Least Tern and Piping Plover Monitoring Protocol Implementation Report for 2005

Prepared for:
Technical Committee

Prepared by:
Executive Director's Office

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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 2005 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 2005 season.

METHODS

Surveys of the central Platte River were conducted in 2005 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 16, 18 and 19 and again on June 23 and 24. No surveys of this section of river were conducted in 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 18, and June 22. They conducted the July survey on July 19 only on the section of river from the Kearney Canal headgates upstream to Cottonwood Ranch 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 9 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 (Nebraska Highway 10) 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 2005 color photographs during a future analysis. Access to two pits owned by Broadfoot Sand and Gravel in the Kearney area (Broadfoot Newark and Broadfoot Kearney South) 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, and 3 days in June. Surveys were only conducted for one day in July, from the Kearney Canal headgates to Cottonwood Ranch. 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 2005 were 27 least tern adults and 10 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.

Fifteen sandpits and four constructed islands were surveyed during both the May and June survey. Twelve sandpits and three constructed islands were surveyed during the July survey. There were 60 least tern and 25 piping plover nests located on sandpits in 2005. No nests were observed on constructed islands in 2005. 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 136 least tern adults, 36 piping plover adults, 20 least tern fledglings, and 9 piping plover fledglings.

Least tern and piping plover nests were located at 6 of the 19 sandpits/constructed islands surveyed (Table 7; Figures 7 and 8). Four of these sites were monitored every three days while nests were active.

There were 60 least tern nests located in 2005; 13 nests at Blue Hole Pit, 2 nests at Broadfoot-Kearney South Pit, 2 nests at Broadfoot-Newark Pit, 12 nests at Bruner-Shelton Pit, 18 nests at Johnson Pit, and 13 nests at Lexington Pit (Table 8). Thirty-eight of the 56 nests monitored successfully fledged at least 1 least tern for a total of 62 least tern fledglings.

There were 25 piping plover nests located in 2005; 6 nests at Blue Hole Pit, 2 nests at Broadfoot-Kearney South Pit, 3 nests at Broadfoot-Newark Pit, 3 nests and Bruner-Shelton Pit, 5 nests at Johnson Pit, and 6 nests at Lexington Pit (Table 9). Fifteen of the 20 nests monitored successfully fledged at least 1 piping plover for a total of 28 piping plover fledglings.

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 large number of birds present at these sites, 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 2005. 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 2005.

Total Nests Initiated

The total nests initiated are the number of nests detected during the site surveys. There were 60 least tern and 25 piping plover nest initiations documented in 2005. There were 56 least tern nests and 20 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 1.30 for least terns (73 eggs/56 nests) and 2.30 for piping plovers (46 eggs/20 nests) monitored in 2005. 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 0.32 for least terns (18 nests lost/56 nests) and 0.25 for piping plovers (5 nests lost/20 nests) monitored in 2005. 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 0.68 for least terns (38 successful nests/56 nests) and 0.75 for piping plovers (15 successful nests/20 nests) monitored in 2005. 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 41 for least terns and 14 for piping plovers at sites monitored in 2005 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 51.5 for least terns and 12 for piping plovers for sites monitored in 2005.

The number of pairs estimated as the maximum number of nests and number of broods detected during one survey was 60 for least terns and 20 for piping plovers at all sites visited in 2005. The alternative estimate, one-half of the number of adults detected during one survey, was

83.5 for least terns and 23 for piping plovers for all sites visited in 2005. 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 1.11 for least terns (62 fledglings/56 nests) and 1.40 for piping plovers (28 fledglings/20 nests) monitored in 2005. 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 2005 was estimated to be 1.51 for least terns (62 fledglings/41 pair) and 2.00 for piping plovers (28 fledglings/14 pair) using the first estimate of pairs above and 1.20 for least terns (62 fledglings/51.5 pair) and 2.33 for piping plovers (28 fledglings/12 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 0.9831 (95% CI: 0.9752, 0.9910) for least terns (1-(18 nests/1063 days)) and 0.9843 (95% CI: 0.9704, 0.9982) for piping plovers (1-(5 nests/319 days)) monitored in 2005 (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 16 of the least tern and 7 piping plover nests located in 2005 (Tables 14 and 15).

Distance to Nearest Bank

There were no least tern nests or piping plover nests monitored in the river channel in 2005.

Nest Elevation

The nest elevation above the water surface averaged 1.01 meters (95% CI: 0.64, 1.38) over the 16 least tern nests visually estimated on sandpits and 1.36 meters (95% CI: 0.97, 1.74) over the 7 piping plover nests visually estimated on sandpits.

Nest Management

There was one nest enclosure placed on a piping plover nest and one visual fence placed on a least tern nest at the Bruner-Shelton pit.

Vegetation Composition

The average vegetation cover visually estimated within the 1 m^2 area over the 12 least tern nests was 0% grass, 3.5% forb, and 0% woody. The average vegetation cover estimated within the 1 m^2 area over the 7 piping plover nests was 0% grass, 3.14% forb, and 0.71% woody. The average vegetation cover estimated within the 5 m^2 area over the 12 least tern nests was 0% grass, 4.17% forb, and 0% woody. The average vegetation cover estimated within the 5 m^2 area over the 7 piping plover nests was 0.29% grass, 3.29% forb, and 0.14% woody.

Vegetation Density

The average density of stems visually estimated within the 1 m^2 area over the 12 least tern nests was 0 stems of grass per m^2, 6.67 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 7 piping plover nests was 0 stems of grass per m^2, 6.00 stems of forb per m^2, and 0.14 stems of woody per m^2. The average density estimated within the 5 m^2 area over the 12 least tern nests was 0 stems of grass per 5 m^2, 19.58 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 7 piping plover nests was 1.14 stems of grass per 5 m^2, 15.43 stems of forb per 5 m^2, and 0.14 stems of woody per 5 m^2.

Vegetation Height

The average height of stems visually estimated within the 1 m^2 area over the 12 least tern nests was 0.08 meters. The average height estimated within the 1 m^2 area over the 7 piping plover nests was 0.17 meters. The average height estimated within the 5 m^2 area over the 12 least tern nests was 0.08 meters. The average height estimated within the 5 m^2 area over the 7 piping plover nests was 0.16 meters.

Colony-level Habitat Characteristics

Nesting colony characteristics were measured at the 6 pits with active nests in 2005 (Table 16).

Colony management

Three of the pits with active least tern or piping plover nests (Johnson pit, Lexington pit and Blue Hole pit) 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. The Bruner-Shelton pit had mylar flagging placed in areas of active mining to deter nest establishment. The two other pits received no management for nesting activities.

