

Fall 12-21-2015

The Status of Fishes in the Missouri River, Nebraska: Selected Ancient Fishes

Kirk D. Steffensen

Nebraska Game and Parks Commission, kirk.steffensen@nebraska.gov

Follow this and additional works at: <http://digitalcommons.unl.edu/tnas>



Part of the [Aquaculture and Fisheries Commons](#), and the [Population Biology Commons](#)

Steffensen, Kirk D., "The Status of Fishes in the Missouri River, Nebraska: Selected Ancient Fishes" (2015). *Transactions of the Nebraska Academy of Sciences and Affiliated Societies*. 478.

<http://digitalcommons.unl.edu/tnas/478>

This Article is brought to you for free and open access by the Nebraska Academy of Sciences at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Transactions of the Nebraska Academy of Sciences and Affiliated Societies by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

The Status of Fishes in the Missouri River, Nebraska: Selected Ancient Fishes

Kirk D. Steffensen

Nebraska Game and Parks Commission, 2200 North 33rd Street, Lincoln, NE 68503

Corresponding author: K. D. Steffensen, email kirk.steffensen@nebraska.gov; phone: (402) 471-1514, fax: (402) 471-4992

Abstract

Several ancient fish species have inhabited the Missouri River and its tributaries for thousands of years prior to major mainstem modifications and fragmentation. However post-anthropogenic modifications, populations of these ancient fish species have been highly diminished. Therefore, the objective of this study was to use historic and current ichthyological records to determine the past and present status for Chestnut Lamprey *Ichthyomyzon castaneus*, Silver Lamprey *Ichthyomyzon unicuspis*, Bowfin *Amia calva*, American Eel *Anguilla rostrata*, and Burbot *Lota lota*. Currently, these species are rarely captured and perhaps extirpated from Nebraska waters.

Keywords: Bowfin, Burbot, Eel, Endangered, Lamprey, Missouri River, Threatened

Introduction

Negative changes to the fish community have been well documented on the Missouri River since the major anthropogenic modifications to the Missouri River occurred throughout the late-1800s and much of the 1900s (Hesse *et al.* 1989, Hesse *et al.* 1993, Hesse 1994ab, Everett *et al.* 2004, Steffensen *et al.* 2014abcd). These river modifications included construction of six mainstem dams and a highly altered river navigation channel from Sioux City, IA (river kilometer [rkm] 1,178.8) to the Mississippi River confluence (rkm 0.0). As a result, the current Missouri River is approximately 35% impounded, 32% channelized, and 33% remaining in a semi-unaltered riverine condition but interspersed between mainstem reservoirs and dams (Keenlyne 1989, Hesse and Mestl 1993). Additionally, these “natural” riverine reaches have a vastly altered hydrograph and temperature and turbidity regime compared to the historic river.

These river modifications have caused the populations of several native fish species to decline and required listing as a federally endangered species (i.e., Pallid Sturgeon [*Scaphirhynchus albus*], 55 FR 36642-36647, U.S. Fish and Wildlife Service 1990) or State of Nebraska endangered species (i.e., Sturgeon Chub [*Macrhybopsis gelida*]). Additionally, Lake Sturgeon (*Acipenser fulvescens*) have been listed as a State of Nebraska threatened species along with several species being listed as State of Nebraska species of concern under the Nebraska Natural Legacy Project’s designation (Tier I: Blue Sucker *Cycleptus elongatus* and Sicklefin Chub *Macrhybopsis meeki*, Tier II: American Eel *Anguilla rostrata*, Black Buffalo *Ictiobus niger*, Bowfin *Amia calva*, Burbot *Lota lota*, Chestnut Lamprey *Ichthyomyzon castaneus*, Common Shiner *Luxilus cornutus*, Flathead chub *Platygobio gracilis*, Paddlefish *Polyodon spathula*, Plains Minnow *Hybognathus placitus*, Silver Lamprey *Ichthyomyzon unicuspis*, Trout-Perch *Percopsis omiscomaycus*, and Western Silvery Minnow *Hybognathus argyritis*. Tier

I species are those that are globally or nationally most at-risk of extinction and which occur in Nebraska; whereas, Tier II species are species that do not meet Tier I criteria but are ranked critically imperiled, imperiled or vulnerable within Nebraska. Recently, recommendations were made to list several additional species as State of Nebraska endangered (i.e., Sicklefin Chub [*Macrhybopsis meeki*], Flathead Chub [*Platygobio gracilis*], and Western Silvery Minnow [*Hybognathus argyritis*]) or threatened (i.e., Shoal Chub [*Macrhybopsis hyostoma*] and Plains Minnow [*Hybognathus placitus*], Steffensen *et al.* 2014) species.

In addition to these native fishes, several ancient species have inhabited the mainstem Missouri River for thousands of years but have not received the same degree of analysis as other fish species. The historic populations of these ancient fishes (i.e., Chestnut Lamprey *Ichthyomyzon castaneus*, Silver Lamprey *Ichthyomyzon unicuspis*, Bowfin *Amia calva*, American Eel *Anguilla rostrata*, and Burbot *Lota lota*) are relatively unknown but their frequency of capture appears to be declining. Therefore, the objective of this paper is to present the historical and current collection records and provide a management recommendation for selected ancient Missouri River fish species.

