

Recipient Name: Illinois Department of Natural Resources

Assistance Agreement Number: Cooperative Agreement No. F16AP00851
(CA-FWS-124)

Project Description: Asian Carp Removal and Monitoring in the Upper
Mississippi River, CAFWS-124

Report Type: Final Report September 5, 2018

Period Covered: June 1, 2016 - June 30, 2018

Final financial report has been submitted under separate cover.

The primary objectives of the study are threefold:

- 1) Targeted removal of 50,000-100,000 lbs of Asian carp species in UMR pools 14-20 using commercial fishers and intensive netting protocols.
- 2) Tagging and recapturing jaw-tagged fish to determine Asian carp population abundance through intense targeted sampling above LD19 in the UMR
- 3) Use 36 larval light traps on a bimonthly basis in pools 17, 18, and 19 backwaters to monitor for the presence of larval Asian carp during the time periods when water temperatures are between 18-30°C.
- 4) Provide travel support assistance for Illinois DNR officials to attend management and policy meetings of the Asian carp ad-hoc Planning Team, UMRCC, ORFMT, and MICRA from July 1, 2016 through June 30, 2018 as practicable.

Asian carp removal and monitoring in the Upper Mississippi River. (Objectives 1-3)

Prepared by Jim Lamer, Western Illinois University

Inclusive dates: June 1, 2016 – August 21, 2017.

Introduction

Bighead carp and silver carp (Asian carp) populations are increasing in abundance and expanding their upstream range within the Upper Mississippi River (UMR). Limited fish passage at Lock and dam 19 (LD19) has slowed their progression and establishment in UMR reaches above Keokuk, IA. However, the detection of young-of-year Asian carp above LD19, although in small densities, indicates that Asian carp populations have reached densities capable of detectable reproduction. To combat this population expansion and decrease Asian carp densities at the established front (pools 17, 18, and 19), additional measures are needed to monitor, control and manage Asian carp while densities are still low and manageable. We propose to use commercial fishers to intensively target Asian carp species for removal at the established front and invasion front (reaches above pool 17), determine population abundance to determine the effects of harvest, and survey for the presence of Asian carp larvae using larval light traps in the northernmost pool (pool 17) of the established front.

Decreasing the abundance and removal of Asian carp by commercial fishers has been successfully executed in the upper IL River to decrease pressure on the electric dispersal barrier. This targeted system of removal is needed in the UMR above LD19 as populations have attained densities high enough to support reproduction and continue to be detected in far northern reaches of the UMR in Wisconsin and Minnesota. Lock and dam 19 is a high head dam with a maximum head difference of 38 ft, restricting all upstream fish passage to the 1200-foot lock chamber. Even though this limited passage has slowed the infiltration and establishment of Asian carp above LD19, they have now reached densities that are increasingly detectable (jumping silver carp), capable of finding mates to support reproduction, and can be sufficiently targeted in known areas of aggregation throughout their established front. The targeted removal of 50,000 – 100,000 lbs of Asian carp annually will help reduce their ecological impact, slow their spread and establishment in the UMR above LD19 and decrease their effective population size. Furthermore, by decreasing their population size we will reduce their opportunities to find mates (Allee effect) and reduce the probability of successful spawning interactions. Total counts and biomass will be recorded from all locations and fish will be available for further scientific inquiry (e.g., age and growth studies, genetic identity, morphometric identification, condition factor, etc.). Total counts and biomass will be directly correlated with recovered jaw tags and population estimates.

Asian carp will be individually jaw-tagged to estimate population estimates above and below LD19. Initial population estimates will be obtained by intensively sampling, marking with unique identifier jaw tags, and then releasing Asian carp back into the system during the initial 1-2 weeks of commercial capture. Program MARK will be used to estimate population size as a function of recaptured (without

replacement) versus initially marked and untagged individuals after weeks 1-2 above LD19. Population estimates will also be calculated for Asian carp in Pool 20 throughout the duration of the study. Population estimates are needed to assess the efficiency and effectiveness of Asian carp sampling and removal efforts above LD19. Initial estimates will set future benchmarks for removal and determine the effectiveness of harvest on an annual basis as part of an adaptive strategy.

