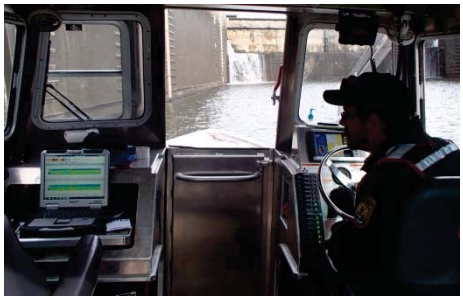
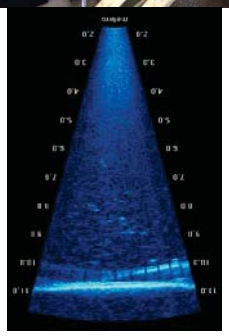
Asian Carp Regional Coordinating Committee

Monitoring and Response Workgroup

Monitoring and Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System

June 2015





ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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The Asian Carp Monitoring and Response Plan was created by a team of biologists, scientists, managers, and administrators from state and federal agencies and includes technical input from government, university, and the private sector specialists. The original plan released in May 2010 was developed by S. Finney, R. Simmonds, S. Pescitelli, S. Shults, J. Mick, G. Sass, and R. Maher. This and earlier versions of the plan have benefitted from reviews by participants of the Monitoring and Response Work Group, Great Lakes state's natural resource agencies, non-governmental organizations, and staff from the Illinois Department of Natural Resources Division of Fisheries, U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service. K. Baerwaldt, Patricia Herman, M. Shanks, N. Barkowski, E. Monroe, R. Simmonds, S. Finney, J. Stewart, N. Bloomfield, T. Hill, W. Doyle, K. Irons, M. O'Hara, D. Wyffels, T. Widloe, B. Caputo, B. Ruebush, J. Zeigler, M. Gaikowski, J. Garvey, M. Brey S. Butler, M. Diana, and D. Wahl contributed project write-ups for the plan. USFWS and INHS provided pictures for the cover. B. Caputo prepared fixed and random site maps. M. O'Hara assembled this draft of the plan.

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2015 – 2017 Monitoring and Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System

EXECUTIVE SUMMARY

The 2015-2017 Monitoring and Response Plan (MRP) has been developed by the Monitoring and Response Workgroup (MRWG) and released by the Asian Carp Regional Coordinating Committee (ACRCC). The plan outlines 2015-2017 actions for Asian carp monitoring and removal in the Chicago Area Waterway System (CAWS) and upper Illinois Waterway. In addition, the plan identifies on-going actions to evaluate the effectiveness of barriers (electrical, chemical, and physical) and gears (e.g. electrofishing, gill/trammel netting, and trap netting) used in the effort to keep Asian carp from becoming established in the CAWS and Lake Michigan. This plan builds upon prior plans developed in 2011, 2012, 2013 and 2014; however the plan will utilize a multiyear approach. This plan will be considered a living document as new findings and technologies are developed the plan will have the flexibility to be amended. This and earlier versions of the plan have benefitted from reviews by technical experts and workgroup members, including, but not limited to Great Lakes state's natural resource agencies and non-governmental organizations. For this amended version of the plan, various projects objectives were modified while others remained consistent to the previous plan. All project plans whether modified or unchanged have been reviewed and submitted for the 2015-2017 MRP. Additional attributes of this MRP such as the historical perspective and appendixes can be found in the previous versions of the plan.

For the purpose of the MRP, the term 'Asian carp' refers to Bighead Carp (*Hypophthalmichthys nobilis*) and Silver Carp (*H. molitrix*), exclusive of other Asian carp species such as Grass Carp (*Ctenopharyngodon idella*) and Black Carp (*Mylopharyngodon piceus*).

The MRWG is following an adaptive approach to Asian carp management and has prepared an interim summary report document (MRWG 2014) containing preliminary results and analysis of actions completed for each of the 21 projects described in the 2014 MRP. The interim reports document is considered a companion document to this 2015 MRP and includes recommendations for modifications and enhancements to project plans based on past results and experiences. Knowledge gaps also were identified and these informed recommendations for new project plans included in this update. All interim summary reports may be found at: www.asiancarp.us.

***Highlights of major initiatives in the 2014 MRP include**:*

- As a result of the extensive sampling with conventional gears to date, we conclude that if there are any live Bighead Carp or Silver Carp in the CAWS upstream of the Electric Dispersal Barrier, they are likely present in low numbers. Based upon Seasonal Intensive Monitoring and previous Planned Intensive Sampling it is recommended to continue to further investigate the leading edge of the Asian Carp population, CAWS commercial netting will include continuation of fixed site sampling and sampling of targeted areas. Seasonal Intensive Monitoring will continue as the alternative to monthly fixed site/random area monitoring, which reduces the frequency of sampling upstream of the Electric Dispersal Barrier. This reduction in effort upstream of the Electric Dispersal

Barrier provides an opportunity to further increase sampling downstream of the Electric Dispersal Barrier. The increase in sampling downstream of the Electric Dispersal Barrier will help to better focus research and monitoring efforts on the leading edge of the Asian Carp population. Furthermore, better understanding of Asian Carp populations downstream of the Electric Dispersal Barrier should prove to be valuable tool for reducing their numbers, thus mitigating the risk of individuals moving upstream to Lake Michigan in the event of a breach at the Electric Dispersal Barrier.

- Barrier Defense Asian Carp Removal Project-Since 2010, the Asian Carp removal program in the upper Illinois Waterway has demonstrated it has the ability to reduce carp abundance at and near the detectable population front and may prevent further upstream movement by populations toward the Electric Dispersal Barrier and Lake Michigan. This program has removed and harvested nearly 3 million pounds of Asian carp since its inception in the Upper Illinois Waterway. Utilizing contracted commercial fishing crews has been a successful approach for Asian Carp removal in areas of the waterway not open to permitted commercial fishing. Additionally with the monitoring efforts refocusing downstream of barrier the will allow commercial fisherman to expend more effort in the target areas Marseilles and Starved Rock pools which have high abundances of Asian Carp. Overall harvest should continue to increase substantially with this increased effort and gear efficiencies.

- Heightened telemetry program near and downstream barrier- Continuation of the telemetry program and maintaining the current level of surrogate species tags within the system while increasing the number of tagged Asian Carp within the Dresden Island pool. Currently, USACE receiver coverage overlaps significantly with receiver coverage from Southern Illinois University Carbondale within the Marseilles pool. USACE recommends moving receivers within the Marseilles pool into the Dresden Island pool and Kankakee River to increase detection resolution while maintaining open communication with SIUC for data sharing and recovery downstream. In order to increase the chances of future tagged fish approaching the barriers, additional tagged fish within the Lockport pool should be captured on the opposite side of the barriers than their release. Efforts will continue to tag fish near the leading edge of the invasion front, increased tagging of fish in Dresden Island near Rock Run Rookery Lake and the confluence of the Kankakee River is critical to understanding Asian carp movements at the leading edge. Also, it is recommended that a portion of our fish released in vicinity of the barriers should contain depth sensor tags to begin analyzing how fish use the entire water column in response to the barriers, barge traffic and clearing events between the Electric Dispersal Barriers.

- Monitoring fish at the Electric Dispersal Barrier System- Fixed DIDSON monitoring of the electric dispersal barrier using a telescopic boom lift will continue when abundances of small fish at the barrier are at their greatest. Further evaluation of operational protocols of the barriers and to identify any potential actions that may be employed will also be studied.

- Des Plain River monitoring - Continue monitoring for adult and juvenile Bighead Carp and Silver Carp in the upper Des Plaines River with emphasis in the four target areas and explore areas upstream of the former Hofmann Dam for potential Asian Carp habitat. The river stage for the Des Plaines River will be monitored during heavy rainfall events and investigations of the physical barrier will be conducted, as needed, in areas where overflow has occurred. Given the limitations of the physical barrier, young-of-year sampling via mini-fyke netting will be conducted to document any potential spawning success.

