2015

2015 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 (2014 – 2015). 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 2015 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

We extend special thanks to our 2015 lower Platte River field technician Lindsay Brown and our 2015 Lake McConaughy field technicians Peyton Burt and Jessica Tramp. We thank Diane Pratt for her work on off-river sites along the lower Platte River in 2015. We also thank Robert Harms and Jeff Runge for their assistance surveying river sandbars along the lower Platte River. We gratefully acknowledge the cooperation and coordination that occurs between various Piping Plover research groups across the Great Plains and thank all of the individuals that provided reports and photos of our plovers during the nonbreeding season.

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 Brocious, Mark Brohman, Brian Buckingham, Gail Campbell, Keith Carroll, Dan Catlin, William Chitty, Kevin Christman, Aaron Clark, Josh Clark, Valerie Cuppens, Jeff Dale, Aaron Decker, Karie Decker, Rangel Diaz, Robin Diaz, Colin Dovichin, 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, Leslie Hershberger, Blair Hill, Brooke Hill, Mike Hodgson, Kelsi Hunt, Zachariah Hutchinson, Terry Jenkins, Colby Johnson, Erik Johnson, Sarah Karpanty, Mike Kelley, Tim Kimmel, Janet Kirk, Aaron Kirk, Scott Klug, LaVern Kwapnioski, Dave Lanoha, Lance Laviolette, Doris Leary, Patrick Leary, Delaina LeBlanc, Mariah Lundgren, Sidney Maddock, Michael Marks, Al Menk, Mark Mesarch, Carl Miller, Timothy Moffett, Dave Moore, Dan Muhleisen, David Newstead, Donald Norman, Dan O'Mally, Melissa Panella, Judd Patterson, Gary Pearson, Bob Pelkey, Dona Phillips, Larkin Powell, Diane Pratt, Raya Pruner, Gary Rasmussen, Mike Reed, Tim Reznicek, Megan Ring, Doug Ritthaler, David Roberts, Erin Roche, Matt Rogosky, Jeff Runge, Chris Runk, Felicia Sanders, Sarah Saunders, Danny Sauvageau, Rick Schneider, Roger Severin, Mark Sherfy, Irina Shulgina, Rachel Simpson, Meghan Sittler, Jon Sohl, Stephen Speicher, Peter Stegen, Kristal Stoner, Jennifer Stucker, Bill Summerour, Jesse Swift, Marilyn Tabor, Pete Thayer, Mary Thies, Dennis Thomas, Lezlie Thomas, Dave Titterington, Dustin Toy, Phillip Vasseur, Melissa Vetricek, T.J. Walker, David Ward, Franklin Weaver, Carol White, Jennifer Wilson, Wilfred Yusek, Sara Zeigler, 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, Bluewater Development Corporation, Cedar Creek Homeowners' Association, Central Sand and Gravel, 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, Ritz Lake Homeowners' Association, Riverview Shores Homeowners' Association, Sandy Pointe Lake Development, 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.

DEFINITIONS

Off River Site Definitions

Active mine – an off-river site managed by a sand and gravel mining company that is actively mined and is regulated by the Mine Safety and Health Administration (MSHA).

Inactive mine – an off-river site managed by a sand and gravel mining company but is no longer actively mined and is no longer regulated by the Mine Safety and Health Administration (MSHA).

Lakeshore housing development – an off-river site, usually managed by a homeowners association, with at least one house on the property that an individual or family occupies for all or part of the year.

Transition site – an off-river site that is no longer managed by a sand and gravel mining company or regulated by the Mine Safety and Health Administration (MSHA) and does not have homeowners in residence on the property; transition sites are primarily managed by the real estate developer rather than a sand and gravel mining company or a homeowners association.

Survival Definitions

Annual survival probability – the probability that an animal alive in one year will still be alive the next year (van der Toorn 1997).

Daily survival probability – the probability that a nest intact or animal alive one day will still be intact or alive the next day (van der Toorn 1997).

Recapture probability – the probability that a previously marked animal will be re-sighted or captured during a session (Lettink and Armstrong 2003).

Seasonal survival probability – the probability that a nest or animal will survive the entire incubation period (nests), incubation and chick-rearing period (adults), or pre-fledging period (chicks); it is estimated by extending the daily survival probability to the appropriate number of days.

Age Definitions

Adult – life stage after completing first migration-winter cycle; a bird is in adult plumage one year of age or older and capable of breeding.

After hatch year – a bird in at least its second calendar year of life (Pyle 1997).

Chick – life stage from hatching to when a bird is capable of flight (plover: hatch day to 27 days post-hatch; tern: hatch day to 20 days post-hatch).

Fledgling – Brief period when a juvenile bird is capable of short flights but is still dependent on parental care.

Hatch year – a bird in first-basic plumage during its first calendar year of life (Pyle 1997).

Juvenile – a bird in juvenal plumage, before the first prebasic molt (Pyle 1997).

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 the 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 their listing status, Interior Least Terns are 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 nearing 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 (e.g., 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.

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, in the Bahamas, and on 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 (e.g., global sea level rise, oil spills, water pollution, and hurricanes).

FOCUS AREA

We define our study area as 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, which includes the lower Platte and Loup rivers from the Loup Public Power District Diversion to the Missouri-Platte River confluence; throughout the remainder of this report our primary study area is referred to as the lower Platte River (Fig. 2). The TPCP concentrates its monitoring and research efforts on off-river nesting habitats along our primary study area. Additional off-river monitoring also occurs at off-river sites along the North Loup, Middle Loup, and Elkhorn rivers. These off-river habitats include lakeshore housing developments, active and inactive sand and gravel mines, and transition sites. The NBP concentrates its monitoring and research efforts on river sandbars along the lower Platte River proper which does not include the Loup or Elkhorn rivers. We define the lower Platte River proper 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).

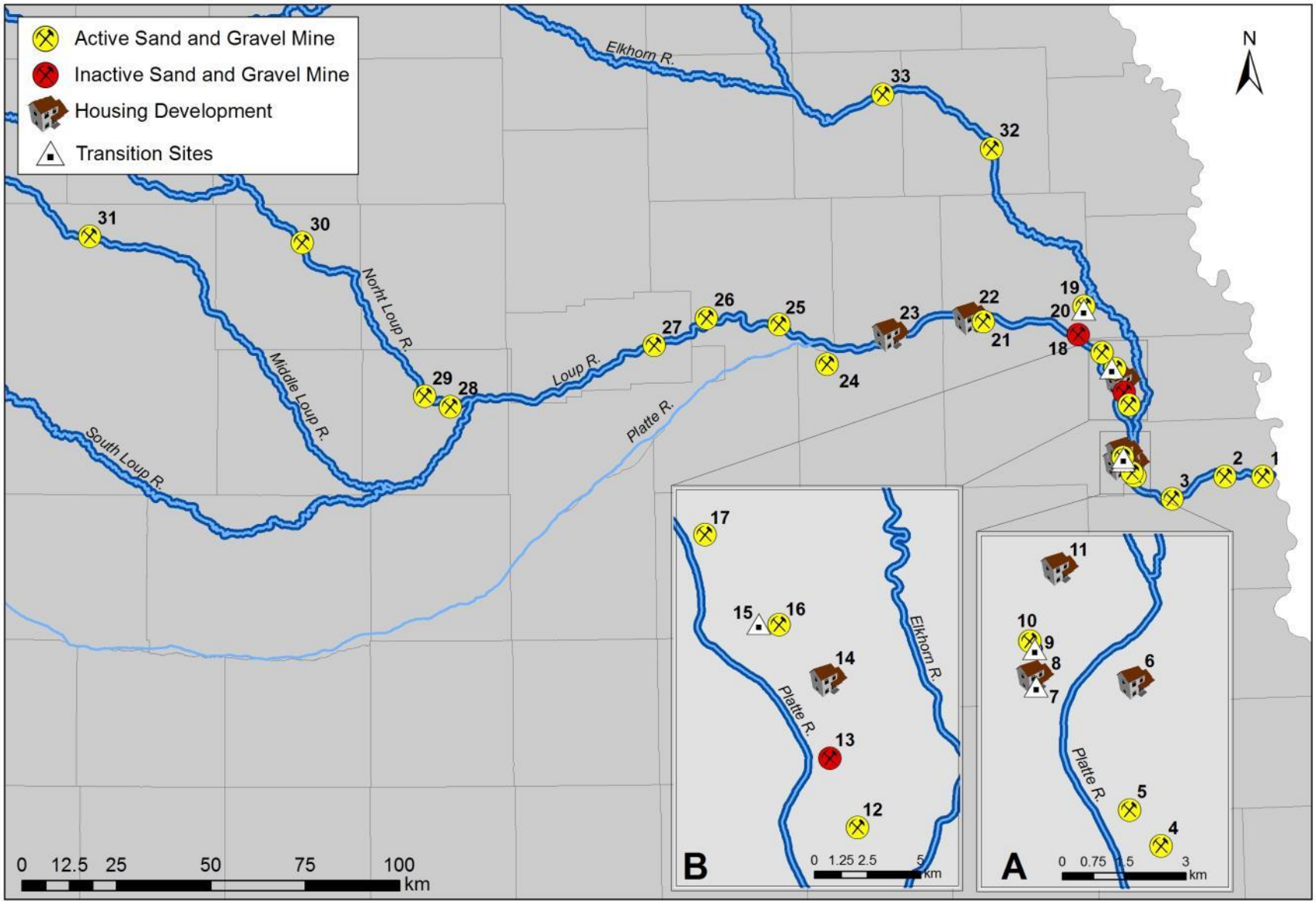

Figure 1. Our study area is highlighted in dark blue. Locations of off-river Interior Least Tern and Piping Plover nesting areas within our study area are marked. Off-river sites can be matched to numbers in Table 1.

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

#	Site Name	River	Owner	Site Type	County	2015 Nesting
1	Oreapolis #8	Platte	Lyman Richey	Active Mine	Cass	Yes
2	New Cullum #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	No
7	Sandy Pointe	Platte	Sandy Pointe Development	Transition	Saunders	Yes
8	Lake Allure	Platte	Homeowners' Association	Housing	Saunders	Yes
9	Sand Creek (South)	Platte	Lake Allure Development	Transition	Saunders	Yes
10	Sand Creek (North)	Platte	Western Sand and Gravel	Active Mine	Saunders	Yes
11	Big Sandy	Platte	Homeowners' Association	Housing	Saunders	No
12	OMG-Graske Pit	Platte	Old Castle Materials Group	Active Mine	Douglas	Yes
13	Waterloo #40	Platte	Lyman Richey	Inactive Mine	Douglas	No
14	Mallard Landing	Platte	Homeowners' Association	Housing	Douglas	No
15	Bluewater	Platte	Bluewater Dev. Corporation	Transition	Douglas	Yes
16	Valley #7	Platte	Lyman Richey	Active Mine	Douglas	Yes
17	KMG	Platte	Mallard Sand and Gravel	Active Mine	Dodge	No
18	Western Fremont	Platte	Western Sand and Gravel	Inactive Mine	Dodge	Yes
19	NE Fremont North	Platte	Lyman Richey	Active Mine	Dodge	Yes
20	Ritz Lake	Platte	Homeowners' Association	Transition	Dodge	Yes
21	Morse Bluff	Platte	Private Mining Company	Active Mine	Dodge	No
22	Riverview Shores	Platte	Homeowners' Association	Housing	Dodge	Yes
23	Socorro Lake	Platte	Homeowners' Association	Housing	Colfax	Yes
24	Bellwood #73	Platte	Central Sand and Gravel	Active Mine	Butler	Yes
25	Columbus #71	Loup	Central Sand and Gravel	Active Mine	Platte	Yes
26	Genoa North #95	Loup	Central Sand and Gravel	Active Mine	Platte	Yes
27	LPPD-Loup Diversion	Loup	Preferred Rocks - LPPD	Active Mine	Nance	Yes
28	North Loup SRA	N. Loup	Central Sand and Gravel	Active Mine	Howard	No
29	E Elba	N. Loup	Tri-County Sand and Gravel	Active Mine	Howard	No
30	Haskell Creek	N. Loup	Ulrich Sand and Gravel	Active Mine	Valley	No
31	Paulsen Gates	M. Loup	Paulsen Sand and Gravel	Active Mine	Custer	No
32	West Point	Elkhorn	West Point Sand and Gravel	Active Mine	Cumming	No
33	Pilger	Elkhorn	Pilger Sand and Gravel	Active Mine	Stanton	No

