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Larval Fish Entrainment 2019

Lower Yellowstone Project, Montana

Missouri Basin and Arkansas-Rio Grande-Texas Gulf Regions

U.S. Department of the Interior

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Cover Photo: Intake Canal horizon view (Reclamation/Eric Best)

Acronyms and Abbreviations

°C	degrees Celsius
AF	acre foot
AF/s	acre-feet per second
cfs	cubic feet per second
cm	centimeter
ESA	Endangered Species Act
FY	fiscal year
ISI	Intake Screens Inc.
km	kilometer
L	liter
LYP	Lower Yellowstone Project
m^3	cubic meter
m^3/s	cubic meters per second
m	meter
mm	millimeter
Reclamation	Bureau of Reclamation
rm	river miles
SD	Standard Deviation
USFWS	U.S. Fish and Wildlife Service
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Service
µm	micrometer

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Executive Summary

Researchers examined larval fish entrainment into the Bureau of Reclamation's (Reclamation) Lower Yellowstone Project Main Canal, northeast of Glendive, Montana, during the 2019 irrigation season. The study objective is to document and determine entrainment rates of the egg and larval life stages of Pallid Sturgeon (*Scaphirhynchus albus*) into the Main Canal.

As part of an overall retrofit of the Lower Yellowstone Project (LYP), the headworks structure for the Main Canal was replaced in 2012 with new headworks and drum screens. The drum screens have a maximum mesh slot size of 1.75 millimeters (mm) and are designed to keep fish larger than 40 millimeters out of the canal.

In partial fulfillment of the Biological Opinion (for the continued operation of the Lower Yellowstone Project U.S. Fish and Wildlife [USFWS] 2016), Reclamation evaluated the entrainment rates of endangered fish into the Main Canal with the new fish screens in place. For this study, larval fish sampling efforts focused on times when sturgeon were likely to be spawning—beginning in mid-June and ending in mid-July 2019. Larval fish samples were collected using four 30-centimeter (cm) diameter, 500 micrometer (µm) plankton trawl nets deployed 0.4-kilometers (¼ mile) downstream of the canal headworks to capture fish larvae and fish eggs. River sampling took place on a limited basis directly upstream of Intake Diversion Dam in the Yellowstone River for density comparisons.

In 2019, a total of 460 canal samples were collected, containing 1,093 larval fish and 261 fish eggs; and 40 river samples were collected, containing 25 larvae and 56 eggs. The average density of larvae in the canal was 0.030 larvae per cubic meter (m^3) (29.50 larvae per acre-foot [AF]) and 0.007 eggs/m^3 (8.68 eggs/AF). The average capture rate in the river was less than the intake sampling with 0.003 larvae/m^3 (3.62 larvae/AF) and greater for eggs with 0.005 eggs/m^3 (6.63 eggs/AF). Five eggs/larvae were identified as sturgeon, and these samples were collected between 07/02/2019 and 07/09/2019 in water that was between 20 and 22 degrees Celsius (°C) temperatures. Further genetic analysis could not be completed to identify whether these samples were Pallid Sturgeon.

Data from previous years suggests that over 90 percent of the larval fish could be protolarvae, which is the earliest developmental life stage. Protolarvae are unable to swim effectively and instead drift downstream within the water column, pass through the fish screens, and are entrained with canal flows. Previous larval fish sampling in 2012-2013 suggests that the majority of larvae in the Main Canal are likely to be Cyprinids (minnows) and Catostomids (suckers). Peak larval entrainment typically occurs in late-June and early-July, while fish egg entrainment is highest in June.

Introduction

The Lower Yellowstone Project (LYP) was authorized by the Secretary of the Interior in 1904 under the Reclamation Act of 1902. Construction of the Intake Diversion Dam, canal headworks, and delivery canals for the LYP began in 1905. The diversion dam is a 12-foot-high and 700-foot-long rocked-filled timber crib weir structure that spans the width of the Yellowstone River and diverts water into the Main Canal. The diversion dam raises the upstream water elevation from two to five feet, depending on river flows. The diversion dam is about 70 river miles (rm) upstream from the confluence of the Yellowstone and Missouri Rivers (Figure 1) and is about 17 miles northeast of Glendive, Montana. The LYP includes the Lower Yellowstone Diversion Dam, canal headworks, Thomas Point Pumping Plant, 71 miles of Main Canal, 225 miles of lateral canals, and 118 miles of drains. The LYP provides a dependable water supply sufficient to irrigate approximately 58,000 acres of bench lands above the west bank of the Yellowstone River in eastern Montana and western North Dakota. Water is carried by gravity to the greater portion of project lands and is also pumped from the Main Canal to irrigate approximately 823 acres in the Intake Irrigation District and 2,300 acres in the Savage Irrigation District. The average annual volume of water diverted for these projects is 327,046 acre-feet (Reclamation 2014).

The rock-filled timber crib weir structure across the Yellowstone River is a partial barrier to many fish species and is likely a total barrier during most years to species such as Pallid Sturgeon (*Scaphirhynchus albus*), Shovelnose Sturgeon (*S. platorynchus*), and Paddlefish

(*Polydon spathula*) (Glickman et al. 2004). Pallid Sturgeon is one of the rarest fish species in the Missouri and Mississippi River basins and was listed as endangered in 1990 (USFWS 1990) under the 1973 Endangered Species Act (ESA). Fish entrainment monitoring by Hiebert et al. (2000) indicated that thousands of fish from 36 different species were entrained annually into the Main Canal.

The original canal headworks did not include fish screens or a fish bypass structure. Reclamation and the U.S. Army Corps of Engineers (USACE) modified the LYP headworks and Main Canal to reduce fish entrainment by constructing a new headworks facility and installing fish screens on the upstream (Yellowstone River) side of the intake conduits. Reclamation and USACE are currently constructing features to improve fish passage at the site by retrofitting the LYP with a 11,150 foot- long bypass channel and replacement weir structure. These retrofits are expected to improve fish passage past the existing diversion structure. Construction is expected to be completed in fiscal year (FY) 2022.