- Identifying Movement Bottlenecks and Changes in Population Characteristics of Asian carp in the Illinois River- There is a need to address the inadequacies of the previous Asian carp population models to make them more useful in terms of decision making relative to the spatial allocation of harvest to minimize propagule pressure on the Electric Dispersal Barrier. As such, an updated model is needed that includes necessary spatially explicit components that incorporate empirically derived probability of movement across the entire Illinois River.

- Asian Carp detection probability- Additional analyses will continue to explore factors that affect the probability of detecting Asian Carp. The continued examination of additional gear types, multi-gear models, and incorporate other sources of data into our modeling efforts to better understand relationships between Asian Carp abundance, site characteristics, gear efficiency, and detectability.

- Pneumatic water guns have been successfully deployed in multiple scenarios to affect fish behavior and for establishing barriers to fish movement. Results look promising for on-going applications of water gun technology to be a tool of Integrated Pest Management (IPM) activities. In 2013 and 2014, water guns were used to create a barrier to Asian carp movement between areas in an Illinois backwater. These trials demonstrated that Asian carp behavior could be modified when water guns were firing. However, the 10 second gap between firings appeared to be sufficient enough to allow for Asian carp to breach the 2 water gun array. Following the difficulties with equipment failures in 2014, reassessment of water guns as a barrier in 2015 is recommended. The goal of this study is to evaluate the use of water guns as a barrier for Asian carp. These trials are expected to validate the use of water guns as a tool for pest management.

More detailed analyses and justifications for changes to sampling protocols are included in the MRWG 2014 Interim Report. As in the past, individual project plans detail procedures and protocols that will allow us to achieve the overall goal and accomplish strategic objectives developed by the workgroup.

The overarching goal and objectives for the plan remain the same - to prevent Asian carp from establishing self-sustaining populations in the CAWS and Lake Michigan. The five strategic objectives to accomplish the overall goal are:

1) Determination of the distribution and abundance of any Asian carp in the CAWS, and use this information to inform response removal actions;

2) Removal of any Asian carp found in the CAWS to the maximum extent practicable;
3) Identification, assessment, and reaction to any vulnerability in the current system of barriers to prevent Asian carp from moving into the CAWS;
4) Determination of the leading edge of major Asian carp populations in the Illinois River and the reproductive success of those populations; and
5) Improvement of our understanding of factors behind the likelihood that Asian carp could become established in the Great Lakes.

Twenty-two projects are proposed to achieve the overarching goal and objectives of the 2015-2017 MRP. Project plans are included to showcase the full range of work that will be on-going or initiated during the coming year. These projects can be categorized geographically as occurring either upstream or downstream of the electric dispersal barrier system and grouped into five categories: Monitoring Projects, Removal Projects and Evaluations, Barrier Effectiveness Evaluations, Gear Effectiveness Evaluations and Development Projects, and Alternative Pathway Surveillance.

MONITORING PROJECTS

Seasonal Intensive Monitoring Upstream of the Barrier (15) – Seasonal intensive monitoring is a modified continuation of Fixed and Random Site Monitoring Upstream of the Dispersal Barrier and Planned Intensive Surveillance in the CAWS. These events will be planned for the spring season (Week of June 8 and 15th) and the fall season (Week of September 14 and 21nd). This project includes standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at sites in the CAWS upstream of the electric barrier system. Monitoring also will include five fixed sites with additional random electrofishing transects and net sets at locations outside of fixed sites to maintain spatial coverage of the waterway. Along with maintaining the spatial coverage upstream of the Electric Dispersal Barrier, each seasonal intensive monitoring event will provide extra sampling focus on a unique location in the CAWs. The two week event in the spring will focus on the Lake Calumet/Cal-Sag area of the CAWs. In 2010 one Bighead Carp was captured with commercial nets and had numerous Rapid Response actions due to positive Asian Carp eDNA samples. In this event pulsed-DC electrofishing, tandem trap nets, Lake Michigan pond nets contracted commercial fishers will be utilized. The two week event in the fall will focus on the North Shore Channel/Chicago River. The Seasonal Intensive Monitoring provides a spatially and temporally adequate assessment of relative abundance and distribution of Asian carp in the CAWS upstream of the Electric Barrier System

Strategy for eDNA Monitoring in the CAWS (22) – A modified strategy for eDNA monitoring that decouples eDNA as a trigger for response actions. In 2015, we will determine whether Asian carp DNA are present in strategic locations in the CAWS to inform status of Asian carp, and detect Asian carp DNA in areas that have been monitored since 2009 to maintain annual data collection to maintain vigilance. Illinois River quantification objectives will be to detect and quantify Bighead and Silver Carp DNA along a gradient in the Illinois River from Lower Lockport Pool to the Marseilles Pool and the lower portion of the Kankakee River. This will complement other field efforts being conducted below the barrier, and may inform control or management actions in the future Possibly confirm spawning events by timing three collection events pre-spawn, spawn, and post-spawn. This may inform control or management actions in the future.

Larval Fish and Productivity Monitoring (25) –Larval fish sampling will occur at approximately biweekly intervals at all sites from April to October. Sampling may occur more frequently during periods when Asian carp eggs and larvae are likely to be present (e.g., during spring months, during periods of rising water levels, or shortly after peak flows). Sampling for phosphorus, cholorophyll, and zooplankton will continue in collaboration with the Ecosystem Responses to Barrier Defense project. Productivity patterns will be evaluated by measuring total phosphorus and chlorophyll *a* concentrations, as well as zooplankton abundance at all sampling locations.

Young-of-Year and Juvenile Asian Carp Monitoring (28) – Monitoring for the presence of young-of-year Asian carp in the Illinois River, Des Plaines River, and CAWS will take place through sampling planned by other projects in the MRP (e.g., Larval Fish and Productivity

Monitoring, Fixed and Random Site Monitoring Upstream of the Barrier, Fixed Site Monitoring Downstream of the Barrier, Gear Efficiency and Detection Probability Study, Des Plaines River and Overflow Monitoring Project). Sampling targets a segment of the Asian carp population typically missed with adult sampling gears and provides information to help determine where in the waterway Asian carp are successfully recruiting young.

Distribution and Movement of Juvenile Asian Carp in the Illinois Waterway (30) – This project specifically targets sampling of young Asian carp in areas not sampled by standard monitoring and gear evaluation projects in an effort to better understand distribution and habitat use by young Bighead and Silver Carp in the Illinois Waterway. Specific areas include tributaries and shallow backwater habitats known to function as nursery areas for young Asian carp. Movement patterns of young will be determined with acoustic telemetry. Sampling will occur during the months of May through September. One week per month will be spent sampling areas which are difficult to access with traditional fisheries boats but can be sampled with our shallow drive (mud motor) boat. Nets will be set and run in the morning (overnight sets) and electrofishing done in the afternoons. Experimental net testing will be conducted as time and resources permit. In addition to boat accessible areas, two weeks will be devoted to sampling five isolated areas which are disconnected from the main channel of the river except in times of overtopping floods. This sampling will take place between May and the end of September.

Fixed and Random Site Monitoring Downstream of the Barrier (36) – This project includes standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at four fixed sites downstream of the Electric Dispersal Barrier system in Lockport pool, Brandon Road pool, and Dresden pool. Fixed and random site pulsed-DC electrofishing and contracted commercial netting will take place bi-weekly from March through December, except during June and September, and will include 8 random sites in the Lockport, Brandon Road, and Dresden Island pools, respectively. Contracted commercial netting in the Marseilles pool will occur at four fixed sites and four random sites. Additional gears such as hoop nets and mini-fyke nets will be continued to enhance monitoring for adult and juvenile Asian carp. Results will provide information on the location of detectable Asian carp populations in the waterway (relative abundance and distribution) and their progression upstream over time. Population data may be compared among sites and across time. This increased effort downstream of the Electric Dispersal Barrier system will help us to better evaluate the leading edge of the Asian carp population front in the Dresden Island pool.

