2018 Upper Mississippi River Asian Carps Egg and Larval Fish Monitoring Program

Geographic Location: Upper Mississippi River, Pools 8-13, La Crosse, Wisconsin to Clinton, Iowa

Participating Agencies: U.S. Fish and Wildlife Service, La Crosse Fish and Wildlife Conservation Office, Project Lead: Mark Fritts

Statement of Need:

Ichthyoplankton monitoring for the eggs and larva of Asian carps (Bighead Carp, Silver Carp, Grass Carp and Black Carp) in the Upper Mississippi River (UMR) is important for timely detection of new spawning events in novel habitats. Researchers have expressed concern that the arrival of Asian carps in the UMR watershed will have cascading effects on local aquatic ecosystems. However, it appears that the success of Asian carps' spawning events may be highly contingent on environmental factors such as sustained, high river discharge during late spring and early summer (Kolar et al 2007; Camacho *et al.* 2016). Understanding why production and recruitment may be limited in some years and in some locations may help managers to recognize bottlenecks in the life history of Asian carps caused by environmental variations and spur the development of new and effective management strategies for limiting their reproduction in unexploited habitats.

Project Objectives:

1) Evaluate Asian carp reproduction (egg, larval, and juvenile densities) in the UMR watershed. The goal of this USFWS-managed program is to establish a monitoring framework on Pools 8-13 of the Mississippi River and its largest tributaries: the Maquoketa, Turkey, and Wisconsin rivers. Researchers at Iowa State University (ISU) maintain a companion monitoring program to accomplish these objectives on Pools 14-20 of the Mississippi River and its tributaries: the Wapsipinicon, Rock, Iowa, Skunk, and Des Moines rivers.
2) Monitor larval fish and egg production of native fishes occurring in the watershed. Yearly monitoring of larval fish and egg drift in the UMR and its tributaries offers opportunities to explore the reproductive habits of fishes aside from Asian carps. These data can help establish a baseline, pre-invasion estimate of native fish production/recruitment in rivers where Asian carps have not yet established robust reproductive populations.

Project Highlights:

- Identification of all fishes collected in April-August 2017 samples was completed in Summer/Fall 2018. No Silver, Bighead, Grass, or Black carps were observed in 306 samples.
- An additional 161 ichthyoplankton tows were collected during May-August 2018. Sampling was restricted to UMR pools 10, 12, and 13 and the Wisconsin and Maquoketa Rivers because of staff shortages.

Methods

Monitoring for Asian carp eggs and larvae using ichthyoplankton tows was conducted at 28 fixed-locations (Figure 1) approximately every 7-10 days from April until August 2017 and May until August 2018. For the purposes of standardization, every effort was made to sample closest to the original sampling location throughout the summer. Sampling locations were adjusted at some sites to prevent fouling of the plankton net if masses of emergent vegetation were present. Ichthyoplankton tows using a 0.5 m diameter net with 500 µm mesh were conducted at the surface at a constant boat speed relative to the shoreline for four minutes at each location. A General Oceanics Model (2030R) flowmeter was mounted in the mouth of the net to estimate volume (m^3) of water filtered during each tow. The sites were arranged in groups of 2-3 tows to document habitat-specific variations in catch rates. Three tows were conducted at each mainstem Mississippi River sites parallel to river flow. The first tow was conducted in the main thalweg for drifting eggs and larvae, the second tow was completed near channel borders where downstream water velocity was slower than the thalweg, and the third tow sampled an adjacent backwater area for mobile larvae (>24 hours post fertilization). At each tributary location, one fixed sampling location was established inside the tributary ~1km upstream of the confluence with the Mississippi River and another location was established along the main channel border of the Mississippi River ~1km downstream of the tributary's confluence. After each tow, ichthyoplankton net contents were rinsed toward the cod end, placed in sample jars, and preserved in 95% non-denatured ethanol. The ethanol was replaced in each sample container after the first 24 hours of storage to further preserve samples for later genetic analyses (Kelso et al. 2012).

