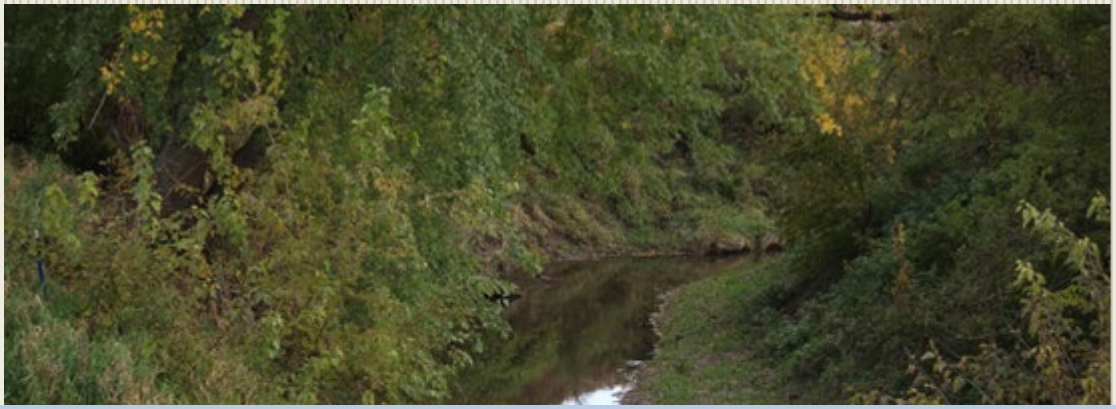

Iowa Tribe of Kansas and Nebraska Rare Fish Assessment

TRIBAL WILDLIFE GRANT PROGRAM

May 31, 2020

Authored by Iowa Tribe of Kansas and Nebraska Indian Reservation

FINAL REPORT

A FISH COMMUNITY ASSESSMENT IN STREAMS WITH EMPHASIS ON RARE SPECIES ON THE IOWA TRIBE OF KANSAS AND NEBRASKA RESERVATION

Submitted to:

Tribal Wildlife Grant Program
U.S. Fish and Wildlife Service
Region 6
Denver Colorado

Submitted by:

Iowa Tribe of Kansas and Nebraska
White Cloud, Kansas

May 31, 2020

NEW CENTURY ENVIRONMENTAL LLC
Environmental Compliance and Stewardship made Cost Effective

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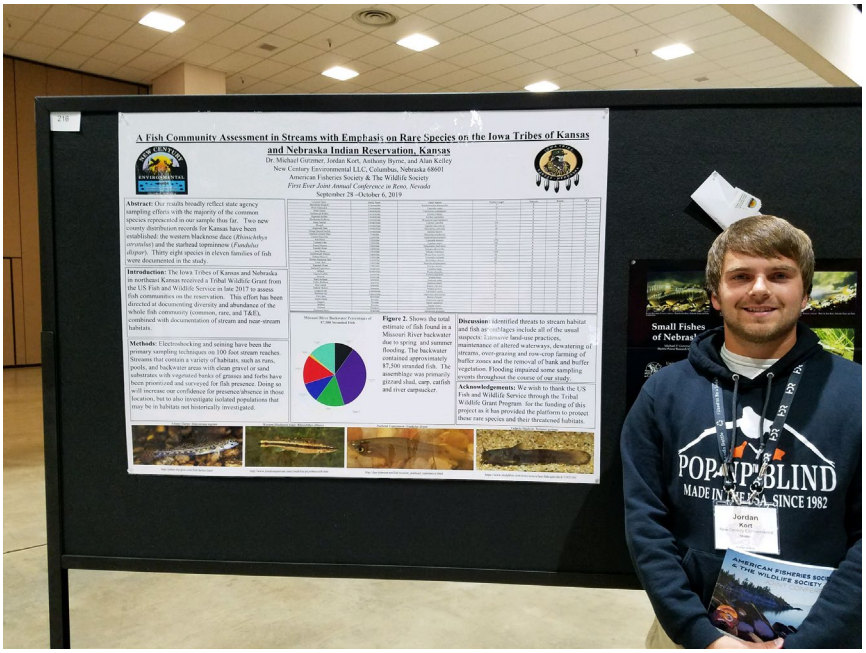

NCE tribal biologist, Jordan Kort representing Iowa Tribe of Kansas Reservation at the American Fisheries Society and The Wildlife Society joint conference in Reno, Nevada, September 28 –October 4, 2019.

Executive Summary

The Iowa Tribe received their *Tribal Wildlife Grant* in July 2017 to assess common and unique fish communities in various lotic systems on the Iowa Tribe of Kansas and Nebraska Reservation. This effort focused on the diversity and abundance of common, rare and sensitive fish species, and notations of other aquatic organisms. Streams that support a variety of habitats, such as runs, pools and backwater areas, were prioritized and surveyed for fish presence and abundance.

Study sites included various perennial stream reaches located on the reservation, including Lost Creek, Roy's Creek (Upper and Lower), the Nemaha River, and backwaters of the Missouri River. The Iowa Tribes rare stream fish assessment provided significant insight into reservation stream fishes. Our results mimic state agency sampling efforts with the majority of the common species represented in our sample size. Significant findings included documented populations or occurrences of western blacknose dace (*Rhinichthys obtusus*) and starhead topminnow (*Fundulus dispar*), which were not reported on past state distribution or documentation lists for this area in Kansas. The tribe sampled 6,006 fish totaling 44 species, within 13 families of fish from the spring 2018 to spring 2020. We also evaluated general habitat conditions in these streams, where surrounding watersheds are greatly affected by agriculture.

1. Introduction

The Iowa Tribe initiated their Tribal Wildlife Grant in late 2017 to assess presence and abundance of common and unique fish communities in select perennial stream segments on the Iowa Tribe of Kansas and Nebraska reservation. This effort emphasized the documentation of presence, diversity and abundance of common, rare and sensitive fish species.

Seven stream and river reaches on the reservation were identified for assessment of sensitive fish species (i.e., threatened, endangered, rare, or general species of concern by state and federal agencies) at specific sites believed to exhibit habitats representative on the reservation. Other streams were previously determined to lack fish habitat (mostly flowing water) and were then excluded from the assessment. Several streams contained to low flows to sample effectively or consistently during the study period.

New Century Environmental, LLC (Columbus, Nebraska) assisted the Tribe and has over 100 years of fishery expertise in the Great Plains, including completion of numerous surveys for fish assemblages in sand-bed prairie streams and maintains an excellent taxonomic staff to support the stream assessment and survey process for the Iowa Tribe of Kansas Project. The purpose of this report is to provide results of fish occurrence, diversity and abundance of species sampled along select reaches of streams and rivers located on the Iowa Tribe of Kansas and Nebraska Reservation.

2. History and Background

The state of Kansas has 144 documented fish species inhabiting its waterways, as well as 27 others that could possibly make their way to the state from nearby river basins. Of the 144 fish species, two are threatened and two are endangered. The Neosho madtom (*Noturus placidus*) and the Arkansas River shiner (*Notropis girardi*) are federally threatened.

The Iowa Tribe of Kansas and Nebraska Reservation lies within Doniphan, Richardson (Nebraska) and Brown counties. These counties do not support critical habitat for the two federally threatened species, pallid sturgeon (*Scaphirhynchus albus*) and Topeka shiner (*N. topeka*). There is potential for habitat on the reservation to support pallid sturgeon; however, none were collected during this study. The Topeka shiner was believed to possibly exist on the reservation due favorable habitat and fish community assemblage conditions identified within the study areas found to be in certain stream locations within the study area, in general.