REMOVAL PROJECTS AND EVALUATIONS

Response Actions in the CAWS (42) – This project includes a threshold framework to support decisions for response actions to remove any Asian carp from upstream of the Brandon Road Lock and Dam to Lake Michigan with conventional or experimental gears. It also allows for targeted response actions at selected locations in the CAWS outside the threshold framework when information gained from such actions may benefit monitoring protocols and Asian carp removal efforts.

Barrier Maintenance Fish Suppression (46) – This project provides a fish suppression plan to support USACE maintenance operations at the electric dispersal barrier system. The plan includes clearing fish from between barriers with water gun technology and evaluating clearing success with split-beam hydroacoustics, side scan SONAR, and DIDSON imaging SONAR.

Barrier Defense Asian Carp Removal Project (50) – This program was established to reduce the numbers of Asian Carp downstream of the electric barrier system through targeted and contracted commercial fishing. Reducing Asian Carp populations is anticipated to lower propagule pressure and the chances of Asian Carp gaining access to waters upstream of the Electric Dispersal Barrier system. Primary areas that will be fished include Starved Rock and Marseilles pools.

Identifying Movement Bottlenecks and Changes in Population Characteristics of Asian Carp in the Illinois River (52) – *Spatially explicit population model*- Asian carp demographic parameters will be updated using existing Asian carp data from all possible sources (state and federal agencies and universities). Data from the LTRMP and any other sources with reliable standardized approaches will be used to investigate the development of species-specific stock recruitment relationships. Catch per unit effort data may at the very least facilitate the scaling of stock-recruitment parameters. Additional explanatory variables, such as river discharge, will be evaluated in these relationships to explain additional recruitment variation. If the catch per unit effort data prove to be inadequate for the development of stock-recruitment relationships, an alternative approach would be to use a similar approach that was used in Tsehaye et al. 2013, but narrow the pool of stocks down to similar species rather than the all-encompassing approach previously used. If this approach is adopted, it will be necessary to explore varying annual recruitment to capture the boom and bust nature of Asian carp recruitment patterns. Similar to the Tsehaye et al. 2013 model, a Bayesian approach will be used for parameter estimates to allow for the incorporation of individual variability and parameter uncertainty in model simulations.

Probability of movement and dam passage-telemetry and tagging- To identify control points or immigration pathways that will inform removal efforts, specifically between the Starved Rock, Marseilles, and Dresden Island pools of the Illinois River, we plan to increase active tracking in the upper Peoria, Starved Rock, Marseilles, and Dresden Island (assisted by USACE) pools. Additional stationary VR2W receivers will also be deployed around the Starved Rock and Marseilles Locks and Dams to measure 3-dimensional movement patterns. We will increase active tracking in backwaters and between main channel receivers to correspond with removal efforts and plankton sampling (Illinois River Biological Station-Havana) and hydroacoustic surveys (SIUC) to determine where fish are located between VR2W detections. Because some acoustic transmitters are expiring this year, we will tag up to 50 additional fish (25 bighead carp and 25 silver carp) per pool of the Illinois River to continue to monitor how fish movement is influenced by control efforts and environmental variables. Finally, to bolster estimates of survival, exploitation, and immigration from 2012-2013 (and further inform the spatially explicit population model) mark-recapture models will be run and completed by May 2015 to incorporate all acoustic tagging and jaw tagging information. Additional fish (up to 1000) will be tagged with jaw tags and acoustic transmitters (up to 50) in the upper Peoria pool just below Starved Rock and Dam to determine if we are missing fish moving with the low number of

active receivers in the Peoria pool. Any 2015 jaw-tagged fish that are recaptured by commercial fishermen above the Starved Rock Lock and Dam will indicate more fish passage than we were detecting with acoustic receivers. We will attempt to focus our tagging efforts (with the help of contracted commercial fishermen) on small Asian carp. Increased hydroacoustic surveys will also be added to this area of the river in 2015 to correspond to observed movement patterns of tagged fish.

Abundance, Demographics, and Hybridization- We will use the approaches developed in previous years (2010-2014) to determine Asian carp density, biomass, species composition, and size structure in the Illinois River. To quantify fish targets, a combination of side-looking and down-looking hydroacoustics and side-scan sonar techniques will be used. Surveys transects will be conducted in main channel, tributaries, side channels, and connected backwater lakes from Dresden Lock and Dam downstream to the purported source of the Asian carp population near the confluence of the Mississippi River.

BARRIER EFFECTIVENESS EVALUATIONS

Telemetry Monitoring Plan (58) – This project uses ultrasonically tagged Asian carp and surrogate species to assess if fish are able to challenge and/or penetrate the electric barrier system and pass through navigation locks in the upper Illinois Waterway. An array of stationary acoustic receivers and mobile tracking will be used to collect information on Asian carp and surrogate species movements.

Understanding Surrogate Fish Movement with Barriers (69) – This project investigates the movements of tagged surrogate fish species in the Dresden Island, Brandon Road, Lockport pools along with specific area such as Brandon Road Lock and Dam and below the Electric Dispersal Barrier Area in Lockport Pool. We will assess the movement of surrogate fish species between barriers and obtain recapture rates to help verify sampling success using multiple gears.

Monitoring Fish Abundance, Behavior, and Barge Interactions at the Electric Dispersal Barrier, Chicago Sanitary and Ship Canal, Illinois (71)- This project continues to evaluate fish behavior between the narrow arrays where the highest-voltage electrical field is located and determine the species of fish present in and directly adjacent to the barrier system. Other components of the project will evaluate behavior of fish near the barrier as barges traverse the barriers and their behavior near barges at the Brandon Road Lock and Dam and in downstream areas of high Asian carp abundance.

Monitoring Fish Density and Spatial Distribution in Lockport, Brandon Road, and Dresden Island Pools and the Associated Lock and Dam Structures (74) – Fish abundances and distributions from the Electric Dispersal Barrier to Dresden Island Dam will be estimated using hydroacoustic sampling following methods from Garvey et al. (2011). Scanning surveys of Lockport Pool are currently being performed monthly and monthly sampling will continue thru April. Seasonal (Spring, Summer, and Fall) scans will be done of Lockport, Brandon Road, and Dresden Island pools. Additional scans may be added at the discretion of project biologists. Split-beam hydroacoustics and side-scan SONAR will be used to survey fish. Transects will be

made parallel to the flow of the river and spaced close enough together to maximize coverage of the water column. Diel sampling will take place in order to assess fish distribution patterns near the barrier throughout a 24-hour period. Complete barrier scans will take place three consecutive times every three hours. This information will be especially useful given that some evidence exists that bighead carp move more in the evening hours than during daylight hours (Schultz 2006). Diel surveys will be performed when Lockport Pool SONAR scans indicate that fish are in high abundance near the barrier, most likely in the summer and fall.

Des Plaines River and Overflow Monitoring (79) – This project provides a plan to monitor for Asian carp spawning activity, if any exists, in the upper Des Plaines River. It also will assess efficacy of the Asian carp barrier fence constructed between the Des Plaines River and Chicago Sanitary and Ship Canal (CSSC) by monitoring for any Asian carp eggs, larvae, and juveniles that may be transported to the CSSC via laterally flowing Des Plaines River floodwaters passing through the barrier fence.

GEAR EFFECTIVENESS EVALUATIONS AND DEVELOPMENT PROJECTS

Evaluation of Gear Efficiency and Asian Carp Detectability (82) – This project will assess efficiency and detection probability of gears currently used for Asian Carp (specifically juvenile Asian Carp) monitoring (pulsed-DC electrofishing, gill nets, and trammel nets) by sampling at sites in the Illinois River, lower Des Plaines River, and CAWS that have varying carp population densities. In addition, a variety of alternative sampling gears such floating experimental gill nets, hydroacoustics, midwater trawls, beach seines, trap nets, mini-fyke nets, small-mesh purse seines and cast nets, will be evaluated to determine their ability to detect juvenile and adult Asian carp. Results will inform decisions on appropriate levels of sampling effort and monitoring regimes, and ultimately improve Asian carp monitoring and control efforts.