Adjacent Land Use

Four of the six pits with active least tern or piping plover nests were adjacent to active sandpits in 2005. Other land uses adjacent to these pits included residential, interstate, river, grassland, and riparian woodland.

Bare Sand Area

This colony habitat characteristic was not estimated for any colonies in 2005.

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 2005.

Channel Width

There were no least tern nests or piping plover nests monitored in the river channel in 2005.

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 2005.

IMPLEMENTATION COSTS

There were 52.5 people-days worked to implement the protocol during the 2005 implementation (Table 19). Each cooperator contributed their time under existing budgets, and no credit was given against the Cooperative Agreement. The amount of time 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 2005 based on river miles.

Survey	From	To	River Miles
May 2005	Chapman	Kearney Diversion	91.7
May 2005	Kearney Diversion	J2 Return	16.6
		Total	108.3
June 2005	Chapman	Kearney Diversion	99.0
June 2005	Kearney Diversion	J2 Return	16.6
		Total	115.6
July 2005	Kearney Diversion	Cottonwood Ranch	3.4
		Total	3.4

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
5/16/2005	362	2.98	628	2.73	1830	4.24
5/18/2005	389	2.96	416	2.42	1070	3.87
5/19/2005	552	3.24	453	2.47	533	3.60
6/22/2005	1600	4.52	1850	3.69	1870	4.26
6/23/2005	1280	4.19	1490	3.47	1780	4.22
6/24/2005	931	3.76	1120	3.20	1600	4.14
7/19/2005	94	2.13	43	1.46	90	2.77

Table 3. The number of adults, nests, chicks, and fledgling least terns and piping plovers observed during each monthly airboat survey of the river, 2001-2005.

	Least Tern				Piping Plover			
Survey	# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
May 2005	18	0	0	0	1	0	0	0
June 2005	27	0	0	0	10	0	0	0
July 2005	3	0	0	0	0	0	0	2
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 straight-line distance using the location reported for each site.

Date	UTM x	UTM y	# Adults	# Juveniles	Activity	Distance to Closest Known Nesting Area (miles)
5/18/2005	461736	4503894	2	0	Flying	4.35
5/18/2005	468747	4503732	2	0	Foraging	0.19
5/18/2005	471170	4503861	4	0	Flying	1.52
5/18/2005	488327	4501751	2	0	Flew off sandbar	2.71
5/18/2005	492191	4500817	1	0	Foraging	0.41
5/18/2005	496015	4501245	2	0	Flying over river	2.09
5/18/2005	511892	4502981	3	0	Foraging	4.83
5/19/2005	521529	4507229	2	0	Resting	1.39
6/22/2005	449196	4503605	2	0	foraging	7.38
6/22/2005	452670	4503396	1	0	foraging	9.38
6/22/2005	470231	4504132	1	0	foraging	0.93
6/24/2005	470378	4504095	2	0	Foraging	1.02
6/24/2005	471363	4503845	6	0	Foraging	1.64
6/24/2005	482671	4501312	2	0	Flying	6.21
6/24/2005	483986	4501279	2	0	Standing	5.39
6/24/2005	488260	4501702	1	0	Preening	2.75
6/24/2005	488846	4501208	1	0	Foraging	2.37
6/24/2005	490255	4500867	1	0	Flying	1.52
6/24/2005	493190	4500864	1	0	Standing	0.42
6/24/2005	496712	4500522	2	0	Standing	2.56
6/24/2005	502936	4496791	1	0	Flying	4.21
6/24/2005	509203	4502007	1	0	Flying	3.28
6/24/2005	510071	4502563	3	0	Standing	3.73
7/19/2005	461736	4503894	1	0	Flying	4.35
7/19/2005	468747	4503732	2	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 straight-line distance using the location reported for each site.

Date	UTM x	UTM y	# Adults	# Juveniles	Activity	Distance to Closest Known Nesting Area (miles)
5/18/2005	492191	4500817	1	0	Flying	0.41
6/22/2005	461736	4503890	1	0	Foraging	4.35
6/23/2005	562173	4526931	1	0	Foraging	38.90
6/23/2005	566804	4532461	1	0	Foraging	42.91
6/24/2005	470871	4504032	4	0	Foraging	1.33
6/24/2005	488846	4501208	1	0	Foraging	2.37
6/24/2005	505823	4501387	2	0	Foraging	1.66
7/19/2005	468747	4503732	0	2	Foraging	0.19

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, 2001-2005.

Survey	# Sites	Least Tern				Piping Plover			
		# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
May 2005	19	30	0	0	0	36	14	0	0
June 2005	19	125	40	10	0	35	3	22	9
July 2005	15	136	21	8	20	19	2	7	7
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 2005. 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	
Lexington Pit	sandpit	34	438763	4509268	27	8	7	7	4	4	Permanent predator fence, trapping, pre-emergent herbicide
Johnson Pit	sandpit	34	468880	4502069	28	15	15	5	3	3	Permanent predator fence, trapping, pre-emergent herbicide
Blue Hole	sandpit	34	468735	4504032	26	6	6	7	5	5	Portable predator fence, predator removal, pre-emergent herbicide
Bruner-Shelton	sandpit	16	521924	4509427	22	12	8	5	2	2	Mylar flagging to deter nest establishment in certain areas.
Cottonwood Ranch	constructed island	9	460254	4503961	2	0	0	1	0	0	
Elm Creek Island	constructed island	9	469434	4503790	0	0	0	0	0	0	
Overton Island	constructed island	8	452603	4503365	2	0	0	0	0	0	
Lexington Island	constructed island	8	438770	4508453	1	0	0	0	0	0	
Central Sand &Gravel -GI	sandpit	3	555873	4527165	0	0	0	1	0	0	
Broadfoot-Newark	sandpit	3	504135	4503466	8	4	3	8	4	2	none
Lilley-Wood River	sandpit	3	536428	4509875	0	0	0	0	0	0	none
Deweese-Alda	sandpit	3	548759	4521648	0	0	0	0	0	0	
Island Landhandlers- GI	sandpit	3	552343	4524639	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
Broadfoot-Kearney South	sandpit	3	492659	4501284	56	15	15	14	2	2	none
TF Odessa	sandpit	2	479146	4501179	0	0	0	0	0	0	
Paulsen's Lexington Pit	sandpit	2	434039	5409125	0	0	0	0	0	0	
OSG Overton Pit	sandpit	2	454962	4503998	0	0	0	0	0	0	