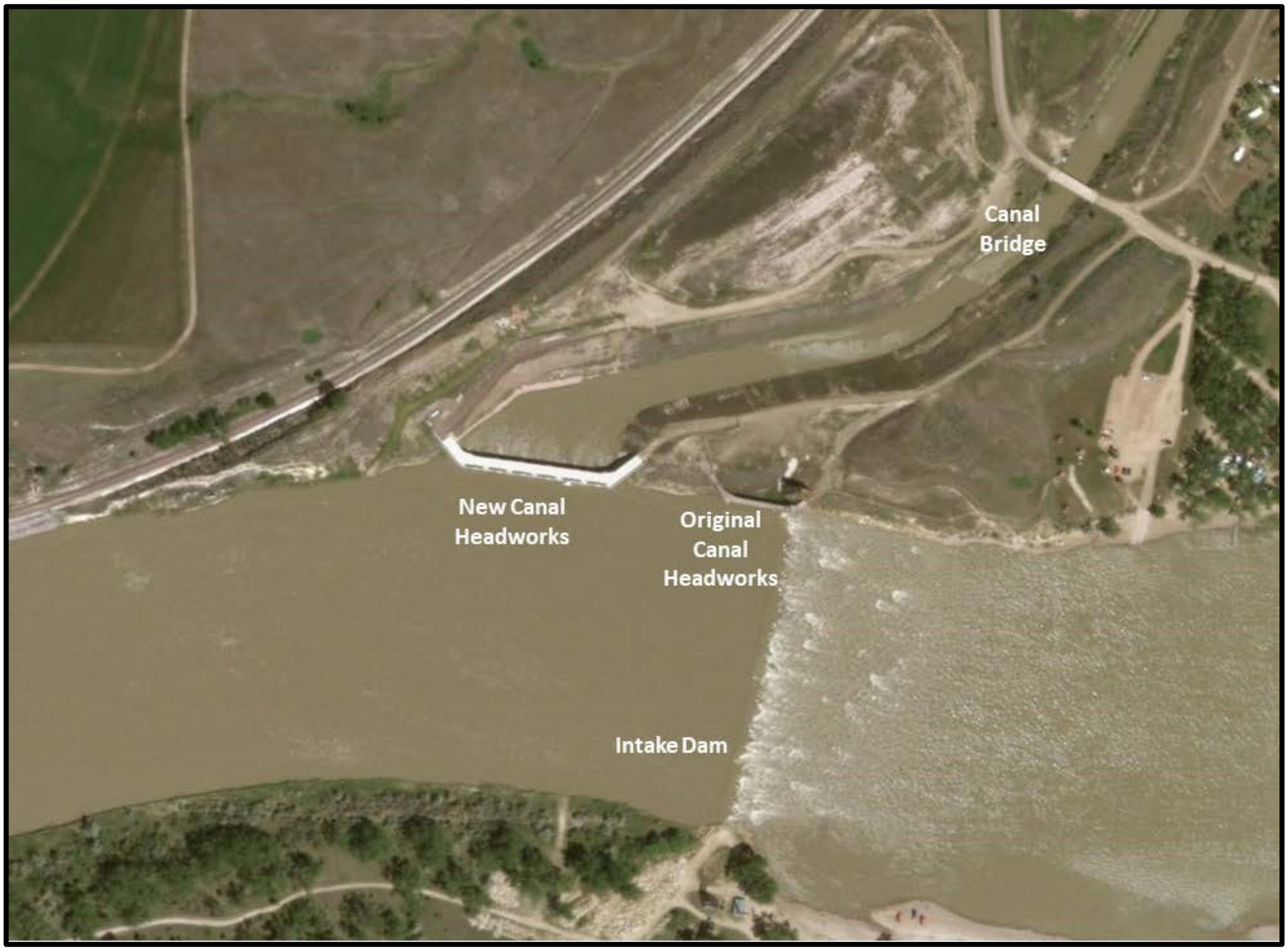

Figure 1. New intake canal headworks, original canal headworks, access bridge and low-head diversion dam across the Yellowstone River.

Fish Screens

To protect Pallid Sturgeon as well as other native fish in the lower Yellowstone River by reducing or eliminating incidental fish entrainment, Reclamation replaced the headworks to correct the unscreened condition of the previous headworks structure in 2012. The new headworks consists of 12 rotating drum screens (Intake Screens Inc. [ISI] T78-100 Tee Fish Screens) that are track mounted and located on the riverside of the inlet conduits. Screens are designed to raise 1.5 meters (m) or 5 feet above the 100-year, ice-impacted water surface and are individually controlled with the capacity to be raised or lowered as necessary (Reclamation 2014) (Figure 2).

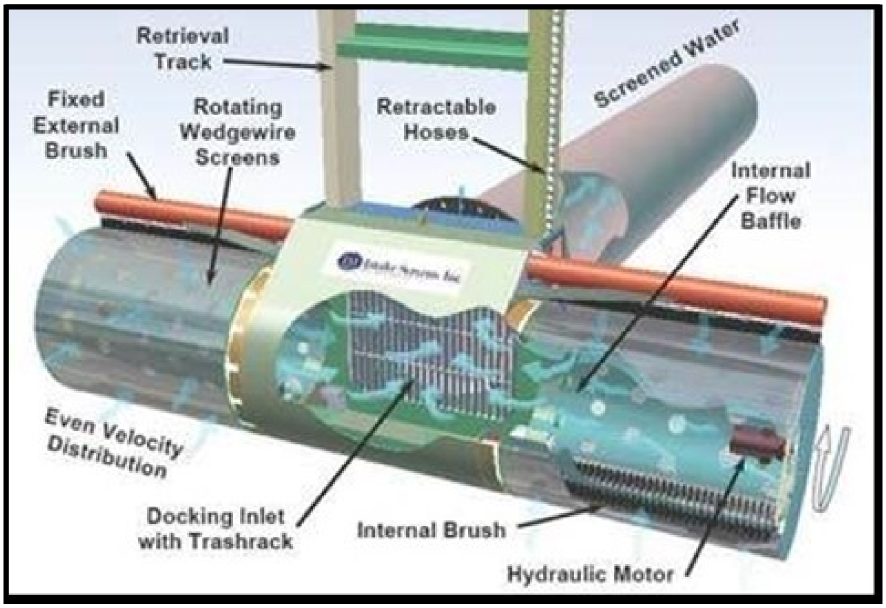

Figure 2. New intake canal fish screens from Intake Screens, Inc. showing ISI T78-100 Tee Screen (diagram from Intake Screens, Inc., all rights reserved).

Eleven of the intake conduits are used to fulfill the LYP full water right of 1,374 cubic feet per second (cfs) and the one additional inlet conduit and drum screen are used as a back-up. Each drum screen is about 2 meter (m) (6.5 feet) in diameter and 7.6 m (25 feet) long. The drum screens have a maximum mesh slot size of 1.75 mm and are designed to keep fish larger than 40 mm out of the canal (Figure 3). Fixed brushes are mounted on the inside and outside of the drum screen and are automated to intermittently rotate and clean both sides of the screen. The screen cylinders rotate against the brushes to remove debris and fish as well as other aquatic organisms impinged on the surface of the screen (Reclamation 2014). Because fish screen criteria specific to Pallid Sturgeon are lacking (USFWS 2007), the fish screens were designed to meet salmonid screening criteria established by the USFWS and the National Marine Fisheries Service (Reclamation 2014).

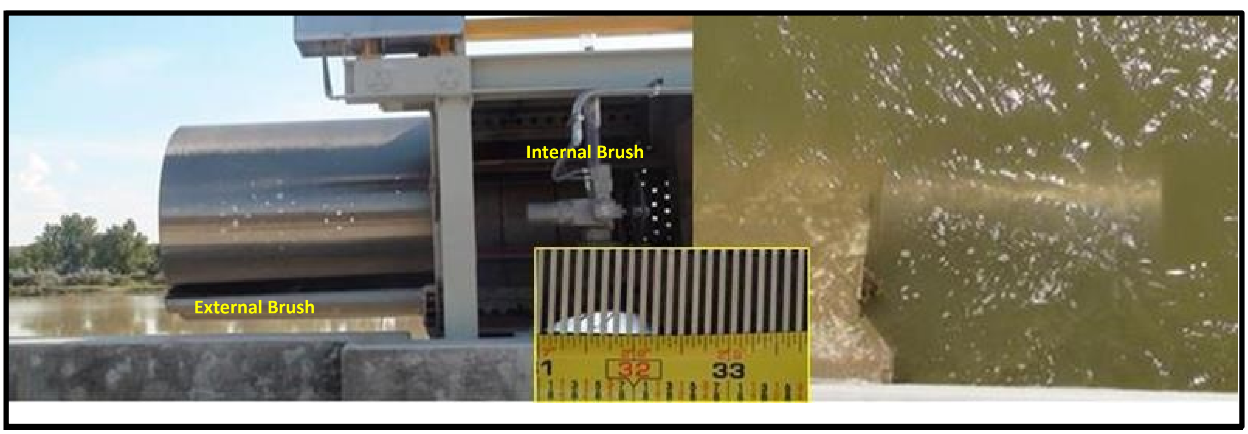

Figure 3. Photo of raised ISI T78-100 Tee Screen drum (left) and submerged position (right) with inset photo showing 1.75-mm slots of wedge wire screen.