2.1 Causes of Habitat Loss

It was apparent that point- and non-point source pollution sources on the reservation streams likely impact diversity and abundance of fish populations, especially the less tolerant species such as dace, darters and

shiners. There is much effort needed for baseline establishment of fish population dynamics to identify environmental limitations and restore habitats in some of the reservation's riverine resources. Many fish species now are threatened by habitat destruction, degradation, modification, and fragmentation resulting from siltation, reduced water quality, tributary impoundment, stream channelization, and stream dewatering. The species also are impacted by introduced predaceous fishes. Increased monitoring of the reservation's streams is required to assist with future management decisions. Roy's Creek, No Hearts Creek, and the Nemaha and Missouri Rivers should be the focus of major study areas. Other ponds, wetlands and aquatic bodies were surveyed as they augmented the project's species list.

Intensive land-use practices, maintenance of altered waterways, dewatering of streams, and continuing tributary impoundment and channelization represent the greatest existing threats to rare fish species. Overgrazing of riparian zones (banks of a natural course of water) and the removal of riparian vegetation to increase tillable acreage greatly diminish a watershed's ability to filter sediments, organic wastes and other impurities from the stream system. Irrigation drawdown of groundwater levels affects surface and subsurface flows which can impact fish species.

3.2 Species of Concern

Table 1 summarize some fish species of concern (or rare) in number species potentially within reservation boundaries. The Tribe is concerned about potential fish species occurrences and population conditions, as well as the resources needed to sustain and enhance these fish communities.

Table 1. List of threatened and endangered and fish species of concern for Richardson County, Nebraska.

County / Fish Scientific Name	Common name	Federal Status	State Status	Global Rank	State Rank
Richardson Co.					
Anguilla rostrata	American eel		Tier II	G4	SNR
Ictiobus niger	Black buffalo		Tier II	G5	S2
Rhinichthys atratulus	Blacknose dace		Tier II	G5	S1
Pimephales notatus	Bluntnose minnow		Tier II	G5	S3
Amia calva	Bowfin		Tier II	G5	S1
Cycleptus elongatus	Blue sucker		Tier I	G3G4	S1
Acipenser fulvescens	Lake sturgeon		Threatened	G3G4	S1
Scaphirhynchus albus	Pallid sturgeon	Endangered	Endangered	G2	S1
Fundulus sciadicus	Plains topminnow		Tier I	G4	S4
Macrhybopsis meeki	Sicklefin chub	Candidate	Tier I	G3G4	S1
Notropis topeka	Topeka shiner	Endangered	Endangered	G3	S1
Macrhybopsis gelida	Sturgeon chub	Candidate	Endangered	G3	S1

Table 1. Continued.

County / Fish Scientific Name	Common name	Federal Status	State Status	Global Rank	State Rank
Doniphan Co.					
M. gelida	Sturgeon chub	Candidate	Threatened	--	--
M. hyostoma	Shoal chub		Threatened	--	--
S. albus	Pallid sturgeon	Endangered	Endangered	--	--
M. meeki	Sicklefin chub	Candidate	Endangered	--	--
H. argyritis	Western silvery minnow		SINC	--	--
H. placitus	Plains minnow		SINC	--	--
Platygobio gracitus	Flathead chub		SINC	--	--
M. storeriana	silver chub		SINC	--	--
N. blennius	River shiner		SINC	--	--
C. elongatus	Blue sucker		SINC	--	--
Luxilus cornutus	Common shiner		SINC	--	--
H. hankinsoni	Brassy minnow		SINC	--	--

These important studies are a critical first step in expanding the Tribe's capacity for restoration and conservation of these important fish communities within valuable ecosystems of the reservation (see Fig. 1). Knowing how habitat plays a significant role in fish community sustainability is equally important. These resources have significant biological and cultural value to the Tribe.

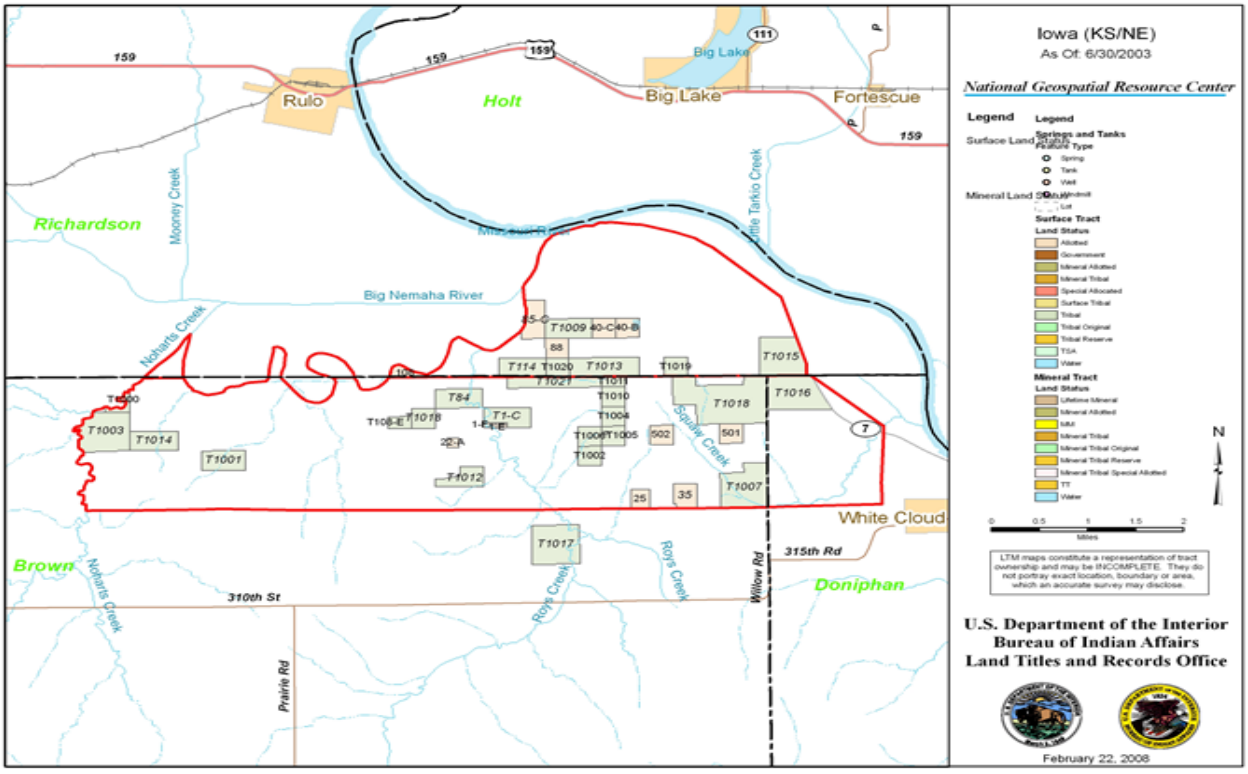

Figure 1. Illustration of the Iowa Tribe of Kansas and Nebraska Reservation's land base, as it continues to grow, resulting in a significant need for greater natural resource management.

The Tribe's conservation officer, Mr. Scott Elrod has done an excellent job in assisting tribal biologists with collecting field data during the study. Tribal biologists provided scientific expertise (according to American Fisheries Society guidelines) required to conduct this important study. The most "un-disturbed" locations noted for natural resource integrity were sampled, when possible or where access was feasible. Some disturbed sites were surveyed as well. All tribal, state and federal files were reviewed for pertinent historical information, current program data, and related reports. Very minimal information was available.

3. Life Histories for Representative Fish Species

Nebraska and Kansas together support 110 and 144 fish species, respectively. In both states, cyprinids (i.e., minnows) comprise the majority of species observed and sampled. Eight out of 10 of the most common species sampled over the last 60 years in Nebraska are fish that would be considered small fishes or minnow species.

