RECLAMATION

Managing Water in the West

ENV-2019-032

Lower Yellowstone Project Fish Entrainment 2014 - 15

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
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Mission Statements

The Department of the Interior conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Cover photo: Headworks of Intake Canal, Montana

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Technical Service Center
Fisheries and Wildlife Resources Group, 86-68290

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Acronyms and Abbreviations

ac-ft	acre-foot
cfs	cubic feet per second
cm	centimeter
ESA	Endangered Species Act
ft	foot/feet
l	liter
LYP	Lower Yellowstone Project
m	meter
m^3	cubic meter
mm	millimeter
n	sample size
N	population size
PVC	polyvinyl chloride
Reclamation	Bureau of Reclamation
rkm	river kilometer
SD	Standard Deviation
TL	total length
TSC	Technical Service Center
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
µm	micrometer

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Executive Summary

Researchers examined larval fish entrainment into the Lower Yellowstone Project Main Canal (Intake Canal), northeast of Glendive, Montana, during the 2014 - 2015 irrigation seasons.

As part of an overall retrofit of the Lower Yellowstone Project, the headworks structure for Intake Canal was replaced in 2012. The new headworks use rotating cylindrical fish screens which have a maximum mesh slot size of 1.75 millimeters (mm) and were designed to keep fish larger than 40 millimeters out of the canal. In fulfillment of the Biological Opinion provided by the U.S. Fish and Wildlife 2012 for the interim and future operations of the Lower Yellowstone Project, the Bureau of Reclamation's (Reclamation) Technical Service Center (TSC) was tasked with evaluating the entrainment rates of endangered fish into the Intake Canal with the new fish screens in place. The objective of the study is to monitor for and determine entrainment rates of the egg and larval life stages of Pallid Sturgeon (*Scaphirhynchus albus*) into Intake Canal.

Sampling began in late May in 2014, soon after the irrigation season started, and ended in late August 2014. In 2015, sampling efforts were focused on times when sturgeon larvae were likely to be drifting in the river and began in mid-June and ended in mid-July. Larval samples were collected using 30-centimeter, 500*u*m plankton trawl nets deployed 0.4-kilometers (¼ mile) downstream of the canal headworks to capture fish larvae and fish eggs. Two trawl nets were used in 2014 and four nets were used in 2015.

In 2014, a total of 324 samples were collected containing 15,535 larval fish and 515 eggs. The average entrainment rate was 0.68 larvae per cubic meter [m^3] (847 larvae per acre foot [ac-ft]) and 0.02 eggs/m^3 (28 eggs/ac-ft). In 2015, 316 samples were collected, containing a total of 6,060 larvae and 37 eggs. The average entrainment rate was 0.18 larvae/m^3 (219 larvae/ac-ft) and 0.001 eggs/m^3 (1.3 eggs/ac-ft).

Data from previous years suggests that over 90 percent of entrained larvae were protolarvae, the earliest developmental life stage. Protolarvae are unable to swim effectively and drift downstream within the water column, easily pass through fish screens, and entrained into the canal. Previous larval sampling in 2012 - 2013 suggests that the majority of larvae in Intake Canal are Cyprinids (minnows) and Catostomids (suckers). Peak larval entrainment typically occurs in late-June and early-July while fish egg entrainment is highest in June. In 2014 and 2015, no Acipenseridae larvae were collected.

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 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 Intake Canal (also termed the "Main Canal"). The diversion dam raises the upstream water elevation from two to five feet depending on river flows. The diversion dam is located approximately 70 river miles upstream from the confluence of the Yellowstone and Missouri Rivers (Figure 1) about 17 miles northeast of Glendive, Montana. The LYP includes the Lower Yellowstone Diversion Dam, canal headworks, Thomas Point Pumping Plant, Intake 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 Intake Canal to irrigate approximately 823 acres in the Intake Irrigation Project and 2,300 acres in the Savage Irrigation Unit. 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 (55 FR 36641-36647) under the 1973 Endangered Species Act (ESA). The original canal headworks, where water was diverted from the Yellowstone River into the Intake Canal did not include fish screens or a fish bypass structure. Fish entrainment monitoring by Hiebert et al. (2000) has indicated that thousands of fish of 36 different species were entrained annually into the canal.

Reclamation and the U.S. Army Corps of Engineers have made modifications to the LYP facilities and are continuing to evaluate proposed modifications to the low-head diversion dam. Modifications to reduce fish entrainment have included constructing a new headworks facility and installing fish screens on the upstream (Yellowstone River) side of the intake conduits. The second component of the retrofit to the LYP is a proposed modification to the low-head diversion dam to allow fish passage.

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

Fish Screens

The purpose of the headworks replacement was to correct the unscreened condition of the previous headworks structure to protect Pallid Sturgeon and other native fish in the lower Yellowstone River by reducing or eliminating incidental fish entrainment. The new headworks has 12 rotating cylindrical screens (ISI T78-100 Tee Fish Screens) that are track mounted and located on the river-side of the inlet conduits. The top of the headworks is approximately 1.5 m (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).

Eleven of the intake conduits are used to fulfill the LYP full water right of 1,374 cfs with one additional inlet conduit and screen as a back-up. Each screen measures approximately 2 m (6.5 feet) in diameter and 7.6 m (25 feet) in total length. The screens have a maximum mesh slot size of 1.75 mm and were 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 screen and are automated to intermittently rotate and clean both sides of the screen.

