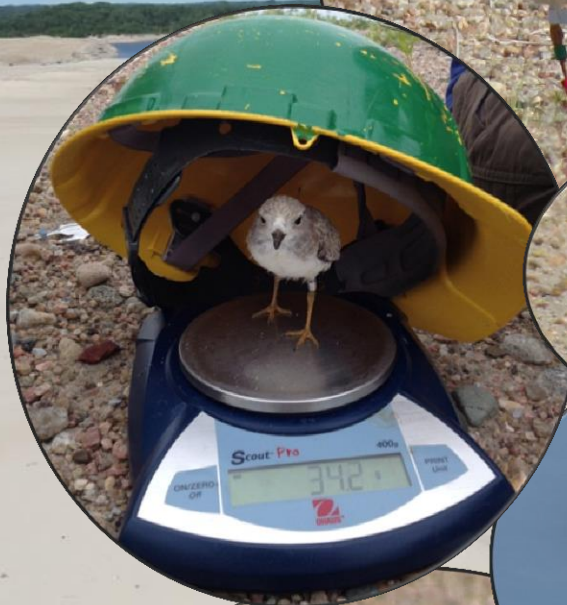


# 2014 Interior Least Tern and Piping Plover Monitoring, Research, Management, and Outreach Report for the Lower Platte River, Nebraska



**2014**  
**Interior Least Tern and Piping Plover**  
**Monitoring, Research, Management, and Outreach**  
**Report for the Lower Platte River, Nebraska**

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Unless otherwise noted, all photographs by Lauren R. Dinan.



## PREFACE

This document reports on our monitoring, research, management, and outreach activities during the past 12 months (2013–2014). 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 not final 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 be 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.

Introduction: This section describes the project area and summarizes conditions encountered during the 2014 field season.

Monitoring: This section describes the data we collect every year for basic demographic analyses and includes the number of nests and chicks found in the focus area. These data are collected and summarized in a form that allows comparison across the ranges of both species.

Research: This section describes our research objectives, research methods, data collection, and data analyses.

Management: This section describes our actions intended to protect Interior Least Terns and Piping Plovers and their nests from interference and disturbance.

Outreach: 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.



Interior 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

## ACKNOWLEDGEMENTS

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We extend our thanks to everyone who works and volunteers with us on this program including: Cindy Ahern, Tony Amos, Carol Aron, Naomi Avissar, Theodore Below, Melissa Bimbi, Mike Bloodsworth, Dave Brakenhoff, Ariana Brocius, Mark Brohman, Brian Buckingham, Gail Campbell, Ben Carlson, Keith Carroll, Dan Catlin, William Chitty, Kevin Christman, Aaron Clark, Josh Clark, Corey Cook, Aaron Decker, Karie Decker, Rangel Diaz, Robin Diaz, Stephen Dinsmore, Barbara Dubas, Betsy Evans, Charlie Ewell, Jim Forde, Michael Forsberg, Jolene Foster, Jim Fraser, Meryl Friedrich, Marvin Friel, Samuel Galick, Rafael Galvez, Doug Ghrist, Belinda Gillam, Mary Goetzinger, Anne Goulden, Cheri Gratto-Trevor, Olivia Graves, David Hanson, Robert Harms, Doug Harrison, Berlin Heck, Scott Hecker, Alice Heckman, Leslie Hershberger, Blair Hill, Mike Hodgson, Ian Hoppe, Paula Hoppe, Les Howard, Kelsi Hunt, Zachariah Hutchinson, Terry Jenkins, Paul Johnsgard, Colby Johnson, Erik Johnson, Mike Kelley, Tim Kimmel, Janet Kirk, Aaron Kirk, Scott Klug, LaVern Kwapnioski, Jeanine Lackey, Lance Laviolette, Doris Leary, Patrick Leary, Delaina LeBlanc, Sidney Maddock, Al Menk, Mark Mesarch, Carl Miller, Timothy Moffett, David Newstead, Donald Norman, Dan O'Mally, Melissa Panella, Judd Patterson, Gary Pearson, Bob Pelkey, Dona Phillips, Chris Poole, Larkin Powell, Diane Pratt, Raya Pruner, Gary Rasmussen, Mike Reed, Doug Ritthaler, David Roberts, Erin Roche, Matt Rogosky, Jeff Runge, Chris Runk, Felicia Sanders, Sarah Saunders, Danny Sauvageau, Rick Schneider, Eric Schoenleber, Mark Sherfy, Irina Shulgina, Ross Silcock, Rachel Simpson, Meghan Sittler, Jon Sohl, Stephen Speicher, Peter Stegen, Kristal Stoner, Jennifer Stucker, Bill Summerour, Jesse Swift, Marilyn Tabor, Pete Thayer, Mary Thies, Chris Thody, Dave Titterington, Phillip Vasseur, Melissa Vetriccek, T.J. Walker, David Ward, Franklin Weaver, Carol White, Jennifer Wilson, Angelina Wright, Wilfred Yusek, and Tim Zuehlke.

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We extend our thanks to all of our partners including: Arps Gravel and Concrete, Big Sandy Homeowners' Association, Cedar Creek Homeowners' Association, Central Sand and Gravel, Five Nines Technology Group, Lake Allure Homeowners' Association, 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, Lyman-Richey, Mallard Landing Homeowners' Association, Nebraska Natural Legacy Project, Nebraska Public Power District, Old Castle Materials, Overland Sand and Gravel, Papio-Missouri Natural Resources District, Paulsen Sand and Gravel, Preferred Rocks of Genoa, Pilger Sand and Gravel, 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.



Two one-day old Interior Least Tern chicks in their nest cup at a sand and gravel mine near Genoa, Nance County, NE.

## INTRODUCTION

The Lower Platte River and its major tributaries provide important nesting and migratory stopover habitat for two bird species of special conservation concern: the state and federally endangered Interior Least Tern (*Sternula antillarum athalassos*) and threatened Piping Plover (*Charadrius melodus*). The Tern and Plover Conservation Partnership (TPCP), based at the University of Nebraska-Lincoln School of Natural Resources, and Nongame Bird Program (NBP), based at the Nebraska Game and Parks Commission (NGPC), work cooperatively on tern and plover monitoring, research, management, and outreach activities in Nebraska. The TPCP and NBP focus monitoring and research efforts along the Lower Platte, Loup, and Elkhorn rivers in the eastern part of the state. We also work on tern and plover issues across the state, including Lake McConaughy, and region.

### FOCUS ANIMALS

The Interior Least Tern is the smallest of the terns found in North America. The species was first described in 1847 from a type specimen collected in Guadeloupe, West Indies (American Ornithologists' Union 1998). Meriwether Lewis and William Clark recorded their first observation of an Interior Least Tern on 5 August 1804 along the Missouri River, near present day Omaha, Nebraska while on their 1803–1805 “Voyage of Discovery” across North America. The species was placed on the Endangered Species List on 27 June 1985 (50 Federal Register 21784–21792), and a Recovery Plan was issued in September 1990. As a result of this listing status, the Interior Least Tern is protected by the Federal Endangered Species Act (1973) and the Nebraska Nongame and Endangered Species Conservation Act (Neb. Rev. Stat. § 37-801-11). A review of the species' population status has recently been completed by the USFWS (P. Hatfield, pers. comm.) and on-going monitoring plans are being developed (J. Bart, pers. comm.).

The Piping Plover is a small, migratory shorebird; the common name reflects the plaintive whistling sound they produce as one of their primary vocalizations. The species was first described in 1824 from a type specimen collected in New Jersey (American Ornithologists' Union 1998). Meriwether Lewis and William Clark saw Piping Plovers, and recorded their observations, in what was to become the state of Nebraska, during their 1803–1805 “Voyage of Discovery” across North America. The species was placed on the Endangered Species List on 10 January 1986 (50 Federal Register 50726–50734), and the Northern Great Plains Recovery Plan (which covers Nebraska) 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. A review of the species' population status was completed in 2009 and a revised recovery plan is near completion (C. Aron, pers. comm.).

Interior Least Terns and Piping Plovers are an integral part of the fauna of Nebraska. Terns and plovers were described by all of the major expeditions that passed through the region (i.e., Lewis and Clark, John James Audubon, Stephen Long, Duke Paul Wilhelm, Governor Kemble Warren and Ferdinand Hayden), but they were known by Native Americans well before that. Historically, terns and plovers flourished on sparsely-vegetated midstream sandbars of the Platte, Missouri, Loup, Elkhorn, and Niobrara rivers. However, much of this natural habitat has been lost due to broad-scale alterations of natural river systems. The amount of suitable sandbar habitat has been reduced by the presence of invasive plant species, construction of dams and reservoirs, river channelization, bank stabilization, hydropower

generation, and water diversion. Terns and plovers frequently nest on human-created habitats that occur outside of the river channel. These habitats are created by industrial and commercial activities such as sand and gravel (aggregate) mining, dredging, and construction operations. This change in nesting habitat from exclusively river sandbars to a combination of on-river and off-river habitats is the result of the decrease in available river nesting habitat and the increase in available human-created off-river nesting habitat. Although human-created habitats offer alternative nesting sites during years where river sandbars are limited, they are not likely to serve as suitable long-term substitutes for riverine nesting habitat.

Interior Least Terns and Piping Plovers are migratory birds that spend significant portions of the year in different parts of the Western Hemisphere. They are only in their nesting areas about four months of the year. The other eight months are spent on migration and on their overwintering areas. Piping Plovers spend the winter along the Gulf of Mexico, southern Atlantic coast, and in the Bahamas/other Caribbean Islands. These habitats are characterized by wide sandy beaches and a combination of sand flats, mudflats, tide pools, marshes, lagoons, and large inlets. Interior Least Terns spend the winter well off-shore and along coasts, bays, estuaries, and river mouths near Central and South America. Loss of overwintering habitat contributed to the decline of both species. The principal threats to tern and plover overwintering habitat include habitat loss and degradation, increased coastal residential and industrial development, and stochastic events (i.e., global sea level rise, oil spills/pollution, and hurricanes).

#### FOCUS AREA

Our study area includes the Lower Platte River system in eastern Nebraska, including the Loup and Elkhorn rivers and numerous off-river sites (Fig. 1, Table 1). We concentrate our monitoring and research efforts in our primary study area, an area which includes the Lower Platte and Loup rivers from the Loup Public Power District Diversion to the Missouri-Platte River confluence (Fig. 2). The TPCP concentrates its monitoring and research efforts on off-river nesting habitats in our primary study area. The NBP concentrates its monitoring and research efforts on river nesting habitat solely on the Lower Platte River and does not include the Loup or Elkhorn rivers. Additional off-river monitoring also occurs at off-river sites along the North Loup, Middle Loup, and Elkhorn rivers. We define the Lower Platte River as the 103 river miles lying between the Loup-Platte River confluence (near Columbus, Platte County) and the Missouri-Platte River confluence (near Plattsmouth, Cass County). 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).



Lower Platte River near South Bend, Cass County, NE in June 2014.

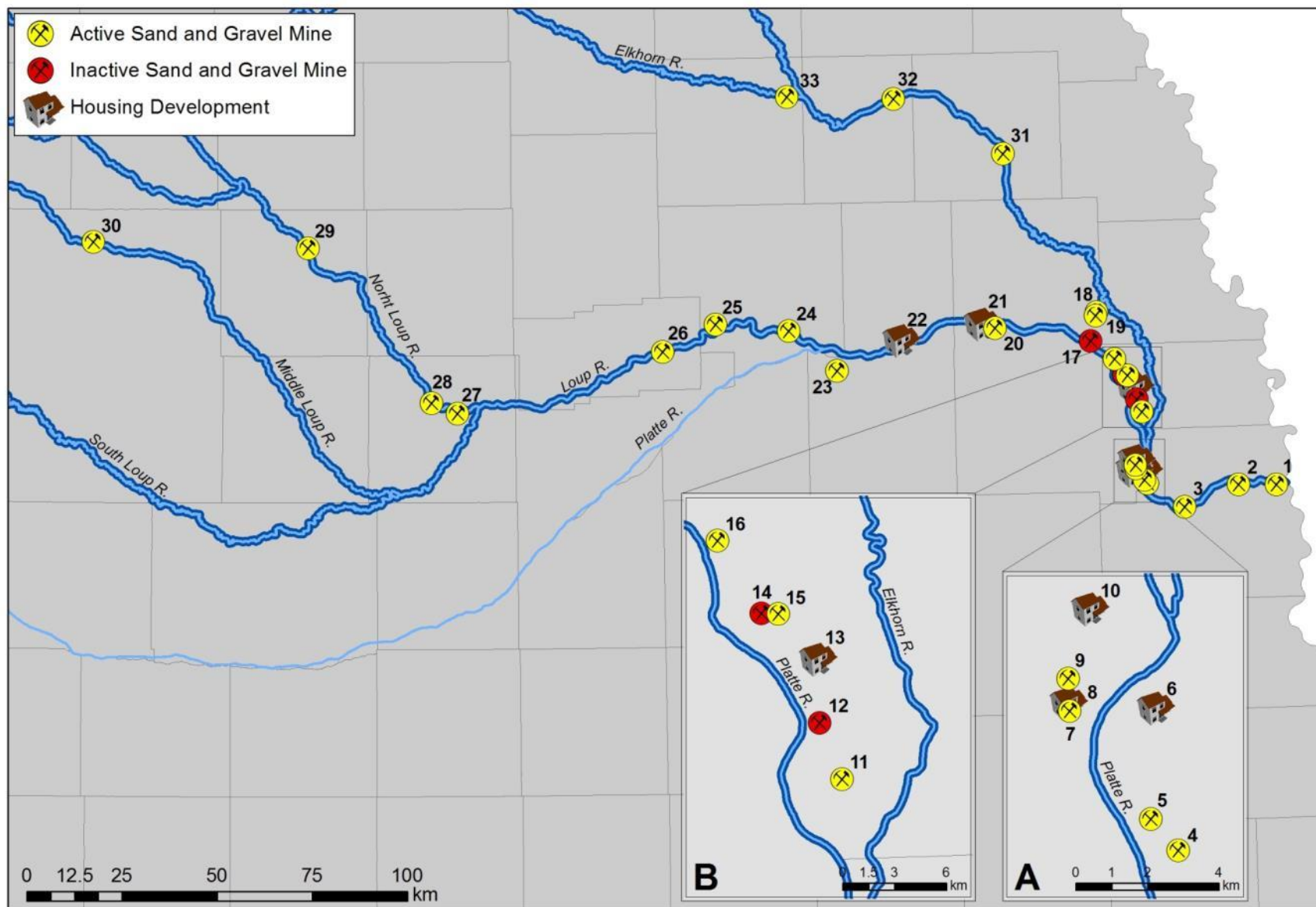


Figure 1. Our study area is highlighted with a dark blue outline. Locations of off-river Interior Least Tern and Piping Plover nesting areas within our study area are marked. Off-river sites can be matched to numbers in Table 1.



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Table 1. Off-river tern and plover nesting sites; site numbers correspond with Figure 1.