3.1 **Sand Shiner** (*Notropis stramineus*)

A member of the Cyprinidae (minnow and carp) family, this common shiner is typically 2-3 inches long, though it can get up to 3.5 inches. They are a small silvery minnow with usually seven anal fin rays. Sand shiners differ from mimic, channel and ghost shiners by having a rather distinct stripe down the center of their back. Its diet is made up of immature aquatic insects, small crustaceans, and plant material that is on the bottom of the stream. This is one of the most common fish found on the reservation and throughout both states.

3.2 **Red Shiner** (*Cyprinella lutrensis*)

This shiner is able to colonize a very diverse habitats across the states of Nebraska and Kansas. The red shiner can be found in open channels of large rivers and streams. However, they are also very commonly found in deep pools, backwaters, and areas where the banks are vegetated. Red shiners are very pollution tolerant, when compared to other small fishes of Nebraska and Kansas. This fish species was the most common fish species found during the study, nearly accounting for half of all fish species sampled. This is not uncommon in similar fish studies (S. Schainost, Nebraska Game and Parks Commission, pers. comm. 2016).

3.3 **Suckermouth Minnow** (*Phenacobius mirabilis*)

This minnow gets its name from a distinctly sub-terminal (ending below tip of snout) mouth. This gives it the appearance of a small sucker. These minnows are found in freshwater streams and rivers with permanent flows. They are most commonly found in mixed, sand-gravel substrate habitat, but can also be found in agriculturally degraded streams. They feed on plankton, small invertebrates with chironomid larvae, and chironomid pupae. This species was commonly observed in No Hearts and Roy's Creeks on the reservation.

3.4 **Brassy Minnow** (*Hybognathus hankinsoni*)

The brassy minnow is designated as a species of concern for Doniphan County in Kansas. Their habitat primarily consists of cool, slow moving streams and creeks that have either a sandy or gravel bottom, overlaid with organic sediment. They can also be found in flooded ponds near rivers, as well as flooded ditches with weedy bottoms. This type of habitat is found throughout the reservation on Roy's and Lost Creeks, where this species was sampled during the study. Brassy minnows are omnivorous eating algae, plankton, and aquatic invertebrates. They are susceptible to predation and do better in habitats with minimal predators.

3.5 Blue Sucker (*Cycleptus elongatus*)

Blue suckers are very rare today, due to habitat segmentation resulting from construction of numerous dams since Euro-American settlement. They are a Tier 1 species in Richardson County as well as a species of concern in Doniphan County. These fish live in river systems with fast flowing currents. They forage for food off the bottom of rivers, which includes aquatic insect larvae, plant material and algae. This species averages between 4-6 pounds and measuring near 25-30 inches in the in the Missouri River on the reservation.

3.6 Pallid Sturgeon (*Scaphirhynchus albus*)

In 1990 the U.S. Fish and Wildlife Service placed the pallid sturgeon on the endangered species list due to low numbers of sightings and interactions. At present, these fish are rarely seen in the wild due to their low population numbers. They average between 30 - 60 inches and roughly weigh 80 pounds when they reach full maturity. Pallid sturgeons are primarily bottom feeders, as well as opportunistic feeders. Little is known about their precise eating habits, but some studies have found they feed on insects, fish and plant material. This study documented occurrences of shovelnose sturgeon (*S. platorynchus*) in fair numbers using short-period-set gill net sampling along the Nemaha River.

3.7 Short and Longnose Gar (*Lepisosteus platostomus*, *L. osseus*)

Short and longnose gar are in the family, Lepisosteidae and are found in North America. Though from the same family, they both have traits that set them apart. Longnose gar have dark spots on the caudal and other fins, with some also on the body and head. The longnose gar gets its name by its relatively longer snout, which is at least 10 times the minimum width.

The shortnose gar is much smaller, rarely reaching five pounds in weight. Its mouth is broad and flat (some compare it to a duck bill) and lined with razor sharp teeth. Both gar species inhibit the same habitat, mostly in creeks and rivers and some ponds. Shortnose gar prefer faster flowing waters in larger rivers but can be found in confluences with smaller creeks. Longnose prefer slower currents, commonly with shallow weed beds.

3.8 Western Blacknose Dace (*Rhinichthys obtusus*)

The western blacknose dace is a member of the Cyprinidae family. This species exhibits very small scales and is different from the closely related longnose dace (*R. cataractae*) by having a much shorter snout, larger eyes, and a very distinct mid-lateral stripe that is prominent along its entire body length. Its diet mainly consists of amphipods and dipteran larvae. They can be found in small, cool, gravelly streams of high to moderate gradient. The blacknose dace population we documented on the reservation appears to be a small remnant population in Kansas. The status of this population on the reservation was unclear;

however, it was believed that it was generally stable.

3.9 Channel Catfish (*Ictalurus punctatus*)

The channel catfish is the most popular sport fish in North America. Its average size is between 2-4 pounds with some reaching 40-50 pounds. Channel catfish are commonly found in a majority of watersheds. They inhibit large reservoirs, lakes, rivers, streams and ponds. They are a very hardy fish and can handle various environmental conditions. Channel catfish are commonly identified by their indistinguishable barbels, which give them their name. Young of year channel catfish were sampled in reservation streams, indicating reproduction and recruitment occurred in many reservation streams.

3.10 Sauger (*Sander canadensis*)

The sauger is a freshwater fish from the Percidae family, closely related to and commonly mistaken for the walleye (*S. vitreus*). Sauger have a fusiform body structure, and as a result they are a well, adapted predatory fish, and are capable of swimming into fast currents with minimal drag. They are different from walleye by their distinctly spotted dorsal fin. They don't have a white spot on the tip of their caudal fin and their color is generally more of a brassy-darker color, depending on the region. They also do not grow as large as walleye, as adult sauger typically weigh from 10-15 ounces. Reservation streams appeared to be important to sauger populations, in terms of localized reproductive and life history strategy for growth of critical life stages.

3.11 Topeka Shiner (*Notropis topeka*)

The Topeka shiner is a small minnow native to prairie streams of the Great Plains. It was named after the town near which it was first discovered (Topeka, Kansas). In 1998, the Topeka Shiner became a federally endangered fish species threatened by habitat destruction, degradation, modification, and fragmentation. It is easily mistaken for the sand shiner, a common minnow found throughout much of Kansas, they have a few distinguishable traits. The Topeka Shiner can be identified by a dark stripe in front of its dorsal fin and a distinct wedge-shaped spot at the base of its tail. It is still not clear whether our reservation still maintains this species. More sampling is needed.

4. Methods

4.1 Water Quality and Discharge

Temporal temperature (ambient and water) and stream discharge data were collected from select stream reaches, using field meters. These systems included the Nemaha-Missouri River confluence, and No Hearts, Upper Roy's and Noland's Creeks. Water samples were also collected from these sites in 2018 to

describe water quality in general. Water quality samples were processed and analyzed by an independent laboratory.

4.2 Riverine Habitat Assessment

To compliment the fishery assessment, we used a simple, straightforward approach to evaluating and scoring habitats. This method allowed for identification of limiting factors, which can be used in future stream restoration and monitoring efforts.

This rapid stream restoration monitoring protocol can be applied to almost any stream restoration design approach (i.e. regenerative storm conveyance, sand berm seepage systems, Natural Channel Design, valley restoration, among others). It uses visual observations to evaluate functional stability of stream restoration projects and focuses on vertical stability, lateral stability, riparian condition and instream structures (i.e. log vane, w-weir). The method does not evaluate any physicochemical or biological functions. The parameters used to evaluate vertical stability, lateral stability, and riparian conditions were based on Harman et al. 2012. It was believed that the fish community assessment could be correlated in a general way to the snapshot habitat condition this protocol afforded us.