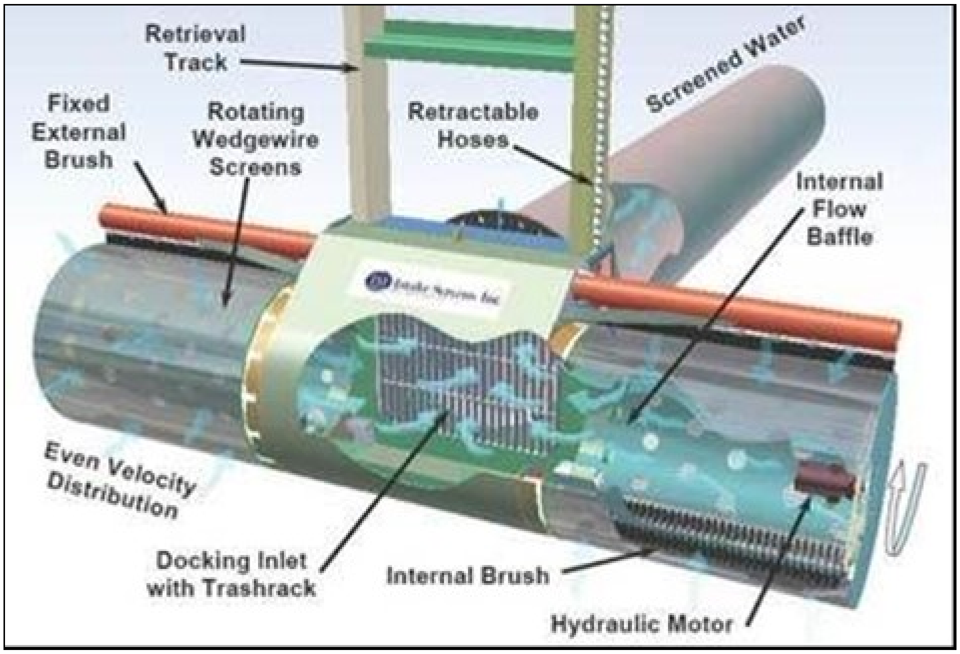

Figure 2. New Intake Canal fish screens from Intake Screens, Inc. showing ISI T78-100 Tee Screen (diagram from Intake Screens, Inc.).

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 (U.S. Fish and Wildlife Service [USFWS] 2007), the fish screens were designed to meet salmonid screening criteria established by the USFWS and the National Marine Fisheries Service (Reclamation 2014).

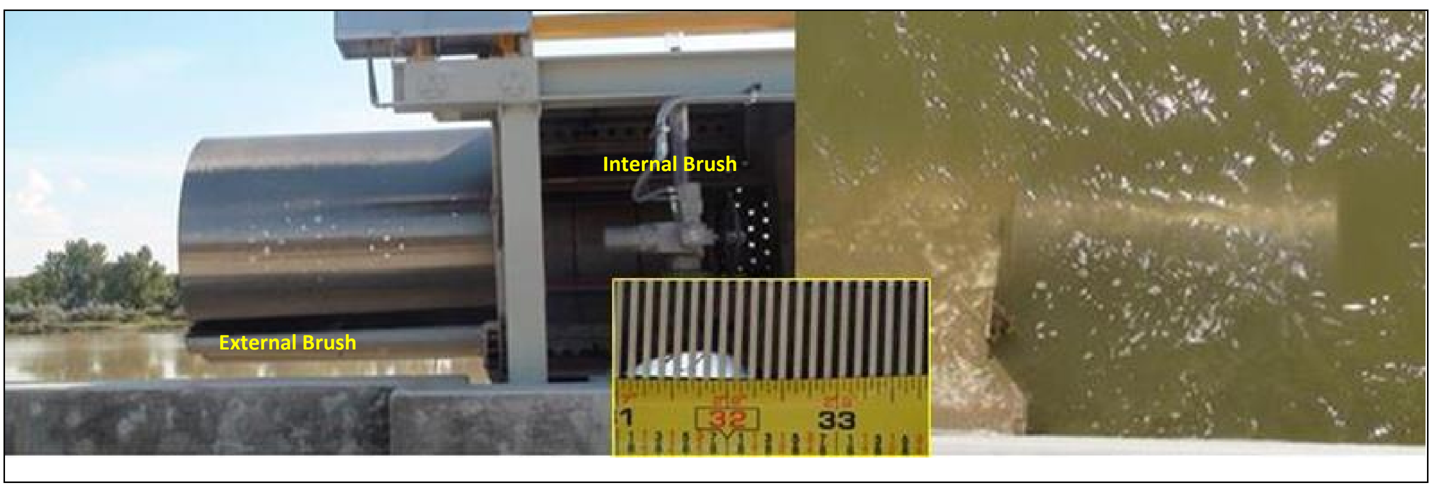

Figure 3. Photo of Raised ISI T78-100 Tee Screen (left) and submerged position (right) with inset photo showing 1.75-mm slots of wedge wire screen.

Fish in the Lower Yellowstone River

The Yellowstone River is the longest free-flowing river in the contiguous United States. The Yellowstone River flows from its headwaters in the Absaroka Range into Yellowstone Lake where the main stem 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). Because the mainstem is not impounded, the river retains a near natural hydrograph fed by large flows of mountain snow-melt 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, 802 - 993 river kilometers (rkm) is the salmonid zone, the middle portion (477 - 801-rkm) is the transition zone and the lower portion (0 - 476-rkm) 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 and the average annual discharge is about 9.3 million ac-ft (White and Bramblett 1993).