Fish Assemblage in the Lower Yellowstone River

The Yellowstone River is the longest free-flowing river in the in the contiguous United States. The Yellowstone River flows from its headwaters in the Absaroka Range into Yellowstone Lake where the mainstem originates and then flows in a north-east direction through Wyoming, Montana, and North Dakota until it empties into the Missouri River above Lake Sakakawea (Figure 4).

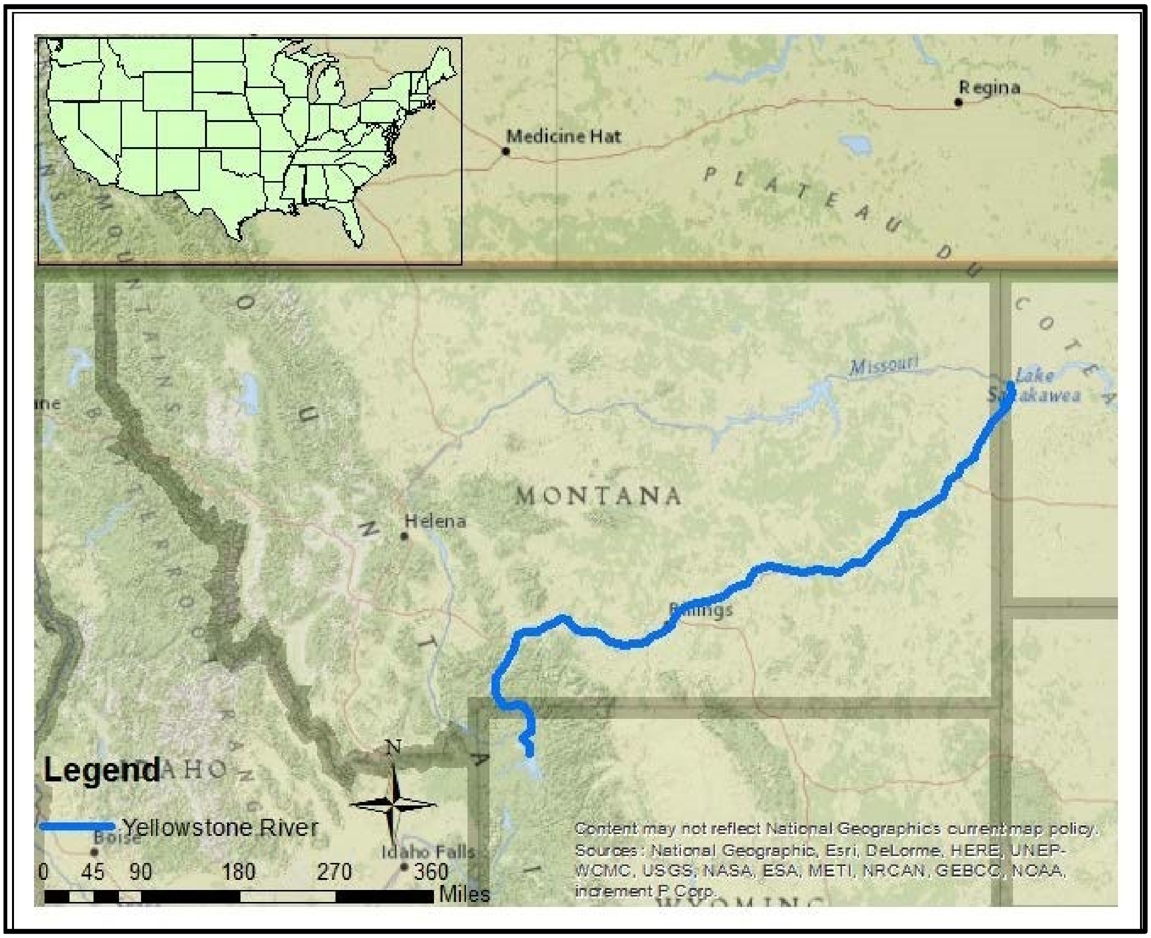

Figure 4. Location map (Yellowstone River from Yellowstone Lake in Wyoming to the Missouri River upstream of Lake Sakakawea in North Dakota).

Because the mainstem is not impounded, the river retains a near natural hydrograph fed by large flows of mountain snowmelt that scour sediment from the upper, middle, and the lower section of river thus, maintaining high turbidity levels in the lower section. From its headwaters, the river changes from a cold-water alpine system to a warm-water prairie river system. Based on the fish distribution, the river can be divided into three zones; the upper portion, 498 to 617 river miles is the salmonid zone, the middle portion (296 to 497 rm) is the transition zone, and the lower portion (0 to 295 rm) is the warm water zone. The mean annual discharge near the mouth is 362 cubic meters per second (m^3/s) or 0.3 acre-feet/second (AF/s), and the average annual discharge is about 9.3 million (AF) (White and Bramblett 1993).

A total of 56 fish species representing 16 families are found in the mainstem Yellowstone, including 20 non-native species. The salmonid zone of the Yellowstone River is dominated by salmonids and is inhabited by 16 fish species representing 6 families. The transition zone has 30 fish species representing 7 families, and the warm water zone has 50 fish species representing 15 families (White and Bramblett 1993; Hiebert et al. 2000; and Montana Fish, Wildlife, and Parks 2003) (Table 1).

The young larvae of most fish species in the lower Yellowstone River cannot swim effectively under their own power and, instead, drift within the current of the water column. They are therefore susceptible to altered river flows and water withdrawals. Drift dispersal and dynamics are not well known or understood, although it has been speculated that dams (including low-head dams) may contribute to increased mortality of eggs and larvae if they pass over and/or through the structure. Settlement and concentration of large numbers of drifting eggs and larvae in dam pools and within river sediment may also lead to poor survival and dispersal of the affected species (Gilligan 2014).

Larval fish in large rivers, such as the lower Yellowstone River, typically become suspended in the water column and are carried downstream for long distances. Larval Pallid and Shovelnose Sturgeon were found to drift from 94 kilometers (km) to 530 km (58.4 to 329.3 miles) in the Missouri River, depending on water velocities (Braaten et al. 2008). However, larval fish in rivers and streams are highly susceptible to entrainment into water diversions such as canals and pumping facilities (Paller 1992). Entrainment potential for larval fish likely escalates when the volume of the river decreases (after peak spring runoff and when irrigation needs increase during the summer period). The number of diversions and longer downstream drift distances for larval fish, (e.g. Pallid Sturgeon) also increase the potential for entrainment.

Table 1. Fish species found in the lower Yellowstone River near Intake Diversion (White and Bramblett 1993, Hiebert et al 2000, and Montana Fish, Wildlife and Parks 2003).

