Negotiating Recovery of Interior Least Tern and Piping Plover on the Central Platte River

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Abstract

Observations of interior least tern (*Sternula antillarum athalassos*) and piping plover (*Charadrius melodus*) use of the central Platte River are reviewed in relation to changes in hydrology and channel morphology over historical timeframes. The first species observations in Nebraska date to the period of exploration in the early 1800s. Observations in the Associated Habitat Reach (AHR) of the central Platte River date to the 1940s. By that time, basin hydrology had been altered by irrigation infrastructure and the channel was actively narrowing in response to changing flow, sediment, and disturbance regimes. Given the lack of species observations in the central Platte River prior to hydrologic alteration, a decline in habitat suitability and use has been inferred from a reduction in unvegetated channel width, a lack of contemporary in-channel nesting, and ongoing species use of the lower segment of the Platte River and other regional river segments. As such, since 1978 the USFWS has consistently found that actions resulting in depletions of flows that could further affect the hydrology of the AHR are likely to jeopardize the continued existence of one or more federally listed threatened or endangered species including interior least tern, piping plover, whooping crane (*Grus americana*), and pallid sturgeon (*Scaphirhynchus albus*). These jeopardy opinions prompted the states of Wyoming, Colorado, and Nebraska and the Department of the Interior to enter into a Cooperative Agreement in 1997 for the purpose of negotiating what would become to be known as the Platte River Recovery Implementation Program (Program). An objective of the Program is to conserve threatened and endangered species habitat in the AHR while accommodating certain ongoing water development activities in the Platte River basin. Here we provide an overview of the history of interior least tern and piping plover use of the Platte River and the context behind negotiations that led to the development of the Program.

Key Words: *Charadrius melodus*, Platte River Recovery Implementation Program, *Sternula antillarum athalassos*, threatened and endangered species

Running Head: Path to Adaptive Management on the Platte River

Introduction

The objective of this literature review is to provide a brief overview of the large body of relevant Platte River literature and outline regulatory actions that led to the formulation of the Platte River Recovery Implementation Program (Program or PRRIP). We begin with a brief review of interior least tern (*Sternula antillarum athalassos*; hereafter, least tern) and piping plover (*Charadrius melodus*) life history, we review historic observations of these species in Nebraska followed by monitoring and research that has occurred within the Associated Habitat Reach (AHR) of the Platte River in central Nebraska (Figure 1), changes in hydrology and channel characteristics over historical timeframes are then explored, and finally, the rationale for regulatory intervention on behalf of the species is discussed.