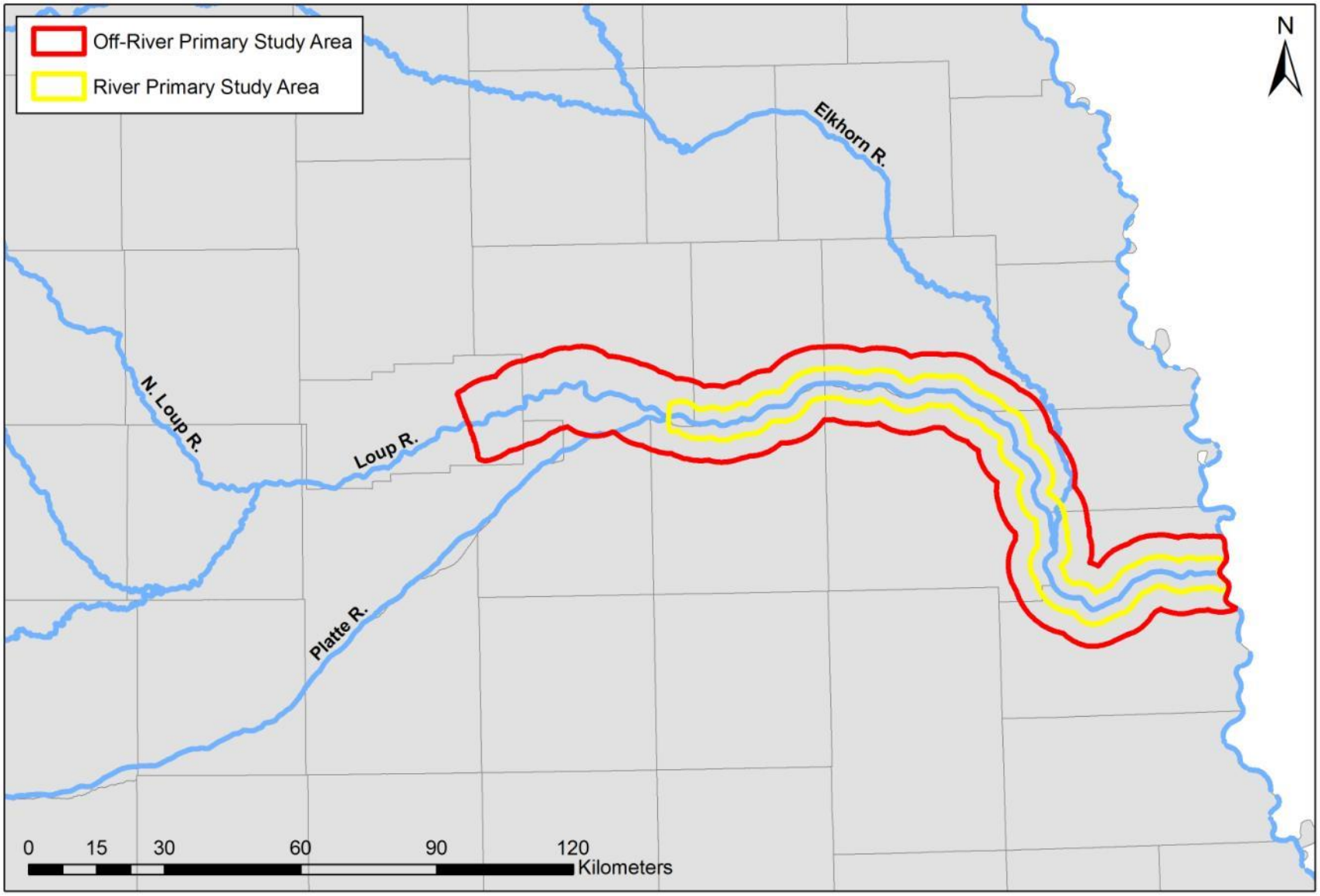

Figure 2. Our primary study area – the red box outlines the area where the TPCP concentrates it off-river monitoring and research efforts, and the yellow box outlines the area where the NBP concentrates its on-river monitoring and research efforts.

2015 OFF-RIVER CONDITIONS

Overall, conditions at off-river sites were similar to previous years. However, notable was the number of sites (4) transitioning from sand and gravel mines to lakeshore housing developments. Prior to the 2015 nesting season, memoranda of understanding (MOU) between the NGPC, TPCP, United States Fish and Wildlife Service (USFWS) and the four new housing developments were completed. We worked closely with the developers and workers at these transition sites throughout the nesting season to avoid take and minimize human disturbance. In 2015, several sand and gravel mining companies modified their operations, relocated dredges, and moved slurry pipes. At established lakeshore housing developments the pace of home construction appeared to increase in 2015. Nesting sandbar habitat was limited on the lower Platte River (see River Conditions, below), which likely increased bird use at off-river sites.

2015 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 the USGS data, we monitored flow conditions by visual inspection of the river at bridge crossings and by direct inspection of the river via kayak.

In 2015, the condition of river sandbars was affected by high water levels throughout most of the nesting season. In 2015, sandbars were inundated from May to mid-July. Water levels peaked at 26,100 cfs at the North Bend gage (USGS 06796000 Platte River) on 6 June and 58,900 cfs at the Louisville gage on 12 June (Figs. 3–4). A majority of sandbars were not exposed until mid-July. As a result of the high flows and lack of exposed sandbars, we were unable to survey the river until 14 July; we did not survey the lower 48 miles of the lower Platte River (between Leshara and the Missouri River confluence).

An off-river nesting site in Douglas County, NE that is transitioning from a sand and gravel mine and into a lakeshore housing development.

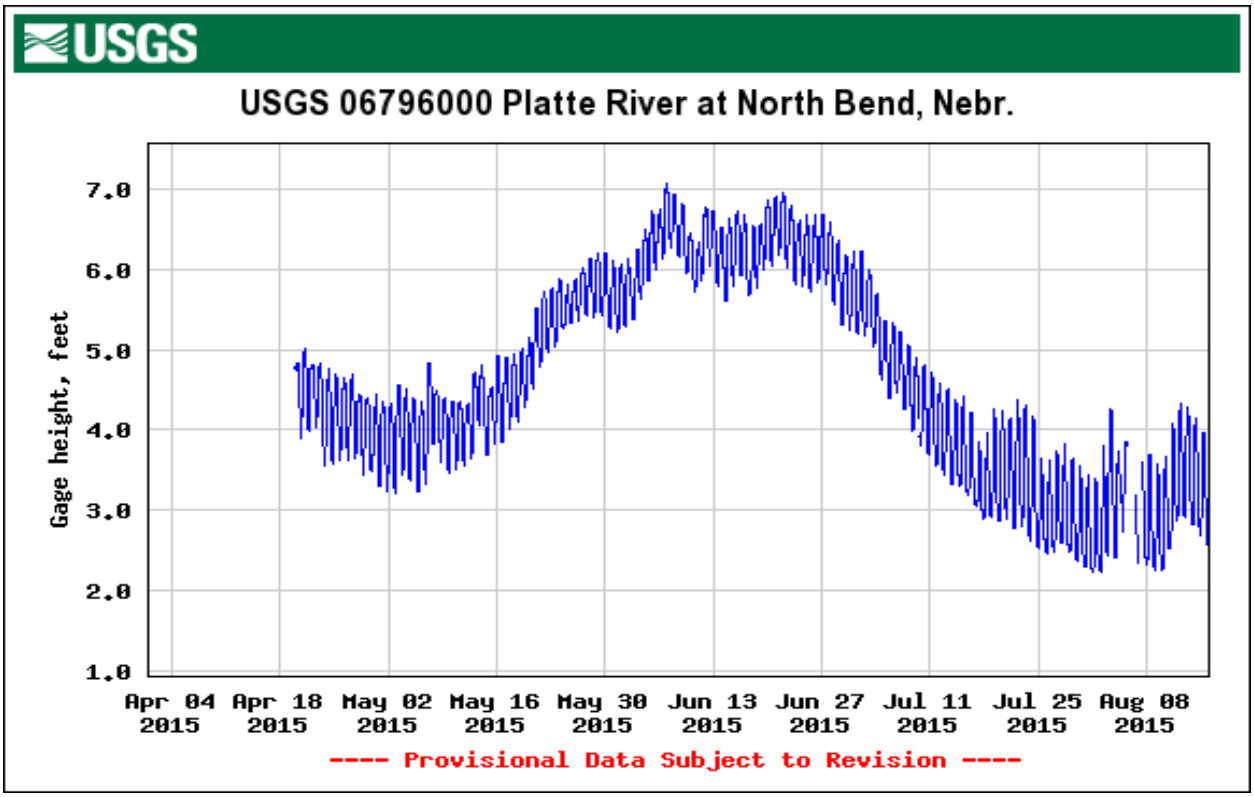

Figure 3. Daily water discharge (cubic feet per second; cfs) measured at the North Bend, Dodge County, USGS gage from 1 April 2015 through 15 August 2015.

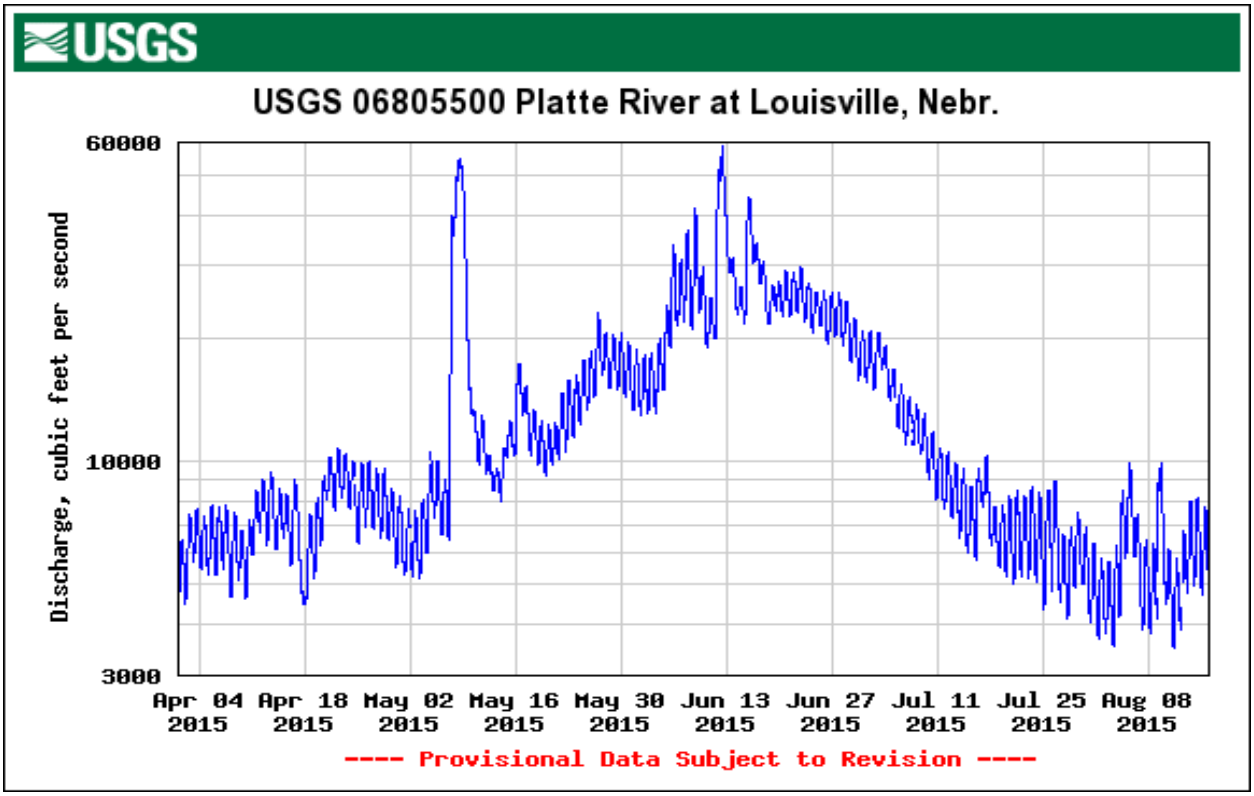

Figure 4. Daily water discharge (cubic feet per second; cfs) measured at the Louisville, Cass County, USGS gage from 1 April 2015 through 15 August 2015.

COLOR BANDING SCHEMES

Piping Plovers and Interior Least Terns are banded across their ranges. Piping Plovers have longer legs than Interior Least Terns which makes it much easier to mark them with color bands. Along the lower Platte River we place a combination of six bands on Piping Plovers and one or two bands on Interior Least Terns. Piping Plovers receive a metal USGS band on one of their upper legs, a colored flag on the opposite upper leg, and a two color bands on each of their lower legs (Fig. 5). Research groups place different colored flags on Piping Plovers to indicate where they were originally banded (Fig. 6). Along the Platte River light blue flags are used. Interior Least Terns always receive a metal USGS band on their lower right leg and in 2015 we started placing a blue alpha-numeric color band their lower left leg (Fig. 5).

Figure 5. Piping Plover chick (left) and Interior Least Tern chick (right).

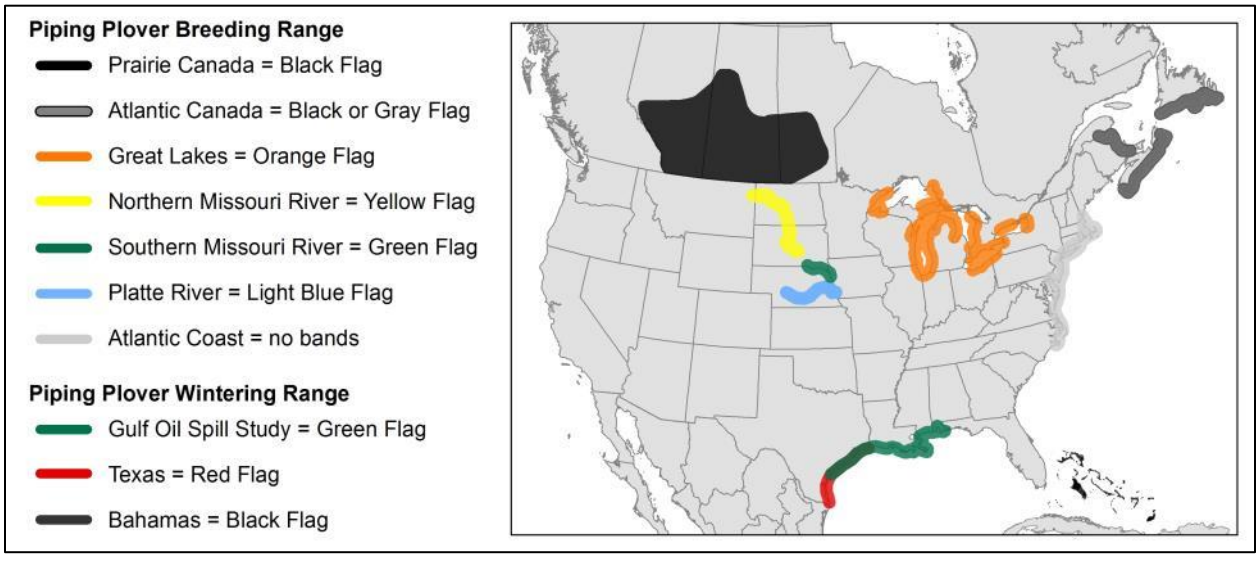

Figure 6. Piping Plover research groups place different colored flags on Piping Plovers to indicate where they were originally banded.

