	5	.
Density of Grass in 5 m2 area	5	.	5	.	5	.
Density of Forb in 5 m2 area	5	0.3849	5	0.6990	5	0.3849
Density of Woody in 5 m2 area	5	.	5	.	5	.
Height of Vegetation in 5 m2 area	5	0.9207	5	0.7845	5	0.9207

Table 18. Correlations between habitat parameters and reproductive parameters for the piping plover nests monitored in 2004 (measurements were not done at all nests as indicated by sample size).

	# Eggs Hatched		Nest Success		# Young Fledged	
Habitat Parameter	n	Correlation	n	Correlation	n	Correlation
Nest Elevation	1	.	1	.	1	.
Cover of Grass in 1 m^2 area	1	.	1	.	1	.
Cover of Forb in 1 m^2 area	1	.	1	.	1	.
Cover of Woody in 1 m^2 area	1	.	1	.	1	.
Density of Grass in 1 m^2 area	1	.	1	.	1	.
Density of Forb in 1 m^2 area	1	.	1	.	1	.
Density of Woody in 1 m^2 area	1	.	1	.	1	.
Height of Vegetation in 1 m^2 area	1	.	1	.	1	.
Cover of Grass in 5 m^2 area	1	.	1	.	1	.
Cover of Forb in 5 m^2 area	1	.	1	.	1	.
Cover of Woody in 5 m^2 area	1	.	1	.	1	.
Density of Grass in 5 m^2 area	1	.	1	.	1	.
Density of Forb in 5 m^2 area	1	.	1	.	1	.
Density of Woody in 5 m^2 area	1	.	1	.	1	.
Height of Vegetation in 5 m^2 area	1	.	1	.	1	.

Table 19. Time (people-days) used to implement the field portions of the least tern and piping plover monitoring protocol in 2004.

Cooperator	Riverine Survey (people-days)	Nest Monitoring (people-days)
NPPD	3	18
CPNRD	2	11
CNPPID	1	0
USFWS	9	0
EDO	0	0
Total	16	29

Figure 1. Discharge (cfs) at Overton, Nebraska (USGS Gage No. 06768000) from May 1 through August 31, 2004.