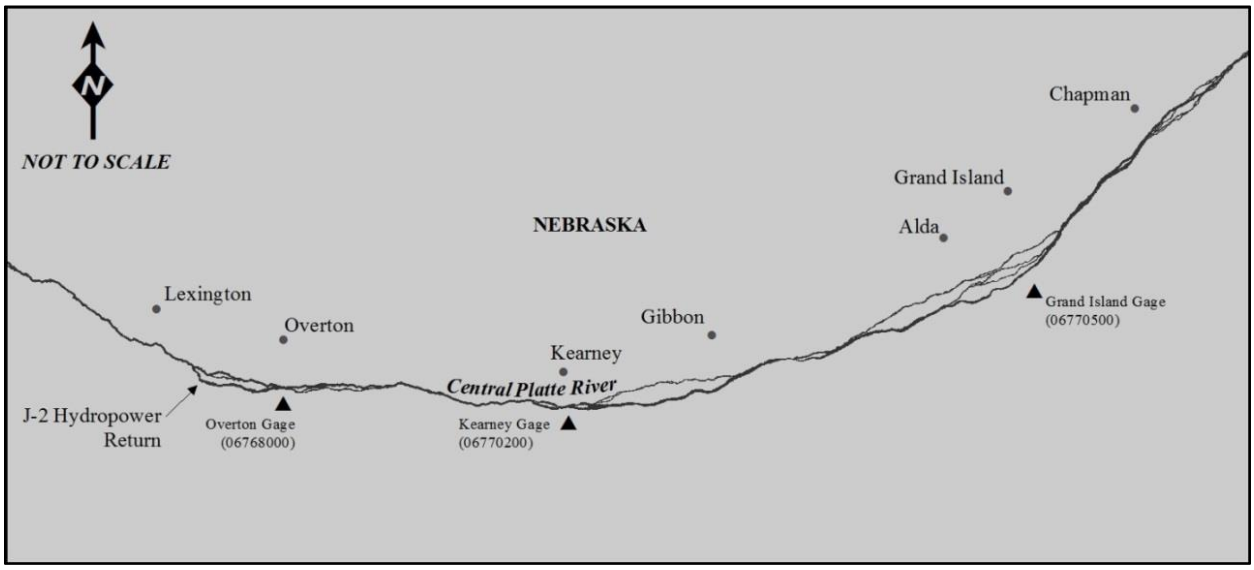

Figure 1. Associated Habitat Reach of the central Platte River in Nebraska extending from Lexington downstream to Chapman.

Least Tern and Piping Plover Life History

Least terns are long-distance migrants that breed in North America and winter in Central and South America. Least terns forage on small fish they capture by diving into shallow riverine habitats and freshwater ponds. The breeding range for least terns spans from Montana to Texas and from Eastern New Mexico and Colorado to Indiana and Louisiana (USFWS 1990). Least terns are a colonial nesting bird that mob predators or other intruders by dive-bombing and defecating on them. The species breeds and nests on barren to sparsely vegetated riverine sandbars, sand and gravel pits, lake and reservoir shorelines, rooftops, ash pits, and salt flats from mid-May to early August. Least terns usually lay three eggs in a shallow scrape and may renest if their nest is destroyed (USFWS 1990). The incubation and brood rearing period for nests and chicks generally lasts from 38 to 50 days. Least terns are a precocial species; however, chicks are not capable of foraging on their own so only a single brood is raised each year as adults must continue to feed offspring for several weeks after fledging. The least tern was listed as endangered on June 27, 1985 (USFWS 1990); however, a recently completed five-year review recommends delisting least terns due to recovery (USFWS 2013). The US Fish and Wildlife Service (USFWS) is now in the process of putting in place the necessary monitoring plans, conservation agreements, and population models in hopes of moving forward with a proposed delisting in the near future.

The northern Great Plains population of piping plovers was listed as threatened on January 10, 1986 (USFWS 2009). Piping plovers breed in North America and Canada and winter along the Atlantic and Gulf coast and in the Bahamas and West Indies. Three breeding populations of piping plovers are recognized; however, this discussion focuses solely on the northern Great Plains population. This population breeds in alkaline wetlands and along lake shorelines of the northern Great Plains and on the Missouri River and its tributaries in North and South Dakota and Nebraska.

Piping plovers on the breeding grounds generally forage on insects and spiders. This species nests from early April to early August and draws predators away from nests and young using an injury feigning broken-wing display (USFWS 2009). Nests are generally located on barren to sparsely vegetated sand and gravel found on riverine sandbars, sand and gravel mines, lake and reservoir shorelines, and sand, gravel or pebbly mud found at alkali wetlands. Piping plovers generally lay four eggs in a shallow scrape lined with small pebbles and may renest if their nest is destroyed. The incubation and brood rearing period for nests and chicks generally lasts from 52 to 65 days. Piping plovers are a precocial species with chicks that forage with an adult from shortly after hatch until fledging. Piping plovers generally only produce a single brood of fledglings; however, renesting after fledgling a brood has been observed (USFWS 2009).

Least tern and piping plover observations along the Platte River prior to systematic monitoring

Historical records of least tern occurrence in Nebraska were compiled by Ducey (1985, 2000) and Pitts (1988). The first recorded observation of least terns in what is now Nebraska was made near the mouth of the Platte River in 1804 by the Lewis and Clark expedition as they traveled up the Missouri River. The next recorded observations were made by Duke Paul Wilhelm at the mouth of the Platte River in 1823. Subsequent observations in the 19th century include the Loup River in 1857, the North Platte River in Keith County in 1859, and on the banks of a wetland basin near York, Nebraska in 1896 and 1897 (Ducey 2000; Pitts 1988). Least terns were next observed nesting on the South Platte River near the city of North Platte in 1926-1929 with 57 nests recorded as well as documentation of foraging movements to the North Platte River and sand pit lakes when the South Platte River went dry (Tout 1947).

