Tern and Plover Monitoring Protocol Implementation Report for 2001

Prepared for:
Technical Committee

Prepared by:
Executive Director's Office

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INTRODUCTION

The Technical Committee agreed at their February 16, 2000 meeting that 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 February 12, 2001 should be implemented in 2001 for the primary purposes of testing, verifying, and modifying the protocol (Appendix A). Existing cooperator staff and equipment was used to conduct the fieldwork. The Executive Director's office (EDO) was tasked to observe protocol implementation, analyze data, write a report, and modify the protocol based on findings in 2001. This report summarizes the data collected in 2001 season and provides recommendations for modifying the protocol.

METHODS

Three surveys, of Platte River channels wider than 50m, were conducted to locate active nests and individual birds (component 1 of the protocol design). Two airboats were used during the May, June and July surveys. Personnel from the Grand Island Field Office, U.S. Fish and Wildlife Service (USFWS) conducted the river survey from Chapman upstream to the Kearney Diversion Canal (near Elm Creek) on May 14-18, June 5, 12, 14-15, and July 12, 13 and 16. Nebraska Public Power District (NPPD) personnel conducted the river survey from the Kearney Diversion Canal upstream to Lexington on May 23, June 13, and July 11. The daily average in-stream (provisional) flows and stage levels for the Kearney and Grand Island gages during the river survey are in table 1 and during the months of May, June and July are in figures 1-4.

A portion of the intensive survey component of the protocol was implemented to test the field procedures. Two one-mile sections of the main channel of the Platte River were intensively surveyed on foot to locate active nests and individual birds. The EDO conducted the survey at Cottonwood Ranch and Rowe Sanctuary on June 13, 2001. The main channel of Cottonwood Ranch was surveyed from river mile 234.5 to river mile 235.5. The main channel on Rowe was surveyed from river mile 203.5 to river mile 204.5.

Three surveys of sandpits were conducted to locate active nests and individual birds (component 3 of the protocol design). NPPD personnel surveyed 7 sandpits from the Lexington bridge to the Odessa bridge and 3 constructed islands. The sandpits between the Odessa and the Gibbon bridge were not surveyed due to time constraints of the participating cooperators. Central Platte Natural Resources District (CPNRD) surveyed 15 active sandpits from the Gibbon bridge to the Chapman bridge. In addition, 12 sandpits between Gibbon and Chapman were

visited by CPNRD during a pre-season reconnaissance and did not fit the criterion for surveying during the 2001 season.

Nests located during the river survey, intensive survey, or sandpit and constructed island surveys 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 most nests after the birds had left the colony area. Colony level characteristics were measured in a geographic information system using the spatially referenced 1998 color infra-red photographs.

A Microsoft Access database was designed by the EDO to store data collected under this protocol. The database contains 11 data tables (Appendix B). Three tables contain information about the river survey, 4 tables document the nest monitoring, 1 table documents the nest habitat, 1 table details the intensive walking survey, 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 6, 5, and 4 days to complete in May, June and July respectively. There were 0 least tern nests and 0 piping plover nests detected during the river surveys. The most birds detected during one river survey were 23 least tern adults, 17 piping plover adults, 5 least tern juveniles, and 12 piping plover juveniles (Table 2). 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 3 and 4. Based on the 2001 International Piping Plover Census report, there were birds detected at three pits in the study area where the Program protocol was not followed (Broadfoot North of Minden [Newark Pit], Minden T&F, Broadfoot West [Broadfoot Kearney-South]). A second calculation of the distance to the nearest known nesting colony shown in tables 3 and 4 assumed there was also nesting at these pits.

The intensive ground survey required 1 day to conduct and detected 0 birds and 0 nests. Since this portion of the protocol was not implemented in full, the searcher efficiency corrections will not be applied to the results presented in this report.

Eighteen sandpits and three constructed islands were surveyed during each of the three survey periods. Four other sandpits were surveyed at least once but were not surveyed for all three surveys. There were 27 least tern and 10 piping plover nests monitored on sandpits in 2001. 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. The most birds detected during one survey to sandpits and constructed islands were 27 least tern adults, 15 piping plover adults, 15 least tern juveniles, and 20 piping plover juveniles (Table 5).

Least tern or piping plover nests were located at 5 of the 25 locations surveyed (Table 6; Figures 5 and 6). These sites were visited every three days while there were active nests. Nests were not physically marked for monitoring purposes.

There were 27 least tern nests monitored in 2001, 11 nests at Blue Hole, 6 nests at Johnson Pit, 8 nests at Lexington Pit, and 2 nests at Lilley-Wood River (Table 7). Twenty of the 27 nests successfully fledged at least 1 least tern for a total of 45 least tern fledglings.

There were 10 piping plover nests monitored in 2001, 4 nests at Blue Hole, 2 nests at Johnson Pit, 3 nests at Lexington Pit, and 1 piping plover nest at TF Pit Odessa (Table 8). Eight of the 10 nests successfully fledged at least 1 piping plover for a total of 23 piping plover fledglings.

Reproductive Parameters

Most of the reproductive parameters listed in the protocol could be estimated with the data collected in 2001. Egg-based statistics could not be calculated because the number of eggs was not counted for each nest. The estimates calculated with data from this year (2001) are not representative of the entire study area because sandpits between Odessa and the Gibbon were not sampled. Formulas for reproductive habitat calculations are located in the protocol.

Total Nests Initiated

The total nests initiated is the number of nests detected during the site surveys. There were 27 least tern nests and 10 piping plover nest initiations documented in 2001 (Tables 9 and 10). All nests initiated were monitored until the nest failed or the fledglings departed the colony.

Nest-based Hatching Success

Nest-based hatching success was estimated to be 1.74 for least terns and 2.80 for piping plovers monitored in 2001. 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).

Egg-based Hatching Success

Egg-based hatching success was not estimated for least terns or piping plovers monitored in 2001. This estimate is calculated as the number of hatched eggs divided by the number of eggs laid. The number of eggs that were laid was not measured for most of the nests monitored in 2001.

Nesting Loss

Nesting loss was estimated to be 0.26 for least terns and 0.20 for piping plovers monitored in 2001. This estimate is calculated as the number of unsuccessful nests divided by the number of nests initiated. A nest is unsuccessful if no eggs hatch.