The rapid methodology used function-based parameters to identify restoration success and recommend future actions. Recommended future actions will always include the rapid assessment protocol, at least through the required monitoring period, but may also include two other recommendations. The first recommendation can be for intensive survey monitoring. Intensive survey monitoring involves detailed measurements at the location of stream adjustment to determine the stability trend of these adjustments. If the results of the intensive survey monitoring show the stream is trending towards degradation, then remediation and/or repair is required. The second recommendation can be for remediation and/or repair. Remediation and/or repair is required if the rapid survey shows that there are widespread stream adjustments that will cause further damage and contribute to other structural or functional problems. Table 2 presents the habitat scores from streams where fishery surveys were conducted in during 2018 and 2019.

Our habitat assessment was conducted in both 2018 and 2019 to identify short term habitat changes and measure two different temporal scoring events to reliably evaluate lotic habitat conditions, in general. When necessary, we conducted stream measurements and calculated dimensionless stream relationships (e.g. bankfull width, belt-width, radius of curvature) to determine whether restored stream characteristics and conditions were within ranges of the restoration design criteria. Discussed below are is a discussion of each of the stream reaches sampled during the study period.

4.3 Fish Community Assessment

In relatively small, low gradient reservation streams, Tribal biologists sampled each study site, specifically to document presence or absence of special-status fish species, other species of concern, and establish a baseline of fish species present on the reservation, in general. Streamflows were variable during the study period which made sampling challenging at times.

Fishery and habitat surveys were conducted 150 ft both upstream and downstream of bridge crossings, in each one the streams or rivers sampled, totaling 300 ft for each stream site. Tribal biologists sampled each study site multiple times throughout the two-year study. At each site (other than the Nemaha, and Missouri Rivers) an entire upstream electrofishing pass (i.e., along the entire 300-ft site was conducted where permissible). Electrofishing surveys were conducted using a Coffelt Mark-10 backpack unit.

When electrofishing was difficult or impossible (i.e., with rocky and coagulated stream bottom substrates), fish survey data were complimented using seine capture data. All identified microhabitats (e.g., pools, open water, vegetated shoreline, etc.) were attempted to be sampled in each stream. In spring 2019, high flows due to flooding prevented effective sampling efforts for these streams.

In the larger rivers, trammel and gill nets were drifted along sample reaches of the Nemaha and Missouri Rivers, which encompassed approximately 985 ft. High flows and depths made seining and electrofishing not feasible for these river reaches. Trammel nets were 6 ft deep and 50 ft (TN50) or 75 ft (TN12) long. On the Missouri and Nemaha Rivers, sturgeon and other larger fish were measured for total length (TL; mm) and weighed (g). All other fish species were measured for TL and other important native (e.g., river carpsucker *Carpiodes carpio* and shorthead redhorse *Moxostoma macrolepidotum*), sport fish (e.g., channel catfish, sauger and walleye), and invasive fish species were weighed when sampled.

Trotlines were deployed in April, July, and August 2018 in the Missouri River. Flooding in 2019 prevented safe and effective sampling across the reservation and in the larger rivers. The smaller streams were too high much of 2019. Trotlines were variable in length and were anchored along overhanging bank vegetation or stable substrate on shore. Twenty octopus circle hooks, size 1/0 baited with earthworms and various cyprinids were attached to the line. Trotlines were only deployed in the first two bends downstream of Nemaha River into the Missouri River confluence.

All captured fish were identified to species, enumerated, examined for anomalies and released. We vouchered specimens for each species of captured fish where field identification was difficult. These voucher specimens were identified in the laboratory. Sampled species of concern were identified, photographed and safely released. Results from these analyses provided species lists and estimates of relative abundance by species and sites. Mean relative weight analyses were not performed for the most common large-bodied fish sampled in the Nemaha and Missouri Rivers; however, some meristic data

were collected and archived for future fishery management needs. Those fish included flathead catfish (*Pylodictis olivaris*), blue catfish (*I. furcatus*), short and longnose gar, common carp (*Cyprinus carpio*), channel catfish, river carpsucker, sauger, shorthead redhorse, and shovelnose sturgeon. Larval fish were not sampled during the study. Juveniles were identified and enumerated when possible in spring and early summer.

Tribal biologists maintained all proper collecting permits necessary for the survey and collection of fish and other aquatic species for the states of Nebraska and Kansas.

5. Results and Discussion

5.1 Water Quality and Stream Discharge of Select Reservation Streams

Water temperatures of select reservation streams (i.e., Nemaha-Missouri River confluence and No Hearts, Upper Roy's and Noland's Creeks) tracked closely with ambient air temperatures due to the streams' shallow depths. No significant differences were found between air and water temperatures among months that were sampled. Multiple comparison tests demonstrated that air temperature was significantly lower (Midwest Labs; $P < 0.10$) than river temperatures during the months of April, May, and August 2018.

Stream discharges were variable, especially during spring and early summer months. Relatively high precipitation events were evident with peaks in the hydrograph throughout the sampling period. Sampling was not possible in the spring and early summer due to flows being too high to safely enter the streams (S. Elrod, pers. comm. 2019). Streamflow changes reflected on the hydrograph due to additional water withdrawals would likely have had adverse impacts on the fish community. Decreased discharge and the timing of such may have reduced spawning success and rearing habitat.

Water quality results of these stream sites are provided in Table 2. Most parameters were within expected and acceptable levels. The Missouri-Nemaha River confluence exhibited higher concentrations of some parameters to those measured in the smaller streams. These included, in general, sodium, sulfate, TDS (except Noland's Creek), SAR, potassium (except Noland's Creek), chloride, and turbidity (except Noland's Creek). Results were indicative of water quality conditions expected for streams and rivers within this ecoregion, as well as those influenced by long term agricultural practices.

Table 2. Summary of water quality results analyzed from sampled collected along select stream and river reaches on the Iowa Tribe of Kansas and Nebraska Reservation, summer 2018.

Parameter	Nemaha-Missouri	No Hearts	Upper Roy's	Noland's
Sodium (mg/L)	25.7	13	12.6	10
Calcium (mg/L)	78.4	55.9	55	93
Magnesium (mg/L)	20.2	11.8	12.9	32
pH	8.12	7.92	8.07	8.12
Nitrate nitrogen (mg/L)	3.1	9.9	8.8	9.2
Sulfate (mg/L)	65	16	15	17
Conductivity (µS/m)	0.616	0.427	0.427	0.653
Total dissolved solids (TDS) (mg/L)	400	278	278	424
Sodium absorption ratio (SAR)	0.7	0.4	0.4	0.2
Phosphorus (mg/L)	0.29	0.21	0.22	0.28
Potassium (mg/L)	3.46	1.73	1.68	3.61
Bicarbonate (mg/L)	244	150	157	315
Chloride (mg/L)	17	14	13	10
Boron (mg/L)	0.05	--	--	--
Iron (mg/L)	1.45	1.71	1.62	3.51
Manganese (mg/L)	0.264	0.211	0.138	0.399
Copper (mg/L)	<0.01	<0.01	<0.01	<0.01
Zinc (mg/L)	<0.01	<0.01	<0.01	0.01
Carbonate as CaCO3 (mg/L)	3	1.2	1.7	3.9
Turbidity (NTU)	27	2	16	27
Chlorophyll *a* (mg/m^3)	23	1	--.	--
Settleable solids mg/L)	--	--	--	0.2

5.2 Site Habitat Descriptions

5.2.1 Nemaha River

The Nemaha River habitat rating (Table 3) scored an average of 108.5, as certain categories scored well, including epi-faunal substrate, pool variability and substrate in the upper portions (Table 3). The direct connection to the Missouri River was a positive attribute as well. The riparian buffer contained several species of *Salix, Populus deltoides, Amorpha fruticosa, Fraxinus pennslyvanica,* and other shrubs and grasses. In our sample reach there was a large scrub shrub and palustrine wetland to the north of the riparian fringe. Steep canyon walls bordered the south side of the river in our inventory reach.