#	Site Name	River	Owner	Site Type	County	2014 Nesting
1	Oreapolis #8	Platte	Lyman Richey	Active Mine	Cass	Yes
2	New Collum #3	Platte	Central Sand and Gravel	Active Mine	Cass	No
3	Louisville Lakes	Platte	Western Sand and Gravel	Active Mine	Sarpy	Yes
4	Linoma Beach #50	Platte	Lyman Richey	Active Mine	Sarpy	No
5	Linoma Beach #51	Platte	Lyman Richey	Active Mine	Sarpy	No
6	Melia	Platte	Private Lake	Housing	Sarpy	Yes
7	Thomas Lakes	Platte	Western Sand and Gravel	Active Mine	Saunders	Yes
8	Lake Allure	Platte	Homeowners' Association	Housing	Saunders	Yes
9	Sand Creek	Platte	Western Sand and Gravel	Active Mine	Saunders	Yes
10	Big Sandy	Platte	Homeowners' Association	Housing	Saunders	No
11	OMG-Graske Pit	Platte	Old Castle Materials Group	Active Mine	Douglas	Yes
12	Waterloo #40	Platte	Lyman Richey	Inactive Mine	Douglas	No
13	Mallard Landing	Platte	Homeowners' Association	Housing	Douglas	No
14	Pleasure Lake #11	Platte	In transition to housing	Inactive Mine	Douglas	Yes
15	Valley #7	Platte	Lyman Richey	Active Mine	Douglas	Yes
16	KMG	Platte	Mallard Sand and Gravel	Active Mine	Dodge	No
17	Western Fremont	Platte	Western Sand and Gravel	Inactive Mine	Dodge	Yes
18	NE Fremont North	Platte	Lyman Richey	Active Mine	Dodge	Yes
19	NE Fremont South	Platte	In transition to housing	Active Mine	Dodge	Yes
20	Morse Bluff	Platte	Private Mining Company	Active Mine	Dodge	No
21	Riverview Shores	Platte	Homeowners' Association	Housing	Dodge	Yes
22	Socorro Lake	Platte	Homeowners' Association	Housing	Colfax	Yes
23	Bellwood #73	Platte	Central Sand and Gravel	Active Mine	Butler	Yes
24	Columbus #71	Loup	Central Sand and Gravel	Active Mine	Platte	Yes
25	Genoa North #95	Loup	Central Sand and Gravel	Active Mine	Platte	Yes
26	LPPD-Loup Diversion	Loup	Preferred Rocks - LPPD	Active Mine	Nance	Yes
27	North Loup SRA	N. Loup	Central Sand and Gravel	Active Mine	Howard	No
28	E Elba	N. Loup	Tri-County Sand and Gravel	Active Mine	Howard	No
29	Haskell Creek	N. Loup	Ulrich Sand and Gravel	Active Mine	Valley	Yes
30	Paulsen Gates	M. Loup	Paulsen Sand and Gravel	Active Mine	Custer	Yes
31	Horseshoe Lake	Elkhorn	Stalp Sand and Gravel	Active Mine	Cumming	No
32	Pilger	Elkhorn	Pilger Sand and Gravel	Active Mine	Stanton	Yes
33	Medelman's Lake	Elkhorn	Central Sand and Gravel	Active Mine	Madison	No

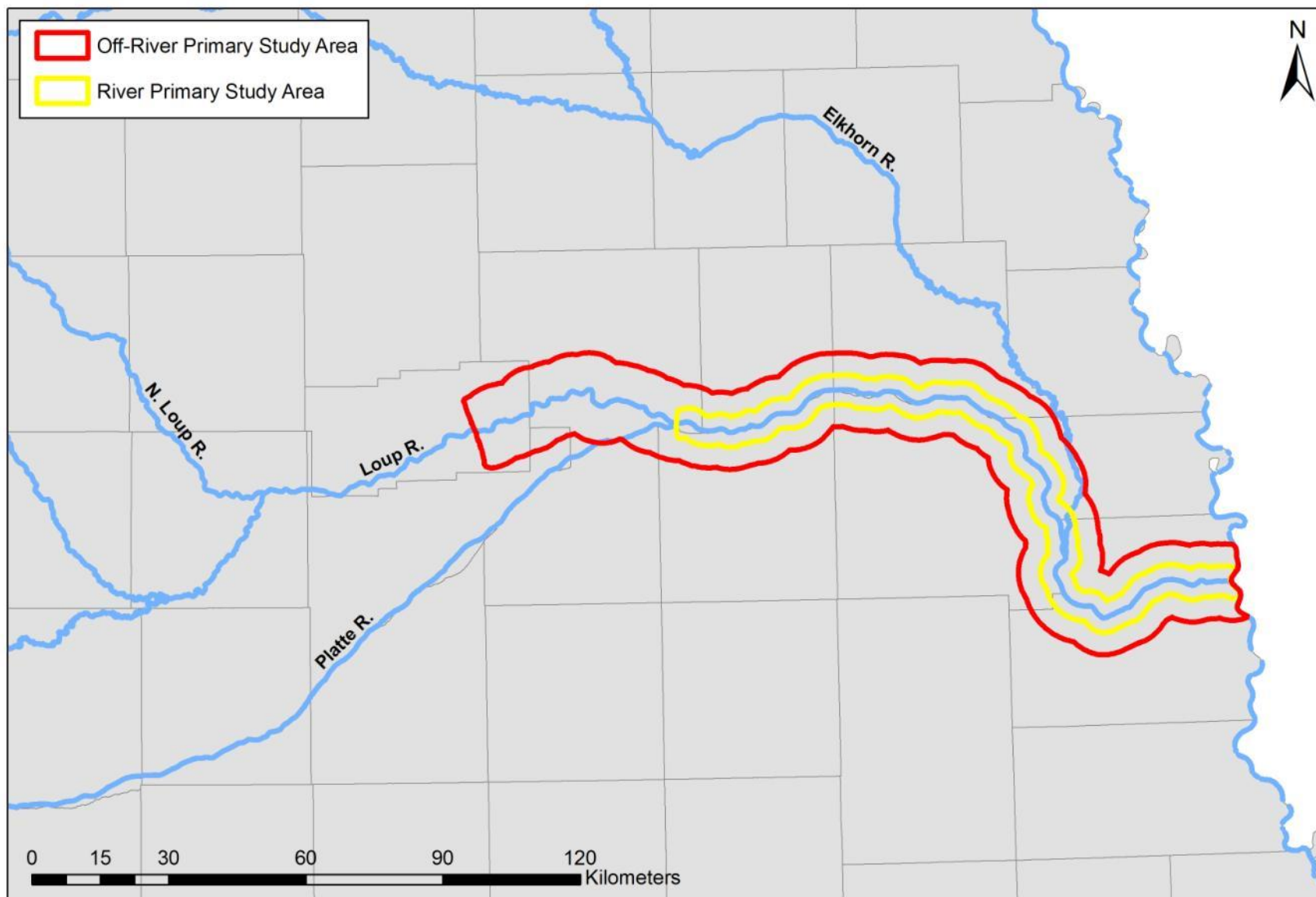


Figure 2. Our primary study area – the red box outlines the area where the TPCP concentrates its off-river monitoring and research efforts, and the yellow box outlines the area where the NBP concentrates its on-river monitoring and research efforts.

### 2014 OFF-RIVER CONDITIONS

Overall conditions at off-river sites remained similar to previous years with no significant changes. In 2014, a number of repair and construction projects were undertaken at sand and gravel mines and lakeshore housing developments. Several sand and gravel mining companies modified their operations, relocated dredges, and moved slurry pipes and two mine sites were transitioning to lakeshore housing developments. The pace of home construction appeared to increase at many of our lakeshore housing development sites. Nesting sandbar habitat was very limited on the Lower Platte River (see River Conditions, below), which increased bird use of off-river sites.

### 2014 LOWER PLATTE RIVER CONDITIONS

The amount of suitable sandbar nesting habitat on the Lower Platte River varies from year to year. Daily and seasonal fluctuations in the volume of water flowing in the river caused by annual rainfall, ice and snow accumulation, ground water levels, and river channel morphology influence sandbar development and maintenance. General flow conditions on the Lower Platte River are monitored by the United States Geological Survey (USGS) stream gages (<http://waterdata.usgs.gov/ne/nwis/rt>). In addition to these USGS data, we monitored flow conditions by visual inspection of the river at bridge crossings and by direct inspection of the river via kayak.

River sandbar conditions in 2014 were affected by above average water levels throughout the months of May and June. These flows followed two dry years (2012 and 2013) where river discharge during the nesting season did not exceed 25,000 cubic feet per second (cfs) at the Louisville gage (USGS 0680550 Platte River). Prior to 2014, the last major high flow event (>60,000 cfs) occurred in June 2010 with peak flows at the Louisville gage reaching 114,000 cfs (see Brown and Jorgensen 2010). The absence of high flow events coupled with the relatively mild winters resulted in high rates of erosion, re-shaping, and reducing elevations of macroform sandbars created during the 2010 high flow event.

In 2014, low-elevation, eroded sandbars were inundated throughout the months of May and June. Water levels peaked at 17,800 cfs at the North Bend gage (USGS 06796000 Platte River) on 17 June and 51,600 cfs at the Louisville gage on 21 June (Figs. 3 – 4). A majority of sandbars were not exposed until early to mid July. As a result of the high flows and lack of exposed sandbars, we were unable to survey the river until 16 July; we did not survey the lower 15 miles of the Lower Platte River (between Louisville and the Missouri River confluence).



A sand and gravel mine in Douglas County, NE in the early stages of transitioning from a mine site to a lakeshore housing development.

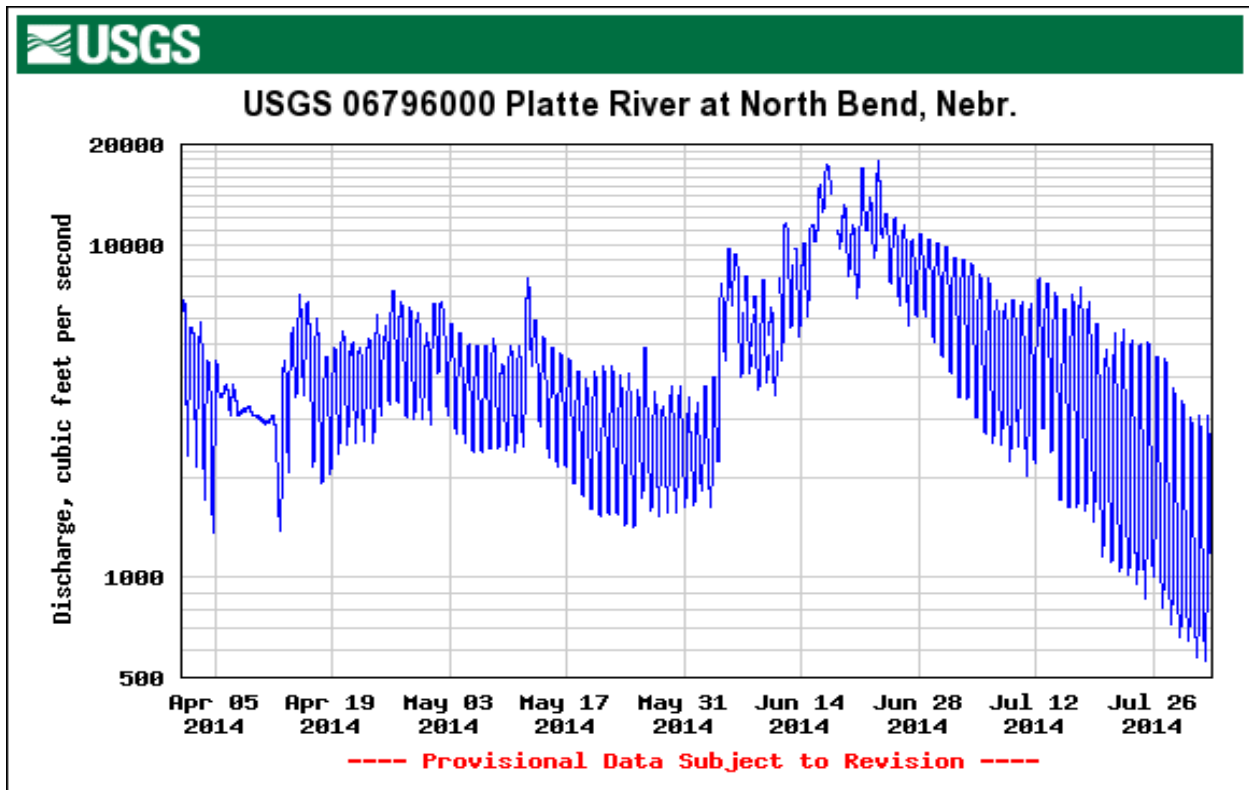


Figure 3. Daily water discharge (cubic feet per second; cfs) measured at the North Bend, Dodge County, USGS gage from 1 April 2014 through 1 August 2014.

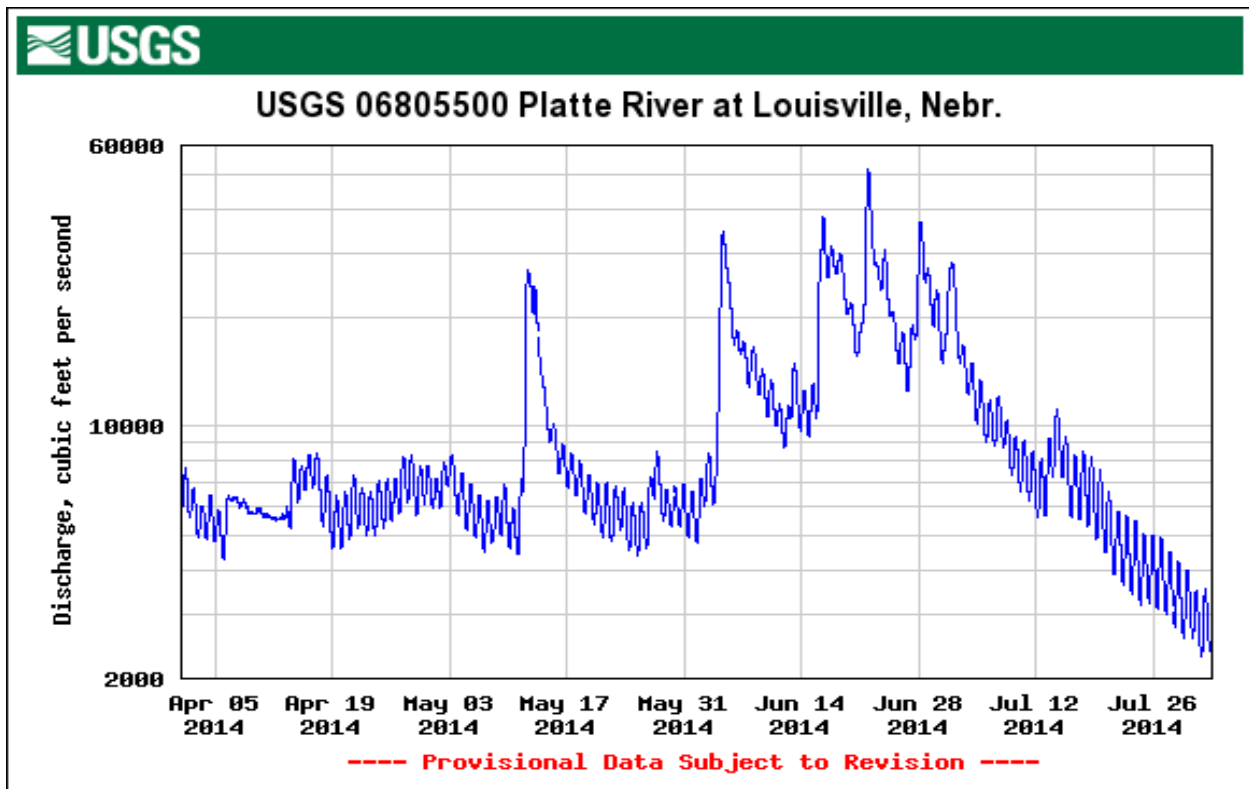


Figure 4. Daily water discharge (cubic feet per second; cfs) measured at the Louisville, Cass County, USGS gage from 1 April 2014 through 1 August 2014.