The next recorded least tern observation on the Platte River occurred near Columbus in 1941, the same year that Lake McConaughy, the largest reservoir in the basin, was completed. Ten

nests were observed on river sandbars (Shoemaker 1941). The first recorded least tern observations in the Program's AHR occurred in 1942 when a colony was discovered nesting on the river near Lexington, Nebraska by Dr. Ray S. Wycoff. Dr. Wycoff studied the colony for 17 years and observed nesting on a low sandbar in the channel, high in-channel island created by sand mining, and at adjacent sandpits (Wycoff 1960). In 1943, a single nest was observed on a swimming lake beach near Plattsmouth (Heineman 1944). In 1948 and 1949 least tern were again observed nesting on the South Platte River (Benckeser 1948; Audubon Field Notes 3:244).

Pitts (1988) compiled records from the Proceedings of the Nebraska Ornithologists Union, Wilson Bulletin, and Nebraska Bird Review and other sources to identify annual adult and nest sightings by county for the period of 1804-1984. Records of adult and nest sightings in the AHR began with Dr. Wycoff's observations which account for the majority of AHR records. Other observations prior to the first systematic survey results for the AHR in 1979 include one mid-reach adult observation in 1960 and observations of adult birds in the downstream portion of the reach in 1953, 1954, 1957, 1959, and 1973.

Early records of piping plover observations in Nebraska are much more limited and are typically very general in nature (Pitts 1988). The earliest mention of the species (Hunter 1900) referred to the piping plover as being "common" in the Nebraska sandhills but "rare" near Lincoln, Nebraska. Subsequent references list the species as a common migrant that breeds in scattered spots along lakes and rivers in the state (Wolcott 1909; Moser 1942; Tout 1951; Nebraska Bird Review 1955; Rosche 1979). The first quantitative observations of adults occurred near Omaha and at Capitol Beach in Lincoln in the early 1940s (Moser 1942). Pitts' (1988) review of adult and nest observations by county (1804-1984) identified six years prior to the beginning of systematic survey efforts when adults were observed near the upper end of the AHR (1950-1952, 1954-1956),

one year in the middle portion of the reach (1957), and two years in the downstream portion of the reach (1954, 1959).

Systematic monitoring of least tern and piping plover in the Associated Habitat Reach

The Program is responsible for implementing certain aspects of the endangered interior least tern (*Sternula antillarum athalassos*; hereafter, least tern) and threatened piping plover (*Charadrius melodus*) recovery plans. More specifically, the Program's Adaptive Management Plan (AMP) management objective is to increase productivity of the least tern and piping plover from the AHR (Program 2006). This ninety-mile reach extends from Lexington, NE downstream to Chapman, NE and includes the Platte River channel and off-channel habitats within three and one half miles of the river (Figure 1).

Intermittent systematic monitoring of least tern piping plover occurrence and productivity has been conducted in the AHR since 1979 with variable degrees of monitoring effort expended every year after 1982 (Pitts 1988; Sidle and Kirsch 1993; Lingle 2004; National Research Council 2005; Baasch 2010, 2012, 2014; Sherfy et al. 2012). A total of approximately 1,789 least tern and 776 piping plover nests have been documented in the AHR (Table 1; Figure 2). Of all nests documented in the AHR, 88.2% of least tern nests and 75.4% of piping plover nests occurred on off-channel sandpit habitat. Approximately 3.3% of least tern nests and 7.1% of piping plover nests occurred on natural sandbars; the remaining in-channel nests were observed on islands that were mechanically created and maintained as nesting habitat.

Table 1. Central Platte River nest incidence by habitat type for the period of 1978–2013.

Habitat Type	Interior Least Tern		Piping Plover	
	Count	Percent	Count	Percent
Sandpit	1,578	88.2%	585	75.4%
Natural Sandbar	59	3.3%	55	7.1%
Constructed or Managed Sandbars	152	8.5%	136	17.5%
Total	**1,789**	**100.0%**	**776**	**100.0%**

