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

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Recommended citation

Brown, M.B., J.G. Jorgensen, and L.R. Dinan. 2011. 2011 Interior Least Tern and Piping Plover Monitoring, Research, Management, and Outreach Report For the Lower Platte River, Nebraska. Joint report of the Tern and Plover Conservation Partnership and the Nongame Bird Program at the Nebraska Game and Parks Commission. Lincoln, NE.

Acknowledgements

Generous financial support for the monitoring, research, management, and outreach activities described in this report was provided by the Nebraska Environmental Trust, Nebraska Game and Parks Commission, Nebraska Game and Parks Commission Wildlife Conservation Fund, Nebraska Natural Legacy Project, Nebraska Bird Partnership, Nebraska State Wildlife Grants, Preferred Rocks of Genoa, United States Fish and Wildlife Service, University of Nebraska-School of Natural Resources, and University of Nebraska Extension.

We extend our thanks to all of the people that contributed to this program including: Jason Alexander, A.F. Amos, Carol Aron, Stan Benke, Beth Bosler, Dave Brakenhoff, Mark Brohman, Linda Brown, Keith Carroll, Dan Catlin, Aaron Clark, Katherine Cullen, Pat DeStefano, Mark Dietz, Kenny Dinan, Rick Eades, Dee Ebbeka, Dave Eigsti, Ruth Eigsti, Lois Ericson, Joy Felio, Jolene Foster, Jim Fraser, Kathy French, Ellen Geockler, Belinda Gillam, Cheri Gratto-Trevor, Robert Harms, Wayne Hathaway, Berlin Heck, Alice Heckman, Leslie Hershberger, Jeremy Hiller, Caroline Hinkelman, Les Howard, Kelsi Hunt, Gregg Hutchison, Paul Johnsgard, Allison Johnson, Richard Karow, Dave Kendle, Michelle Koch, Ron Kruml, Mark Kuzila, Jeanine Lackey, Jill Liske-Clark, Jackie Loomis, Sidney Maddock, John McCarty, Courtney McCusker, Mark Mesarch, Bruce Mellberg, Melissa Panella, Gary Pearson, Sue Ellen Pegg, Richard Plumtree, Kelly Powell, Chris Poole, Diane Pratt, Mike Reed, Lindsay Rogers, Jeff Runge, Joel Sartore, Rick Schneider, Kirk Schroeder, Rachel Simpson, Meghan Sittler, Kristal Stoner, Marilyn Tabor, Martha Tacha, Scott Taylor, Chris Thody, Dave Titterington, Drew Tyre, Ben Wheeler, Carol White, Don Wilhite, LaReesa Wolfenbarger, Ron Zelt, and Kenton Zimmer.

We extend our thanks to all of our partners including: Arps Gravel and Concrete, Big Sandy Homeowners' Association, Cedar Creek Homeowners' Association, Central Nebraska Public Power and Irrigation District, Central Sand and Gravel, Five Nines Technology Group, Girl Scouts-Spirit of Nebraska, Hallett Materials, Lake Socorro Homeowners' Association, Loup Public Power District, Lower Platte North Natural Resources District, Lower Platte River Corridor Alliance, Lower Platte South Natural Resources District, Lower Platte River Weed Management Area, Lyman-Richey, Mallard Landing Homeowners' Association, Mallard Sand and Gravel, Nebraska Nebraska Public Power District, Old Castle Materials, Overland Sand and Gravel, Papio-Missouri Natural Resources District, Paulsen Sand and Gravel, Platte River Recovery Implementation Program, Preferred Sands of Genoa, Riverview Shores Homeowners' Association, Stalp Sand and Gravel, Tri-County Sand and Gravel, Ulrich Sand and Gravel, United States Army Corps of Engineers, United States Geological Survey, and Western Sand and Gravel.

Preface

This document reports on our monitoring, research, management, and outreach activities during the past 12 months (2011). We prepared it to inform our partners, cooperating agencies, funding sources, and other interested parties of our activities and to provide a preliminary summary of our results.

The data, data analyses, results, summaries, and interpretations found in this document are <u>not final</u> and should be considered as such when being cited or referred to in documents, reports, proposals, or presentations. Please contact us before using any of this material and for additional information that may have become available.

In an effort to make the information in this document more accessible, it is divided into five (5) sections: Introduction, Monitoring, Research, Management, and Outreach.

<u>Introduction</u>: This section describes the project area and summarizes conditions encountered during the 2011 field season.

<u>Monitoring</u>: This section describes the data we collect every year for basic demographic analysis and includes the number of nests, adults, eggs, chicks, and fledglings found in the focus area. These data are collected and summarized in a form that allows comparison across the range of each species.

<u>Research</u>: This section describes our research objectives, data collection, and data analyses.

<u>Management</u>: This section describes our actions to protect Interior Least Terns and Piping Plovers and their nests from interference.

<u>Outreach</u>: This section describes our efforts to increase public awareness and understanding of Interior Least Terns and Piping Plovers and to promote environmental literacy.

The following icons are used on maps to designate nest locations.

nterior Least Tern nest

Piping Plover nest

"Fortunately protection has come in time to save this beautiful species from complete extermination with which it certainly was threatened."

Arthur Cleveland Bent
Life Histories of North American Gulls and Terns

Introduction

The Tern and Plover Conservation Partnership (TPCP), based at the University of Nebraska-School of Natural Resources, and the Nongame Bird Program (NBP), based at the Nebraska Game and Parks Commission (NGPC), work cooperatively on Interior Least Tern and Piping Plover monitoring, research, management, and outreach in Nebraska. While the focus of our work is the Lower Platte, Loup, and Elkhorn Rivers in the eastern part of the state, we address tern and plover issues across the state and region. Our joint program includes terns and plovers nesting in on-river habitats (midstream river sandbars) and in off-river human-created habitats (sand and gravel mines and lakeshore housing developments). The TPCP leads our efforts at off-river habitats; the NBP leads our efforts at on-river habitats.

Focus Animals

The Interior Least Tern (*Sternula antillarum athalassos*) is a state and federally listed endangered species (50 Federal Register 21784–21792). The Least Tern was placed on the Endangered Species List on 27 June 1985, and a Recovery Plan was issued in September 1990. The listing status of this species is managed under the auspices of the Federal Endangered Species Act (1973) and the Nebraska Nongame and Endangered Species Conservation Act (Neb. Rev. Stat. § 37-801 -11). The Least Tern was first described as a species in 1847 from a type specimen collected in Guadeloupe, West Indies (Checklist of the Birds of North America 1998. American Ornithologists' Union).

The Piping Plover (*Charadrius melodus*) is a state and federally listed threatened species (50 Federal Register 50726–50734). The species was placed on the Endangered Species List on 10 January 1986, and the Northern Great Plains Recovery Plan was issued in May 1988. The listing status of this species is managed under the auspices of the Federal Endangered Species Act (1973) and the Nebraska Nongame and Endangered Species Conservation Act (Neb. Rev. Stat. § 37-801 -11). Critical habitat for the Northern Great Plains breeding population was designated in Montana, Nebraska, South Dakota, and Minnesota on 11 September 2002 (67 Federal Register 57637). The United States District Court vacated the portion of critical habitat located in Nebraska on 13 October 2005; to date, it has not been reinstated. Piping Plovers were first described as a species in 1824 from a type specimen collected in New Jersey (Checklist of the Birds of North America. 1998. American Ornithologists' Union).

Interior Least Terns and Piping Plovers are an integral part of the fauna of Nebraska. There are numerous references to them in Native American culture (e.g., *ūt* is the word for plover in the Pawnee language). They were frequently seen by early explorers and pioneers who passed through the region. Meriwether Lewis and William Clark observed Least Terns in what became the state of Nebraska on their 1803–1805 "Voyage of Discovery", referring to them as a 'frequently observed bird'. Least Terns were the first new bird species noted by Lewis and Clark; on 5 August 1804 they saw a tern flying above the Missouri River in present-day Washington County, Nebraska. Clark wrote in his journal about terns, noting that "this bird is very noysey when flying which it dose extremely swift the motion of the wing is much like that of Kildee it has two notes like the squaking of a small pig only on reather a higher kee, and the other kit'-tee'-kit'-tee'—as near as letters can express the sound." Lewis and Clark also observed Piping Plovers in what became the state of Nebraska, referring to them in their journals as 'small kildee'. Artist John James Audubon traveled along the Missouri River and through the Nebraska Territory in 1843. He reported seeing Least Terns near the confluence of the Vermillion and Missouri Rivers, in present day Dixon County, Nebraska. In 1820, members of the Major Stephen Long Expedition found Least Terns

nesting along the Missouri River in present-day Washington County, Nebraska. In 1823, Paul Wilhelm, the Duke of Wurttemberg, reported finding Least Terns nesting on sandbars near the mouth of the Platte River in present day Cass County, Nebraska. Members of the Gouverneur Kemble Warren Expedition (1855–1857) reported finding Least Terns and Piping Plovers nesting on sandbars near the confluence of the Loup and Platte Rivers (an area they called the Loup Fork), in present day Platte County, Nebraska. Ferdinand Hayden, traveling with the Warren Expedition, commented that Least Terns and Piping Plovers were very abundant and nested on sandbars in the Platte River. Least Terns were reported, in 1859, to be nesting along the North Platte River, east of Ash Hollow, in Keith County. Reports from the 1860s and 1870s indicate that Least Terns were nesting in Cedar, Dixon, Lancaster, and Sarpy counties; Piping Plovers were reported nesting in Dakota, Dixon, Sarpy, and Wayne counties during this period.

The Great Plains populations of both species have declined due to the broad-scale alteration of the natural river systems and the corresponding loss of nesting habitat. Terns and plovers rely on expanses of bare or sparsely-vegetated sand for nesting habitat; this includes midstream river sandbars and areas that are created by industrial or commercial activities. The amount of river sandbar nesting habitat has been reduced by invasive plant species, construction of dams and reservoirs, river channelization, bank stabilization, island armoring, hydropower generation, and water diversion.

Loss of overwintering habitat has also contributed to both species' declines. Overwintering habitat for Great Plains Piping Plovers occurs along the United States Atlantic and Gulf Coasts, northeastern Mexican coast, and Caribbean islands. Least Terns winter along coastal areas of Central and South America. Threats to overwintering habitat include sea level rise due to global climate change and residential, industrial, and commercial development.

Focus Area

Our focus area includes the Lower Platte, Elkhorn, and Loup River systems in eastern Nebraska (Fig. 1). The Loup and Elkhorn Rivers are tributaries of the Lower Platte River. We define the Lower Platte River as the 103 river miles lying between the Loup River (near Columbus, Platte County) and Missouri River (near Plattsmouth, Cass County) confluences. River mile 0 is defined as the Missouri-Platte River confluence. The Lower Platte River passes through eight counties (Platte, Colfax, Butler, Dodge, Saunders, Douglas, Sarpy, and Cass) and four Natural Resources Districts (Lower Platte South, Lower Platte North, Papio-Missouri, and Lower Loup).

In the Lower Platte River, on-river habitat includes river sandbars used for nesting and the river channel, which is used for foraging. Off-river (also referred to as human-created) habitat includes sand and gravel mines and lakeshore housing developments. At off-river habitats, the birds use the waste sand piles and beaches for nesting and the pit lakes for foraging. In eastern Nebraska, off-river habitats are rarely found more than three miles from a river, and birds nesting at off-river habitats often travel to the river to forage. See Table 1 for a listing of the off-river sites used by terns and plovers in 2011.

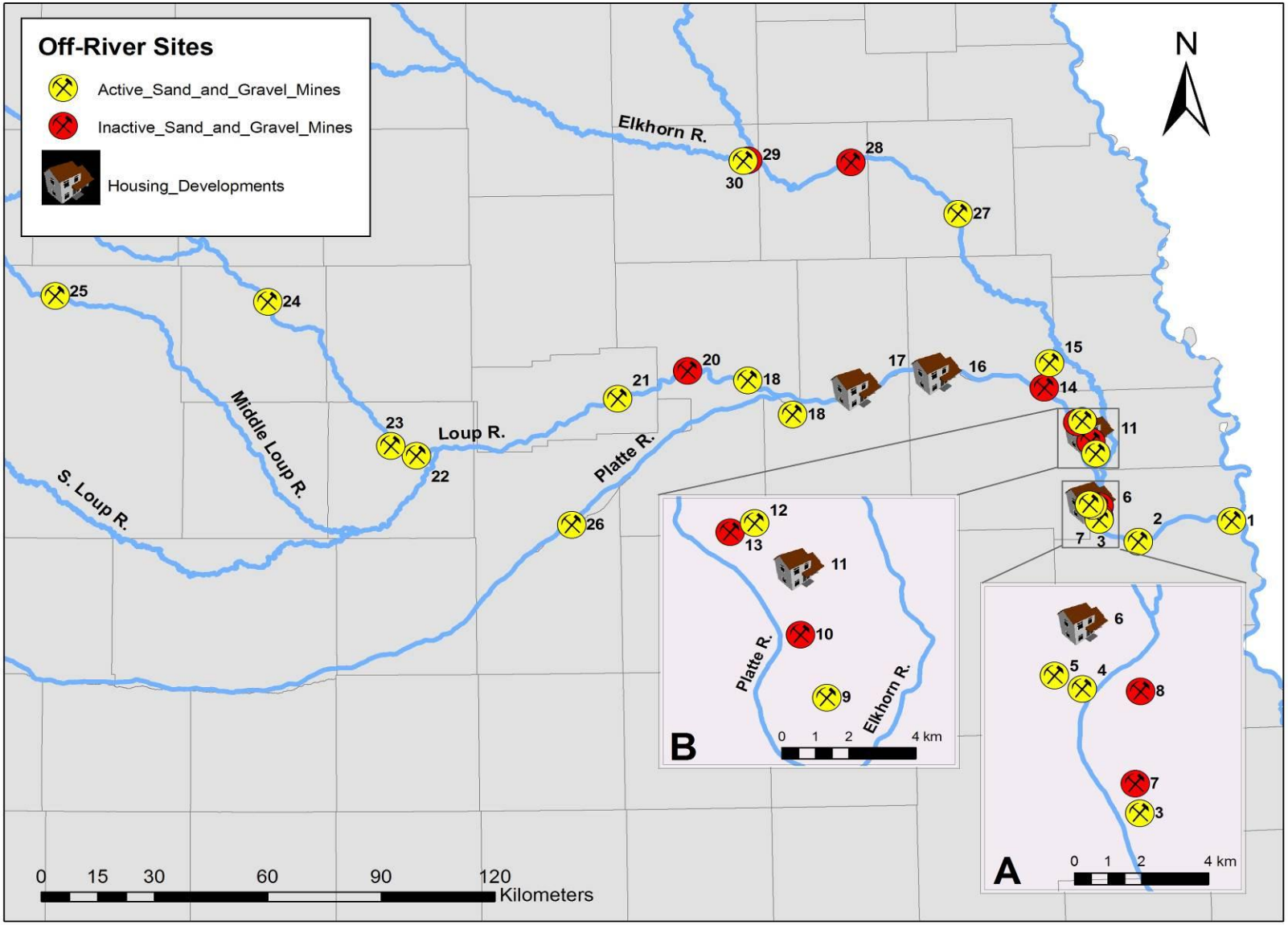

Figure 1. Locations of all known off-river Interior Least Tern and Piping Plover nesting areas in eastern Nebraska. Off-river sites can be matched to numbers in Table 1.

Table 1. Off-river Interior Least Tern and Piping Plover nesting sites; site numbers correspond with Figure 1.

Site	Site Name	River	Owner	Site Type	County
1	Four Mile Creek (Oreopolis)	Platte	Lyman Richey	Active Mine	Cass
2	Louisville Lakes (Louisville)	Platte	Western Sand and Gravel	Active Mine	Sarpy
3	New Linoma Beach (Linoma Beach)	Platte	Lyman Richey	Active Mine	Sarpy
4	Thomas Lakes (N Riverside)	Platte	Western Sand and Gravel	Active Mine	Saunders
5	Sand Creek (NW Riverside)	Platte	Western Sand and Gravel	Active Mine	Saunders
6	Big Sandy (Big Sandy)	Platte	Homeowners' Association	Housing Development	Saunders
7	Old Linoma Beach (Old Linoma Beach)	Platte	Lyman Richey	Inactive Mine	Sarpy
8	Melia (Melia)	Platte	Private	Inactive Mine	Sarpy
9	OMG-Venice (OMG)	Platte	Old Castle Materials Group	Active Mine	Douglas
10	Lyman Richey Waterloo (Lake Clagus)	Platte	Lyman Richey	Inactive Mine	Douglas
11	Mallard Landing (Timber Lake Lodge)	Platte	Homeowners' Association	Housing Development	Douglas
12	New Valley (Valley)	Platte	Lyman Richey	Active Mine	Douglas
13	Pleasure Lake (Lyman Richey Valley)	Platte	Lyman Richey	Inactive Mine	Douglas
14	Western Fremont (N Woodcliff)	Platte	Western Sand and Gravel	Inactive Mine	Dodge
15	NE Fremont (Fremont #47)	Platte	Lyman Richey	Active Mine	Dodge

Site	Site Name	River	Owner	Site Type	County
16	Riverview Shores (Riverview Shores)	Platte	Homeowners' Association	Housing Development	Dodge
17	Socorro Lake (Lake Socorro)	Platte	Homeowners' Association	Housing Development	Colfax
18	Wilson Creek (Bellwood)	Platte	Central Sand and Gravel	Active Mine	Butler
19	Shady Lake Road (Columbus)	Loup	Central Sand and Gravel	Active Mine	Platte
20	W Lookingglass Creek (Monroe)	Loup	Central Sand and Gravel	Inactive Mine	Platte
21	LPPD- Loup Diversion (Sandpile)	Loup	Preferred Rocks of Genoa	Active Mine	Nance
22	North Loup SRA (Batenhorst @ St. Paul)	Loup	Central Sand and Gravel	Active Mine	Howard
23	E Elba (Tri-County)	Loup	Tri-County Sand and Gravel	Active Mine	Howard
24	Haskell Creek (Ulrich's)	Loup	Ulrich Sand and Gravel	Active Mine	Valley
25	Paulsen Gates (Gates)	Loup	Paulsen Sand and Gravel	Active Mine	Custer
26	Overland (Mowitz - Central City)	Loup	Overland Sand and Gravel	Active Mine	Hamilton
27	Horseshoe Lake (Stalps')	Elkhorn	Stalp Sand and Gravel	Active Mine	Cumming
28	Red Fox WMA (Pilger)	Elkhorn	Pilger Sand and Gravel	Inactive Mine	Stanton
29	Andy's Lake (Pilger/Norfolk))	Elkhorn	Pilger Sand and Gravel	Inactive Mine	Madison
30	Medelman's Lake (Norfolk #92)	Elkhorn	Central Sand and Gravel	Active Mine	Madison

*Site name as recorded on Nebraska Game and Parks Commission (NGPC) database; informal site names are in parentheses.

2011 Lower Platte River Conditions

The amount of sandbar nesting habitat in the Lower Platte River that is available to terns and plovers varies from year to year. It depends on daily and seasonal fluctuations in the volume of water flowing in the river, annual amounts of rain, ice and snow, ground water levels, and river channel morphology. All of these factors influence sandbar development and maintenance. General flow conditions on the Lower Platte River are monitored by USGS stream gages (http://waterdata.usgs.gov/ne/nwis/rt). In addition to these data, we monitor flow conditions by visual inspection of the river at bridge crossings and by direct inspection via canoe and kayak.