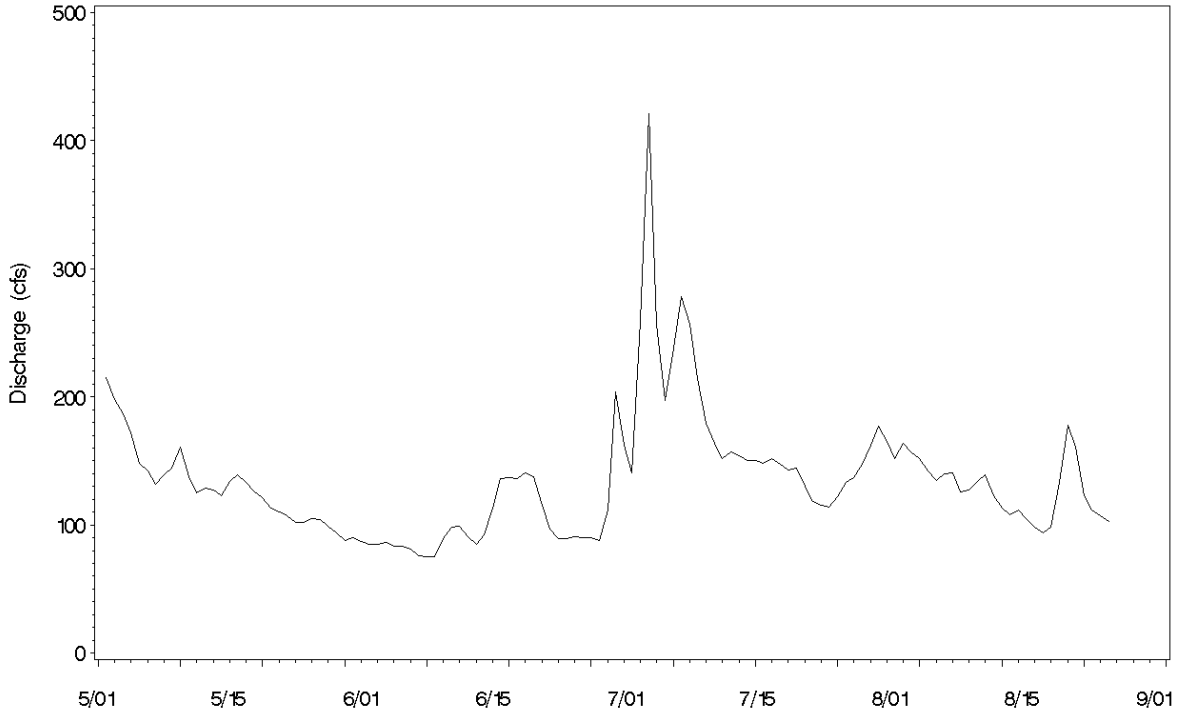

Figure 2. Stage (ft) at Overton, Nebraska (USGS Gage No. 06768000) from May 1 through August 31, 2004.

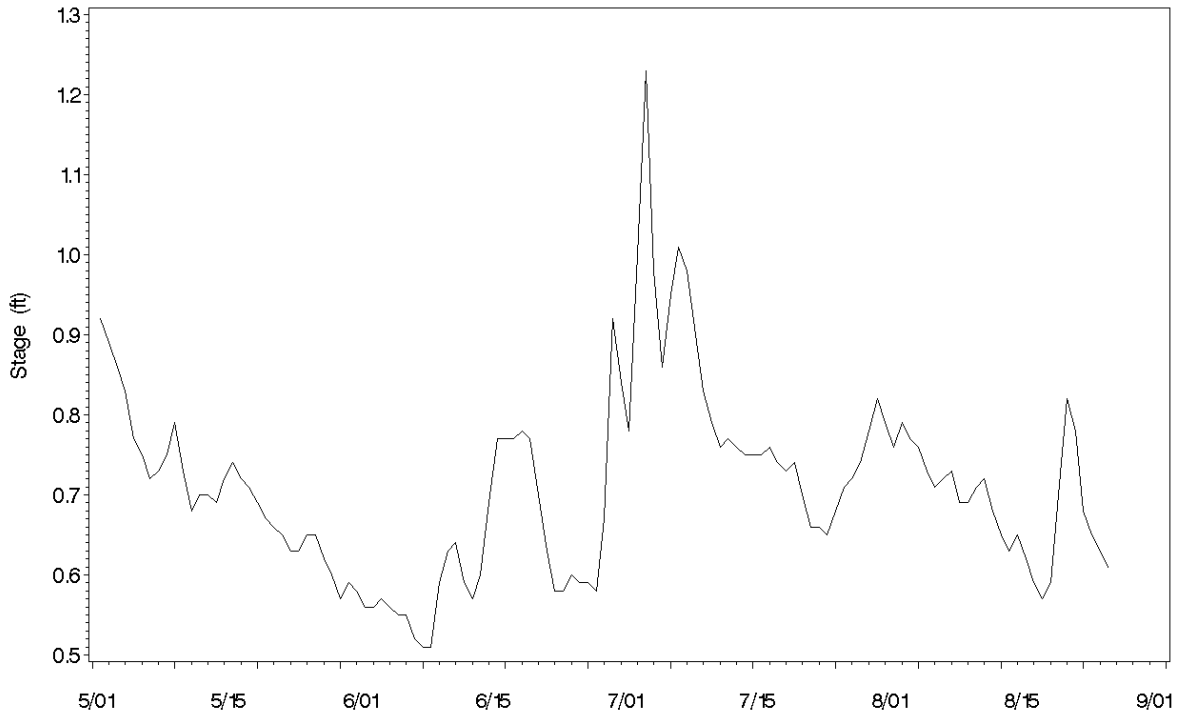

Figure 3. Discharge (cfs) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2004.