Chestnut Lamprey *Ichthyomyzon castaneus*

Description

Chestnut Lamprey are a freshwater, parasitic fish that are most frequently encountered in large rivers and reservoirs attached to a host fish. Chestnut Lamprey reach a maximum length of 305 mm (12 inches) at maturity and are generally tannish-yellow to olive in color (Pflieger 1997). Lamprey are easily identified by an oral feeding disc and lack of paired fins. In the spring, adults aggregate in medium to large sized rivers for spawning over coarse gravel. Chestnut Lamprey are a communal spawning species that spawn in groups of 20 or more (Pflieger 1997) with a sin-

gle female in Oklahoma reported to contain about 42,000 eggs (Hall and Moore 1954). Post-hatch larva or ammocoetes burrow into the soft stream bed material where they can live for three to six years (Morris *et al.* 1974, Stackpoole 1997) and attain lengths greater than 152 mm (6 inches). Larval lampreys have a “U” shaped sucking disc but do not have developed eyes. Larval Chestnut Lamprey transforms into adults and emerge in the spring with developed eyes and a circular feeding disc. Adult Chestnut Lamprey attach to a host fish and feed parasitically on their host’s body fluids. Feeding commonly occurs for a couple days after which the lamprey drops off without harm to their host fish. Adults live for one to two years before spawning and die after completing their spawning cycle.

Distribution

Chestnut Lamprey primarily inhabits the Mississippi River basin, including the Missouri River up to Gavins Point Dam, NE (rkm 1,305.2) and the Red River of the North to Lake Winnipeg (Lee *et al.* 1980). Additionally, Chestnut Lamprey are found in the eastern tributaries of Lake Michigan. Specifically in the Missouri River, Pflieger (1997) noted that Chestnut Lamprey are rarely encountered above St. Joseph, MO (rkm 722.6).

Collection Records

Chestnut Lamprey are lacking in many of the early ichthyological records. Johnson (1942) did not collect any Chestnut Lamprey during his thesis collection efforts; however, hatchery employees reported capturing fish with lampreys attached from the Missouri and lower Platte River (reported in Johnson 1942). There appears to be discrepancies in historic lamprey occurrences in Nebraska as Bailey (1959) reported that Silver Lamprey occurred more frequently compared to Chestnut Lamprey. However, Morris *et al.* (1974) believed that Chestnut Lamprey were the only lamprey species thought to occur in Nebraska and Miller (1972) reported Chestnut Lamprey as an endangered species in Nebraska. No Chestnut Lamprey were collected during ichthyological studies from Gavins Point Dam to Rulo, NE (rkm 801.3) during the latter half of the 1900s (Bailey and Allum 1962, Schmulbach *et al.* 1975, Hesse *et al.* 1989, Berry and Young 2004). Pflieger and Grace (1987) noted Chestnut Lampreys decrease in relative abundance in the Missouri River downstream of the Nebraska/Kansas border.

Since 1963, only one specimen has been captured. A crew from the Nebraska Game and Parks Commission was electrofishing as part of the U. S. Environmental Protection Agency’s Great Rivers Environmental Monitoring and Assessment Project and collected a single adult (210 mm) on 21 September 2004 just north of Rulo, NE (rkm 792.9, Table 1). Chestnut Lamprey are currently listed as a Tier II species at risk by the Nebraska Natural Legacy Project.

Silver Lamprey *Ichthyomyzon unicuspis*

Description

Silver Lamprey are a freshwater, parasitic lamprey that inhabit large rivers and lakes (Pflieger 1997). Silver Lamprey reach a maximum length of 381 mm (15 inches), which is slightly larger than Chestnut Lamprey. As their name implies, Silver Lamprey are generally greyish in color with a light-colored belly but have the same mouth structure (i.e., oral disc) that differentiate lampreys from other species. Similar to Chestnut Lamprey, Silver Lamprey migrate upstream into medium-size rivers to spawn over sand and/or gravel bars (Becker 1983); however, Silver Lamprey have been documented to migrate further upstream to spawn compared to Chestnut Lamprey (Stackpoole 1997). Silver Lamprey have a reported fecundity of approximately 10,800 eggs (Lee *et al.* 1980). Post-hatch, larval lamprey drift downstream and burrow into the river bed. Silver Lamprey remains as juveniles for four to seven years (Scott and Crossman 1985). Morphologically, larval Chestnut and Silver Lamprey have similar transformations into adults. After transforming into an adult, Silver Lamprey survive for approximately 12 to 13 months before spawning and dying shortly thereafter.