During 2010, very high river discharge levels (greater than 110,000 cfs during June at the Louisville USGS gage) built large, high-elevation macro-form sandbars. Macro-form remnants from the 2010 high flow event persisted through the 2011 breeding season. River conditions during the 2011 breeding season were characterized by above average discharge over the entire breeding season (Figs. 2 and 3). During May, river discharge increased and exceeded 30,000 cfs at the Louisville gage, which inundated all sandbars in the system. By late May, river discharge began to decrease and sandbars were exposed. During the first half of June, we surveyed the river sandbars and found nesting terns and plovers. However, river discharge again increased during the latter part of June and again exceeded 30,000 cfs at the Louisville gage. Following this second increase, river discharge decreased by early July and continued to decrease throughout the remainder of the nesting season.

2011 Off-River Conditions

In 2011, off-river conditions changed substantially from 2008, 2009 and 2010. The easing of the 2010 economic recession affected the sand and gravel mining and lakeshore housing development industries and increased activities in both areas. Several sand and gravel mining companies modified their operations by expanding existing sandpits, relocating dredges and separating plants or moving slurry pipes. Several small sandpits were opened; these new sandpits have not produced enough waste sand to attract nesting birds, but within the next 2 – 3 years we expect to find birds at these sites. Several mine sites that ceased production in 2010 remained closed, which allowed the birds to nest at those locations without human interference. The pace of construction at lakeshore housing developments increased, which eliminated nesting habitat at some locations. Flooding along the Missouri Rivers eliminated most on-river nesting habitat from the Gavin's Point reach and further upstream. This flooding acted to "dam" the Lower Platte River at the confluence near Plattsmouth, Cass County and caused localized flooding which closed at least one mine. High river flows caused by seasonal precipitation and releases from upstream dams (i.e. Kingsley Dam at Lake McConaghy) from mid-June to mid-July 2011 overtopped most of the sandbars in the Lower Platte River. Lake McConaughy near Ogallala, Keith County was at full storage capacity during 2011 which eliminated nearly all lakeshore nesting habitat at Lake McConaughy. These conditions caused terns and plovers in Nebraska to range widely in effort to find nesting locations; many of these birds chose to locate their nests at the off-river sites.

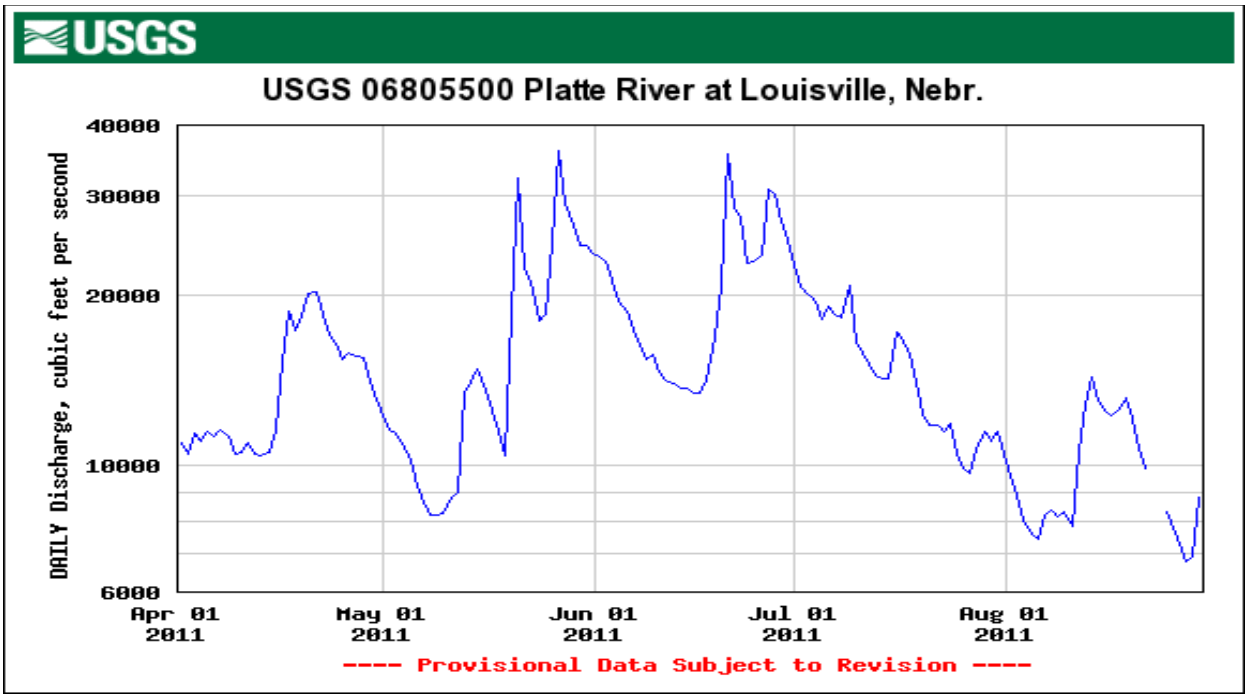

Figure 2. Daily water discharge (cubic feet per second; cfs) measured at the Louisville, Cass County, USGS gage from April 1, 2011 through August 31, 2011.

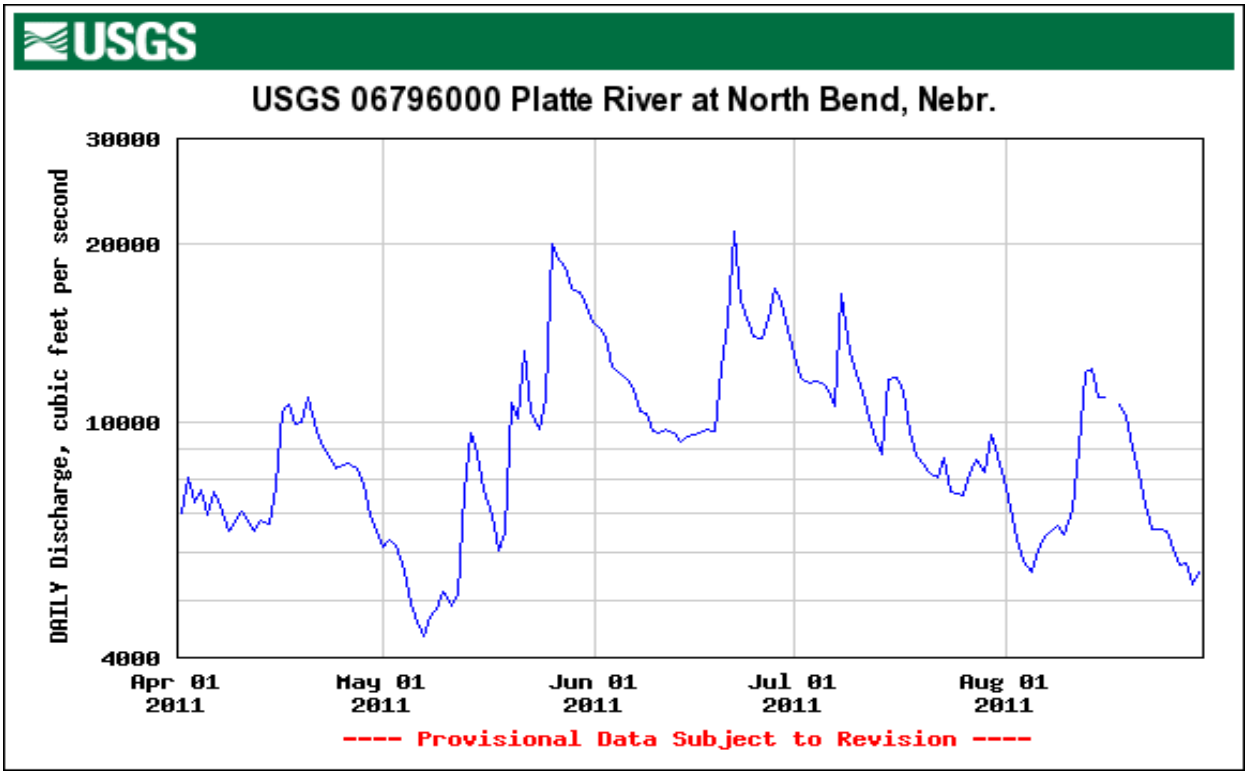

Figure 3. Daily water discharge (cubic feet per second; cfs) measured at the North Bend, Dodge County, USGS gage from April 1, 2011 through August 31, 2011.

Monitoring

Regional Movements of Color-banded Piping Plovers

Breeding Range

We have observed a number of previously color-banded Piping Plovers in our Lower Platte River study area from 2008 through 2011. In 2011, all except one of the plovers that we observed along the Lower Platte River carrying light blue flags were originally banded by us along the Lower Platte River. One of the light blue flagged plovers we observed on a sandbar this summer was originally banded by United States Geological Survey (USGS) along the Central Platte River on a sand pit near Elm Creek, Buffalo County. Most of the plovers we observed carrying green flags were originally banded along the Gavin's Point Dam reach of the Missouri River between Sioux City, Dakota County, NE and Yankton, Yankton County, SD (K. Hunt, G. Pavelka, D. Catlin and J. Felio, pers. comm.). However, four of the green flagged birds we observed this field season were originally banded in the winter of 2011 along the US Gulf Coast as a part of a Deepwater Horizon Oil Spill recovery study. We also observed a plover carrying a yellow flag on a sandbar in the Lower Platte River; this bird was originally banded at Lake Sakakawea, Mercer County, along the Missouri River in North Dakota. This particular plover is the only yellow flagged plover that has been observed along the Lower Platte River and it has now been observed here three years in a row (2009, 2010, and 2011).

Nineteen of the thirty-one Piping Plovers we first banded in 2008 have been re-sighted in 2009, 2010, and/or 2011. Seventeen of the plovers banded in 2008 were sighted again in the Lower Platter River breeding area in 2009, four of the plovers banded in 2008 were sighted again in 2010, and seven of the plovers banded in 2008 were sighted again in 2011. Nine of the plovers banded in 2008 have been re-sighted in multiple years. Twenty out of the forty Piping Plovers banded in 2009 were seen in the Lower Platte River breeding area again in 2010 and/or 2011. Thirteen of these plovers were seen in 2010 and eleven were seen in 2011. Four of these 2009 plovers were seen in both 2010 and 2011. Fifteen out of the fifty seven plovers banded in 2010 were seen in the Lower Platte River breeding area again in 2011.

Twenty-two green-flagged plovers were observed at off-river sites along the Lower Platte River in 2011 (Fig. 4). Ten were observed near North Bend, Dodge County, four near Genoa, Nance County, six near Fremont, Dodge County, one near Ashland, Saunders County, and one near Valley, Douglas County. Six green-flagged plovers were seen on Lower Platte River sandbars in 2011. During the winter of 2011, after the 2010 Deepwater Horizon oil spill, several adult piping plovers were banded with green flags (and distinctive cobalt blue or yellow leg bands) while on their wintering grounds. This summer we observed two of these Deepwater Horizon plovers at a housing development near North Bend, Dodge County, one at an inactive sand and gravel mine near Fremont, Dodge County and one on a sandbar in the Lower Platte River near river mile 13, Sarpy County.

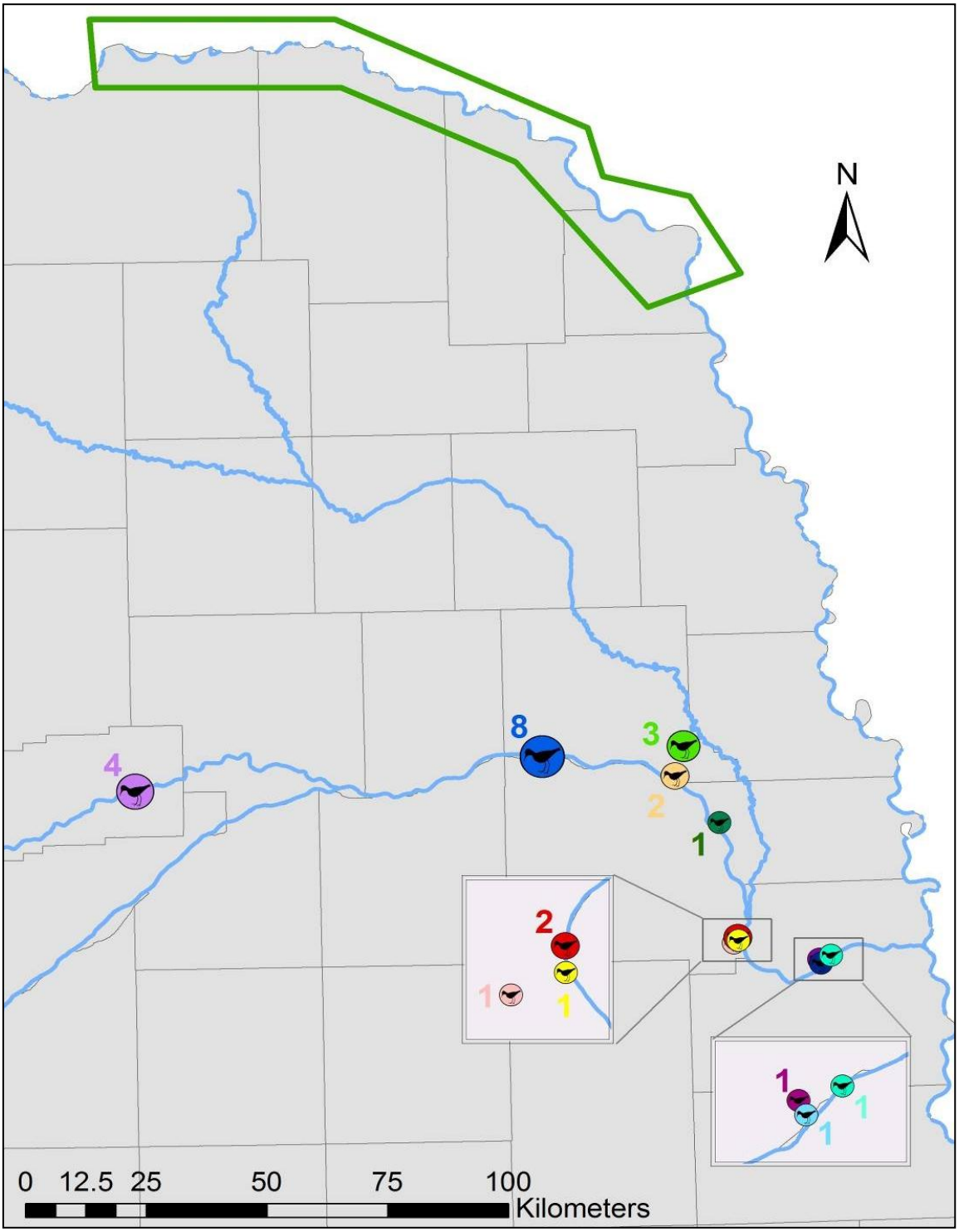

Figure 4. Locations of Green Flagged Piping Plovers originally banded on the Gavin's Point Dam reach of the Missouri River (green box) and seen along the Lower Platte River in 2011. Each colored marker represents the site where Piping Plovers were seen at river and off-river locations. The yellow dot marks the location where a plover originally banded at Lake Sakakawea in North Dakota was seen on a river sandbar in 2011. The numbers represent the number of uniquely color banded birds observed at each site.

Over-wintering Range

A number of Piping Plovers banded along the Lower Platte River in 2008, 2009, 2010 and 2011 have been observed along the United States Gulf Coast during the non-breeding season (Fig. 5). From 2008 to 2011, 35 Lower Platte River light blue flagged plovers have been re-sighted along the US Gulf Coast during the non-breeding season; there have been a total of 57 winter re-sightings of these light blue flagged plovers (several birds have been seen more than one time.

Piping Plovers banded along the Missouri River and the Gulf Coast have been observed nesting along the lower Platte River in Nebraska (Fig. 6). Four of the green flagged plovers that were observed along the lower Platte River during the 2011 breeding season were originally banded along the Gulf Coast. The yellow flagged plover that has been observed along the Lower Platte River for the past 3 years has also been observed along the gulf coast during the winter months.

These plovers have been seen at Dauphin Island (Mobile), Alabama; Marcos Island (Naples), Florida; St. Joseph‘s State Park (Tallahassee), Florida; Elmers Island, Louisiana; Grand Isle, Louisiana; Raccoon Island, Louisiana; East Ship Island, Mississippi; Ocean Springs, Mississippi; Corpus Christi, Texas; Matagorda Island, Texas; Mollie Beattie, Texas; Mustang Island, Texas; North Pass, and Redfish Bay, Texas; San Hose Island Gulf Beach, Texas; and South Padre Island, Texas.

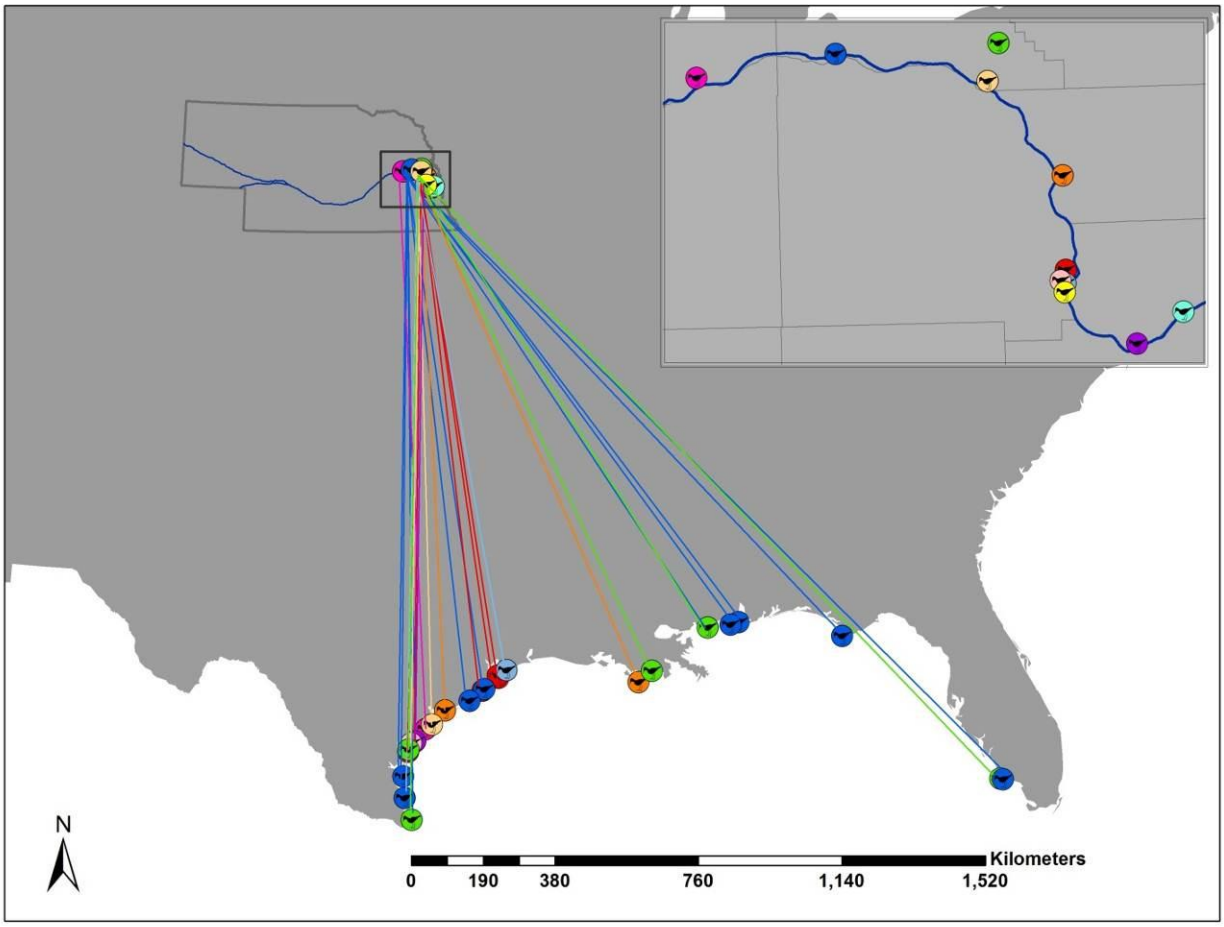

Figure 5. Locations where light blue-flagged Piping Plovers, that were originally banded along the Lower Platte River, have been seen during the non-breeding season on the United States Gulf Coast from 2008 to 2011. Color markers on the map represent the nesting area where birds were originally banded along the Lower Platte River.