Nesting Success

Nesting success was estimated to be 0.74 for least terns and 0.80 for piping plovers monitored in 2001. This estimate is calculated as the number of successful nests divided by the number of nests initiated. A nest is successful if at least 1 chick is observed initially or 1 chick 15 days old is observed.

Nest-based Fledgling Success

Nest-based fledgling success was estimated to be 1.66 for least terns and 2.30 for piping plovers monitored in 2001. 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 was not estimated for least terns or piping plovers monitored in 2001. This estimate is calculated as the number of fledglings divided by the number of pairs. The estimation of the number of pairs was not specified in the protocol.

Mayfield Daily Survival Rate

Mayfield daily nest survival rate was estimated to be 0.9831 (95% CI: 0.9705, 0.9958) for least terns and 0.9773 (95% CI: 0.9455, 1.009) for piping plovers monitored in 2001 (Tables 11 and 12). 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 for this first year of protocol implementation. As the monitoring data is collected throughout the first increment, these analyses will be possible.

Before-After Analysis

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

Nesting Habitat Characteristics

Nest characteristics were measured at most of the 27 least tern nests and 10 piping plover nests monitored in 2001 (Tables 13 and 14). Nesting colony characteristics were measured at the 5 pits with active nests in 2001 (Table 15).

Distance from Nest to Water

The distance from the nest to water averaged 26.92 meters (95% CI: 21.78, 32.07) over the 26 least tern nests measured on sandpits and 48.88 meters (95% CI: 31.46, 66.29) over the 8 piping plover nests measured on sandpits.

Distance to Nearest Bank

There were no least tern nests or piping plover nests monitored in the river channel in 2001.

Channel Width

There were no least tern nests or piping plover nests monitored in the river channel in 2001.

Substrate Type

The average substrate over 25 least tern nests was 87.60% fine sand, 9.76% coarse sand, 2.36% small gravel, and 0.08% large gravel. The average substrate over 8 piping plover nests was 77.50% fine sand, 10.00% coarse sand, 7.25% small gravel, and 5.25% large gravel.

Distance to Nearest Nest

The distance from a nest to the nearest nest averaged 21.29 meters (95% CI: 16.18, 26.40) over the 24 least tern nests measured on sandpits and 42.88 meters (95% CI: 18.55, 67.20) over the 8 piping plover nests measured on sandpits.

Distance to Obstruction

The distance from a nest to an obstruction greater than 30cm in height averaged 24.33 meters (95% CI: 6.65, 42.02) over the 3 least tern nests measured on sandpits and 39.00 meters (95% CI: 11.56, 66.44) over the 2 piping plover nests measured on sandpits.

Nest Elevation

This nest habitat characteristic was not measured at any nest in 2001.

Sandbar/Island Height

There were no nests monitored in the river channel in 2001.

Nesting Colony Area

This colony habitat characteristic was not measured at any colonies in 2001.

Pond Size

The size of the pond adjacent to the colony averaged 9.67 hectares (95% CI: 4.41, 14.94) over the 4 least tern colonies located at sandpits and 12.94 hectares (95% CI: 10.59, 15.29) over the 4 piping plover colonies located at sandpits. The data for pond size at each colony was estimated using tools in ArcView and the 1998 color infra-red photographs.

Distance from Colony to River

The distance from the colony to nearest active river channel averaged 624 meters (95% CI: 135.51, 1112.49) over the 4 least tern colonies located at sandpits and 583.75 meters (95% CI: 61.76, 1105.74) over the 4 piping plover colonies located at sandpits. The data for distance from each colony to river was estimated using tools in ArcView and the 1998 color infra-red photographs.

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 laid, number of eggs hatched, an indicator of nest success, and the number of chicks fledged were calculated by species (Tables 16 and 17). 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 nest habitat characteristics and the number of nests initiated, nest-based hatching success, nesting success, and nest-based fledgling success were calculated by species (Table 18).

INCIDENTAL OBSERVATIONS

Portions of the Broadfoot sandpit located east of highway 10 and north of Minden were surveyed in one visit by Mark Czaplewski (CPNRD) to document use by the target species in the study area. Six adult least terns, 2 adult piping plovers, 1 least tern nest (with 3 eggs) and 3 piping plover chicks were observed on June 29, 2001.

The 2001 International Piping Plover Census was conducted from the Wood River mouth (river mile 154.6) to the Lexington Bridge (river mile 251) on June 11,12, 19, 20, and 21. There were 21 least terns and 3 piping plovers observed during the river survey that were designated as floaters. These birds were observed in a location without nesting habitat and greater than 1 mile from a nesting sandpit colony. There were 23 sandpits surveyed and 75 least terns, 26 piping plover, and 9 piping plover pairs observed.

There were 6 pits visited by the International Piping Plover Census in 2001 that were not surveyed by the Cooperative Agreement effort (2001 International Piping Plover Census Report; map numbers 82-87). Birds were detected at three of these pits. At the 'Broadfoot North of Minden' pit (mentioned above in Mark Czaplewski's observations) there were 12 least tern adults and 1 piping plover adult observed on June 19. At the 'Minden T&F' pit there was 1 piping plover adult observed on June 20. At the 'Broadfoots West' pit there were 9 least tern adults, 3 piping plover adults, and 1 piping plover pair observed on June 19.

IMPLEMENTATION COSTS

There were 47 people-days worked to implement the current protocol during the 2001 implementation (Table 19). This estimate is based on the use of 2 people in the airboat during the riverine survey, though there were usually more observers present for the pilot season. 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.

Each cooperator contributed their time under existing budgets, and no credit was given against the Cooperative Agreement. The EDO also spent approximately $16,000 observing protocol implementation, designing the database, entering the data, and writing the report. The equipment used during the 2001 implementation of this protocol was furnished by the cooperators and the Cooperative Agreement did not purchase any equipment.

RECOMMENDATIONS FOR MODIFICATIONS TO THE PROTOCOL

1. Add a component detailing the monitoring of constructed riverine nesting islands. These sites should be surveyed for active nests and individual birds at least 3 times a season (May 15, June 15, July 15).

2. Use the number of birds detected on May 15, June 15, and July 15 at each sandpit and constructed island as an index to abundance of birds. The surveyors will spend at least 20 minutes at each site on these survey days to obtain the best estimates of bird counts. If the survey is not conducted on the 15th, the survey nearest this date should be recorded as the monthly survey.