A total of 56 fish species representing 16 families are found in the main stem Yellowstone and 20 species are not native to the river. 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 and representing 15 families. Additionally, Brook Stickleback (*Culaea inconstans*), Cisco (*Coregonus artedi*), Sicklefin Chub (*Macrhybopsis meeki*) and Spottail Shiner (*Notropis hudsonius*) have been documented in the lower Yellowstone River (White and Bramblett 1993, Hiebert et al. 2000, Montana Fish, Wildlife and Parks 2003) (Table 1).

The young larvae and eggs of most fish species found in the lower Yellowstone River are present as drift, meaning that they cannot swim effectively under their own power and instead, drift with the current (Moser and Watson 2006). Larval Pallid and Shovelnose Sturgeon were found to drift from 94 to 530 rkm (58.4 to 329.3 river miles) in the Missouri River, depending on water velocities (Braaten et al. 2008). They are susceptible to altered river flows and water withdrawals. 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 and Schiller 2004). 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 ichthyoplankton, (e.g., Pallid Sturgeon) also increase the potential for entrainment. **Error! Reference source not found.** lists fish species found near the Intake Division.

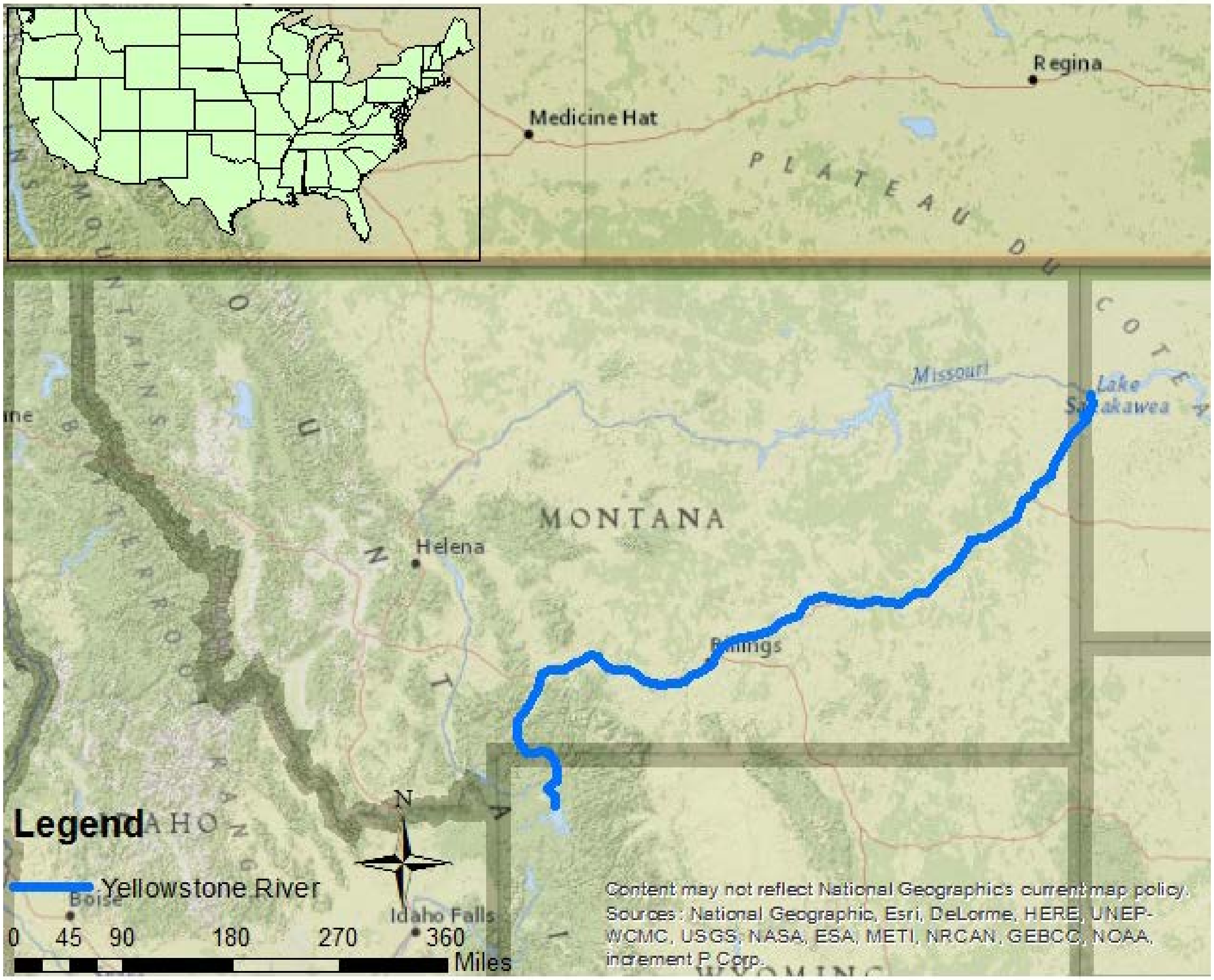

Figure 4. Map of Yellowstone River from Yellowstone Lake in Montana to Lake Sakakawea in North Dakota.