MONITORING

MONITORING REGIONAL MOVEMENTS OF BANDED PIPING PLOVERS AND INTERIOR LEAST TERNS

Piping Plover Breeding Season Observations

This was the eighth year we captured and color-banded Piping Plovers along the lower Platte River. To date, we have banded 541 plovers; 131 adults and 410 chicks (Table 2). A majority of plovers (536) 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 in our primary study area that were originally banded in locations throughout the Great Plains and US Gulf Coast. In 2015, we observed plovers that were originally banded along the lower Platte River, the central Platte River, the Missouri River between South Sioux City, NE and Yankton, SD, the Missouri River north of Yankton, SD, and the US Gulf Coast. Plovers banded along the central Platte River and the Missouri River north of Yankton, SD are banded by USGS biologists (E. Roche, pers. comm.). Plovers banded along the Missouri River between South Sioux City, NE and Yankton, SD and some plovers banded along the US Gulf Coast 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 in Texas are banded by biologists with the Coastal Bend Bays and Estuaries Program (CBBEP; D. Newstead, pers. comm.).

In 2015, we observed 78 previously banded Piping Plovers in our primary study area. We observed 60 light blue-flagged plovers originally banded along the lower Platte River, two light blue-flagged plovers originally banded along the central Platte River, one yellow-flagged plover originally banded along the Missouri River north of Yankton, SD, ten green-flagged plovers originally banded along the Missouri River south of Yankton, SD, three green-flagged plovers banded along the US Gulf Coast, and two red-flagged plovers banded near Galveston Island, Texas.

Over the last eight 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 3). Of the 431 plovers banded on the lower Platte River prior to 2015, 135 (31%) have been re-sighted during the breeding season at least one year after they were banded; 117 (27%) returned to nest along the lower Platte River, 15 (3%) were observed nesting on the Missouri River, and three (<1%) were observed nesting on the Niobrara River. A majority (62%) of lower Platte River plovers that returned to the lower Platte River to nest were originally banded as adults. A majority (89%) of lower Platte River plovers reported nesting outside of the lower Platte River were originally banded as chicks. Overall, 57% of the lower Platte River plovers banded as adults and 15% of the lower Platte River plovers banded as chicks have been re-sighted at least once during a breeding season at least one year after they were banded.

In 2015, nine lower Platte River plovers were observed nesting outside of the lower Platte River; all of these plovers were observed nesting on the Missouri River in northeast Nebraska and southeast South Dakota. Eight of these plovers were originally banded as chicks and one was originally banded as an adult. The plover originally banded as an adult was also observed nesting along the lower Platte River this year. This was our 4th confirmed instance of Piping Plovers successfully hatching eggs and rearing chicks on both the lower Platte River and the Missouri River in the same nesting season.

Table 2. Number of Piping Plovers banded along 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
2015	17	93	110
TOTAL	**131**	**410**	**541**

Table 3. Number of Piping Plovers previously banded along the lower Platter River 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	73	2	0	75
Chicks	44	13	3	60
TOTAL	**117**	**15**	**3**	**135**

Interior Least Tern Breeding Season Observations

This was our first year capturing and banding adult Interior Least Tern and our eighth year capturing and banding Interior Least Tern chicks in our primary study area along the lower Platte River. To date, we have banded 1088 terns; 20 adults and 1068 chicks (Table 4). All of the adult terns and a majority of the tern chicks (725) were banded at off-river sites.

We used blue alpha-numeric color bands on Interior Least Tern adults and chicks for the first time in 2015. We captured 25 adult terns; five of the 25 were birds originally banded along the lower Platte River prior to the 2015 nesting season. Three adults were originally banded at off-river sites and two were originally banded on river sandbars. We did not recapture any terns originally banded outside of the lower Platte River.

Over the last eight years we received only three reports of lower Platte River Interior Least Terns nesting outside of the lower Platte River. Two terns banded in 2008 and 2010, respectively, were observed nesting along the Missouri River in 2012 and one tern banded in 2011 was observed nesting along the central Platte River in 2015.

Table 4. Number of Interior Least Terns banded on the lower Platte River each year.

Year	Adults	Chicks	TOTAL
2008	0	168	168
2009	0	190	190
2010	0	111	111
2011	0	118	118
2012	0	76	76
2013	0	93	93
2014	0	110	110
2015	20	202	222
TOTAL	**20**	**1068**	**1088**

Piping Plover 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 (winter of 2014–2015; Fig. 7). As of 27 August 2015, we received 14 reports of lower Platte River plovers in their winter range following the 2015 breeding season; 13 observed along the US Gulf Coast and one observed on the US Atlantic Coast. The first lower Platte River plover reported in its winter range following the 2015 breeding season was originally banded as an adult in July 2014. This plover returned to nest along the lower Platte River in 2015 and was last observed in Nebraska on 1 July 2015. Twelve days, and 1000 miles, later this plover was observed at Alligator Point, Florida on 13 July 2015. Four of the 14 lower Platte River plovers reported in wintering areas after June 2015 were originally banded along the lower Platte River in 2015. One was banded as an adult in 2015 and three were banded as chicks in 2015. The first young bird to arrive on the US Gulf Coast was banded as a 1-day old chick at a housing development in Dodge County, Nebraska, on 1 June 2015. On 14 July 2015 this plover was observed as a fledgling on a river sandbar near in Dodge County. On 1 August 2015 this plover was reported over 800 miles away near Galveston, TX.

Over the past seven years, 77 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 77 plovers, 35 were originally banded as adults and 42 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 29 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 292 reports of lower Platte River plovers observed during the non-breeding seasons (2008–2015), with most reports provided by resident and visiting birders and recreational wildlife photographers.

Three green-flagged plovers and two red-flagged plovers observed along the lower Platte River in 2015 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 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. Two of the US Gulf Coast green-flagged plovers observed in 2015 have been observed nesting along the lower Platte River for the last five consecutive years.

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

State	Number of LPR Plovers reported	Percent of total
Alabama	1	1%
Florida	19	25%
Georgia	1	1%
Louisiana	9	12%
Mississippi	4	5%
South Carolina	2	3%
Texas	41	53%

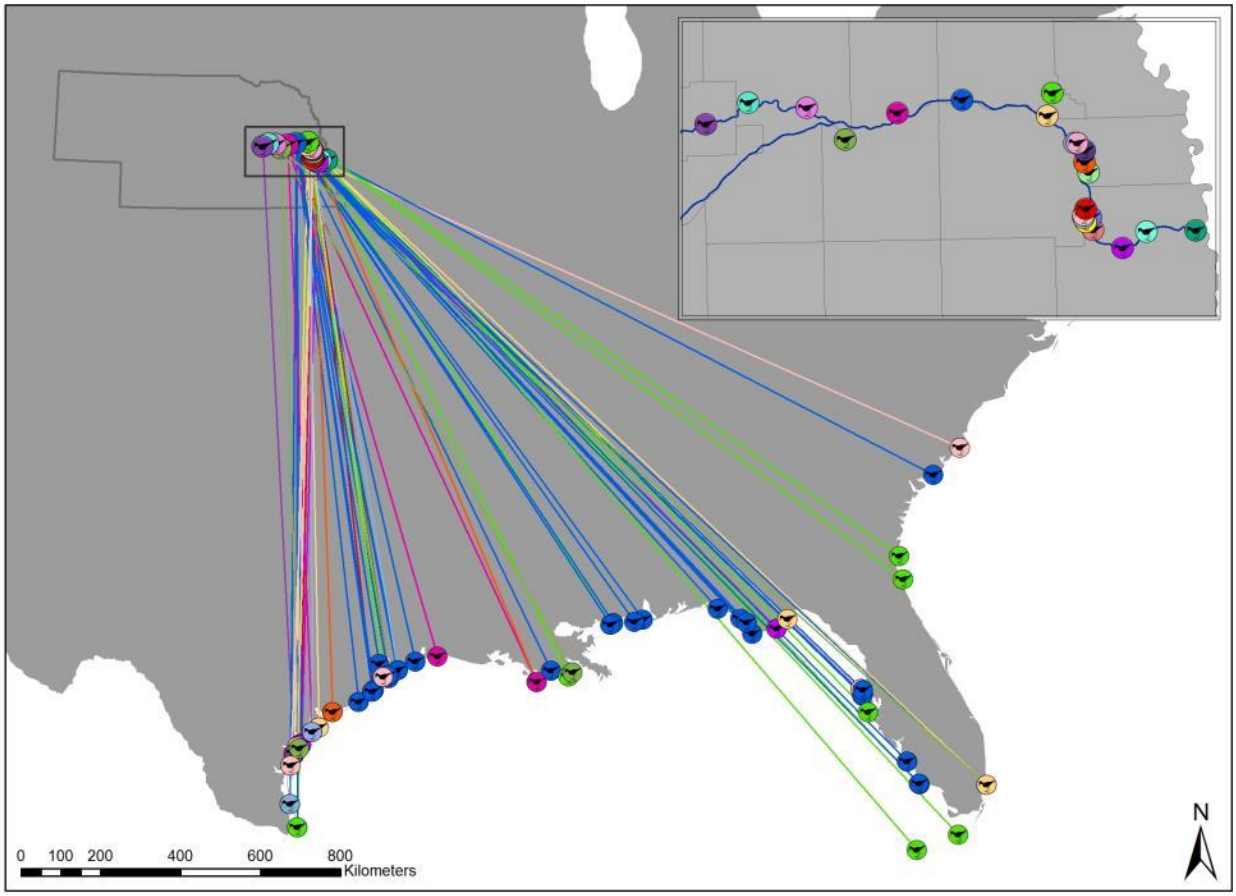

Figure 7. Locations where light blue-flagged plovers, originally banded in our primary study area, have been observed during the non-breeding season on the US Gulf and Atlantic coasts from 2008 to 2015. Each colored marker in Nebraska represents a nesting site where plovers have been banded and each marker on the coast shows the location where an individual light blue-flagged plover has been re-sighted during the winter.

This plover was banded as a 1-week old chick in June 2015 in Dodge County, NE. It was re-captured two weeks later at the same site in Dodge County, NE. About a month later, on 29 July 2015, this plover was re-sighted in Bay County, FL. Far right photo by Kevin Christman.

Migration Period

Over the last eight years we only received two reports of lower Platte River plovers in the interior of the United States but outside of their breeding range during migration. Both of these reports occurred during spring migration. 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. 8). This report was of a plover originally banded as an adult in Saunders County, Nebraska 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 the previous year. We did not receive any migratory reports during the spring or fall of 2015.

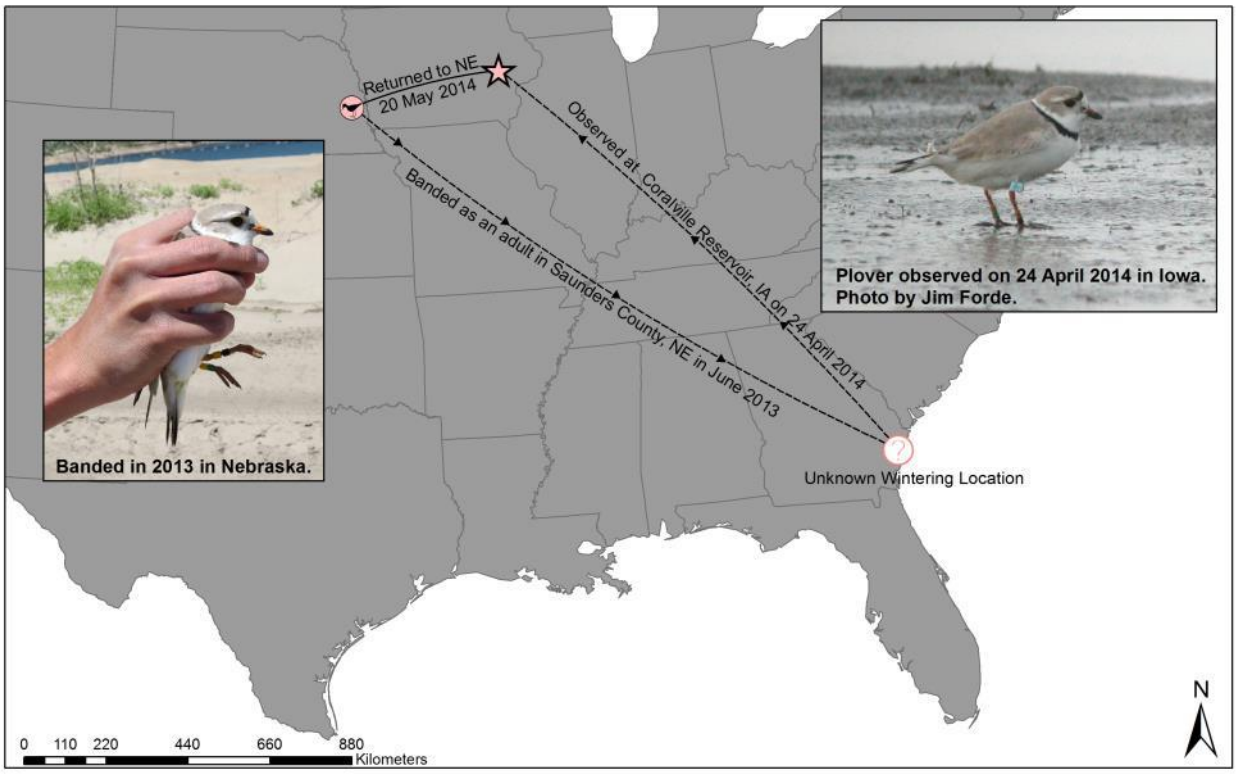

Figure 8. Lower Platte River plover observed in the interior United States during spring migration 2014. The pink dot represents the location where this plover was banded as an adult in 2013 and where it returned to nest in 2014. The pink star represents the location in Iowa where this plover was observed from 20–24 April 2014.