5.2.2 Missouri River

The Missouri River scored an average of 98. The habitat condition categories that lowered the overall score related to channel alteration, sinuosity, vegetative cover protection and riparian zone. The riparian fringe is highly altered with agriculture on both sides. Channelization of the river channel (for barge traffic) has eliminated many shallow pool and riffle areas necessary for foraging of young and adult fish. Flooding was a factor and limited any sampling during 2019 as river levels were above flood stage throughout most of the sampling season. Vegetative borders in our study reach adjacent to the reservation were very thin and contained the typical assemblage of the more common trees, shrubs, forbs and grasses.

5.2.3 Upper Roy's Creek

The average score for Upper Roy's Creek was almost 110. This score was generally reflective of general disturbances associated with agriculture. The riparian buffers varied among locations on the stream, with row crop agriculture adjoining riparian areas in many locations. Erosion appears to have been prominent for quite some time. Some of the more common riparian flora observed was *Juglans nigra, Xanthium strumarium, Acer saccharinum, Morus alba, Echinocystis lobata, Ablution theophrasti, Gleditsia tricanthos, Artesmia trifida, Setaria* sp., *and Toxicodendron ryebergii.*

5.2.4 Lower Roy's Creek

The average score for the Lower Roy's Creek site was 92.5, which was reflective of disturbances related to agriculture, housing, roads and some apparent channelization on the Nemaha River floodplain. As the stream gradient decreased, pools with increased sediment deposition were apparent. The riparian flora assemblage was similar to that observed on Upper Roy's Creek.

Table 3. Results of stream habitat values for select riverine segments on the Iowa Tribe of Kansas and Nebraska Reservation, 2018-19 (adapted from USFWS 2014).

Habitat Parameter / Date	**Survey Stream / River**						
10/29/2018	**Nemaha**	**Missouri**	**Upper Roy's**	**Lower Roy's**	**Lost/No Hearts**	**Elisha**	**Noland's**
1. Epifaunal substrate	15	15	12	11	16	13	10
2. Pool substrate	16	11	13	10	19	10	8
3. Pool variability	14	11	12	8	19	10	6
4. Sediment deposition	12	16	9	9	11	10	5
5. Channel flow	11	16	13	12	13	5	4
6. Channel alteration	12	8	16	16	19	16	10
7. Channel sinuosity	11	5	13	9	16	15	10
8. Bank stability	6	7	8	8	8	8	3
9. Vegetative protection	5	5	9	8	6	8	7
10. Riparian zone	6	3	4	5	5	8	4
Total	**108**	**97**	**109**	**96**	**132**	**103**	**67**
7/31/2019							
1. Epifaunal substrate	16	15	16	10	16	13	10
2. Pool substrate	14	11	12	12	18	10	8
3. Pool variability	14	13	10	9	19	10	6
4. Sediment deposition	15	15	11	5	12	10	5
5. Channel flow	12	17	11	12	13	9	5
6.Channel alteration	11	8	12	11	16	16	11
7. Channel sinuosity	10	6	16	10	16	15	12
8. Bank stability	7	6	7	8	8	8	6
9. Vegetative protection	5	5	9	8	9	9	6
10. Riparian zone	5	3	6	4	9	7	4
Total	109	99	110	89	136	107	73
Average of both years	**108.5**	**98**	**109.5**	**92.5**	**134**	**105**	**70**

5.2.5 Lost Creek and No Hearts Creek

The Lost and No Hearts Creek system had the highest average habitat score at 134 (Table 3). Even though there likely were agricultural impacts along this watershed, they appeared to be minimized by wider stream buffers and in some cases, excellent tall grass parcels on tribal land that eliminated erosion and chemical conduits to the stream in a stream section with good to excellent in-stream habitat features. Tree, shrub and grass diversity was the highest at this location. Additional flora species like *Quercus macrocarpa, Acer saccharinum, Tilia americana and Laportea canadensis* and prickly ash encompass the fringe on tribal property properly securing the sediments and inputs from the surrounding land base.

5.2.6 Elisha Creek

This creek's habitat rating scored 105 and the greatest limitation of the stream was believed to be reduced flows. It was believed the primary limiting factor to fish diversity was restricted migration due to presence of fish barriers in the form of log jams and falls. Vegetative cover was generally good and species observed were found to representative of the reservation and stream habitats in general.

5.2.7 Noland's Creek

This site had was the lowest habitat score at 70 (Table 3). Sedimentation and high nitrogen inputs were believed to be the primary stressors on the stream. Lower stream flows and absent vegetative cover within the riparian corridor raised concerns about adequate protection from the surrounding watershed and all the pollutants nearby.

5.3 Fish Community Assessments

Fish sampling commenced in April 2018, we expected that fish community assessment would reveal no significant differences of abundances and diversity among stream study reaches. There were few differences in species richness among the stream sites in 2018-19, particularly between Roy's Creek and No Hearts Creek. Fish that were not sampled included pallid sturgeon, blue sucker, bigmouth buffalo, smallmouth buffalo, bluntnose minnow, northern pike (*Esox Lucius*), and pumpkinseed (*Lepomis gibbosus*).

A total of 6,006 fish were sampled during the entire study, which included 44 species (Appendix Table A1). The dominant species sampled included were red shiners (*Cyprinella lutrensis*), sand shiners (*Notropis stramineus*), flathead chubs (*Platygobio gracilis*), gizzard shad (*Dorosoma cepedianum*), channel catfish, and river carpsuckers.

Use of trammel nets predominately captured large-bodied adult fish while electrofishing captured small-bodied and young of year fish. Presence of young fish indicated a stream's support of suitable spawning

and rearing habitat. Short- and longnose gar were the most abundant fish captured in the Nemaha and the Missouri Rivers, ranging in length from 27-565 mm. Channel catfish ranged in length from 23-765 mm and sauger ranged 137-482 mm. Another native fish, the shorthead redhorse, ranged in length from 39-408 mm. Common carp ranged 77-746 mm in length. Shovelnose sturgeon were only captured by trammel net and ranged in length from 548- 658 mm, which was similar to that reported for the Nemaha River during the study.

The most abundant species captured with trammel nets were river carpsucker, channel catfish, sauger, and shorthead redhorse. Large amounts of small and large woody debris made drifting trammel nets in May 2018 difficult and substantially increased sampling time for each sampling unit. After June, less woody debris made drifting trammel nets more manageable, which resulted in increased sampling effort.

Studies in other riverine habitats in the Great Plains (Appendix Table A2) used trammel netting and tote barge electrofishing. We did not have access to a tote barge electroshocker. In the Niobrara River as an example, several fish species were captured that were not detected in previous studies that used electrofishing, seining, primacord, and a fish kill to sample fish in the last 30 years (Hesse et al. 1979; Hesse and Newcomb 1982; Gutzmer et al. 2002). However, studies prior documented 13 other species that were not detected in our study. Partial explanation of this may be due to the fact that Hesse and Newcomb (1982) and Gutzmer et al. (2002) both sampled sites upstream of Spencer Dam. Interestingly, our study documented the first records of bigmouth (*Ictiobus cyprinellus*) and smallmouth buffalo (*I. bubalus*), blue sucker, and bluntnose minnow (*Pimephales notatus*) in the Niobrara River (Schainost 2008).

Our goal for sampling tribal waters, in part, was to document presence of blue sucker*,* paddlefish (*Polyodon spathula*) and orange-throated darter (*Polyodon spathula*), which all fell short during the study. The Missouri is a popular sport fishery for channel, blue and flathead catfish and those species were well represented in the study.