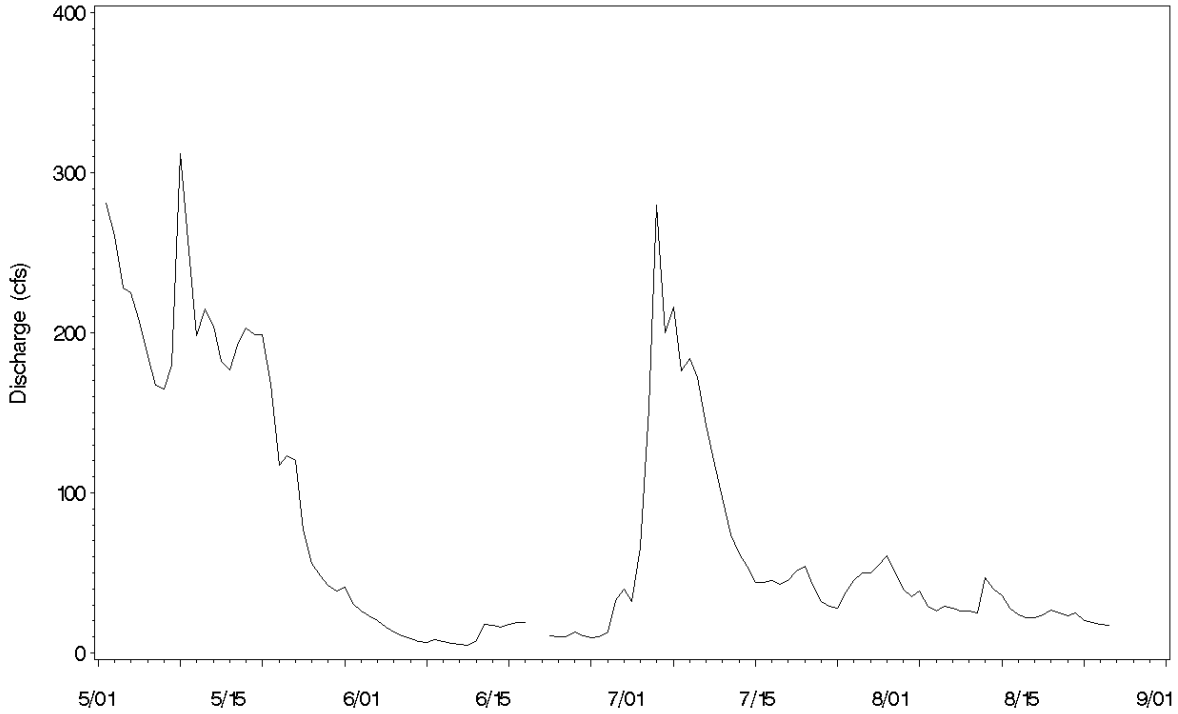

Figure 4. Stage (ft) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2004.