Evidence of Asian carp reproduction was detected as early as 2009 in pool 19, and indicates that areas of the UMR above LD19 are capable of providing the hydrological requirements needed for successful Asian carp spawning, egg maturation, and development. Furthermore, this indicates that Asian carp have reached densities high enough to allow for potential mates to find each other and spawn successfully. The highest abundance of adult Asian carp above LD19 occurs in pools 17, 18, and 19, and larvae and young-of-year Asian carp have been detected from pools 16, 18, and 19. A need exists to comprehensively monitor for larval Asian carp in pools 17, 18 and 19 to detect and quantify larval Asian carp establishment in the the established front. Monitoring Asian carp reproduction and the detection of larval Asian carp will be imperative for informing the best management practices in the UMR above LD19.

Purpose/objectives:

The primary purpose of this research is to take action to reduce Asian carp population densities, monitor their recruitment, and control their expansion in the Upper Mississippi River.

The primary objectives of the study are threefold:

1) Targeted removal of 50,000-100,000 lbs of Asian carp species in UMR pools 14-20 using commercial fishers and intensive netting protocols.

A total of 124,930.66 lbs (Table 1) was removed during the project period of June 1, 2016 to August 21, 2017. This project period included all sampling up until the removal efforts began under the new contract. The majority of fish removed and fishing effort was conducted in Pool 19, which contain the highest densities based on mark and recapture estimates and silver carp made up a majority of the species removed. The poundage removed exceeded the 50,000 to 1000,000 target goal. All sampling was conducted with only one fisherman during this time period and future project period numbers are likely to increase with additional fishermen.

Fish that were captured and removed by gill net were predominantly removed with 4 to 5 in mesh. Five-inch mesh was almost exclusively used in areas such as Big Timber and Cleveland backwaters (Pool 17), Sunset Marina and Credit Island backwater (Pool 16), and New Boston Bay, 5-inch mesh was the most effective. Five-inch was also used in Pool 19, but 4-inch mesh was preferred in areas such as Nauvoo/Montrose Flats area and the mouth of the Skunk River. Preferred method of setting was pounding, however during lower water and cooler water temps, dead sets were often very effective especially when setting as backwaters were beginning to dewater in response to falling water levels.

We started to rely heavily on acoustic receiver and manual tracking data USFWS-La Crosse, and USGS-UMESC to help locate aggregations of fish and increase efficiency (fishing where there were known aggregations of fish instead of just trouble shooting their locations). Because of the vast area that Pool 19 and the remaining Pools cover, targeted sampling using Judas fish has increased catch rates. Furthermore, starting in 2017, our biologist crews would carry a VR100 in the contract boat and listen at each location to refine the removal approach and further increase efficiency.

Each year we are learning more about their behavior and evaluating the most effective means of removal. Information on timing and environmental cues responsible for their movements into backwaters are staging above spillways are critical to mass removal techniques and create opportunities to target and remove large amounts of fish in the future using intensive harvest and mass removal gear such as pound nets and seine.

Table 1. Total lbs of removed fish from Pools 16-20 for project period June 1, 2016-August 21, 2017. Weights are given in g and lbs.

Reach		Bighead Carp	Silver Carp	Grass Carp	Hybrid	Bulk	Total
Pool 16	g	2060681.00	694332.00	4940087.0	1760.00	1916484.0	8899264.00
	lbs	4533.50	1527.53	10868.19	3.87	4216.26	19578.38
Pool 17	g	2139939.00	5917042.00	1331058.0	102614.0	669048.00	10159401.0
	lbs	4707.87	13017.49	2928.33	225.75	1471.91	22350.68
Pool 18	g	2933483.00	5663189.00	587188.00	167132.0	0.00	9910320.00
	lbs	6453.66	12459.02	1291.81	367.69	0.00	21802.70
Pool 19	g	4900078.00	9918671.00	2387759.0	509210.0	3005275.2	23151675.0
	lbs	10780.17	21821.08	5253.07	1120.26	6611.61	50933.69
Pool 20	g	1823608.00	2803929.00	192510.00	62442.00	619154.00	4666003.00
	lbs	4011.94	6168.64	423.52	137.37	1362.14	10265.21
Total	g	13857789.0	24997163.0	9438602.0	843158.0	6209961.2	56786663.0
	lbs	30487.14	54993.76	20764.92	1854.95	13661.91	124930.66

2) Tagging and recapturing jaw-tagged fish to determine Asian carp population abundance through intense targeted sampling above LD19 in the UMR

Tagging efforts were all conducted in a 4-week window during the fall of 2016 to evaluate population abundance. Population abundances could be determined for a combined bighead and silver carp (Table 2). Individual estimates were not possible due to bulk captures and lack of individual sorting at time of fish disposal. The time required to tag was 4 weeks less than was required to tag fish in the fall of 2015 due to more familiarity with the system and efficiency at capturing fish. The first year of tagging (2015) did not produce robust estimates because many of the tagged fish showed strong habitat fidelity and were recaptured from the same habitats (not reflecting true population estimates). Therefore, tagging in the fall of 2017 was spread out to areas that are considered to have more transient fish (ephemeral backwaters and main-channel sites when possible).