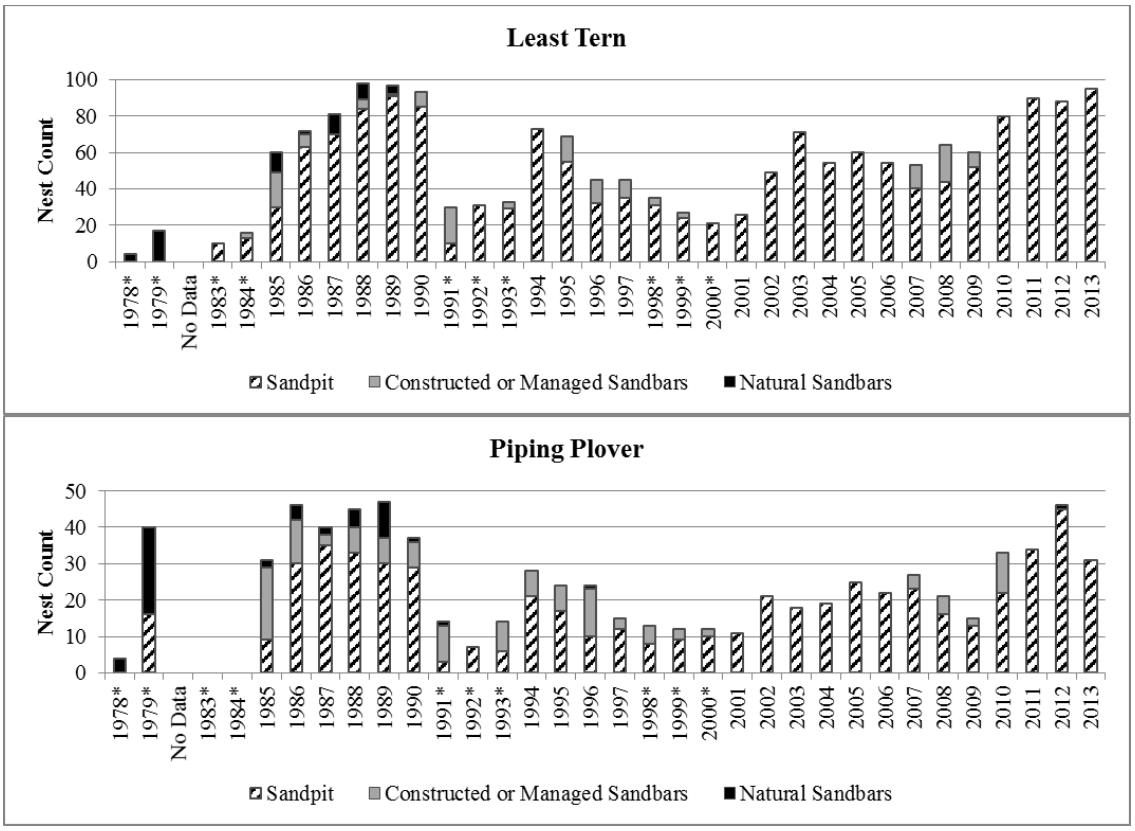

Figure 2. Central Plate River least tern and piping plover nest incidence 1978–2013 by year and habitat type. Asterisks indicate periods when monitoring effort changed substantially.

In-channel habitat selection and productivity investigations

Two on-channel habitat selection and productivity analyses were conducted in the AHR during the late 1970s and mid-1980s when the species were observed utilizing natural sandbar habitat (Faanes 1983; Ziewitz et al. 1992). The investigations identified low quantities of suitable nesting habitat and observed high levels of nest loss and chick mortality due to inundation of sandbars. Faanes noted a total loss of nests and young, while Ziewitz noted 8 of 13 nests were lost to inundation. Similarly, Lingle (1993) noted high mortality associated with inundation of nests and chicks. A reduction of peak flows and vegetation encroachment into the channel from the pre-development period were cited as the reasons for low nest incidence and poor productivity (Atkins 1979; Faanes 1983; Ziewitz et al. 1992).

Changes in Associated Habitat Reach hydrology over historical timeframes

Water development in the Platte River basin began in the mid-1800s as settlers migrated to the region in search of gold and to homestead after the Federal Government opened the basin for settlement. The Platte River is now heavily developed with over seven thousand diversion rights and seven million acre-feet of storage (Figure 3; Simons & Associates Inc. 2000). Platte River discharge records begin in 1895, fifteen years before the completion of Pathfinder Dam, the first major agricultural storage project in the basin. Mean annual discharge and the magnitude of the mean annual peak discharge in the contemporary river are less than 40% of what was observed during the brief period of record prior to reservoir construction (Table 2; Stroup et al. 2006).