In the laboratory, eggs and larvae were separated from detritus, counted, and preserved for morphometric and, if necessary, genetic identification. Eggs were not identified but rather sorted into two size classes (<5 mm or ≥5 mm diameter) to determine those that were 'possible' Asian carps (≥5 mm). All larval fishes were identified to the lowest taxonomic level using Auer (1982) and Holland-Bartels et al. (1990) as the primary taxonomic keys. Family and genus level identifications occurred due to damaged individuals or the absence of practical ways of differentiating morphological similarities to the species or genus level. Fish recognized as having a full complement of fins were categorized as juvenile fish. A minimum of 10% of processed samples underwent independent quality control (QC) procedures to validate the morphometric identifications.[RA1][FMW2] All fishes identified as 'possible' Asian carps using keys provided by Chapman (2006) and Chapman and George (2011) were immediately submitted to the Whitney Genetics Lab for genetic confirmation of species assignment. The developmental stage (yolk-sac, larval, or juvenile) and key characteristics (length, number of myomeres, and pigmentation pattern, among others) of all fishes were documented.

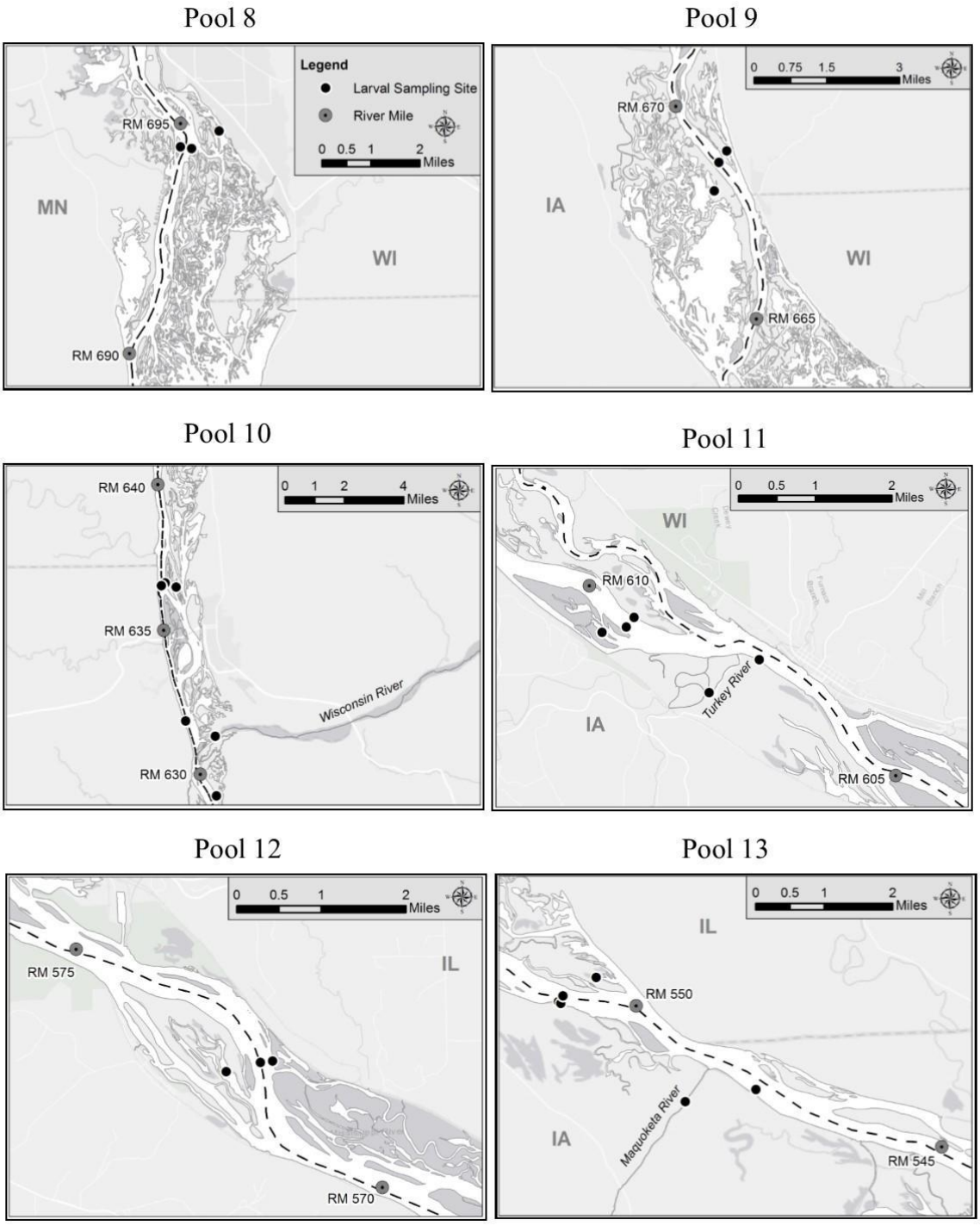

Figure 1. Map of ichthyoplankton netting locations in Navigational Pools 8-13 of the Upper Mississippi River monitored during 2017. Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community.