Interior Least Tern Non-Breeding Season Observations

Five Interior Least Terns originally banded along the lower Platte River have been observed in Texas during the months of July, August and September. Three of these reports occurred in 2014 and two occurred in 2015.

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 2015. 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, Garmin Ltd., Olathe, KS, USA). 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 ten 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 approximately one year or older, in adult plumage, and capable of breeding

Chicks: plovers – hatch day to 27 days post-hatch; terns – hatch day to 20 days post hatch

Fledglings: birds capable of flight but still dependent on parents

Juveniles: birds capable of sustained flight and independent from parents but not in adult plumage (within the first year of life)

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 2015, we located 71 Piping Plover nests and 346 Interior Least Tern nests at off-river sites in our primary study area (Table 6). These nests were distributed across 19 sites, three sites along the Loup River and 16 sites along the lower Platte River (Figs. 9–10). This included three lakeshore housing developments, four transition sites and 12 sand and gravel mines. In 2015, 56% of plover nests and 28% of tern nests were confirmed successful, while 23% of plover nests and 37% of tern nest were confirmed failed (Tables 7–8). We observed 108 plover chicks and 218 tern chicks on off-river sites (Table 6).

Table 6. The number of Interior Least Tern and Piping Plover nests and chicks observed at each off-river site along the lower Platte River 2015.

		Piping Plover		Interior Least Tern	
Off-River Site	**Habitat**	**# Nests**	**# Chicks**	**# Nests**	**# Chicks**
LPPD Loup Diversion	Mine	3	2	22	10
Genoa North #95	Mine	3	5	14	5
Columbus #71	Mine	4	3	24	15
Bellwood #73	Mine	1	2	12	5
Socorro Lake	Housing	1	0	8	14
Riverview Shores	Housing	10	13	24	18
Morse Bluff	Mine	0	0	0	0
Ritz Lake	Transition	10	22	15	16
NE Fremont (North)	Mine	2	0	3	2
Western Fremont	Mine	1	0	11	5
KMG	Mine	0	0	0	0
Valley #7	Mine	1	1	0	0
Bluewater	Transition	13	18	114	61
Mallard Landing	Housing	0	0	0	0
Waterloo #40	Mine	0	0	0	0
OMG Graske Pit	Mine	1	1	1	0
Sandy Pointe	Transition	1	4	0	0
Lake Allure	Housing	1	4	34	48
Sand Creek (North)	Mine	5	5	2	0
Sand Creek (South)	Transition	11	23	7	0
Big Sandy	Housing	0	0	0	0
G Plant	Mine	0	0	19	11
Melia	Housing	0	0	0	0
Linoma Beach #50	Mine	0	0	0	0
Linoma Beach #51	Mine	0	0	0	0
Louisville Lakes	Mine	2	4	34	8
New Collum #3	Mine	0	0	0	0
Oreapolis #8	Mine	1	1	2	0
TOTAL		**71**	**108**	**346**	**218**

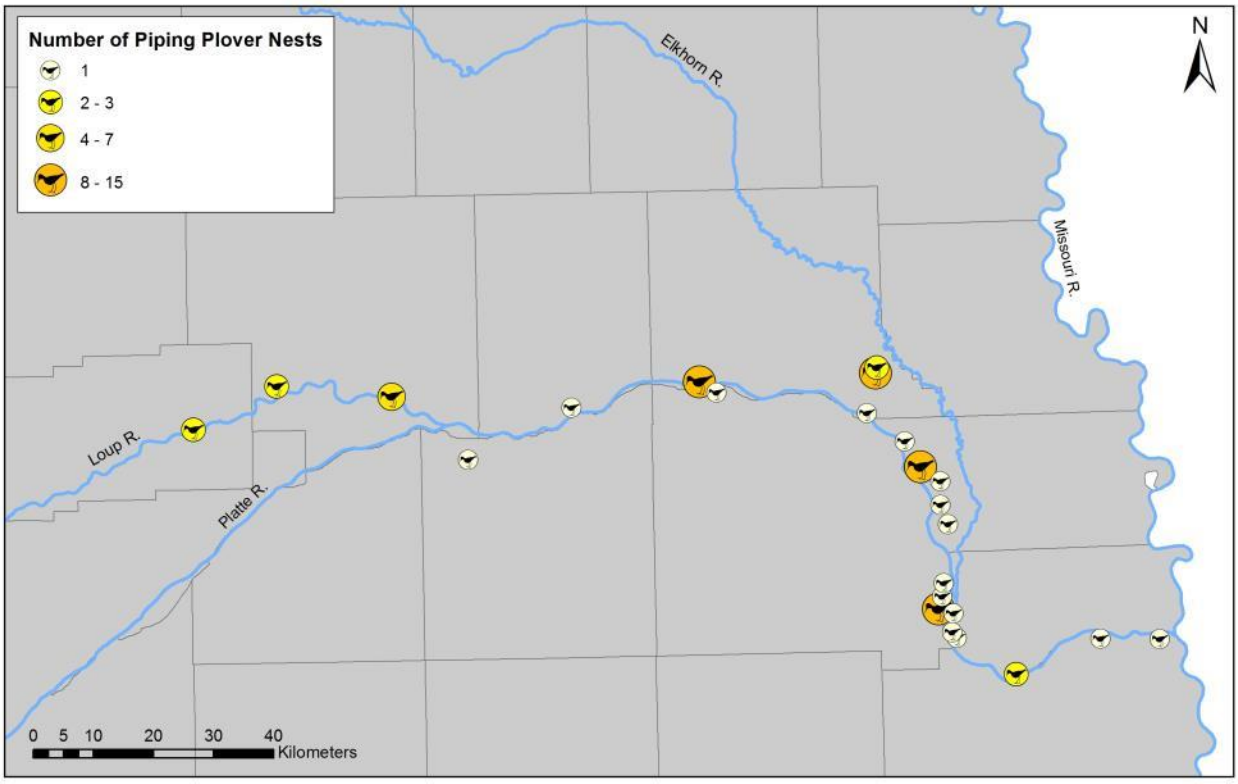

Figure 9. Location of off-river Piping Plover nesting sites in our primary study area in 2015.

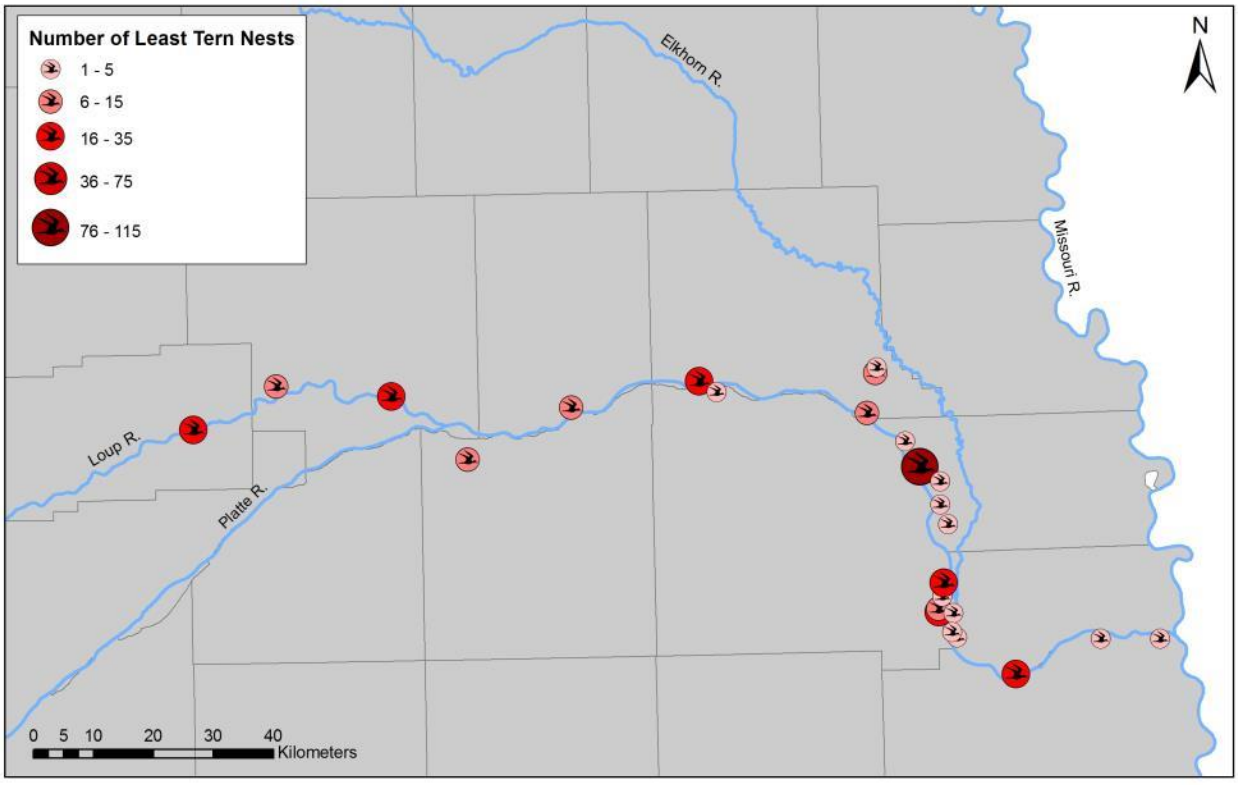

Figure 10. Location of off-river Interior Least Tern nesting sites in our primary study area in 2015.

Table 7. The fate of Piping Plover nests on off-river sites along the lower Platte River in 2015.

	Mines		Housing		Transition		Total	
Nest Fate	**#**	%	**#**	%	**#**	**%**	**#**	**%**
Confirmed Successful	10	14%	14	20%	16	23%	40	56%
Likely Successful	4	6%	3	4%	7	10%	14	20%
Confirmed Failed	9	13%	5	7%	2	3%	16	23%
Likely Failed	0	0%	0	0%	0	0%	0	0%
Undetermined	1	1%	0	0%	0	0%	1	1%
TOTAL	**24**	**34%**	**22**	**31%**	**25**	**35%**	**71**	**100%**

Table 8. The fate of Interior Least Tern nests on off-river sites along the lower Platte River in 2015.

	Mines		Housing		Transition		Total	
Nest Fate	**#**	%	**#**	%	**#**	**%**	**#**	**%**
Confirmed Successful	31	9%	39	11%	28	8%	98	28%
Likely Successful	29	8%	23	7%	38	11%	88	25%
Confirmed Failed	56	16%	19	5%	52	15%	127	37%
Likely Failed	9	3%	0	0%	3	1%	12	3%
Undetermined	21	6%	0	0%	0	0%	21	6%
TOTAL	**146**	**42%**	**81**	**23%**	**121**	**35%**	**346**	**100%**

Lindsay Brown (left) and Lauren Dinan (right) banding a newly hatched Piping Plover chick at a transition site in Dodge County, NE.

Methods: On-River Habitat

Access to river sandbars differs from access to off-river sites, so we take a different approach to 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 2015, river surveys were conducted by airboat. Kayaks surveys were not conducted in 2015 due to the high water levels throughout most of the nesting season.

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).

Results: On-River Habitat

In 2015, high water levels prevented us from surveying the river until mid-July. We cooperated with the USFWS to survey a portion of the lower Platte River via airboat, from river mile 103 near Columbus, Platte County to river mile 48 near Leshara, Douglas County. We did not survey the lower 48 miles of the lower Platte River (between Leshara and the Missouri River confluence) in 2015.

In 2015, we recorded a total of eight Interior Least Tern nests on seven lower Platte River sandbars between Columbus and Leshara (Fig. 11, Table 9). We did not observe any Piping Plover nests on river sandbars in 2015. We were unable to confirm nest fates of most nests on river sandbars as each sandbar was only visited once or twice. One nest was confirmed hatched on 28 July when two (>5 day old) chicks were observed. One other nest was confirmed abandoned on 28 July.

Table 9. 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 2015.