Fishery survey results during the 2018-19 study indicated d on the three separate calendar years of study, our results reflected the highest catch per effort using seining in the smaller streams. Given the diverse size and habitat conditions of the reservation's riverine resources, we determined that multiple gear types (e.g., trammel nets, seines and electrofishing) are needed to accurately measure fish communities in terms of relative abundance and size structure. Trammel nets were effective at capturing large-bodied fish while electrofishing captured juveniles and young fish, as well as small-bodied fish and difficult to sample fish. Although channel catfish were collected with trammel nets, baited hoop nets may be more effective and easier to deploy. Our results showed that large-bodied fish generally used the entire water course of the Missouri River up the Nemaha River, and then into reservation streams. The streams on the reservation tended to support small-bodied and young of the year fish species and appeared to be more spatially and temporally variable.

6. Proposed Management of Each Species

The tribe proposes to conduct periodic fish community monitoring on the Iowa Tribe of Kansas and Nebraska Reservation; based on information reported during our two-year study. Remnants of these historic fish community assemblages are worth protecting and doing everything we can from a habitat and stream protection perspective going forward (see recommendations).

The Tribe has documented over the course of this study that there are different fish species which are in need of conservation concern and periodic monitoring will help establish trends of their population status. Without further study and habitat management, fish assemblages in these streams can become threatened without proper monitoring and management.

7. Assessed Threats to Biodiversity

It is apparent agriculture is the number primary threat to upland and wetland habitats on the reservation. Small silt laden prairie streams such as Roy Creek are generally stable, with plant communities that fluctuate periodically due to altered, high, low, or no flow conditions.

Flora species vary from location to location depending on soil type, moisture requirements, elevation, nutrient reserves and sunlight. Generally, aquatic (riparian and wetland) plants are very similar within large regions that have common characteristics related to geology and climate. The major requirement for riparian plants is that water be present either all or most of their life cycle and this explains the presence of many wetland and aquatic species in river floodplain environments. There are many exceptions that come into play when investigations begin into wetland, wet meadow and riparian habitats and what floras are present.

Our reservation is experiencing recent growth and expansion all the time, increased farming activities and loss of CRP lands combined are adversely affecting habitats and especially rare and sensitive plant communities. Anticipated climate change impacts, energy development and continued agricultural threats all seem imminent on the reservation. There appears to be an ever-growing need to establish baseline information regarding these important natural communities within our tribal ecosystem.

Some observations of habitat degradation with on the reservation include:

1) Loss of extensive riparian flora along the Missouri River. *Highway encroachment and farming have eliminated all but a small fringe of vegetative growth along the corridor*.

2) Rulo Bluffs. Even though somewhat isolated, is at risk for continued acreage loss and invasive conversion.

3) Roy Creek. Lack of adequate buffer strips throughout much of its reach, is contributing to point and non-point source run-off from adjacent agricultural ground.

4) Nohearts Creek. Lack of adequate buffer strips throughout much of its reach, is contributing to point and non-point source run-off from adjacent agricultural ground.

5) Nemaha River. Loss of instream habitat and excessive run-off.

Historic and current land use practices have significantly impacted many native species in the ecoregion of the reservation. It is evident with large mammals such as bison and other large herbivores have been extirpated across much of the Great Plains since the 1870s, as have a number of large predators. More recently, other grassland species have begun to demonstrate widespread declines and this is evident in our wetland areas as well. The Tribe is very concerned about threatened, endangered and rapidly disappearing plant species on our lands.

Agricultural practices and farm policy have long affected the welfare of fish and wildlife communities in much of the United States. Impacts associated with conversion of natural habitats to crop and livestock agricultural production has historically been a primary cause of natural ecosystem degradation and fish and wildlife habitat loss (Noss et al. 1995; Tewksbury et al. 2002). These agricultural advances can place further stress on biodiversity, potentially damaging ecosystem services associated with native biota, such as pollination. We are intent on preserving and sustaining any tall grass prairie remnants as well with possible locations remaining within the reservation.

In order to properly manage any wildlife or plant species, biologists and program managers must have a good understanding of the life history, current status and management goals for each species and/or complex. Without an outside funding source, we will probably never be able to conduct these important studies and our unique habitat resources will continue to suffer from neglect along with lost opportunity for our people to appreciate and utilize these resources. We have very limited information regarding biological studies, and annual surveys to identify species composition, relative abundance, overall population status and health of our local flora and other animal species in those habitats and we propose to actually preserve and manage properly what we have remaining.

Other potential threats include:

- **Habitat Conversion: Agriculture:** Conversion of natural vegetation to either annual cropland or tame hay land and other forms of agriculture.

- **Habitat Conversion: Strip Mining:** Destruction of natural vegetation as the result of surface mining. This threat is primarily the result of large-scale operations (i.e., coal, bentonite), rather than removal for gravel. Sand and gravel extraction may be more common on the reservation.

- **Habitat Conversion: Oil and Gas:** Conversion of natural vegetation associated with oil or gas development. Impacts include drill pads, roads, storage facilities, and pipelines.

- **Habitat Conversion: Logging**: Logging practices that eliminates historic stand structure (i.e., high-grading or clear-cut of some community types). Sustainable logging practices may remove large or old growth trees but retain structure. This will be minimal the reservation.

- **Exotic Species:** The presence and spread of non-native species capable of invading undisturbed habitats and altering species composition and potentially processes (i.e. increased fire frequency associated with cheat grass). Includes both plants and animals.

- **Poor Grazing Management:** Management practices that cause natural communities to deteriorate. This may include continuous over-utilization or under-utilization. Patches comprised of various grazing intensities were considered beneficial for maintaining biodiversity.

- **Loss of Fire Regime:** Exclusion of fire. Loss of this disturbance may promote expansion of woody species, stabilization of sand hills, and altered ecological composition.

- **Hydrologic Alteration:** Damming or dewatering of streams or tributaries.

- **Recreational Use:** Activities that displace species, promote spread of exotic species, or destroys natural communities (i.e., off-road vehicle recreation).

- **Pesticide Drift/Application:** Misapplication of pesticides, especially around sensitive species, or application for large-scale nonselective control of pests (i.e., aerial application for grasshopper control).

- **Wetland Drainage/Filling:** Degradation of wetland hydrology through manipulation of basins.

Overall, we will depend on proven procedures and techniques in developing our final work plan and biological investigations which will include: managing for a biologically diverse, balanced, and a healthy ecosystem that; meet Tribal strategic objectives, implement a monitoring strategy and develops supporting databases, identifies and protects critical habitats, identifies the causes of habitat loss or degradation and recommends corrective actions, ensures that fish populations are protected from exploitation caused by unregulated commercialization and other unlawful activities, identify and implement strategies to buffer the effects of rural residential development (mainly tribal scattered home sites) and identify opportunities to protect, enhance or restore threatened ecosystems.

We know we will have to address habitat losses and subsequent improvement and development in the coming years. Human encroachment has resulted in numerous resource impacts.

Pursuant to 16 USCS & 3772 (4), [Title 16. Conservation; Chapter 57B. Partners for Fish and Wildlife] "The term for habitat improvement means "restoring, enhancing, or establishing physiographic, hydrological, or disturbance conditions necessary to establish or maintain native plant and animal communities, including periodic manipulations to maintain intended habitat conditions on completed project sites." As stated by Partners for Fish and Wildlife we need to focus our attention on habitat improvement in order to keep the rare species alive and well on the reservation for generations to come.

Habitat can be created and maintained by placing gravel, rocks, and cement, into streams to improve spawning areas. Real and artificial trees can also be placed in strategic locations in different streams which will be used for cover and safety. Another improvement that works well for protecting existing species is to make deep pools where possible. In doing so will create better habitat, ensure water during dry years, and protect them from siltation for years to come.

An *Iowa Tribe Stream Habitat Plan* should be developed with funding from all those who will benefit from improved water quality.