Asian Carp Gear Development and Evaluation (85) – All gears have had trials performed and been shown to be effective. We have prototypes of all gears on hand and are working with a contractor to modify as needed. The Paupier can sample Silver Carp in areas of high density and can effectively sample carp as they exist a variety of habitats including sizes from age zero to large adults. The Mamou was effectively proven in a backwater of the Illinois and Missouri river tributaries catching numerous YOY Asian carp along with other native fishes in one trawl. The Lampara seine effectively corralled schools of Asian Carp, but could not capture fish due to a lack of mechanical power and speed. A net designer will be contracted to consult during prototype net deployments and trials.

Unconventional Gear Development Project (87) – Unconventional gears will be set at multiple sites in order to evaluate their effectiveness across a range of Asian carp densities. Gears will be evaluated for the numbers and sizes of Asian carp and other fishes they are able to capture in comparison with traditional sampling gears. Alternative methods of driving Asian carp into surface-to-bottom gill nets will continue to be evaluated at select sites on a seasonal basis. Treatments will include a control set (no driving), driving fish using traditional pounding methods, and driving fish using pulsed-DC electrofishing. Great Lakes trap (pound) nets will be set for extended periods (1-2 weeks) at select sites. Additional new gears and gear combinations may also be incorporated into sampling efforts as they become available.

Water Gun Development and Testing (89) – Pneumatic water guns that emit high pressure underwater sound waves have potential to deter fishes or kill them if they are in close enough proximity to the wave source. This technology is being evaluated to determine its effects on lock structures in the CAWS (e.g., lock walls and in-water equipment) and as an alternative tool to rotenone for fish suppression in support of electric dispersal barrier system maintenance. If proven successful, water guns may be further evaluated for potential use as a permanent tool to defend navigation locks in the CAWS or elsewhere to keep Asian carp from moving into the Great Lakes. In addition, alternative barrier technologies are of interest. Carbon Dioxide (CO2) has shown promise as a non-physical barrier of Asian Carp in controlled laboratory studies. We recommend including an additional IPM demonstration with a CO2 barrier as an alternative to water guns.

ALTERNATIVE PATHWAY SURVEILLANCE

Alternative Pathway Surveillance in Illinois - Law Enforcement (93) – This project created a more robust and effective enforcement component of IDNR's invasive species program by increasing education and enforcement activities at bait shops, bait and sport fish production/distribution facilities, fish processors, and fish markets/food establishments known to have a preference for live fish for release or food preparation. Inspection and surveillance efforts will take place in the Chicago Metropolitan Area including Cook and the collar counties, with eventual expansion statewide and potentially across state boundaries.

Alternative Pathway Surveillance in Illinois - Urban Pond Monitoring (96) - This project provides monitoring and removal efforts for Asian carp that may have been unintentionally stocked in urban fishing ponds in the Chicago Metropolitan Area. Monitoring with eDNA technology and conventional gears (electrofishing and netting) has previously occurred in local fishing ponds and has detected and removed Asian carp (possibly introduced as contaminants in shipments of stocked sport fish). Revisits of contaminated ponds and further monitoring and surveillance efforts will continue in the Chicago Metropolitan Area including Cook and the collar counties.

Seasonal Intensive Monitoring in the CAWS

Participating Agencies: IDNR (lead), INHS, USFWS, and USACE (field support), USCG (waterway closures when needed), USGS (flow monitoring and dye tracking when needed), MWRD (waterway flow management and access), USEPA and GLFC (project support)

Location: Seasonal intensive monitoring will take place in the CAWS upstream of the Electric Dispersal Barrier.

Introduction and Need: Detections of Asian carp eDNA upstream of the Electric Dispersal Barrier in 2009 initiated the development of a monitoring plan using boat electrofishing and contracted commercial fishers to sample for Asian carp at five fixed sites upstream of the barrier. In addition, random area sampling began in 2012 in order to increase the chance of encountering Asian carp in the CAWS beyond the designated fixed sites. Based on the extensive sampling performed upstream of the Electric Dispersal Barrier from 2010 through 2013 (682 hours of electrofishing, 445.8 km (277 mi) of gill/trammel net, 2.2 km (1.4 mi) of commercial seine hauls) and only one Bighead Carp being collected in Lake Calumet in 2010, fixed site and random area sampling effort was reduced upstream of the barrier to two Seasonal Intensive Monitoring (SIM) events starting in 2014. The reduction of effort upstream of the Electric Dispersal Barrier allows for increased monitoring efforts downstream of the barrier. The increase in sampling downstream of the Electric Dispersal Barrier will focus sampling efforts on the leading edge of the Asian carp population, which will serve to reduce their numbers in this area thus mitigating the risk of individuals moving upstream towards the Electric Dispersal Barrier and Lake Michigan by way of the CAWS. Results from SIM upstream of the Electric Dispersal Barrier will contribute to our understanding of Asian carp abundances in the CAWS and guide conventional gear or rotenone rapid response actions designed to remove Asian carp from areas where they have been captured or observed.

Objectives:

1) Remove Asian carp from the CAWS upstream of the Electric Dispersal Barrier when warranted; and
2) Determine Asian carp population abundance through intense targeted sampling efforts at locations deemed likely to hold fish.

Status: Seasonal intensive monitoring is a modified continuation of Fixed and Random Site Monitoring Upstream of the Electric Dispersal Barrier and Planned Intensive Surveillance in the CAWS.

Methods:

A variety of gears will be used during SIM, including pulsed DC-electrofishing, trammel and gill nets, deep water gill nets, a commercial seine and Great Lake pound nets to capture and remove any Asian carp present in areas where eDNA has been found to accumulate. The goal is to complete 150 electrofishing runs and 150 net sets (trammel/gill nets, deep water gill nets) during each two week event.

Electrofishing Protocol - All electrofishing will use pulsed DC current and include 1-2 netters (two netters preferred). Locations for each electrofishing transect will be identified with GPS coordinates. Electrofishing transects should begin at each coordinate and continue for 15 minutes in a downstream direction in waterway main channels (including following shoreline into off-channel areas) or in a counter-clockwise direction in Lake Calumet. Electrofishing boat operators may switch the safety pedal on and off at times to prevent pushing fish in front of the boat. Common Carp will be counted without capture and all other fish will be netted and placed in a tank where they will be identified and counted, after which they will be returned live to the water. Schools of young-of-year (YOY) Gizzard Shad < 152.4 mm (6 in) long will be subsampled by netting a portion of each school encountered and placing them in a holding tank along with other captured fish. Due to similarities in appearance and habitat use YOY Gizzard Shad will be examined closely for the presence of Asian carp and enumerated. Crew leaders should fill in as much information on the data sheets as possible for each station/transect and record the location for the start of each run with GPS coordinates (decimal degrees).

Netting Protocol – Contracted commercial fishers will be used for net sampling at fixed and random sites and nets used will be large mesh gill nets that are 3 m (10 ft) deep x 91.4 m (300 ft) long in bar mesh sizes ranging from 88.9-108 mm (3.5-4.25 in). Locations for each net set will be identified with GPS coordinates. Most sets will be of short duration and include driving fish into the nets with noise (e.g., plungers on the water surface, pounding on boat hulls, or revving tipped up motors). Though longer duration sets, particularly in Lake Calumet, may also be incorporated. In an effort to standardize netting effort, short duration sets will be 15- to 20-minutes long and "pounding" will extend no further than 137.2 m (450 ft) from the net. Captured fish will be identified to species and enumerated. Locations of net sets should be recorded with GPS coordinates (decimal degrees). An IDNR biologist will be assigned to each commercial net boat to monitor operations and record data.