		Piping Plover	Interior Least Tern
River Sandbar	**River Mile**	**# Nests**	**# Nests**
RM 74.75	74.75	0	1
RM 75.75	75.75	0	1
RM 77.25	77.25	0	1
RM 98.25	98.25	0	2
RM 66.00	66.00	0	1
RM 66.25	66.25	0	1
RM 66.75	66.75	0	1
TOTAL		**0**	**8**

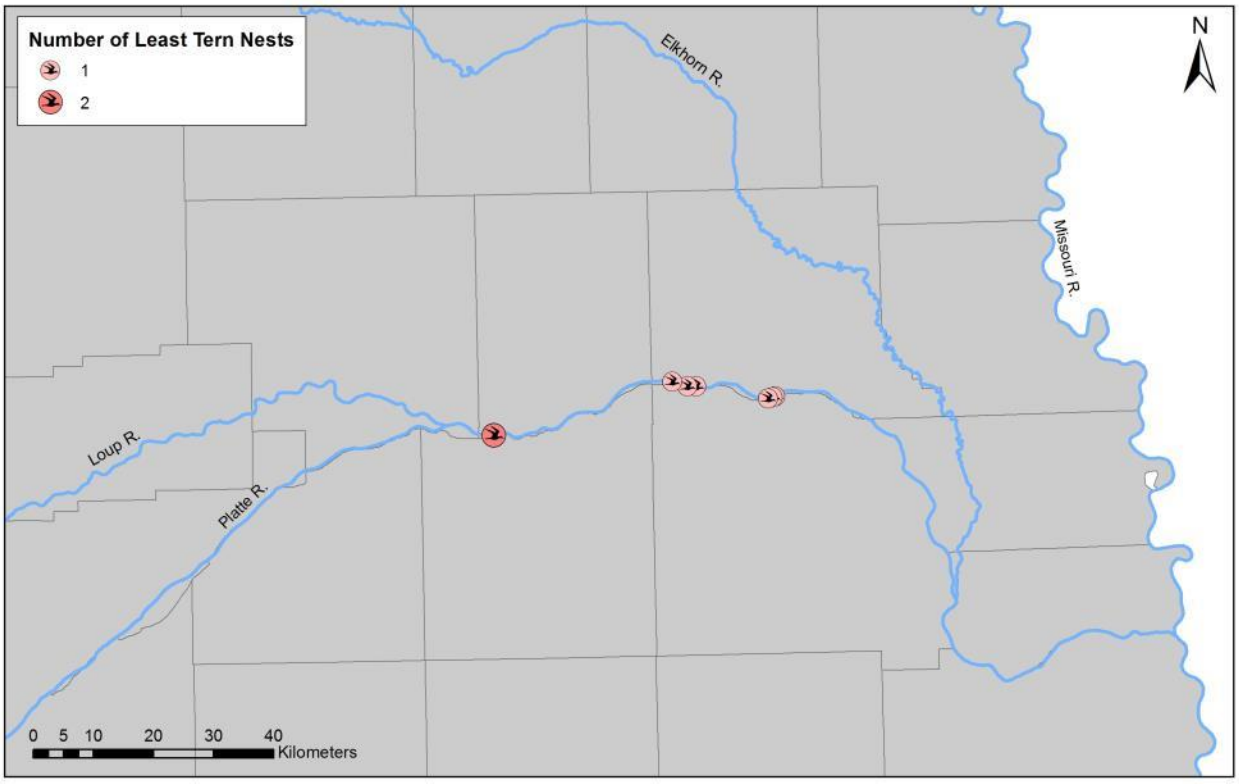

Figure 11. Location of Interior Least Tern colonies on river sandbars along the lower Platte River in 2015.

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 constructed scatterplots of tern and plover chick growth from hatching to fledging. We estimated nest, adult, and chick survival by using capture-mark-recapture and statistical modeling techniques (Program MARK; http://www.cnr/colostate.edu/~gwhite/mark/mark.htm).

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 USFWS through an inter-agency agreement with the NGPC (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 the beginning of the field season with the Bird Banding Laboratory and others with an interest in tern and plover research.

At off-river sites, we captured and banded adult Piping Plovers and Interior Least Terns during incubation. The capture, handling, and banding protocols used for plovers were the same as those used in previous years. This year, was the first year we captured, handled, and banded adult terns and placed HD video cameras at tern and plover nests to determine band combinations without re-capturing and handling the birds. We followed protocols developed and used by USGS biologists on the central Platte and Missouri rivers (E. Roche, C. Dovichin, pers. comm.). The HD video cameras were provided by USGS biologists Erin Roche, Collin Dovichin, Dustin Toy and Megan Ring.

Adult Piping Plovers were captured using a simple box trap placed over the nest (Fig. 12). This method is effective and minimizes risk of injury to the adult and eggs. Box traps have no moving parts; the bird walks through the door, settles on its nest, and is captured. Adult terns were captured using a remote control triggered bow net trap that was placed around the nest (Fig. 13). The adult tern settles on its nest, a net is triggered using a remote control, the net goes over the adult and nest, and the adult is captured. The a remote control triggered bow net trap was made and provided to us by USGS biologists Erin Roche, Collin Dovichin, Dustin Toy and Megan Ring. We captured plover and tern chicks by picking them up from the sand or from their nests.

We exercise great caution when handling and banding birds. We do 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 are observed after banding and on subsequent visits to determine if there are any behavioral changes or signs of injury. As part of our protocol, we are 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, 2014 or 2015.

Figure 12. 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).

Figure 13. Remote control triggered bow net trap placed over an Interior Least Tern nest showing the bird approaching the trap (A), settling down on the nest (B), and a biologist getting the tern out of the trap after the net was triggered over the bird and nests (C).

In 2015, 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 eight combinations (yellow over yellow, yellow over black, green over yellow, green over green, green over black, green over gray, black over yellow, black over green) on the bird's lower left leg; indicating that the bird was banded along the lower Platte River in 2015. We placed a unique combination of two color bands (yellow, green, black, or gray) on the lower right leg. The unique color band combination indicates each bird's individual identity (Fig. 14).

We measured the mass of each Piping Plover adult by placing the bird in a cloth bag and suspending it from a Pesola scale (± 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 banded each Interior Least Tern adult and chick with an individually numbered metal USGS band (size 1A) on their lower right leg. We also placed a blue alpha-numeric band the lower left leg for adult terns and tern chicks >3 days old (Fig. 14). We measured each chick's body mass using a digital scale (Ohaus SP401, Parsippany, NJ, USA) 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 tern or plover chicks.

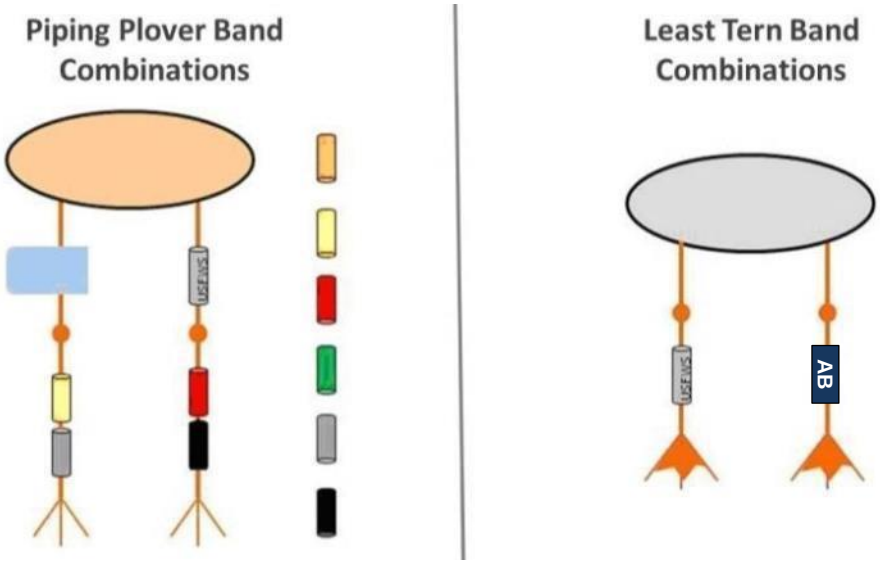

Figure 14. Diagram illustrating the banding scheme used on Piping Plovers and Interior Least Terns banded along the lower Platte River. The flags, color bands, and metal bands may be on either leg and plover color combinations vary.

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. We weighed birds when we recaptured 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 (*f*). 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 2015 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.

Annual Survival Analysis

We constructed individual encounter histories for all plovers captured, recaptured, or observed in our primary study area from 2008 through 2015. 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 Scatterplots

Our growth scatterplots for 2015 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) or SigmaPlot (2011). 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-sighting

In 2015, we banded 110 Piping Plovers and 222 Interior Least Terns; all banding occurred at off-river sites. We captured and banded 17 adult plovers and 93 plover chicks. Most plover chicks (74%) were less than one week old when banded. We re-sighted 60 plovers that were originally banded along the lower Platte River in previous years, ten that were originally banded along the Missouri River south of Yankton, SD, one that was originally banded along the Missouri River north of Yankton, SD, two that were originally banded along the central Platte River, and five originally banded along the U.S. Gulf Coast.

We captured and banded 20 tern adults and 202 tern chicks. Most tern chicks (85%) were less than one week old when banded. We recaptured five adult terns originally banded along the lower Platte River as chicks prior to the 2015 nesting season. Three of the recaptured adults hatched and were banded at off-river sites and two hatched and were banded on river sandbars.

A newly banded interior Least Tern chick.

Daily and Seasonal Survival

Piping Plover Nest Survival

We estimated Piping Plover nest survival from 70 nests located at off-river sites (22 at lakeshore housing developments, 23 at sand and gravel mines, and 25 at transition sites). We did not include one plover nest in which nest fate was undetermined. In 2015, off-river plover nests had an apparent daily survival probability of 0.99 ± 0.00. The apparent seasonal survival probability, over the 28-day incubation period, was 0.69 ± 0.07. The apparent daily survival probability for plover nests at lakeshore housing developments was 0.99 ± 0.01 and the apparent seasonal survival probability was 0.74 ± 0.12. The apparent daily survival probability for plover nests at sand and gravel mines was 0.98 ± 0.01; the apparent seasonal survival probability was 0.53 ± 0.12. The apparent daily survival probability for plover nests at transition sites was 0.99 ± 0.00; the apparent seasonal survival probability was 0.86 ± 0.10 (Fig. 15).

In 2015, we placed protective exclosures around 44 of the 70 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 0.99 ± 0.00 and a seasonal survival probability of 0.82 ± 0.07; while nests without protective exclosures had a daily survival probability of 0.97 ± 0.01 and a seasonal survival probability of 0.41 ± 0.12 (Fig. 15).

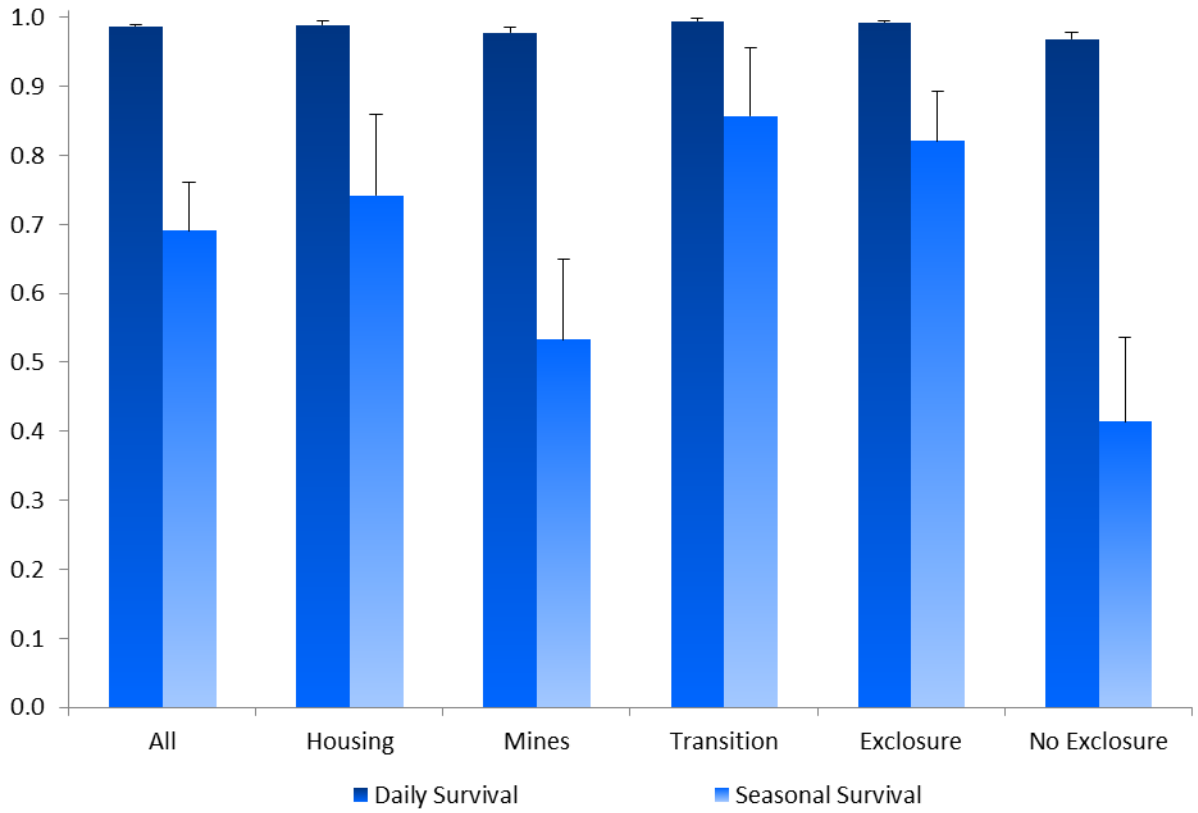

Figure 15. Daily and seasonal survival probabilities of Piping Plover nests at off-river sites in 2015.