## MONITORING

### MONITORING REGIONAL MOVEMENTS OF COLOR-BANDED PIPING PLOVERS

#### **Breeding Season Observations**

This was our seventh year capturing and placing colored leg bands on Piping Plovers nesting in our primary study area along the Lower Platte River. To date, we have banded 431 plovers; 114 adults and 317 pre-fledging age (28 days and younger) chicks (Table 2). All plovers (426) color-banded in our primary study area were captured at off-river sites; however, we banded five plover chicks with metal USGS bands only on river sandbars in 2009. Since 2008, we have observed plovers originally banded in locations throughout the Great Plains and US Gulf Coast (Table 3) in our primary study area. In 2014, we observed plovers that were originally banded along the Lower Platte River, Central Platte River, Missouri River between South Sioux City, NE and Yankton, SD, and the US Gulf Coast. Plovers banded along the Lower Platte and Central Platte rivers carry a light blue flag on one of their upper legs. Plovers banded along the Central Platte River are banded by USGS biologists (E. Roche, M. Sherfy, pers. comm.). Plovers banded along the Missouri River, and some plovers banded along the US Gulf Coast, carry a green flag on one of their upper legs, and are banded by the Virginia Tech University Shorebird Program (D. Catlin, J. Fraser, K. Hunt, M. Friedrich, pers. comm.). Some plovers banded along the US Gulf Coast (Texas) carry a red flag on one of their upper legs and are banded by biologists with the Coastal Bend Bays and Estuaries Program (CBBEP; D. Newstead, pers. comm.). In previous years (2009, 2010, and 2011), we observed a yellow-flagged plover along the Lower Platte River, originally banded at Lake Sakakawea in North Dakota.

In 2014, we observed 53 previously-banded Piping Plovers in our primary study area; 52 were observed at off-river sites and one was observed on a Lower Platte River sandbar. In 2014, we observed 37 light blue-flagged plovers originally banded along the Lower Platte River, two light blue-flagged plovers originally banded along the Central Platte River, nine green-flagged plovers originally banded along the Missouri River, two green-flagged plovers banded along the US Gulf Coast, and three red-flagged plovers banded near Galveston Island, Texas.

Over the last six years, a number of Piping Plovers originally banded along the Lower Platte River have been re-sighted nesting in other locations across the Great Plains (Table 4). Of the 332 plovers banded on the Lower Platte River prior to 2014, 111 (33%) have been re-sighted during the breeding season at least one year after they were banded; 93 (28%) returned to nest along the Lower Platte River, 15 (5%) were observed nesting on the Missouri River, and three (1%) were observed nesting on the Niobrara River. We found that a majority (62%) of the Lower Platte River plovers that returned to the Lower Platte River to nest were originally banded as adults and a majority (94%) of the Lower Platte River plovers reported nesting outside of the Lower Platte River study area were originally banded as chicks. In total, 68% of the Lower Platte River plovers banded as adults and 21% of the Lower Platte River plovers banded as chicks have been re-sighted at least once during a breeding season.

In 2014, 12 Lower Platte River plovers were observed nesting outside of the Lower Platte River study area; all of these plovers were observed nesting on the Missouri River. Eight of them were observed attending a nest on the Missouri River and four were observed incidentally and were not associated with a nest. A majority (9; 75%) of these plover were originally banded as chicks. Two of these birds were observed in the Lower Platte River study area in 2014.

Table 2. Number of Piping Plovers banded on the Lower Platte River each year.

Year	Adults	Chicks	TOTAL
2008	19	12	31
2009	18	23	41
2010	9	48	57
2011	15	31	46
2012	11	73	84
2013	15	58	73
2014	27	72	99
<b>TOTAL</b>	<b>114</b>	<b>317</b>	<b>431</b>

Table 3. Number of Piping Plovers previously banded in a different region and re-sighted on the Lower Platte River (this table includes birds observed during the breeding season during multiple years).

Year	Lower Platte River	Central Platte River	Missouri River (NE/SD)	Missouri River (ND)	US Gulf Coast	TOTAL
2009	14	0	10	1	0	25
2010	18	0	8	1	0	27
2011	21	1	15	1	4	42
2012	24	2	10	0	6	42
2013	30	2	9	0	4	45
2014	37	2	9	0	5	53

Table 4. Number of Piping Plovers previously banded as adults and chicks and re-sighted during the breeding season at least a year after they were originally banded.

Age Banded	Lower Platte River	Missouri River	Niobrara River	TOTAL
Adults	58	1	0	59
Chicks	35	14	3	52
<b>TOTAL</b>	<b>93</b>	<b>15</b>	<b>3</b>	<b>111</b>



**Non-Breeding Season Observations**

Winter Range

A number of Piping Plovers banded along the Lower Platte River were observed in wintering areas during the non-breeding season (2013-2014; Fig. 5). As of 1 October 2014, we received 22 reports of Lower Platte River plovers in their winter range following the 2014 breeding season; 20 observed along the US Gulf Coast and two observed on the US Atlantic Coast. The first Lower Platte River plover reported in its winter range following the 2014 breeding season was originally banded as an adult in June 2014; it successfully hatched and raised three chicks and was last observed along the Lower Platte River on 2 July. Fifteen days and 1000 miles later this plover was observed at St. George State Park, Florida on 17 July 2014. Twelve of the 22 Lower Platte River plovers reported in their overwintering areas already this year were originally banded along the Lower Platte River in 2014. Five of these birds were banded as adults in 2014 and seven were banded as chicks in 2014. The first young of the year to arrive on the US Gulf Coast was banded as a nearly fledged 24-day old chick in Dodge County, Nebraska, on 1 July 2014. A little over a month after fledging this plover was reported over 1000 miles away in Florida on 12 August 2014.

Over the past seven years, 63 plovers originally banded in our primary study area have been re-sighted in their winter range during the nonbreeding season, with several birds observed more than once. Of the 63 plovers, 28 were originally banded as adults and 35 were originally banded as chicks. Winter sightings of Lower Platte River plovers extend from the southern tip of Texas to the Florida Keys and north along the US Atlantic Coast to South Carolina. Lower Platte River plovers have been reported in seven states and 26 counties along the coast (Table 5). The majority of winter re-sightings have occurred along the US Gulf Coast. The first reports of Lower Platte River plovers along the US Atlantic Coast occurred during the winter of 2012–2013 when four Lower Platte River plovers were reported in that area. To date, we have received a total of 171 reports of Lower Platte River plovers observed during the non-breeding seasons (2008 – 2014), with most reports provided by resident and visiting bird watchers and recreational wildlife photographers.

Two green-flagged plovers and three red-flagged plovers observed along the Lower Platte River in 2014 were originally banded along the US Gulf Coast. The green-flagged plovers were banded as a part of a BP - Deepwater Horizon Oil Spill (NRDA) recovery study being conducted by the Virginia Tech Shorebird Program (D. Catlin, pers. comm.). A total of seven plovers banded as a part of this oil spill study have been observed along the Lower Platte River. Both of the US Gulf Coast green-flagged plovers observed in 2014 have been observed nesting along the Lower Platte River for the last four years in a row.

Table 5. States where Lower Platte River plovers have been observed overwintering.

State	Number of LPR Plovers reported	Percent of total
Alabama	1	2%
Florida	15	24%
Georgia	1	2%
Louisiana	5	8%
Mississippi	3	5%
South Carolina	2	3%
Texas	36	57%

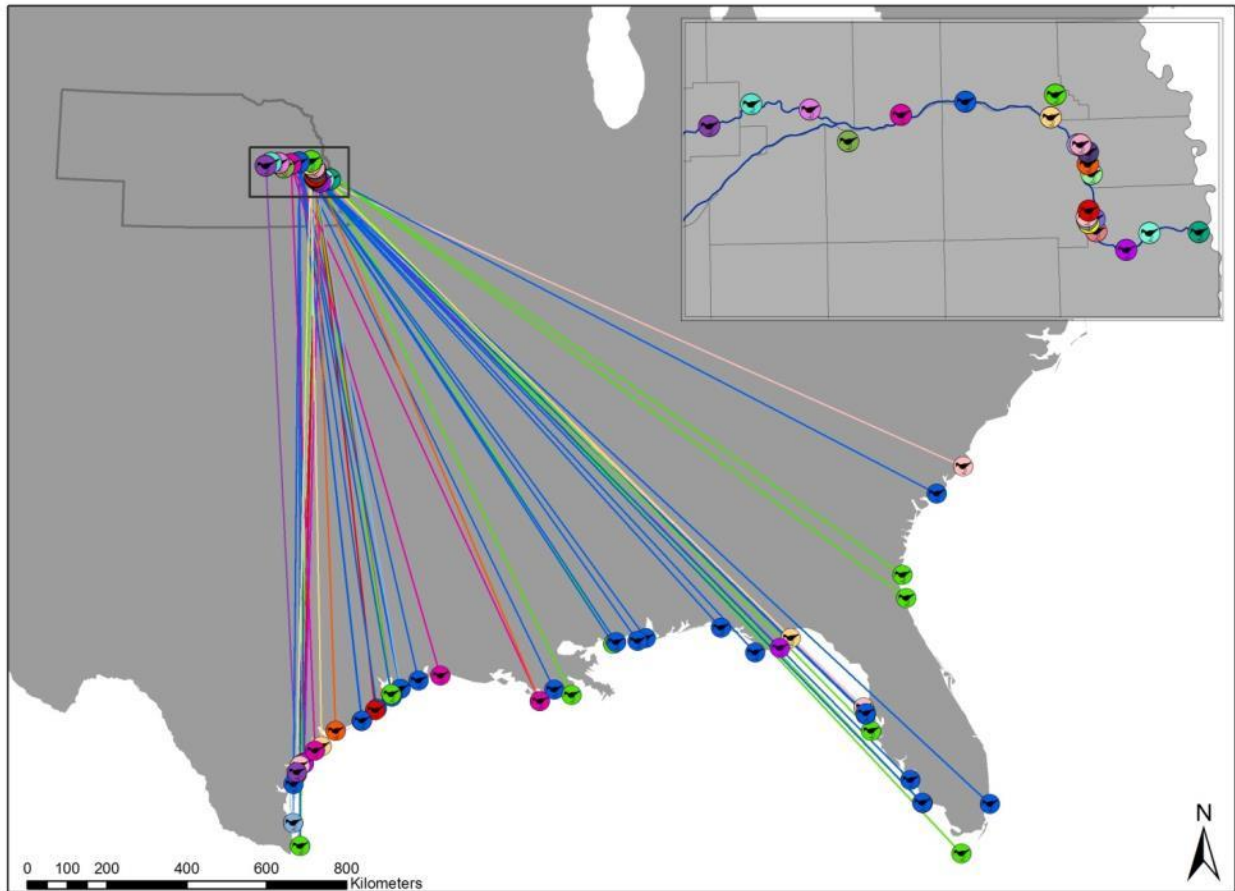


Figure 5. Locations where light blue-flagged plovers, originally banded in our primary study area, have been observed during the non-breeding season on the US Gulf and Atlantic coasts from 2008 to 2014. Each colored marker in Nebraska represents a nesting site where plovers have been banded and each marker on the coast shows the location where an individual light blue-flagged plover has been re-sighted during the winter.



Piping Plover banded along the Lower Platte River as a 12-day old chick in July 2014 and re-sighted at Huguenot Park, FL in September 2014. Large photo by Gail Pfon.

© gail pfon



Migration Period

We received two reports of Lower Platte River plovers in the interior United States during the spring migration period. The first report was of a plover banded as a chick in June 2012 in Dodge County, Nebraska. This plover was observed at Lake Tyler in northeast Texas on 2 May – 3 May 2013 and just a couple weeks later on 21 May this bird was reported nesting on a Missouri River sandbar in northeast Nebraska. The second report occurred during the spring of 2014 (Fig. 7). This report was of a plover originally banded in Saunders County, Nebraska, as an adult in June 2013. We do not know where this bird spent the winter but on 20 – 24 April 2014 it was observed at Coralville Reservoir, Iowa. On 20 May 2014 this bird was observed nesting at the same site it was banded at the previous year.



Figure 6. Lower Platte River plover observed in the interior United States during spring migration 2014. The pink dot represents the location where this plover was banded as an adult in 2013 and where it returned to nest in 2014. The pink star represents the location in Iowa where this plover was observed from 20 – 24 April 2014.



## MONITORING NESTS AND CHICKS

### **Methods: Off-River Habitat**

We began conducting Interior Least Tern and Piping Plover surveys at each off-river site in late April 2014. We surveyed each site every five to seven days (some sites were visited more frequently than this when we were working to re-sight and band chicks). We searched for terns and plovers and their nests or evidence of nest scrapes. Each nest was assigned a unique identification number. We recorded nest locations using a handheld GPS unit (Garmin Oregon 550t). We recorded the number of eggs in each nest and “floated” the eggs in water to determine the nest initiation date (Hays and LeCroy 1972). A majority of the nests were located one to seven days after the first egg was laid. Using the egg floating data, we calculated the eggs’ expected hatch date, assuming a 28-day incubation period for plovers and a 21-day incubation period for terns. We located nests throughout the season. All nests at off-river sites were visited every five to seven days. During each subsequent nest visit, we counted the number of terns and plovers present, located new nests, checked known nests, and searched for and banded tern and plover chicks. We only “floated” eggs on the day the nest was first found. We determined 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; nest cup may contain small pieces of eggshell

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

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

Undetermined: nest not re-checked prior to hatch date or not enough evidence to determine nest fate

At some off-river sites, Interior Least Terns and Piping Plovers placed their nests in areas not accessible to us for safety reasons. Some areas of active mine sites present possible cave-in hazards and we work with the mine company to avoid these areas. In these cases, we only recorded the number of nests, eggs, adults, chicks, fledglings and juveniles that were visible from a distance.

We recorded the total number of active nests and the total number of terns and plovers of each age class. The age classes we used were:

Adults: birds at least one year old and in adult plumage

Chicks: plovers 1 – 27 days post-hatch and terns 1 – 20 days post-hatch (incapable of flight)

Fledglings: birds capable of flight but still dependent on parents

Juveniles: birds capable of sustained flight and independent from parents

We recorded any notable observations including weather conditions, bird injuries, and evidence of disturbance caused by humans, dogs, cats, vehicles, natural predators, or recent severe weather events. We recorded the band combinations of all terns and plovers observed and recaptured with leg bands.

**Results: Off-River Habitat**

In 2014, we located 58 Piping Plover nests and 287 Interior Least Tern nests at off-river sites in our primary study area (Table 6). These nests were distributed across 18 off-river sites, three sites along the Loup River and 15 sites along the Lower Platte River (Figs. 7 – 8). This included four lakeshore housing developments and 14 sand and gravel mines. In 2014, 59% of plover nests and 33% of tern nests were confirmed successful, while 19% of plover nests and 38% of tern nest were confirmed failed (Tables 7 – 8). We observed 80 plover chicks and 195 tern chicks on off-river sites (Table 6).