Distribution

Silver Lamprey reside in the middle and upper reaches of the Mississippi River, northward into the Hudson Bay, Great Lakes, and St. Lawrence River tributaries (Lee *et al.* 1980). A few isolated capture records have been reported in the Missouri River and the lower Mississippi River in Mississippi (Lee *et al.* 1980). In the Missouri River, Pflieger (1997) noted a lack of Silver Lamprey throughout Missouri but were known to occur in Nebraska and South Dakota, as the range of Silver Lamprey extends farther upstream compared to Chestnut Lamprey (Bailey 1959).

Collection Records

A silver lamprey was captured from the Missouri River near Chamberlain, SD (Everman and Cox 1896) while Bennett (1931, published in Jones 1963) reported Silver Lamprey collected from the Platte and Missouri Rivers. However, Morris *et al.* (1974) stated that only the Chestnut Lamprey is thought to occur in Nebraska while Berry and Young (2004) stated Silver Lamprey are more common. Similar to Chestnut Lamprey, Silver Lamprey were not collected in any of the early ichthyological studies (Johnson 1942, Bailey and Allum 1962, Schmulbach *et al.* 1975, Hesse *et al.* 1989, Berry and Young 2004). Miller (1972) reported Silver Lamprey as a Nebraska endangered species.

Silver Lamprey have not been collected from the Missouri River in Nebraska since 1931 until three specimens were collected when sampling for adult Paddlefish immediately below Gavins Point Dam near Yankton, South Dakota in June 2015 (D. Pauley, Nebraska Game and Parks

Table 1. Capture history for species of interest from the Missouri River for 1963 to present day. River kilometers are approximate as historical records did not include specific locations.

Species	Site	River Km	Date	Length (mm)	Weight (g)	Count
Chestnut Lamprey (<i>Ichthyomyzon castaneus</i>)						
	Rulo	801.2	9/21/2004	210		1
Silver Lamprey (<i>Ichthyomyzon unicuspis</i>)						
	Gavins Point Tailwaters	1,305.2	6/8/2015	169		1
	Gavins Point Tailwaters	1,305.2	6/9/2015	194		1
	Gavins Point Tailwaters	1,305.2	6/10/2015	198		1
Bowfin (<i>Amia calva</i>)						
	Decatur	1,112.1	5/8/1990	558		1
American Eel (<i>Anguilla rostrata</i>)						
	Brownville	861.0	5/9/1974	285	28	1
	Brownville	861.0	5/22/1974	665	565	1
	Brownville	861.0	6/12/1974	520	270	1
	Brownville	861.0	6/20/1974	728	842	1
	Brownville	861.0	6/26/1974	756	1000	1
	Brownville	861.0	7/24/1974	660	640	1
	Brownville	861.0	8/21/1974	494	250	1
	Brownville	861.0	8/21/1974	623	520	1
	Brownville	861.0	8/21/1974	710	470	1
	Brownville	861.0	9/26/1974	410	115	1
	Decatur	1,112.1	5/4/1975	425	94	1
	Brownville	861.0	5/5/1975	565	390	1
	Brownville	861.0	5/21/1975	600	500	1
	Brownville	861.0	5/21/1975	678	620	1
	Brownville	861.0	5/28/1975	552	308	1
	Brownville	861.0	6/12/1975	471	175	1
	Brownville	861.0	6/12/1975	520	270	1
	Brownville	861.0	6/12/1975	631	510	1
	Brownville	861.0	6/17/1975	490		1
	Brownville	861.0	6/17/1975	660		1
	Brownville	861.0	7/1/1975	570	410	1
	Brownville	861.0	7/1/1975	572	365	1
	Brownville	861.0	7/14/1975	530		1
	Brownville	861.0	7/29/1975	470	510	1
	Decatur	1,112.1	8/4/1975	548	426	1
	Brownville	861.0	8/6/1975	425	140	1
	Brownville	861.0	8/28/1975	705	784	1
	Brownville	861.0	9/18/1975	626	520	1
	Brownville	861.0	10/9/1975	606	408	1
	Decatur	1,112.1	5/23/1977	625	530	1
	Decatur	1,112.1	9/15/1977	550	310	1
	Gavins Point Tailwaters	1,305.2	8/1/1983	389		1
	Gavins Point Tailwaters	1,305.2	8/1/1983	852		1
	Gavins Point Tailwaters	1,305.2	9/11/1984	652		1
	Gavins Point Tailwaters	1,305.2	9/18/1985	480		1
	Gavins Point Tailwaters	1,305.2	9/23/1985	627		1
	Gavins Point Tailwaters	1,305.2	5/14/1986	566		1
	Gavins Point Tailwaters	1,305.2	8/5/1986	725		1
	Gavins Point Tailwaters	1,305.2	9/23/1986	498		1
	Brownville	861.0	8/19/1998	981	2100	1

Continued

Table 1. Capture history for species of interest from the Missouri River for 1963 to present day. River kilometers are approximate as historical records did not include specific locations. (Continued)