Results and Discussion:

2017 Results

We collected 12,076 larval and juvenile fish in 306 ichthyoplankton tows conducted between 20 April and 25 August 2017. Laboratory processing of samples was completed via contractual agreement with LimnoTech, Inc. (Ann Arbor, MI). Ichthyoplankton identification specialists with LimnoTech used visual identification methods, supported by genetic confirmation where necessary, of larval and juvenile fishes to complete 2017 sample processing during Summer/Fall 2018. No Bighead, Silver, Grass, or Black carps were idenitified in the samples. Table 1 provides information on the total catch identified to family. A monthly breakdown of catch statistics is provided in Table 2. The relative abundance of eggs peaked in June. The relative abundance of larval and juvenile fishes peaked in mid-June and early July.

[RA3]

Table 1. Total catch of fishes from ichthyoplankton monitoring in four tributaries and Pools 8-13 of the Upper Mississippi River during 2017. Specimens were identified to family.

Family	Number Identified
Atherinopsidae	14
Catostomidae	327
Centrarchidae	4,252
Clupeidae	1,567
Cyprinidae*	5,088
Hiodontidae	2
Lepisosteidae	1
Moronidae	9
Percidae	506
Sciaenidae	286
Unknown	24

*Family Cyprinidae did not include any Bighead, Silver, Grass, and Black carps

[RA4]

Table 2. Total catch of larval and juvenile fishes from ichthyoplankton monitoring in six pools of the Upper Mississippi River and four tributaries during 2017.

[FMW5]

Mississippi River Pools		Fishes
Pool 8 Totals		2,443
	April	40
	May	12
	June	2,158
	July	224
	August	9
Pool 9 Totals		1,888
	April	41
	May	11
	June	1,679
	July	145
	August	12
Pool 10 and Wisconsin River Confluence Totals		1,032
	April	44
	May	68
	June	457
	July	376
	August	87
Pool 11 and Turkey River Confluence Totals		592
	April	0
	May	59
	June	331
	July	152
	August	50
Pool 12 Totals		1,530
	April	19
	May	68
	June	645
	July	574
	August	224
Pool 13 and Maquoketa River Confluence Totals		4,806
	April	33
	May	133
	June	1,784
	July	2,210
	August	646

2018 Results

We collected 161 ichthyoplankton tows between 16 May and 21 August 2018. All samples were collected during daylight hours between 7.47 a.m. and 5.14 p.m. All sampling was conducted

without incident and the samples collected are currently being processed by LimnoTech, Inc. These data will be summarized and analyzed in the 2019 annual report. Specific questions or requests for 2017-18 data can be directed to Mark Fritts (mark_fritts@fws.gov).

Recommendation:

While the results of our initial survey indicate that Asian carps did not reproduce in Pools 8-13 of the UMR during 2016 and 2017, we believe that future surveys may be necessary given the evidence of sporadic production and recruitment documented in Silver and Bighead carp from the Illinois River (Gibson-Reinemer et al. 2017). That study indicates that Asian carps' recruitment is closely tied to early summer flooding events and that production and recruitment are rarely observed in years when these specific hydrologic conditions are unavailable. We recommend that ichthyoplankton monitoring be conducted in the UMR for, at least, five additional years to incorporate sampling within a spectrum of hydrologic conditions.

We also recommend that these data on Asian carp production be incorporated into more complex, watershed-scale analyses of Asian carp population dynamics and movement patterns (Rahel and Jackson 2007). If Asian carp eggs or larvae are detected, specialized spacial analyses could help regional managers more precisely determine the times and locations of Asian carp spawning events and the destinations of drifting eggs and larvae (e.g. Hightower et al. 2012 and Garcia et al. 2013). This information, in turn, could be used to direct novel control strategies that target adult Asian carp and limit successful spawning events or early life-stages survival.

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