In 2014, two sites had large concentrations of nesting Interior Least Terns. These two sites were productive; 51 nests confirmed hatched and 118 chicks banded. These two sites combined supported 31% of the tern nests and 61% of the tern chicks observed on off-river sites along the Lower Platte River in 2014.

In 2014, one Piping Plover nest and eight Interior Least Tern nests were found in our study area but outside our primary study area. One plover nest and seven tern nests were on off-river sites along the Loup River west of the Loup Diversion Canal, and one tern nest was on an off-river site along the Elkhorn River (Table 9). For more information on these nests see Appendix A and B.



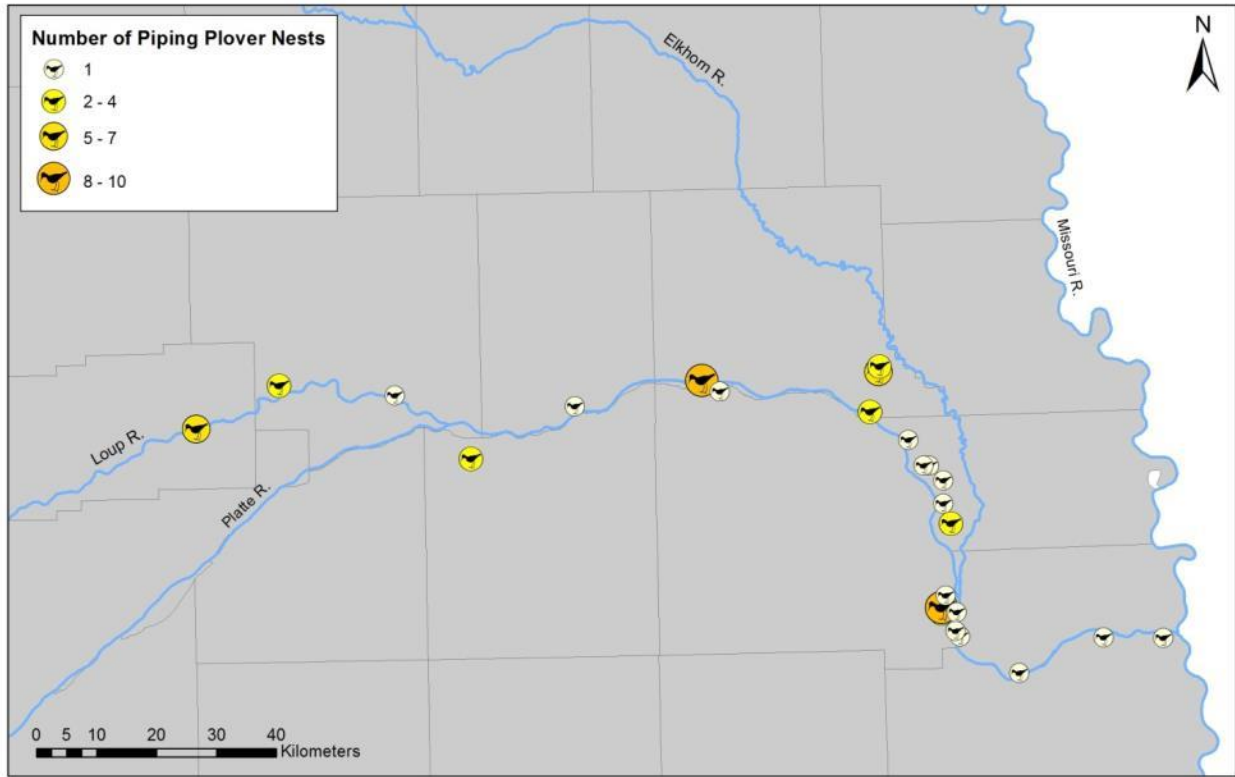


Figure 7. Location of off-river Piping Plover nesting sites in our primary study area in 2014.

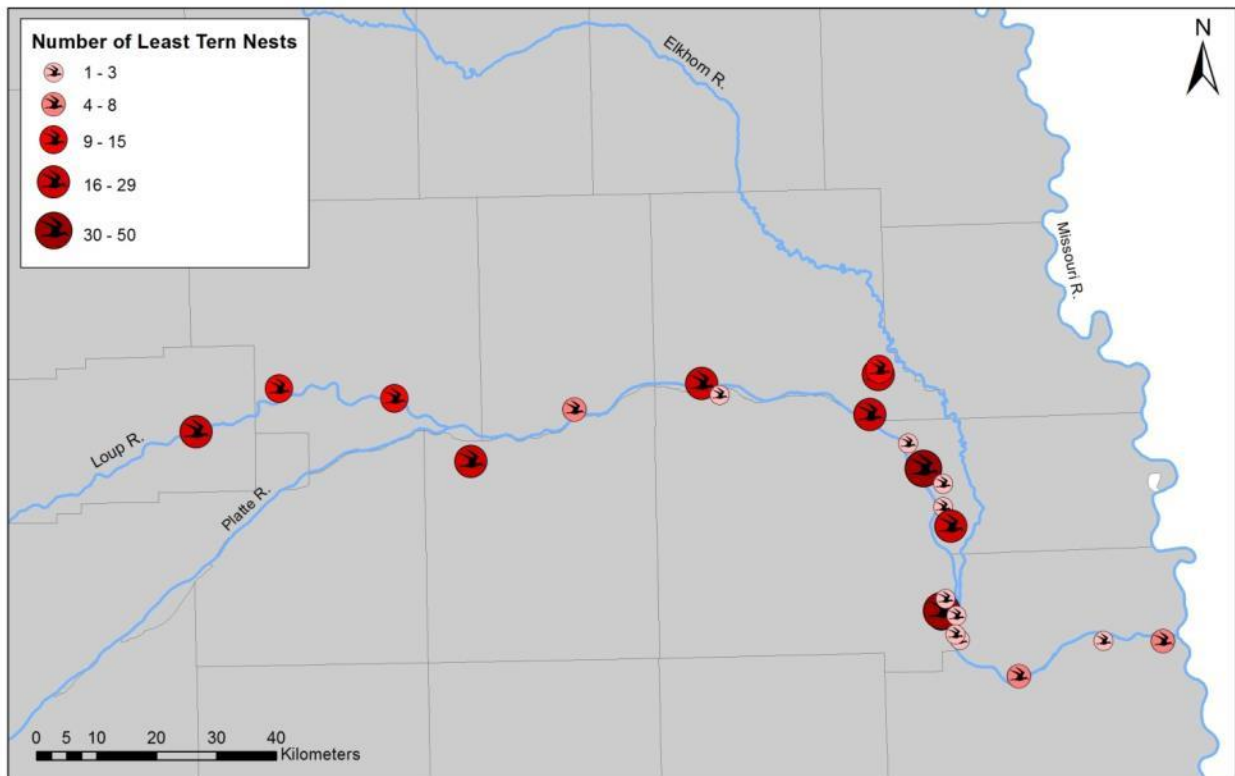


Figure 8. Location of off-river Interior Least Tern nesting sites in our primary study area in 2014.

Table 6. The number of Interior Least Tern and Piping Plover nests and chicks observed at each off-river site in our primary study area in 2014.

Off-River Site	Habitat	Piping Plover		Interior Least Tern	
		# Nests	# Chicks	# Nests	# Chicks
LPPD Loup Diversion	Mine	7	0	22	2
Genoa North #95	Mine	2	3	11	3
Columbus #71	Mine	1	4	9	0
Bellwood #73	Mine	4	6	24	20
Socorro Lake	Housing	1	4	4	1
Riverview Shores	Housing	10	20	21	18
Morse Bluff	Mine	0	0	0	0
NE Fremont South	Mine	6	5	29	17
NE Fremont North	Mine	4	10	9	1
Western Fremont	Mine	2	4	21	2
KMG	Mine	0	0	0	0
Valley #7	Mine	1	4	2	2
Pleasure Lake #11	Mine	1	1	42	62
Mallard Landing	Housing	0	0	0	0
Waterloo #40	Mine	0	0	0	0
OMG Graske Pit	Mine	3	4	20	5
Thomas Lakes	Mine	2	2	12	0
Lake Allure	Housing	1	0	0	0
Sand Creek	Mine	10	8	47	56
Big Sandy	Housing	0	0	0	0
Melia	Housing	1	2	0	0
Linoma Beach #50	Mine	0	0	0	0
Linoma Beach #51	Mine	0	0	0	0
Louisville Lakes	Mine	1	3	7	6
New Collum #3	Mine	0	0	0	0
Oreapolis #8	Mine	1	0	7	0
<b>TOTAL</b>		<b>58</b>	<b>80</b>	<b>287</b>	<b>195</b>

Table 7. The fate of Lower Platte River Piping Plover nests on off-river sand and gravel mines and housing developments in our primary study area in 2014.

Nest Fate	Mines		Housing		TOTAL	
	#	%	#	%	#	%
Confirmed Successful	24	53	10	77	34	59
Likely Successful	3	7	2	15	5	9
Confirmed Failed	11	24	0	0	11	19
Likely Failed	5	22	1	8	6	10
Undetermined	2	4	0	0	2	3
<b>TOTAL</b>	<b>45</b>	<b>100</b>	<b>13</b>	<b>100</b>	<b>58</b>	<b>100</b>

Table 8. The fate of Lower Platte River Interior Least Tern nests on off-river sand and gravel mines and housing developments in our primary study area in 2014.

Nest Fate	Mines		Housing		TOTAL	
	#	%	#	%	#	%
Confirmed Successful	84	32	10	40	94	33
Likely Successful	44	17	10	40	54	19
Confirmed Failed	106	40	2	8	108	38
Likely Failed	25	10	0	0	25	9
Undetermined	3	1	3	12	6	2
<b>TOTAL</b>	<b>262</b>	<b>100</b>	<b>25</b>	<b>100</b>	<b>287</b>	<b>100</b>

Table 9. The number of Interior Least Tern and Piping Plover nests at off-river sites in our study area but outside of our primary study area in 2014.

Off-River Site	Habitat	# of Piping Plover Nests	# of Least Tern Nests
Ulrich	Mine	0	1
Paulsen – Gates	Mine	1	6
Tri-County	Mine	0	0
Pilger	Mine	0	1
<b>TOTAL</b>		<b>1</b>	<b>8</b>



Lauren Dinan (left) and Lindsay Brown (right) banding a newly hatched Interior Least Tern chick at a sand and gravel mine in Douglas County, NE.

**Methods: On-River Habitat**

Access to river sandbars differs from access to off-river sites, so we take a different approach monitoring terns and plovers nesting on midstream river sandbars. We monitored river conditions for the presence of sandbar habitat early in the nesting season. In 2014, river surveys were conducted by kayak and airboat. Kayaks provide the advantage of moving slowly and quietly on the river, which limits disturbance to nesting terns and plovers. Airboats provide the advantage of moving quickly and permit us to survey large sections of the river in a day.

We visually scanned for the presence of terns and plovers and behaviors suggestive of nesting or breeding. When a colony was located, we surveyed the sandbar for nests. Once nests were found, we used the same nest monitoring method as for off-river nests. We recorded nest locations using a handheld GPS unit and recorded the number of eggs in the nests. We floated the eggs to determine the nest initiation date (Hays and LeCroy 1972).

In 2014, most stretches of the river were only surveyed once to determine nest locations and numbers. We did not determine nest success.

**Results: On-River Habitat**

In 2014, high water levels prevented us from surveying the river until mid-July. We conducted river surveys via kayak from river mile 57 near Fremont, Dodge County to river mile 15 near Louisville, Cass County. We were unable to kayak from river mile 15 to river mile 0 near Plattsmouth, Cass County, due to high water levels; however, we surveyed the Cedar Creek sandbar complex (river mile 13 – river mile 12) by scanning it with spotting scopes from a nearby road. The USFWS provided data from airboat surveys on the upper portion of the Lower Platte River. USFWS airboat surveys were conducted from river mile 103 near Columbus, Platte County to river mile 49 near Leshara, Saunders County (Rabbe 2014).

In 2014, a total of 26 Interior Least Tern nests were recorded on eight Lower Platte River sandbars (Fig. 9, Table 10). We did not observe any Piping Plover nests on the river in 2014. The USFWS recorded 13 tern nests on the upper portion of the Lower Platte River and we recorded 13 tern nests on the lower portion of the river. We were unable to confirm nest fates because each site was only visited one or two times. In the USFWS’s final survey conducted on 19 August it was noted that several recently fledged terns were observed with adults (Rabbe 2014). However, the provenance of these fledged terns is not known.

Table 10. The location of Interior Least Tern and Piping Plover nesting colonies and the number of nests observed in each colony on Lower Platte River sandbars in 2014.

River Sandbar	River Mile	Piping Plover	Interior Least Tern
		# Nests	# Nests
East Cedar Creek Sandbar	12.75	0	10
Schramm Sandbar	22.00	0	2
River Mile 31	31.50	0	1
River Mile 66	66.00	0	5
River Mile 73.5	73.50	0	1
River Mile 83.5	83.50	0	2
River Mile 87	87.00	0	2
River Mile 90.5	90.50	0	3
<b>TOTAL</b>		<b>0</b>	<b>26</b>

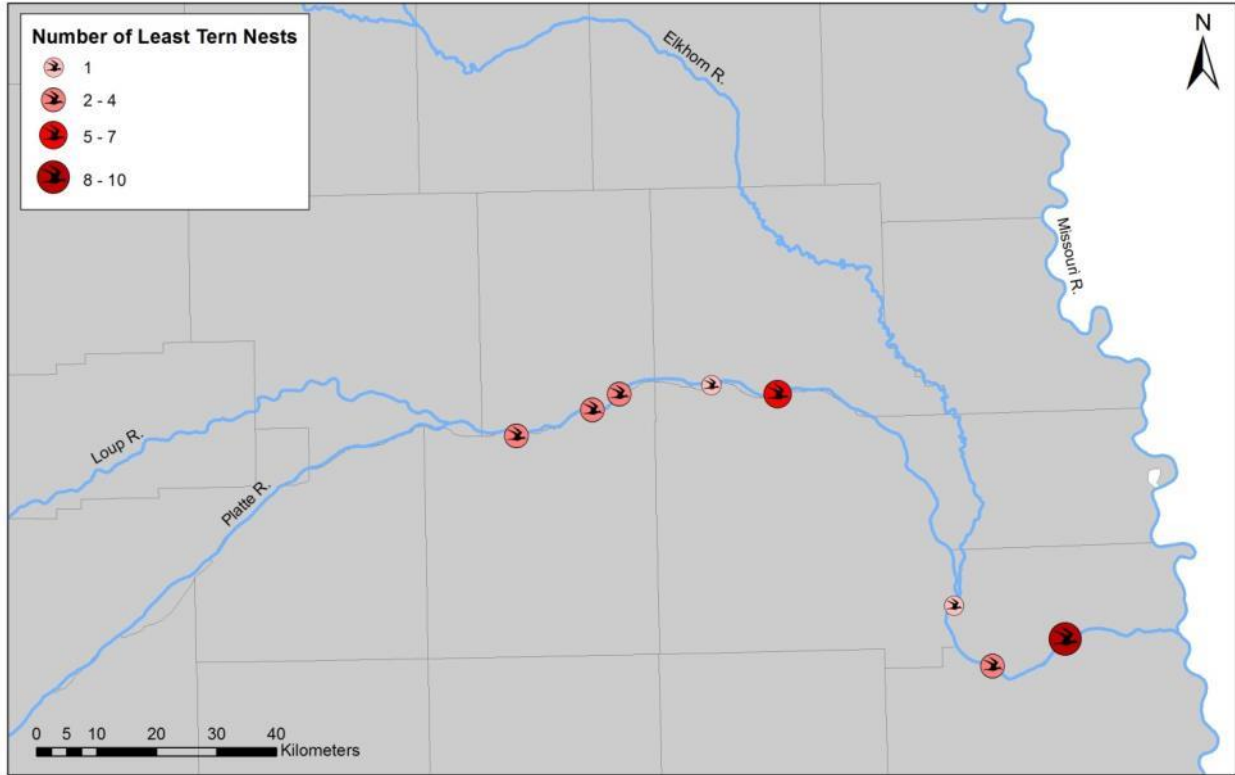


Figure 9. Location of Interior Least Tern colonies on river sandbars along the Lower Platte River in 2014.