Common Name	*Scientific Name*	Native
Sturgeons	**Acipenseridae**	
Pallid Sturgeon	*Scaphirhynchus albus*	Y
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Y
Paddlefishes	**Polyodontidae**	
Paddlefish	*Polydon spathula*	Y
Sturgeons	**Acipenseridae**	
Pallid Sturgeon	*Scaphirhynchus albus*	Y
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Y

Common Name	*Scientific Name*	Nativ e
Pikes	**Esocidae**	
Northern Pike	*Esox lucius*	N
Trouts and Salmons	**Salmonidae**	
Cisco	*Coregonus artedi*	N
Rainbow Trout	*Oncorhynchus mykiss*	N
Mountain Whitefish	*Prosopium williamsoni*	Y
Brown Trout	*Salmo trutta*	N
Pikes	***Esocidae***	
Northern Pike	*Esox lucius*	N

Common Name	*Scientific Name*	Native
Paddlefishes	**Polyodontidae**	
Paddlefish	*Polydon spathula*	Y
Mooneyes	**Hiodontidae**	
Goldeye	*Hiodon alosoides*	Y
Carps and Minnows	**Cyprinidae**	
Lake Chub	*Couesius plumbeus*	Y
Common Carp	*Cyprinus carpio*	N
W. Silvery Minnow	*Hybognathus argyritis*	Y
Brassy Minnow	*Hybognathus hankinsoni*	Y
Plains Minnow	*Hybognathus placitus*	Y
Sturgeon Chub	*Machrybopsis gelida*	Y
Sicklefin Chub	*Macrhybopsis meeki*	Y
Golden Shiner	*Notemigonus crysoleucas*	N
Emerald Shiner	*Notropis atherinoides*	Y
Spottail Shiner	*Notropis hudsonius*	N
Sand Shiner	*Notropis stramineus*	Y
Fathead Minnow	*Pimephales promela*	Y
Flathead Chub	*Platygobio gracilis*	Y
Longnose Dace	*Rhinichthys cataractae*	Y
Creek Chub	*Semotilus atromaculatus*	Y
Suckers	**Catostomidae**	
River Carpsucker	*Carpiodes carpio*	Y
White Sucker	*Catostomus commersonii*	Y
Longnose Sucker	*Catastomus catastomus*	Y
Mountain Sucker	*Catastomus platyrhynchus*	Y
Smallmouth Buffalo	*Ictiobus bubalus*	Y
Bigmouth Buffalo	*Ictiobus cyprinellus*	Y
Shorthead Redhorse	*Moxostoma macrolepidotum*	Y
Drums and Croakers	**Sciaenidae**	
Freshwater Drum	*Aplodintus grunniens*	Y

Common Name	*Scientific Name*	Native
Bullheads and Catfishes	**Ictaluridae**	
Black Bullhead	*Ameiurus melas*	N
Yellow Bullhead	*Ameiurus natalis*	N
Channel Catfish	*Ictalurus punctatus*	Y
Stonecat	*Noturus flavus*	Y
Trouts and Salmons	**Salmonidae**	
Cisco	*Coregonus artedi*	N
Rainbow Trout	*Oncorhynchus mykiss*	N
Mountain Whitefish	*Prosopium williamsoni*	Y
Brown Trout	*Salmo trutta*	N
Cods	**Gadidae**	
Burbot	*Lota lota*	Y
Killifishes	**Cyprinodontidae**	
Plains Killifish	*Fundulus zebrinus*	N
Sticklebacks	**Casterosteidae**	
Brook Stickleback	*Culaea inconstans*	Y
Sunfishes	**Centrarchidae**	
Rock Bass	*Ambloplites rupestris*	N
Green Sunfish	*Lepomis cyanellus*	N
Pumpkinseed	*Lepomis gibbosus*	N
Bluegill	*Lepomis macrochirus*	N
Smallmouth Bass	*Micropterus dolomieu*	N
Largemouth Bass	*Micropterus salmoides*	N
White Crappie	*Pomoxis annularis*	N
Black Crappie	*Pomoxis nigromaculatus*	N
Perciforms	**Cercidae**	
Yellow Perch	*Perca flavescens*	N
Sauger	*Sander canadensis*	Y
Walleye	*Sander vitreus*	N

Methods

Larval Fish Sampling

To evaluate larval fish entrainment into the Main Canal, we sampled in the canal downstream from the fish screens using plankton trawl nets. Sampling started in mid-June and ended in mid-July 2019 to focus efforts on the time when sturgeon were likely to be spawning (Backes 2012) (Figure 5).

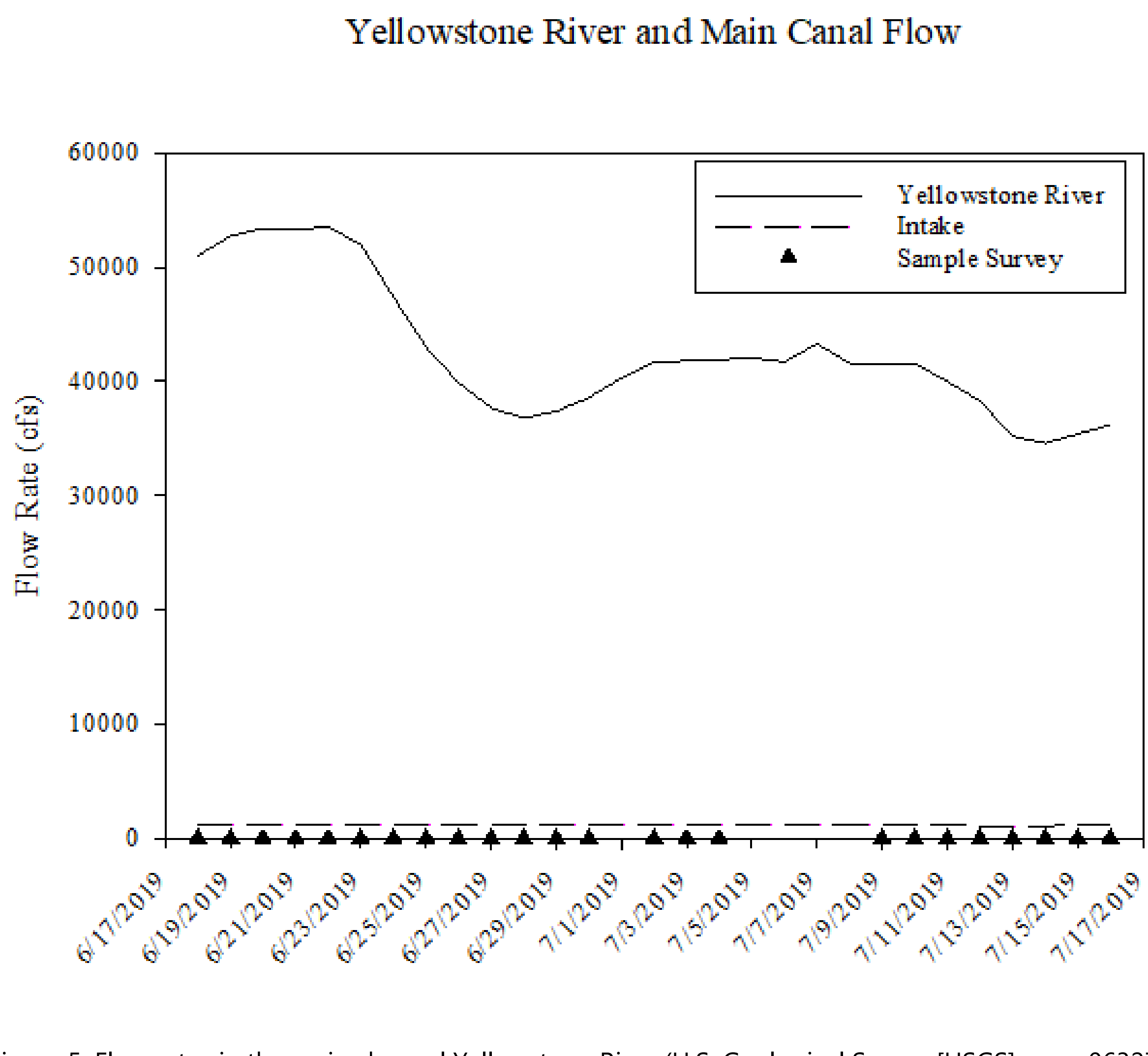

Figure 5. Flow rates in the main channel Yellowstone River (U.S. Geological Survey [USGS] gage 06327500 near Glendive, MT) and LYP channel (Lower Yellowstone Irrigation District) 2019. Larval fish sampling periods are designated by triangles.