Species	Site	River Km	Date	Length (mm)	Weight (g)	Count
<i>Burbot (Lota lota)</i>						
	Decatur	1,112.1	9/25/1970	366		1
	Brownville	861.0	11/20/1970	261		1
	Decatur	1,112.1	4/12/1971	502		1
	Decatur	1,112.1	4/19/1971	263		1
	Decatur	1,112.1	4/26/1971	420		1
	Decatur	1,112.1	2/13/1974	293	227	1
	Brownville	861.0	3/6/1974	448	737	1
	Decatur	1,112.1	4/22/1974	385	330	1
	Brownville	861.0	5/22/1974	365	328	1
	Decatur	1,112.1	5/28/1974	289	140	1
	Brownville	861.0	6/5/1974	360	270	1
	Decatur	1,112.1	8/19/1974	431	310	1
	Brownville	861.0	8/27/1974	432	375	1
	Decatur	1,112.1	9/16/1974	438	300	1
	Decatur	1,112.1	10/15/1974	344	184	1
	Brownville	861.0	10/17/1974	380	260	1
	Brownville	861.0	10/31/1974	270	95	1
	Brownville	861.0	11/20/1974	125	13	1
	Brownville	861.0	3/31/1975	381	392	1
	Brownville	861.0	4/17/1975	347	268	1
	Brownville	861.0	5/1/1975	366	322	1
	Decatur	1,112.1	6/10/1975	367	242	1
	Decatur	1,112.1	9/23/1975	344	180	1
	Nebraska City	906.4	4/11/1978	291		1
	Niobrara	1,356.2	9/11/1978			68
	Gavins Point Tailwaters	1,305.2	8/1/1983	392		1
	Gavins Point Tailwaters	1,305.2	10/19/1983	434		1
	St. Helena	1,285.5	4/5/1984	4		1
	St. Helena	1,285.5	4/16/1984	4		1
	Gavins Point Tailwaters	1,305.2	4/3/1985	50		1
	St. Helena	1,285.5	5/20/1985	9		1
	St. Helena	1,285.5	5/20/1985	10		1
	Lewis and Clark Lake	1,313.2	6/10/1985	377		1
	Brooky Bottoms	1,263.3	3/31/1986	5		1
	Gavins Point Tailwaters	1,305.2	10/18/1988	327		1
	Lower Boyd County	1,393.9	4/24/1989	314		1
	Lower Boyd County	1,393.9	4/24/1989	316		1
	Boyer Chute	1,022.7	10/5/1993	495		1
	Lewis and Clark Lake	1,313.2	6/30/1998	49		1
	Lewis and Clark Lake	1,313.2	7/8/1998	213	64	1
	Ponca	1,212.6	10/5/1998	465	500	1
	Verdel	1,370.5	8/4/2000	300	190	1
	Verdel	1,370.5	8/4/2000	316	200	1
	Verdel	1,370.5	8/4/2000	450	500	1
	Ponca	1,212.6	8/10/2000	312	195	1
	Ponca	1,212.6	8/10/2000	315	200	1
	Ponca	1,212.6	8/10/2000	432	550	1
	St. Helena	1,285.5	8/16/2000	264	120	1
	St. Helena	1,285.5	8/16/2000	265	125	1
	St. Helena	1,285.5	8/16/2000	315	210	1
	St. Helena	1,285.5	8/16/2000	315	240	1
	St. Helena	1,285.5	8/16/2000	316	245	1
	Ponca	1,212.6	9/20/2001	400	350	1
	Mulberry Bend	1,247.6	8/21/2002	399	300	1
	Mulberry Bend	1,247.6	8/20/2003	64		1
	Decatur	1,112.1	9/25/1970	366		1

Commission (NGPC), Pers. Comm., Table 1). These specimens were attached to the adult paddlefish and ranged from 169 to 198 mm. This is the first time Silver Lamprey have been found attached to Paddlefish in the Gavins Point Dam Tailwaters even though thousands of Paddlefish have been sampled at this location since 1995 (G. Mestl, NGPC, Pers. Comm.). Paddlefish are highly migrational so determining the Silver Lamprey originated maybe difficult. Paddlefish have been documented to migration downstream through the mainstem dams and travel hundreds of miles in the open river below Gavins Point Dam (Pracheil *et al.* 2012). Silver Lamprey are currently listed as a Tier II species at risk by the Nebraska Natural Legacy Project.

Management recommendation – Chestnut and Silver Lamprey

Historic and present day collection records for both lamprey species are lacking; however, its recommend to continue to list them as a Tier II species. Lamprey abundance is difficult to discern but the anthropogenic modifications to the Missouri River and the lower reaches of its tributaries has likely negatively impacted both species. Adults require a stable gravel substrate and larval lamprey require a soft, stable stream bed. These conditions are more prevalent in the upper Mississippi River where lampreys occur more frequently (Berry and Young 2004).

The recent collection of Silver Lamprey's by Pauley and others below Gavins Point is of high interest. As paddlefish sampling continues, documenting lamprey occurrence is vital to understanding lamprey's abundance and distribution.