3. Change the criterion for sampling sandpits and constructed islands to relate to the presence of sand with less than 20% vegetation. Determining which sandpits had been inactive for less than 5 years was too difficult to assess during the pilot 2001 season. Since all parties agree bare sand is a requirement for nesting, the biases and inferences associated with sampling only bare sand are acceptable.

4. Remove the intensive sampling survey to a research component of the monitoring protocol. Describe the walking procedures in more detail. The surveyors should walk in the channel to view all bare sand in each section from a distance of 200m or less.

5. Estimate the number of broods at each site on each visit. The number of nests plus the number of broods can be used as an index to the number of pairs. Kirsch has published the day with the maximum number of nests and broods to standardize the number of fledglings at a site. A brood is defined as a clutch of chicks or fledglings from the same nest.

6. Recommend bringing the colony level habitat use investigation into this protocol and removing the separate IMRP investigation from table 1 of the IMRP.

7. Recommend surveying all bare sand in channels greater than 75m river during the riverine survey. Also recommend standardization of river survey by river mile. The goal of the riverine survey is to locate active nests on the river for the purposes of tracking the changes in the number of nests through time. An index to tern and plover reproduction in the study area is needed in order to document the change in the number of nests. This index should standardize the number of nests by the effort spent looking for the nests. As the river changes through time, the amount of bare sand will change and the amount of nesting will change. If the amount of time spent looking for nests is dependent on bare sand, the index will track the number of nests per unit of bare sand. An index standardized by river mile will reflect the changes in the number of nests regardless of the change in the amount of bare sand. Since the survey area will be restricted to channels greater than 75m, all inferences with this data will be to channels greater than 75m.

RECOMMENDATIONS FOR FUTURE IMPLEMENTATION OF THE PROTOCOL

1. Recommend random assignment of surveyors to river sections. The different surveyor abilities and design of the seating in the two airboats cause different chances of observing terns and plovers by the two survey crews. If the number of nests is to be compared throughout the river system, the biases associated with each airboat crew should be spread throughout the river system. Otherwise, the estimates of bird nest numbers by sections are confounded with survey crew.

2. Riverine surveys should use GPS to track the survey route. Documenting the length of river surveyed would allow comparisons of survey parameters through time to be standardized by effort.

APPENDICIES

A. Protocol: Monitoring reproductive success and reproductive habitat parameters of least terns and piping plovers in the central Platte River valley – dated February 12, 2001

B. Data Tables:

- Daily Survey Counts
- Daily Survey Header
- Intensive Survey
- Nest Habitat
- Nest Header
- Nest Observations
- Observers
- River Survey Bird Observations
- River Survey Channel Obs
- River Survey Header
- Sites

TABLES

Table 1. Discharge (cfs) and stage (feet) at Kearney, Nebraska (USGS Gage No. 06770200) and Grand Island, Nebraska (USGS Gage No. 06770500) during river survey dates.

	Kearney		Grand Island	
Date	Discharge	Stage	Discharge	Stage
5/14/2001	2180	3.71	2020	2.32
5/15/2001	1860	3.57	1940	2.30
5/16/2001	1580	3.43	1770	2.22
5/17/2001	1400	3.34	1590	2.14
5/18/2001	1340	3.31	1470	2.08
5/23/2001	490	2.77	893	1.75
6/05/2001	979	3.24	1090	1.95
6/12/2001	658	3.00	719	1.66
6/13/2001	662	2.99	701	1.64
6/14/2001	566	2.91	664	1.61
6/15/2001	428	2.79	654	1.60
7/11/2001	537	2.87	561	1.59
7/12/2001	522	2.86	541	1.57
7/13/2001	558	2.89	524	1.55
7/16/2001	493	2.84	585	1.62

Table 2. The number of adults, nests, chicks, and fledgling least terns and piping plovers observed during each monthly survey of the river in 2001.

	Least Tern				Piping Plover			
	# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
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 3. 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. The estimates were calculated without assuming the two pits where birds were detected during the 2001 International Piping Plover Census (not surveyed following the protocol) were nesting colonies and then assuming there was nesting present.

Date	UTM x	UTM y	# Adults	# Juveniles	Distance to Closest Known Nesting Area (miles)	Distance to Closest Nesting Area Assuming Breeding at 2 Pits (miles)
5/15/2001	472319.2	4503597	4	0	2.24	2.24
5/15/2001	504744.5	4501057	2	0	20.44	1.45
5/15/2001	504961.1	4501094	2	0	20.30	1.45
5/15/2001	508720.1	4501944	1	0	17.91	2.75
5/23/2001	443796	4504420	2	0	4.34	4.34
5/23/2001	452556	4503251	2	0	9.35	9.35
5/23/2001	468433	4503707	1	0	0.28	0.28
5/23/2001	470374	4504108	2	0	1.02	1.02
6/5/2001	569480	4534541	1	0	25.63	25.63
6/12/2001	542125	4513153	1	0	4.08	4.08
6/13/2001	468399	4503579	1	0	0.35	0.35
6/13/2001	470271	4504080	2	0	0.95	0.95
6/13/2001	470271	4504080	2	0	0.95	0.95
6/14/2001	504198	4503674	1	0	20.39	0.27
6/15/2001	470476	4504166	2	0	1.08	1.08
6/15/2001	471394	4503968	2	0	1.65	1.65
6/15/2001	471845	4503719	3	0	1.94	1.94
6/15/2001	485002	4501548	1	0	10.02	4.40
6/15/2001	491828	4500943	3	0	14.28	0.33
6/15/2001	505757	4501382	3	0	19.78	1.46
6/15/2001	511365	4503004	1	0	16.15	4.25
7/11/2001	464032.6	4503848	1	0	2.92	2.92
7/11/2001	469022.4	4503743	4	4	0.25	0.25
7/11/2001	469232.9	4503755	2	0	0.35	0.35
7/16/2001	472294	4503584	1	0	2.23	2.23
7/16/2001	472538	4503559	3	0	2.38	2.38
7/16/2001	492750	4500729	1	1	14.86	0.59
7/16/2001	504616	4503698	1	0	20.14	0.21
7/16/2001	508684	4501932	3	0	17.93	2.73

Table 4. 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. The estimates were calculated without assuming the two pits where birds were detected during the 2001 International Piping Plover Census (not surveyed following the protocol) were nesting colonies and then assuming there was nesting present.