Four plankton trawl nets (30- cm diameter by 2.5 m long) were deployed simultaneously from the Intake Dam fishing and camping access bridge about 0.4-km (¼-mile) downstream from the headworks (Figure 6). The distance from the headworks to the bridge was thought to be enough to allow for sufficient mixing of all the 12 inlet conduits (see Figure 1). Nets were spaced evenly along the access bridge and lowered to the bottom of the water column. Nets were deployed for approximately 30 minutes every two hours, depending on debris loads.

Larval sampling was also conducted directly upstream of Intake Dam by boat on select dates between mid-June and mid-July 2019. River sampling entailed using paired 50 cm by 75 cm (rectangular frame) by 3 m long trawl nets. The sampling boat was anchored in the river current near the thalweg of the river, and nets were deployed simultaneously for 10 to 30 minutes—depending on debris load.

To estimate the volume of water filtered by the net, a General Oceanics mechanical flowmeter was attached to the net's collar using stranded steel cable wire (Figure 6A). The flowmeter was checked daily for water leakage, air bubble formation, and proper propeller rotation and was flushed and refilled as necessary. Both the start and stop counts registered by the flowmeter were recorded along with the duration of deployment.

Figure 6. (A. Left). Photo of larval fish sampling gear showing plankton trawl net, depressor weight, flow meter, and PVC collecting bucket at the back end of the net. (B. Right). Photo of Intake Canal looking downstream from the access bridge showing the surface sampling nets and the ropes leading to the bottom sampling nets.

Laboratory Analyses

All samples retrieved from the nets were placed into 0.95 liter (L) plastic jars. The samples were preserved in 95 percent ethanol so that if a potential sturgeon larva was captured, DNA analysis could be performed in a laboratory. The samples were then labeled numerically and logged into a notebook along with the date, time, location, depth, and flow meter count. Samples were then transported to a lab for processing.

Figure 7. Separating larval fish in the laboratory using a plastic dropper.

In the lab, the samples were poured into a number 40 sieve (0.42-mm or 0.0165-inches), thoroughly rinsed with tap water, and placed onto one side of a deep-dish plastic container (Figure 7). The sample was then carefully spread out into smaller portions and the larval fish separated from the detritus, similar to Wanner et al. 2011.

Larval fish and eggs were placed into a scintillation vial filled with ethanol and labeled with the appropriate sample number. The number of larval fish and eggs was tallied for each sample, and density was calculated based on the volume of water filtered (using the formula in the General Oceanics Flowmeter Manual 2008) then extrapolated further using daily canal flows to estimate daily entrainment rates (e.g., density of larvae/m^3 and density of eggs/m^3). The daily canal gage measurements were used to estimate daily canal flow and were assumed not to change within a day when sampling occurred. By extrapolating our rate of entrainment or density per cubic meter of water from the plankton nets, we estimated the total number of fish larvae and the total number of eggs entrained per acre-foot of canal water for the days sampled.

In previous sampling runs (e.g., 2012 and 2013), all larval fish collected were sent to the University of New Mexico, Museum of Southwestern Biology for identification. The Museum of Southwestern Biology found that the vast majority of larval fish from 2012 and 2013 were Cyprinids or Catastomids. However, the purpose of the studies conducted after 2015 is to determine the entrainment rates for sturgeon only. Therefore, beginning in 2015, any larvae with acipenseriform-like qualities were removed from the rest of the sample and sent to Southern Illinois University for DNA analysis. Starting in 2018, any eggs that were thought to have acipenseriform-like qualities were also sent to Southern Illinois University. All other larvae were not identified and simply counted to calculate total entrainment.

Results

Larval Fish/Egg Results

In the Lower Yellowstone Main Canal, we collected a total of 460 samples in 24 days of sampling between June 18th and July 16th. The average sample collection time was 30 minutes. Flows were much lower in the Main Canal, averaging 1,193 cfs/day than in the Yellowstone River (average 42,548 cfs). In June and July 2019, the Yellowstone River daily mean flow ranged between 34,600 and 53,500 cfs near Glendive, Montana, which is greater than historical discharge for this stretch of river at this time of year (see Figure 5). The sampling period encompassed the time when sturgeon larvae in the Yellowstone River are thought to be drifting downstream. On average, samples contained 2.38 larvae and 0.57 eggs. Over the entire sampling effort, 1,093 larvae and 261 eggs were caught. The average capture rate was 0.030 larvae/m^3 (29.50 larvae/AF) and 0.007 eggs/m^3 (8.68 eggs/AF; Figure 8 and Figure 9).

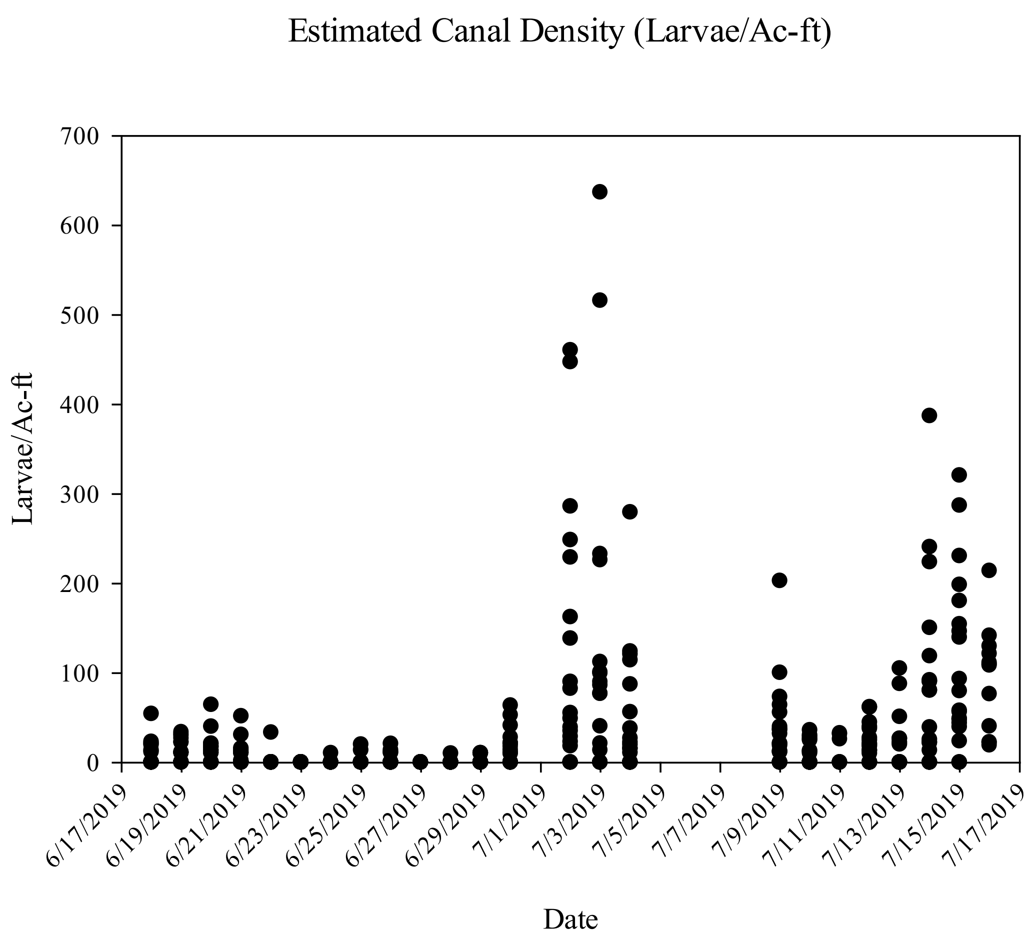

Figure 8. Estimated canal density of larval fish per acre-foot of water during the 2019 sampling period in the Yellowstone River Main Canal.