Bowfin *Amia calva*

Description

Bowfin are the only extant species of the Amiiformes and are a carnivorous fish that inhabit low velocity backwaters of large river and lakes with low turbidity levels and abundant vegetation (Morris *et al.* 1974, Becker 1983). Bowfin reach a maximum length of 870 mm (34 inches) but are generally between 457 and 610 mm (Lee *et al.* 1980). In their adult stage, Bowfin are olive-green in coloration with a lighter colored belly. Bowfins display sexual dimorphism with mature males having a black spot surrounded by an orange to yellow ring at the base of their caudal fin. Females lack this spot and are often larger in size. The diets of adult bowfin consist of fish and crayfish. Bowfins spawn from late-April through June when water temperatures are between 16 and 19°C (Scott and Crossman 1985). Males build nests to attract female where they release approximately 64,000 eggs (Eddy and Underhill 1974). Males violently guard the larval Bowfin until they are 2 months

old (approximately 104 mm, Becker 1983) and age-0 bowfin school until they reach approximately 100 mm (4 inches, Pflieger 1997). Adults are solitary and reach maturity at age 2 to 3.

Distribution

Bowfin inhabits most of eastern North American including the Mississippi river basin from Minnesota to the Gulf coast and from Florida to the Great Lake region. However, bowfin were not reported to ascend upstream in the Missouri River (Lee *et al.* 1980). However, Hrabik *et al.* (2015) reported that bowfins were regularly captured prior to river modifications (i.e., damming and channelization) near Omaha, NE.

Collection Records

Bowfins were not collected during Johnson's (1942) sampling efforts. However, Johnson (1942) described that hatchery employees reported rare sightings in the Missouri River mainly in cut-off lakes in northeastern Nebraska. In 1959, a single bowfin was collected from the Missouri River near Falls City and was documented as the first verified record of bowfin in the state (Jones 1963). Since then only a single specimen has been collected. This fish was collected on 8 May 1990 while electrofishing around Decatur (rkm 1,112). The fish was 558 mm but no weight was recorded. Bowfin are currently listed as a Tier II species at risk by the Nebraska Natural Legacy Project.

Management recommendation

Bowfins are likely another species that have been highly affected by river alternations and modifications. Bowfins prefer clear water in areas of slack water and abundance of aquatic vegetation; however, the current Missouri River configuration has little to no habitats that meet those requirements. Additionally, over-fishing may have contributed to its rarity but bowfin were likely not kept and consumed. Bowfins were considered an undesirable species which affected the more popular sport fish fishery; therefore, were discarded in high abundances (Coker 1930, Scarnecchia, 1992). No records can confirm this occurred in Nebraska waters, but Smith's (1898) commercial fish report did not have an individual classification for Bowfin. Bowfin could have been included in the "Garfish" or "Other Fish" categories. These categories were not highly exploited but Bowfin are likely sensitive to over-fishing. Currently to conserve any remnant populations that may exist, no Bowfin harvest is allowed in Nebraska. This management recommendation was implemented 2015; however, Bowfin have likely already been extirpated from Nebraska and warrant a Tier I listing.

American Eel *Anguilla rostrata*

Description

Sixteen *Anguilla* species occur worldwide with only American Eel occurring in North America and Nebraska waters. American Eels are a catadromous species with adults living most of their lives (approximately 20 years) in freshwater systems before they return to the Sargasso Sea to breed (Lee *et al.* 1980). American Eels range in length from 406 to 838 mm (16-33 inches) and are olive brown in color (Pfleiger 1997). American Eels are easily distinguished from lamprey by the presences of a jaw, single gill opening and paired pectoral fins. American Eels inhabit large streams and rivers and prefer areas of little flow and silt substrate. Migration by adults out of freshwater systems occurs in the fall with spawning occurring from late winter into the summer (Breder and Rosen 1966). Communal spawning occurs at depths of 400-500 m. Female eels are highly fecund containing greater than 10 million eggs (Morris *et al.* 1974). American Eels are semelparous with mortality occurring after completing their spawning cycle. Larval eels or leptocephali are transparent with a leaf-shaped body form. These larval fish are carried by the ocean currents and reside in ocean systems for approximately one year until they transform into an adult-like body shape to migrate into freshwater systems (Becket 1983). After which, adult eels are carnivorous, nocturnal feeders and consume live fish and other invertebrates.

Distribution

American Eel are found throughout the eastern North American river and their large tributaries from Greenland to the northern part of South American (Lee *et al.* 1980). American Eel migrate up the Mississippi River to southern Minnesota and its major tributaries. In the Missouri River, American Eel range upstream to Gavins Point Dam. Female eels migrate further upstream than males so it is suspected all eels in Nebraska are likely females (Morris *et al.* 1974).

Collection Records

In 1894, 11,351 kg (250 lb.) of eels were commercially harvested from the Platte River (Smith 1898). Johnson (1942) reported state seining crew's collecting eels from the Platte and Missouri River. In 1958, Kidd (1958, unpublished in Jones 1963) reported the collection of a single specimen from an undisclosed area of the Missouri River. Hrabik *et al.* (*In Press*) reported that American Eels were common in the Missouri River near Omaha prior to river modifications.