Date	UTM x	UTM y	# Adults	# Juveniles	Distance to Closest Known Nesting Area (miles)	Distance to Closest Nesting Area Assuming Breeding at 3 Pits (miles)
5/15/2001	541030.4	4512565	1	0	39.10	23.39
5/23/2001	452556	4503252	1	0	9.35	9.35
6/13/2001	468399	4503579	1	0	0.35	0.35
6/13/2001	469436.8	4503620	1	0	0.51	0.51
6/15/2001	470739	4504138	1	0	1.25	1.25
6/15/2001	471394	4503968	2	0	1.65	1.65
7/11/2001	454948.2	4503399	1	0	8.58	8.58
7/11/2001	469022.4	4503743	1	0	0.25	0.25
7/11/2001	469232.9	4503755	3	6	0.35	0.35
7/11/2001	469965.5	4503985	0	1	0.76	0.76
7/12/2001	544764	4514633	1	0	41.62	25.96
7/12/2001	547850	4515298	1	0	43.58	27.92
7/16/2001	472294	4503584	4	0	2.23	2.23
7/16/2001	473443	4503433	3	5	2.95	2.95
7/16/2001	510737	4502959	1	0	19.66	3.87
7/16/2001	511739	4502950	2	0	20.28	4.49

Table 5. The number of adults, nests, chicks, and fledgling least terns and piping plovers observed during each monthly survey at sand pits and constructed islands in 2001.

	Least Tern				Piping Plover			
Survey	# Adults	# Nests	# Chicks	# Fledglings	# Adults	# Nests	# Chicks	# Fledglings
May 2001	6	0	0	0	11	3	0	0
June 2001	27	14	0	0	15	1	20	0
July 2001	21	0	15	14	2	1	0	1

Table 6. Sandpits and constructed islands monitored for least tern and piping plover reproduction in 2001. Number of adults is the maximum observed across all the surveys at the site. Estimation of the number of pairs was not detailed in the protocol.

Site	Site type	# Surveys	UTM x	UTM y	Least Tern			Piping Plover			Site management
					# adults	# pairs	# nests	# adults	# pairs	# nests	
Johnson Pit	sandpit	26	468880.5	4502069	9	-	6	4	-	2	Predator fencing and trapping, Pre-emergent herbicide application
Lexington Pit	sandpit	26	438763.2	4509268	16	-	8	7	-	3	Predator fencing and trapping, Pre-emergent herbicide application
Blue Hole	sandpit	24	468735.9	4504032	12	-	11	6	-	4	Predator fencing and trapping, Pre-emergent herbicide application
TF Odessa	sandpit	8	479146.6	4501179	0	-	0	1	-	1	None
Elm Creek Island	constructed island	8	469434	4503790	1	-	0	0	-	0	Predator fencing
Overton Island	constructed island	8	452603.8	4503365	2	-	0	2	-	0	None
Lexington Island	constructed island	7			1	-	0	0	-	0	Predator fencing, Pre-emergent herbicide application
Lilley-Wood River	sandpit	5	536428	4509875	4	-	2	0	-	0	None
Wildrose Lake - West	sandpit	3	542839	4514463	0	-	0	0	-	0	None
Knight-Chapman	sandpit	3	565680	4537371	0	-	0	0	-	0	None
Hooker Bros -GI South	sandpit	3	555613	4525340	0	-	0	0	-	0	None
TF Elm Creek	sandpit	3			0	-	0	0	-	0	None
Trust Wildrose - East	sandpit	3	544098	4514586	0	-	0	0	-	0	None
Deweese-Alda	sandpit	3	548759	4521648	0	-	0	0	-	0	None
Island Landhandlers- GI	sandpit	3	552343	4524639	0	-	0	0	-	0	None
Hooker Bros - GI West	sandpit	3	551433	4526439	0	-	0	0	-	0	None
Bruner-Shelton	sandpit	3	521924	4509427	0	-	0	0	-	0	None
Bruner-Gibbon	sandpit	3	512930	4503686	0	-	0	0	-	0	None
Paulsen's Lexington Pit	sandpit	3			0	-	0	0	-	0	None
OSG Overton Pit	sandpit	3			0	-	0	0	-	0	None
Central Sand &Gravel -GI	sandpit	3	555873	4527165	0	-	0	0	-	0	None
Alda - South	sandpit	2	544294	4520374	0	-	0	0	-	0	None
JIL Asphalt - GI	sandpit	2	551127	4524821	0	-	0	0	-	0	None
F	sandpit	1	560411	4528520	0	-	0	0	-	0	None
A	sandpit	1	564981	4536799	0	-	0	0	-	0	None

Table 7. Least tern nests monitored in the Cooperative Agreement study area in 2001.

Site	Nest #	First Date Observed	# Eggs	Date Hatched	# Chicks Initially Observed	# Chicks Fledged	Date Fledged	Final Status	Nest Management
Blue Hole	4.01	5/31/01		6/20/01	3	3	7/11/01	Fledged	
Blue Hole	5.01	5/31/01						Failed- Predated	
Blue Hole	6.01	6/4/01		6/20/01	2	2	7/9/01	Fledged	
Blue Hole	7.01	6/6/01	3					Failed- Predated	
Blue Hole	8.01	6/6/01	2	6/28/01	2	1	7/16/01	Fledged	
Blue Hole	9.01	6/12/01		7/7/01	3	3	7/24/01	Fledged	
Blue Hole	11.01	6/26/01		7/10/01	3	3	8/3/01	Fledged	
Blue Hole	12.01	7/3/01		7/15/01	2	2	8/3/01	Fledged	
Blue Hole	13.01	7/3/01		7/19/01				Unknown Outcome	
Blue Hole	14.01	7/3/01		7/11/01	2	2	7/31/01	Fledged	
Blue Hole	15.01	7/3/01		7/11/01	2	2	7/31/01	Fledged	
Johnson Pit	2.01	5/29/01		6/17/01	3	3	7/6/01	Fledged	
Johnson Pit	3.01	5/29/01						Failed- Predated	
Johnson Pit	4.01	6/4/01		6/17/01				Failed- Abandoned	
Johnson Pit	5.01	6/6/01		6/22/01	2	3	7/10/01	Fledged	
Johnson Pit	7.01	6/12/01		6/28/01	2	2	7/16/01	Fledged	
Johnson Pit	8.01	6/19/01		7/10/01		2	7/29/01	Fledged	
Lexington Pit	2.01	5/31/01		6/21/01	3	2	7/9/01	Fledged	
Lexington Pit	3.01	5/31/01		6/22/01	2	2	7/12/01	Fledged	
Lexington Pit	4.01	5/31/01		6/19/01	2	2	7/9/01	Fledged	
Lexington Pit	5.01	6/4/01		6/19/01	3	3	7/9/01	Fledged	
Lexington Pit	8.01	6/19/01		7/5/01	2	2	7/24/01	Fledged	
Lexington Pit	9.01	6/29/01		7/8/01	2	2	7/26/01	Fledged	
Lexington Pit	10.01	6/29/01		7/15/01	2	2	8/3/01	Fledged	
Lexington Pit	11.01	6/29/01		7/15/01	2	2	8/3/01	Fledged	
Lilley-Wood River	1.01	6/12/01	3					Failed- Predated	
Lilley-Wood River	2.01	6/12/01	0					Failed- Abandoned	