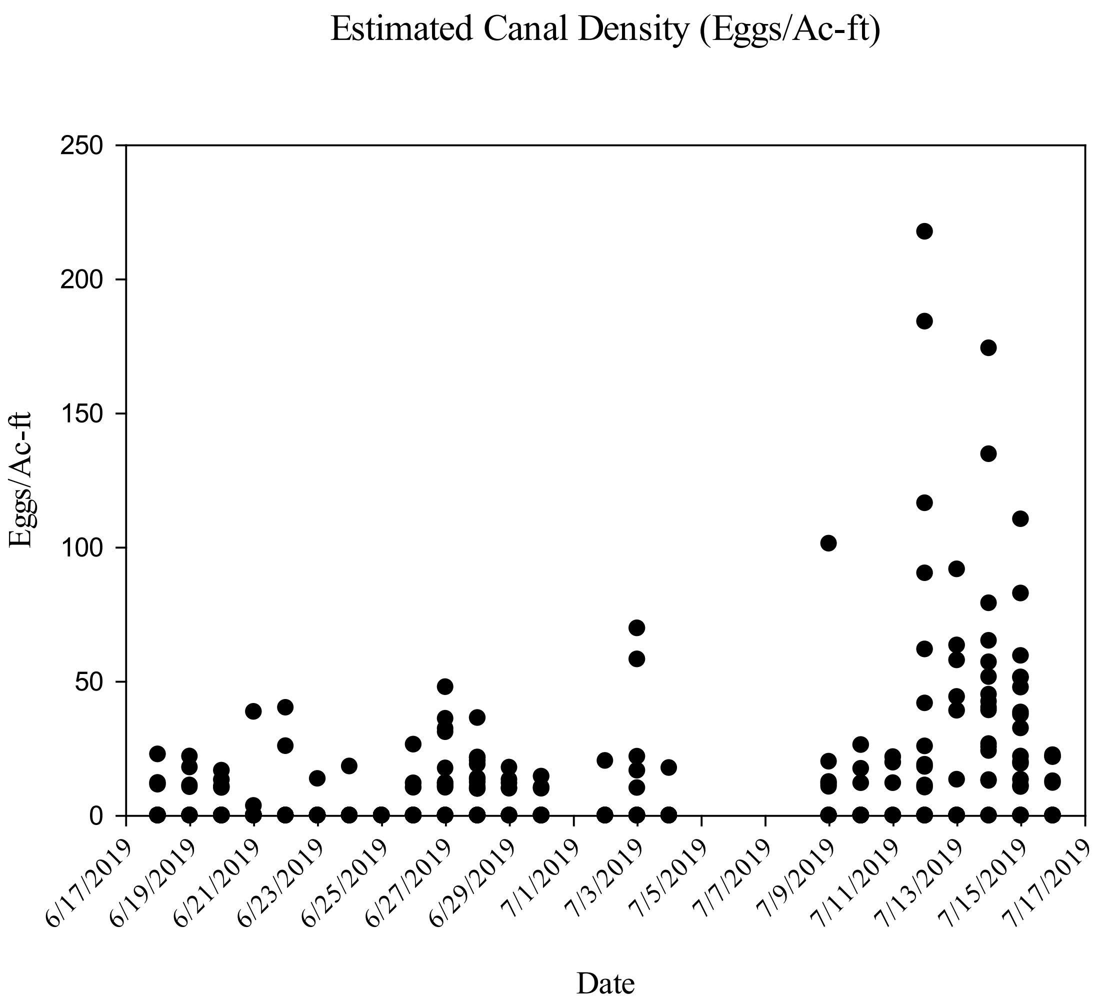

Figure 9. Estimated canal density of fish eggs per acre-foot of water during the 2019 sampling period in the Yellowstone River Main Canal.

In addition to sampling at the Main Canal, samples were also collected from the mainstem Yellowstone River from a boat using somewhat different protocols. In the mainstem Yellowstone River, a total of 40 samples were collected in 2 days of sampling on July 2 and July 15. The average sample collection time was 17 minutes. On average, samples from the mainstem contained 0.625 larvae and 1.400 eggs. Over the entire sampling effort, 25 larvae and 56 eggs were caught. The average capture rate in the river was lower than in the canal, with 0.003 larvae/m^3 (3.62 larvae/AF) and greater for eggs with 0.005 eggs/m^3 (6.63 eggs/AF; Figure 10 and Figure 11).

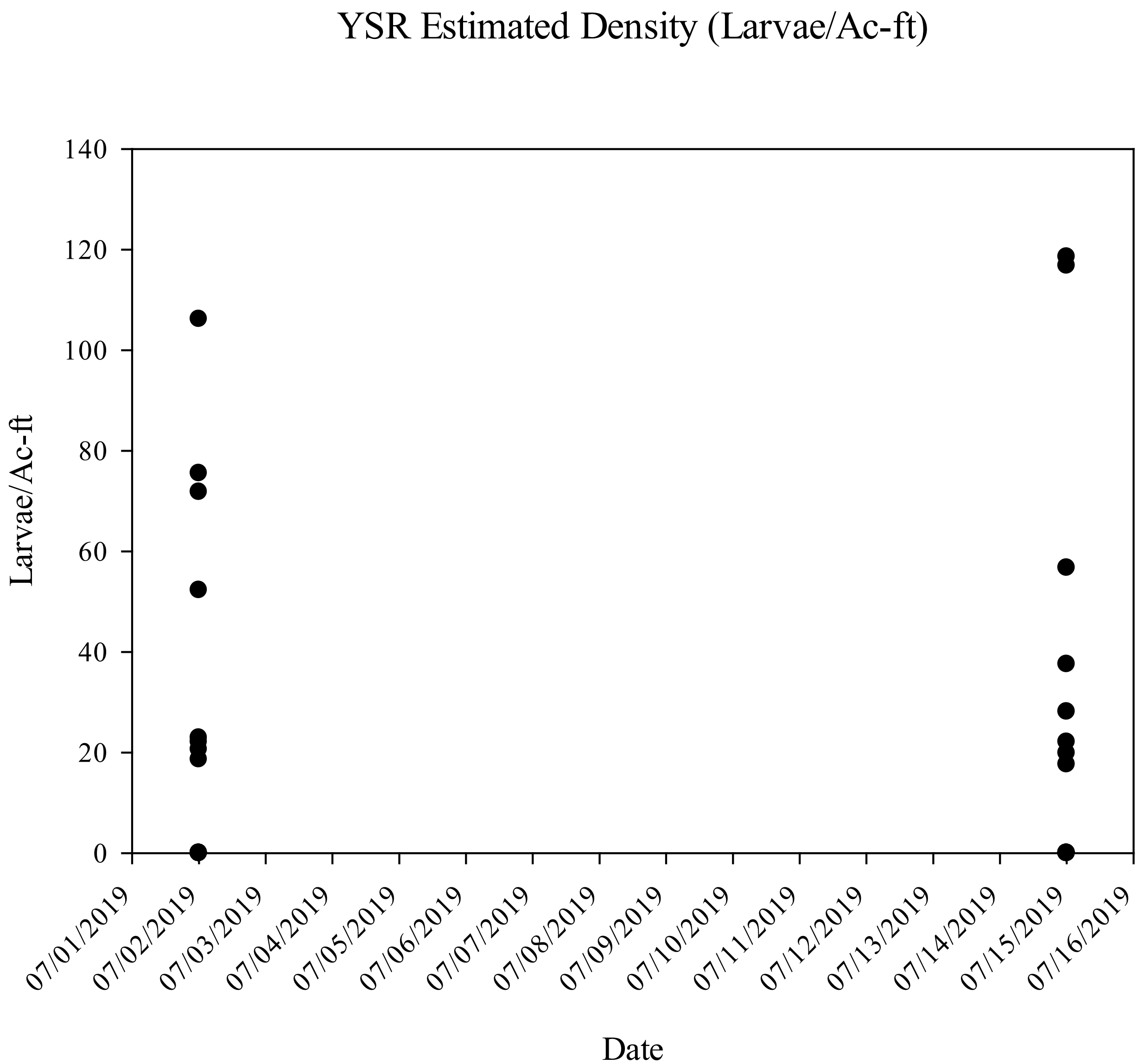

Figure 10. Estimated density of fish larvae per acre-foot of water during the 2019 sampling period in the Yellowstone River (YSR = Yellowstone River).