Estimates are based on number of fish removed and number of tagged fish removed. Any fish that have been called in by non-contracted fishermen were removed from the analysis. However, this model does not consider winter mortality. Winter mortality is a concern since fall tagging at lower water temps could slow healing and increase vulnerability to winter and ice conditions. Therefore, to eliminate this source of bias, no fish were tagged in the fall of 2017 and all fish for 2018 will be tagged in the spring of 2018 only. Future estimates will reflect a full year of tag recovery in the absence of uncontrollable sources of mortality (winter mortality).

Table 2. Bighead and silver carp (combined due to bulk numbers) tagged in fall of 2016 and recaptured through Spring of 2017. Schnabel estimates and 95% confidence intervals for estimated population sizes in the pools.

Reach	Tagged	Recaptures	Population estimate
Pool 17	72	3	18384 ± 11928
Pool 18	57	8	3876 ± 1990
Pool 19	137	9	38832 ± 20056
Total	266	20	

3) Use 36 larval light traps on a bimonthly basis in pools 17, 18, and 19 backwaters to monitor for the presence of larval Asian carp during the time periods when water temperatures are between 18-30°C.

Quadrafoil light traps were used to sample larval fish in Pools 17, 18, and 19 of the Mississippi River. We sampled 648 sites on 58 days from May 17th, 2016 to September 28th, 2016. We deployed our traps a

least 1 hour after sunset and allowed them to fish for a minimum of 1 hour. We targeted backwater habitats, lotus beds, and small tributaries with very little flow (Figure 1). Samples were preserved in 95% ethanol or fixed in 10% buffered formalin and switched to 70% ethanol after 24 hours. We collected 485,537 fish and were able to identify 390,919 larval fish and 93,140 post-larval fish. We were able to document multiple successful bigheaded carp spawning events in Pool 19, however, larval Asian carp were not collected from Pool 17 or Pool 18 (Figure 2,3). Collection of larval and juvenile bigheaded carp (N=1,767) from 47 different traps on 12 sampling days occurred from May 31st to August 18th, but peaked in June (Table 3). At least 7 individual cohorts were identified with the possibility for an additional cohort. The mid-August larval detection is late compared to what is suggested for Asian carp in other parts of the Mississippi River Basin and globally. The continued high water and flashy nature of potential spawning source tributaries contributed to a very strong year for Asian carp reproduction. This is the first major reproductive evidence for Asian carp spawning above Lock and Dam 19.

The large number of samples and tedious work in separating and enumerating taxa from larval samples results in delayed reporting of reproductive evidence. However, the ability to detect larva over a range of days they are in the system offers some advantages over larval tows, which are very punctuated and can often miss reproductive events due to the spatial and temporal scale of sampling. These two methods work well in concert giving insight into magnitude, frequency, and source location of larval fishes. 2017 larval light sampling is underway. Other gears to help cut down on processing time should be explored, including pelagic and benthic tows.