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

Common Name		
Pallid Sturgeon	*Scaphirhynchus albus*	Y
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Y
Paddlefish	*Polydon spathula*	Y
Goldeye	*Hiodon alosoides*	Y
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
River Caprsucker	*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
Bullheads and Catfishes	**Ictaluridae**	
Black Bullhead	*Ameiurus melas*	N
Yellow Bullhead	*Ameiurus natalis*	N
Channel Catfish	*Ictalurus punctatus*	Y
Stonecat	*Noturus flavus*	Y
Northern Pike	*Esox lucius*	N
Cisco	*Coregonus artedi*	N
Rainbow Trout	*Oncorhynchus mykiss*	N
Mountain Whitefish	*Prosopium williamsoni*	Y
Brown Trout	*Salmo trutta*	N
Burbot	*Lota lota*	Y
Plains Killifish	*Fundulus zebrinus*	N
Brook Stickleback	*Culaea inconstans*	Y
Rock Bass	*Ambloplites rupestris*	N
Green Sunfish	*Lepomis cyanellus*	N
Pumkinseed	*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
Yellow Perch	*Perca flavescens*	N
Sauger	*Sander canadensis*	Y
Walleye	*Sander vitreus*	N
Drums and Croakers	**Sciaenidae**	
Freshwater Drum	*Aplodintus grunniens*	Y

Methods

Larval Sampling

To evaluate larval fish entrainment into the Intake Canal, we sampled downstream from the fish screens using plankton trawl nets. In 2014, sampling started in late May and ended in late August, covering most of the irrigation season and the descending hydrograph limb (Figure 5). In 2015, sampling started in mid-June and ended in mid-July, to focus efforts on the time when sturgeon larvae were likely to be drifting (Backes 2012 Personal Communication) (Figure 6).
In 2014, sampling was conducted every other week for 48 hours each time. In 2015, sampling was limited to mornings, days, and evenings.

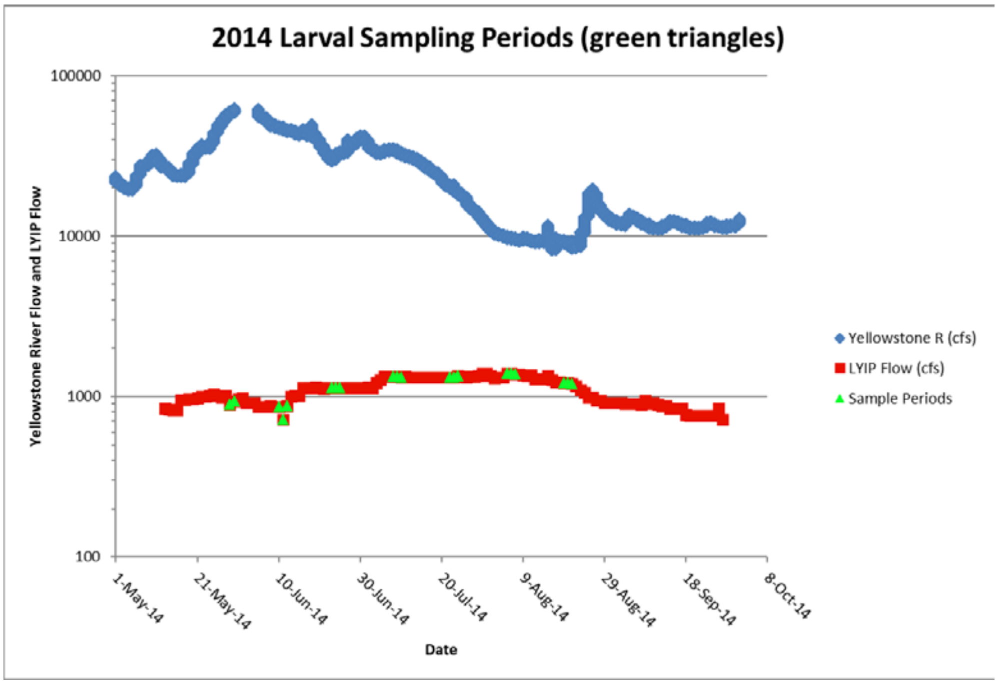

Figure 5. Larval sampling periods (green triangles) during the 2014 LYP irrigation season and flow in the Yellowstone River (USGS gage 06327500 near Glendive, Montana).