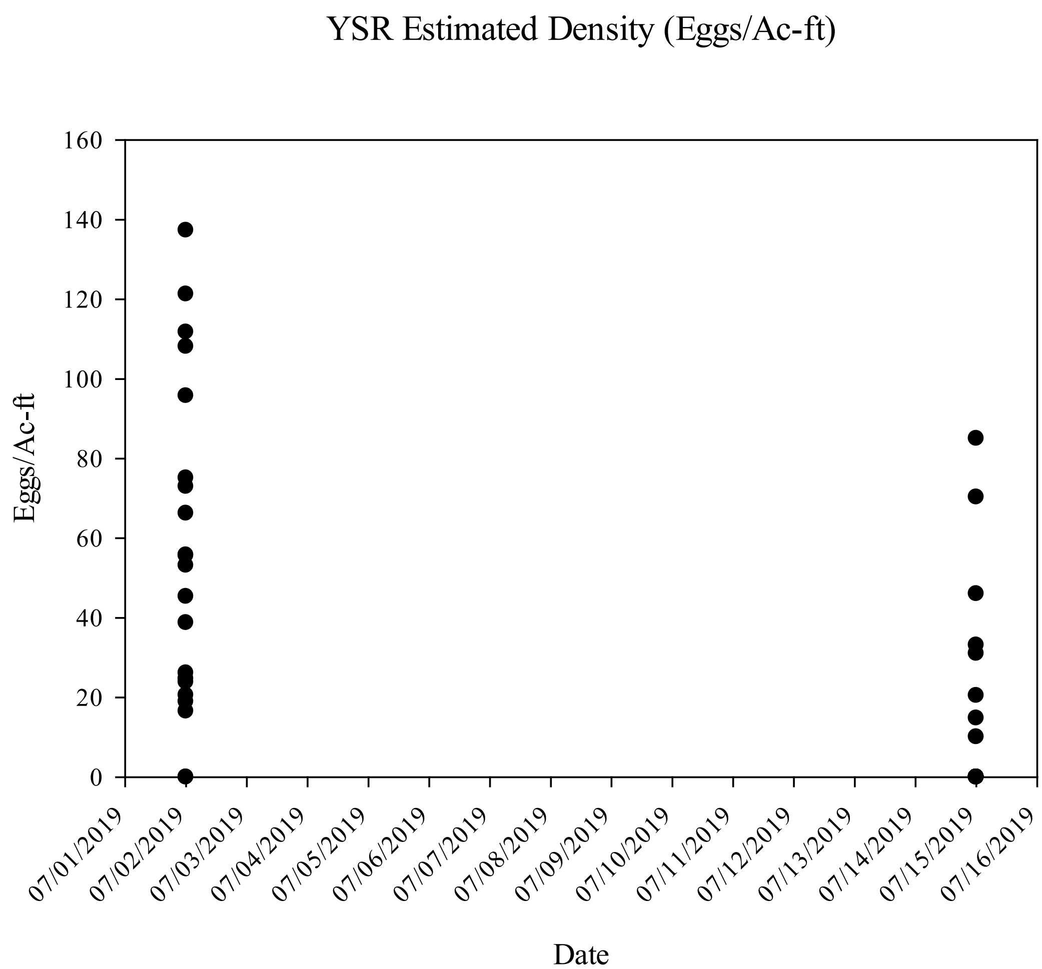

Figure 11. Estimated density of fish eggs per acre-foot of water during the 2019 sampling period in the Yellowstone River.

Estimated Larval/Egg Entrainment

Because the LYP provides water to so many users, a significant amount of water is dispersed through the Main Canal. The average daily water volume through the Main Canal was 2,395 AF per day during our survey dates. Though the fish screens prevent larger fish from being entrained into the canal, they do not prevent fish larvae or eggs from being entrained. The average rate of entrainment for fish larvae was 30.10 larvae/AF of water. The average rate of entrainment for eggs was 8.61 eggs/AF of water. By extrapolating the canal larvae and egg density over the volume of water entering the Main Canal, we estimate that on average, 71,489 larvae were entrained each day of the 2019 sampling season. For eggs, an estimated average of 20,539 were entrained each day (Figure 12 and Figure 13). However, due to high variability in fish and egg densities between samples, the accuracy and significance of extrapolated data should be read with caution. Estimates assume that dispersal of eggs and larvae are equal throughout the water column.

DNA Results

In 2019, two larvae and nine egg samples from the canal were identified as potential acipenseriformes and sent out to the Southern Illinois University-Carbondale Conservation Genomics Laboratory for further identification using DNA analysis. Six samples were either further identified as not *Acipenseridae* or unable to retrieve accurate DNA (Kashiwagi et al. 2020). The five remaining samples were determined to be sturgeon *Acipenseridae.* Three of these samples were collected in the River on 7/02/2019 in 21°C , one sample was collected in the canal on 7/03/2019 at a range between 20-22°C and one sample was collected in the canal on 7/09/2019 in 20°C and determined to be a shovelnose sturgeon. Due to difficulties in extracting DNA for SNP analysis, other samples were not delineated as Pallid or Shovelnose Sturgeon.