American Eel were regularly collected throughout the 1970s while electrofishing in the Brownville (rkm 861.0) and Decatur (rkm 1,112) areas (N = 31) (Table 1). Collections became rarer in the 1980s when only eight American

Eels were captured in the tailwaters below Gavins Point Dam (rkm 1,305.2). Over the past couple decades, only two specimens have been captured. Nebraska Game and Parks Commission personnel captured a single American Eel while hoop netting around Brownville on 19 August 1998. The second record was captured just north of Nebraska City, NE (rkm 907.5) on 14 April 2010. It was collected on a baited trotline and was 511 mm and 234 g. Overall, the mean length for all American Eels captured in Nebraska is 584 mm and varied from 285 to 981 mm. American Eels are currently listed as a Tier II species at risk by the Nebraska Natural Legacy Project.

Management recommendation

American Eel are now rarely captured in the Missouri or Mississippi Rivers, they were considered common 50 years ago (Becker 1983). Haro *et al.* (2000) presented evidence for the range-wide population decline of American Eel and determine several potential factors are likely the cause for the decline, including: migration barriers, habitat loss and alternation, hydro turbine mortality, over fishing, and oceanic conditions. Currently, American Eel are categorized as a Nebraska sport fish and ranked as a Tier II species of concern by the Nebraska Natural Legacy Project. A no harvest restriction was implemented in 2015 but I recommend listing American Eel as a state endangered species.

Burbot *Lota lota*

Description

Burbot is the only Gadidae species that live exclusively in freshwater and inhabits cool, brackish waters of large rivers (Becker 1983). Burbot are nocturnal feeders while spending the daylight hours along undercut banks (Hubbs and Lagler 1964). Adult Burbot can attain length of 837 mm (33 inches, Lee *et al.* 1980) but are generally between 305-483 mm (12-19 inches) while attaining a maximum age of 20 years. Burbot are olive-green to brown in coloration and easily identified by a single, large chin barbel, two separated dorsal fins, and pelvic fins. Adult diets consist of fish and crayfish, while juveniles feed on nymphs and other aquatic insects (Pfleiger 1997). Communal spawning generally occurs under the ice in the mid-winter months when water temperatures are near zero (Becker 1983). Female can expel greater than 1 million eggs over rock and gravel habitats with no parental care given post-spawn. Eggs hatch after 4 to 5 weeks and the young disperse into nursery streams for protection (Harlan and Speaker 1956).

Distribution

Burbot are widely distributed north of the 40th parallel across North America, Asia and Europe (Lee *et al.* 1980).

On the Missouri River, Burbot range from the headwaters downstream along Nebraska's border to approximately the Grand River confluence in Missouri (rkm 402.3, Pfeleiger 1997).

Collection Records

Johnson (1942) collected a single specimen in the Niobrara River in 1939 while hatchery employees reported high abundance of adults in the Platte and Niobrara Rivers. They were collected above and below Gavin Point Dam, shortly after its closure (Kidd 1958, unpublished in Jones 1963), and from the Loup Power Canal near Columbus (Todd 1946, unpublished in Jones 1963). Morris *et al.* (1974) reported Burbot from the Missouri River and the lower part of the Platte River with the specimens most often occurring in creel surveys below Gavins Point Dam.

Of these five species presented in this paper, Burbot are the most commonly collected. Burbot were regularly collected with hoop nets (N = 5) and electrofishing (N = 19) near Brownville (rkm 861) and Decatur (rkm 1,112) in the 1970s. Also in the 1970s, sixty-eight Burbot were collected while primacord sampling by Niobrara (rkm 1,355.9). Over the past thirty years, twenty-two adults were captured in the unchannelized reaches (upper unchannelized, N = 7; lower unchannelized, N = 15) while electrofishing. Only one specimen has been collected in the channelized reach of the Missouri River (i.e., Boyer Chute [rkm 1,022.7]). Some level of reproduction occurred in the mid-1980s as larval Burbot were collected with larval drift nets at Gavins Point tailwaters (rkm 1,305.2, N = 1), St Helena (rkm 1,285.5, N = 4), and Brooky Bottoms (rkm 1,263.3, N = 1; Table 1). Finally, one larval Burbot was captured on 30 June 1998 during NGPC's annual Lewis and Clark Lake Trawl. Burbot are currently listed as a Tier II species at risk by the Nebraska Natural Legacy Project.

Management recommendation

Hesse (1993) recommended Burbot be listed as an endangered species under the Nebraska Nongame and Endangered Species Conservation Act; however, no state action occurred. Similar to most threatened and endangered species of the Missouri River, Burbot were sensitive to river regulations and modifications. Channelization eliminated backwater habitats, which are necessary nursery habitat for young Burbot (Hesse 1993). Furthermore, the mainstem dams increased their vulnerability to anglers and the population was quickly diminished (Hesse 1993). The current status of Burbot remains relatively unknown but remnant populations likely still exist; therefore, I reiterate Hesse's (1993) recommendation that Burbot need to be listed as a state endangered species. If endangered species listing does not occur, fishing restrictions such as a no-harvest restriction would need to be implemented.