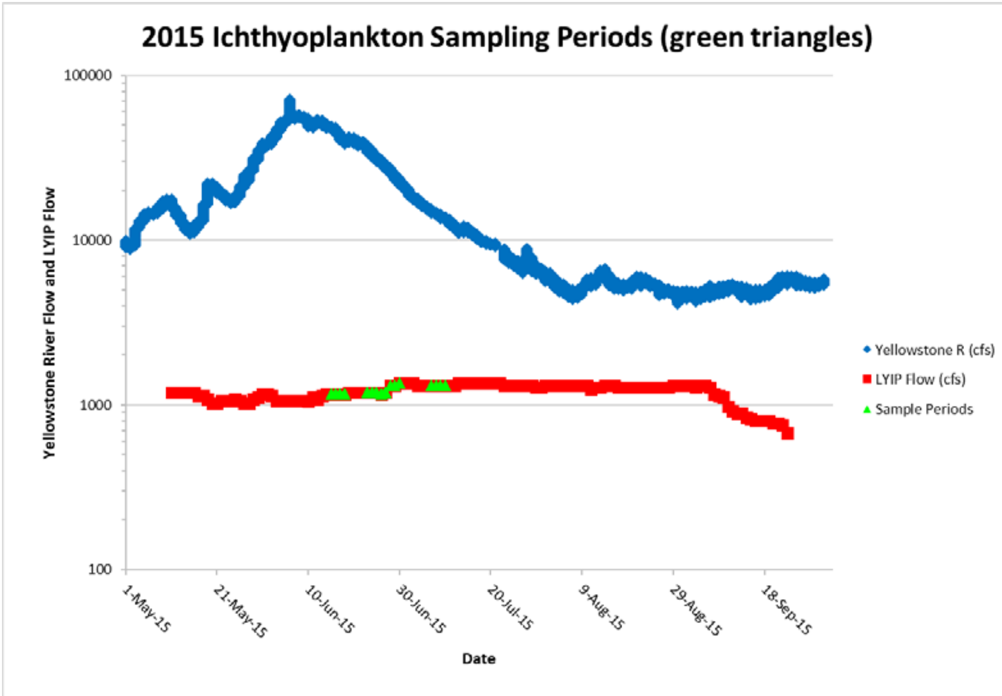

Figure 6. Larval sampling periods (green triangles) during the 2015 LYP irrigation season and flow in the Yellowstone River (U.S. Geological Survey [USGS] gage 06327500 near Glendive, Montana).

In 2014, two 30 cm by 7 m 500 micrometer (µm) plankton trawl nets were deployed simultaneously from the Intake Dam fishing and camping access bridge about 0.4 kilometers [km] (¼ mile) downstream from the headworks (Figure 7). The distance from the headworks to the bridge was thought to be enough to allow for sufficient mixing of all of the 12 inlet conduits (see Figure 1). Therefore, the samples should be representative of the entire diversion. The nets were deployed for 30 minutes every two hours, depending on debris loads. In 2015, the number of plankton nets was increased from two to four. For each pair of nets, one net was designed to collect at the water's surface and the other near the bottom of the water column. Both nets were deployed in the center of the canal. To estimate the volume of water filtered by the net, a General Oceanics mechanical flowmeter was attached to one side of the net's collar using stranded steel cable wire (Figure 7A). 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 7. (A) (eft). Photo of ichthyoplankton 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.

All samples retrieved from the nets were placed into 0.950 liter (l) plastic container. In 2014, the samples were preserved in 10 percent formalin with diluted Rose Bengal used to stain the ichthyoplankton for easy visibility. In 2015, the samples were preserved in 95 percent ethanol so that if sturgeon larvae were captured and further laboratory analysis were necessary, samples could be identified using DNA testing. 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.

In the lab, the samples were poured into a number 40 sieve (0.42 mm [0.0165 inch]) and thoroughly rinsed with tap water and then placed onto one side of a deep-dish plastic container (Figure 8A). The sample was then carefully spread out into smaller portions and the ichthyoplankton separated from the detritus, similar to Wanner et al. 2011 (Figure 8B). Larval fish and eggs were placed into a scintillation vial filled with formalin or 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 (i.e., density larvae/m^3 and density 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 using our rate of entrainment and 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 that we sampled.

Figure 8. (A) (top). Separating ichthyoplankton in the laboratory using a Nalgene unitary plastic dropper. (B) (bottom). Photo of Ichthyoplankton (stained red) visible from detritus.

Entrainment Net Sampling

Entrainment nets were used to evaluate entrainment of larger juvenile and adult fishes through the Intake Canal inlets with and without fish screens in place. The entrainment effort intended to evaluate Yellowstone River fish small enough to pass through the fish screen. Three intake inlets, thought to be representative of the diversion, were selected for sampling. Of the 12 Intake inlets, inlet numbers 2, 7 and 11 were sampled on 18 dates between May 29 and August 20, 2014.

The entrainment nets were designed to cover the outlet pipe and were 1.22 m (4 feet) wide and 1.83 m (6 feet) high and 10 m (32 feet) long. Nets were constructed from square heavy black delta mesh ($^{1}/_{8}$ inch), with a cod end consisting of a 6 in diameter removable polyvinyl chloride (PVC) bucket. Nets were attached to an aluminum frame connected to guide cables strung from a framework mounted to the concrete railing on the intake deck. Nets were raised and lowered from the top of the diversion dam using a steel cable attached to a manual winch (Figure 9). Due to flow rates and large numbers of fish living in the afterbay, aluminum guide frames were added to the culverts to help hold the nets in place and limit the number of fish entering the net from the surrounding water. During deployment, one operator lowered the net, and another person stood on the culvert and helped guide the net into position. The net deployment process took approximately 5 minutes per net, and nets were deployed sequentially. Nets were fished for approximately one hour each time. Species, total length, and body condition were recorded for the fish captured. If a large number of fish were captured, only 20-30 for each species were measured and the rest were simply counted. Comparisons with and without screens could only be done during low water in late July and August due to operational concerns at the facility. Having the screen raised while the intake was open imparts some risk to the facility, as should a large piece of debris become lodged in the intake there would be no way to shut off the flow to the canal.

Figure 9. (A) (right) Photo of steel frame structure used to extend the entrainment net frame out about 2.5 meters to line up over the outlet area of the box culvert. (B) (left) Photo of net.