Table 8. Piping plover nests monitored in the Cooperative Agreement study area in 2001.

Site	Nest #	First Date Observed	# Eggs	Date Hatched	# Chicks Initially Observed	# Chicks Fledged	Date Fledged	Final Status	Nest Management
Blue Hole	1.01	5/24/01	4	6/7/01	3	2	6/29/01	Fledged	Exclosure
Blue Hole	2.01	5/24/01	4	6/5/01	4	4	6/29/01	Fledged	Exclosure
Blue Hole	3.01	5/31/01		6/3/01	3	3	6/29/01	Fledged	
Blue Hole	10.01	6/26/01	4	7/19/01	4	2	8/8/01	Fledged	
Johnson Pit	1.01	5/25/01		6/6/01	4	3	6/29/01	Fledged	
Johnson Pit	6.01	6/12/01						Unknown Outcome	
Lexington Pit	1.01	5/29/01		6/4/01	4	3	6/29/01	Fledged	
Lexington Pit	6.01	6/4/01		6/4/01	4	4	6/29/01	Fledged	
Lexington Pit	7.01	6/8/01			2	2	6/29/01	Fledged	
TF Odessa	1.01	5/28/01	4					Failed- Unknown	

Table 9. Least tern reproductive parameter estimates for the 2001 nesting season. The number of eggs laid and the egg-based hatch success can not be reliably estimated because observers did not count eggs consistently. Estimation of the number of pairs was not detailed in the protocol.

Site	# Eggs	# Chicks Initially Observed	# Nests Initiated	# Successful Nests	# Unsuccessful Nests	# Eggs Hatched	# Fledglings	Nest-based Hatch Success	Egg-based Hatch Success	Nesting Loss	Nesting Success	Nest-based Fledgling Success	Pair-based Fledgling Success
Blue Hole	-	19	11	8	3	19	18	1.72	-	0.27	0.73	1.63	-
Johnson Pit	-	7	6	4	2	10	10	1.66	-	0.33	0.67	1.66	-
Lexington Pit	-	18	8	8	0	18	17	2.25	-	0	1	2.12	-
Lilley-Wood River	-	0	2	0	2	0	0	0	-	1	0	0	-
All sites	-	44	27	20	7	47	45	1.74	-	0.26	0.74	1.66	-

Table 10. Piping plover reproductive parameter estimates for the 2001 nesting season. The number of eggs laid and the egg-based hatch success can not be reliably estimated because observers did not count eggs consistently. Estimation of the number of pairs was not detailed in the protocol.

Site	# Eggs	# Chicks Initially Observed	# Nests Initiated	# Successful Nests	# Unsuccessful Nests	# Eggs Hatched	# Fledglings	Nest-based Hatch Success	Egg-based Hatch Success	Nesting Loss	Nesting Success	Nest-based Fledgling Success	Pair-based Fledgling Success
Blue Hole	-	14	4	4	0	14	11	3.5	-	0	1	2.75	-
Johnson Pit	-	4	2	1	1	4	3	2	-	0.5	0.5	1.5	-
Lexington Pit	-	10	3	3	0	10	9	3.33	-	0	1	3	-
TF Odessa	-	0	1	0	1	0	0	0	-	1	0	0	-
All sites	-	28	10	8	2	28	23	2.8	-	0.2	0.8	2.3	-

Table 11. Mayfield daily nest survival rate and incubation survival rate for least terns in 2001. Incubation survival rate is the daily rate times itself for every day of incubation (21 times).

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	11	3	163	0.9816	0.0001	0.9605	1.0027	0.6770	0.4294	1.0572
Johnson Pit	6	2	109	0.9817	0.0002	0.9559	1.0074	0.6778	0.3882	1.1665
Lexington Pit	8	0	134	1.0000	Undef.	Undef.	Undef.	1.0000	Undef.	Undef.
Lilley-Wood River	2	2	9	0.7778	0.0192	0.5006	1.0549	0.0051	0.0000	3.0744
All sites	27	7	415	0.9831	0.0000	0.9705	0.9958	0.6996	0.5331	0.9149

Table 12. Mayfield daily nest survival rate and incubation survival rate for piping plovers in 2001. Incubation survival rate is the daily rate times itself for every day of incubation (28 times).

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	4	0	52	1.0000	Undef.	Undef.	Undef.	1.0000	Undef.	Undef.
Johnson Pit	2	1	19	0.9474	0.0026	0.8449	1.0498	0.2201	0.0089	3.9018
Lexington Pit	3	0	6	1.0000	Undef.	Undef.	Undef.	1.0000	Undef.	Undef.
TF Odessa	1	1	11	0.9091	0.0075	0.7357	1.0824	0.0693	0.0002	9.1917
All sites	10	2	88	0.9773	0.0003	0.9455	1.0090	0.5253	0.2082	1.2868

Table 13. Nest level habitat characteristics measured at least tern nests monitored in 2001 (measurements were not done 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		
Distance to Nearest Water	sandpit	26	26.92	21.78	32.07	14	78
Percent Fine Sand	sandpit	25	87.60	85.80	89.40	75	90
Percent Coarse Sand	sandpit	25	9.76	9.36	10.16	5	10
Percent Small Gravel	sandpit	25	2.36	0.78	3.94	0	10
Percent Large Gravel	sandpit	25	0.08	-0.03	0.19	0	1
Distance to Nearest Nest	sandpit	24	21.29	16.18	26.40	2	56
Distance to Obstruction	sandpit	3	24.33	6.65	42.02	10	41