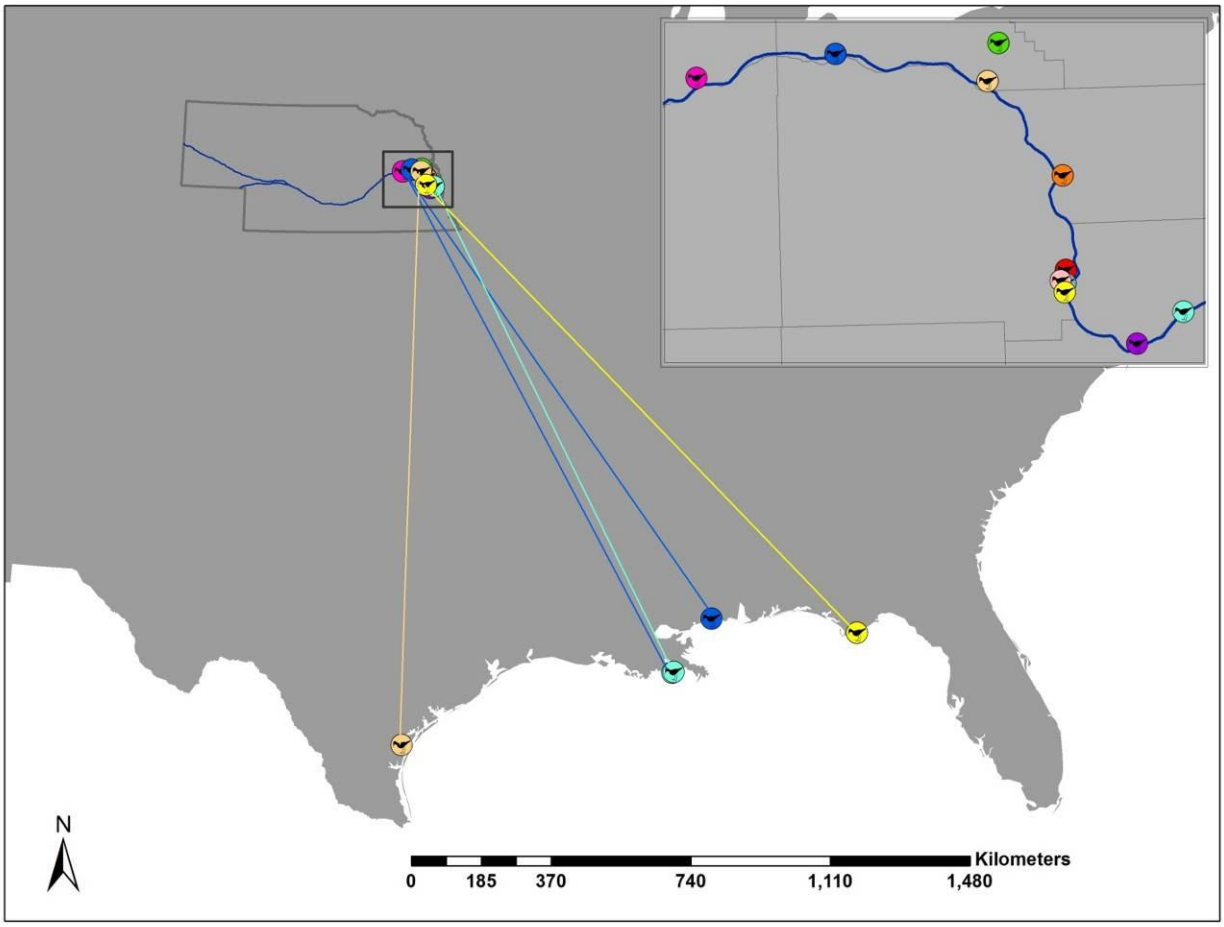

Figure 6. Locations where green and yellow flagged Piping Plovers have been seen during the non-breeding season on the United States Gulf Coast from 2008 to 2011. Color markers on the map represent the area were the birds were first observed along the Lower Platte River. The yellow marker represents the yellow flagged plover that was originally banded at Lake Sakakawea in 2008. The other color markers on the Gulf Coast represent the green flagged plovers that were originally banded along the Gulf Coast during the 2010/2011 winter.

Nest Monitoring

Methods – Off-river habitat

Beginning in late-April, we began visiting all sand and gravel mines and lakeshore housing developments in the focus area. We concentrated our early-season attention on sites that supported nesting terns and plovers in the past. We did this because terns and plovers are philopatric and tend to return to areas where they nested successfully in the past. Each site was visited every 4 – 5 days and surveyed for terns and plovers. When birds were observed at a site, the open sandy areas were searched for nests or evidence of nest scrapes. Most nests were located by observing adult birds sitting on nests. We recorded the location of every tern and plover nest that we found using a handheld GPS unit (Garmin Oregon 550t), and each nest was assigned a unique number. We 'floated' the eggs in each nest to determine when they were laid (H. Hays and M. LeCroy 1972 Wilson Bulletin 83: 425 – 429); the majority of the nests were

located 1 – 7 days after the first egg was laid. Using the egg floating data, we calculated the eggs' expected hatching date, assuming a 28-day incubation period for plovers and a 21-day incubation period for terns. We continued to locate nests throughout the season. All nests at off-river sites were visited every 4 – 5 days during the incubation period. These visits were to check for the presence of incubating adults and to count the number of eggs present; we did not repeat the "floating" procedure. We scored the status of each tern and plover nest based on the following criteria:

> Confirmed successful: 'pipped' eggs or newly-hatched chick(s) observed in or in the immediate vicinity (< 1 meter) of the nest cup
>
> Likely successful: empty but intact nest cup located on or after the expected hatch date; may contain small pieces of eggshell in nest cup
>
> Confirmed failure: nest cup and/or eggs found destroyed or abandoned
>
> Likely lost: nest not relocated on repeat visits prior to expected hatch date

At some off-river sites, terns and plovers placed their nests in areas that were not accessible to us for safety reasons. In these cases, we only recorded the number of nests, eggs, adults, chicks, juveniles, and fledglings that were visible from a safe distance.

On each regular visit to the sites, the total number of active nests and the total number of terns and plovers of each age class were recorded. The age classes we used were:

Adults: birds in full adult plumage

Chicks: 1 – 3 days, 4 – 10 days, 11 – 15 days

Juveniles: chicks older than 15 days, but still dependent on their parents

Fledglings: chicks capable of sustained flight and independent of their parents

If any adults or chicks were observed with leg bands, the color band combination was recorded. Any miscellaneous observations, including evidence of disturbance, vehicle tracks, weather conditions, or injuries were also recorded.

Results Off-River

Nesting Interior Least Terns and Piping Plovers were distributed across fourteen off-river sites in the entire study area (two sites along the Loup River and twelve sites along the Lower Platte River) in 2011 (Figs. 7 – 8). This included four lakeshore housing developments and ten sand and gravel mines. Nearly all of these sites have been used for nesting in previous years; a newer sand and gravel mine near Valley, Douglas County was unused for nesting in the past and did have one Least Tern nest on it this year. See Table 1 for description and location information for all sites, used and unused, in the focus area.

Piping Plovers began arriving in the focus area in late April. The first off-river sighting was near Ashland, Saunders County on 26 April 2011, when seven birds were seen at an active sand and gravel mine. Interior Least Terns began arriving in the focus area in mid-May. The first off-river sighting was of a pair of terns at a dredging operation near Genoa, Nance County on 23 May

2011. This is more than two weeks later than our first off-river tern sighting last year witch was on 7 May 2010.

Based on egg 'floating' data, the first off-river plover egg was laid on 29 April 2011 at a lakeshore housing development near North Bend, Dodge County and the last was laid on 26 June 2011 at an active sand and gravel mine near Louisville, Sarpy County. The first off-river tern egg was laid on 26 May 2011 at an active sand and gravel mine near Fremont, Dodge County. The last off-river tern egg was laid on 18 July 2011 at a lakeshore housing development near Schuyler, Colfax County.

The first off-river plover egg hatched on 31 May 2011 at a lakeshore housing development near North Bend, Dodge County and the last hatched on 1 August 2011 at an active sand and gravel mine near Louisville, Sarpy County; a span of 62 days. The first off-river tern egg hatched on 14 June 2011 at an active sand and gravel mine near Fremont, Dodge County and the last hatched on 9 August 2011 at an active sand and gravel mine near Ashland, Saunders County; a span of 56 days.

The last sighting of both off-river plovers and off-river terns was on 9 August 2011 at an active sand and gravel mine near Ashland, Saunders County and a lakeshore housing development near North Bend, Dodge County.

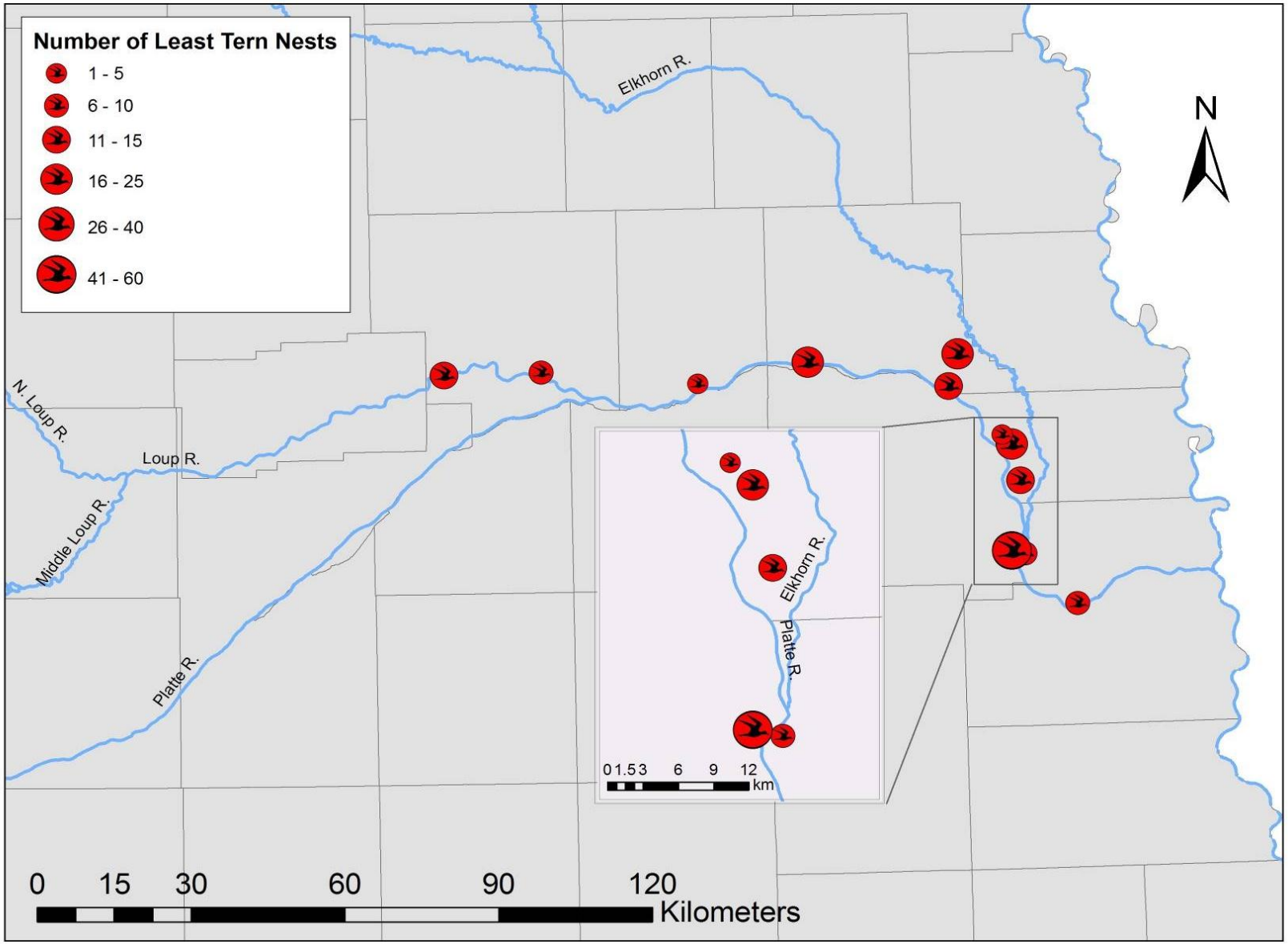

Figure 7. Location of off-river Interior Least Tern nesting sites in 2011.

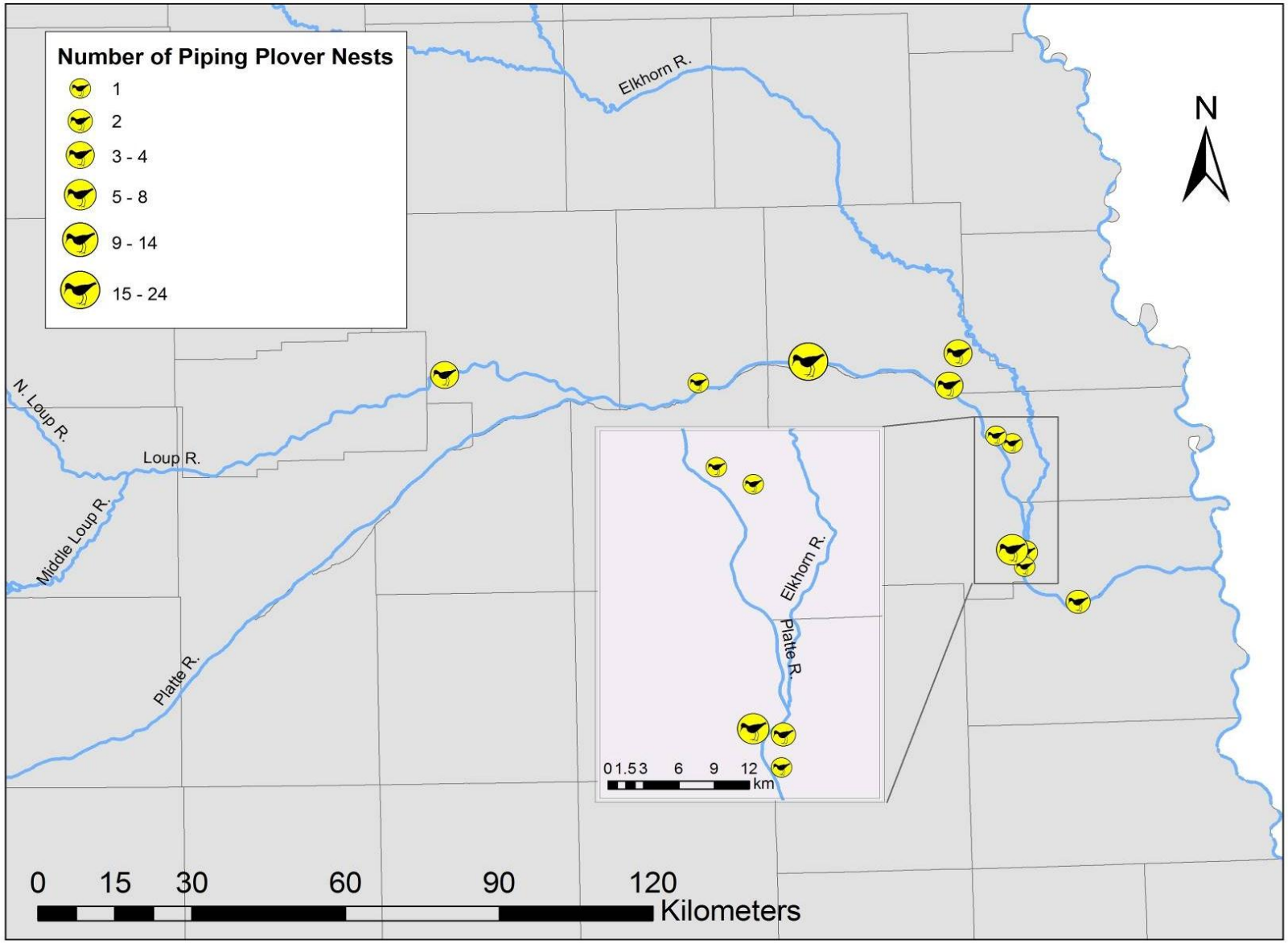

Figure 8. Location of off-river Piping Plover nesting sites in 2011.

Table 2. The fate of Lower Platte River Interior Least Tern and Piping Plover nest on off-river sand and gravel mines and housing developments.