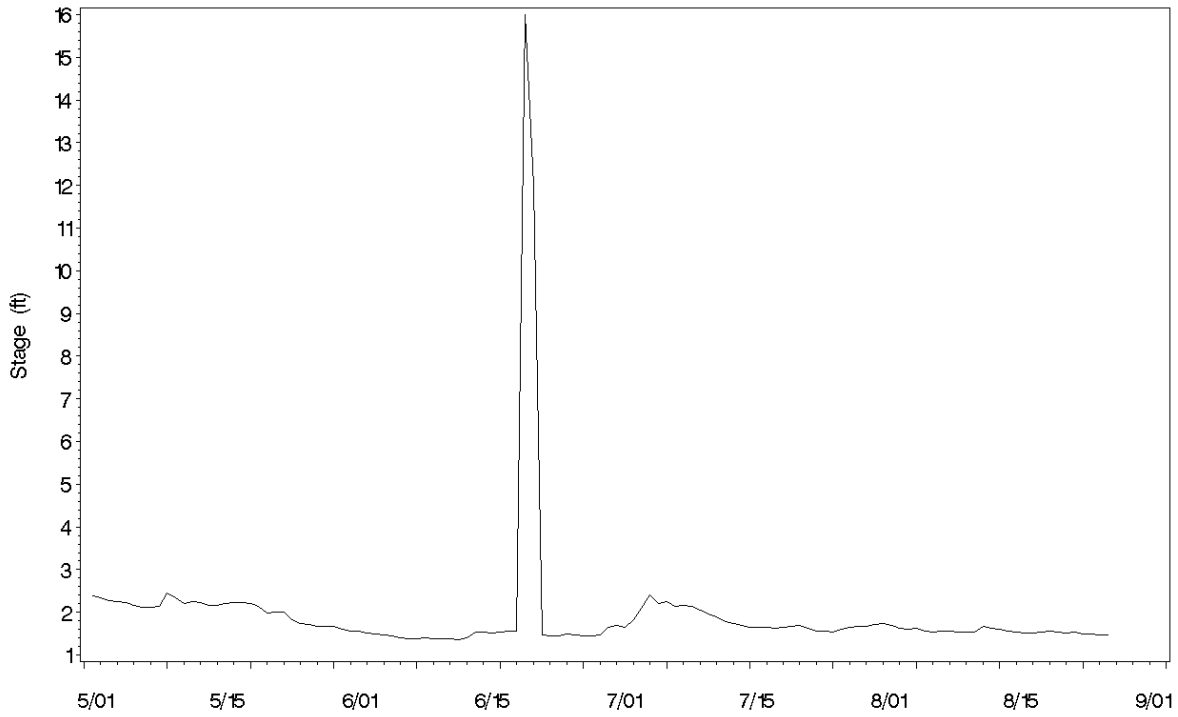

Figure 5. Discharge (cfs) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2004.