Table 14. Nest level habitat characteristics measured at piping plover nests monitored in 2001 (measurements were not done 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		
Distance to Nearest Water	sandpit	8	48.88	31.46	66.29	19	85
Percent Fine Sand	sandpit	8	77.50	71.36	83.64	70	90
Percent Coarse Sand	sandpit	8	10.00	10.00	10.00	10	10
Percent Small Gravel	sandpit	8	7.25	4.11	10.39	0	10
Percent Large Gravel	sandpit	8	5.25	1.70	8.80	0	10
Distance to Nearest Nest	sandpit	8	42.88	18.55	67.20	2	100
Distance to Obstruction	sandpit	2	39.00	11.56	66.44	25	53

Table 15. Colony level habitat characteristics for each sandpit with least tern (LETE) or piping plover (PIPL) nests in 2001. Values were estimated from 1998 digital color-infra red photographs.

Site name	Nesting Species	Distance to River (m)	Pond Size (m^2)
Blue Hole	LETE/PIPL	226	99719
Johnson Pit	LETE/PIPL	1340	120523
Lexington Pit	LETE/PIPL	574	145526
Lilley-Wood River	LETE	356	21222
TF Odessa	PIPL	195	151887

Table 16. Correlations between habitat parameters and reproductive parameters for the 27 least tern nests monitored in 2001 (measurements were not done at all nests as indicated by sample size).

	# Eggs Laid		# Eggs Hatched		Nest Success		# Young Fledged	
Habitat Parameter	n	Correlation	n	Correlation	n	Correlation	n	Correlation
Distance to Nearest Water	26	0.0859	26	-0.2170	26	-0.2613	26	-0.2665
Percent Fine Sand	25	-0.1668	25	0.0244	25	0.1166	25	-0.0149
Percent Coarse Sand	25	0.3641	25	0.3242	25	0.3364	25	0.3115
Percent Small Gravel	25	0.0356	25	-0.1771	25	-0.2565	25	-0.1358
Percent Large Gravel	25	0.1621	25	0.1884	25	0.1657	25	0.2134
Distance to Nearest Nest	24	0.1999	24	0.2495	24	0.2827	24	0.1617
Distance to Obstruction	3	0.5514	3	0.9234	3	0.9234	3	0.9234

Table 17. Correlations between habitat parameters and reproductive parameters for the 8 piping plover nests monitored in 2001. Correlations can not be calculated for percent coarse sand because the values are constant at all sites. The correlations can not be calculated for distance to obstruction and the number of eggs laid and number of fledged because the reproductive parameters are constant at both sites (measurements were not done at all nests as indicated by sample size).

	# Eggs Hatched		# Eggs Laid		Nest Success		# Young Fledged	
Habitat Parameter	n	Correlation	n	Correlation	n	Correlation	n	Correlation
Distance to Nearest Water	8	0.4255	8	0.4019	8	0.4481	8	0.1501
Percent Fine Sand	8	0.3593	8	0.3419	8	0.3419	8	-0.0339
Percent Coarse Sand	8	.	8	.	8	.	8	.
Percent Small Gravel	8	-0.4167	8	-0.4462	8	-0.2454	8	-0.0465
Percent Large Gravel	8	-0.2536	8	-0.1973	8	-0.3749	8	0.0998
Distance to Nearest Nest	8	0.2460	8	0.2158	8	0.1942	8	0.3473
Distance to Obstruction	2	.	2	-1.0000	2	.	2	-1.0000

Table 18. Correlations between colony level habitat parameters and reproductive parameters for the 4 least tern and 4 piping plover colonies monitored in 2001.

Habitat Parameter	# Nests Initiated	Nest-based Hatch Success	Nesting Success	Nest-based Fledgling Success
Least Terns	4	4	4	4
Distance to River	-0.1803	0.2694	0.2172	0.3127
Size of Pond	0.6814	0.9819	0.9763	0.9864
Piping Plovers	4	4	4	4
Distance to River	-0.1631	0.0881	0.0139	0.0552
Size of Pond	-0.7079	-0.5842	-0.5234	-0.4717

Table 19. Time (people-days) used to implement least tern and piping plover monitoring protocol in 2001.

Cooperator	Riverine Survey (people/days)	Intensive Survey (people/days)	Nest Monitoring (people/days)
NPPD	3	0	15
CPNRD	2	0	10
CPPID	1	0	0
USFWS	14	0	0
EDO	0	2	0
Total	20	2	25

Figure 1. Discharge (cfs) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2001.

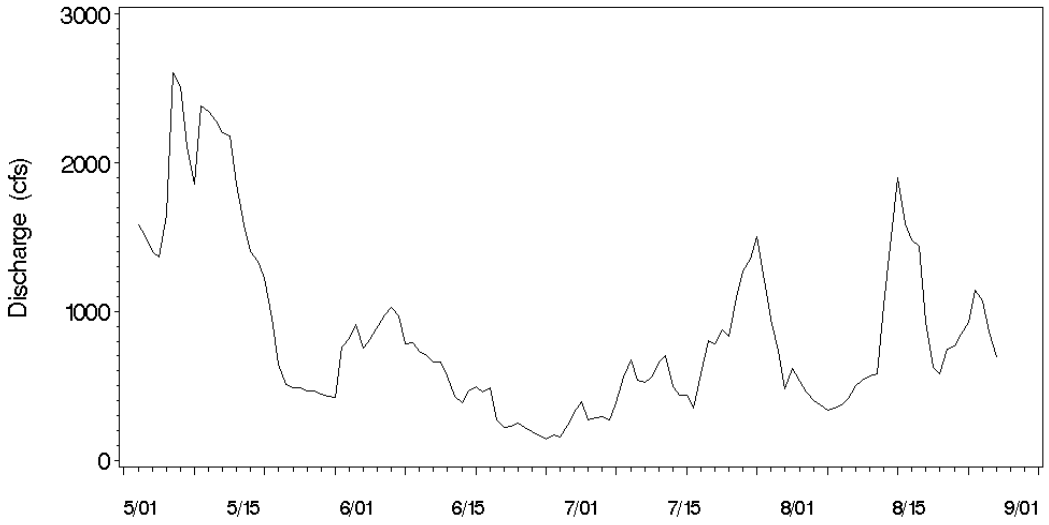


Figure 2. Stage (ft) at Kearney, Nebraska (USGS Gage No. 06770200) from May 1 through August 31, 2001.