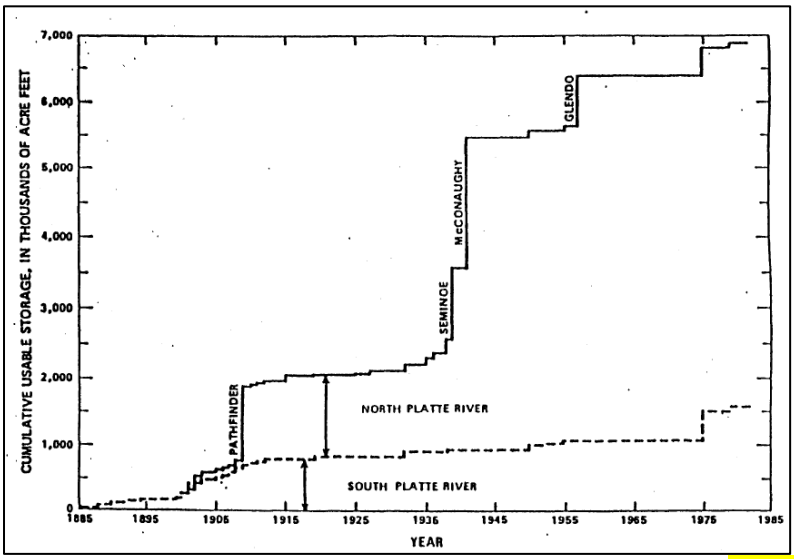

Figure 3. Cumulative usable storage in reservoirs in the Platte River basin (Simons and Associates Inc. 2000).

Table 2. Mean annual discharge and mean annual peak discharge at Overton gage adapted from Stroup et al. (2006).

	1895-1909	**1910-1927**	**1928-1941**	**1942-1958**	**1959-1974**	**1975-1998**	**1999-2013**
Mean Annual Discharge (cfs)	4,584	4,323	1,845	1,223	1,636	1,938	1,232
Mean Annual Peak Discharge (cfs)	20,725	18,218	11,548	6,685	7,301	7,176	5,056

158 ***Changes in Associated Habitat Reach sediment transport over historical timeframes***

159 There is little bed material or sediment transport data available for the historical AHR.
160 Simons and Associates Inc. (2000) generated a crude predevelopment sediment transport estimate
161 of approximately 7.8 million tons per year based on a flow/sediment regression analysis and an
162 estimate of sediment trapping in North Platte River reservoirs. Murphy et al. (2006) estimated
163 much lower predevelopment sediment loads on the order of 1-2 million tons per year using a range
164 of sediment discharge equations and discharge records from the period of 1895-1909. As indicated
165 by the differences in these estimates, there is a high degree of uncertainty related to sediment loads
166 in the historical AHR. Contemporary sediment load estimates are less variable and generally range
167 from 400,000 – 1,000,000 tons per year (Simons and Associates Inc. 2000; Murphy et al. 2004;
168 HDR Inc. et al. 2011).

169 One of the most substantial changes in sediment dynamics from predevelopment conditions
170 is a sediment deficit in the upper half of the AHR due to clear water hydropower returns at the J-
171 2 Return structure on the south channel downstream of Lexington, NE (Figure 4; Holburn et al.
172 2006). An average of approximately 73% of Platte River flow is diverted at the Tri-County
173 Diversion Dam downstream of North Platte and returns to the river at the J-2 Return where it
174 constitutes approximately 47% of river flows (Murphy et al. 2004). Once diverted at North Platte,
175 flow travels through several off-line reservoirs, where almost all of the sediment is trapped.
176 Accordingly, return flows at the J-2 Return structure are sediment-starved resulting in a sediment
177 deficit below the return.