8. Adjacent Land Use Description and Improvements

The land around our stream study sites is mainly agriculture with the exception of a few sites being rangeland and livestock pasture. These streams have become degraded, eroded and silted in due to decades of land use practices needing a conservation perspective. Most of our sample sites were difficult to sample due to the heavily silted soft bottoms. Streams that were adjacent to pasture ground typically had natural rocky and gravel substrates.

Some streams were impacted by livestock and agriculture more so than others. Streams located next to farmland need immediate attention and improvements to ensure fish assemblages continue to survive. One major improvement to most streams would be to provide and enhance stream buffers extending 20-50 ft along stream corridors creeks and tributaries. A buffer would act as a barrier and collect runoff, debris, and silt from entering the streams, and thus helping them regain their natural forms. Degradation is also a problem and can be improved by leaving trees along the streams as a barrier to hold the banks in place, thereby protecting bank integrity and strength. Other bank stabilization measures can be implemented as well (e.g., riprap, rock cribs, etc.).

Cross and Moss (1987) attributed the general decline of several prairie fish species to unstable water levels, loss of aquatic vegetation, and increasing temperatures and turbidity resulting from agricultural development of the Great Plains. We know that accelerated erosion has added a larger and more continuous sediment load to most prairie streams than they experienced when bison were the chief

contributor to sediment loading. We also know that small streams of the Great Plains frequently become intermittent during the low-flow period of late summer. In pre-agricultural times, pools in these streams were maintained by groundwater percolation and presumably. Topeka shiners and several dace species were adapted to this type of flow regime.

Many human activities now compete for both ground and surface waters in our prairie states, leaving many small streams nearly too dry in late summer. Because Topeka shiners prefer pool habitats, they may become trapped during low flows and die from anoxia or exposure. Kerns (1981) noted that high mortality of Topeka shiners in Kansas from just these conditions, despite this species' exceptional drought resistance. Gutzmer and Luce (1996) found chemical residues to be a possible limiting factor in prairie streams near the Platte River in Nebraska. Farm chemicals could be factor on the reservation as well.

The general decline of aquatic plants in streams could also be a factor in habitat quality (Gutzmer 2004) and contribute to fish community composition on the reservation. Few, if any, aquatic macrophytes were noted in reservation streams. In addition, it has been speculated that further habitat alteration from activities such as ditching, channelization, and impoundment may be contributing to the documented loss of Topeka shiner populations (Tabor 1989). We also know that in stream reaches where largemouth bass have been introduced, Topeka shiners are rare to non-existent.

In Kansas, at least, the presence of largemouth bass in a reach and the number of ponds or impoundments in the area correlates highly with Topeka shiner absence (Schrank et al. 2001). The presence of northern pike, yellow perch and smallmouth bass could also be limiting Topeka shiner presence in reservation streams as they were noted at several viable stream sites.

Determining fish species richness is difficult to obtain without numerous sampling efforts and rapid assessments may limit our effectiveness at these sites. If additional funding is available, repeated fish sampling in the top five streams is highly recommended using an electroshocker unit as well as additional seining. Seasonal variation in sampling could also determine species not previously sampled. Gutzmer et al. (1996) found seasonal and man induced environmental effects can significantly affect fish diversity and abundance at any given stream or river location.

9. General Recommendations

1) Conduct future fishery investigations of the top three sites revealed in this study effort in 2018-2020. There is no doubt additional species will be documented that could justify introduction or propagation plans to be developed in coming years concerning the Topeka shiner and other rare or sensitive species found in reservation streams. Additional life history and critical life stages data could enhance management of these fish species.

2) Facilitate electrofishing surveys that will collect hard to seine habitats and species and embellish our species list for future use and management of these unique resources. Populations continually change and this data is significant.

3) As a result of this study other concepts for investigation include a thorough investigation of headwater streams throughout the reservation. Roy's Creek and No Hearts Creek, along with other streams in the bluffs region of the reservation should be evaluated for fish, macroinvertebrates, algae, periphyton and aquatic macrophytes. It is apparent these fish communities are still generally misunderstood. Hydraulic and hydrological components should also be assessed where possible.

4) A reservation wide land-use guidance document, in addition to *Iowa Tribe Stream Habitat Plan* should be prepared for lands adjacent to sensitive water bodies, wetlands, lakes and streams. Numerous land use issues were noted during study that could be rectified with further documentation and remediation. In a separate study, a habitat development and improvement plan should be developed.

5) As more fish diversity and abundance data is collected and archived, conservation and species introduction programs can be considered and potentially implemented and put into place with greater confidence in the coming years as agricultural pollution and global climate changes occur at an increasing rate.

6) At a minimum fish sampling regimen should continue in Roy's and No Hearts creek to formally document presence of the Topeka shiner and other rare species that we suspect could be present there.

10. Conclusions

A total of 6,006 fish totaling 44 species (in 13 families) were sampled on the Iowa Tribe Kansas and Nebraska Reservation during 2018-19. The study demonstrated that only the continuously flowing streams maintain generally stable fish communities after decades of agriculture impacts and encroaching farmland.

The unique species we encountered will eventually be extirpated by habitat destruction, degradation, modification, and fragmentation resulting from siltation, reduced water quality, tributary impoundment, stream channelization, and stream dewatering. Many species also are impacted by introduced predaceous fishes. Without question there are stream habitats found on the reservation that can support Topeka shiner and other rare fish populations. We hope to prevent that from occurring as much as possible.

Intensive land-use practices, maintenance of altered waterways, dewatering of streams, and continuing tributary impoundment and channelization represent the greatest existing threats to the Topeka shiner and other rare fishes. Overgrazing of riparian zones (banks of a natural course of water) and the removal of riparian vegetation to increase tillable acreage greatly diminish a watershed's ability to filter sediments, organic wastes and other impurities from the stream system. Irrigation draw-down of groundwater levels affects surface and subsurface flows which can impact the species.

Historically, populations of Topeka shiners, western blacknose dace and numerous darters were considered to be the most stable range-wide, due to their occurrence in the watersheds dominated by high quality prairie with generally very good grazing management and land stewardship. The two streams, Roy's and No Hearts are certainly candidates for these criteria as well as several other streams found on the reservation.

Habitat condition is failing with high amounts of increased sediment loads in all streams. Water quality conditions are generally stable, but with certain improvements could mean population stability for many declining species.

The Iowa Tribe of Kansas and Nebraska's rare stream fish assessment has provided significant insight into reservation stream fishes. Our results mimic, and in some ways surpass state agency sampling efforts with the majority of the common species represented in our sample size. We have documented some dace and topminnows which are not found on state distribution or documentation lists. We would like to continue periodic monitoring and protect our remaining aquatic resources long into the future.

11. Acknowledgements

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Appendix A
Fish Result Summary Tables

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Table A1. Summary of total number of fish sampled at select riverine study sites on the Iowa Tribe of Kansas and Nebraska Reservation, 2018-19.