Table 8. Least tern nests located in the Cooperative Agreement study area in 2005. 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	6	5/24/2005						Failed- Unknown	
Blue Hole	7	5/24/2005						Failed- Unknown	
Blue Hole	8	5/24/2005						Failed- Unknown	
Blue Hole	9	5/27/2005						Failed- Unknown	
Blue Hole	10	5/27/2005						Failed- Unknown	
Blue Hole	11	5/27/2005						Failed- Predated	
Blue Hole	12	6/6/2005	2					Failed- Predated	
Blue Hole	13	6/16/2005						Failed- Predated	
Blue Hole	14	6/27/2005						Failed- Predated	
Blue Hole	15	6/27/2005		7/17/2005	2	2	8/3/2005	Fledged	
Blue Hole	16	6/27/2005		7/8/2005	2	2	7/27/2005	Fledged	
Blue Hole	17	6/27/2005						Failed- Predated	
Blue Hole	19	6/27/2005		7/19/2005	1			Failed- Predated	
Broadfoot-Kearney South	3	6/24/2005	3					Unknown Outcome	
Broadfoot-Kearney South	4	6/24/2005	3					Unknown Outcome	
Broadfoot-Newark	4	6/24/2005	3					Unknown Outcome	
Broadfoot-Newark	5	6/24/2005	2					Unknown Outcome	
Bruner-Shelton	4	6/24/2005			2	2	7/5/2005	Fledged	
Bruner-Shelton	5	6/24/2005			2	2	7/8/2005	Fledged	
Bruner-Shelton	6	6/24/2005						Failed- Unknown	
Bruner-Shelton	7	6/24/2005	2					Failed- Predated	
Bruner-Shelton	8	6/24/2005	3	6/27/2005	2	2	7/21/2005	Fledged	
Bruner-Shelton	9	6/24/2005	2	7/4/2005	2	2		Fledged	
Bruner-Shelton	10	6/24/2005	2		2	2	8/4/2005	Fledged	Visual fence
Bruner-Shelton	11	6/30/2005	2		2			Failed- Unknown	
Bruner-Shelton	12	6/30/2005			2	2	8/4/2005	Fledged	
Bruner-Shelton	13	6/30/2005			2	2	8/4/2005	Fledged	

Bruner-Shelton	14	6/30/2005			2	2	8/4/2005	Fledged	
Bruner-Shelton	15	7/5/2005			2	1	8/8/2005	Fledged	
Johnson Pit	5	5/27/2005		6/16/2005	2	2	7/8/2005	Fledged	
Johnson Pit	6	6/1/2005		6/20/2005	2	2	7/8/2005	Fledged	
Johnson Pit	7	6/1/2005		6/20/2005	1	1	7/8/2005	Fledged	
Johnson Pit	8	6/1/2005		6/22/2005	2	2	7/12/2005	Fledged	
Johnson Pit	9	6/1/2005		6/22/2005	2	2	7/12/2005	Fledged	
Johnson Pit	10	6/6/2005		6/27/2005	1	1	7/14/2005	Fledged	
Johnson Pit	11	6/6/2005		6/27/2005	3	2	7/14/2005	Fledged	
Johnson Pit	12	6/6/2005		6/28/2005	2	2	7/14/2005	Fledged	
Johnson Pit	13	6/6/2005		6/27/2005	2	2	7/14/2005	Fledged	
Johnson Pit	14	6/6/2005		6/27/2005	2	2	7/14/2005	Fledged	
Johnson Pit	15	6/7/2005						Failed- Predated	
Johnson Pit	16	6/10/2005		7/1/2005				Failed- Predated	
Johnson Pit	17	6/10/2005		6/28/2005	1	1	7/14/2005	Fledged	
Johnson Pit	18	6/10/2005		6/28/2005	2	2	7/14/2005	Fledged	
Johnson Pit	19	6/15/2005						Failed- Predated	
Johnson Pit	20	6/23/2005		7/12/2005	2			Unknown Outcome	
Johnson Pit	22	7/5/2005		7/18/2005	1			Unknown Outcome	
Johnson Pit	23	7/5/2005		7/12/2005				Failed- Predated	
Lexington Pit	5	5/27/2005		6/14/2005	2	2	7/5/2005	Fledged	
Lexington Pit	6	6/1/2005		6/22/2005	2	2	7/8/2005	Fledged	
Lexington Pit	7	6/1/2005		6/22/2005	2	2	7/8/2005	Fledged	
Lexington Pit	8	6/1/2005		6/23/2005	3	3	7/23/2005	Fledged	
Lexington Pit	9	6/1/2005						Failed- Unknown	
Lexington Pit	10	6/7/2005		7/1/2005	2	2	7/23/2005	Fledged	
Lexington Pit	11	6/7/2005		7/10/2005	2			Failed- Unknown	
Lexington Pit	12	6/14/2005		7/9/2005	2	2	7/31/2005	Fledged	
Lexington Pit	14	6/27/2005						Failed- Unknown	
Lexington Pit	15	7/5/2005		7/12/2005	2	2	8/1/2005	Fledged	
Lexington Pit	16	7/5/2005		7/19/2005	3	3	8/8/2005	Fledged	
Lexington Pit	18	7/10/2005		7/20/2005	2	2	8/8/2005	Fledged	
Lexington Pit	19	7/10/2005		8/2/2005	1			Failed- Predated	

Table 9. Piping plover nests located in the Cooperative Agreement study area in 2005. 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	5/9/2005	4	5/31/2005	3	3	6/27/2005	Fledged	
Blue Hole	2	5/9/2005	4	5/31/2005	3	2	6/27/2005	Fledged	
Blue Hole	3	5/12/2005						Failed- Unknown	
Blue Hole	4	5/12/2005	4					Failed- Unknown	
Blue Hole	5	5/17/2005	4					Failed- Unknown	
Blue Hole	18	7/5/2005		7/3/2005	3	3	7/25/2005	Fledged	
Broadfoot-Kearney South	1	5/16/2005	2					Unknown Outcome	
Broadfoot-Kearney South	2	5/16/2005	4					Unknown Outcome	
Broadfoot-Newark	1	5/16/2005	4					Unknown Outcome	
Broadfoot-Newark	2	5/16/2005	4					Unknown Outcome	
Broadfoot-Newark	3	6/24/2005	4					Unknown Outcome	
Bruner-Shelton	1	6/24/2005	4	7/10/2005	4			Failed- Predated	Enclosure
Bruner-Shelton	2	6/30/2005		7/19/2005	3			Failed- Predated	
Bruner-Shelton	3	7/14/2005	4		4	2	7/30/2005	Fledged	
Johnson Pit	1	5/9/2005						Failed- Other	
Johnson Pit	2	5/17/2005		6/1/2005	4	3	7/1/2005	Fledged	
Johnson Pit	3	5/20/2005		6/13/2005	4	4	7/5/2005	Fledged	
Johnson Pit	4	5/24/2005	3	6/19/2005	3	3	7/8/2005	Fledged	
Johnson Pit	21	7/5/2005		7/3/2005	3	2	7/25/2005	Fledged	
Lexington Pit	1	5/11/2005		5/31/2005	3			Failed- Unknown	
Lexington Pit	2	5/17/2005		6/3/2005	3			Failed- Unknown	
Lexington Pit	3	5/17/2005		6/12/2005	4	4	7/5/2005	Fledged	
Lexington Pit	4	5/24/2005						Failed- Unknown	
Lexington Pit	13	6/23/2005		7/9/2005	1	1	7/31/2005	Fledged	
Lexington Pit	17	7/8/2005		7/23/2005	1	1	8/11/2005	Fledged	