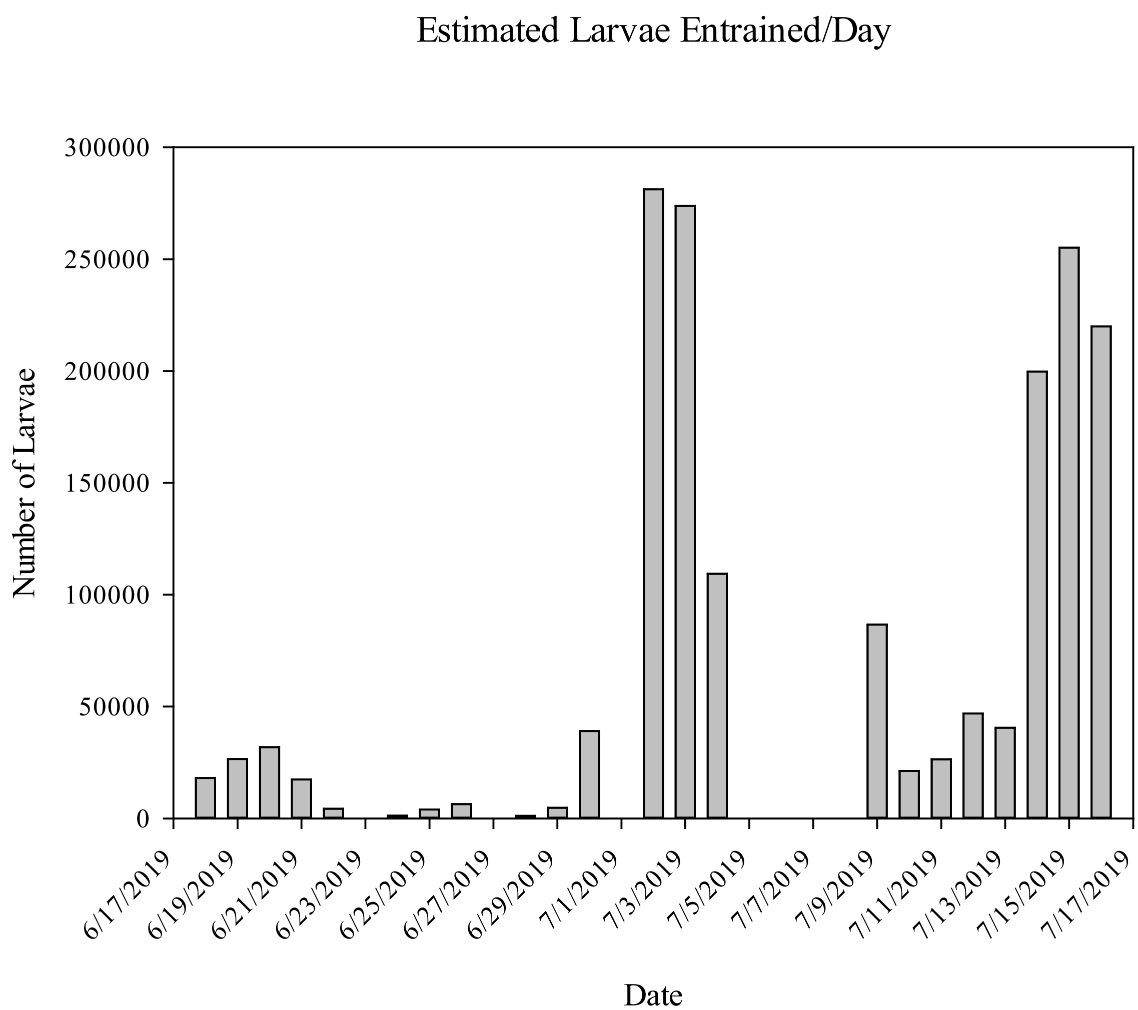

Figure 12. Total estimated entrainment of larval fish per day during the 2019 sampling periods in the Yellowstone River Main Canal.

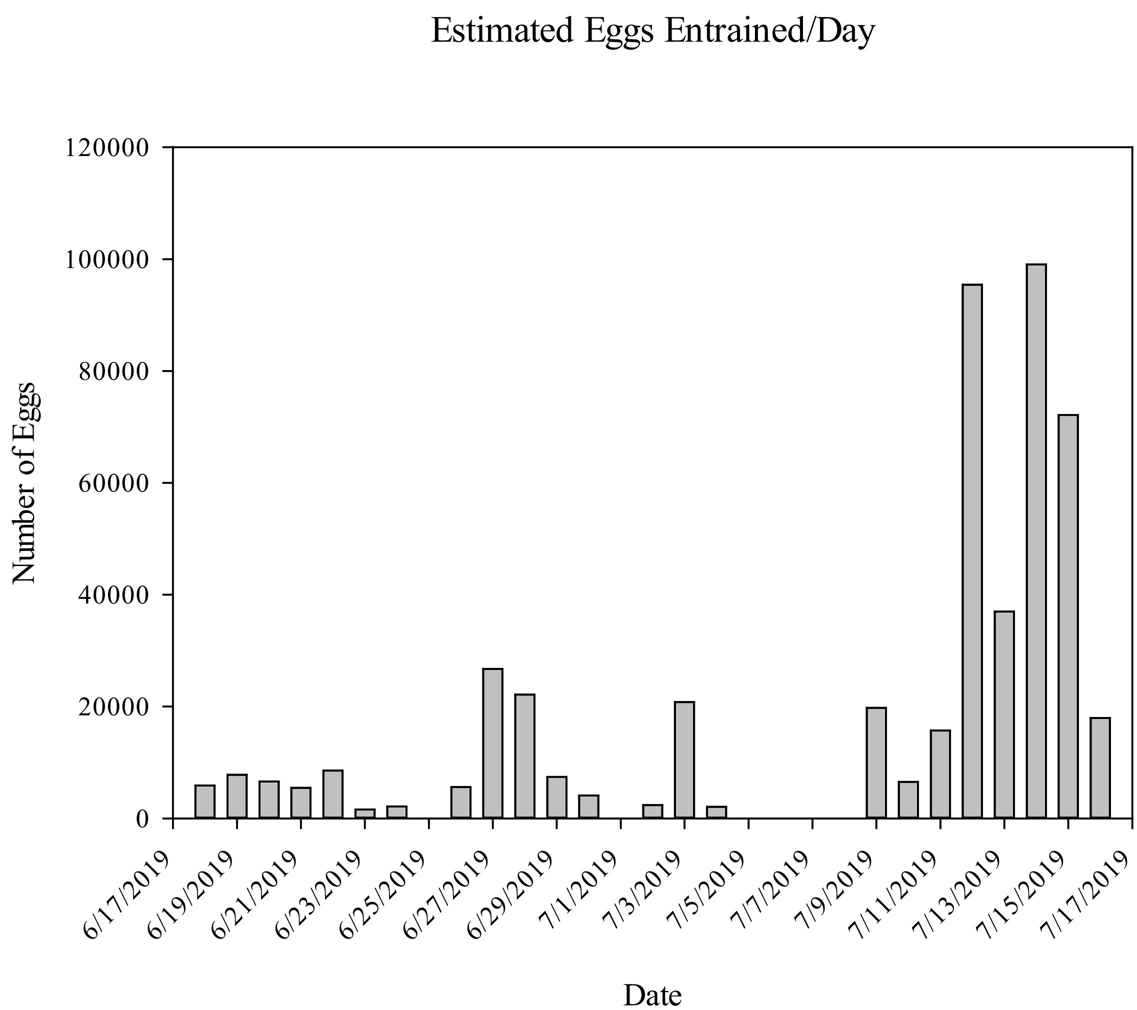

Figure 13. Total estimated entrainment of fish eggs per day during the 2019 sampling periods in the Yellowstone River Main Canal.

Discussion

Fish screens at the Main Canal have been in operation since 2013, large numbers of fish larvae and eggs are entrained into the canal each year. This is not unexpected as the screens were not designed to specifically exclude larval fish. Whether the intakes have a measurable impact on sturgeon or other native fish populations is still unknown. However, the screens should prevent adult sturgeon and larger juveniles from becoming entrained during spawning season and therefore lost to the system.

To date, no known Pallid Sturgeon larvae or eggs have been found in the canal nor in the in the Yellowstone River sampling during this project. This is not unexpected due the relative difficulty in sampling for larval pallid sturgeon (Braaten et al. 2008) as well as the low population abundance of Pallid Sturgeon throughout the Missouri and Yellowstone River basins (Jordan et al. 2016). However, the Yellowstone River remains an important river system for Pallid

Sturgeon recovery and possible recruitment (Jaeger et al. 2009 and Braaten et al. 2015). Therefore, further sampling and monitoring for Pallid Sturgeon larvae and eggs will continue in 2020.

A total of five *Acipenseridae* were confirmed as entrained within the canal in 2019. It is still unknown whether four of these five were Pallid Sturgeon or Shovelnose Sturgeon due to difficulties in preserving DNA. While it is known that paddlefish and sturgeon spawning migrations are impeded by Intake Dam, a resident population of shovelnose sturgeon remains upstream of Intake Dam. Further steps will be taken to preserve DNA samples to ensure analysis can be completed and increased sampling with in the mainstem river will continue for comparisons. These comparisons should help to determine the effectiveness of our sampling techniques for sturgeon species within the Intake Canal.

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