## RESEARCH

### ESTIMATING SURVIVAL RATES

Accurately estimating demographic parameters, such as daily and seasonal survival probabilities for individual birds and nests, leads to a better understanding of Interior Least Tern and Piping Plover population dynamics. This allows us to develop and implement more effective management strategies for these two species. We estimated 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**

#### Banding and Re-sighting

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 US 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 # 241; 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 field season with the Bird Banding Laboratory and others with an interest in tern and plover research.

At off-river sites, we captured, banded, and color marked adult Piping Plovers during incubation. The capture, handling, and banding protocols used in 2014 were the same as those used in the previous six years. We used a simple box trap placed over the nest for capture (Fig. 10). This method is effective and minimizes risk of injury to the adult and eggs. Box traps have no moving parts, so nesting birds and their eggs are not injured during capture; the bird walks through the door, settles on its nest, and is captured. 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, 2011, 2012, 2013, or 2014.



Figure 10. 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.

In 2014, we banded each Piping Plover, adult and chick, with an individually-numbered metal USGS band (size 1A) on the upper left leg. We placed a light blue flag on the upper right leg; the light blue flag indicates that this bird was banded in Nebraska along the Platte River. We placed two color bands in one of six combinations (green over red, red over red, red over yellow, red over green, red over black, and red over gray) on the bird's lower left leg; indicating that this bird was banded along the Lower Platte River in 2014. We placed a unique combination of two color bands (red, yellow, green, black, or gray) on the lower right leg. The unique color band combination indicates each bird's individual identity (Fig. 11).

We measured the mass of each Piping Plover adult by placing the bird in a cloth bag and suspending it from a Pesola scale ( $\pm 0.3\%$  accuracy). We measured the following morphological characters for adult plovers: 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 (LRD) to minimize measurement error. We measured the left and right sides of each bird so 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 overwintering habitat for birds; better foraging habitat provides better overwintering survival, nutrition and health for nesting birds.

We captured Piping Plover and Interior Least Tern chicks by picking them up from the sand or from their nests. We banded plover chicks using the same protocol as adult plovers (Fig. 12). We did not place color bands on tern chicks because their legs are very short. We place an individually-numbered USGS band (size 1A) on each tern chick's lower right leg (Fig. 12). We measured each chick's body mass using a digital scale (Ohaus SP401) that was accurate to  $\pm 0.1$  gram. Scales were calibrated using a standardized weight to ensure accuracy. We did not take any morphological measurements of tern or plover chicks.

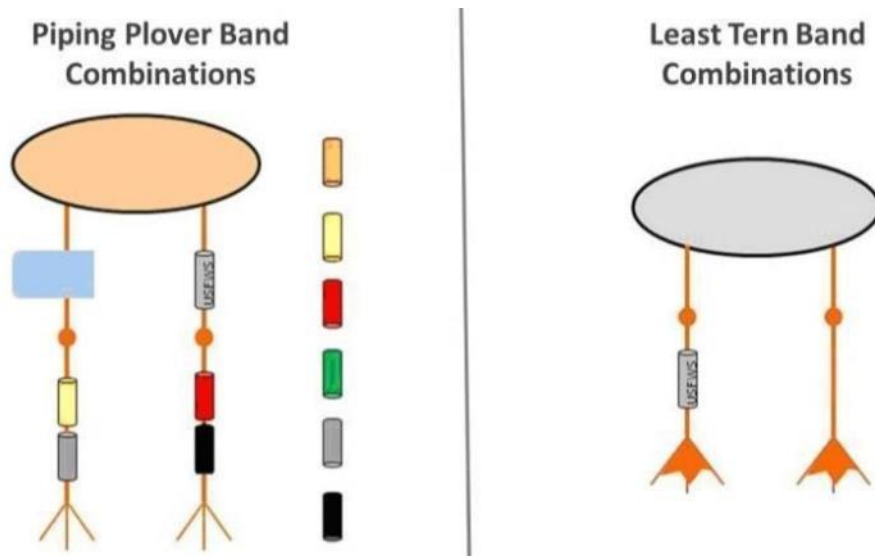


Figure 11. Diagram illustrating the banding scheme used on Piping Plovers and Interior Least Terns banded along the Lower Platte River. The flags, color bands, and metal bands may be on either leg and plover color combinations vary.

### Daily and Seasonal Survival Analyses

We monitored Piping Plover and Interior Least Tern nests throughout the nesting season (see Monitoring section for details). We used nest monitoring data to calculate daily and seasonal nest survival probabilities. We attempted to re-sight banded terns and plovers every five to seven days. If birds were recaptured, we weighed them. We used this capture-mark-recapture dataset to calculate daily and seasonal survival probabilities for each individual.

We estimated survival probabilities using the software program MARK (White and Burnham 1999). We used the general methods of Lebreton et al. (1992), Burnham and Anderson (2002), and Dinsmore and Dinsmore (2007). We assessed model fit for each analysis using the Akaike's Information Criterion (AIC); the model with the lowest AIC value was considered the model that best fit the data.

#### *Nest Survival Analysis*

We used data from nest monitoring (see Monitoring section) to estimate nest survival. We estimated nest survival probabilities 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 ( $j$ ). Due to small sample sizes we did not include any covariates in our model and assumed constant survival across the season. We provide both apparent daily survival probability and apparent seasonal survival probability. Apparent seasonal survival is the probability a nest will survive the 21- or 28-day incubation period and it is estimated by extending the daily survival probability to the appropriate number of incubation days.

#### *Within Year Individual Survival Analysis*

We constructed individual encounter histories for all terns and plovers captured, recaptured or observed at off-river sites. We used this data to determine the probability of adults and chicks surviving the 2014 nesting season. We provide both apparent daily survival probability and apparent seasonal survival probability for adults and chicks. Adult plovers included in this analysis were originally color-banded along the Lower Platte River, Central Platte River, Missouri River, or the US Gulf Coast. Tern and plover chicks included in this analysis were produced and banded in our primary study area. We did not include any covariates in the models. We attempted 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 relatively small sample sizes.

#### *Between Year Annual Survival Analysis*

We constructed individual encounter histories for all plovers captured, recaptured, or observed in our primary study area from 2008 through 2014. We used this data to determine the probability of Piping Plovers surviving from one year to the next. We do not have sufficient numbers of re-sightings of Interior Least Terns to consider them in this type of analysis.

### Growth Curve Analysis

Our growth curve analysis for 2014 included only tern and plover chicks produced at off-river sites. We weighed chicks every time they were encountered. In cases where the chick was banded while still in or very close to the nest, we 'age' them based on the nest's known hatching date. If chicks were banded after they left the nest, we estimated their age using an age-based time series of photographs.

## Statistical Analysis

All statistical analyses were performed using SAS (2004), Prism (2000), or SigmaPlot (2011). Due to small sample sizes, we used nonparametric statistical tests; statistical significance was set at  $P < 0.05$ . Means ( $\pm 1$  SE) are reported.

## **Results**

### Banding and Re-sighting

In 2014, we banded 99 Piping Plovers and 190 Interior Least Terns; all banding occurred at off-river sites.

At off-river sites, we captured and banded 27 plover adults and 72 plover chicks. We re-sighted 36 plovers that were originally banded along the Lower Platte River in previous years, 9 plovers that were originally banded along the Missouri River, two originally banded along the Central Platte River, and five originally banded along the US Gulf Coast.

At river sandbars, we re-sighted one plover originally banded along the Lower Platte River in a previous year. We did not band any plover adults or chicks on river sandbars in 2014.

At off-river nesting sites, we captured and banded 190 tern chicks. Most tern chicks were less than one week old when banded. Four adult terns with a metal band on their right leg were observed throughout the nesting season. We did not recapture any of these banded adults.

At river sandbars, we did not band any terns on river sandbars in 2014.



A two-week old Interior Least Tern chick that was banded as a one-day old chick and was recaptured.

Daily and Seasonal Survival

*Piping Plover Nest Survival*

We estimated Piping Plover nest survival from 56 plover nests located at off-river sites (13 at lakeshore housing developments and 43 at sand and gravel mines). We did not include two plover nests in which nest fate was undetermined. In 2014, off-river plover nests had an apparent daily survival probability of  $0.981 \pm 0.005$ . The apparent seasonal survival probability, over the 28-day incubation period, was  $0.584 \pm 0.086$ . The apparent daily survival probability for plover nests at lakeshore housing developments was  $0.996 \pm 0.004$  and the apparent seasonal survival probability was  $0.894 \pm 0.107$ . The apparent daily survival probability for plover nests at sand and gravel mines was  $0.975 \pm 0.006$ ; the apparent seasonal survival probability was  $0.492 \pm 0.086$ .

In 2014, we placed protective exclosures around 33 of the 56 off-river Piping Plover nests. Nests with protective exclosures had higher daily and seasonal survival probabilities than nests without protective exclosures. Nests with protective exclosures had a daily survival probability of  $0.993 \pm 0.003$  and a seasonal survival probability of  $0.821 \pm 0.073$ ; while nests without protective exclosures had a daily survival probability of  $0.962 \pm 0.015$  and a seasonal survival probability of  $0.338 \pm 0.146$  (Fig. 12).

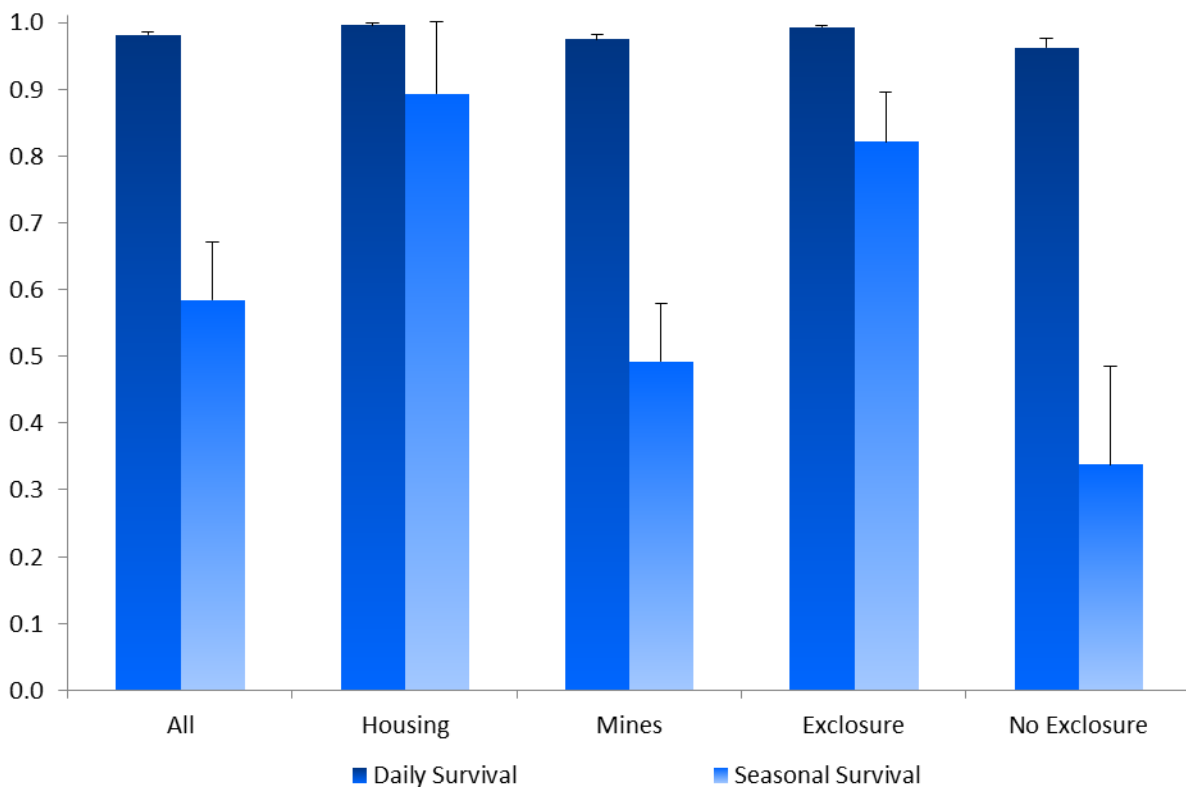


Figure 12. Daily and seasonal survival probabilities of Piping Plover nests on off-river sites in 2014.

*Interior Least Tern Nest Survival*

We estimated Interior Least Tern nest survival from 282 nests at off-river sites (22 at lakeshore housing developments and 260 at sand and gravel mines). We did not include 6 tern nests in which nest fate was undetermined. In 2014, the apparent daily survival probability of off-river tern nests was  $0.966 \pm 0.003$ . The apparent seasonal survival probability, over the 21-day incubation period, was  $0.487 \pm 0.033$ .

Tern nests at lakeshore housing developments had an apparent daily survival probability of  $0.995 \pm 0.004$  and an apparent seasonal survival probability of  $0.900 \pm 0.104$ . Tern nests at sand and gravel mines had an apparent daily survival probability  $0.963 \pm 0.003$  and an apparent seasonal survival probability of  $0.453 \pm 0.030$  (Fig. 13). In 2014, we were unable to estimate nest survival for tern nests on river sandbars.