Fixed and Random Area Sites Upstream of the Electric Dispersal Barrier - *(weeks of June 8th and September 14th)*

The sampling design includes intensive electrofishing and netting at five fixed sites and four random site sampling areas (Figure 1). Random area sampling will exclude areas of the waterway designated as fixed sites. Random sites will be generated with GIS software from shape files of designated random site areas and will be labeled with Lat-Lon coordinates in decimal degrees.

Upstream Fixed Site Descriptions and Effort - A description of fixed site locations and sampling effort targets is summarized below. The duration of each electrofishing run will be 15 minutes and length of each net set will be 182.9 m (600 ft).

Site 1 – Lake Calumet. Sampling will be limited to shallower areas north of the Connecting Channel (this avoids deep draft areas with steep walls but includes channel drop off areas that exist north of the Connecting Channel).

Site 2 – Calumet/Little Calumet River from T.J. O'Brien Lock and Dam to its confluence with the Little Calumet River South Leg ~11.3 km (7 mi).

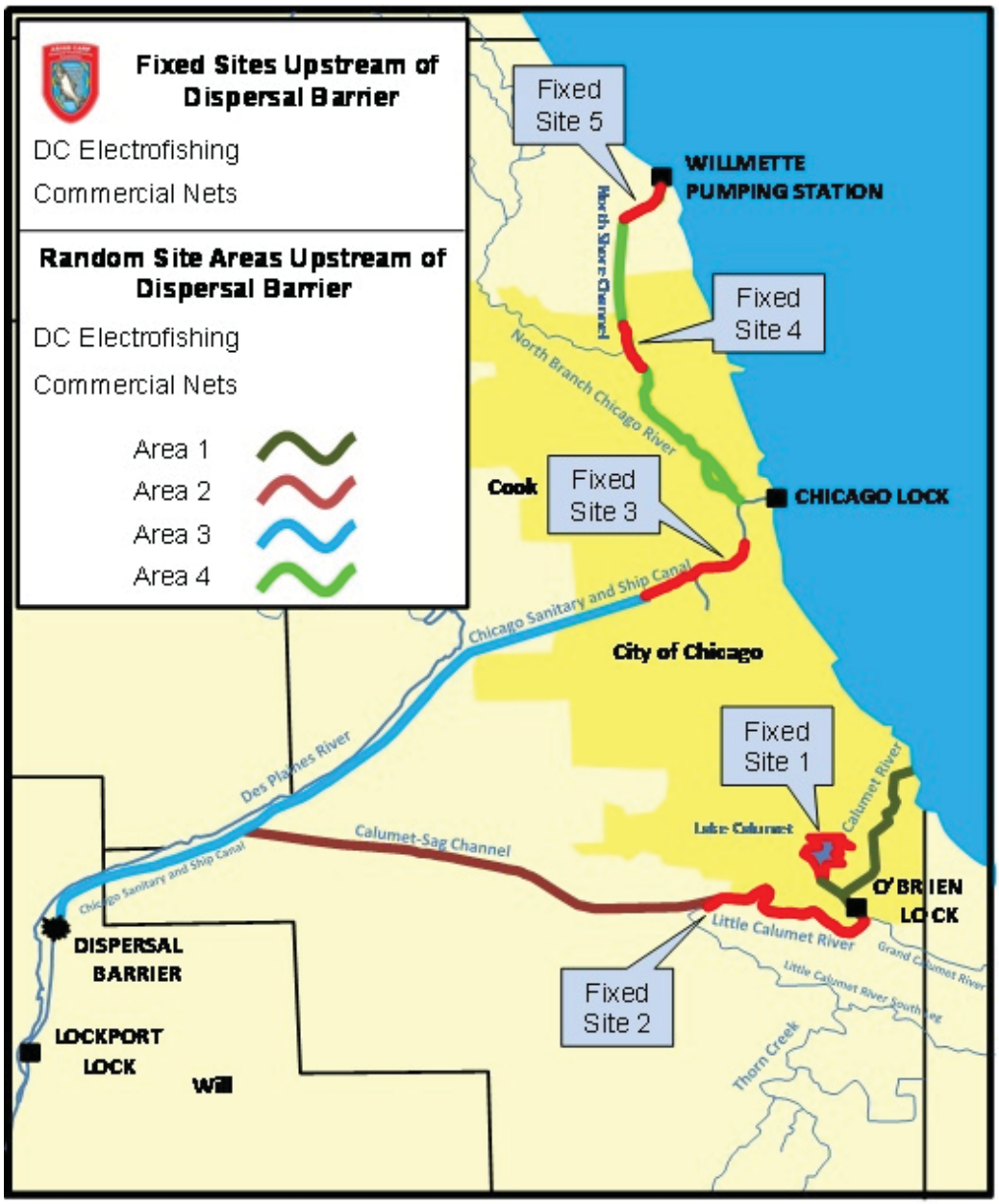


Figure 1. Fixed site and random site sampling areas for electrofishing and commercial netting upstream of the Electric Dispersal Barrier.

Site 3 – Chicago Sanitary Ship Canal (CSSC) and South Branch Chicago River from Western Avenue upstream to Harrison Street ~6.4 km (4 mi).

Site 4 – North Branch Chicago River and North Shore Channel from Montrose Avenue north to Peterson Avenue ~3.2 km (2 mi).

Site 5 – North Shore Channel from Golf Road north to Wilmette Pumping Station ~3.2 km (2 mi).

Upstream Random Site Sampling Area Descriptions and Effort - A description of random sampling areas and sampling effort targets is summarized below. As with fixed sites, the duration of each electrofishing run will be 15 minutes and length of each net set will be 182.9 m (600 ft). Four random areas have been identified to facilitate coordination with fixed site sampling (Figure 1).

Area 1 – Lake Calumet Connecting Channel and Calumet River
Area 2 – Cal-Sag Channel from its confluence with the CSSC to the Little Calumet River
Area 3 – CSSC from Western Avenue downstream to the Electric Dispersal Barrier
Area 4 – North Shore Channel (between Fixed Site 4 and 5), North Branch Chicago River, and Chicago River

Lake Calumet, Calumet River and Random Area Sites Upstream of the Electric Dispersal Barrier - *(week of June 15th)*

Lake Calumet - Prior to sampling, crews will set Great Lake pound nets at the entrance to Lake Calumet to prevent fish immigration/emigration (Figure 2). This will, however, be contingent on water conditions as flows in and out of Lake Calumet prevented pound nets from being set in 2014. Commercial seining will occur in the North section for two days, then in the South section for one day (Figure 2). Commercial gill/trammel nets and deep water gill nets will be fished in Lake Calumet, Calumet Connecting Channel and Calumet River. Gill and trammel nets will be set for short duration and will have fish driven into the nets with noise as described above. Deep water gill nets may be set for longer duration. They will be well marked with buoys when left unattended, with IDNR law enforcement officers securing the area. Agency electrofishing crews will operate throughout the monitoring event. Samples will be collected 15 minutes at a time, enumerating catches of fish netted. Electrofishing may also be used in conjunction with commercial fishers to move fish into nets.

In conjunction with sampling efforts in Lake Calumet and the Calumet River, electrofishing and gill/trammel netting will also take place at four random site sampling areas throughout the CAWS upstream of the Electric Dispersal Barrier as mentioned above (Figure 1).