Table 10. Least tern reproductive parameter estimates for the 2005 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	6	13	13	5	3	10	2	4	0.38	0.77	0.23	0.31	0.67	0.31
Bruner-Shelton	12	11	12	20	10	2	11	17	1.67	0.17	0.83	1.42	1.42	1.55
Johnson Pit	15	14	18	25	14	4	0	21	1.39	0.22	0.78	1.17	1.40	1.50
Lexington Pit	8	13.5	13	23	11	2	0	20	1.77	0.15	0.85	1.54	2.50	1.48
	41	51.5	56	73	38	18	13	62	1.30	0.32	0.68	1.11	1.51	1.20

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 2005 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	3.5	6	9	3	3	16	8	1.50	0.50	0.50	1.33	1.60	2.29
Bruner-Shelton	2	2.5	3	11	3	0	8	2	3.67	0.00	1.00	0.67	1.00	0.80
Johnson Pit	3	2.5	5	14	4	1	3	12	2.80	0.20	0.80	2.40	4.00	4.80
Lexington Pit	4	3.5	6	12	5	1	0	6	2.00	0.17	0.83	1.00	1.50	1.71
	14	12	20	46	15	5	27	28	2.30	0.25	0.75	1.40	2.00	2.33

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 2005. 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	13	10	170	0.9412	0.0003	0.9051	0.9773	0.2800	0.1232	0.6170
Bruner-Shelton	12	2	290	0.9931	0.0000	0.9834	1.0028	0.8647	0.7034	1.0610
Johnson Pit	18	4	352	0.9886	0.0000	0.9773	0.9999	0.7866	0.6179	0.9986
Lexington Pit	13	2	251	0.9920	0.0000	0.9808	1.0033	0.8454	0.6657	1.0706
All Sites	56	18	1063	0.9831	0.0000	0.9752	0.9910	0.6986	0.5896	0.8268

Table 13. Mayfield daily nest survival rate and incubation survival rate for piping plovers in 2005. 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	6	3	97	0.9691	0.0003	0.9339	1.0042	0.4149	0.1474	1.1254
Bruner-Shelton	3	0	53	1.0000				1.0000		
Johnson Pit	5	1	65	0.9846	0.0002	0.9541	1.0151	0.6478	0.2682	1.5234
Lexington Pit	6	1	104	0.9904	0.0001	0.9712	1.0095	0.7630	0.4418	1.3039
All Sites	20	5	319	0.9843	0.0000	0.9704	0.9982	0.6425	0.4314	0.9517

Table 14. Nest level habitat characteristics estimated at least tern nests in 2005 (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	16	1.01	0.64	1.38	0.00	2.50
Cover of Grass in 1 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Cover of Forb in 1 m2 area	sandpit	12	3.50	0.78	6.22	0.00	15.00
Cover of Woody in 1 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Density of Grass in 1 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Density of Forb in 1 m2 area	sandpit	12	6.67	2.61	10.73	0.00	20.00
Density of Woody in 1 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 1 m2 area	sandpit	12	0.08	0.03	0.14	0.00	0.30
Cover of Grass in 5 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Cover of Forb in 5 m2 area	sandpit	12	4.17	1.80	6.53	0.00	10.00
Cover of Woody in 5 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Density of Grass in 5 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Density of Forb in 5 m2 area	sandpit	12	19.58	6.79	32.38	0.00	70.00
Density of Woody in 5 m2 area	sandpit	12	0.00	0.00	0.00	0.00	0.00
Height of Vegetation in 5 m2 area	sandpit	12	0.08	0.02	0.15	0.00	0.30

Table 15. Nest level habitat characteristics estimated at piping plover nests in 2005 (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	7	1.36	0.97	1.74	0.20	1.80
Cover of Grass in 1 m2 area	sandpit	7	0.00	0.00	0.00	0.00	0.00
Cover of Forb in 1 m2 area	sandpit	7	3.14	1.41	4.88	0.00	5.00
Cover of Woody in 1 m2 area	sandpit	7	0.71	-0.69	2.11	0.00	5.00
Density of Grass in 1 m2 area	sandpit	7	0.00	0.00	0.00	0.00	0.00
Density of Forb in 1 m2 area	sandpit	7	6.00	0.76	11.24	0.00	20.00
Density of Woody in 1 m2 area	sandpit	7	0.14	-0.14	0.42	0.00	1.00
Height of Vegetation in 1 m2 area	sandpit	7	0.17	0.09	0.25	0.00	0.30
Cover of Grass in 5 m2 area	sandpit	7	0.29	-0.08	0.65	0.00	1.00
Cover of Forb in 5 m2 area	sandpit	7	3.29	0.62	5.95	0.00	10.00
Cover of Woody in 5 m2 area	sandpit	7	0.14	-0.14	0.42	0.00	1.00
Density of Grass in 5 m2 area	sandpit	7	1.14	-0.36	2.65	0.00	5.00
Density of Forb in 5 m2 area	sandpit	7	15.43	4.24	26.61	0.00	40.00
Density of Woody in 5 m2 area	sandpit	7	0.14	-0.14	0.42	0.00	1.00
Height of Vegetation in 5 m2 area	sandpit	7	0.16	0.08	0.23	0.00	0.30

Table 16. Colony level habitat characteristics for each sandpit with least tern (LETE) or piping plover (PIPL) nests in 2005.