Interior Least Tern Nest Survival

We estimated Interior Least Tern nest survival from 325 nests at off-river sites (81 at lakeshore housing developments, 123 at sand and gravel mines, and 121 at transition sites). We did not include 21 tern nests in which nest fate was undetermined. In 2015, the apparent daily survival probability of off-river tern nests was 0.97 ± 0.00. The apparent seasonal survival probability, over the 21-day incubation period, was 0.54 ± 0.03. Tern nests at lakeshore housing developments had an apparent daily survival probability of 0.99 ± 0.00 and an apparent seasonal survival probability of 0.78 ± 0.06. Tern nests at sand and gravel mines had an apparent daily survival probability 0.96 ± 0.00 and an apparent seasonal survival probability of 0.45 ± 0.05. Tern nests at transition sites had an apparent daily survival probability 0.9638 ± 0.0048 and an apparent seasonal survival probability of 0.46 ± 0.05 (Fig. 16). In 2015, we did not estimate nest survival for tern nests on river sandbars.

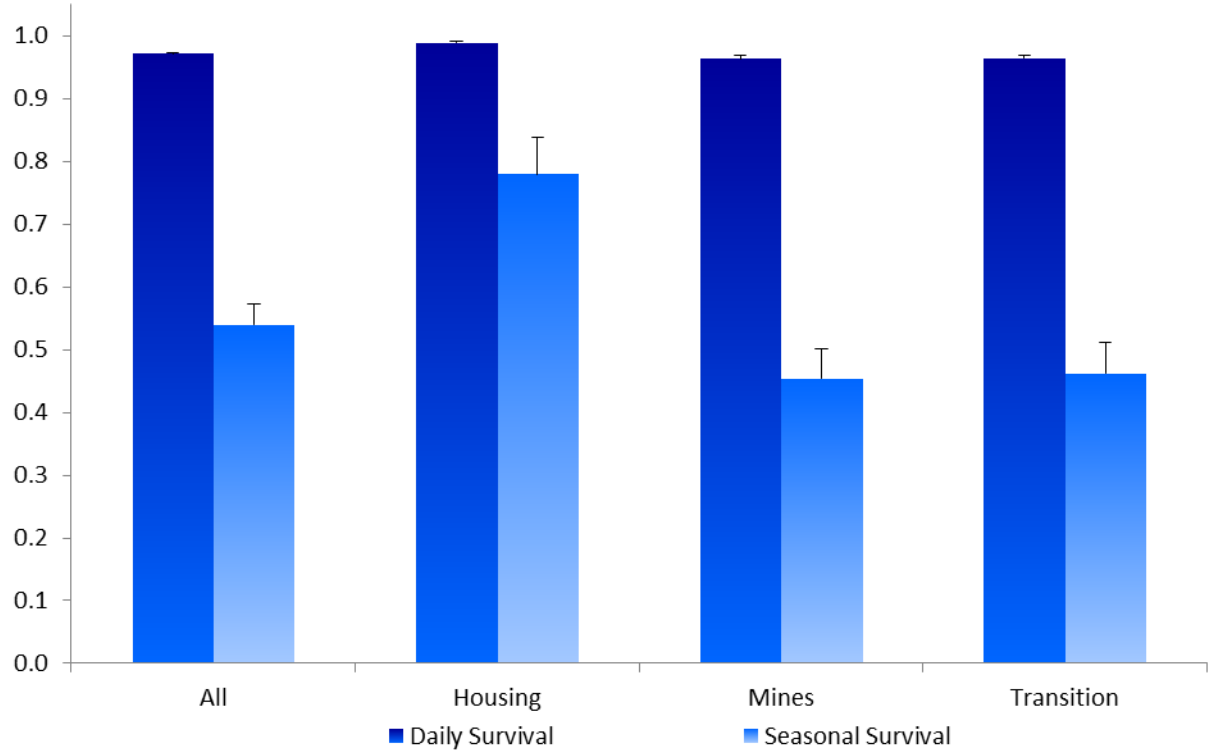

Figure 16. Daily and seasonal survival probabilities of Interior Least Tern nests at off-river sites in 2015.

Within Year Individual Survival

In 2015, the apparent daily survival probability for adult plovers nesting at off-river sites was 0.99 ± 0.00. The apparent seasonal survival probability was 0.70 ± 0.06. The apparent daily survival probability for plover chicks reared at off-river sites was 0.97 ± 0.01. The apparent seasonal survival probability was 0.40 ± 0.12. The apparent daily survival probability for adult terns nesting at off-river sites was 0.96 ± 0.02 and the apparent seasonal survival probability was 0.46 ± 0.16. The apparent daily survival probability for tern chicks reared on off-river sites was 0.96 ± 0.01 and the apparent seasonal survival probability was 0.42 ± 0.11 (Fig. 17). The 2015 seasonal survival estimate for Piping Plover chicks increased when compared to seasonal survival estimates recorded from 2012 to 2014 (Fig. 18). The 2015 seasonal survival estimate for Interior Least Tern chicks decreased when compared to 2014 but is still substantially higher than seasonal survival estimates on off-river sites in years prior to 2014 (Fig. 19).

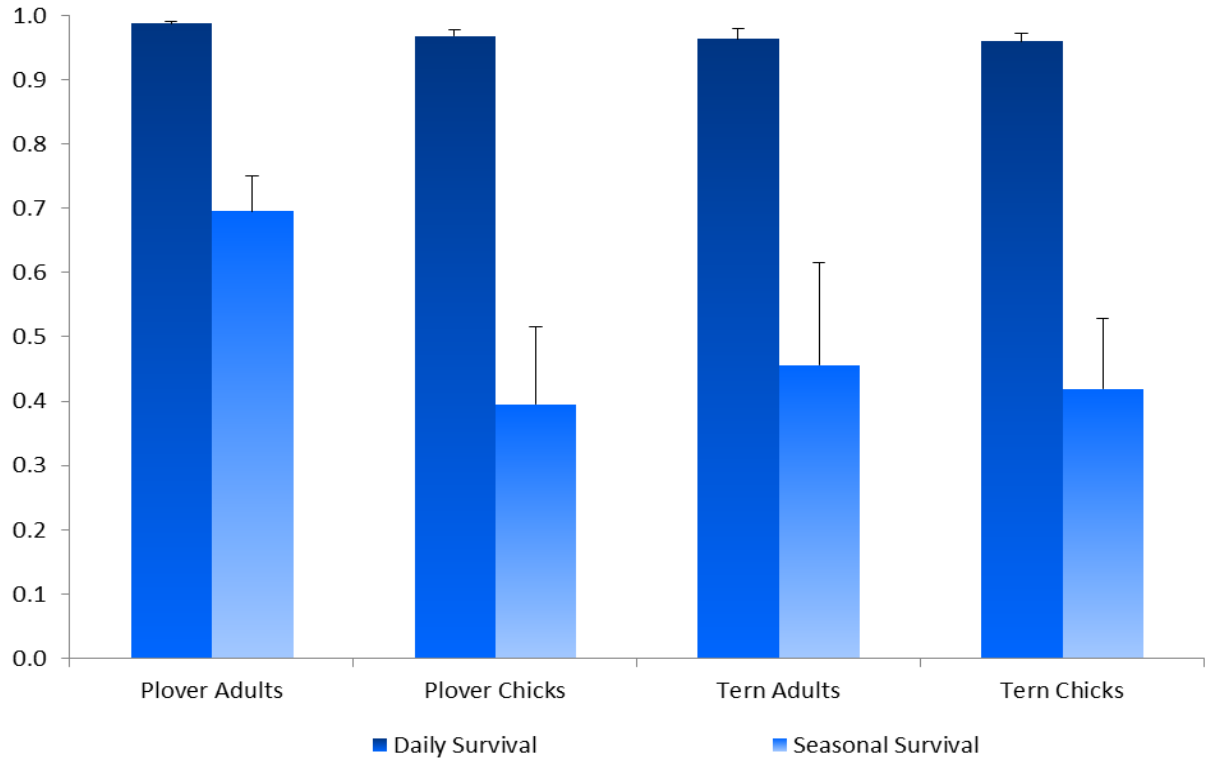

Figure 17. Piping Plover and Interior Least Tern within year daily and seasonal survival probabilities at off-river sites in 2015.

Four 1-day old plover chicks adventuring out of their nest cup for the first time.

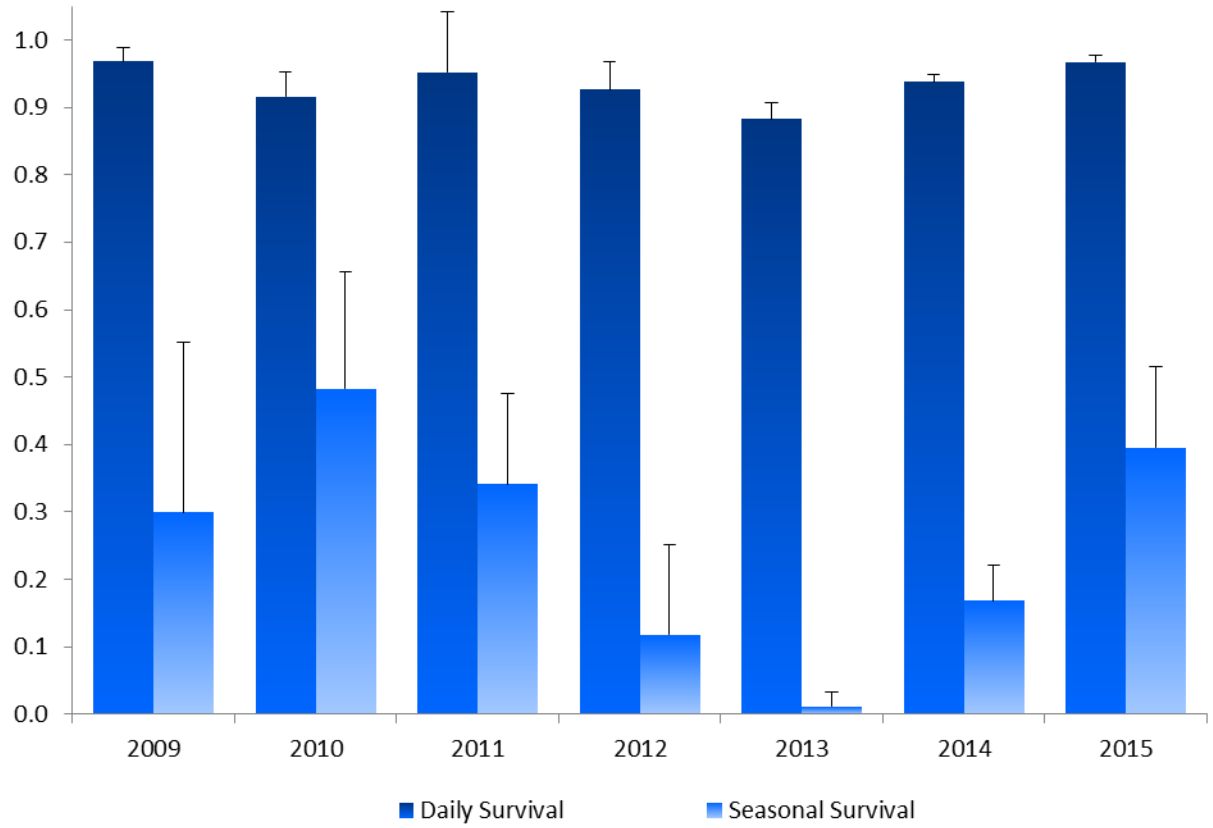

Figure 18. Piping Plover chick daily and seasonal survival at off-river sites each year.

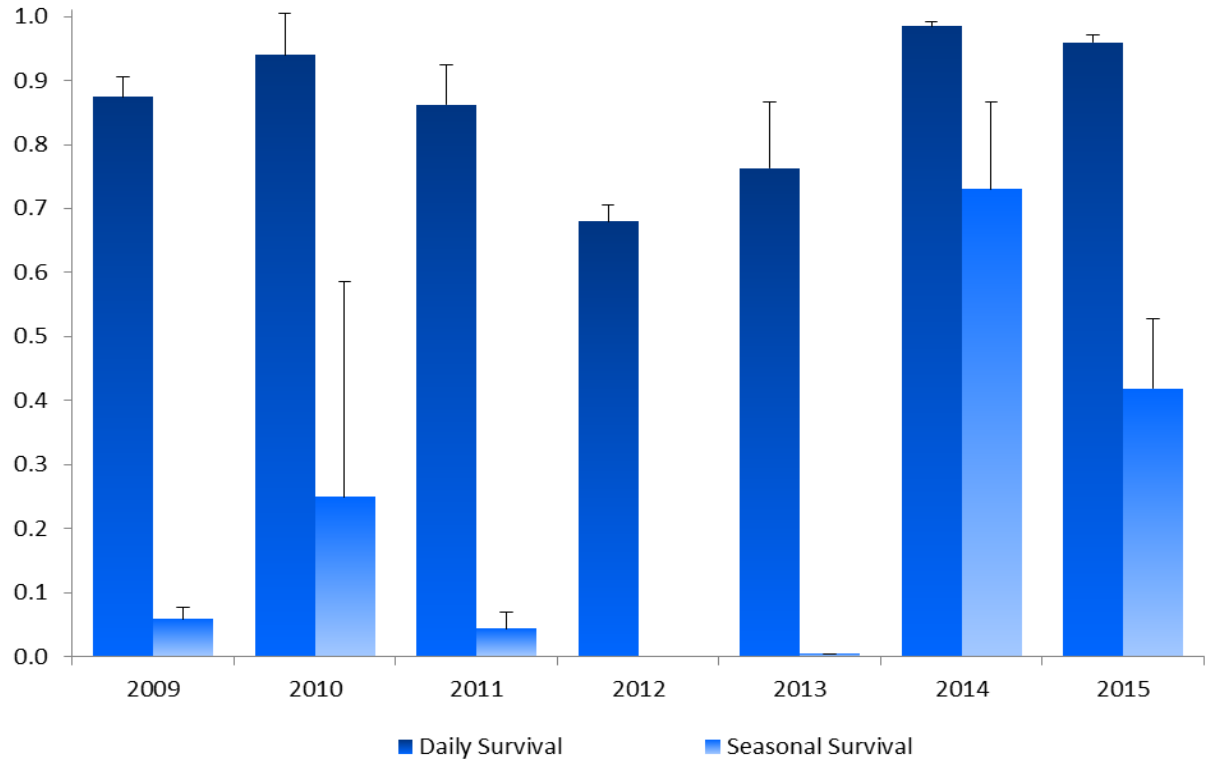

Figure 19. Interior Least Tern chick daily and seasonal survival at off-river sites each year.