NEST FATE ON OFF-RIVER SITES				
	Interior Least Terns		Piping Plovers	
Nest Fate	Sand and Gravel Mines	Housing Developments	Sand and Gravel Mines	Housing Developments
Confirmed Hatched	22	3	13	9
Likely Hatched	72	35	7	9
Depredated	7	3	1	1
Inundated	11	4	1	0
Undetermined	16	3	0	3
Abandoned	16	2	1	4
TOTAL	144	50	23	26

Table 3. Interior Least Tern fledgling rate on the Lower Platte River off-river sites in 2011

2011 OFF-RIVER SITES WITH INTERIOR LEAST TERNS PRESENT								
Off-River Sites	Habitat	Adults	Nests	Nests Failed	Eggs	Eggs Failed	Chicks	Fledgling Rate **
Oreopolis	Mine	0	0	0	0	0	0	0
Louisville Lakes	Mine	13	10	6	UKN	UKN	2	0.2
New Linoma Beach	Mine	2	0	0	0	0	0	0
Sand Creek	Mine	37	56	9	106	16	32	0.571
Melia	Mine	10	6	1	18	3	1	0.167
OMG	Mine	19	13	9	24	14	3	0.231
Waterloo	Mine	3	0	0	0	0	0	0
Mallard Landing	Housing	34	24	0	UKN	UKN	13	0.542
New Valley	Mine	3	1	0	UKN	UKN	0	0
Pleasure Lake	Mine	2	0	0	0	0	0	0
Western Fremont	Mine	17	12	4	22	6	5	0.417
NE Fremont	Mine	29	24	12	56	21	5	0.208
Riverview Shores	Housing	33	21	7	51	14	11	0.524
Lake Socorro	Housing	9	4	4	5	5	0	0
Shady Lake Road	Mine	14	9	3	21	7	3	0.333
LPPD/Genoa	Mine	17	13	5	27	10	7	0.538
Horseshoe Lake	Mine	5	0	0	0	0	0	0
Housing		76	49	11	56	19	24	0.355
Mines		171	144	49	274	77	58	0.190
TOTAL		247	193	60	330	96	82	0.219
** = number of chicks per nest								

Table 4. Piping Plover fledgling rate on the Lower Platte River off-river sites in 2011

2011 OFF-RIVER SITES WITH PIPING PLOVERS PRESENT								
Off-River Sites	**Habitat**	**Adults**	**Nests**	**Nests Failed**	**Eggs**	**Eggs Failed**	**Chicks**	**Fledgling Rate ****
Louisville Lakes	Mine	4	2	0	7	2	0	0
New Linoma Beach	Mine	2	0	0	0	0	0	0
Sand Creek	Mine	9	7	1	25	5	6	0.857
Old Linoma Beach	Mine	2	1	0	4	0	4	4.00
Melia	Mine	4	2	0	8	0	5	2.500
OMG	Mine	1	0	0	0	0	0	0
Waterloo	Mine	1	0	0	0	0	0	0
Mallard Landing	Housing	2	1	0	4	0	3	3.00
Pleasure Lake	Mine	4	1	0	4	1	3	3.00
Western Fremont	Mine	9	4	0	15	0	7	1.750
NE Fremont	Mine	9	3	2	11	8	9	3.00
Riverview Shores	Housing	44	24	5	88	17	21	0.875
Lake Socorro	Housing	2	1	1	4	4	0	0
Shady Lake Road	Mine	3	0	0	0	0	0	0
LPPD/Genoa	Mine	9	3	0	12	0	6	2.00
Housing		48	26	6	96	21	24	1.292
Mines		57	23	3	86	16	40	1.425
TOTAL		105	49	9	182	37	64	1.399
** = number of chicks per nest								

Methods – On-river habitat

Because access to on-river nesting sites differs from off-river sites, we took a different approach to monitoring terns and plovers nesting on midstream river sandbars. We began monitoring river conditions for the presence of sandbar habitat early in the nesting season. Once river flows and water depth decreased (exposing sandbars), we began regularly surveying the river by kayak for the presence of terns and plovers. Kayak surveys provide the advantage of moving slowly (< 10 kph) and quietly on the river, which limits the amount of disturbance to nesting terns and plovers. The presence of birds foraging in the river indicated that birds might be nesting on a nearby sandbar. When a colony was located, the sandbar was thoroughly surveyed for nests. Once nests were found, we used the same nest monitoring method as for off-river nests. Nest locations were recorded with a handheld GPS unit (Garmin Oregon 550t), the number of eggs was recorded, and the eggs were 'floated' to determine the nest initiation date (H. Hays and M. LeCroy. 1971. Wilson Bulletin 83:425 – 429). Nesting colonies were visited every 2 – 7 days when water levels allowed. These visits were to check for the presence of incubating adults and to count the number of eggs present; we did not repeat the "floating" procedure. We scored the status of each tern and plover nest based on the following criteria:

Confirmed successful: 'pipped' eggs or newly-hatched chick(s) observed in or in the immediate vicinity (< 1 meter) of the nest cup

Likely successful: empty but intact nest cup located on or after the expected hatch date; may contain small pieces of eggshell in nest cup

Confirmed failure: nest cup and/or eggs found destroyed or abandoned

Likely lost: nest not relocated on repeat visits prior to expected hatch date

Results – On-river

High water conditions during mid-June and early July caused an interruption in nesting on the Lower Platte River. These high water conditions impacted plover use and productivity on the river more than it impacted tern use and productivity on the river. High water limited our ability to survey the river during these times, but because of the high water levels no nesting habitat was available. River surveys performed prior to the June inundation, covered river miles (RMs) 0 – 102. These surveys located 56 Least Tern nests and seven Piping Plover nests on eight different sandbars (Figs. 9 and 10 and Table 4). None of these nests survived the high water levels.

After the high water levels receded in mid-July, only the previously productive stretches of the river were surveyed on 13 and 14 July 2011. During these surveys, we located five Interior Least Tern colonies including one on the North Camp Ashland sandbar, one on the South Camp Ashland sandbar, one on the Cullom sandbar and two on the Cedar Creek sandbar complex. During these surveys seven tern nest were found on the Cedar Creek sandbar complex, two on the Cullom sandbars, eleven on the North Camp Ashland sandbar, and eighteen on the South Camp Ashland sandbar. We also located four Piping Plover nests; one on the Cedar Creek Sandbar, one on the North Camp Ashland sandbar and two on the South Camp Ashland sandbar. The large colonies on the North and South Camp Ashland sandbars were then surveyed every three to five days until 8 August. During these surveys following the high water, a total of 42 tern nests and three plover nests were found on these two sandbars. These two sandbars were very productive with 23 tern nests confirmed successful, fifteen nests likely successful, twelve nests with fate undetermined, one nest confirmed failure, and 69 tern chicks banded. Of the three plover nests one was confirmed hatched and two likely hatched. See Figs. 11 and 12 and Table 5 for location and description information for these sites and Table 6 for the nest fate information of the Lower Platte River on-river nests.

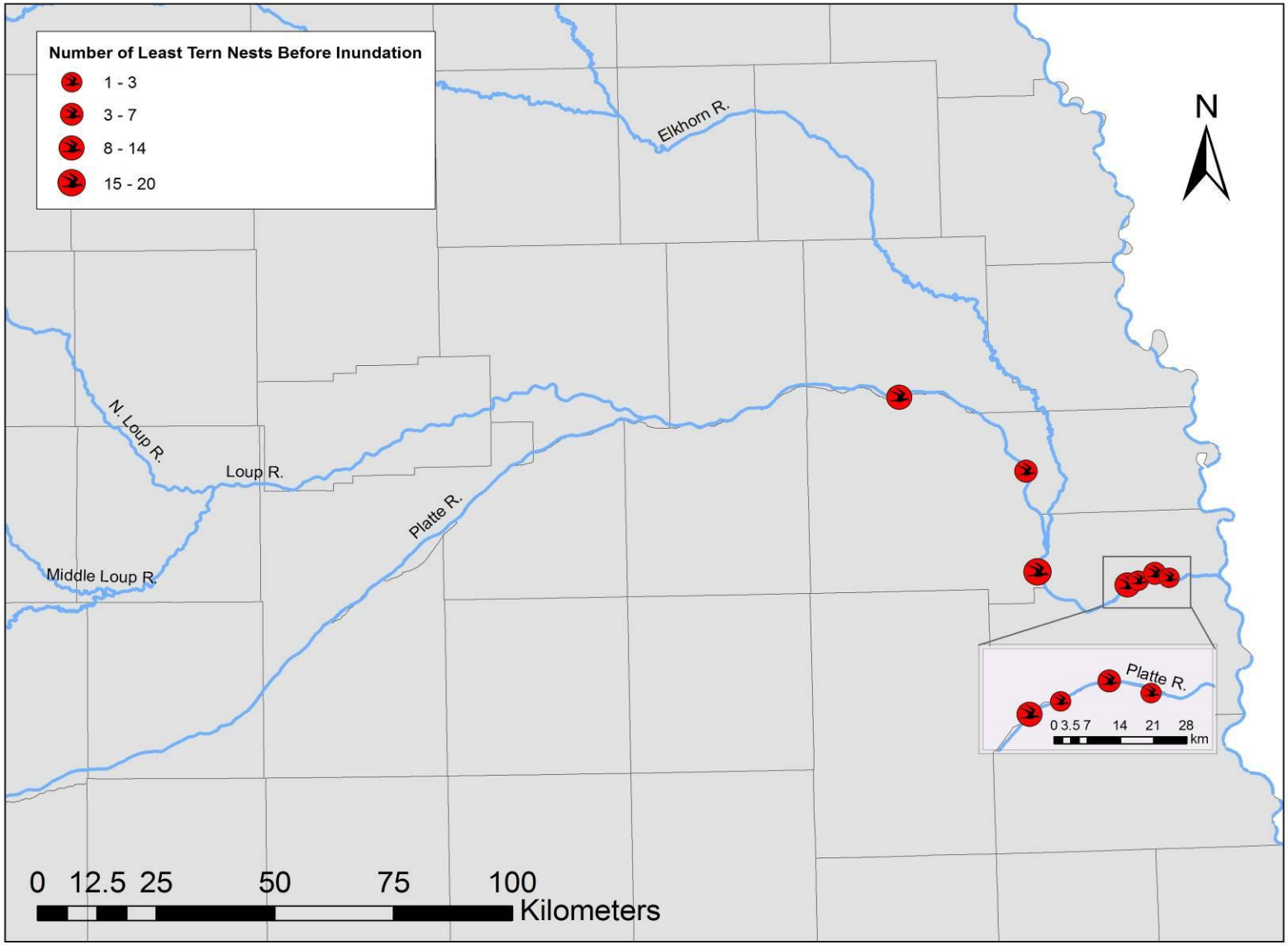

Figure 9. Location of on-river Interior Least Tern nesting sites in 2011 prior to the June inundation.

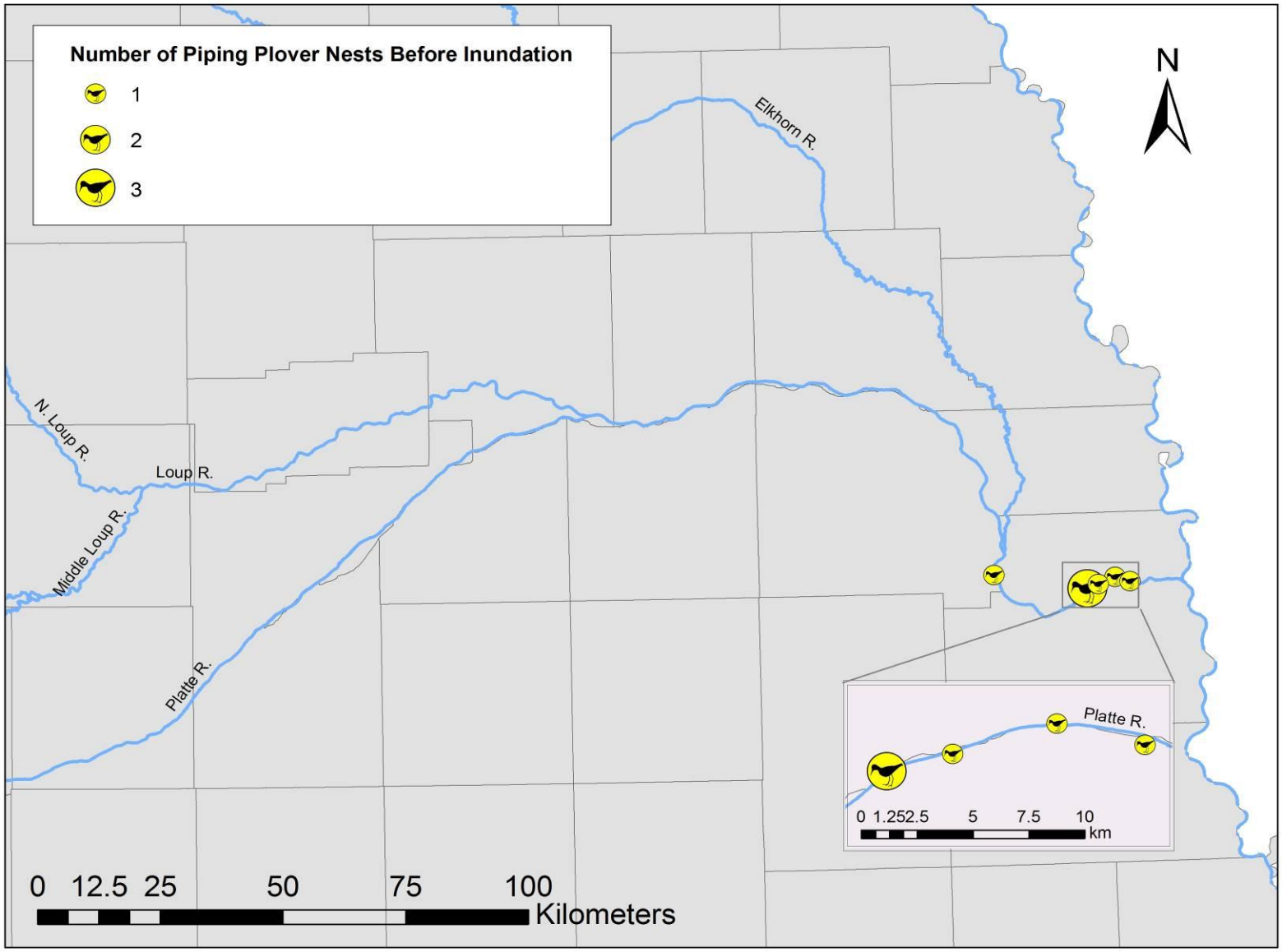

Figure 10. Location of on-river Piping Plover nesting sites in 2011 prior to the June inundation.

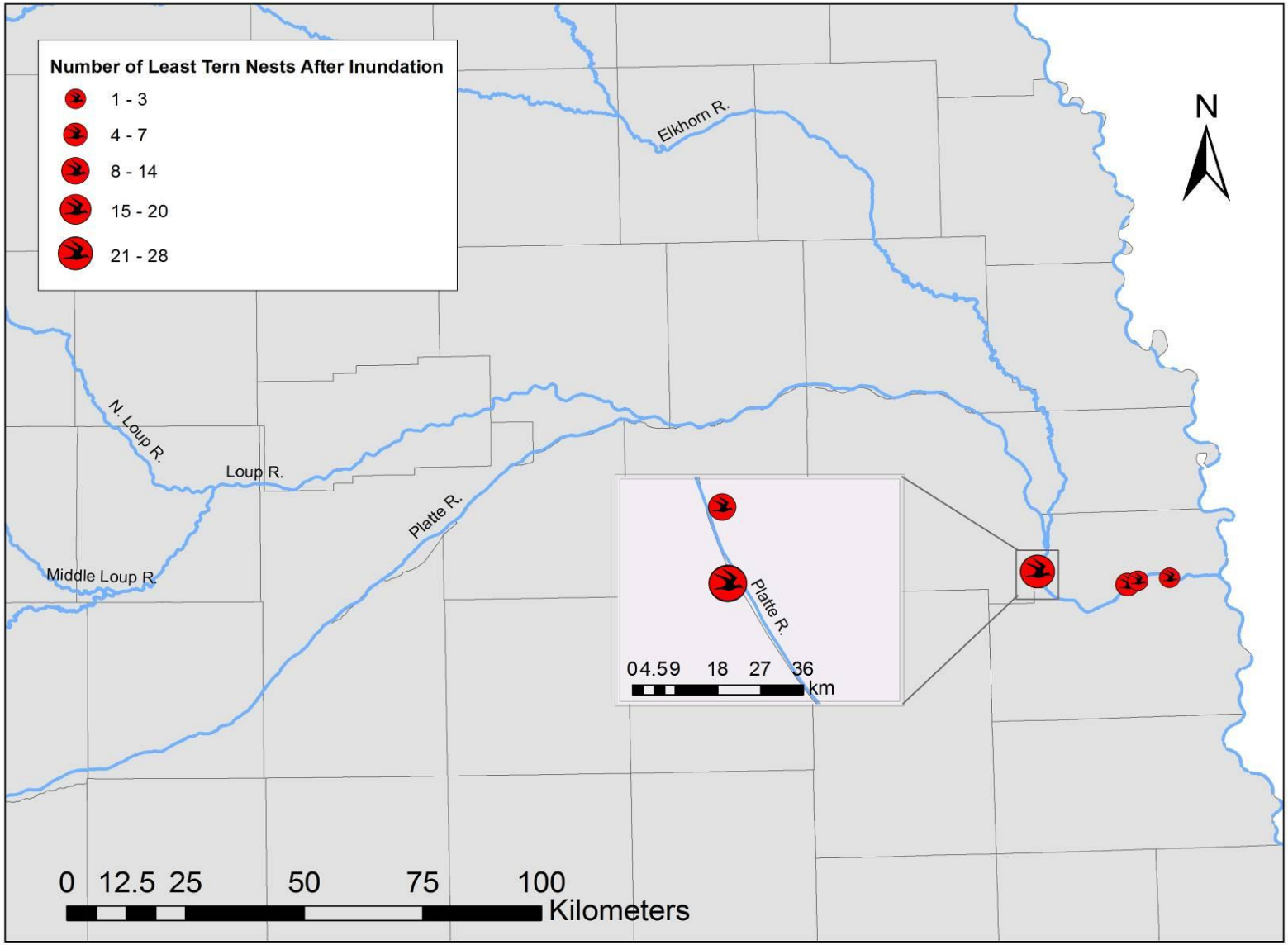

Figure 11. Location of on-river Interior Least Tern nesting sites in 2011 after the June inundation.

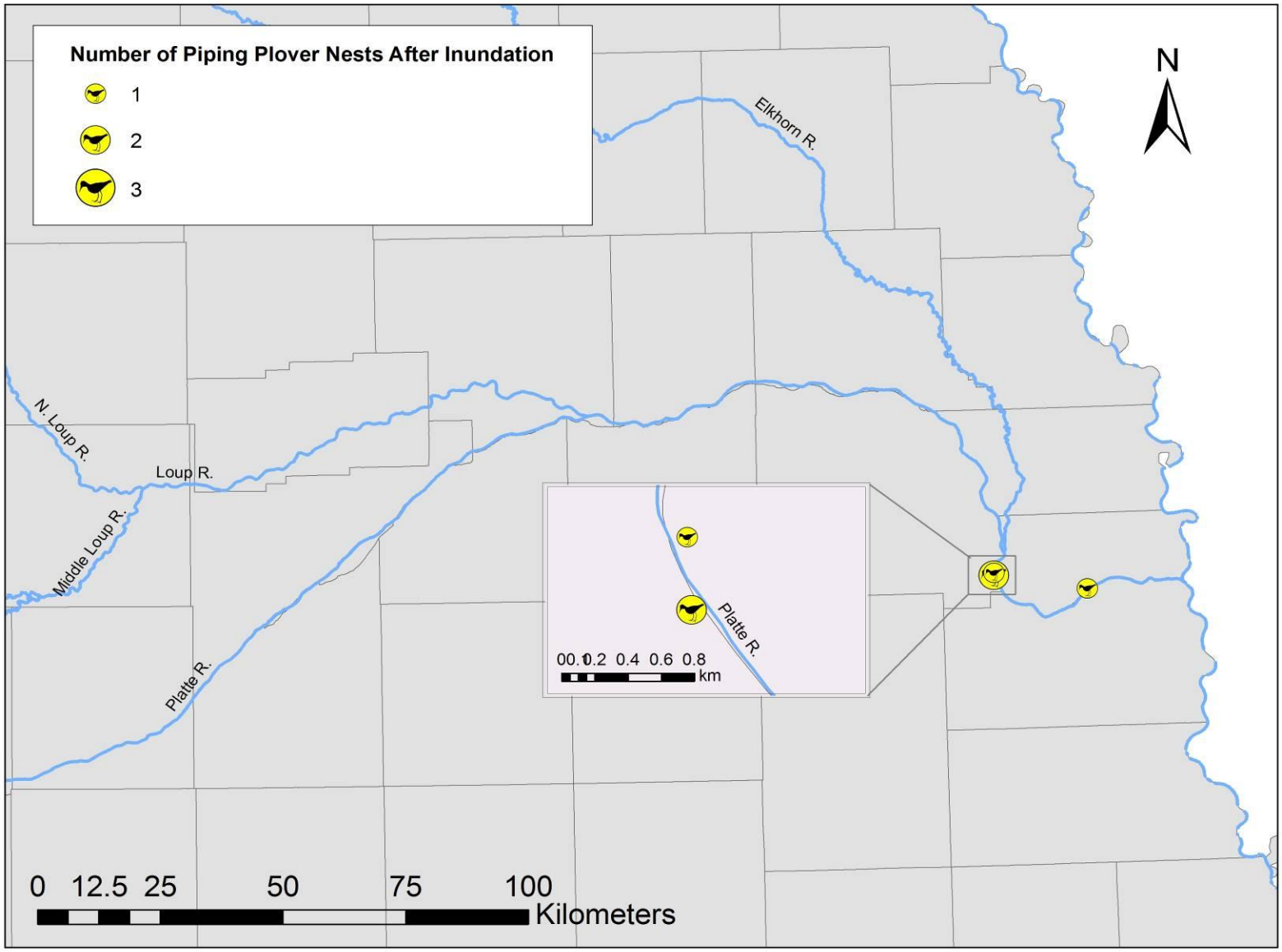

Figure 12. Location of on-river Piping Plover nesting sites in 2011 after the June inundation.