Site name	Nesting Species	Colony Management	Adjacent Land Use
Bruner-Shelton	LETE PIPL	Dianne Beachley (LETE/PIPL Partnership) placed mylar flagging in areas to deter nest establishment	Active sandpit surrounded by grassland
Broadfoot-Newark	LETE PIPL	none	Active sandpit surrounded by riparian woodland, grassland and residential
Broadfoot-Kearney South	LETE PIPL	none	Large active sandpit surrounded by river, commercial development
Johnson Pit	LETE PIPL	Permanent predator fence, trapping, pre-emergent herbicide	Agriculture, public recreation area
Lexington Pit	LETE PIPL	Permanent predator fence, trapping, pre-emergent herbicide	River, abandoned sandpit, residential, interstate
Blue Hole	LETE PIPL	Portable predator fence, predator removal, pre-emergent herbicide	Active sandpit surrounded by river, residential, interstate, public recreation area

Table 17. Correlations between habitat parameters and reproductive parameters for the least tern nests monitored in 2005 (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	8	.	8	.	8	0.2623
Cover of Grass in 1 m2 area	8	.	8	.	8	.
Cover of Forb in 1 m2 area	8	.	8	.	8	0.2919
Cover of Woody in 1 m2 area	8	.	8	.	8	.
Density of Grass in 1 m2 area	8	.	8	.	8	.
Density of Forb in 1 m2 area	8	.	8	.	8	0.3810
Density of Woody in 1 m2 area	8	.	8	.	8	.
Height of Vegetation in 1 m2 area	8	.	8	.	8	0.4174
Cover of Grass in 5 m2 area	8	.	8	.	8	.
Cover of Forb in 5 m2 area	8	.	8	.	8	0.4174
Cover of Woody in 5 m2 area	8	.	8	.	8	.
Density of Grass in 5 m2 area	8	.	8	.	8	.
Density of Forb in 5 m2 area	8	.	8	.	8	0.4044
Density of Woody in 5 m2 area	8	.	8	.	8	.
Height of Vegetation in 5 m2 area	8	.	8	.	8	0.3111

Table 18. Correlations between habitat parameters and reproductive parameters for the piping plover nests monitored in 2005 (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	2	1.0000	2	.	2	.
Cover of Grass in 1 m2 area	2	.	2	.	2	.
Cover of Forb in 1 m2 area	2	.	2	.	2	.
Cover of Woody in 1 m2 area	2	-1.0000	2	.	2	.
Density of Grass in 1 m2 area	2	.	2	.	2	.
Density of Forb in 1 m2 area	2	-1.0000	2	.	2	.
Density of Woody in 1 m2 area	2	-1.0000	2	.	2	.
Height of Vegetation in 1 m2 area	2	-1.0000	2	.	2	.
Cover of Grass in 5 m2 area	2	.	2	.	2	.
Cover of Forb in 5 m2 area	2	.	2	.	2	.
Cover of Woody in 5 m2 area	2	-1.0000	2	.	2	.
Density of Grass in 5 m2 area	2	.	2	.	2	.
Density of Forb in 5 m2 area	2	-1.0000	2	.	2	.
Density of Woody in 5 m2 area	2	-1.0000	2	.	2	.
Height of Vegetation in 5 m2 area	2	1.0000	2	.	2	.

Table 19. Time (people-days) used to implement the field portions of the least tern and piping plover monitoring protocol in 2005. Time estimate for NPPD nest monitoring does not include travel time.

Cooperator	Riverine Survey (people-days)	Nest Monitoring (people-days)
NPPD	3	14.5
CPNRD	2	14
CNPPID	2	0
USFWS	15	0
EDO	0	0
UNK	2	0
Total	24	28.5

Figure 1. Discharge (cfs) at Overton, Nebraska (USGS Gage No. 06768000) from May 1 through August 31, 2005.

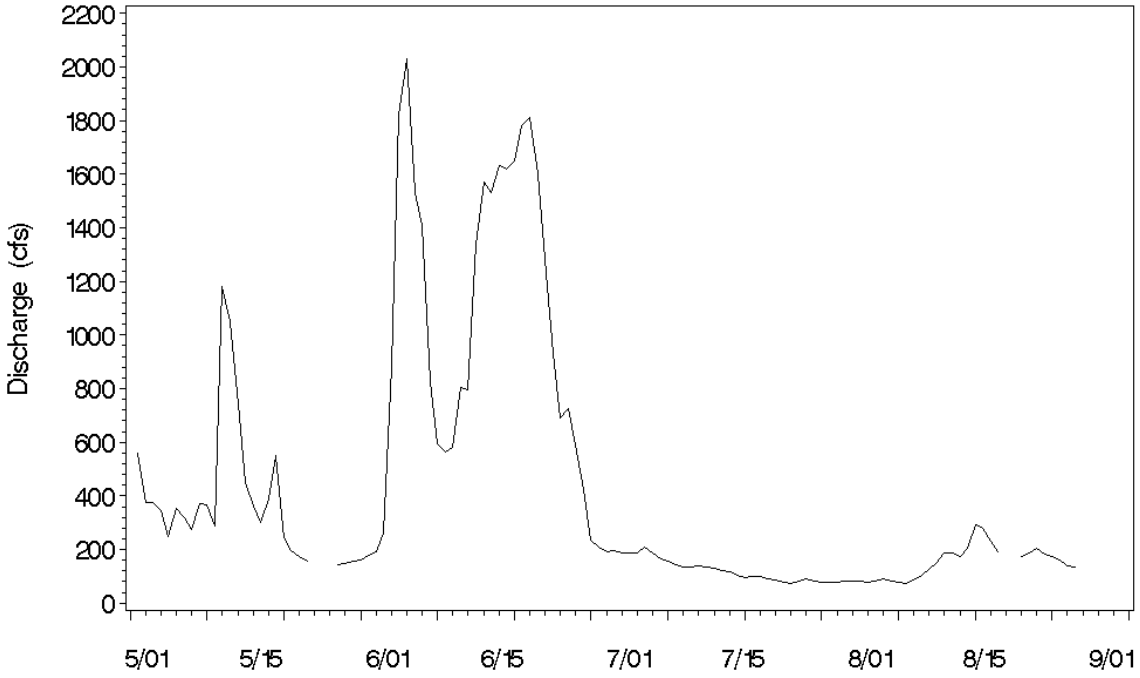


Figure 2. Stage (ft) at Overton, Nebraska (USGS Gage No. 06768000) from May 1 through August 31, 2005.