Results and Discussion

Larval Entrainment

In 2014, a total of 324 samples were collected in 20 days of sampling over a 75-day period. The average sample collection time was 30 minutes, with the exception of the 2 dates in May when sampling efforts were shortened to 15 minutes because of debris loads. Debris loads are typically higher with higher river flows and with rain events. In May 2014, the Yellowstone River was flowing between 55,000 - 62,400 cfs, and the river was on the ascending hydrograph limb (see Figure 5). Sampling encompassed most of the spring and summer when fish in the Yellowstone River are spawning. In 2014, 15,612 larvae and 523 eggs were caught. The average entrainment rate was 0.69 larvae/m^3 (847 larvae/ac-ft) and 0.02 eggs/m^3 (28 eggs/ac-ft) (Figure 10 through Figure 13).

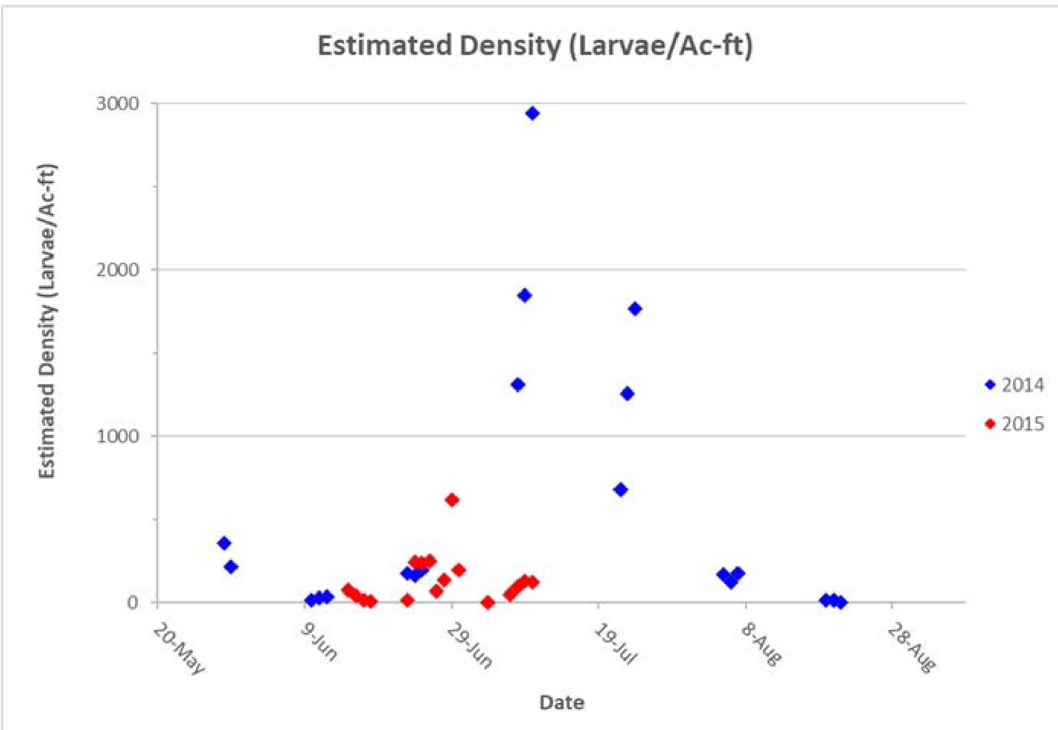

Figure 10. Estimated density of larval fish entrained per acre-foot of canal water during the 2014 and 2015 sampling periods.