Family Name	Scientific Name	Common Name	Roy's Lower	Roy's Upper	Lost Creek	Noland's	Missouri	State	Nemaha	Total
Acipenseridae	*Scaphirhynchus platorynchus*	Shovelnose sturgeon					2		5	7
Catostomidae	*Carpiodes carpio*	River carpsucker	6	9	70				7	92
	Catostomus commersonii	White Sucker		2	6					8
	Ictiobus bubalus	Smallmouth buffalo							2	2
	I. cyprinellus	Bigmouth buffalo		1						1
	Moxostoma macrolepidotum	Shorthead redhorse			3					3
Centrarchidae	*Lepomis cyanellus*	Green sunfish	1	9	320					330
	L. macrochirus	Bluegill	4	12	38			4		58
	L. humilis	Orangespotted sunfish	9		10					19
	Micropterus salmoides	Largemouth bass	8	4	10			2		24
Clupeidae	*Dorosoma cepedianum*	American gizzard shad	3	3	8					13
Cyprinidae	*Campostoma anomalum*	Central stoneroller			6					6
	Cyprinella lutrensis	Red shiner	182	1317	1276			79		2854
	Cyprinus carpio	Common carp	20	108	99		8	5		240
	Hybognathus hankinsoni	Brassy minnow		23	57					80
	H. argyritis	Western silvery minnow			1					1
	Notropis atherinoides	Emerald shiner	4		60					64
	N. stramineus	Sand shiner	217	734	595	2		19		1567
	N. dorsalis	Bigmouth shiner	4		1					5
	Phenacobius mirabilis	Suckermouth minnow	6	14	20			1		41
	Pimephales promelas	Fathead minnow	18	19	201	3			3	244
	Rhinichthys cataractae	Longnose dace	24	3	2			6		35
	R. obtusus	Western blacknose dace	1	7	23					31
	Semotilus atromaculatus	Creek chub		24	70					94
	Hypophthalmichthys molitrix	Silver Carp			1				2	3
	Macrhybopsis storeriana	Silver chub	1	2						3
	Luxilus cornutus	Common shiner		3						3
Fundulidae	*Fundulus dispar*	Starhead topminnow			3					3
Hiodontidae	*Hiodon alosoides*	Goldeye							1	1
Ictaluridae	*Ictalurus punctatus*	Channel catfish	4	8	5				16	33
	I. furcatus	Blue catfish					4		8	12
	Noturus lavus	Stonecat	1		1					2
	N. gyrinus	Tadpole madtom			2					2
	Ameiurus melas	Black bullhead	2		10					12
	A.natalis	Yellow bullhead		6	6					12
Pylodictidae	*Pylodictis olivaris*	Flathead chub					3			3
Lepisostidae	*Lepisosteus osseus*	Longnose gar						2	6	8
	L. platostomus	Shortnose gar		2	9		2	3	38	54
Moronidae	*Morone chrysops*	White bass						8	2	10
Percidae	*Etheostoma nigrum*	Johnny darter	3		4					7
	Sander canadensis	Sauger		6						6
	S. vitreus	Walleye	1	7						8
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum	1		1				3	5
Total No.			**520**	**2,323**	**2,917**	**5**	**19**	**129**	**93**	**6,006**

Table A2, Fish species sampled by the on the Iowa Tribe of Kansas and Nebraska Reservation (2018-19) and during previous studies (Hesse et al. 1978; Hesse and Newcomb 1982) (X = species present; O = Absent).

mmon Name:	Family Name	Scientific Name	No. Sampled	Nebraska	Kansas	Tribe
Shovelnose sturgeon	**Acipenseridae**	***Scaphirhynchus platorynchus***	7	X	O	X
River carpsucker	**Catostomidae**	***Carpiodes carpio***	92	X	X	X
White sucker		***Catostomus commersonii***	8	X	X	X
Smallmouth buffalo		***Ictiobus bubalus***	2	X	X	X
Bigmouth buffalo		***I. cyprinellus***	1	X	X	O
Shorthead redhorse		***Moxostoma macrolepidotum***	3	X	X	X
Green sunfish	**Centrarchidae**	***Lepomis cyanellus***	330	X	X	X
Orangespotted sunfish		***L. humilis***	19	X	X	O
Bluegill		***L. macrochirus***	58	X	X	X
Largemouth bass		***Micropterus salmoides***	24	X	X	X
American gizzard shad	**Clupeidae**	***Dorosoma cepedianum***	13	X	X	X
Central stoneroller	**Cyprinidae**	***Campostoma anomalum***	6	X	X	O
Red shiner		***Cyprinella lutrensis***	2854	X	X	X
Common carp		***Cyprinus carpio***	239	X	X	X
Mirror carp		***C. carpio* (variation of common)**	1			
Brassy minnow		***Hybognathus hankinsoni***	80	X	X	X
Western silvery minnow		***H. argyritis***	1			
Emerald shiner		***Notropis atherinoides***	64	X	X	X
Sand shiner		***N. stramineus***	1567	X	X	X
Bigmouth shiner		***N. dorsalis***	5	X	X	X
Suckermouth minnow		***Phenacobius mirabilis***	41	X	X	X
Fathead minnow		***Pimephales promelas***	244	X	X	X
Longnose dace		***Rhinichthys cataractae***	35	O	O	X
Western blacknose dace		***R. obtusus***	31	O	O	X
Creek chub		***Semotilus atromaculatus***	94	X	X	X
Silver carp		***Hypophthalmichthys molitrix***	3			
Silver chub		***Macrhybopsis storeriana***	3			
Common shiner		***Luxilus cornutus***	3			
Starhead topminnow	**Fundulidae**	***Fundulus dispar***	3	O	O	X
Goldeye	**Hiodontidae**	***Hiodon alosoides***	1	X	X	X
Channel catfish	**Ictaluridae**	***Ictalurus punctatus***	33	X	X	X
Blue catfish		***I. furcatus***	12	X	O	X
Stonecat		***Noturus lavus***	2	X	X	O
Tadpole madtom		***N. gyrinus***	2	X	O	O
Black bullhead		***Ameiurus melas***	12	X	X	O
Yellow bullhead		***A. natalis***	12	X	X	X
Longnose gar	**Lepisostidae**	***Lepisosteus osseus***	8	X	X	X
Shortnose gar		***L. platostomus***	54	X	X	X
White bass	**Moronidae**	***Morone chrysops***	10	X	X	X
Johnny darter	**Percidae**	***Etheostoma nigrum***	7	X	O	O
Saugeye		***Sander canadensis***	6	O	O	O
Walleye		***S. vitreus***	8	O	X	O
Flathead chub	**Pylodictidae**	***Pylodictis olivaris***	3	O	O	O
Freshwater drum	**Sciaenidae**	***Aplodinotus grunniens***	5	X	X	X

Appendix B

Fish Photo Voucher Collection, 2018-2020

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Photo 1 – Emerald shiner *Notropis atherinoides;* red shiner below.

Photo 2 – Juvenile common carp, *Cyprinus carpio*

Photo 3 – Emerald shiner *Notropis atherinoides*

Photo 4 – Female suckermouth minnow, *Phenacobius mirabilis*

Photo 5 – Blue catfish, *Ictalurus furcatus*

Photo 6 – River carpsucker, *Carpiodes carpio*

Photo 7 – Suckermouth minnow, *Phenacobius mirabilis*

Photo 8 – Green sunfish X bluegill hybrid

Photo 9 – Starhead topminnow, *Fundulus dispar*

Photo 10 – Yellow bullhead, *Ameiurus natalis*

Photo 11 – Juvenile bluegill green sunfish hybrid

Photo 12 – White sucker (Red shiner and sand shiner also)

Photo 13 – Longnose gar, *Lepisosteus osseus*

Photo 14 – Bigmouth buffalo, *Ictiobus cyprinellus*

Photo 15 – Shovelnose sturgeon, *Scaphirhynchus platorynchus*

Photo 16 – Gizzard shad, *Dorosoma cepedianum*

Photo 17 – Shorthead redhorse, *Moxostoma macrolepidotum*

Photo 18 – Western blacknose dace, *Rhinichthys obtusus*

Photo 19 – Bluegill on the right of photo

Photo 20 – More dace

Photo 21 – Goldeye, *Hiodon alosoides*

Photo 22 – Freshwater drum, *Aplodinotus grunniens*

Photo 23 – Flathead catfish, *Platygobio gracilis*

Photo 24 – Channel catfish*, Ictalurus punctatus*

Photo 25 – Male red shiner, *Notropis lutrensis*, in breeding colors