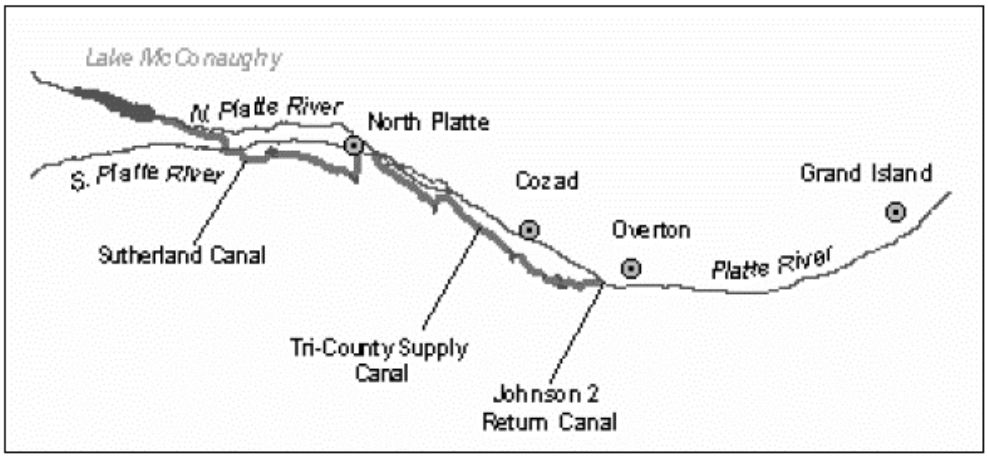

Figure 4. Map of Lake McConaughy, Tri-County Supply Canal and J-2 Return Canal. Figure reproduced from Department of the Interior (2006).

Changes in Associated Habitat Reach channel morphology over historical timeframes

The reduction in AHR active channel width (unvegetated width between permanently vegetated left and right banks) over historical timeframes through expansion of woody vegetation was first quantified by Williams (1978) and has been expanded upon in several subsequent analyses (Eschner et al. 1983; Currier et al. 1985; Peake 1985; O'Brien and Currier 1987; Lyons and Randle 1988; Sidle et al. 1989; Johnson 1994; Simons and Associates 2000; Parsons 2003; Murphy et al. 2004; Schumm 2005; Horn et al. 2012). With the exception of Parsons (2003), which asserted no width change, investigators have generally concluded that the AHR experienced a substantial width reduction as a result of the expansion of cottonwood forest into the channel. The change is evident in comparisons of aerial photography (Figure 5).

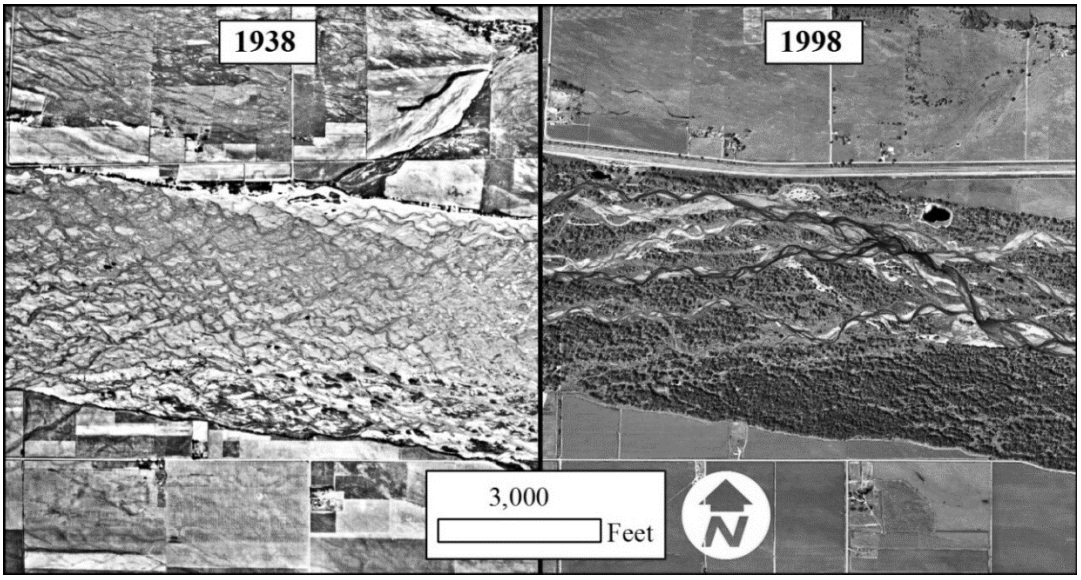

Figure 5. Comparison of 1938 and 1998 aerial photographs of the Associated Habitat Reach at River Mile 218 in the Odessa to Kearney bridge segment. Much of the 1998 channel area is occupied by riparian cottonwood forest.

The surveyed bank-to-bank or total width of the channel in the 1860s excluding large permanent islands was highly variable and averaged 3,800 ft (Figure 6). The proportion of the total width of the historical channel that was unvegetated is not known but has been estimated to be on the order of 90% (Johnson 1994). At the earliest aerial photography collection in 1938, unvegetated channel width averaged 2,600 ft. By 1998, average unvegetated width was 900 ft. Johnson (1994) evaluated the rate of change in active channel width in the AHR from 1938 to 1988 and found the majority of narrowing occurred during the 1940s and 1950s with channel area stabilizing by the 1980s (Figure 7).