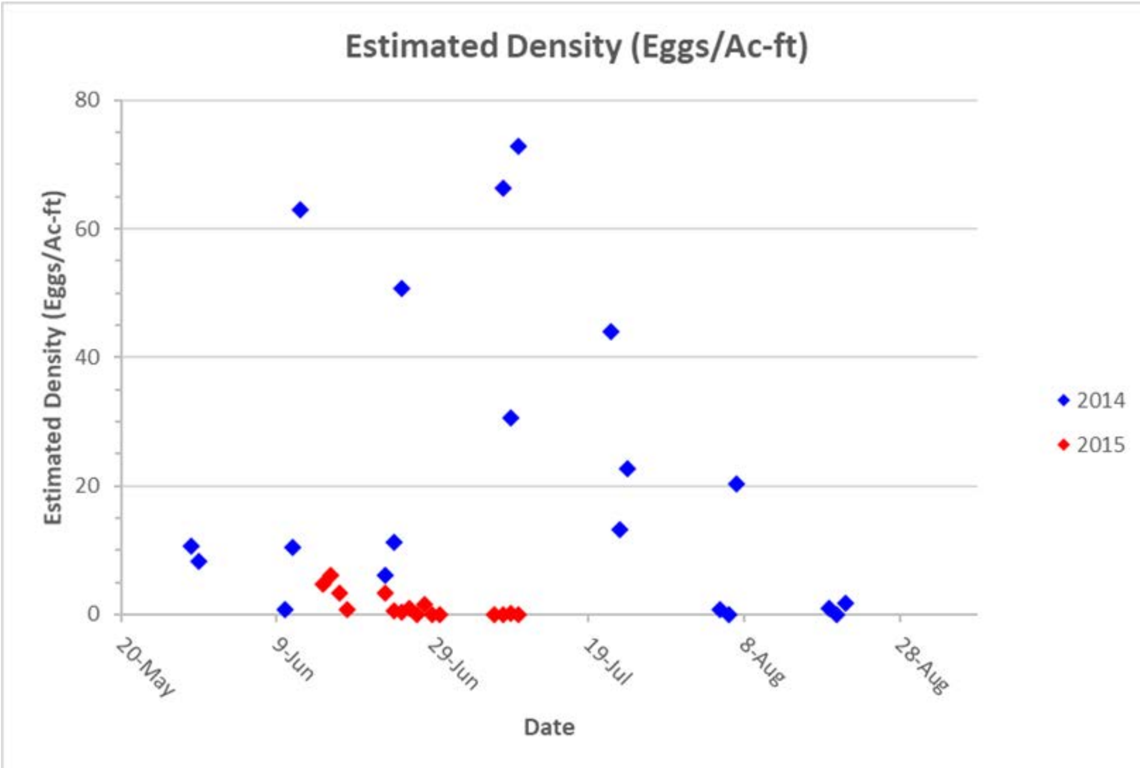

Figure 11. Estimated density of fish eggs entrained per acre-foot of canal water during the 2014 and 2015 sampling periods.

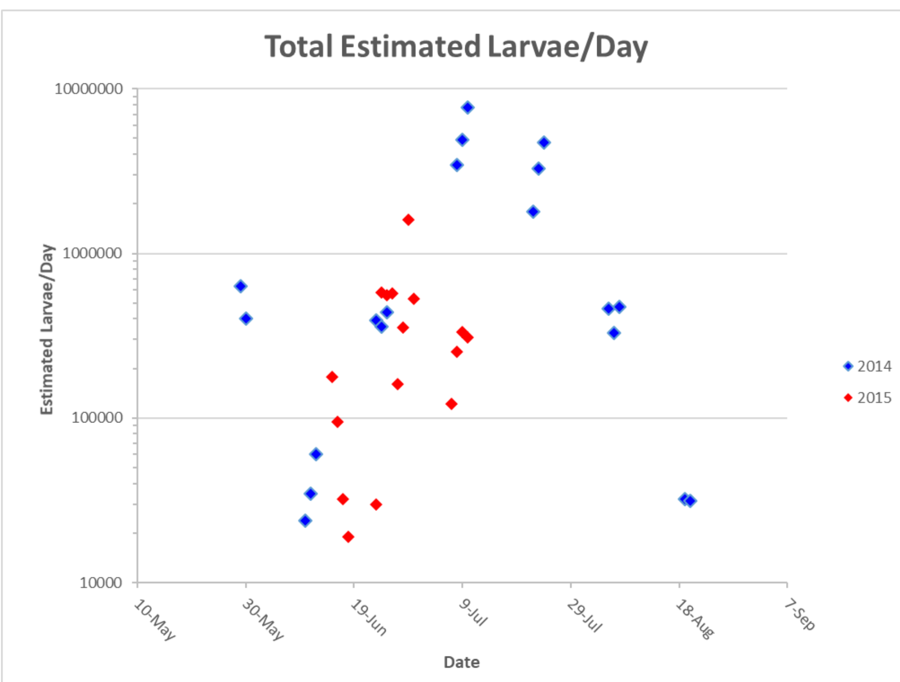

Figure 12. Total estimated entrainment of larval fish per day during the 2014 and 2015 sampling periods.

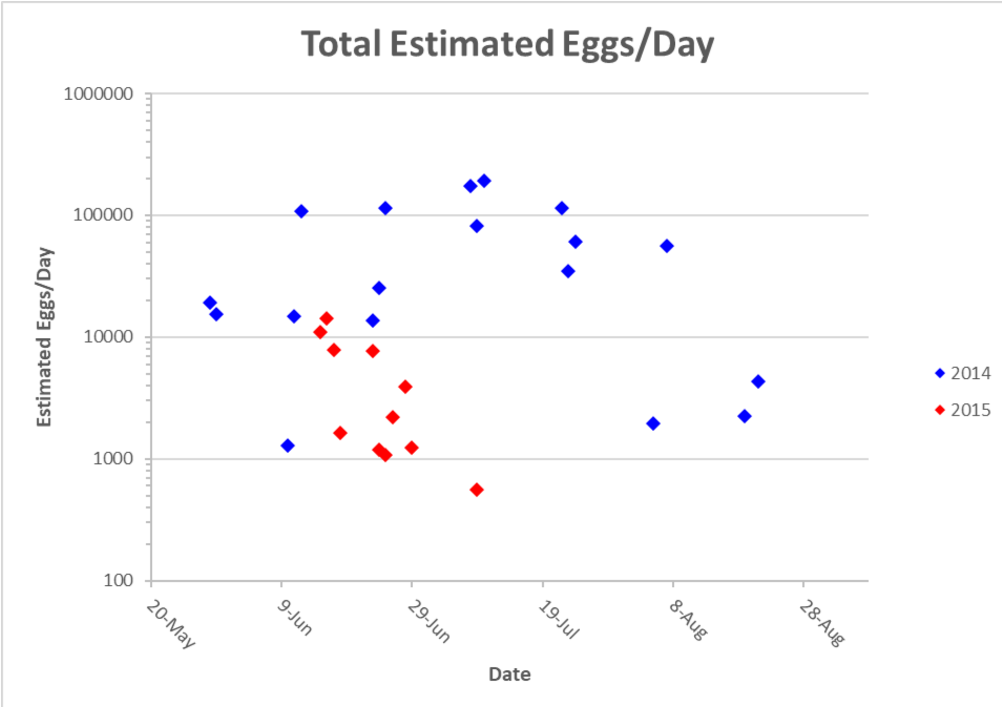

Figure 13. Total estimated entrainment of fish eggs per day during the 2014 and 2015 sampling periods.