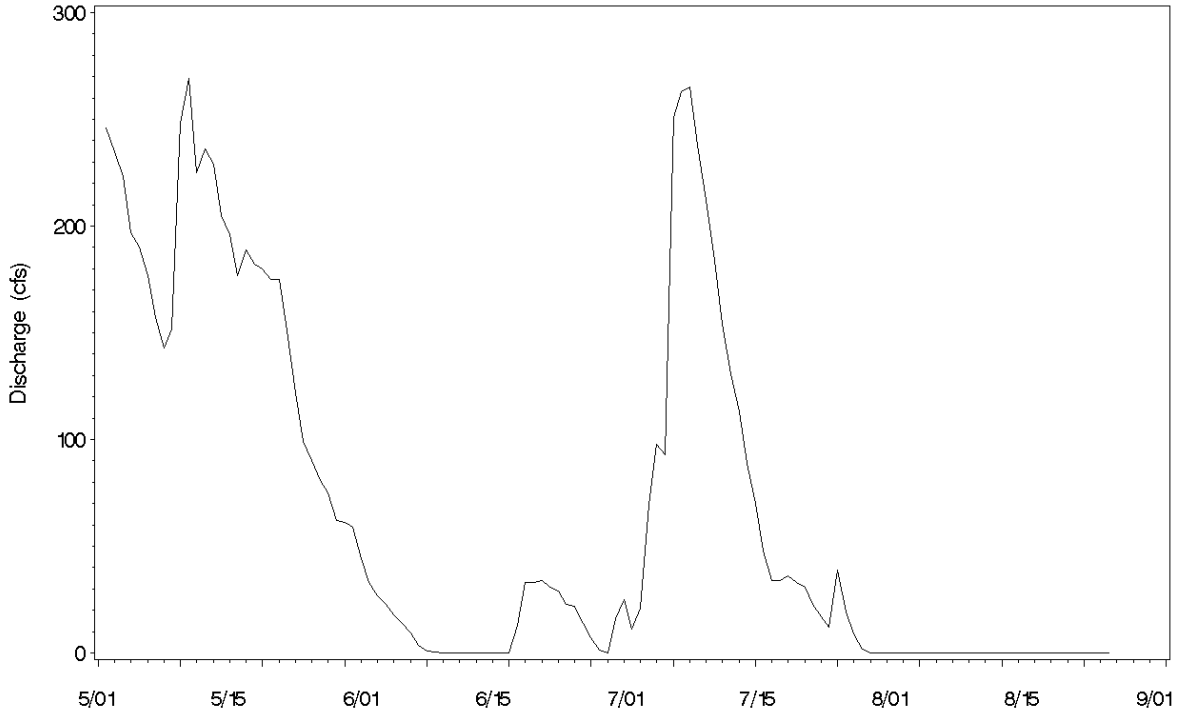

Figure 6. Stage (ft) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2004.

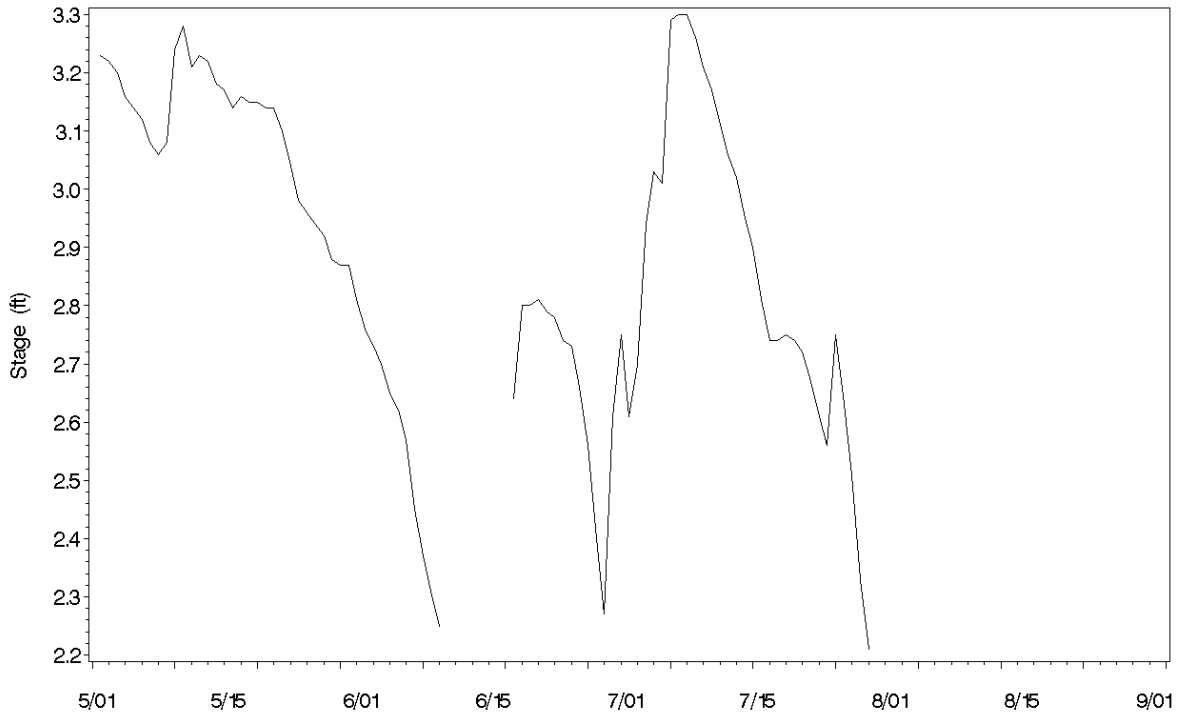

Figure 7. Sandpits and constructed islands surveyed for the 2004 season and locations of least tern sightings and nesting. Background image is the Fall 2003 color infrared photograph.