North Shore Channel, Chicago River and Random Area Sites Upstream of the Electric Dispersal Barrier - *(week of September 21st)*

North Shore Channel - Sampling will occur between the Argyle Street Bridge, located just downstream from the North Shore Channel and North Branch Chicago River confluence, and the Wilmette Pumping Station (Figure 3). Teams will begin at the upper and lowermost site boundaries and work toward the middle. Each team of two electrofishing boats and one net boat will work together to set nets across the channel and drive fish to nets with electrofishing and noise from "pounding" on the hull of boats and revving trimmed up motors. Each team will set three nets across the channel at intervals of 457.2 to 731.5 m (500 to 800 yds) apart, after which electrofishing and noise to drive fish will occur between the nets. The net closest to the outer site boundary will then be pulled and reset 457.2 to 731.5 m (500 to 800 yds) closer to the site center and the process repeated. To maximize sampling time, electrofishing will begin in the area between the remaining nets while the outer net is being moved. The idea is to leapfrog the

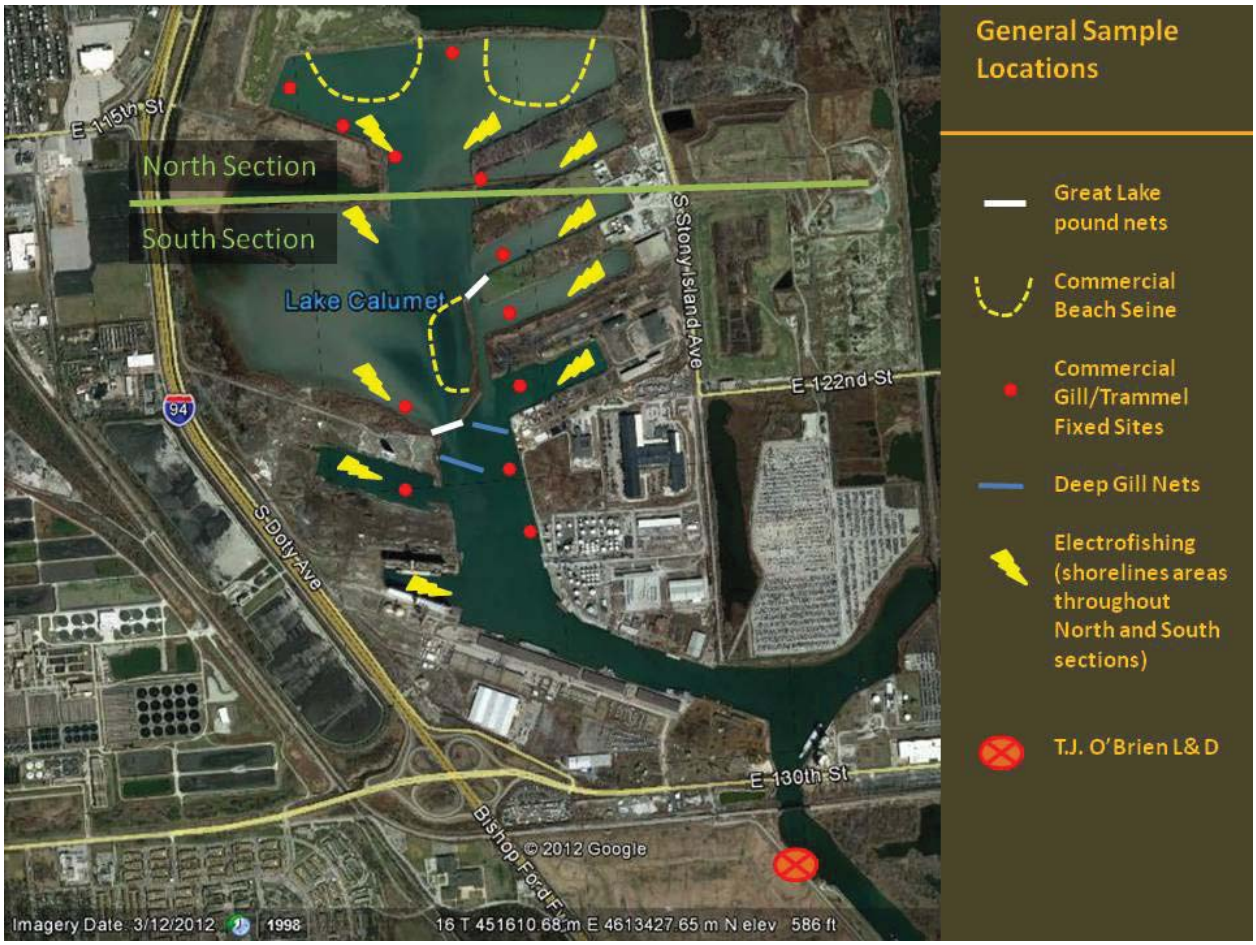


Figure 2. Sampling locations in Lake Calumet. Sample locations are approximate and subject to change.

nets after each electrofishing and fish driving episode so that each team gradually moves toward the site midpoint.

Chicago River and South Branch Chicago River/Bubbly Creek - Electrofishing will occur around the entire shoreline of the basin between Lake Shore Drive and Chicago Lock and near Wolf Point (confluence of the North Branch Chicago River and Chicago River) (Figure 3). During this time net boats will set deep water gill nets (IDNR will provide one 9.1 m (30 ft) deep gill net for each net boat) in areas off of the main navigation channel. Nets will be set for short duration and attended at all times. Noise from "pounding" on the hull of boats and revving trimmed up motors will be used to drive fish into the nets. Electrofishing boats will also be used to drive fish into the nets. When sampling in these areas is complete crews will travel down river and sample eight barge slips and backwater areas in the South Branch Chicago River near Bubbly Creek (Figure 3). Barge slip sampling will have a block net set at the entrance of each slip. Electrofishing boats will then shock from the back of the slip out towards the main channel, driving fish into the block net while collecting stunned fish along the way. A second net may be set midway within longer slips to sample them more effectively.

Figure 3. Sampling locations in the North Shore Channel, Chicago River and South Branch Chicago River/Bubbly Creek area.

In conjunction with sampling efforts in the North Shore Channel and Chicago River, electrofishing and gill/trammel netting will take place at four random site sampling areas throughout the CAWS upstream of the Electric Dispersal Barrier as mentioned above (Figure 1).

For all SIM activities accurate sampling time will be recorded with all fish identified to species. GPS coordinates (decimal degrees) will be taken at the location of all net sets and at the beginning of electrofishing runs. Grass Carp will be kept and put on ice for transfer to Dr. Greg Whitledge (SIU) for ploidy analysis. Any Bighead Carp or Silver Carp collected will immediately be reported to the Operations Coordinator and/or Law Enforcement who will bring a cooler to secure fish. GPS location, time, and specific gear will be recorded as accurately as possible (mesh size, type, depth). Any Asian carp will be transferred to Dr. John Epifanio, with tissues shared among research agencies as per the 2015 MRP. Furthermore, capture of a Bighead Carp or Silver Carp would initiate a level two rapid response upon conferring with MRWG members, additional effort or time frame could change.

2015 Sampling Schedule:

Spring Event
Week of June 8th
Fixed and random area sites upstream of the Electric Dispersal Barrier

Week of June 15th
Lake Calumet, Calumet River and random area sites upstream of the Electric Dispersal Barrier

Fall Event
Week of September 14th
Fixed and random area sites upstream of the Electric Dispersal Barrier

Week of September 21st
North Shore Channel, Chicago River and random area sites upstream of the Electric Dispersal Barrier

Deliverables: Results for SIM will be reported daily during events and compiled for monthly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

Chicago Area Waterway System and Illinois River Below the Barrier Strategy for eDNA Monitoring in the CAWS and Temporal eDNA Quantification Below the Barrier

Lead Agency: US Fish and Wildlife Service

CAWS Monitoring Objectives:

1. Determine whether Asian carp DNA is present in strategic locations in the CAWS to inform status of Asian carp

2. Detect Asian carp DNA in areas that have been monitored since 2009 to maintain annual data collection to maintain vigilance

Illinois River Quantification Objectives:

1. Detect and quantify Asian carp DNA along a gradient in the Illinois River from Lower Lockport Pool to the Marseilles Pool and the lower portion of the Kankakee River. This will complement other field efforts being conducted below the barrier, and may inform control or management actions in the future.

2. Possibly confirm spawning events by timing three collection events pre-spawn, spawn, and post-spawn. This may inform control or management actions in the future.

USFWS FWCOs will be responsible for the field collection of eDNA samples and the Whitney Genetics Lab will be responsible for processing samples. All samples will be collected and processed according to the 2015 QAPP. Only the CAWS results will be posted to this site: http://www.fws.gov/midwest/fisheries/eDNA.html.

