ICHTYOPLANKTON MONITORING FOR EVIDENCE OF ASIAN CARP REPRODUCTION IN POOLS 8-13 OF THE UPPER MISSISSIPPI RIVER

Geographic Location: Upper Mississippi River, Pools 8-13, La Crosse, Wisconsin to Clinton, Iowa
Lead Agency: USFWS- La Crosse Fish and Wildlife Conservation Office

Participating Agencies:
University of Wisconsin- La Crosse
Iowa State University
USGS – Upper Midwest Environmental Services Center
Western Illinois University

Statement of Need:
Ichthyoplankton monitoring for the eggs and larva of Asian carps 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:

- All fishes collected during 2016 sampling were identified during Winter/Spring 2017. No Silver, Bighead, Grass, or Black carps were observed in 240 samples.
- 319 samples were sucessfully collected from the UMR during April-August 2017. These

samples are currently being examined by staff of the La Crosse FWCO and fishes and eggs will be identified as soon as possible.

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. For the purposes of standardization, every effort was made to sample closest to the original sampling location throughout the summer. Sampling locations had to be relocated in some situations because of the growth of emergent vegetation that fouled the plankton nets. 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 (m3) 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 occurring near channel borders where water velocity is moving downstream slower than the thalweg, and the third in 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 are separated from detritus, counted, and preserved for morphometric and, if necessary, genetic, identification. All larval fishes are identified to the lowest taxonomic family using Auer (1982) as a primary taxonomic key. Asian carp eggs and larvae are identified to genus using keys provided by Chapman (2006) and Chapman and George (2011). All fishes identified as 'possible' Asian carps are immediately submitted to the Whitney Genetics Lab for genetic confirmation of species assignment. The developmental stage of all fishes is differentiated based on fin development. Fish recognized as having a full complement of fins will be categorized as juvenile fish.

Following identification, egg and larval densities (number/m3 of water sampled) will be compared among sites and sample dates within a year. Akaike's Information Criterion (AIC) will be used to evaluate how environmental variables (e.g., temperature, discharge, gage height, rising or declining or stable flow within 24 hour period of sampling event, etc.) are related to egg and larval densities with the most supported model identified by the lowest AIC value.