Table 5. The location of Interior Least Tern and Piping Plover nesting colonies and the number of nests in each colony found on sandbars in the Lower Platte River in 2011.

Colony Name	River Mile	Number of Tern Nests Before Inundation	Number of Tern Nests After Inundation	Number of Plover Nests Before Inundation	Number of Plover Nests After Inundation
East Cedar Creek	12	3	1	1	0
West Cedar Creek	13	8	6	3	1
Gun Club	9	7	0	1	0
Cullom	7	2	2	1	0
North Camp Ashland	29	21	14	0	1
South Camp Ashland	28	0	28	1	2
River Mile 45	45	5	0	0	0
River Mile 67	67	10	0	0	0

Table 6. The fate of Lower Platte River Interior Least Tern and Piping Plover nest on river sandbars

Nest Fate	Interior Least Terns Before Inundation	Interior Least Terns After Inundation	Piping Plovers Before Inundation	Piping Plovers After Inundation
Confirmed Hatched	0	23	0	1
Likely Hatched	0	15	0	2
Depredated	0	0	0	0
Inundated	56	0	7	0
Undetermined	0	12	0	1
Abandoned	0	1	0	0
TOTAL	56	53	7	4

Research

Estimating Survival Rates

Accurately estimating demographic parameters, such as daily and seasonal survival probabilities for individual birds and nests, will lead to a better understanding of local and regional population dynamics of Interior Least Terns and Piping Plovers. This will allow us to develop effective management strategies for these two species. In 2011, we continued to improve our estimates of nest, adult, and chick survival by using capture-mark-recapture and statistical modeling techniques (Program MARK). We also constructed growth curves for tern and plover chicks.

Methods

We conducted all bird capture and banding under the authorization of the USGS Bird Banding Laboratory (Patuxent Wildlife Research Center, http://www.pwrc.usgs.gov/bbl) and the U.S. Fish and Wildlife Service through an inter-agency agreement with the Nebraska Game and Parks Commission (MBB holds Federal Master Bird Bander Permit # 23545, with Threatened and Endangered Species endorsements and Nebraska Educational and Scientific Permit # 905; the TPCP holds Federal Threatened and Endangered Species handling permit #TE 070027-1; JGJ holds Federal Master Bird Bander Permit #20259, with Threatened and Endangered Species endorsements). Color-band combinations were coordinated prior to the field season with the Bird Banding Laboratory and others with an interest in tern and plover research.

We captured, banded, and color marked adult Piping Plovers during incubation at off-river sites (Figs. 13 – 14). Out of concern for the birds' safety, we used a simple box trap placed over the nest for capture (Fig. 13). Box traps have no moving parts, so the nesting birds and their eggs are not injured during capture; the bird walks through the door, settles on its nest, and is captured.

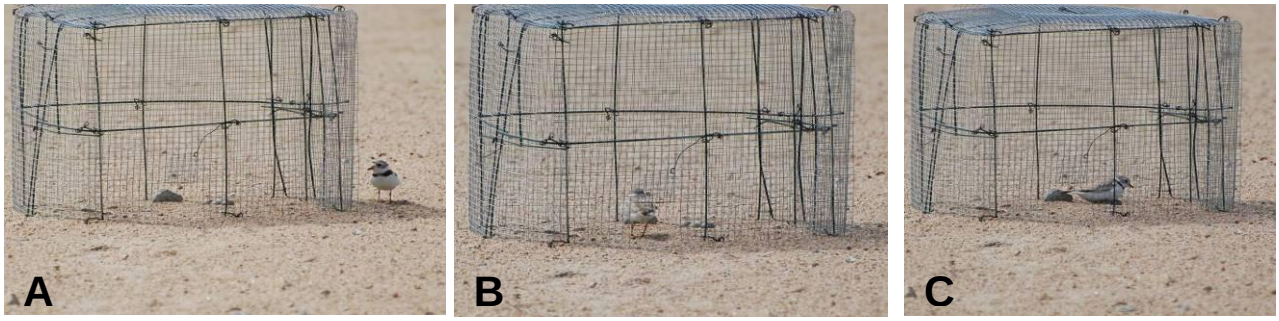

Figure 13. Wire box trap placed over a Piping Plover nest showing the bird approaching the trap (A), entering through the open "door" (B), and settling on the nest (C). Time elapsed is less than one minute.

Our capture, handling, and banding protocols were the same as those used in 2008, 2009, and 2010. We exercised caution when handling and banding birds. We did not capture or band birds during extreme weather (cold, windy, rainy, or when inclement weather was forecast) or when the temperature was above 85° F (30° C). Birds were observed after banding and on subsequent visits to determine if there were any behavioral changes or signs of injury. As part of our protocol, we were to suspend all banding activities if problems or injuries were observed

at any time. We did not observe any problems or injuries to birds as a result of monitoring, capture, handling, or banding in 2008, 2009, 2010, or 2011.

Each plover adult and chick received an individually-numbered metal USGS band (size 1A) on one upper leg (Fig. 14). On the opposite upper leg, each bird received a light blue flag; the light blue color indicates that the bird was banded along the Platte River. Along the Lower Platte River, we use light blue flags that are 'half length' and not crimped when placed on the bird's leg. On one lower leg, each bird received a unique combination of two different color bands (black, gray, green, red, yellow and occasionally orange) indicating its individual identity. On the opposite lower leg, each bird received two color bands in one of two combinations (yellow over gray or red over yellow); these color combinations indicate that the bird was banded at a Lower Platte River off-river site in 2011. In 2008 plovers banded on the Lower Platte River off-river sites received a single color band (green or red) on the lower leg, in 2009 they received two color bands (red over green, red over yellow or red over red) on the lower leg, and in 2010 they receive two color bands (green over green, yellow over red, and a few with red over red). No plovers were banded on the on-river sites. See Appendix B for a complete listing of all color band combinations used in 2008, 2009, 2010, and 2011.

We did not band any adult Interior Least Terns; however, we did capture one adult tern that had a radio transmitter attached to a numbered, metal USGS band on its upper left leg. The radio was placed on the bird in 2007 at river mile 755 on the Missouri River (near Ponca; Gavin's Point Reach). The bird was identified as a female based on a blood test (J. Stucker, pers. comm.). We did not place color bands on any tern chicks in 2011, only individually-numbered metal USGS bands (size 1A).

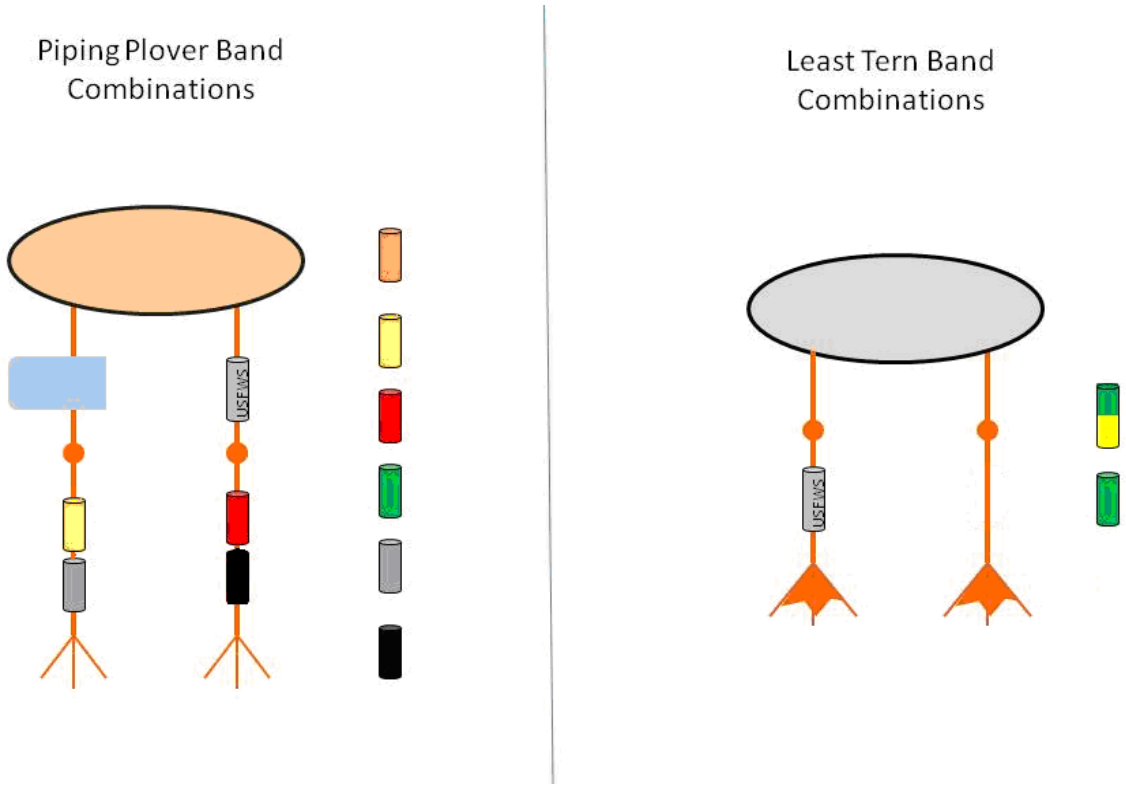

Figure 14. Diagram illustrating the color banding scheme used with Piping Plovers and Interior Least Terns in the Lower Platte River focus area. The flags, color bands, and metal bands may be on either leg and plover color combinations vary.

After banding adult plovers, we measured the mass of each individual by placing the bird in a cloth bag and suspending it from a Pesola™ scale (± 0.3 % accuracy). We took the following morphological measurements for every adult plover we captured: length of the left and right flattened wing chord (wrist to the distal end of the outermost primary feather), length of the left, right, and middle tail feathers, length of the left and right tarsus (unfeathered leg above the hallux), length of the culmen (exposed midline ridge of the beak), width of the beak at the nostrils, and length of the total skull (distal end of the beak to the posterior end of the skull. All measurements were taken by one individual (MBB) to minimize measurement error. Each measurement was taken twice so a "repeatability index" could be calculated. We calculated a composite metric of all measurements (the geometric mean) to provide an index of each bird's overall size. The left and right sides of each bird were measured so a measure of bilateral symmetry could be calculated. Symmetry is a commonly used measure of an individual bird's "quality." The symmetry of skeletal parts and feathers reflects an individual's nutrition and health during development; this gives us a metric to assess the "quality" of birds produced at different nesting habitats (on-river versus off-river) and in different years. Symmetry also gives us a way to assess the quality of over-wintering habitat for birds; better foraging habitat provides better over-wintering survival, nutrition and health for nesting birds.

We captured Piping Plover chicks at off-river sites by picking them up from the sand or from their nests. Plover chicks' legs are long enough that we were able to color band them using the same protocol as we did with adult plovers. See Appendix B for a complete listing of all color band combinations used in 2008, 2009, 2010, and 2011. We measured each chick's body mass by placing chicks on a digital scale (Ohaus® SP401) that was accurate to ± 0.1 gram. Scales were calibrated using a standardized weight to ensure accuracy. We did not take any morphological measurements of plover chicks.

We captured Interior Least Tern chicks at off-river sites by picking them up from the sand or from their nests. Tern chicks' legs are very short, so on both on-river and off-river sites we only put an individually-numbered USGS band (size 1A) on each bird's lower right leg (Figure 13). In previous years tern chicks also received a single (green or yellow/green split band) colored band on their opposite lower leg. On both on-river and off-river sites we measured each tern chick's body mass by placing chicks on a digital scale (Ohaus® SP401) that was accurate to ± 0.1 gram. We did not take any morphological measurements of tern chicks.

Survival analyses: After banding individual Piping Plover adults and chicks and Interior Least Tern chicks, we attempted to re-sight them as frequently as possible. Upon re-sighting we noted where they were seen, which birds they were seen with, and what they were doing. We used this capture-mark-recapture dataset to calculate daily and seasonal survival probabilities for each individual. After individual tern and plover nests were located, we monitored them throughout the nesting season (see Monitoring section for details). We used information from this monitoring dataset to calculate daily and seasonal nest survival probabilities.

We estimated survival probabilities using the software program MARK (G.C. White and K.P. Burnham 1999. Bird Study 46: S120 – S139). We used the general methods of J.-D. Lebreton et al (Ecological Monographs 1992. 62: 67 – 118), K. P. Burnham and D. R. Anderson (2002. Model Selection and Multimodel Inference: a Practical Information-Theoretic Approach 2nd edition, New York: Springer), and S.J. Dinsmore and J.J. Dinsmore (Studies in Avian Biology 2007. 34: 73 – 83). Model fit for each analysis was assessed by the AIC (Akaike's Information Criterion); the model with the lowest AIC was considered the model that best fit the data.

Individual Survival Analysis

Individual encounter histories were constructed for all Piping Plover adults and chicks that were captured, recaptured or observed at off-river sites throughout the nesting season. All adult plovers included in this analysis were color-banded along the Lower Platte River (light blue leg flags) or along the Missouri River (green leg flags). All plover and tern chicks included in this analysis were produced and banded along the Lower Platte River.

We did not include any covariates in the models. We tried to fit models with varying degrees of time-dependence to the data, but the model that included constant survival and constant recapture probabilities {phi(c), p(c)} was always the best-fitting model based on AIC; this is most likely due to our small sample sizes.

Nest Survival Analysis

We used data from nest monitoring (see Monitoring and Management sections) to analyze nest survival. Nest survival probabilities were calculated using the nest-survival utility in Program MARK. We constructed encounter histories by summarizing the day each nest was found (*k*), the last day the nest was found active (*l*), the last day the nest was checked for activity (*m*), and the fate of the nest (*f*). Due to small sample sizes we did not include any covariates in our model and assumed constant survival across the season.

Growth Curve Analysis:

Our growth curve analysis included Piping Plover chicks that were produced at off-river sites and Interior Least Tern chicks that were produced at both on-river and off-river sites. All tern and plover chicks were banded and weighed when they were first encountered. They were re-weighed every time they were subsequently encountered. In cases where the chick was banded while still in or very close to the nest, we could 'age' them based on the nest's known hatching date. If chicks were banded after they left the nest, we estimated their age from an age-based time series of photographs.

Statistical Analysis:

All statistical analyses were performed using either SAS (SAS Institute. 2004. SAS/STAT User's Guide, Version 9.1. SAS Institute, Cary, NC) or Prism (GraphPad Prism, Version 3.00 for Windows, Graph Pad Software, San Diego, CA). Due to small sample sizes, we used nonparametric statistical tests; statistical significance was set at $P < 0.05$. Means (± 1 SE) are reported.

Results

Banding and Re-sightings

At the off-river sites we captured and banded fifteen Piping Plover adults and 31 Piping Plover chicks. We re-sighted 28 adult plovers that we had banded along the Lower Platte River in 2008, 2009, or 2010, 19 adult plovers that were banded along the Missouri River (green flags), and three adult plovers that were banded along the US Gulf Coast after the Deep Horizon oil spill (green flags and cobalt blue bands).

At the on-river sites we re-sighted one adult plover and one juvenile plover that were banded along the Lower Platte River (light blue flag), one adult plover that was banded along the Central Platte River at a sand and gravel mine near Elm Creek, Buffalo County in 2010 (crimped light blue flag), five adult plovers that were banded along the Missouri River in 2007, 2009, and 2011 (green flag), one adult plover that was banded along the US Gulf Coast after the Deep Horizon oil spill (green flag and cobalt blue bands), and one adult plover that was banded along the Missouri River at Lake Sakakawea in North Dakota, Mercer County in 2008 (yellow flag).

At the off-river nesting sites we captured and banded 51 Interior Least Tern chicks. Most tern chicks were less than one week old when banded. One adult Interior Least Tern with a radio transmitter was recaptured at a sand and gravel mine near Venice, Douglas County on 24 June 2011. This tern was originally banded on the Missouri River near Ponca State Park in 2007. One adult tern with a metal band on its lower right leg was sighted at Riverview Shores, a housing development near North Bend, Dodge County on 1 July 2011. We did not recapture this bird so we do not know when or where it was originally banded.

At the on-river sites we captured and banded 69 Interior Least Tern chicks; 35 of these chicks were banded when they were less than one week old. All 69 tern chicks hatched from nests that were located on two different sandbars near Ashland, Saunders County. Twenty-eight of these tern chicks were re-sighted again at least once during the field season.

Daily and Seasonal Survival

Piping Plover Nest Survival: We based our calculation of Piping Plover nest survival on a population of 49 nests located at off-river sites (26 at lakeshore housing developments and 23 at sand and gravel mines). Off-river nests in 2011 had an apparent daily survival probability of 0.9909 ± 0.0030. When those daily survival probabilities are extended over the 28-day incubation period, off-river plover nests in 2011 had an apparent seasonal survival probability of 0.7737 ± 0.0696 (Fig. 15).

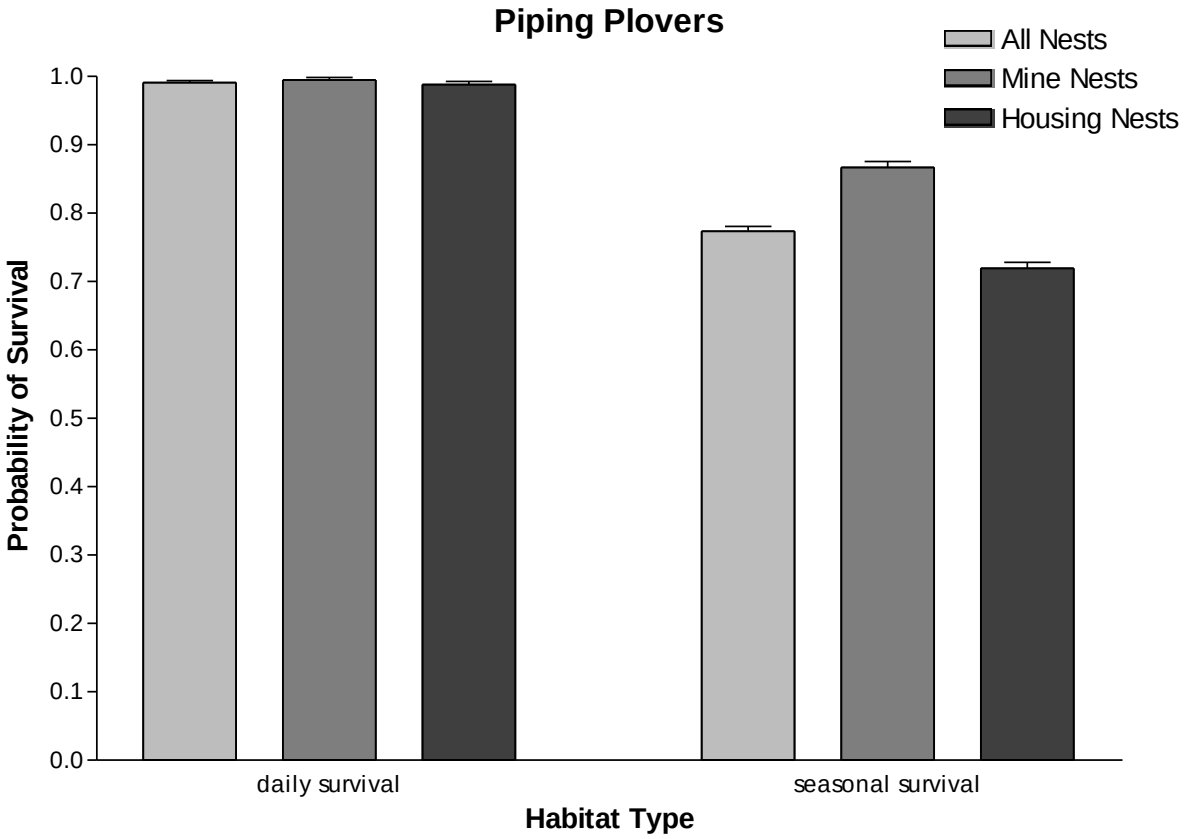

Figure 15. Off-river Piping Plover apparent daily nest survival probability and seasonal survival probability (28 days). All off-river nests (housing developments and sand and gravel mines combined) had a daily survival probability of 0.9909 ± 0.0030 and a seasonal survival probability of 0.7737 ± 0.0696. The nests at housing developments had a daily survival probability of 0.9883 ± 0.0044 and a seasonal survival probability of 0.7194 ± 0.0088. The nests at sand and gravel mines had a daily survival probability of 0.9949 ± 0.0036 and a seasonal survival probability of 0.8669 ± 0.0086.