In 2014, the sampling season extended over a longer period than 2015 and with the exception of a pulse of larvae the first sampling event, a generally bell shape curve existed where larval densities were low early in the season, peaked near the beginning of July and then tailed off into August.

In 2015, larval sampling shows an increase across the sampling period; however, sampling only went through mid-July. In 2015, 300 samples were collected in 16 days of sampling over a 30-day period from mid-June through mid-July. The average sample collection time was 45 minutes. Over the entire sampling effort, 6,056 larvae and 37 eggs were caught. In 2015, our sampling efforts were more closely timed to occur with the period we would expect that larval sturgeon might be present in the Yellowstone River. It was assumed by mid-July that spawning and potential hatching of sturgeon eggs was complete.

Sampling in the Intake Canal did indicate we captured more larvae with surface tows in the canal than with tows near the canal bottom. For both 2014 and 2015, using a Wilcoxon Signed Rank Test on the paired daily averages, significantly more larvae were captured in surface waters than deep in the canal. For 2014, the median values were 0.0487 larvae/m^3 near the bottom and 0.226 larvae/m^3 in surface waters ($p < 0.001$). For 2015, the median value for deep samples was 0.056 larvae/m^3 and 0.101 larvae/m^3 for shallow samples ($p = 0.025$). Vertical movement within the water column of drifting fishes is not uncommon (Pavlov et al. 1978, Oesmann 2003, and Lechner et al. 2016). We have not done similar vertical sampling within the Yellowstone as nets were bottom-oriented to focus on Pallid Sturgeon larvae (Braaten et al. 2008). We did not do any sampling at night to look at diel differences as indications are time of day is not as important when sampling larval sturgeon—the focus of our study.

Entrainment Sampling

Sampling using the large entrainment nets on the culvert outlets occurred May 29 - 30, June 10 - 12, 23 - 24, July 8 - 10, 22 - 24, and August 5 - 7 and 19 -20, 2014. Sampling with screens raised occurred during the last sampling week of July and during both weeks in August. A total of 2,072 fish were collected from 199 samples. Of the 199 samples, 24 were collected with the screens raised netting 1,398 fish, and 175 with screens down, netting 674 fish (Table 2). Thirty-four of the 175 sets with screens down contained no fish, or only eggs and larvae. Approximately 2,000 unidentified larval fish and eggs were captured during netting operations, however, they were not included in the final analysis as they were typically associated with, and trapped by debris in the nets, as most were more than small enough to simply pass through the mesh material.

Flathead chub, Longnose dace and Sturgeon Chub were captured in significant numbers—regardless of whether screens were raised or lowered. A large part of this was due to the presence of large numbers of each of these species living in the afterbay of the diversion. These fish probably entered at some point as larvae and have survived and matured in the canal. Visual observations from prior years, as well as during 2014 using underwater cameras and surface observations, show numbers of each of these species milling around the culvert outlets, likely feeding on debris and larvae as they come out of the culverts. Observations indicate a lot of these fish dart in and out of the culverts and only become trapped when the entrainment net is lowered over the culvert outlet and they are flushed into it.

Year-to-year variations of fish population in the Yellowstone River, which might be linked to runoff, water temperatures and a suite of other environmental variables, likely dictate differences in entrainment of larger fishes we saw from 2013 to 2014. Large numbers of juvenile and adult Emerald shiner were entrained in 2013, but in 2014 they were almost nonexistent. Almost no YOY channel cats were captured in 2013, but over 400 were in 2014—again, indicating significant year-to-year variation in fish populations of the Yellowstone River.

Table 2. Numbers of Fish Captured in Culvert Entrainment Nets with Screens in Place and with Screens Raised.

Screen Down	Number	Avg/Sample	Screen Raised	Number	Avg/Sample
Bigmouth buffalo	1	0.006	Bigmouth buffalo	11	0.46
Bluegill	1	0.006	Brook stickleback	1	0.04
Channel catfish	19	0.109	Channel catfish	415	17.29
Common carp	1	0.006	Common carp	101	4.21
Creek chub	2	0.011	Creek chub	11	0.46
Flathead chub	107	0.611	Emerald shiner	8	0.33
Goldeye	2	0.011	Flathead chub	419	17.46
Green Sunfish	1	0.006	Freshwater Drum	1	0.04
Longnose dace	214	1.223	Goldeye	15	0.63
River carpsucker	1	0.006	Lake chub	1	0.04
Sauger	1	0.006	Largemouth bass	15	0.63
Shorthead redhorse	10	0.057	Longnose dace	203	8.46
Stonecat	40	0.229	Longnose sucker	3	0.13
Sturgeon chub	269	1.537	River carpsucker	3	0.13
Unidentified	1	0.006	Sand shiner	4	0.17
Western Silvery minnow	1	0.006	Sauger	4	0.17
White crappie	1	0.006	Shorthead redhorse	5	0.21
White sucker	2	0.011	Stonecat	14	0.58
			Sturgeon chub	131	5.46
Total	674		Unidentified	7	0.29
			Walleye	1	0.04
			Western Silvery Minnow	1	0.04
			White crappie	21	0.88
			White sucker	3	0.13
			Total	1398	

DNA Results

In 2014 and 2015, no larvae were found that morphologically appeared to be Acipenserids. Consequently, no samples were sent out for DNA analysis.

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