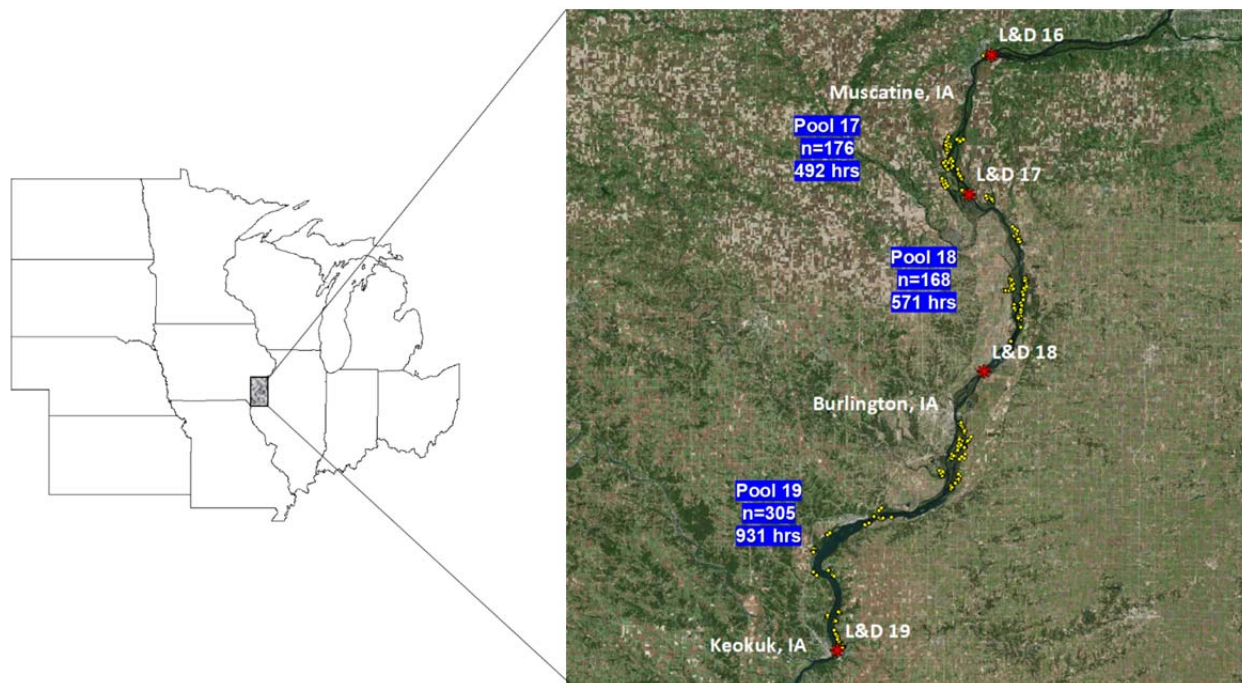


Figure 1. Larval light trap sampling locations (2016).

Table 3. Asian carp larval light trap captures (2016).

Date	Larvae	Post-Larvae	Number of Samples
5/31/2016	8	0	1
6/7/2016	14	0	2
6/8/2016	873	0	11
6/16/2016	18	18	5
6/20/2016	54	0	2
6/23/2016	679	4	11
6/29/2016	0	1	1
6/30/2016	53	9	8
7/14/2016	0	1	1
7/27/2016	15	3	3
7/28/2016	3	0	1
8/18/2016	15	0	1

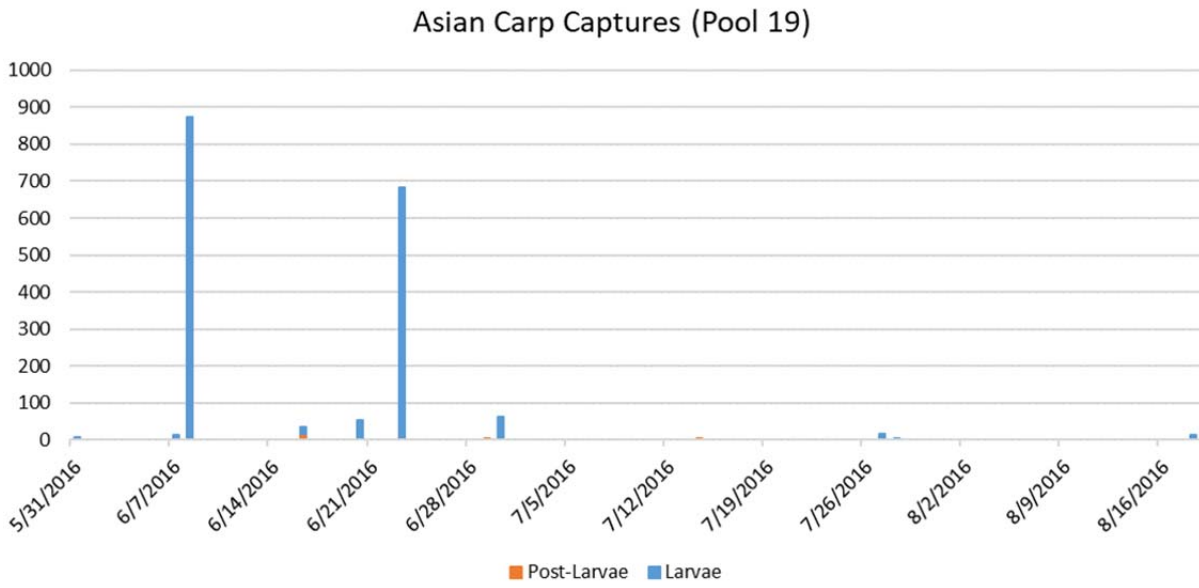


Figure 2. Frequency and magnitude of Asian carp captures during the 2016 sampling period.