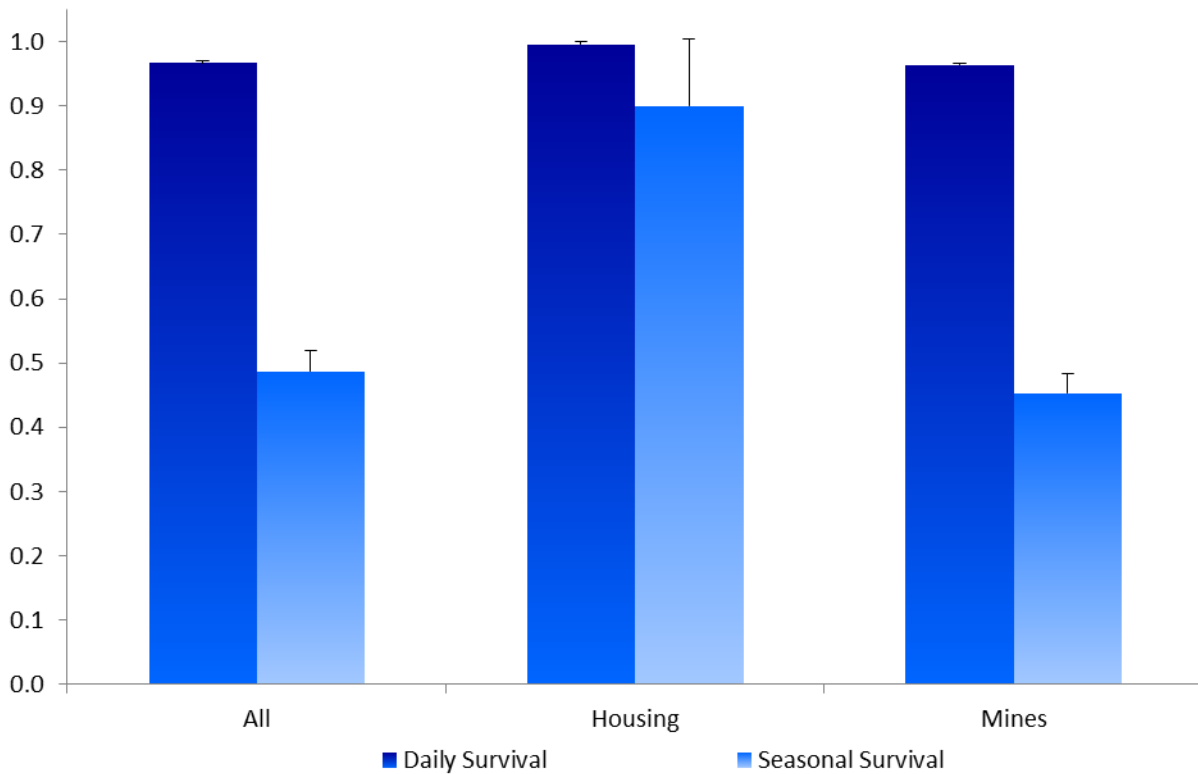


Figure 13. Daily and seasonal survival probabilities of Interior Least Tern nests on off-river sites in 2014.

#### *Within Year Individual Survival*

The apparent daily survival probability for adult plovers nesting at off-river sites was  $0.983 \pm 0.003$ . The apparent seasonal survival probability was  $0.626 \pm 0.052$  (Fig. 14). Adult plovers had a higher survival probability at housing developments than at sand and gravel mines (Fig. 15).

The apparent daily survival probability for plover chicks reared at off-river sites was  $0.938 \pm 0.011$ . The apparent seasonal survival probability was  $0.169 \pm 0.052$  (Fig. 14). We found that plover chicks had higher survival probability at sand and gravel mines than at housing developments (Fig. 16).

Based on our population of Interior Least Tern chicks banded in 2014, the apparent daily survival probability for terns reared on off-river sites was  $0.985 \pm 0.007$  and the apparent seasonal survival probability of terns reared on off-river sites was  $0.730 \pm 0.138$  (Fig. 14). Due to the low number of tern recaptures at housing developments we were unable to compare survival probabilities of at housing developments and mine sites. The 2014 seasonal survival estimate is substantially higher than seasonal survival estimates on off-river sites in previous years (Fig. 17).

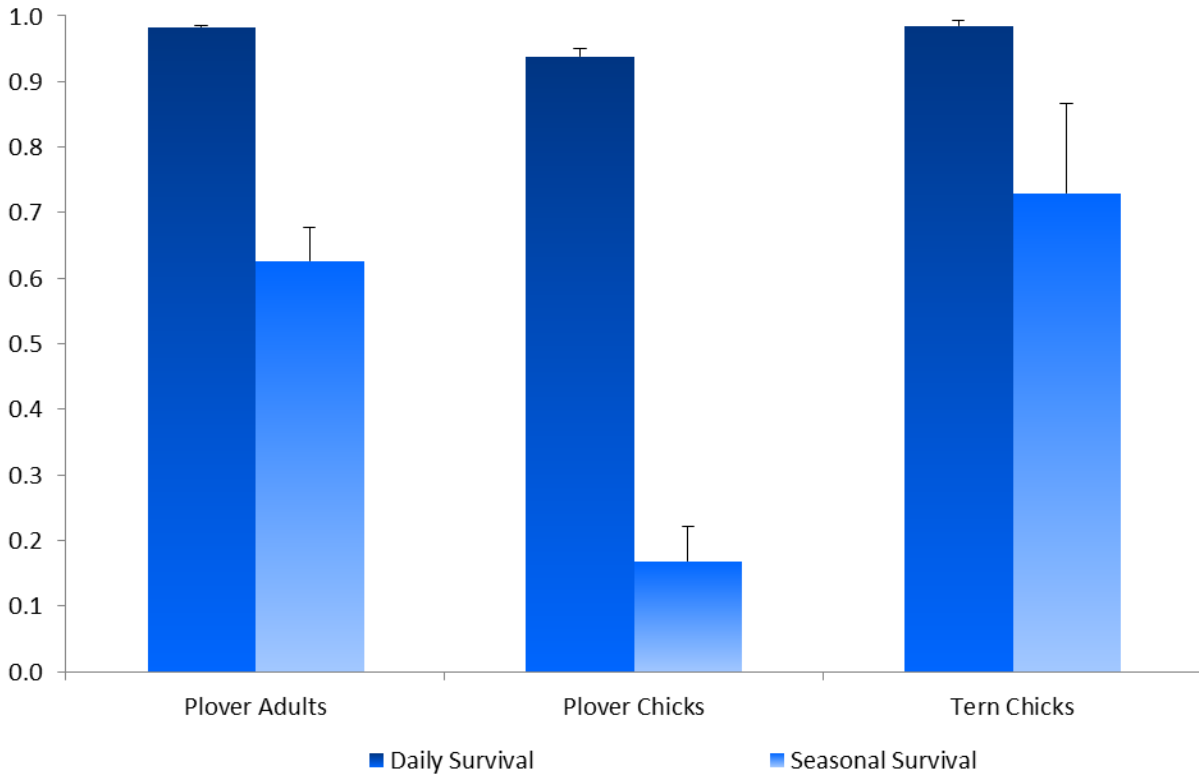


Figure 14. Piping Plover and Interior Least Tern within year daily and seasonal survival probabilities on off-river sites in 2014.

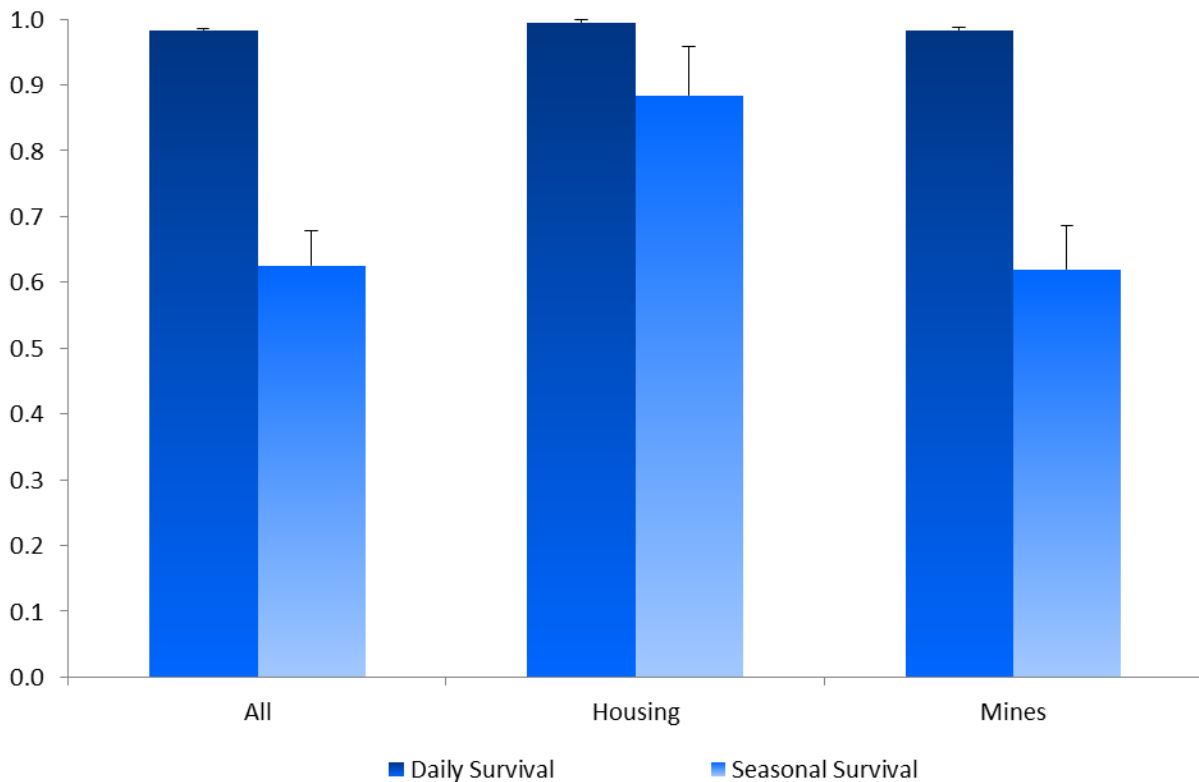


Figure 15. Piping Plover adult daily and seasonal survival at off-river sites in 2014.

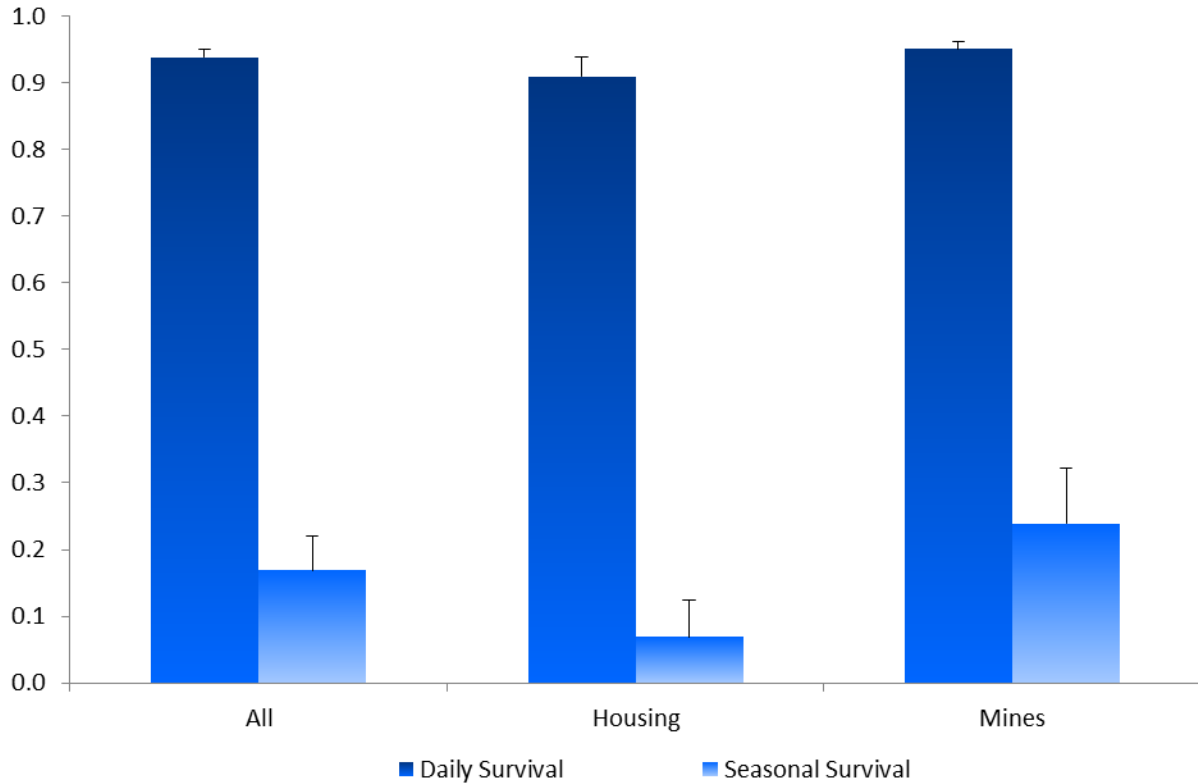


Figure 16. Piping Plover chick daily and seasonal survival at off-river sites in 2014.

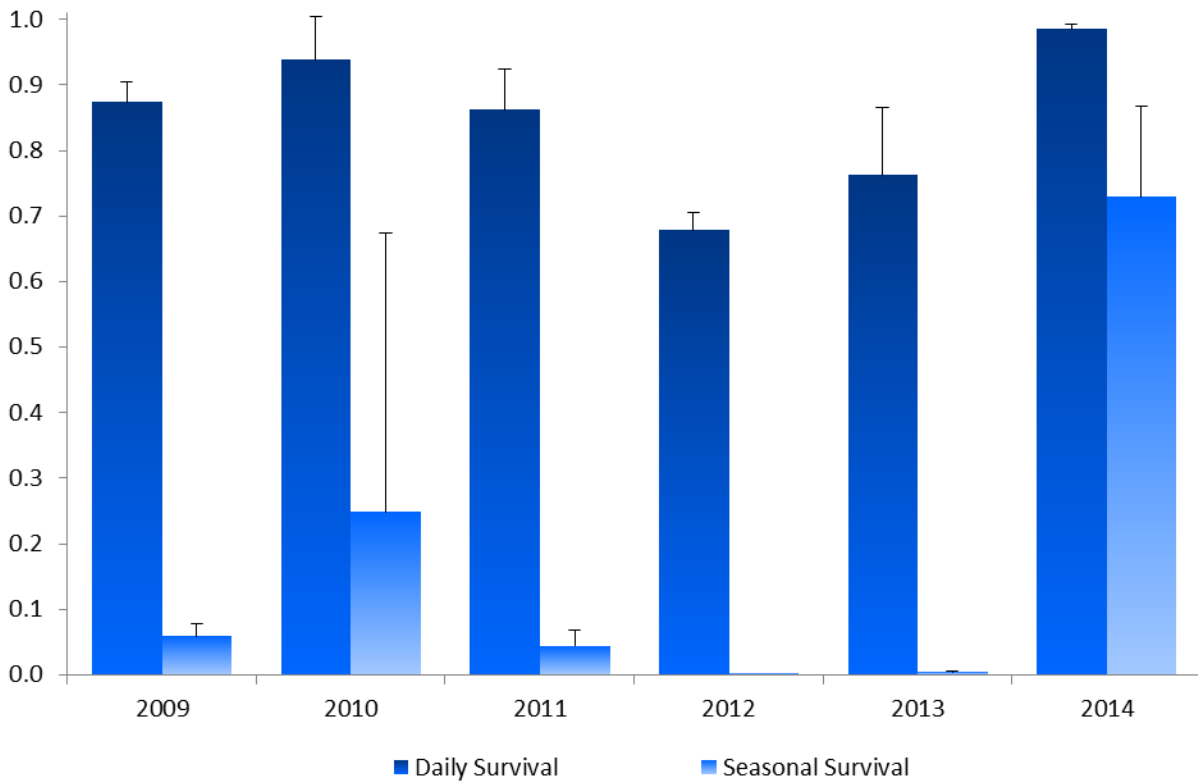


Figure 17. Interior Least Tern chick daily and seasonal survival at off-river sites each year.



*Between Year Annual Survival*

The apparent annual survival probability for plovers originally banded as adults along the Lower Platte River, 2008 to 2014, was  $0.719 \pm 0.037$  and the annual recapture probability was  $0.711 \pm 0.052$  (Fig. 18). We found apparent annual survival for adult plovers was slightly higher for those banded at lakeshore housing developments than sand and gravel mines (Fig. 18).