Annual Survival

We estimated annual survival probabilities for plovers banded along the lower Platte River as adults and chicks from 2008 to 2015. The apparent annual survival probability for plovers originally banded as adults along the lower Platte River, 2008 to 2015, was 0.71 ± 0.03 and the annual recapture probability was 0.77 ± 0.04. The apparent annual survival probability for plovers originally banded as chicks over their first migration-winter cycle (hatch year) was 0.42 ± 0.08 and the recapture probability was 0.27 ± 0.06. The apparent annual survival probability for plovers originally banded as chicks over their subsequent migration-winter cycles (after hatch year) was 0.57 ± 0.08 and the recapture probability was 0.46 ± 0.09 (Fig. 20). 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.

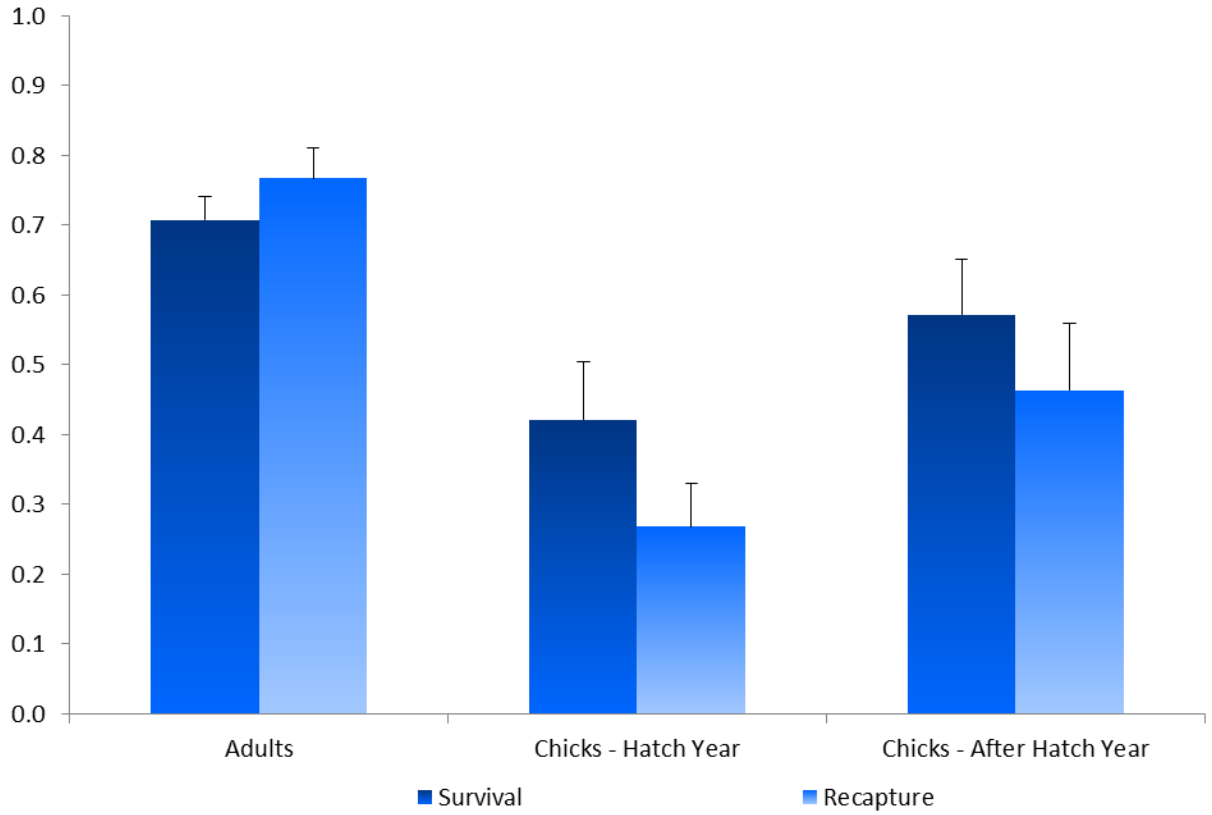

Figure 20. Annual survival and recapture probabilities for Piping Plovers originally banded as adults and chicks along the lower Platte River from 2008 to 2015.

Growth Scatterplots

We created scatterplots of Piping Plover and Interior Least Tern chick growth from hatching to fledgling. Scatterplots were created from 87 plover chicks and 193 tern chicks banded on off-river sites in 2015 (Figs. 21–22).

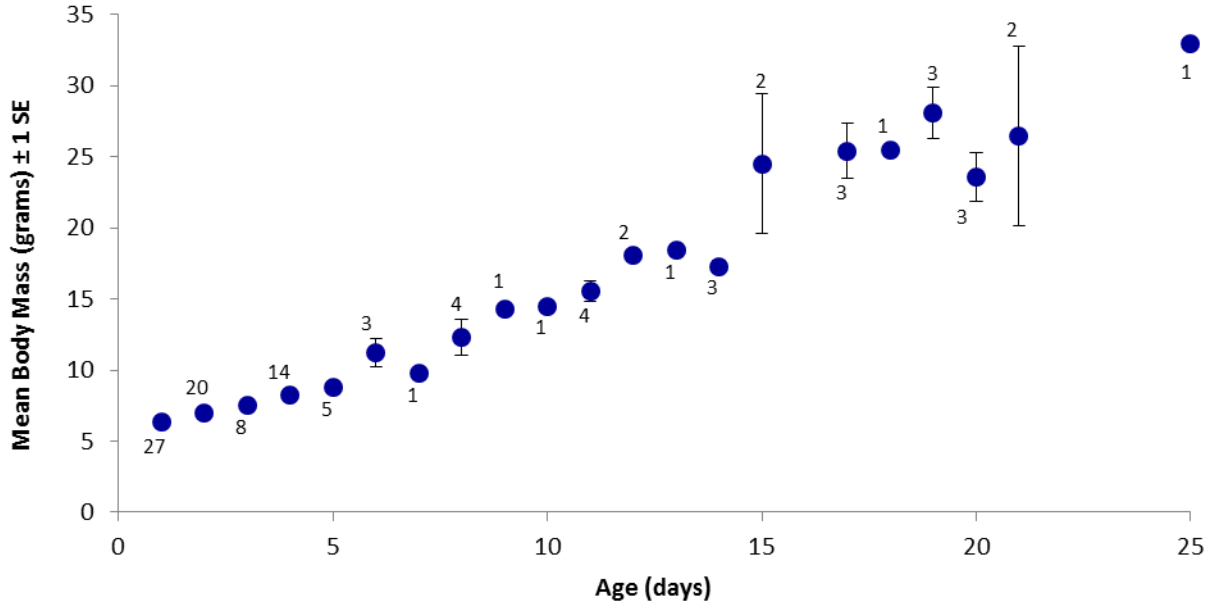

Figure 21. Scatterplot of Piping Plover chick growth from hatching to fledging at off-river sites in 2015. The graph shows the data represented as mean body mass, standard error, and sample size (number in each age class).

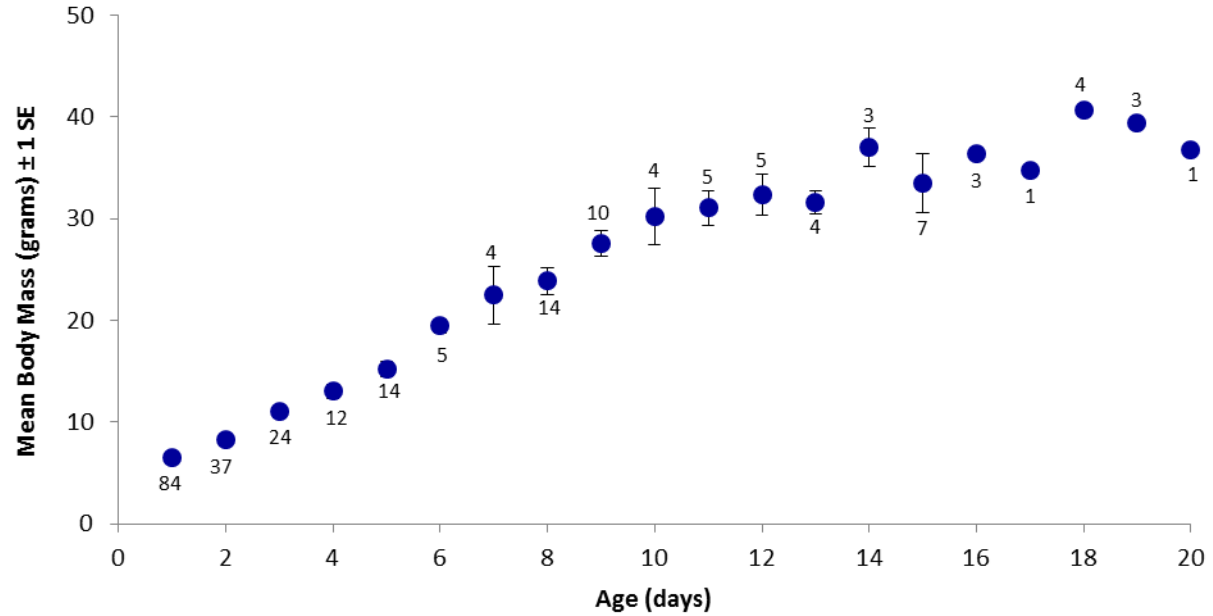

Figure 22. Scatterplot of Interior Least Tern chick growth from hatching to fledging at off-river sites in 2015. The graph shows the data represented as mean body mass, standard error, and sample size (number in each age class).

MANAGEMENT

The TPCP uses a voluntary, proactive approach to reduce human-bird conflicts and avoid 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 the aggregate (sand and gravel) mines in our focus area. We discuss 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 real estate developers and 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.

Mine Safety and Health Administration (MSHA)

Every year, all TPCP personnel receive MSHA training and certification for scientific (non-miner) workers. In 2015, 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 human foot or vehicle traffic is to be expected, 'psychological' barriers are added. These barriers consist of black or orange cord tied between the "Keep Out" sign posts with red-silver Mylar™ streamers attached to the cord to make it more visible.

Based on conversations with mine personnel and homeowners' associations before the nesting season begins, we mark off the areas where it would be safest for 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 will 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 the 1) substrate is disturbed by raking, 2) vegetation is present, 3) substrate particle size is unattractive to the birds or 4) areas are physically disturbed in some other way (J. Marcus, J. Dinan, R. Johnson, E. Blakenship, and J. Lackey 2007. Waterbirds 30: 251–258). In addition to planting vegetation, resurfacing the sand, and raking the substrate, we often opt for a physical method of discouraging birds from nesting in an area. Before the birds arrive, we put up grids of three-foot-tall fiberglass 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 exclosures around plover nests, but not tern nests because of the birds' behavior around their nests—plovers walk up to their nests while terns fly up to their nests. These exclosures 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 are tied between each of the poles. These marked off areas only help to protect tern nests from human disturbance; they do not reduce natural predation.

Lake McConaughy Piping Plover Human Dimensions Study

In 2015, we completed the third season of a research project initiated in 2013 aimed at improving the understanding of interactions between human recreation and nesting Piping Plovers on beaches of Lake McConaughy, Keith County. During the all three seasons, we conducted personal interview surveys of people using the beaches and observed Piping Plover nests during incubation to evaluate bird response to human disturbance. The personal interview surveys addressed recreationists' knowledge of wildlife protection laws and beach use regulations and their opinions on the birds. The nest and brood observations addressed the birds' responses to human-caused disturbances. In 2015, we completed additional personal interview surveys and conducted an experiment addressing how close to or far from the nest a disturbance had to be to cause a plover attending a nest to respond (by leaving the nest). We changed the personal interview survey questions every year letting us address a broader set of issues.

A roped off area around a tern nest at a site that was transitioning from a sand and gravel mine to a lakeshore housing development.

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 and lectures, 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 along 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. 23–24). 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.

Platte River Time-Lapse Project (http://plattebasintimelapse.com)
BridgeCam: Working with Michael Forsberg, Jeff Dale, and Nebraska Educational Television, (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 support nesting terns and plovers in the past). The video is streamed for viewing via a link on our web page.