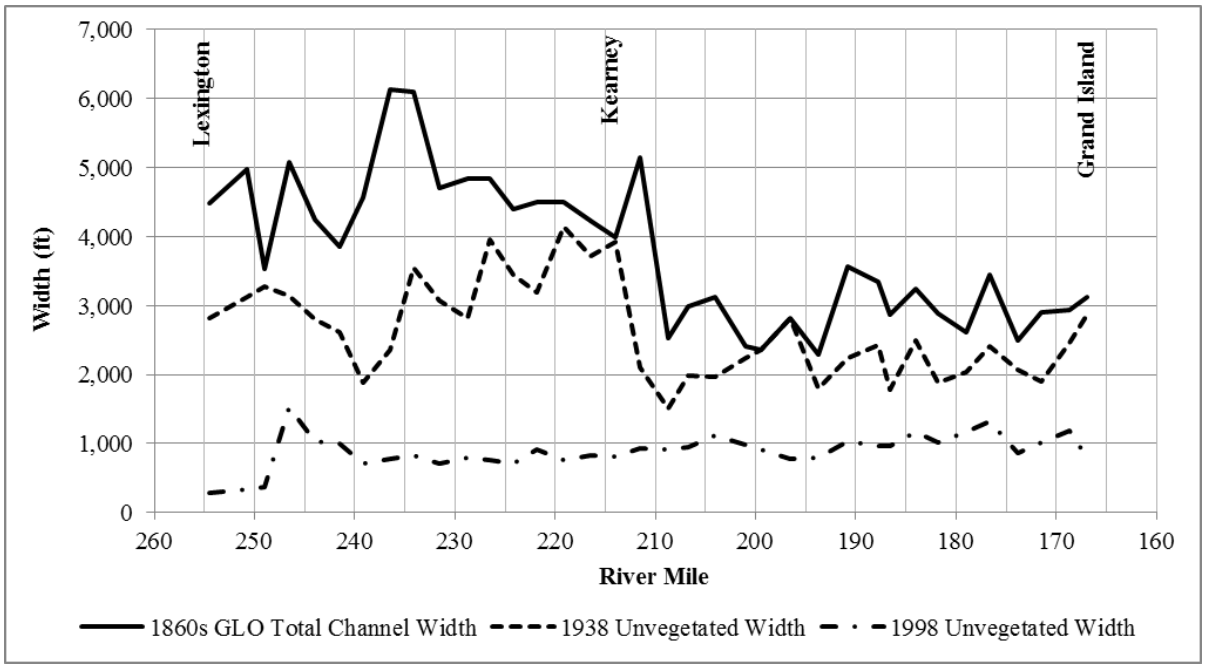

Figure 6. Total channel width in the Associated Habitat Reach from the 1860s General Land Office (GLO) survey, total unvegetated width in 1938 aerial photographs and total unvegetated width in 1998 aerial photographs.

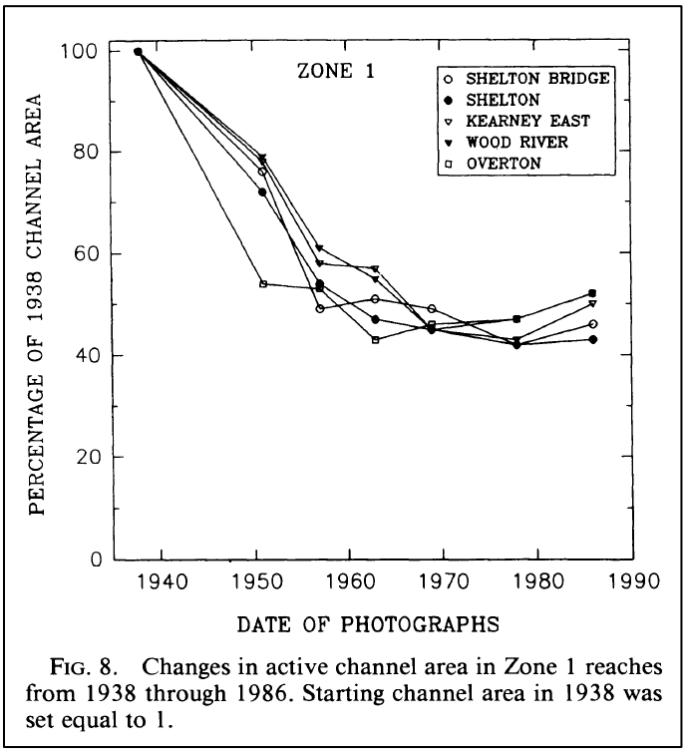

FIG. 8. Changes in active channel area in Zone 1 reaches from 1938 through 1986. Starting channel area in 1938 was set equal to 1.