Methods of water collection may vary between early detection samples or quantification samples, depending on the results of a methods comparison study currently in review. Early detection and monitoring samples will be collected by either filtering or centrifuging, whichever is approved. Samples below the barrier are not considered early detection and monitoring, thus they will be collected via the centrifugation method which has been in the QAPP since 2013, and has also been successfully applied by other federal agencies in carp-infested waters.

CAWS monitoring details: One event in June 2015; 240 samples. Similar to 2014 MRP, eDNA will not be used as a trigger for rapid response actions. eDNA results will be communicated to the IL DNR as soon as they are available, and then posted on the USFWS eDNA webpage per our communication protocol. A summary of all 2015 eDNA results will be made available to the MRWG at the end of the year.

CAWS Sites and number of samples to be collected:

SITE DESCRIPTION	# SAMPLES
North Shore Channel downstream from the Wilmette Pump Station	60
Chicago River downstream from Chicago Lock	60
Little Calumet River downstream from TJ O'Brien Lock	60
Lake Calumet	60

Illinois River details: Three events in 2015 will occur pre-spawn, during spawn, and post-spawn. Water temperatures will be monitored by FWCO staff and will guide pre-spawn and spawn events. Pre-spawn sampling will be conducted when water temperatures are below 18 ^{o}C, and spawning sampling will occur when water temperatures are between 18-20 ^{o}C. Post-spawn sampling will occur later in the summer during lower flow conditions, and avoid any midsummer rising hydrograph events that may trigger additional spawning activity. During each event, 300-400 samples will be collected at evenly spaced intervals within reaches between barriers relative to total river length. Each sample will consist of a pair of 50-ml centrifuge tubes which will be processed in the lab as a single sample.

Illinois and Kankakee River sites and number of samples to be collected:

SITE DESCRIPTION	# SAMPLES
Lower Lockport Pool (~8 km)	50
Brandon Road Pool (~10 km)	50
Dresden Island Pool (~20 km)	75
Kankakee River to first barrier (~15 km)	75
Marseilles Pool (~40 km)	100
Total	350

Deliverables: Results of the CAWS sampling event will be reported as positive/negative for sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP. Results from the Illinois River events will be reported as positive negative and starting copy number and will be summarized for an annual interim report but will not be posted on line.

Larval Fish Monitoring in the Illinois Waterway

Participating Agencies: INHS (lead), Eastern Illinois University (field and lab support)

Location: Larval fish sampling will take place at 9 sites in the Illinois and Des Plaines River downstream of the electric dispersal barrier (LaGrange, Peoria, Starved Rock, Marseilles, Dresden Island, and Brandon Road Pools), and at two sites in the CAWS upstream of the electric dispersal barrier (Figure 1). Larval fish sampling will also occur at sites in the Sangamon, Salt Fork of the Sangamon, Spoon, and Mackinaw Rivers to assess potential Asian carp spawning in Illinois River tributaries. Sites may be dropped, or additional sites added as needed in order to complete study objectives.

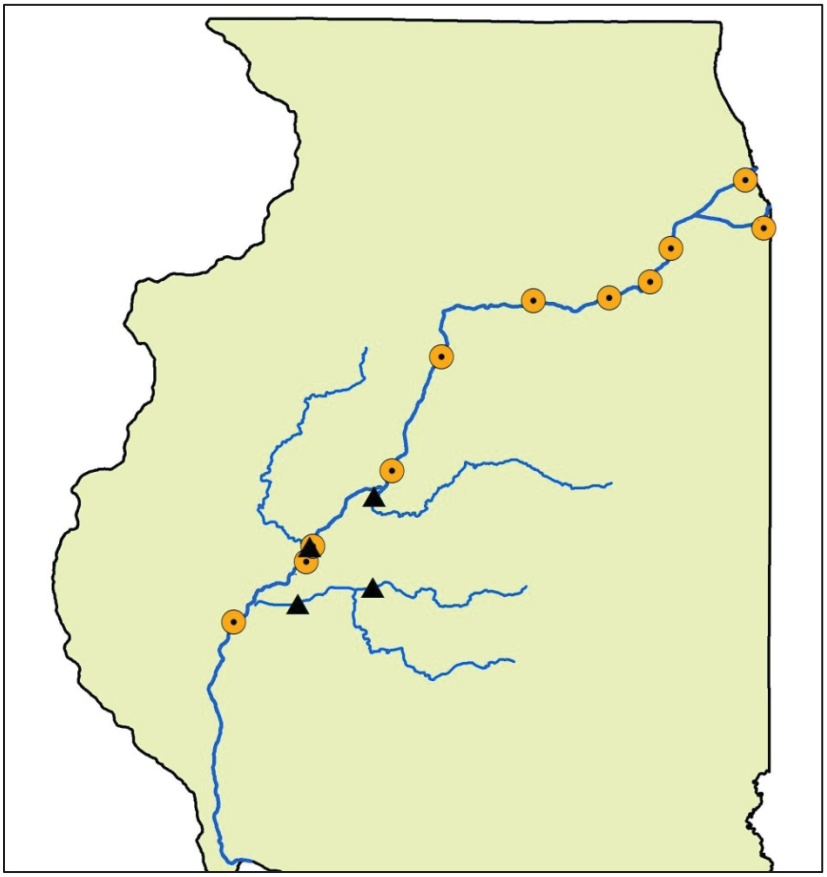


Figure 1. Map of larval fish sampling sites in the Illinois Waterway (circles) and in tributary rivers (triangles).

Introduction and Need: Factors affecting the early life stages of fish strongly influence recruitment to adult populations. An evaluation of Asian carp reproduction and recruitment in different sections of the Illinois Waterway is needed to better understand Asian carp population dynamics in this system and potentially develop management strategies targeting early life stages. Asian carp eggs are semibuoyant and drift in river currents for approximately a day before hatching. Larvae settle in backwaters, creeks, and flooded areas outside of the main channel, which serve as nursery areas. Larval and juvenile Asian carp have previously been collected in the Alton, LaGrange and Peoria Pools of the Illinois River, but the potential for

Asian carp reproduction in upstream reaches or in tributaries of the Illinois Waterway is unknown. Additionally, reproduction and recruitment are known to be highly variable among years in the lower Illinois River. Information on the spatial and temporal distribution of Asian carp eggs and larvae will help to identify adult spawning areas, determine reproductive cues, and characterize relationships between environmental variables and survival of young Asian carp.

Objectives: We are sampling fish eggs and larvae in the Illinois Waterway and its tributaries to:

1.) Identify locations and timing of Asian carp reproduction in the Illinois Waterway;
2.) Monitor for Asian carp reproduction in the CAWS; and
3.) Determine relationships between environmental variables (e.g., temperature, discharge, habitat type) and Asian carp reproduction and recruitment.

Status: During five years of sampling (2010 – 2014), 2,694 larval fish samples have been collected from main channel and backwater sites of the Illinois Waterway, capturing over 86,000 individual larval fish. In all years, Clupeids, primarily gizzard shad (*Dorosoma cepedianum*), were the most numerous larval fish taxa captured, although Cyprinids (excluding Asian carp), Sciaenids, Catostomids, and Centrarchids were also abundant in larval fish samples. Asian carp larvae have been collected in all years, but only from sites in the LaGrange and Peoria Pools. No Asian carp larvae have been observed in any upstream pools, and no evidence of Asian carp reproduction has been found in the CAWS. During 2014, large numbers of Asian carp larvae were observed in the LaGrange (n = 2,573) and Peoria (n = 2,658) Pools, but none were observed upstream of the Peoria Pool. The numbers of Asian carp larvae observed in 2014 were substantially higher than in previous years of ichthyoplankton sampling, suggesting that Asian carp reproductive output was much higher in 2014 than in 2010 – 2013. Sampling in tributaries collected an additional 185 ichthyoplankton samples in 2014, capturing over 4,700 larval fish and over 1,800 eggs. Processing and identification of these samples is ongoing. Additionally, over 19,000 potential Asian carp eggs have been tentatively identified from Illinois River samples. Subsamples of potential Asian carp eggs have been sent to the USFWS Whitney Genetics Lab for genetic confirmation and results of egg collections will be reported once questions regarding egg identification have been clarified.