Educational (STEM) curriculum and documentary production: We are pleased to be working with Michael Forsberg, Michael Farrell, Peter Stegen, Valerie Cuppins, and Nebraska Educational Television as they develop a tern and plover educational curriculum suitable for upper level elementary-middle school students and teachers. Lauren Dinan and Lindsay Brown participated in a short film discussing how they got involved in conservation and research—the film is intended to encourage young women to consider STEM as a career path. Several of our terns and plovers will be featured in a documentary film currently production by the Platte River Time-Lapse Project team.

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. We established a 'Chimney Swift Club' for students at Irving Middle School (Deana Hughes and Ann Ellenberger, teacher sponsors).

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.

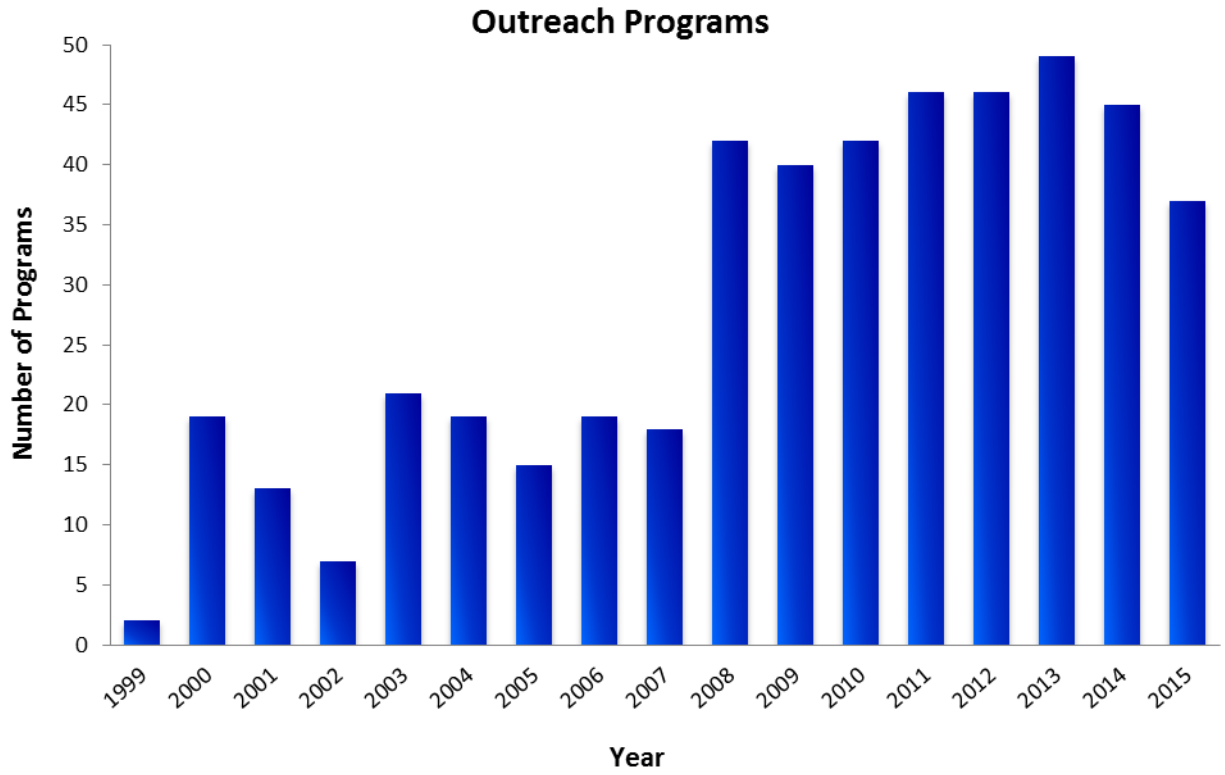

Figure 23. Number of programs delivered by the TPCP from 1999 through 2015 (this only includes scheduled programs; we frequently deliver impromptu presentations).

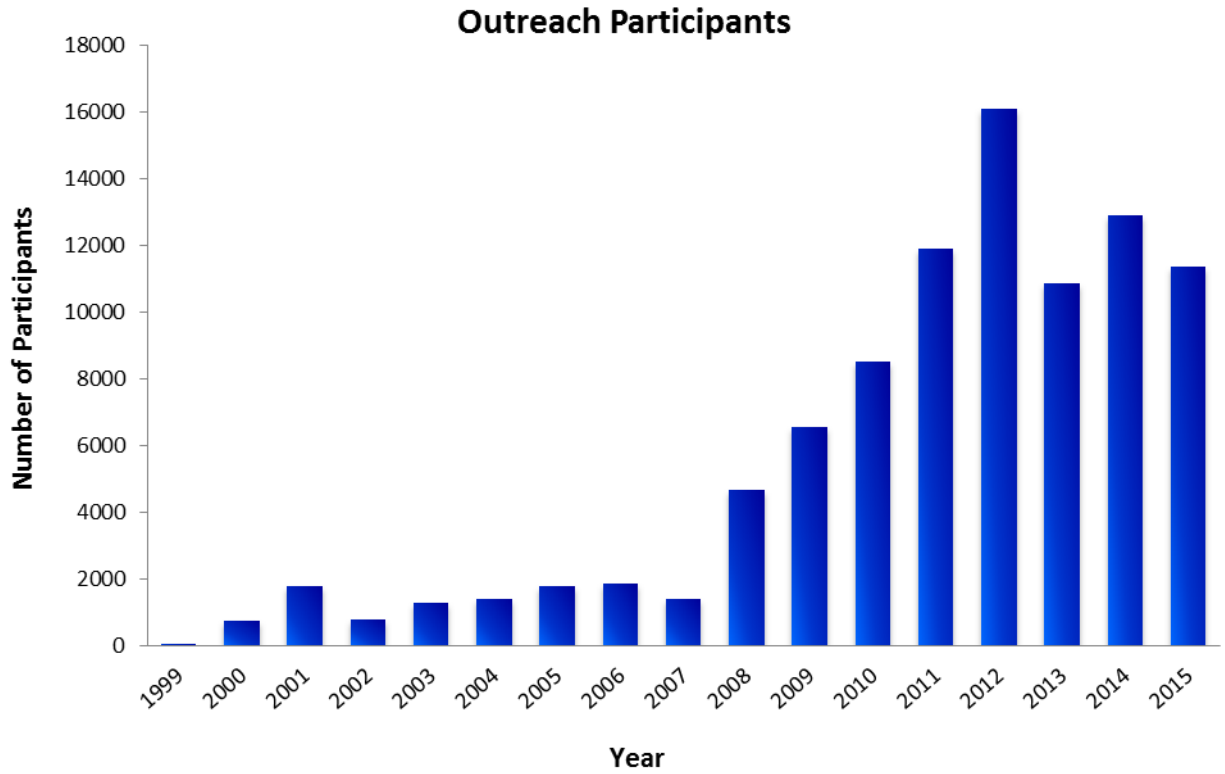

Figure 24. Number of participants in TPCP programs from 1999 through 2015 (this only includes scheduled programs; we frequently deliver impromptu presentations).

Programs for the General Public

Ashland Elementary School Family Nature Night, Ashland, NE
Big Bend Audubon Society, Kearney, NE
Conestoga Elementary School Family Nature Night, Murray, NE
Rotary Club, David City, NE
Durham-Smithsonian Museum Teacher's Night Out, Omaha, NE
EarthWellness Festival, Lincoln, NE
Eastridge Elementary School Family Nature Night, Lincoln, NE
Fredstrom Elementary School Family Nature Night, Lincoln, NE
Fremont Eco-Fair, Fremont, NE
Indigo Bridge Bookstore Indi-Zoo, Lincoln, NE
Iowa Western Community College, Council Bluffs, IA
Irving Middle School Chimney Swift Club, Lincoln, NE
McPhee Elementary School Family Nature Night, Lincoln, NE
National Bird Day (Nebraska History Museum), Lincoln, NE
National Pi Day (Nebraska History Museum), Lincoln, NE
Nebraska Audubon's Nebraska Crane Festival, Kearney, NE
Nebraska Audubon's Crane Festival, Wild Experience Room, Kearney, NE
Prescott Elementary School Family Nature Night, Lincoln, NE
Wahoo Bird Club, Wahoo, NE

Homeowners' Associations

Big Sandy, Bluewater, Lake Allure, Lake Socorro, Mallard Landing, Riverview Shores, Sandy Pointe, Thomas Lakes, and Ritz Lake

University of Nebraska-Based Education Programs

Cedar Point Biological Station Research Round-Up
Center for Grassland Studies
SNR Career Fair (in cooperation with USACE personnel)
SNR Applied Ecology Seminar
UNL Women in Science Festival
UNL Women's Club
UNO Biology Department Seminar

Education-Curriculum Development Activities

Informal Educators of Lincoln Network
Iowa Western Community College Environmental Studies
Lincoln Public Schools STEM
Nebraska Alliance of Conservation and Environment Educators
Nebraska Association of Teachers of Science
University of Nebraska School of Natural Resources

Conferences

Acoustical Society of America, Pittsburgh, PA
Missouri River Institute, Vermillion, SD

Missouri River Natural Resources Conference, Nebraska City, NE
Nebraska Natural Legacy Conference, Kearney, NE
Nebraska Wind Energy Conference, Omaha, NE
Waterbird Society, La Paz, Mexico
Western Hemisphere Shorebird Reserve Network, Wallops Island, Virginia
Wilson Ornithological Society (with Society of Canadian Ornithologists, and Association of Field Ornithologists, Wolfville, NS, Canada

Professional Committees and Workgroups

Lower Platte River Weed Management Area
Nebraska Bird Partnership Steering Committee and Conservation and Science Advisory workgroups
Nebraska Environmental Trust Technical Advisory Committee (we review grants every year)
PACE (Planning, Aggregate, Community, Environment)
Nebraska Audubon Crane Festival Committee

Miscellaneous

Interior Least Tern 5-year review: provided assistance to the review team and helped test the post-delisting monitoring protocol

Featured in the Media

"Plover trouble in Texas" Nongame Bird Blog http://neblandvm.outdoornebraska.gov/2015/09/plover-trouble-in-texas/, 12 September 2015

"In search of Erwin at Bunche Beach: Part 2", by Bob Pelky, http://swfloridabirder.blogspot.com, 11 September 2015

"In search of Erwin at Bunche Beach: Part 1", by Bob Pelky, http://swfloridabirder.blogspot.com, 4 September 2015

"Good heavens, Helen, what are those birds doing?" Nongame Bird Blog http://neblandvm.outdoornebraska.gov/2015/06/good-heavens-helen-what-are-those-birds-doing/, 5 June 2015

"Cranes, chimney swifts and climate", editorial featured on Lincoln Journal Star opinion page (prepared by LJS editorial staff), 16 May 2015

"Tracking Erwin: 1,325 days later", Nongame Bird Blog, http://neblandvm.outdoornebraska.gov, 4 February 2015

"See a watershed in motion", NebraskaLand Magazine, January-February 2015

"Searching for Nebraska Piping Plovers on the Laguna Madre", Nongame Bird Blog, http://neblandvm.outdoornebraska.gov, 25 January 2015

"Color banding shows movement of Piping Plovers", Lincoln Journal Star, 25 January 2015

"Company Birds", NEBCO/Western Sand and Gravel, annual employee meeting video, January 2015

"As the world terns", by Michael Forsberg, Platte Basin Time Lapse Project web page, 13 October 2014

"Endangered Birds Depend on Heavy Industry for Survival by Ariana Brocious", NET/NPR and Platte Basin Time Lapse Project web page, 13 October 2014

"NET radio spotlights efforts to protect endangered birds", NGPC Weekly, 10 October 2014

"NPR features the success of the TPCP", NGPC Non-game bird blog, 3 October 2014

Grants and Fundraising

Toward adaptive Management: evaluating Piping Plover management at Lake McConaughy, Nebraska State Wildlife Grant, Nebraska Game and Parks Commission, awarded 2013–2016

Publications

Hunt, K. L., Dinan, L. R., Friedrich, M. J., Brown, M. B., Jorgensen, J. G., Catlin, D. H., and Fraser, J. D. *In Press*. Double brooding of Piping Plovers (*Charadrius melodus*) in the Great Plains. Waterbirds: xxx-xxx.

Jorgensen, J.G. and M.B. Brown. 2015. Evaluating recreationists' awareness and attitudes toward Piping Plovers (*Charadrius melodus*) at Lake McConaughy, Nebraska, USA. Human Dimensions of Wildlife 20: 367-380.

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Jorgensen, J. G., Dinan, L. R., Brown, M. B. 2014. Interior Least Tern and Piping Plover habitat selection and nest and chick survival on the lower Platte River system. USFWS Section 6 E-15-R.

Brown, M.B., L.R. Dinan, and J.G. Jorgensen. 2014. 2014 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.

Reviewers for Professional Publications and Organizations

Oecologia
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 through 2018

University of Nebraska Teaching and Mentoring

NRES 399 Independent Research (instructor)

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

NRES 497 Career Experiences (supervisor and evaluator)

NRES 498/898 Ornithology Laboratory (instructor)

NRES 898 Academic Publishing (with Mark Burbach)

“Being a better mentor: a workshop for mentors and mentors-to-be”, presented by Association for Women in Science, Wolfville, NS, Canada

Mentor, Lincoln Public Schools, Lincoln, NE, job shadowing program

An adult Piping Plover being removed from the box trap so that it can be banded and measured.

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