Figure 7. Change in active channel area in the upper half of the Associated Habitat Reach 1938-1988 from aerial photography (Johnson 1994).

The drivers of woody vegetation expansion were explored in many of the channel width analyses with investigators generally concluding the change was due to alterations in hydrology caused by water development in the basin. Alternative hypotheses of the specific mechanisms of narrowing include: a reduction of peak flow magnitude and associated ability to scour vegetation (Williams 1978; O'Brien and Currier 1987; Murphy et al. 2004); a reduction in flow during the cottonwood germination period leading to increased recruitment (Johnson 1994; Simons and Associates 2000); and a decrease in desiccation mortality of seedlings in summer as the river transitioned from ephemeral to perennial due to irrigation return flows (Schumm 2005).

Although changes in AHR channel width have been widely studied and debated, sandbar characteristics in the historical river are not well documented. Several investigations include brief descriptions of sandbars and islands recorded by travelers in the 19th Century (Eschner et al. 1983; Simons and Associates 2000; Murphy et al. 2004). The most descriptive observation of bedforms was contained in Mattes (1969) who reproduced a quote from a Mr. Evens in 1848 describing the Platte River near Kearney as "running over a vast level bed of sand and mica *** continually changing into short offsets like the shingled roof of a house***." Other travelers generally characterized the bed of the river as being comprised of innumerable sandbars continually shifting and moving downstream (James 1823; Mattes 1969).

The first detailed characterization of AHR sandbar morphology was provided by Ore (1964) who classified Platte River bedforms as transverse bars. Further attempts to characterize sandbar morphology identified dominant bedforms as transverse/linguoid bars (Smith 1971; Blodgett and Stanley 1980), macroforms (Crowley 1981, 1983), or a combination of both types (Horn et al. 2012). The historical accounts of Platte River bedforms appear to agree well with contemporary descriptions of transverse/linguoid bars.

Regulatory intervention in the Platte River Basin through the Endangered Species Act

The interior population of the least tern was listed as endangered under the Endangered Species Act in 1985 and the piping plover was listed as threatened in 1986. Soon after listing, the USFWS made the determination that these species were threatened by upstream impoundments and diversions that reduced the magnitude of the annual spring runoff credited with historically creating and maintaining suitable sandbar nesting habitat on a near-annual basis (Freeman 2010; Department of the Interior 2006). The Biological Opinion for the Program provides the rationale for USFWS conclusions about the effects of upstream water development on least tern and piping plover habitat in the AHR (USFWS 2006). A decline in habitat suitability within the AHR has been inferred from the body of evidence documenting a substantial change in Platte River hydrology and reduction in unvegetated channel width over historical timeframes, presence of nesting on sandpits but lack of suitable sandbar nesting habitat and in-channel productivity in the contemporary AHR, and species use of riverine habitat in the contemporary lower Platte River which experiences higher peak flow and stage change magnitudes (USFWS 2006).

Actions resulting in depletions of Platte River flows that could further affect the hydrology of the AHR were believed to jeopardize the continued existence of one or more federally listed threatened or endangered species including interior least tern, piping plover, whooping crane, and pallid sturgeon (USFWS 2006). These jeopardy opinions prompted the states of Wyoming, Colorado, and Nebraska and the Department of the Interior to enter into a Cooperative Agreement in 1997 for the purpose of negotiating a program to conserve threatened and endangered species habitat in the AHR while accommodating certain ongoing water development activities in the basin. The negotiation process culminated in the development of the Platte River Recovery Implementation Program (Program). Since 2007, the Program has been implementing an Adaptive

Management Plan (AMP) to reduce uncertainties related to the responses of terns and plovers to management actions on the central Platte River and to investigate hypotheses related to tern and plover use of and productivity on in-channel and off-channel habitat.

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