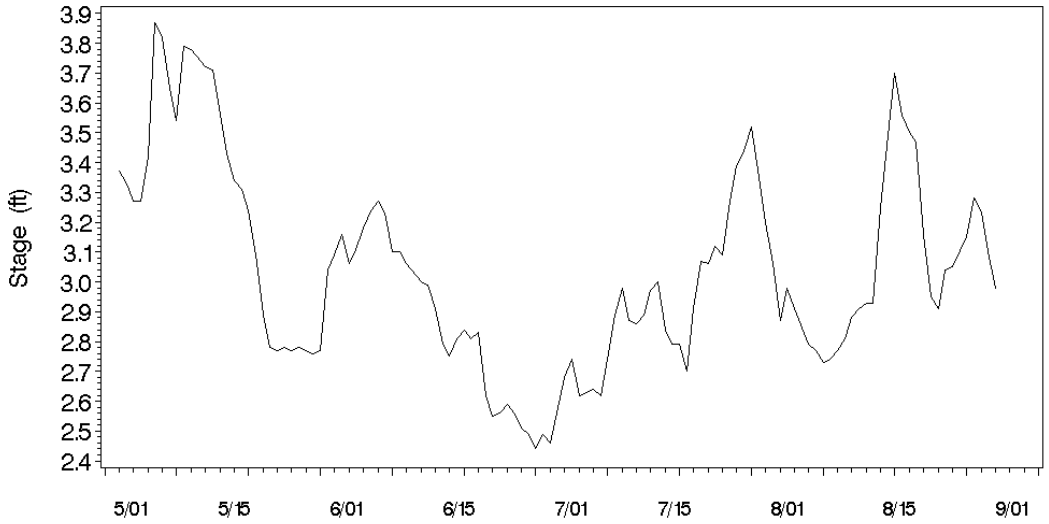


Figure 3. Discharge (cfs) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2001.

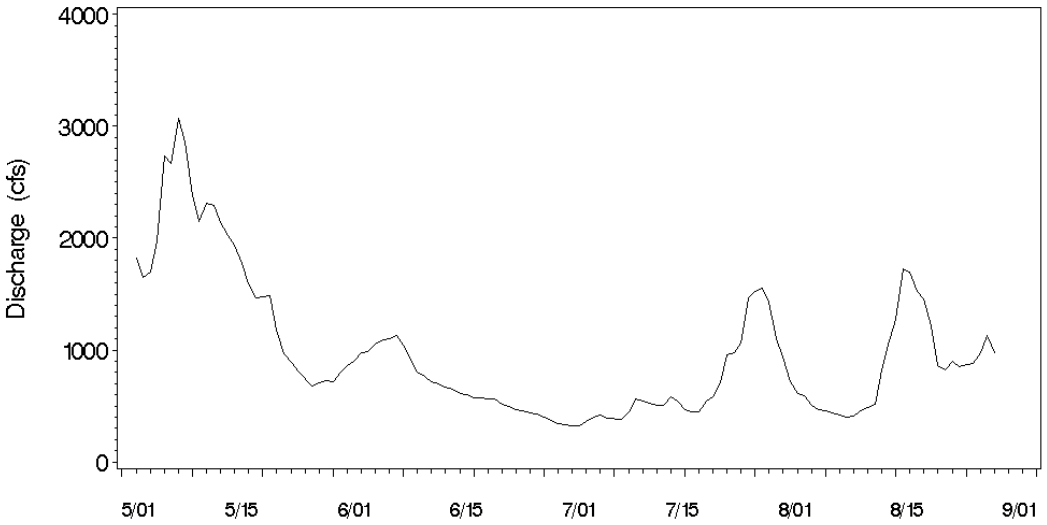


Figure 4. Stage (ft) at Grand Island, Nebraska (USGS Gage No. 06770500) from May 1 through August 31, 2001.