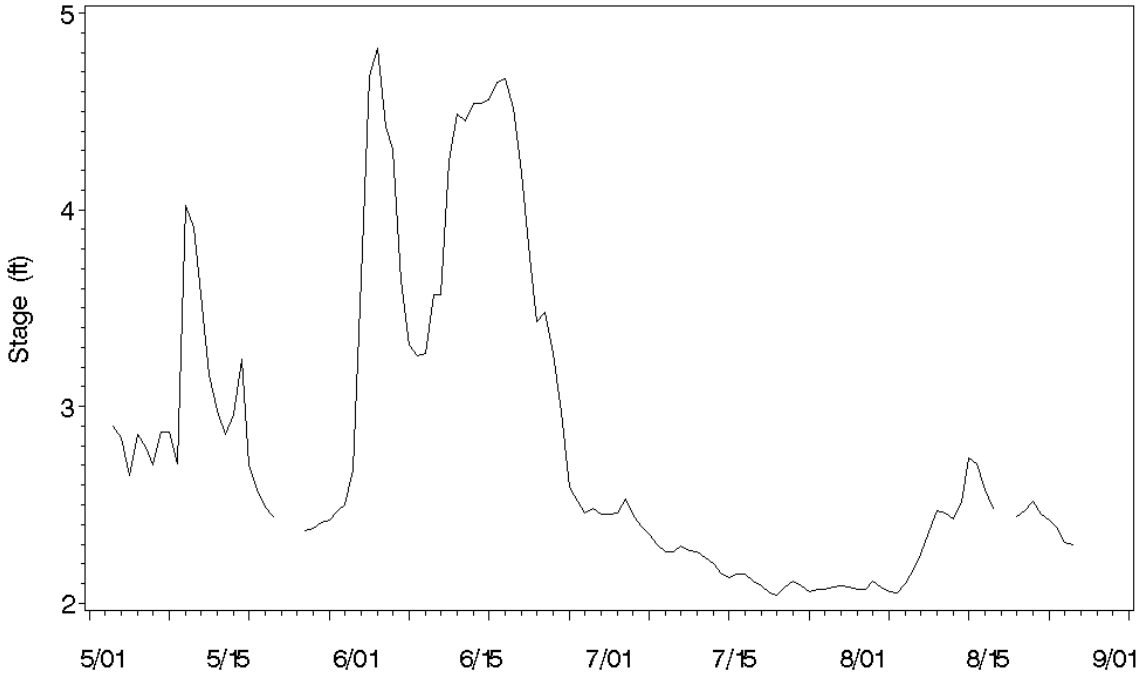


Figure 3. Discharge (cfs) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2005.

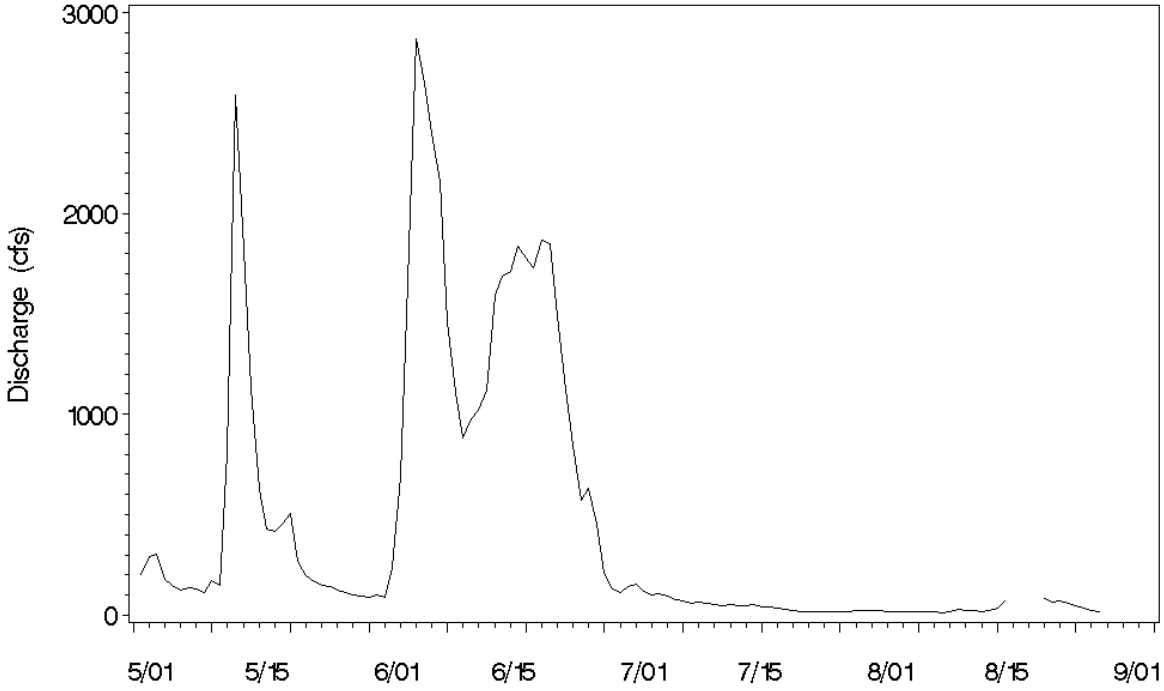


Figure 4. Stage (ft) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2005.

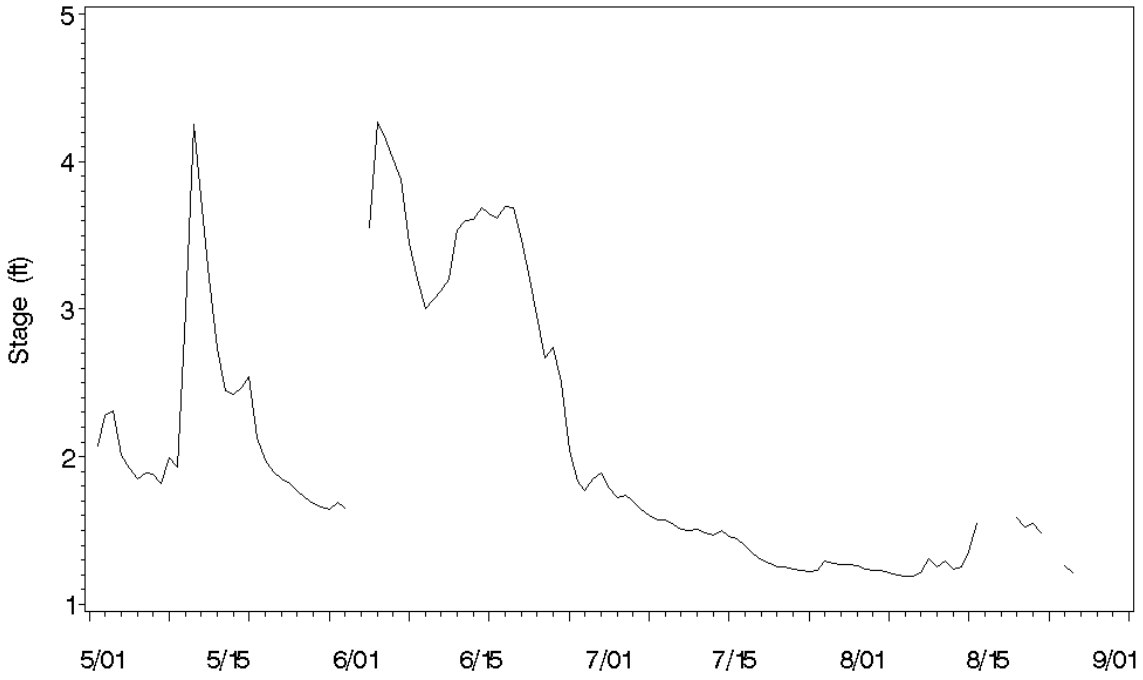


Figure 5. Discharge (cfs) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2005.