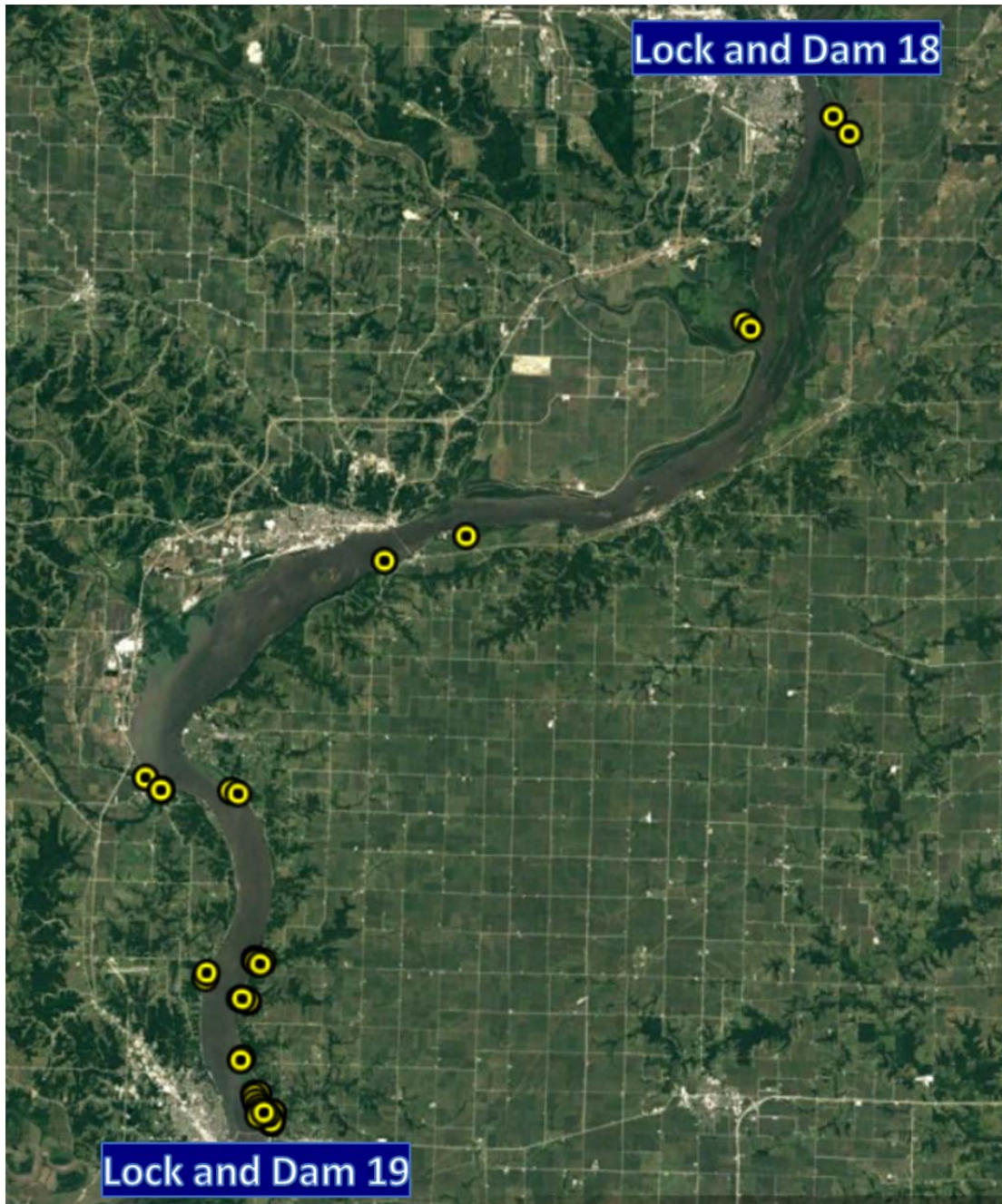


Figure 3. Sites where larval Asian carp were captured in light traps during the 2016 sampling period.

Provide travel support assistance for Illinois DNR officials to attend management and policy meetings of the Asian carp ad-hoc Planning Team, UMRCC, ORFMT, and MICRA from July 1, 2016 through June 30, 2018 as practicable. (Objective 4)

IDNR provided on bequest of USFWS Greg Conover logistical support for a regional Asian carp meeting in Springfield Illinois by providing conference support, fully utilizing the funds as noted in this objective.