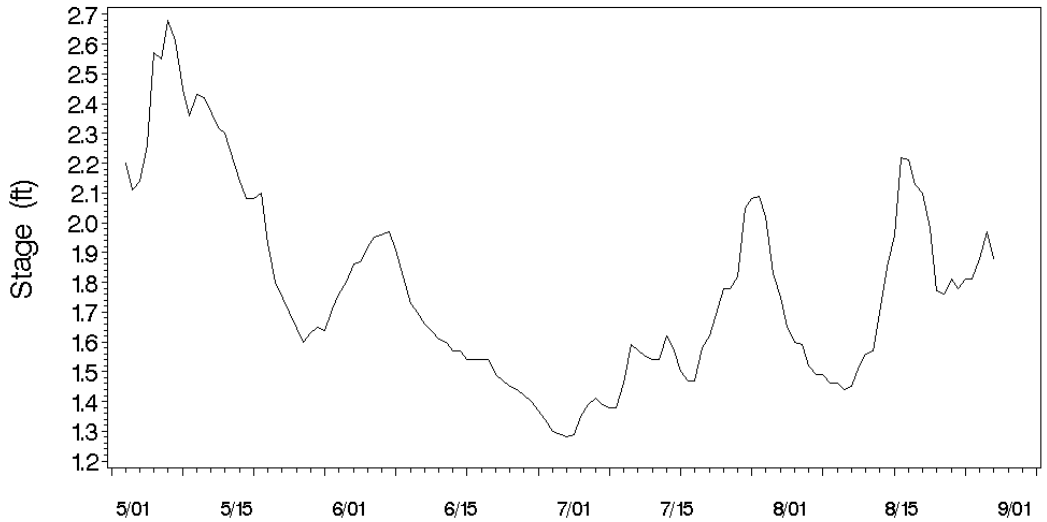
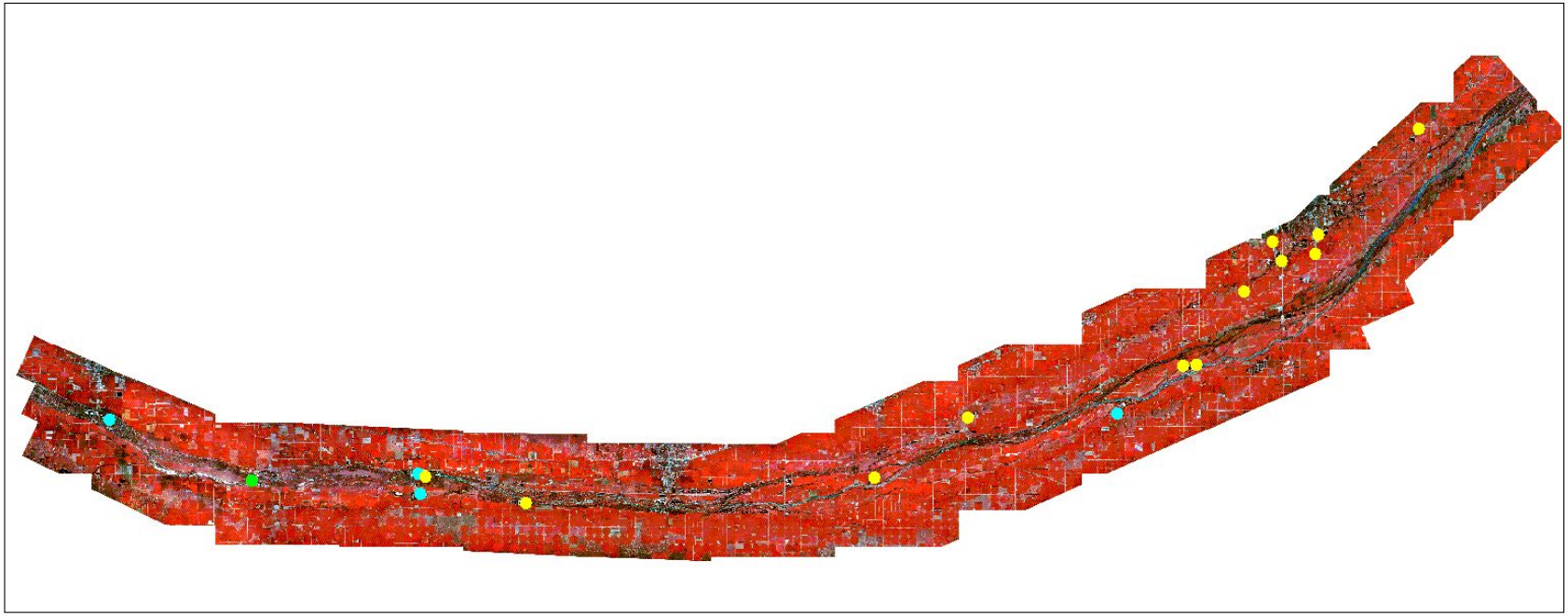


Figure 5. Sandpits and constructed islands surveyed for the 2001 season and locations of least tern sightings and nesting.



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

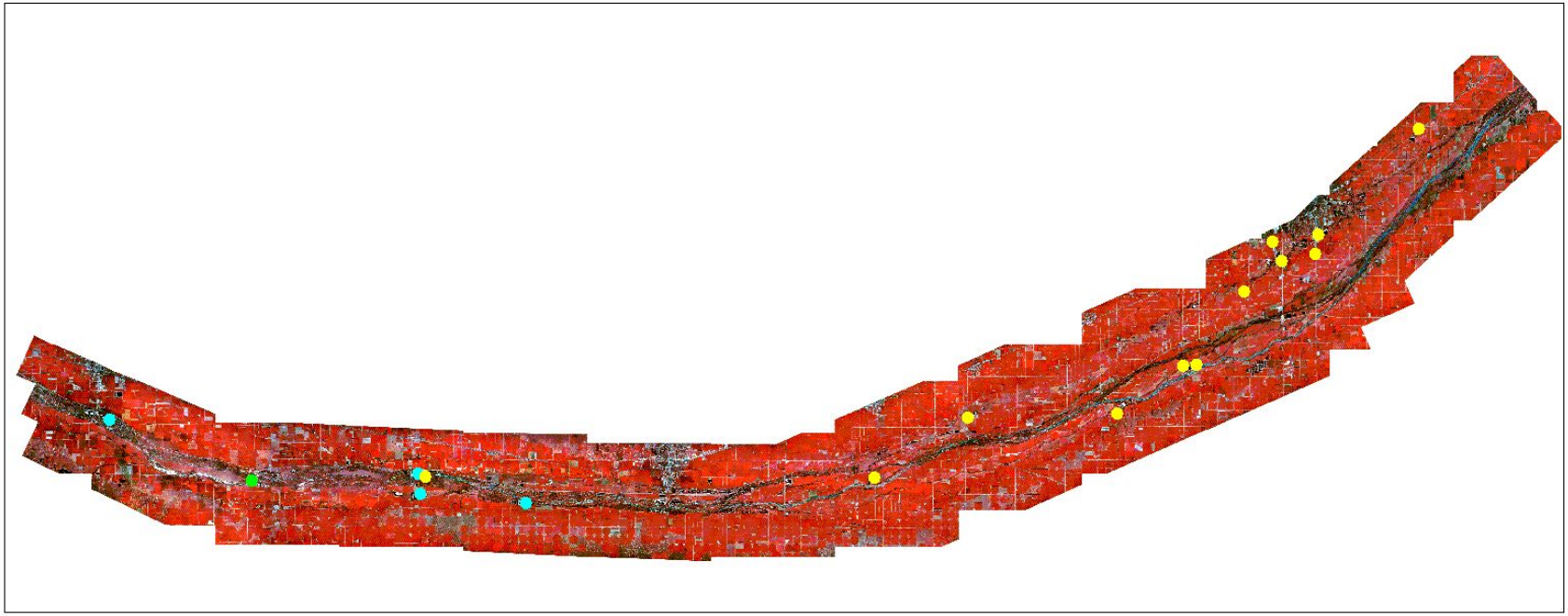
20 0 20 40 Miles

Least Tern Legend

- **No least terns**
- **Least tern presence**
- **Least tern nests**

N

Figure 6. Sandpits and constructed islands surveyed for the 2001 season and locations of piping plover sightings and nesting.



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

20 0 20 40 Miles

Piping Plover Legend

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

N