Conclusions

These ancient fish species survived in the Missouri River for thousands of years prior to extensive modifications. However in a little over a century since modifications on the Missouri River, these species are very rare in the Nebraska reaches of the Missouri River and are likely approaching or perhaps extirpated from the state. Focused research is needed to ultimately determine the status of these species. Electrofishing has proven to be the best method to sample for at least the Bowfin, American Eel and Burbot, I recommend the development of a standard electrofishing survey to document the abundance of these species in Nebraska's reach of the Missouri River, especially immediately below Gavins Point Dam where it's likely the dam is a migration barrier and these species may aggregate in higher abundances.

The likelihood for improving the populations of these species or other imperiled species under the current management plan on the Missouri River (U.S. Fish and Wildlife Service 1980, U.S. Army Corps of Engineers 2001) is highly improbable. The mainstem dams impede necessary migration pathways while river wide modifications have reduced or eliminated critical spawning, nursery, and rearing habitats. Off-channel habitats that meet the life history requirements for several native fish species have been eliminated while channelization produced a sand bed, single channel which is not the preferred habitat for any of these species. Restoration of off-channel habitat has the greatest potential to benefit these species.

References

- Bailey RM. (1959) Parasitic lampreys (*Ichthyomyzon*) from the Missouri River, Missouri and South Dakota. *Copeia* 1959: 162-163.
- Bailey RM and Allum MO. (1962) *Fishes of South Dakota* (No.119). Museum of Zoology, University of Michigan, Ann Arbor, MI. 131 pp.
- Becker GC. (1983) *Fishes of Wisconsin*. University of Wisconsin Press, Madison, WI. <http://digital.library.wisc.edu/1711.dl/EcoNatRes.FishesWI>
- Berry Jr. CR and Young B. (2004) Fishes of the Missouri National Recreational River, South Dakota and Nebraska. *Great Plains Research* 14: 89-114.
- Breder Jr. CM and Rosen DE. (1966) *Modes of reproduction in fishes*. American Museum of Natural History, New York, NY. 941 pp.
- Coker RE. (1930) Studies of common fishes of the Mississippi River at Keokuk. *U.S. Bureau of Fisheries Bulletin* 45: 141-225.
- Eddy S and Underhill JC. (1974) *Northern fishes*. University of Minnesota Press, Minneapolis, MN. 414 pp.
- Evermann BW and Cox UO. (1896) Report upon the fishes of the Missouri River basin. *United States Fish Commission* 20: 325-429.
- Everett SR, Scarnecchia DL, and Rychman FL. (2004) Distribu-