We estimated between year annual survival rates for plovers originally banded as chicks using data from mines and housing developments combined. The apparent survival probability for plovers originally banded as chicks over their first migration-winter cycle was  $0.465 \pm 0.127$  and the recapture probability was  $0.250 \pm 0.078$  (Fig. 19). These estimates do not distinguish between mortality and dispersal to breeding areas separate from their natal areas (e.g., away from our study area), so they are likely biased low. The apparent survival probability for plovers originally banded as chicks over their subsequent migration-winter cycles was  $0.545 \pm 0.109$  and the recapture probability was  $0.391 \pm 0.127$  (Fig. 19).

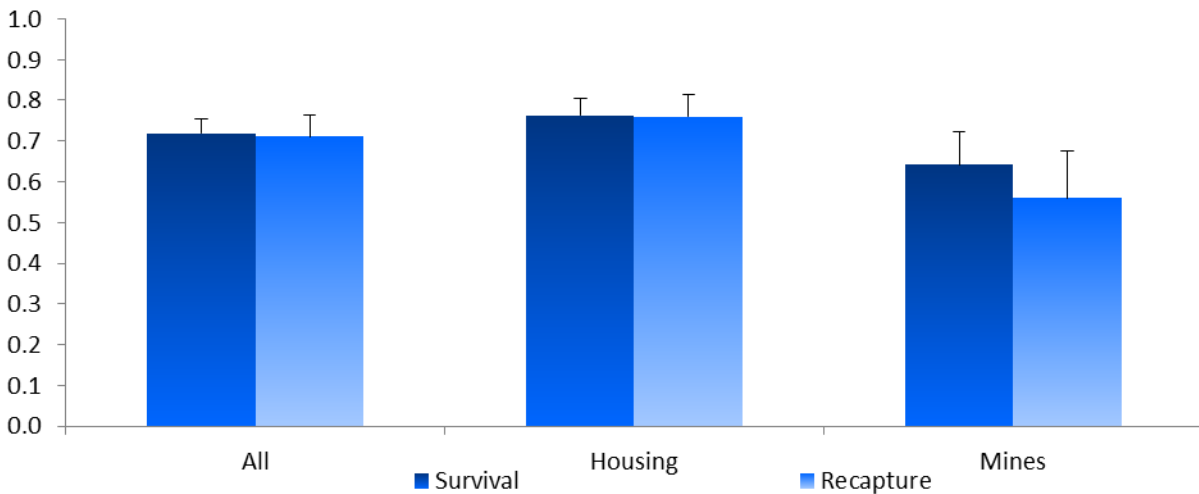


Figure 18. Between year annual survival and recapture probabilities for Piping Plovers originally banded as adults along the Lower Platte River from 2008 to 2014.

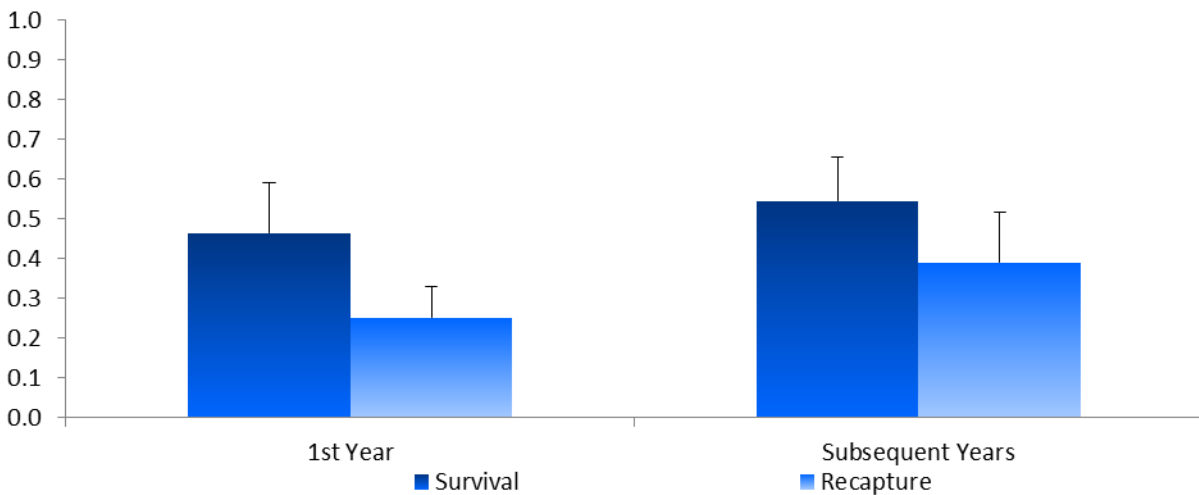


Figure 19. Between year annual survival and recapture probabilities for Piping Plovers originally banded as chicks along the Lower Platte River from 2008 to 2014. The first set of columns shows the survival and recapture probabilities during plover's first migration-winter cycle and the second set of columns shows the survival and recapture probabilities over the subsequent years.

Growth Curves

We created Piping Plover and Interior Least Tern growth curves from the 72 plover chicks and 190 tern chicks banded on off-river sites in 2014. The best fit regression lines for tern and plover chick growth curves were third-order polynomials. The regression line that best fit our 2014 plover chick data showed that plover chicks grew at a fairly constant rate with their growth rate increasing slightly as they got older and then leveling off as they reached fledgling age (Fig. 20). The regression line that best fit our 2014 tern chick growth data showed that tern chicks reared on off-river sites grew more rapidly when they were younger and the growth rate decreased as they came closer to fledging (Fig. 21).

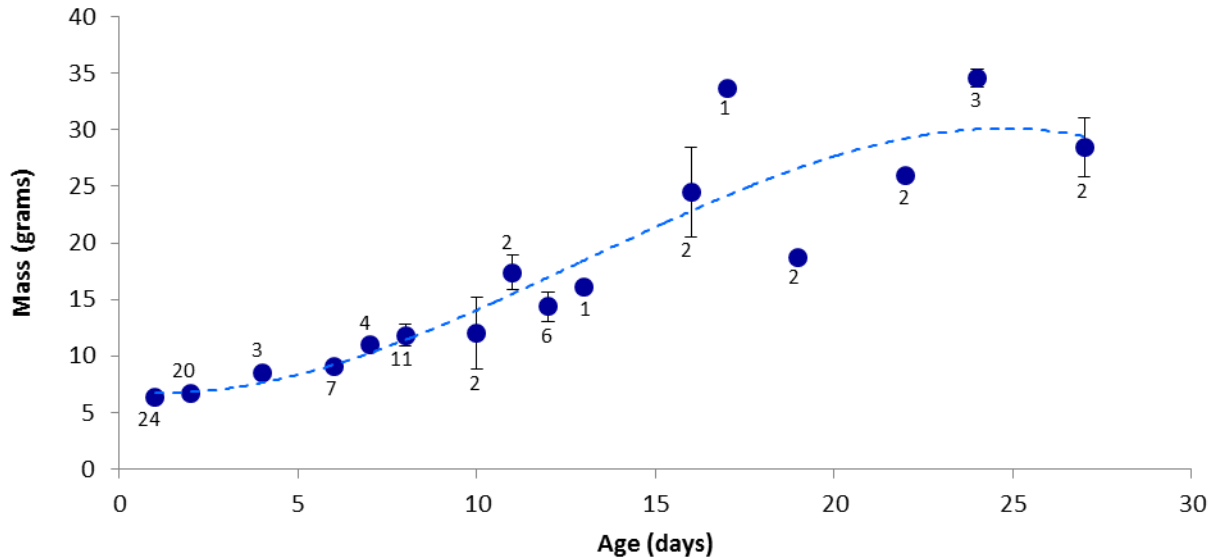


Figure 20. Growth rate of Piping Plover chicks reared on off-river sites in 2014. The graph shows the data represented as mean body mass, standard error, sample size (number weighed at each age) and the best fitting third order polynomial trend line describing plover chicks' growth rate ( $R^2 = 0.840$ ).

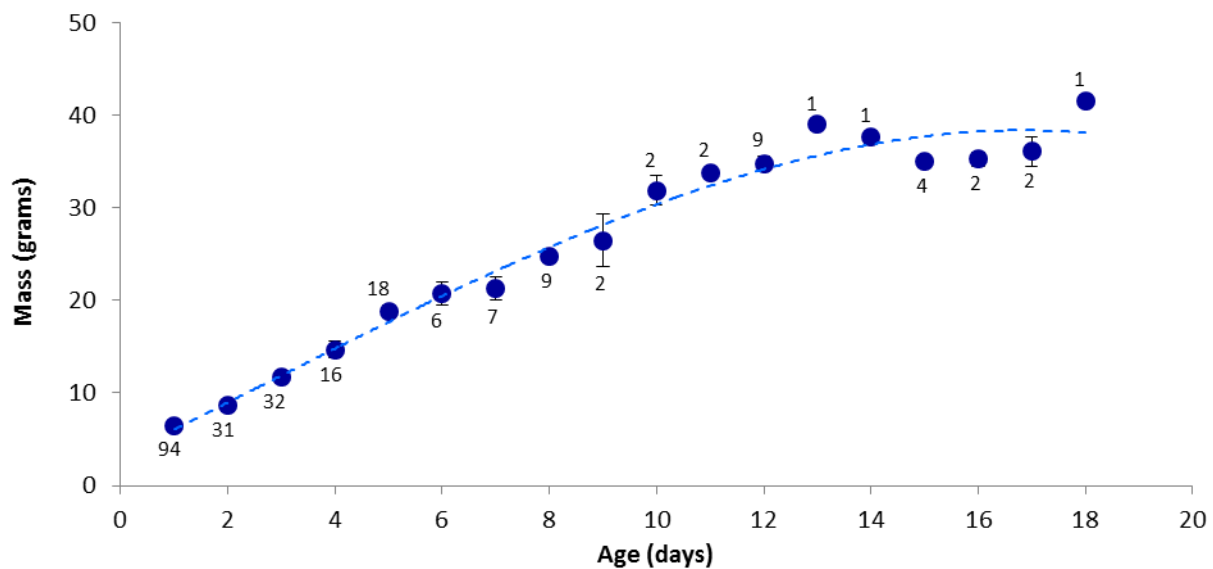


Figure 21. Growth curve of Interior Least Terns chicks reared on off-river sites in 2014. The graph shows the data represented as mean body mass, standard error, sample size (number weighed at each age) and the best fitting third order polynomial trend line describing tern chicks' growth rate ( $R^2 = 0.972$ ).

## **MANAGEMENT**

The TPCP uses a voluntary, proactive approach to reduce human-bird conflicts and reduce the need for law enforcement actions in Interior Least Tern and Piping Plover management.

Before terns and plovers return to Nebraska in the spring and the field season begins, TPCP personnel meet with the production crews and property managers of all area aggregate (sand and gravel) mines. We discuss the companies' production plans for the upcoming season, safety regulations, and site access. We pay particular attention to concerns mine personnel have regarding on-site activities of the TPCP and changes to federal MSHA (Mine Safety and Health Administration) policy as it applies to non-mine personnel. We also meet with homeowners' associations at the lakeshore housing developments. At these meetings, we discuss the construction plans for the area and site access. We pay particular attention to property owners' concerns regarding on-site activities of the TPCP.

The result of these meetings is a set of site-specific management and monitoring plans; an equally valuable result is the TPCP becoming better acquainted with the people living and working at these sites. This makes our management efforts easier to implement and more effective as the nesting season progresses. We maintain close contact with these individuals throughout the season, so we can quickly respond to any on-site changes that develop.

### **MSHA (Mine Safety and Health Administration)**

Every year, all TPCP personnel receive MSHA (Mine Safety and Health Administration) training and certification for scientific (non-miner) workers. In 2014, our training was again provided by Tim Zuehlke, a MSHA certified trainer, and included mine safety, Red Cross First Aid, CPR and AED training. Copies of TPCP personnel certification cards are provided to the mining companies for their records.

### **Protecting Interior Least Tern and Piping Plover Nests**

To protect tern and plover nesting areas, we erect "Keep Out" signs around the perimeter of all off-river nesting areas; these signs were designed in 2008 by the TPCP and have been widely adopted for use across Nebraska and other parts of the northern Great Plains. In areas where considerable human foot or vehicle traffic is to be expected, 'psychological' barriers are added. These barriers consist of black or orange cord tied between all of the "Keep Out" sign posts with red-silver Mylar™ streamers attached to the cord to make it more visible.

Based on conversations with mine production managers and homeowners' associations before the nesting season begins, we mark off the areas where it would be safest for the terns and plovers not to nest. At mines, these are areas that are going to be dredged during the nesting season or where heavy equipment is going to be operating. At housing developments, these are areas where buildings are to be constructed or utilities are to be installed. We know that terns and plovers avoid nesting in areas where substrate is disturbed by raking, vegetation is present, substrate particle size is unattractive to the birds or where the surface has been physically disturbed (J. Marcus, J. Dinan, R. Johnson, E. Blakenship, and J. Lackey 2007. *Waterbirds* 30: 251 – 258). Along with planting vegetation, resurfacing the sand, and raking the substrate, when absolutely necessary we opt for a physical method of discouraging birds from nesting in an area. Well before the birds arrive, 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 use protective wire mesh nest enclosures around plover nests, but not tern nests because of the birds' behavior around their nests—plovers walk up to their nests and terns fly up to their nests. In 2014, we placed enclosures around 35 off-river plover nests; the remaining 23 nests did not have enclosures. These enclosures help to protect plover nests from both human disturbance and natural predation. For terns, we place protective boundaries around tern nesting colonies that were in areas with human activity. We do this by placing a ring of 3-foot tall rebar poles around the nesting area; black cord with red-silver Mylar strips 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.

#### **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 continued our cooperative project to clear vegetation from sandbars in the Lower Platte River (river mile 0 – 103). In late summer weedy vegetation on sandbars, including invasive phragmites and purple loosestrife, was sprayed with herbicide using GIS controlled helicopter sprayers (SkyCopters, Ulysses, KS) and handheld sprayers. Winter ice jams and high spring flows overtopping the sandbars removes much of the standing, dead vegetation making the sandbars attractive to nesting terns and plovers.

#### **Lake McConaughy Piping Plover Human Dimensions Study**

In 2014, we completed the second season of a research project initiated in 2013 aimed at helping us better understand the impacts of human recreation on the nesting success of Piping Plovers on the beaches of Lake McConaughy, Keith Co., NE. During the first season, we conducted surveys of people using the beaches and observed Piping Plover nests during incubation to quantify the amount of disturbance the birds' experience. During the second season, we continued conducting surveys and observing incubating plover nests, but added observation of brood behavior to quantify how adults and chicks utilized the beach. The survey questions addressed knowledge and opinions of wildlife protection laws, Piping Plovers, and beach use regulations.



Piping Plover nest with a wire enclosure around it at a sand and gravel mine in Saunders County, NE.

## OUTREACH

Essential to our mission to protect Interior Least Terns and Piping Plovers is our outreach program. 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 nesting 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 opportunities to reach as many different constituencies as possible with our message of common-sense conservation. The number of adults and children we are able to reach across the state has grown substantially over the past few years (Figs. 22 – 23). The TPCP is now one of the go-to programs in Nebraska's environmental education community. We have evolved from being an organization that needed to seek out events to participate in to one that receives a stream of requests for participation. It is gratifying for us to meet people who know what the TPCP does and who commend us for our work.