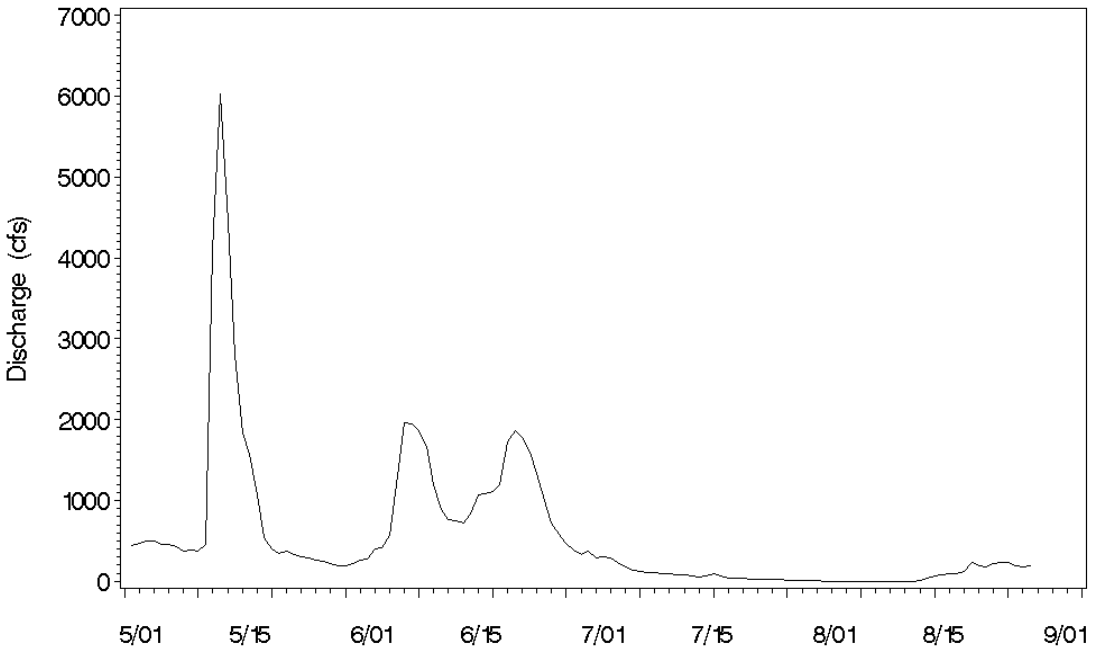


Figure 6. Stage (ft) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2005.

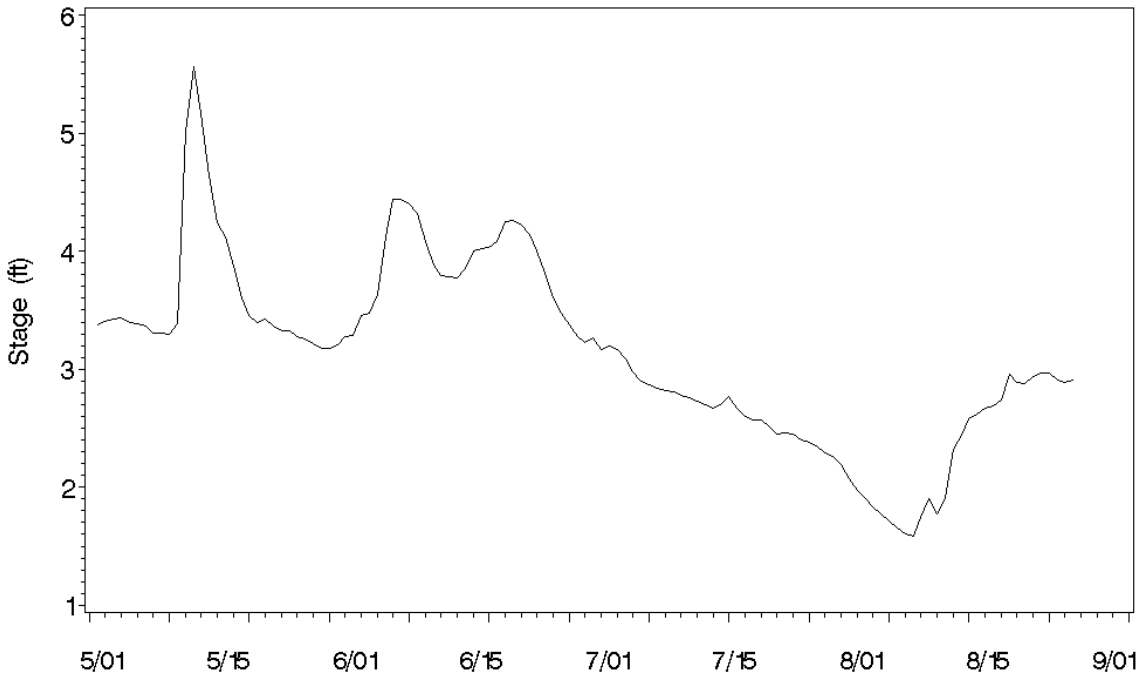


Figure 7. Sandpits and constructed islands surveyed for the 2005 season and locations of least tern sightings and nesting. Background image is the Fall 2003 color infrared photograph.