- tion and habitat use of Sturgeon Chub (*Macrhybopsis gelida*) and sicklefin (*M. meeki*) in the Missouri and Yellowstone River, North Dakota. *Hydrobiologia* 527: 183-193.
- Hall GE and Moore GA. (1954) Oklahoma lampreys: their characterization and distributions. *Copeia* 1954: 127-135.
- Harlan JR and Speaker EB. (1956) *Iowa fish and fishing*. Iowa Conservation Commission. 377 pp.
- Haro A, Richkus W, Whalen K, Hoar A, Dieter Busch W, Lary S, Brush T and Dixon D. (2000) Population decline of the American Eel: Implications for research and management. *Fisheries* 25: 7-16.
- Hesse LW. (1993) The status of Nebraska Fishes in the Missouri River, 2. Burbot (Gadidae: *Lota lota*). *Transactions of the Nebraska Academy of Science* 20: 67-71.
- Hesse LW. (1994a) The status of Nebraska fish in the Missouri River, selected chubs and minnows (Cyprinidae): Sicklefin Chub (*Macrhybopsis meeki*), Sturgeon Chub (*M. gelida*), Silver Chub (*M. storeriana*), speckled chub (*M. aestivalis*), Flathead Chub (*Platygobio gracilis*), Plains Minnow (*Hybognathus placitus*), and Western Silvery Minnow (*H. argyritis*). *Transactions of the Nebraska Academy of Science* 21: 99-108.
- Hesse LW. (1994b) The status of Nebraska fishes in the Missouri River. Sauger (Percidae: *Stizostedion canadense*). *Transactions of the Nebraska Academy of Science* 21: 109-121.
- Hesse LW and Mestl GE. (1993) An alternative hydrograph for the Missouri River based on the precontrol condition. *North American Journal of Fisheries Management* 13: 360-366.
- Hesse LW, Mestl GE, and Robinson JW. (1993) Status of selected fishes in the Missouri River in Nebraska with recommendations for their recovery. In LW Hesse *et al.* (Editors), *Restoration planning for the river of the Mississippi River ecosystem*, pp. 327--340. (Washington, D.C., National Biological Survey, Biological Report 19)
- Hesse LW, Schmulbach JC, Carr JM, Keenlyne KD, Unkenholz DG, Robinson JW and Mestl GE. (1989) Missouri River fishery resources in relation to past, present and future stresses. In DP Dodge (Editor), *Proceedings of the International Large River Symposium*, pp 352-371. (Canadian Special Publication of Fisheries and Aquatic Science 106).
- Hrabik, RA, Schainost SC, Stasiak RH, and Peters EJ (2015) The fishes of Nebraska. University of Nebraska – Lincoln, Lincoln, NE.
- Hubbs CL and Lagler KF. (1964) *Fishes of the Great Lakes region*. University of Michigan Press, Ann Arbor, MI. 213 pp.
- Johnson RE. (1942) *The distributions of Nebraska fishes*. M.S. Thesis, University of Michigan, Ann Arbor, MI. 152 pp.
- Jones DJ. (1963) *A history of Nebraska's fisheries resources*. Nebraska Game and Parks Commission, Lincoln, NE. 79 pp.
- Keenlyne KD. (1989) *Report on the pallid sturgeon*. U.S. Fish and Wildlife Service, Pierre, SD. 53 pp.
- Lee DS, Gilbert CR, Hocutt CH, Jenknins RE, McAllister DE and Stauffer Jr. JR. (1980) *Atlas of North American Freshwater Fishes*. North Carolina State Museum of Natural History, Raleigh, NC. 867 pp.
- Miller RR. (1972) Threatened Freshwater Fishes in the United States. *Transactions of the American Fisheries Society* 2: 239-252.
- Morris J, Morris L and Witt L. (1974) *The fishes of Nebraska*. Nebraska Game and Parks Commission, Lincoln, NE. 98 pp.
- Pfliieger WL. (1997) *The fishes of Missouri*. Missouri Department of Conservation, Jefferson City, MO. 372 pp.
- Pfliieger WL and Grace TM. (1987) Changes in the fish fauna of the lower Missouri River, 1940-1983. In WJ Matthews and DC Heins (Editors), *Community and Evolutionary ecology of North American Stream Fishes*, pp. 166-177. (Norman, OK, University of Oklahoma Press).
- Pracheil BM, Pegg MA, Powell LA and Mestl GE. (2012) Swimways: Protecting paddlefish through movement-centered management. *Fisheries* 37:449-457.
- Scarnecchia DL. (1992) A reappraisal of gars and bowfins in fishery management. *Fisheries* 17: 6-12.
- Schmulbach JC, Gould G and Groen CL. (1975) Relative abundance and distribution of fishes in the Missouri River Gavins Point Dam to Rulo, Nebraska. *Proceedings of the South Dakota Academy of Science* 54: 194-222.
- Scott WB and Crossman EJ. (1985) *Freshwater fish of Canada*. Fisheries Research Board of Canada, Ottawa, Ontario, Canada. 966 pp.
- Smith HM. (1898) Statistics of the fisheries of the interior water of the United States. *United States Commission of Fish and Fisheries* 1898: 489-574.
- Stackpoole S. (1997) *The five lamprey's of Michigan's Great Lakes*. Michigan Sea Grant. 4 pp.
- Steffensen KD, Shuman DA, Klumb RA and Stukel S. (2014a) The status of fishes in the Missouri River, Nebraska: Pallid Sturgeon (*Scaphirhynchus albus*). *Transaction of the Nebraska Academy of Science* 34: 3-15.
- Steffensen KD, Stukel S and Shuman DA. (2014b) The status of fishes in the Missouri River, Nebraska: Shovelnose Sturgeon (*Scaphirhynchus platyrhynchus*). *Transaction of the Nebraska Academy of Science* 34: 16-26.
- Steffensen KD, Shuman DA and Stukel S. (2014c) The Status of Fishes in the Missouri River, Nebraska: Shoal Chub (*Macrhybopsis hyostoma*), Sicklefin Chub (*M. meeki*), Sturgeon Chub (*M. gelida*), Silver Chub (*M. Storeriana*), Flathead Chub (*Platygobio gracilis*), Western Silvery Minnow (*H. argyritis*), Brassy Minnow (*H. hankinsoni*), and Plains Minnow (*Hybognathus placitus*). *Transactions of the Nebraska Academy of Science* 34: 49-67.
- Steffensen KD, Stukel S and Shuman DA. (2014d) The status of fishes in the Missouri River, Nebraska: Sauger (*Sander canadensis*). *Transaction of the Nebraska Academy of Science* 34: 68-79.
- U.S. Fish and Wildlife Service. (1980) *Missouri River stabilization and navigation project, Sioux City, Iowa to Mouth detailed fish and wildlife coordination act report*. U.S. Army Corps of Engineers, Kansas City, MO. 162 pp.
- U.S. Fish and Wildlife Service. (1990) Endangered and threatened wildlife and plants; determinations of endangered status for the pallid sturgeon. *Federal Registry* 55(173): 36641-36647.
- U.S. Army Corps of Engineers. (2001) *Missouri River mainstem reservoir system master water control manual, Missouri River basin*. U.S. Army Corps of Engineers, Omaha, NE. 432 pp.