Piping Plover Individual Survival: Based on our population of color-marked adult Piping Plovers, the apparent daily survival probability for adult plovers nesting at sand and gravel mine sites was 0.9837 ± 0.00709 (see Fig. 16). When that daily survival probability is extended over the 28-day incubation period, adult plovers at sand and gravel mine sites had an apparent survival probability of 0.6308 ± 0.1320. Based on a similar calculation, the apparent probability of adult plovers at sand and gravel mine sites surviving the 28-day brood rearing period was also 0.6308 ± 0.1320. The apparent daily recapture probability for adult plovers at sand and gravel mines was 0.1069 ± 0.01881.

The apparent daily survival probability for birds nesting at lakeshore housing development sites in 2011 was 0.9833 ± 0.0053 (see Fig. 16). When that daily survival probability is extended over the 28-day incubation period, adult plovers had an apparent survival probability of 0.6235 ± 0.09759. Based on a similar calculation, the apparent probability of adult plovers at lakeshore housing developments surviving the 28-day brood rearing period was also 0.6235 ± 0.09759. The apparent daily recapture probability for adult plovers at lakeshore housing developments was 0.1125 ± 0.01447.

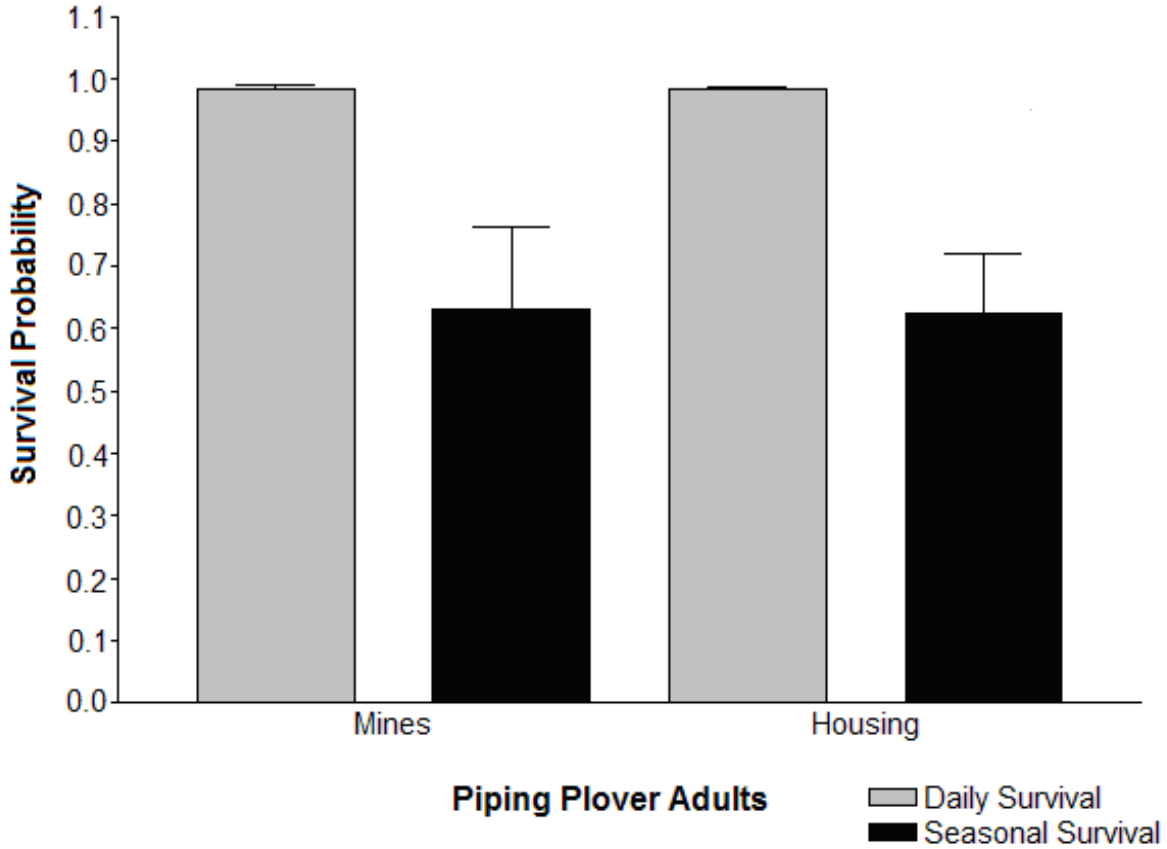

Figure 16. Piping Plover adult's apparent daily and seasonal survival probabilities on off-river sites.

Based on our population of color-marked Piping Plover chicks, the apparent daily survival probability for plover chicks reared at sand and gravel mine sites in 2011 was 0.9265 ± 0.04426 (see Fig. 17). When that daily survival probability is extended over the 28-day fledging period, plover chicks at sand and gravel mine sites in 2011 had an apparent seasonal survival probability of 0.1179 ± 0.14505. The apparent daily recapture probability for plover chicks at sand and gravel mines was 0.0887 ± 0.06091.

The apparent daily survival probability for birds reared at lakeshore housing development sites in 2011 was 0.9899 ± 0.1438 (see Figure 17). When that daily survival probability is extended over the 28-day fledging period, plover chicks had an apparent seasonal survival probability of 0.7543 ± 0.32219. The apparent daily recapture probability for plover chicks at lakeshore housing developments in 2011 was 0.0804 ± 0.03103.

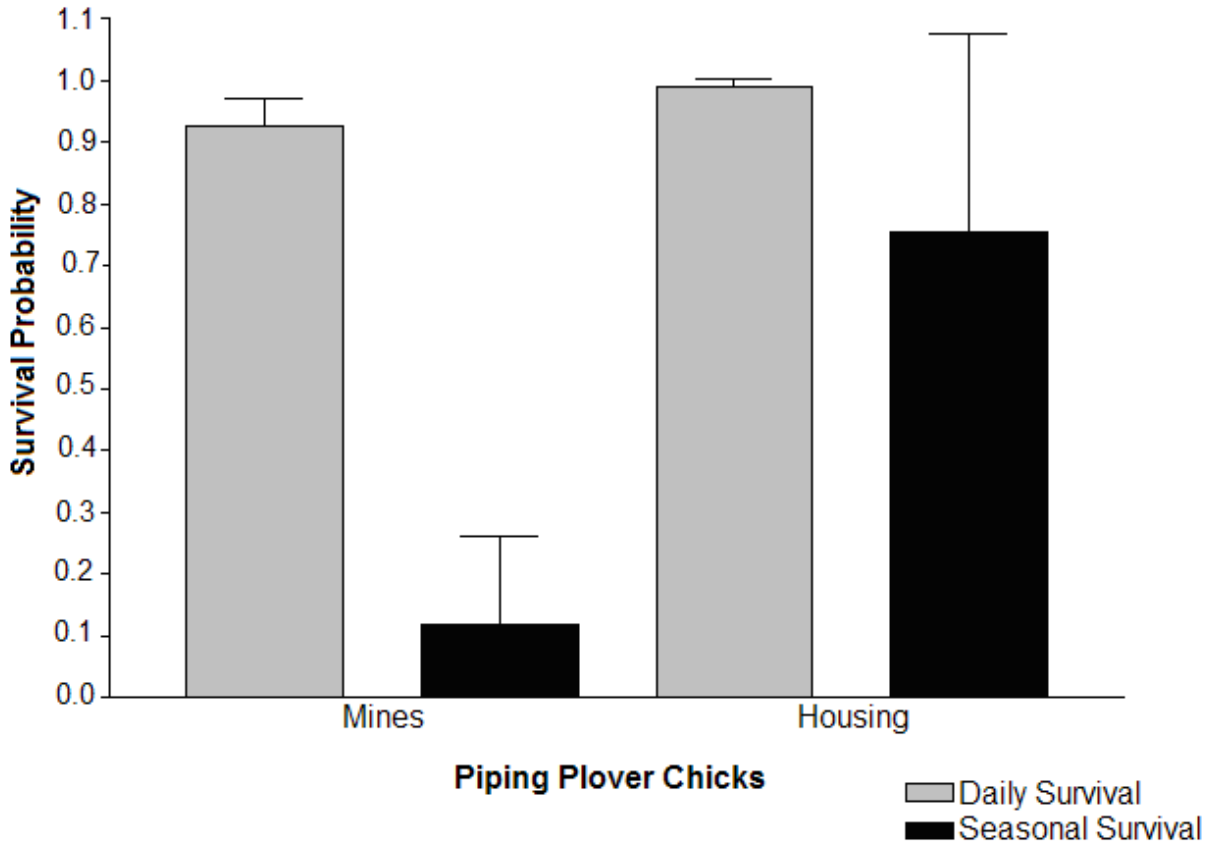

Figure 17. Piping Plover chick's apparent daily and seasonal survival probabilities on off-river sites.

These survival and recapture estimates are likely biased and the standard error values large due to small sample sizes and the inability of Program MARK to distinguish between mortality and permanent emigration; hence we refer to them as apparent. We expect to refine these estimates in the future as our population of banded individuals increases.

Piping Plover Chick Growth Curve: We based the calculation of our Piping Plover chick growth curve on our population of banded plover chicks produced at off-river sites. The regression line that best fit our 2011 data is similar to 2010 and shows that plover chicks grew at a fairly constant rate until fledging, in contrast to 2008 and 2009 when they grew rapidly for the first two weeks of life and then less rapidly until they fledged (Fig. 18).

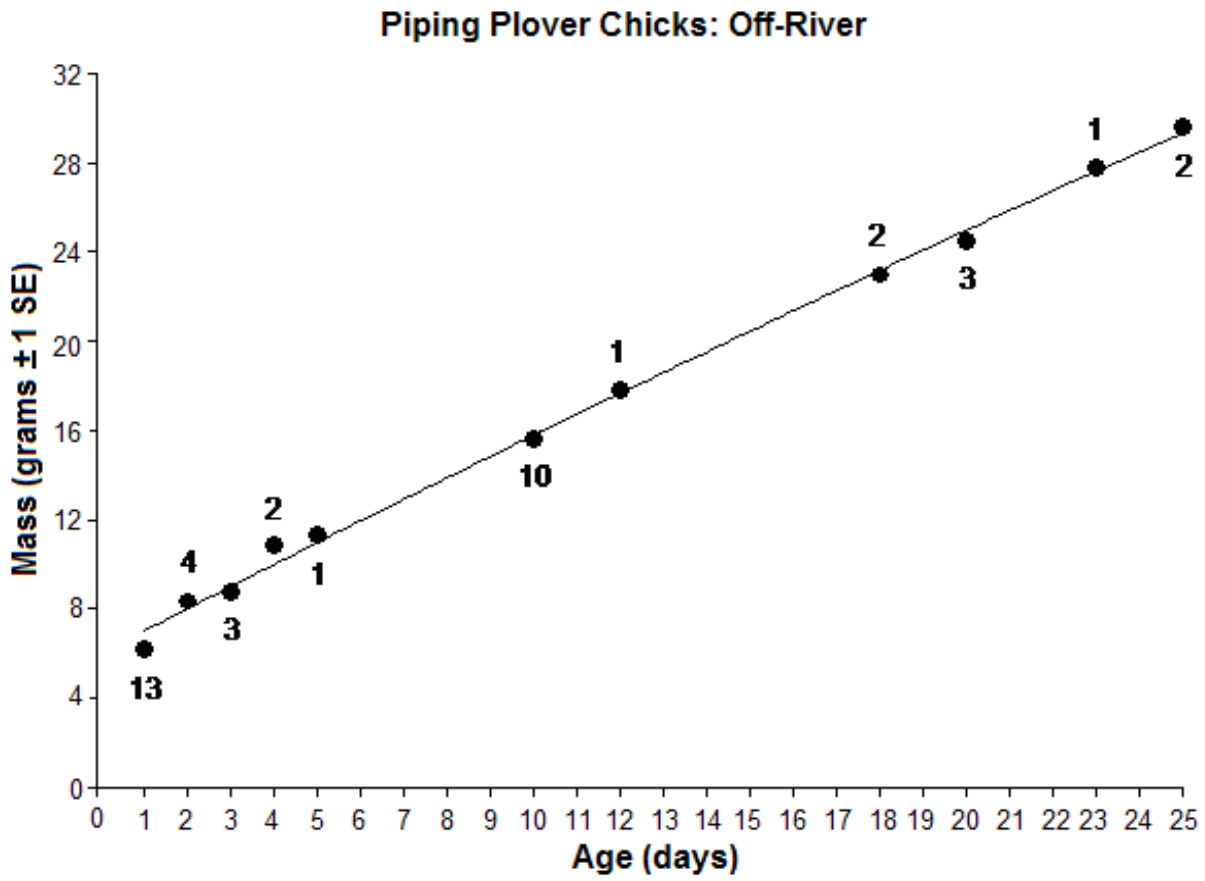

Figure 18. Growth rate of Piping Plover chicks from off-river sites. The graph shows the data represented as mean mass, standard error and sample size (number of individuals weighed at each age).

Interior Least Tern Nest Survival: For the off-river interior Least Tern nests we based our calculation of Interior Least Tern nest survival on a population of 194 nests (50 at lakeshore housing developments and 144 at sand and gravel mines). Off-river interior Least Tern nests in 2011 had an apparent daily survival probability of 0.9778 ± 0.0029. When the daily survival probability is extended over the 21-day incubation period, tern nests had an apparent seasonal survival probability of 0.6236 ± 0.0452. We estimate that tern nests at lakeshore housing developments in 2011 had an apparent daily survival probability of 0.9870 ± 0.0039 and an apparent seasonal survival probability of 0.7603 ± 0.0799. We estimate that tern nests at sand and gravel mines had an apparent daily survival probability 0.9736 ± 0.0038 and an apparent seasonal survival probability of 0.5701 ± 0.0525 (Fig. 19).

For the on-river interior Least Tern nests we based our calculation of interior Least Tern nest survival on a population of 42 nests (14 on the North Camp Ashland sandbar, and 28 on the South Camp Ashland sandbar). On-river interior Least Tern nests in 2011 had an apparent daily survival probability of 0.9877 ± 0.0061. When the daily survival probability is extended over the 21-day incubation period, tern nests had an apparent seasonal survival probability of 0.7711 ± 0.1280.

The combined interior Least Tern daily nest survival probability for both on-river (sandbars) and off-river (housing developments and sand and gravel mines) nests in 2011 was 0.9789 ± 0.0027 and the seasonal nest survival probability was 0.6386 ± 0.0429 (Fig. 19).

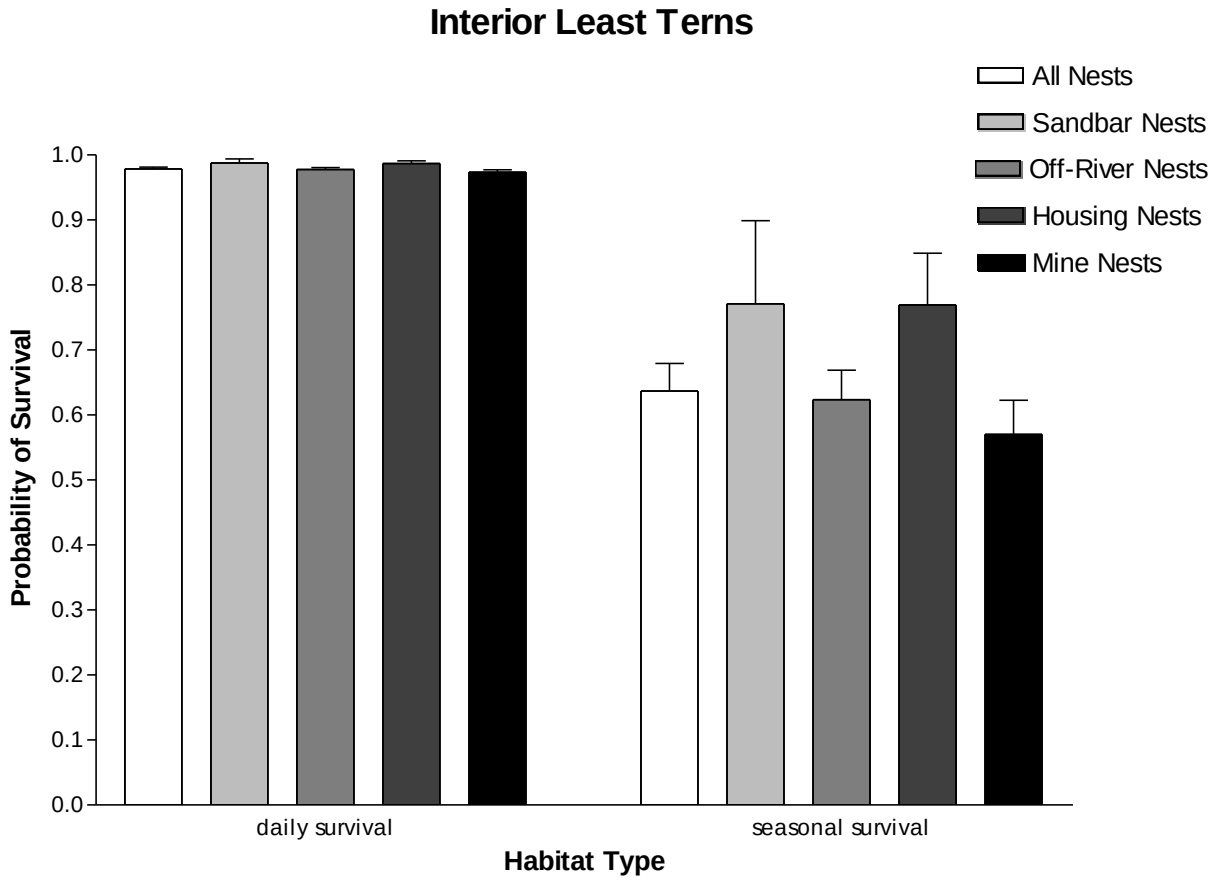

Figure 19. Interior Least Tern apparent daily nest survival probability and 21-day incubation period survival probability (seasonal survival). All on-river (sandbars) and off-river (housing developments and sand and gravel mines) nests combined had a daily survival probability of 0.9789 ± 0.0027 and a combined seasonal survival probability of 0.6386 ± 0.0429. On-river nests had a daily survival probability of 0.9843 ± 0.0064 and a seasonal survival probability of 0.7174 ± 0.1206. Off-river (housing developments and sand and gravel mines) nests had a daily survival probability of 0.9778 ± 0.0029 and a seasonal survival probability of 0.6236 ± 0.0452. The nests at housing developments had a daily survival probability of 0.9870 ± 0.0039 and a seasonal survival probability of 0.7603 ± 0.0799. The nests at sand and gravel mines had a daily survival probability of 0.9736 ± 0.0038 and a seasonal survival probability of 0.5701 ± 0.0525.