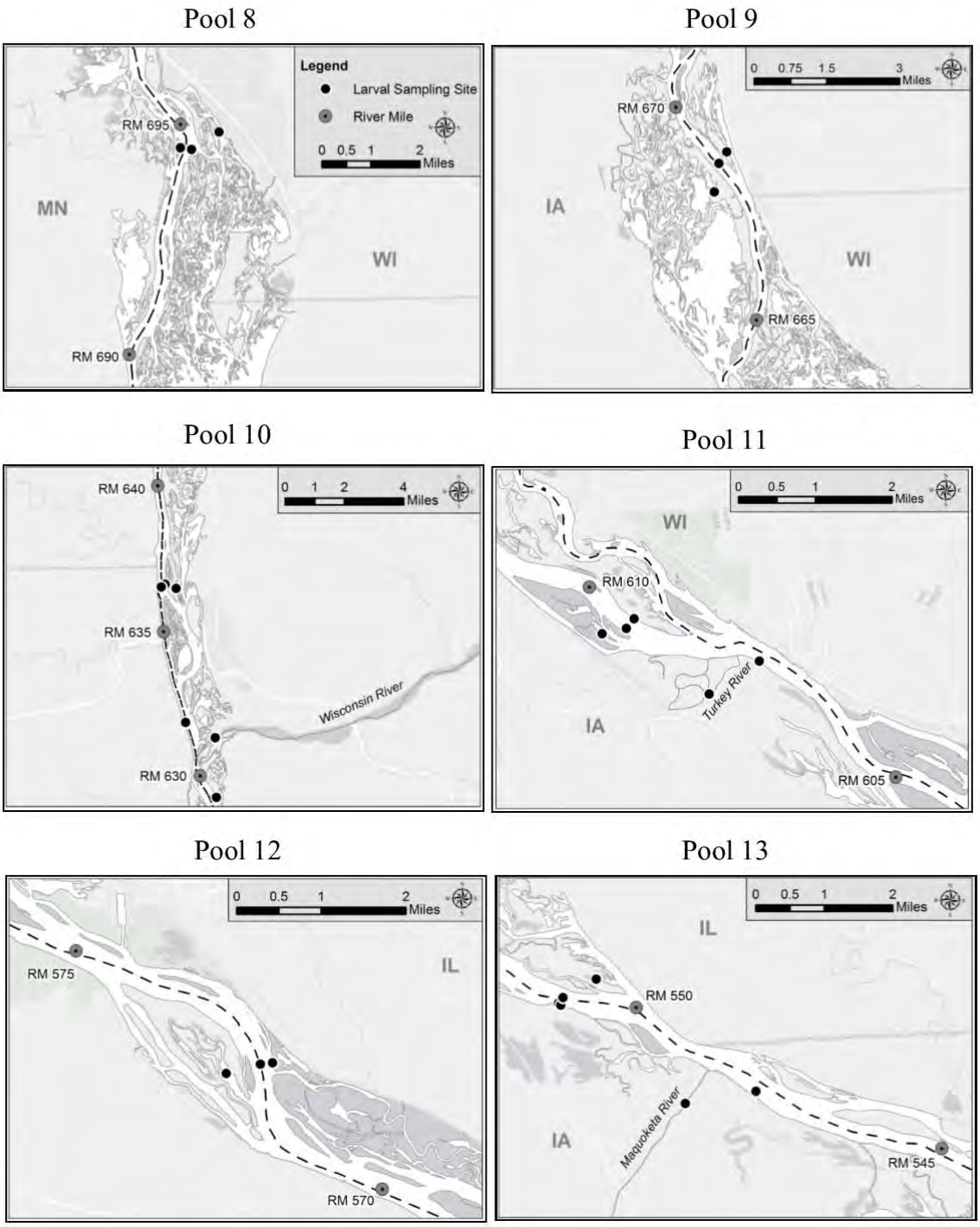

Figure 1. Map of ichthyoplankton netting locations in Navigational Pools 8-13 of the Upper Mississippi River monitored during 2017. Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community.

Results and Discussion:

2016 Results

5,242 larval and juvenile fish and 3,659 eggs were collected in 240 ichthyoplankton tows conducted between 11 May and 31 August 2016. Initial visual evaluations of larval and juvenile fishes were completed in Winter/Spring 2017 and did not identify any Bighead, Silver, Grass, or Black carps 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 May and decreased throughout June, July, and August. The relative abundance of larval and juvenile fishes peaked during late June and early July.

Table 1. Total catch of fishes from ichthyoplankton monitoring in four tributaries and Pools 8-13 of the Upper Mississippi River during 2016. Specimens were identified to family.

Family	Number Identified
Atherinidae	1
Catostomidae	164
Centrarchidae	160
Clupeidae	272
Cyprinidae*	3934
Hiodontidae	1
Lepisostidae	2
Moronidae	7
Sciaenidae	606

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

Table 2. Total catch of eggs and larval and juvenile fishes from ichthyoplankton monitoring in six pools of the Upper Mississippi River and four tributaries during 2016.

Mississippi River Pools	Eggs	Fishes
Pool 8 Totals	552	500
May	303	8
June	137	15
July	112	469
August	0	8
Pool 9 and Upper Iowa River Confluence Totals	151	121
May	90	7
June	37	65
July	24	38
August	0	11
Pool 10 and Wisconsin River Confluence Totals	877	533
May	760	33
June	69	257
July	31	173
August	17	70
Pool 11 and Turkey River Confluence Totals	431	149
May	275	17
June	68	80
July	86	46
August	2	6
Pool 12 Totals	1167	773
May	837	98
June	322	375
July	4	270
August	4	30
Pool 13 and Maquoketa River Confluence Totals	322	3163
May	163	3
June	18	1530
July	133	1572
August	8	58

2017 Results:

319 samples were collected between 20 April and 24 August 2017. All samples were collected during daylight hours between 7.03 a.m. and 6.10 p.m. All sampling was conducted without incident and the samples collected are currently being processed in the laboratory at the La

Crosse FWCO. These data will be summarized and analyzed in the 2018 annual report. Specific questions or requests for 2017 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, we believe that future surveys are 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 carps' production be incorporated into more complex, watershed-scale analyses of Asian carps 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 both target adult Asian carps and limit successful spawning events or early life-stages growing in nursery habitats.

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