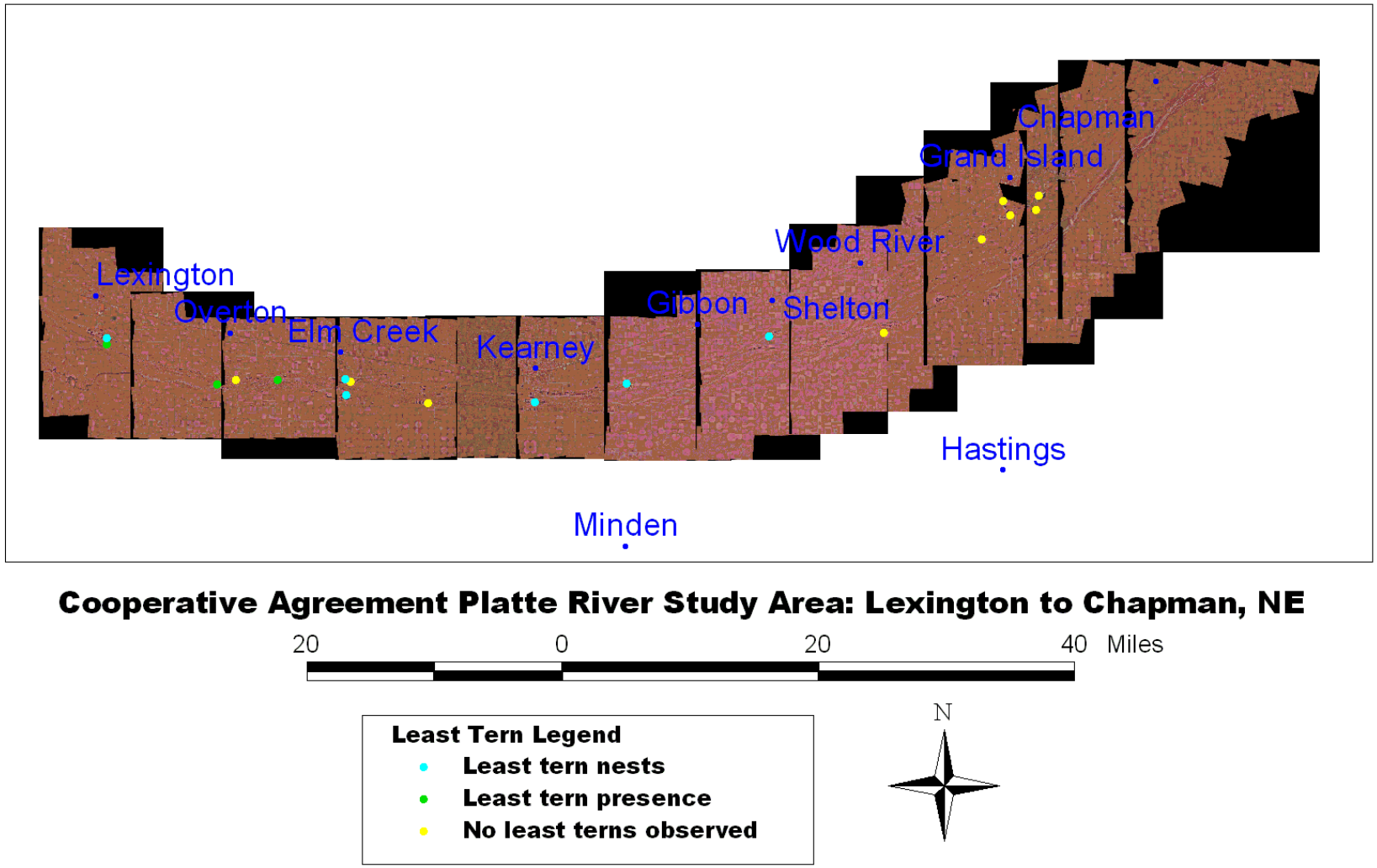
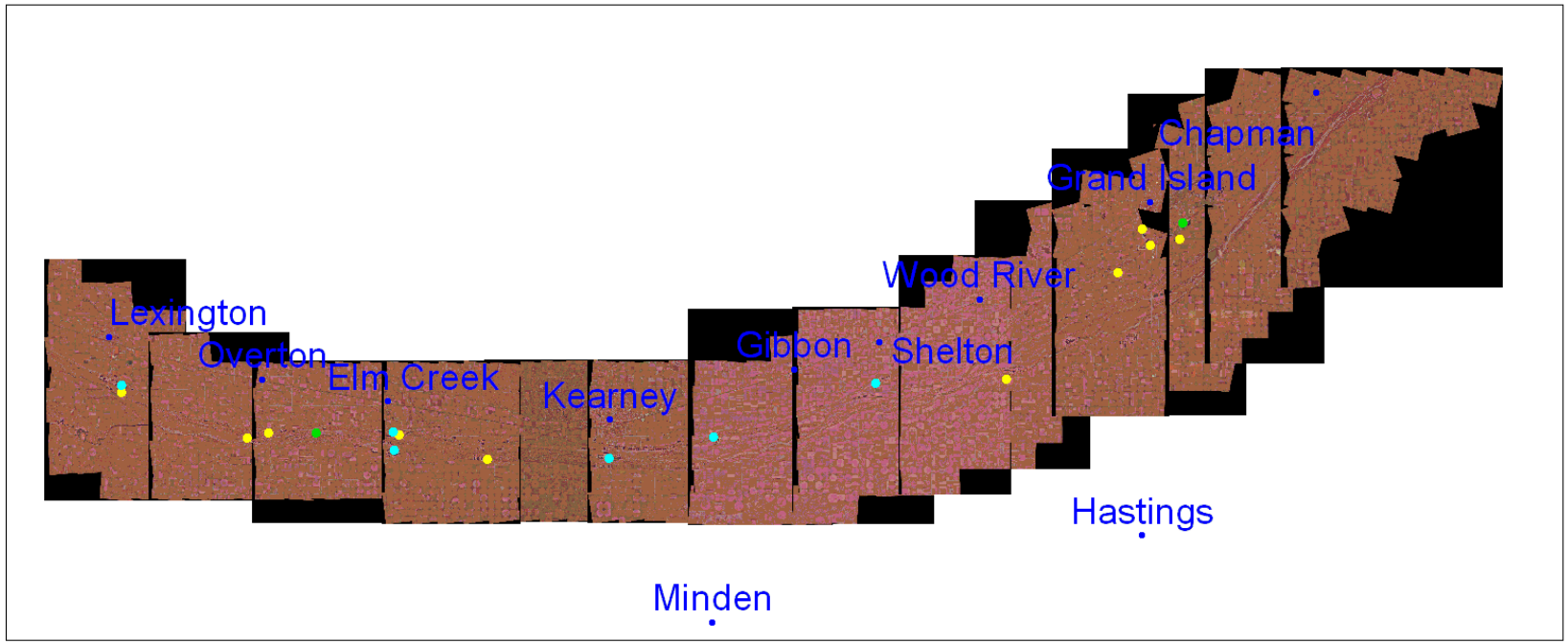


Figure 8. Sandpits and constructed islands surveyed for the 2005 season and locations of piping plover sightings and nesting. Background image is the Fall 2003 color infrared photograph.



Cooperative Agreement Platte River Study Area: Lexington to Chapman, NE

20 0 20 40 Miles

Piping plover legend
- **Piping plover nests**
- **Piping plover presence**
- **No piping plovers observed**

N