Interior Least Tern Chick Survival: Based on our population of banded Interior Least Tern chicks, the apparent daily survival probability for birds reared on off-river housing developments and sand and gravel mines in 2011 was 0.8621 ± 0.06166 (Fig. 20). When that daily survival probability is extended over the 21-day fledging period, tern chicks at off-river sites in 2011 had an apparent survival probability of 0.0442 ± 0.02499. The apparent daily recapture probability for tern chicks at off-river sites in 2011 was 0.0484 ± 0.03021.

The apparent daily survival probability for tern chicks reared on river sandbars in 2011 was 0.9973 ± 0.02542 (Fig. 20). The only on-river locations where tern chicks were banded and monitored were the North and South Camp Ashland Sandbars. When that daily survival probability is extended over the 21- day fledging period, tern chicks on river sandbars had an apparent survival probability of 0.9454 ± 0.07056. The apparent daily recapture probability for tern chicks on river sandbars was 0.0935 ± 0.02345.

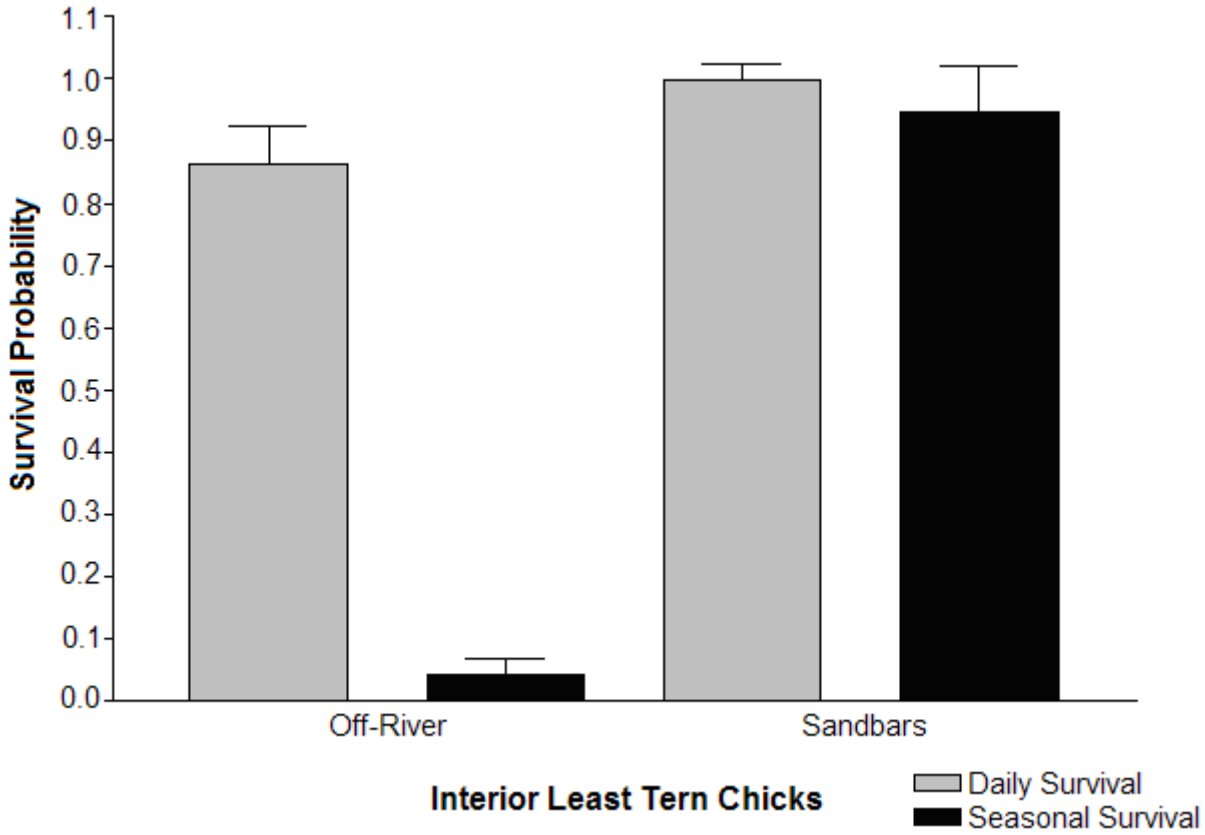

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Figure 20. Interior Least Tern chick apparent daily survival probability and probability of survival to fledging.

Interior Least Tern Chick Growth Curve: We based the calculation of our Interior Least Tern chick growth curves on our population of banded tern chicks produced at off-river and on-river sites. The regression line that best fits our 2011 data shows that tern chicks reared on off-river sites grew at a fairly constant rate until fledging (Fig. 21), in contrast to the tern chicks reared on river sandbars which grew rapidly for the 10 days of life and then less rapidly until they fledged (Fig. 22).

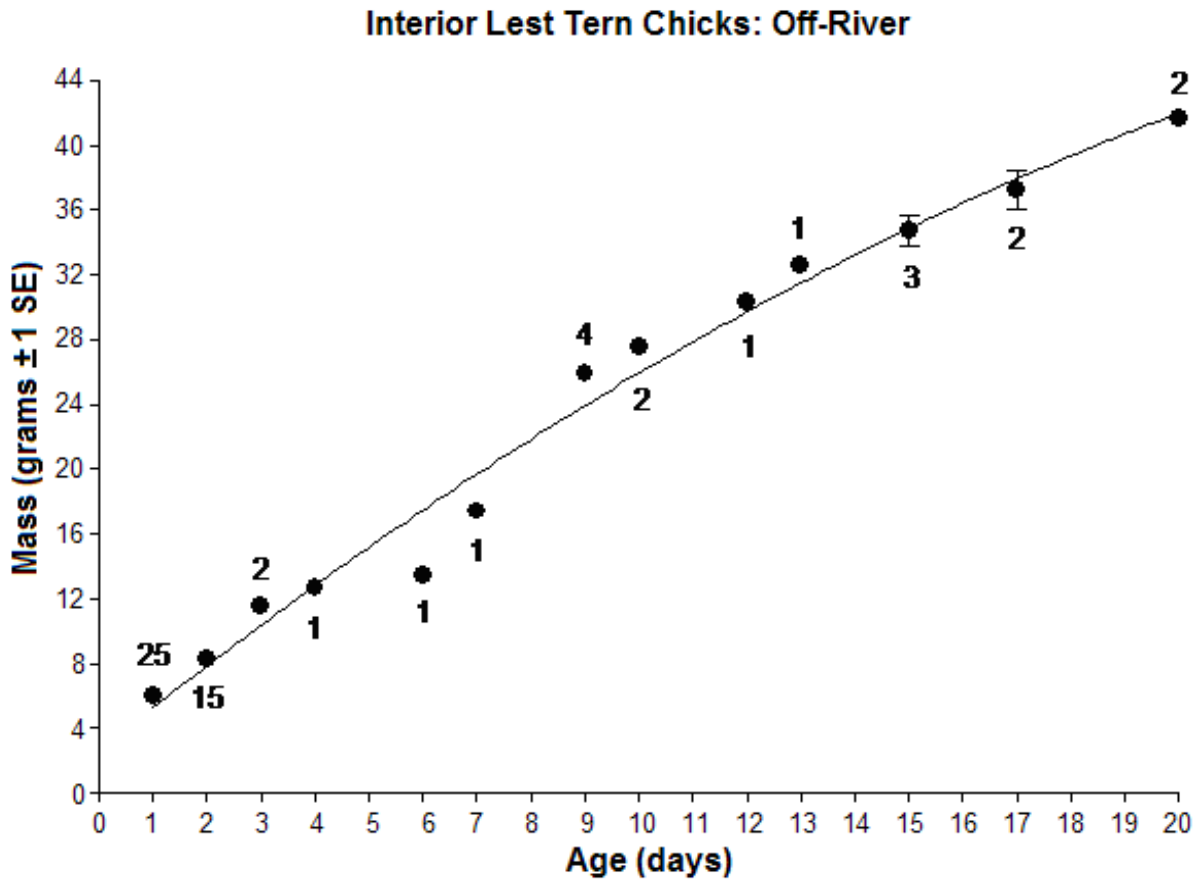


Figure 21. Growth curve of Interior Least Terns chicks reared on off-river sites. The graph shows the data represented as mean mass, standard error and sample size (number of individuals weighed at each age).

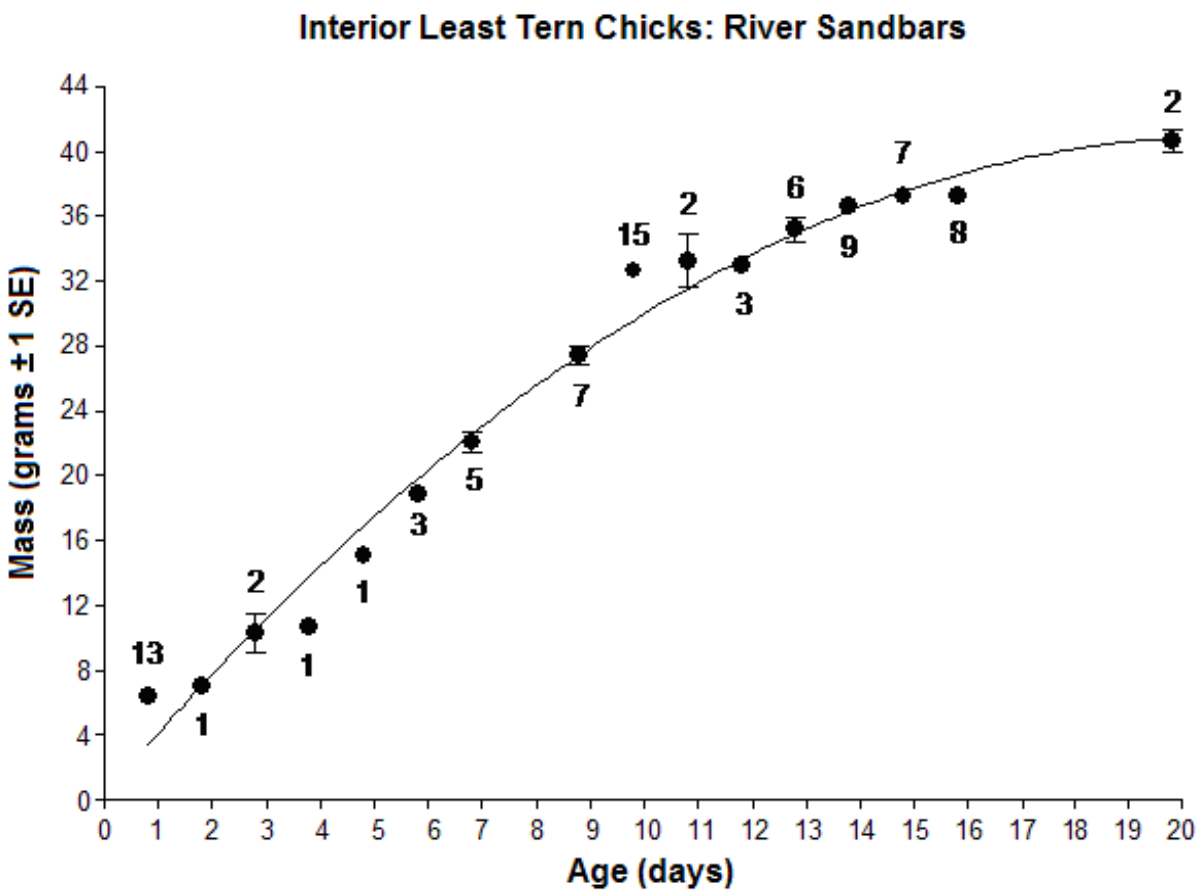


Figure 22. Growth curve of Interior Least Terns chicks reared on river sandbars. The graph shows the data represented as mean mass, standard error and sample size (number of individuals weighed at each age).

Off-river Interior Least Tern and Piping Plover nesting success

The traditional index of reproductive success for terns and plovers that is reported and used for comparison between sites is a 'fledge ratio'. Fledge ratio is calculated as the number of fledglings per adult pair over a defined spatial or temporal area. As a matter of practicality, this is usually calculated as the number of fledglings per nest. The number of fledglings used in the calculation is based on the number of birds directly observed. Fledge ratios have major limitations. Unless these birds are individually marked and detection rates corrected, errors are introduced into the calculation.

Using the 'fledglings per nest' method, we found that the Interior Least Tern fledge ratio for off-river sites was 0.2195 chicks per nest (0.3552 at housing developments and 0.1904 at sand and gravel mines) (Table 3). The Piping Plover fledge ratio for off-river sites was 1.3988 chicks per nest (1.2917 at housing developments and 1.4256 at sand and gravel mines) (Table 4).

Identification of Fish Captured by Interior Least Terns

We collected the dead fish we found on the sand near tern nests; we assume that these represented a sample of what adult terns were feeding their chicks. The fish were identified as brook silverside (*Labidesthes sicculus*), larval gizzard shad (1 inch or less in length, *Dorosoma cepedianum*), largemouth bass (2 inches or less in length, *Micropterus salmoides*), red shiner (2 inches or less in length, *Cyprinella lutrensis*), emerald shiner (2 inches or less in length, *Notropis atherinoides*), and sunfish (2 inches or less in length, Family Centrarchidae) were also found. Based on body size, larval gizzard shad are likely fed to very young chicks, with larger fish added as the chicks grow in size. Courting male terns often 'present' female terns with male red shiner (silver with red fins). Fish identifications were made by Dustin Martin, Mark Pegg and Kevin Pope (all UNL SNR).

Management

The Tern and Plover Conservation Partnership uses a voluntary, proactive approach to avoid human-bird conflicts and to eliminate the need for law enforcement actions in tern and plover management. There were no conflicts or need for law enforcement intervention in 2011, as was the case in 2008, 2009, and 2010.

Before terns and plovers returned to Nebraska and the field season began, TPCP met with the production and land managers of all area sand and gravel mines. We discussed the mining companies' production plans for the season, safety regulations, and site access. We paid particular attention to concerns mine personnel had regarding previous on-site activities of the TPCP and changes to MSHA (Mine Safety and Health Administration) policy as it applies to non-mine personnel. We also met with homeowners' associations at the lakeshore housing developments. At these meetings, we discussed the construction plans for the area and site access. We paid particular attention to property owners' concerns regarding previous on-site activities of the TPCP.

The result of each these meetings was a set of site-specific management and monitoring plans; an equally valuable result was becoming acquainted with the people living and working at these sites. This made our management efforts easier to implement as the season progressed. We maintained close contact with these individuals throughout the season, so we could respond to any on-site changes that developed.

Protecting Interior Least Tern and Piping Plover Nests

In order to protect tern and plover nests, we put up "Keep Out" signs around the perimeter of all off-river nesting areas; these signs were designed in 2008 by the TPCP and are being adopted for use across Nebraska. In areas where considerable human foot or vehicle traffic was expected, additional 'psychological' barriers were added. These barriers consisted of black cord tied between all of the "Keep Out" sign posts; we tied red-silver Mylar™ streamers to the cord to make it more visible.

Based on conversations with mine production managers and homeowners' associations before the nesting season began, we mapped out the areas where it would be best if the terns and plovers did not nest. These were areas within the mine property that were going to be dredged during the nesting season or where heavy equipment was going to be operating. At the housing

developments, these were areas where buildings were to be constructed or utilities were to be installed. We know that terns and plovers prefer not to nest in areas where the substrate is disturbed by raking, where there is any surface vegetation, where the substrate particle size is unattractive to the birds or where there is any physical disturbance (J. Marcus, J. Dinan, R. Johnson, E. Blakenship, and J. Lackey 2007. Waterbirds 30: 251 – 258). Planting vegetation, resurfacing the sand, and raking the substrate are labor intensive, so we opted for the physical disturbance method of discouraging birds from nesting in an area. In areas where we did not want the birds to nest, we put up grids of three-foot-tall poles with 16-foot-long streamers of red-silver Mylar™ flagging attached to them. The poles are set 16 feet apart. When the streamers blow in the wind, they make a crackling sound and sweep the ground, which discourages the birds from attempting to nest in the area.

We placed protective wire mesh nest exclosures around 39 off-river plover nests; the remaining 10 nests did not have exclosures. These wire exclosures help to protect plover nests from both human disturbance and natural predation. We did not put any wire exclosures around tern nests. However, we did place protective boundaries around tern nesting colonies that were in areas with considerable human activity. We did this by placing a ring of rebar poles around the boundary of the nesting area; black cord was tied between each of the poles. These roped off areas only help to protect tern nests from human disturbance; they do not reduce natural predation.

International Piping Plover Census: Every five years, a survey of all Piping Plover habitats (i.e. river sandbars, sand and gravel mines, lake shore housing developments, ocean beaches) is conducted to estimate the current total population size (number of individuals) of the species. The survey is coordinated by Elise Elliott-Smith and Susan Haig (Oregon State University USGS Cooperative Research Unit) and employs sophisticated statistical techniques to develop robust estimates. The survey results are used to evaluate progress toward species recovery (and eventual delisting) and direct/redirect resources so that recovery proceeds apace. The TPCP, in cooperation with the NGPC Nongame Bird Program surveyed the Lower Platte and parts of the Loup and Elkhorn rivers. Final results of the survey will not be available for several months, but estimates from Nebraska suggest that the population of Piping Plovers may have decreased by half for reasons that are not entirely clear but may include the Missouri River flooding of 2011 and the BP-Deepwater Horizon oil spill of 2010.

USFWS – NGPC MOUs: The two regulatory agencies, US Fish and Wildlife Service and Nebraska Game and Parks Commission, which are responsible for enforcing the federal Endangered Species Act and the Nebraska Non-game and Endangered Species Conservation Act, initiated the development of Memoranda of Understanding (MOUs) with of the four largest sand and gravel mining corporations in the state. These MOUs define the corporations and the agencies roles and responsibilities for the terns and plovers nesting on sand and gravel mine property. The MOUs provide the birds with additional protections and the TPCP with additional operating funds (under the MOUs, the corporations are committed to monitoring and protecting the birds—a service that will be provided by the TPCP).

Lower Platte River Weed Management Area sandbar restoration project: In cooperation with the Lower Platte South, Lower Platte North and Papio-Missouri Natural Resource Districts and the Lower Platte River Weed Management Area, we initiated a cooperative project to clear vegetation from sandbars in the Lower Platte River (river mile 0 – 103). In late summer 2011, weedy vegetation on sandbars was sprayed with herbicide using GIS controlled helicopter sprayers (SkyCopters from Ulysses, KS). We expect winter ice jams and high spring flows to

overtop the sandbars and remove any standing, dead vegetation making the sandbars attractive to nesting terns and plovers.