**TernCam:** Jeff Dale (Lincoln, NE; TrlCam, Inc.), Aaron Clark (Omaha, NE), Mark Mesarch (SNR UNL), and Ben Wheeler (Ord, NE; NGPC) helped us present "TernCam" in 2014—a streaming video camera based at a sand and gravel mine near Gates, NE . The video streamed live and could be viewed on our web page during the nesting season. In 2014, the camera focused on one nest, which successfully hatched two chicks. The camera is solar powered and the video streams via a wireless internet connection. In 2014, TernCam received visitors from around the world; many visitors also visited other sections of our web page.

**SwallowCam:** Working with Michael Forsberg, Jeff Dale, Nebraska Educational Television, and the Platte River Time Lapse Project (<http://plattebasintimelapse.com>), we placed a streaming video camera on the Lied Hiker-Biker Trail Bridge over the South Platte River near South Bend, NE. The camera can be turned to focus on the Cliff Swallow nests on the bridge or turned to look up the river towards the west (and sandbars that have supported nesting terns and plovers in the past).

**Chimney SwiftCam:** Working with Michael Forsberg, Jeff Dale, the Lincoln Public Schools (Irving Middle School) and Westminster Presbyterian Church in Lincoln, NE, we placed several cameras in and on chimneys at the school and the church that supports nesting and migratory roosting colonies of Chimney Swifts. Students in the 'Chimney Swift Club' at IMS will be included in several research projects associated with the camera beginning in Fall 2014.

**On-Line Activities:** The internet and social media continue to be important tools in expanding our outreach program. Our website (<http://ternandplover.unl.edu>) underwent a complete redesign during the past year and it is frequently updated with information about the Partnership. Our YouTube videos, "Respect the Signs, Respect the Birds", "Plover at Nest" and "Points about Plovers" continue to generate interest in the TPCP.

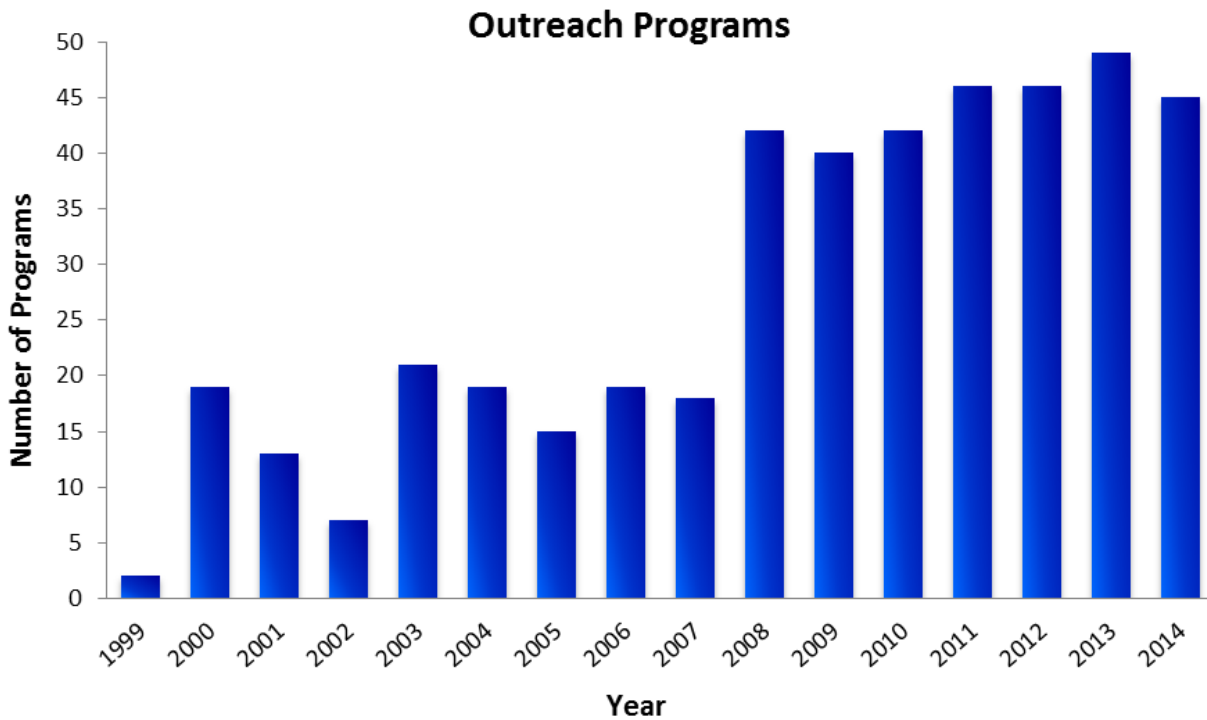


Figure 22. Number of programs delivered by the TPCP from 1999 through 2014 (this only includes scheduled programs; we frequently deliver impromptu presentations).

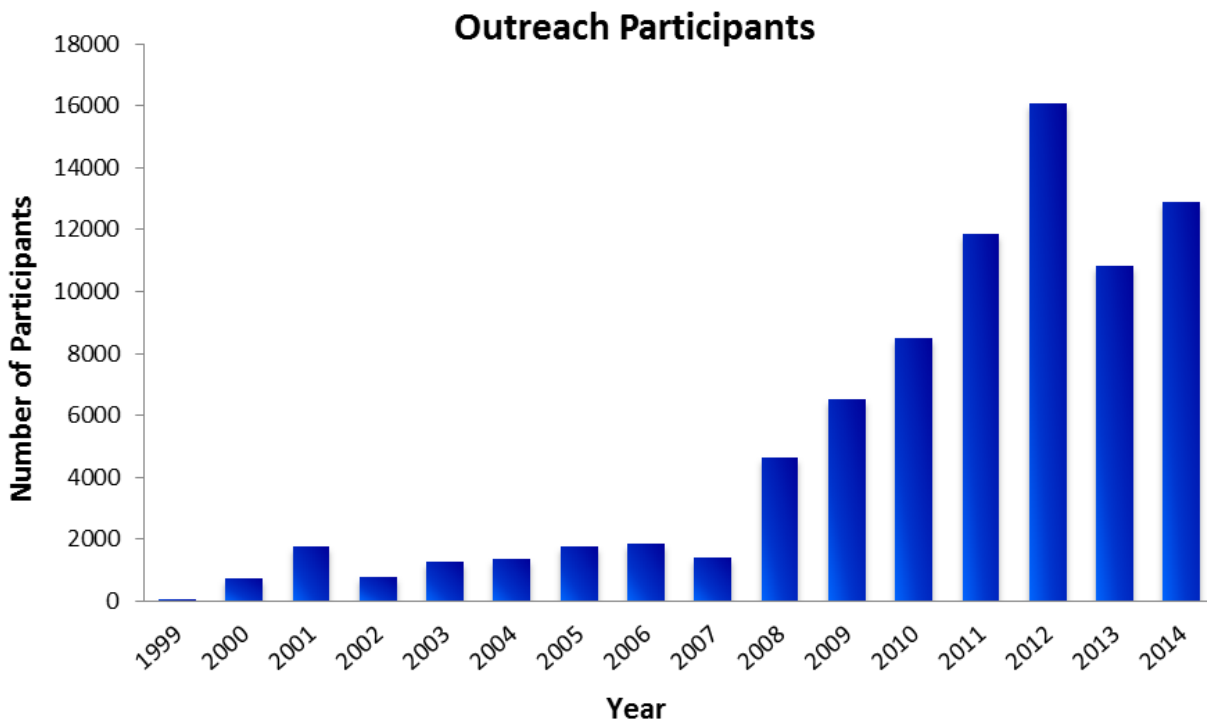


Figure 23. Number of participants in TPCP programs from 1999 through 2014 (this only includes scheduled programs; we frequently deliver impromptu presentations).

### **Programs for the General Public**

Audubon's Nebraska Crane Festival, Kearney, NE  
Calvert Elementary School Family Nature Night, Lincoln, NE  
Capital City Foot Printers, Lincoln, NE  
Cavett Elementary School Family Nature Night, Lincoln, NE  
Dimensions School Family Nature Night, Lincoln, NE  
Durham-Smithsonian Museum Teacher's Night Out, Omaha, NE  
EarthWellness Festival, Lincoln, NE  
Eastridge Elementary School Family Nature Night, Lincoln, NE  
Elmwood-Murdock Public School Family Nature Night, Murdock, NE  
Fremont Eco-Fair, Fremont, NE  
Iowa Western Community College, Council Bluffs, IA  
Lakeview Elementary School Family Nature Night, Lincoln, NE  
Lincoln Kiwanis Sunrisers, Lincoln, NE  
Lincoln Public Schools Science Fair, Lincoln, NE  
Marley Elementary School, Family Nature Night, Lincoln, NE  
Nebraska Junior Academy of Sciences, Lincoln, NE  
Nebraska Science Festival, Lincoln, NE  
Sandhills Discovery, Ainsworth, NE  
Wahoo Bird Club, Wahoo, NE  
Wild Experience Room, Kearney, NE

### **Homeowners' Associations**

Big Sandy, Blue Water, Lake Allure, Lake Socorro, Mallard Landing, Riverview Shores, Thomas Lakes, Ritz Lake

### **University of Nebraska-Based Education Programs**

Cedar Point Biological Station Research Round-Up  
SNR Career Fair  
SNR Environmental Studies Showcase

### **Education-Curriculum Development Activities**

Iowa Western Community College Environmental Studies  
Lincoln Public Schools  
Nebraska Alliance of Conservation and Environment Educators  
University of Nebraska School of Natural Resources

### **Conferences**

Association of American Geographers, Tampa, FL  
Atlantic Coast Piping Plover and Least Tern Biennial Workshop, Shepherdstown, WV  
Congress for Wildlife and Livelihoods on Private and Communal Lands, Estes Park, CO  
International Ornithological Congress, Tokyo, Japan  
Midwest Fish and Wildlife Conference, Kansas City, MO  
Missouri River Institute, Vermillion, SD

Missouri River Natural Resources Conference, Nebraska City, NE  
Nebraska Concrete and Aggregate Association, Grand Island, NE  
Nebraska Natural Legacy Conference, Nebraska City and Gering, NE  
Wilson Ornithological Society, Newport, RI

### **Professional Committees and Workgroups**

Lower Platte River Weed Management Area  
Nebraska Bird Partnership Steering Committee  
Nebraska Environmental Trust Technical Advisory Committee  
Rivers and Wildlife Celebration Committee

### **Miscellaneous**

Interior Least Tern 5-year review: provided assistance to the review team  
KQED-QUEST: online sustainability science

### **Featured in the Media**

“Endangered Species Daily Facts: Interior Least Terns”; [www.fws.gov/midwest/endangered/ESDaily](http://www.fws.gov/midwest/endangered/ESDaily),  
calendar, Twitter feed and [www.facebook.com/USFWSMidwest](http://www.facebook.com/USFWSMidwest).

“Good news for endangered species on Lower Mississippi River Interior Least Tern, other species benefit  
from collaborative approach to conservation”, interview Science magazine (with Erik Stodstad).

October 2014, “Endangered birds depend on heavy Industry for survival” by Ariana Brocius – Platte  
Basin Timelapse, NET and Nebraska’s NPR Station.

August 2014, “Piping Plovers returning to Gulf Coast”, NebraskaLand Magazine – Nongame Bird Blog.

June 2014, “Piping Plover beach battle”, NebraskaLand Magazine – Nongame Bird Blog (also in Lincoln  
Journal Star and Omaha World Herald).

May 2014, “What do swallows eat on a cold windy day”, The Prairie Ecologist blog.

April 2014, “Happenings on the Hill”, Preferred Sands of Genoa newsletter.

April 2014, “Researchers discover unusual prairie chicken movement”, Today’s Exclusive on NSF Science  
360 news service, <http://news.science360.gov/archives/20140423>.

March 2014, “Searching for Nebraska Piping Plovers in Texas”, NebraskaLand Magazine – Nongame Bird  
Blog.

February 2014, “An update on Erwin the Plover”, NebraskaLand Magazine – Nongame Bird Blog.

February 2014, “For the birds”, Pit and Quarry Magazine.

January 2014, “Spotted...Again”, NebraskaLand Magazine – Nongame Bird Blog.

December 2013, “How people drove evolution in Cliff Swallows”, KQED QUEST.



December 2013. "A riddle: what do the Lower Platte and the Missouri Rivers have in common", Platte River Update-LPRCA Fall/Winter newsletter.

October 2013. "They grow up so quickly", NebraskaLand Magazine – Nongame Bird Blog.

### **Grants and Fundraising**

Imperiled Birds and their Habitat in Nebraska, Nebraska Environmental Trust, year 3 (2012–2015)

Toward Adaptive Management: Evaluating Piping Plover Management at Lake McConaughy, Nebraska State Wildlife Grant, Nebraska Game and Parks Commission, awarded 2013–2015

### **Publications**

Brown, M.B., J.G. Jorgensen and L. Dinan. 2013. 2013 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 Nebraska Game and Parks Commission Non-game Bird Program, Lincoln, NE.

Johnsgard, P.A., E. Fowler, M. Forsberg, M.B. Brown, P. Freeman, J. Loomis, D. Ebbeka. 2014. Game Birds of the World-The Madsen Collection. Conservation and Survey Division, University of Nebraska, Lincoln, NE.

Jorgensen, J.G. and M.B. Brown. 2013. Evaluating interactions between recreationists and Piping Plovers (*Charadrius melodus*) at Lake McConaughy, NE. Joint report of the Tern and Plover Conservation Partnership and the Nebraska Game and Parks Commission Non-game Bird Program. Lincoln, NE.

Smith, J.A., L.A. Powell, and M.B. Brown. in review. Crows, pitchers, and conservation: training biologists for work on private lands. Wildlife Society Bulletin.

### **Reviewers for Professional Publications and Organizations**

Auk (American Ornithologists' Union)  
Ecology and Evolution  
Great Plains Research (Center for Great Plains Studies)  
Ibis (British Ornithologists' Union)  
Nebraska Environmental Trust  
Nebraska Game and Parks Commission  
United States Fish and Wildlife Service  
Wilson Journal of Ornithology (Wilson Ornithological Society)

### **Miscellaneous**

Hold UNL IACUC#877 research approval certificate

Hold UNL IRB#20130213371EX research approval certificate

Hold NGPC Scientific and Educational permit # 905. Authorized to trap, net, band, release, and salvage endangered Least Tern, threatened Piping Plover, and incidental species

Hold USFWS Master Bander permit # 23545, with authorization to trap, use mist nets, and band all species except waterfowl, eagles and all endangered/threatened species except Interior Least Terns and Piping Plovers

Hold USFWS Threatened and Endangered Species permit # TE070027-0. Authorized to handle endangered Interior Least Terns and threatened Piping Plovers; reauthorized in 2014 for five more years (through 2018)

**University of Nebraska Teaching and Mentoring**

NRES 433/833 Wildlife Management Techniques (with Larkin Powell)

NRES 497 Career Experiences (supervisor and evaluator)

NRES 898 Biodiversity Conservation (instructor with Larkin Powell and Mark Pegg)

ENVIR 294 Individual and Cultural Perspectives on the Environment (interview client)

ENVIR 499a/499b Senior Thesis in Environmental Studies (supervisor)



Piping Plover nest with four newly hatched chicks at a sand and gravel mine in Douglas County, NE.

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**APPENDIX A.**

Locations of Piping Plover and Interior Least Tern nesting colonies found at off-river sites outside of our primary study area.