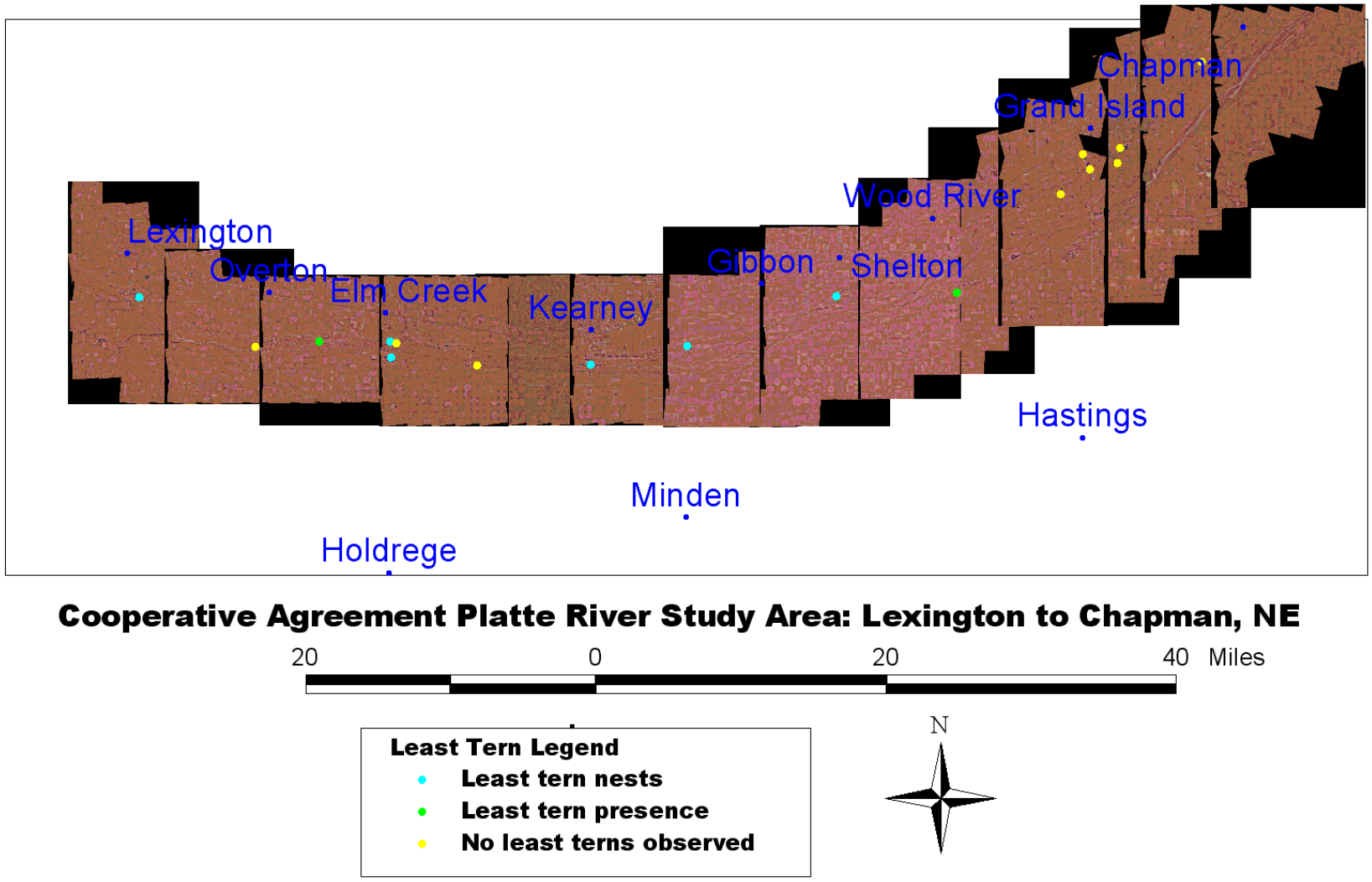

Figure 8. Sandpits and constructed islands surveyed for the 2004 season and locations of piping plover sightings and nesting. Background image is the Fall 2003 color infrared photograph.