Preferred Rocks of Genoa-Loup Public Power District Bird Management Area:

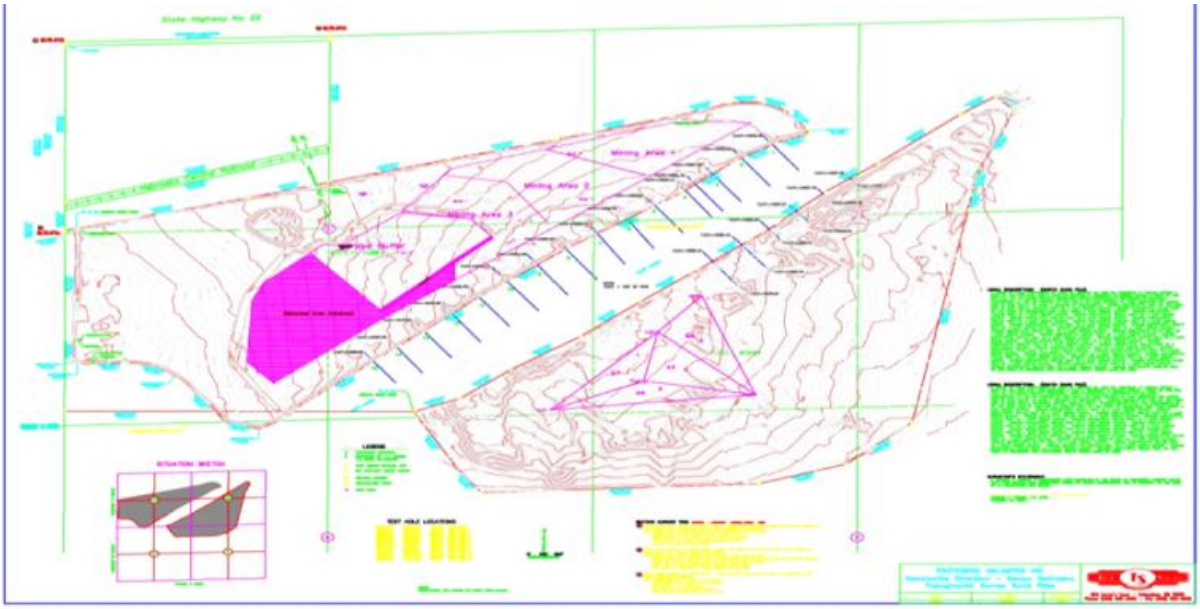


Figure 23. Schematic diagram of the "North Sand Management Zone" found at the LPPD Headworks – Preferred Rocks of Genoa facility.

In March 2008, the United States Fish and Wildlife Service, Nebraska Game and Parks Commission, and Preferred Rocks of Genoa entered into a Memorandum of Understanding (MOU) outlining the management of the Interior Least Terns and Piping Plovers nesting on the North Sand Management Zone (NSMZ). The TPCP and Loup Public Power District (LPPD) are cooperators, not signatories, to the MOU. The NSMZ is adjacent to the LPPD's Loup Diversion and settling basin near Genoa, Nance County, NE. Sand is dredged from the settling basin and pumped onto the NSMZ. As part of their standard operating policy, LPPD stops dredging the settling basin when the birds arrive and begin nesting; dredging resumes after the birds depart. With the assistance of Preferred Rocks of Genoa employees Dave Kendle (Plant Manager), Kenton Zimmer (Maintenance Supervisor), Richard Plumtree (Production Supervisor), and Gary Pearson (LPPD Headworks Supervisor), TPCP monitored the birds nesting at the NSMZ in 2011.

Loup Public Power District-FERC (Federal Energy Regulatory Commission) relicensing project: In 2009, Loup Public Power District, which operates the North Sand Management Zone near the Loup Diversion and settling basin near Genoa, Nance County, NE (see above) initiated the process of renewing their 25-year license to operate hydropower-generating facilities near Monroe and Columbus, Platte County, NE. The TPCP cooperates with FERC, LPPD, HDR Engineering, United States Fish and Wildlife Service, Nebraska Game and Parks Commission, United States National Parks Service, and others on this relicensing project. Our role is to serve as threatened and endangered species experts, in general, and Interior Least Tern and Piping Plover experts, in particular.

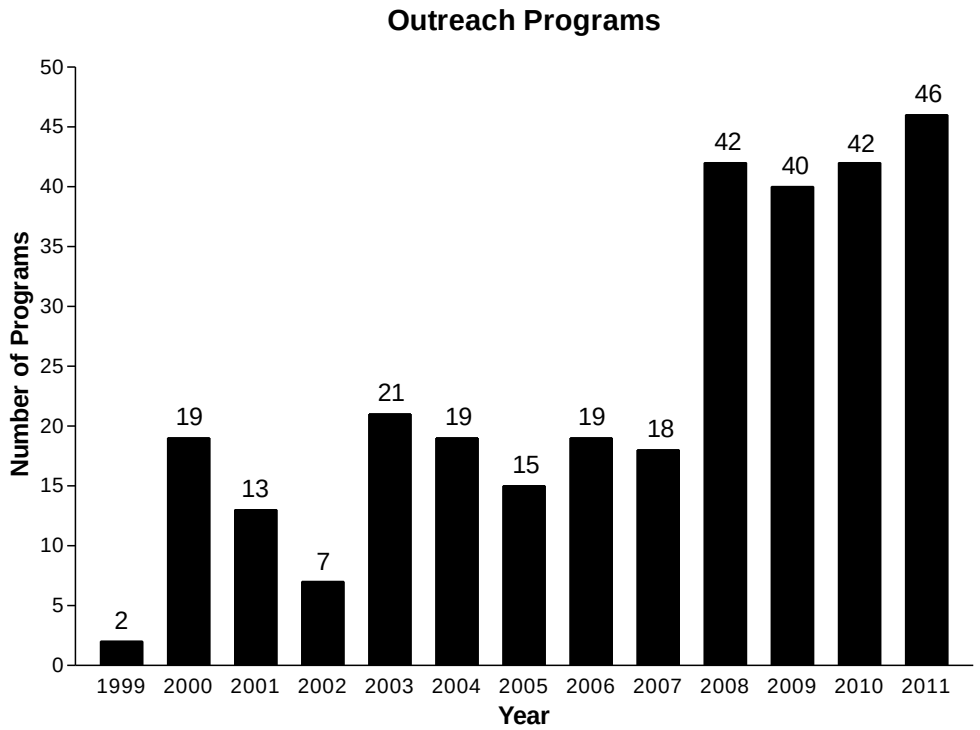
Central Playa Lakes Wetlands Survey: In 2009, 2010 and 2011, the TPCP participated in the annual spring wetlands survey for the Central Playa Lakes Biologically Unique Landscape (BUL). Participants in this event, coordinated by TCPC cooperator Ben Wheeler, visit all the playa lakes in the BUL and identify and count all water birds seen.

MSHA (Mine Safety and Health Administration): In 2011, the TPCP provided MSHA-approved mine safety training (with endorsement for scientific workers) for all individuals working with terns and plovers on sand and gravel mines in the Lower Platte and Loup Rivers. We also provided MSHA training to the tern and plover monitoring personnel working with the Platte River Recovery Implementation Program. This training is mandated by the United States Department of Labor 30 CFR Part 46 regulations.

Outreach

An important part of our mission to protect Interior Least Terns and Piping Plovers involves outreach. The TPCP is an important member of Nebraska's conservation and environmental education community. We are frequently called upon to give presentations, assist with symposia, workshops and festivals, participate in workgroups, and serve on committees. While the majority of our outreach efforts are focused on terns and plovers in Nebraska's Lower Platte River, we appreciate that we play a broader role in improving environmental literacy locally, regionally, and nationally. We take advantage of every opportunity to reach as many different constituencies as possible with our message of common-sense conservation.

Essential to the mission of the Tern and Plover Conservation Partnership is the continued growth of our outreach program. The number of adults and children that we are able to reach across the state has grown substantially over the past four years. The TPCP is now one of the go-to programs in Nebraska's environmental education community. The TPCP has evolved from being an organization that needed to seek out events to participate in to one that receives a continuous stream of requests for participation. It is very gratifying for us to meet people who know what the TPCP does and who commend us for our work.



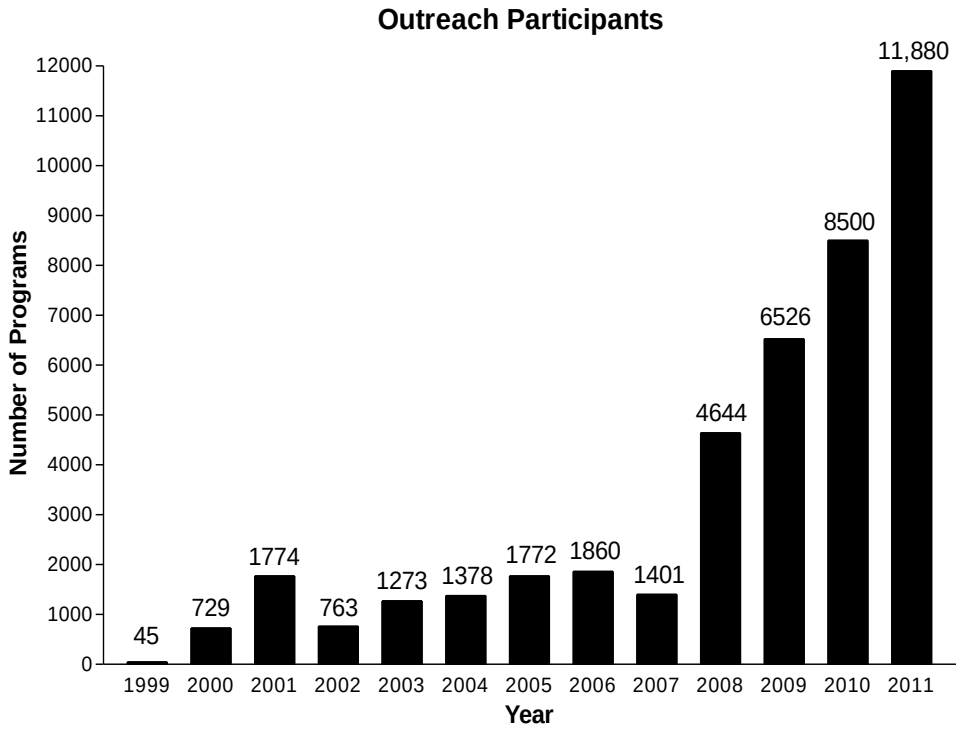


Figure 24. Number of programs delivered by the TPCP during 1999 – 2011 (top) and number of participants in TPCP programs during 1999 – 2011 (bottom). These include only scheduled programs; we frequently deliver impromptu presentations.

Kearney2011: The Tern and Plover Conservation Partnership served as the local host for the joint meeting of three international ornithological societies in 2011. The meeting was held in conjunction with the annual migration stopover of Sandhill Cranes in the Platte River of Nebraska. The Association of Field Ornithologists, Cooper Ornithological Society, and Wilson Ornithological Society conference was held at the Younes Conference Center in Kearney, NE from 9 – 13 March 2011. The boards of directors of the Ornithological Societies of North America (OSNA) and Nebraska Bird Partnership (NBP) also met during the conference. Over 500 people attended the conference, including representatives from the United States, South Africa, Denmark, France, Great Britain, Canada, the Czech Republic and Mexico. A tern and plover symposium held during the conference, organized by Dan Catlin from Virginia Tech University, substituted for the Nebraska Tern and Plover Meeting in 2011.

TernCam: Five Nines Technology Group (Aaron Clark) of Lincoln, NE and Ben Wheeler (NGPC) helped us maintain "TernCam" in 2011, our venture into the "CritterCam" market. Next year we plan to focus the camera on both Piping Plover and Interior Least Tern nests.

On-Line Activities: The internet and social media have become important tools in expanding our outreach program. Our website (http://ternandplover.unl.edu) is frequently updated with information about the Partnership; to date it has received over 34,000 hits. Our *YouTube* videos continue to generate interest in the TPCP. "Respect the Signs, Respect the Birds" has been viewed 3286 times, "Plover at Nest" has been viewed 2734 times, and "Points about Plovers" has been viewed 1229 times. We have 600 friends on our Facebook page.

Programs for the General Public:

Becoming an Outdoors Woman (BOW), Halsey, NE
Boy Scout troop presentations, Lincoln, NE
Calvert Family Nature Nights, Lincoln, NE
Clinton Community Learning Center, Lincoln, NE
Clinton Family Nature Nights, Lincoln, NE
Custer County new home for Missouri River flood refugees, Custer County, NE
Dimensions Family Nature Nights, Lincoln, NE
Durham Museum Teacher's Night Out, Omaha, NE
Earth Day Celebration at Antelope Park, Lincoln, NE
Earth Wellness Festival, Lincoln, NE
Eastridge Family Nature Nights, Lincoln, NE
Faith Lutheran Family Nature Nights, Lincoln, NE
Fort Kearny Expo, Minden, NE
Fremont Eco-Fair, Fremont, NE
Groundwater Festival, Grand Island, NE
International Migratory Bird Day-Fontenelle Forest, Omaha, NE
Lower Platte River Corridor Alliance Kayak Tour, Leshara, NE
Lower Platte River Corridor Alliance Water Quality Open, South Bend, NE
McPhee Family Nature Nights, Lincoln, NE
Morley Family Nature Nights, Lincoln, NE
Nebraska Nature and Visitor Center, Alda, NE
Platte River Expo, South Bend, NE
Rivers and Wildlife Celebration Wild Experience Room, Kearney, NE
Riley Family Nature Nights, Lincoln, NE
"The Big Year" movie debut, Grand Theater, Lincoln, NE

Wachiska Audubon Christmas Bird Count, Lincoln, NE
Wachiska Audubon Crane Trip, Alda, NE
Wachiska Audubon Prairie Days, Lincoln, NE
Wachiska Aububon Society, Lincoln, NE
West Lincoln Family Nature Nights, Lincoln, NE
Wyuka Safari in the Park, Lincoln, NE

Homeowners' Associations

Big Sandy, Cedar Creek, Lake Socorro, Mallard Landing, Riverview Shores

University of Nebraska-Based Education Programs

Career Day at School of Natural Resources
Colorful Creatures at Morrill Hall
EnvironMentors (mentored student won 1st place in the 2011 National Council for Science and the Environment competition in Washington DC)
NaturePalooza at Morrill Hall
OLLI (Osher Lifelong Learning Institute) Lecture and Tour
Paul A. Olson Seminar, Center for Great Plains Studies, Lincoln, NE
SNR Weatherfest

Education-Curriculum Development Activities

State of Nebraska Environmental Literacy Plan
Informal Educators of Lincoln Network
Iowa Western Community College Environmental Studies
Nebraska Alliance of Conservation and Environment Educators
Nebraska Bird Library
Project BEAK
University of Nebraska School of Natural Resources

Conferences

American Ornithologists' Union, Jacksonville, FL
Association of Field Ornithologists-Cooper Ornithological Society-Wilson Ornithological Society, Kearney, NE
CMPS-Wildlife Society, Gering, NE
Northern Great Plains Piping Plover meeting, Omaha, NE
Nebraska Chapter of the Wildlife Society, Hastings, NE
Rivers and Wildlife Celebration, Kearney, NE

Professional Committees and Workgroups

Communication, Conservation, Science Advisory and Education workgroups, Nebraska Bird Partnership
Nebraska Environmental Trust Technical Advisory Committee
PACE (Planning, Aggregate, Community, Environment)
Rivers and Wildlife Celebration Committee
University of Nebraska SNR Managers and Staff Advisory committees
Steering Committee, Nebraska Bird Partnership
Wachiska Audubon Society Education Committee

Miscellaneous

Earth2Lincoln. Outreach Coordinator Chris Thody hosts this 30-minute talk show on KZUM community radio on Monday evenings from 6:00 – 6:30 pm. Guests (and topics) in 2011

included Naomi Alhadeff (NGPC education program), Mary Bomberger Brown (terns and plovers in 2011), Ken Dewey (Weatherfest), Caroline Hinkelman (NGPC Open Fields and Water program), Jill Liske-Clark (Nebraska Bird Partnership, Nebraska Birding Trails and Nebraska Bird Library), Brandy Lively (Nebraska Master Naturalist), Annabel Lee Major (Nebraska Master Naturalist), Dick Meyer (Nebraska Statewide Arboretum), Kevin Poague (Spring Creek Prairie Audubon Center), Lindsey Rogers (NGPC education program), Dave Sands (Nebraska Land Trust, Kristal Stoner (Nebraska Natural Legacy Project and Wildlife Conservation Fund), Dave Titterington (Nebraska Birding Trails), and Donna Woudenberg (human dimensions/conservation studies at UNL).

Nebraska State Fair 4-H. As we have for the past several years, the Partnership coordinated the judging of the 4-H Wildlife exhibits at the Nebraska State Fair in Grand Island, NE.

Featured in media

'Ord new home for Missouri River refugees', Ord Quiz, 6 July

'Elkhorn River site of international piping plover census', Norfolk Daily News, 21 June

'Sandbar study to help nesting plovers and terns', Lincoln Journal Star, 27 March

'Notes: Birds, watchers gathering', Omaha World Herald, Sunday, 13 March

'Warblers, plovers, on ornithologists' agenda', Kearney Hub, Friday, 11 March

'EnvironMentors student researches dogs on Santee reservation', reprinted from 21 Oct. 2010 Niobrara Tribune (snr.unl.edu/about us)

'Endangered Nebraska species subject of seminar', UNL news release (newsroom.unl.edu/releases), picked up by news services nationwide

Fundraising

AGRI/NRES 103 recitation stipend
www.goodsearch.com and www.goodshop.com donations
Tern and plover product sales (t-shirts, tote bags, hats, tumblers, plush animals, etc) in SNR Maps and More Store and Nebraska Nature and Visitors' Center (Alda, NE)
Photographs with Pebbles the Giant Plover donations
IMBTA and GBEPA surveys contracts
MSHA training seminars
Preferred Rocks of Genoa stipend
Seminar honoraria
Donation from the Association of Field Ornithologists, Cooper Ornithological Society and Wilson Ornithological Society
Donation from the Nebraska Bird Partnership/Rivers and Wildlife Celebration

Grants

Nebraska Environmental Trust "Tern and Plover Conservation Partnership: Protecting Imperiled Birds and their Habitat in Nebraska", submitted

Publications

Brown, M.B., J. Dinan, R.J. Held, R.J. Johnson, J.G. Jorgensen, J. Lackey, J.F. Marcus, and C.M. Thody. 2011. A partnership model for sustainable threatened and endangered species conservation in Nebraska: the Tern and Plover Conservation Partnership. Wader Study Group Bulletin 118: 22 – 25.

Brown, M.B., J.G. Jorgensen, S.E. Steckler, M.J. Panella, W.R. Silcock and C.M. Thody. 2011. A review of Interior Least Tern and Piping Plover management, conservation, and recovery on the Lower Platte River, Nebraska. Joint report of the Tern and Plover Conservation Partnership and the Nongame Bird Program at the Nebraska Game and Parks Commission, Lincoln, NE.

Reviewers

Auk (American Ornithologists Union)
Biological Journal of the Linnean Society
Great Plains Research
Nebraska Environmental Trust
United States Geological Survey
Wilson Journal of Ornithology

"…so now that man is no longer its deadly enemy, there is little to check the species from repopulating its breeding haunts in its former numbers…"

A.C. Bent, Life Histories of North American Shorebirds
1929

Photo by LaReesa Wolfenbarger