Asian carp appear to have had multiple spawning events in 2014, as indicated by the timing of larval occurrences. The first observations of significant numbers of Asian carp larvae occurred at multiple sites in the LaGrange Pool on June 18. None were collected at these same sites during the week of June 23. However, at that time, high densities of Asian carp larvae appeared in the Peoria Pool. During the following week (June 30 – July 4), large numbers of Asian carp larvae were again collected from main channel sites in the LaGrange Pool, and then large numbers of Asian carp larvae appeared in LaGrange Pool backwater sites during the week of July 7. These occurrences of Asian carp larvae coincided with a prolonged rise in the hydrograph that occurred between mid-June and mid-July, as well as water temperatures continuously above 23°C. The continued presence of small numbers of Asian carp larvae from mid-July to early August in both the LaGrange and Peoria Pools suggests that additional, although less prolific spawning activity continued to occur during the summer in 2014. Few larval fish of any taxa were collected after August.

Methods: Larval fish samples will be collected using a 0.5 m-diameter ichthyoplankton push net with 500um mesh. To obtain each sample, the net will be pushed upstream using an aluminum

frame mounted to the front of the boat. Boat speed will be adjusted to obtain 1.0 – 1.5 m/s water velocity through the net. Flow will be measured using a flow meter mounted in the center of the net mouth and will be used to calculate the volume of water sampled. Fish eggs and larvae will be collected in a meshed tube at the tail end of the net, transferred to sample jars, and preserved in 90% ethanol. Four larval fish samples will be collected at each mainstem and backwater site on each sampling date. Sampling transects will be located on each side of the river channel, parallel to the bank, at both upstream and downstream locations within each study site. At tributary sites, three samples will be collected on each sampling date, one near each bank and another in the center of the channel. In the laboratory, fish eggs and larvae will be separated from other materials. All eggs will be retained for future analyses, whereas larval fish will be identified to the lowest possible taxonomic unit. Larval fish densities will be calculated as the number of individuals per m^3 of water sampled.

Sampling Schedule: In 2015 and subsequent years, larval fish sampling will occur at approximately biweekly intervals at all sites from April to October. Sampling may occur more frequently during periods when Asian carp eggs and larvae are likely to be present (e.g., during spring months, during periods of rising water levels, or shortly after peak flows).

Deliverables: Results of each sampling event will be reported for monthly sampling summaries. Data will be summarized and project plans updated for annual revisions of the MRP.

Young-of-Year and Juvenile Asian Carp Monitoring

Participating Agencies: IDNR (lead); INHS, USFWS, and USACE (field support)

Location: Sampling will take place in the Illinois River, Des Plaines River, and CAWS.

Introduction and Need: Bighead Carp and Silver Carp are known to spawn successfully in larger river systems where continuous flow and moderate current velocities transport their semi-buoyant eggs during early incubation and development. Spawning typically occurs at water temperatures between 18°C and 30ºC during periods of rising water levels. Environmental conditions suitable for Asian carp spawning may be available in the CAWS and nearby Des Plaines River, particularly during increasingly frequent flooding events.

Successful reproduction is considered an important factor in the establishment and long term viability of Asian carp populations. The risk Asian carp will establish viable populations in Lake Michigan increases if either species is able to successfully spawn in the CAWS. Successful spawning in the upper Des Plaines River also could pose a threat because larval fish may be washed into the CSSC upstream of the electric dispersal barrier during extreme flooding. The transport of larvae to the CSSC can occur despite the installation of concrete barrier and fencing between the waterways because larval fish are small enough to pass through the ¼-inch (6.4 mm) mesh fencing used for the separation project. Whereas larvae washed into the CSSC likely would be transported downstream past the electric dispersal barrier during flooding, these fish might become established in the lower Lockport Pool and recruit to the juvenile life stage. This poses a threat because small fish <3.0 inches (76.2 mm) long might be capable of swimming upstream past the electric dispersal barrier at the current settings (Holliman 2011). An additional threat may occur if juvenile Asian carp from spawning events in downstream pools disperse to the Lockport Pool via navigation locks. Even though there has been no evidence of successful Asian carp reproduction in the CAWS, Des Plaines River, or upper Illinois River, targeting young-of-year and juvenile Asian carp in monitoring efforts is needed because these life stages may not be detected in conventional sampling geared toward adults.

Objectives: We will use multiple gears suitable for sampling small fish to:

1) Determine whether Asian carp young are present in the CAWS, lower Des Plaines River, and Illinois River; and
2) Determine the uppermost waterway reaches where young Asian carp are successfully recruiting.

Status: Sampling for young Asian carp as part of standard monitoring began in late summer 2010 and continued through 2013. Electrofishing protocols for fixed site monitoring upstream and downstream of the electric dispersal barrier were modified to include small fish sampling. Small mesh gill nets (mesh sizes = 0.75-2.0 inches(19.1-50.8 mm)) and mini-fyke nets were added to the gear evaluation study and fished at several stations in the Illinois River, Des Plaines River, and CAWS. No young Asian carp were captured with any sampling gears upstream of Starved Rock Lock and Dam. For more detailed results see 2013 interim summary report document (MRWG 2014).

Methods: As in the past, 2014-2016 sampling for young-of-year and juvenile Asian carp will take place through other projects of the MRP. Projects included are Larval Fish and Productivity Monitoring, Seasonal Intensive Monitoring in the CAWS, Fixed Site Monitoring Downstream of the Dispersal Barrier, Gear Efficiency and Detection Probability Study, Rapid Response Actions in the CAWS, Barrier Maintenance Fish Suppression Project, and the Des Plaines River and Overflow Monitoring Project. Electrofishing protocols will include subsampling schools of small fish <6 inches (152.4 mm) long (typically gizzard shad) by netting a portion of each school encountered during each electrofishing transect. Netted small fish will be held in a holding tank and examined individually for the presence of Asian carp before being returned to the waterway. Keeping small fish tallies separate from larger fish will provide an estimate of the relative abundance of young Asian carp in each sample of small fish.

In addition to electrofishing, mini-fyke nets, beach seine and small mesh gill nets will be fished at several stations in the Illinois Waterway and CAWS (see Gear Efficiency Study) and mini-fyke nets will be fished at fixed sites downstream of the electric dispersal barrier (see Fixed Site Sampling Downstream of the Dispersal Barrier below). These gears will be set in shallower habitats off of the main navigation channel and fished for 1-2 net-nights (mini-fyke), 8-10 hauls (beach seine) and 32-128 hours (small mesh gill nets). Mini-fyke nets will be incorporated into fixed site monitoring plans upstream of the electric dispersal barrier if successful spawning and recruitment of young Asian carp progresses up the waterway closer to Lake Michigan.

Additional sampling gears that target Asian carp, such as purse seine and pound nets, will be used and are currently being evaluated. We will add new gears to our arsenal of sampling tools pending results and recommendations of current researchers. The beach seine will be used in targeted monitoring of Asian carp in tributaries and backwater habitats of the Illinois Waterway downstream of the Brandon Road Lock and Dam as part of a new study evaluating distribution and movement of small Asian carp (see Distribution and Movement of Small Asian Carp in the Illinois Waterway plan).

Sampling Schedule: Small fish sampling will take place from March through December, as part of other monitoring projects in the MRP.

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

Distribution and Movement of Small Asian Carp in the Illinois Waterway

Participating Agencies:
USFWS Carterville Fish and Wildlife Conservation Office (lead), USFWS Columbia Fish and Wildlife Conservation Office (field support)

Location:
Areas sampled will be within the Peoria, Starved Rock, Marseilles, and Dresden Island pools. Known populations of adult Asian carp exist in all pools of the Illinois River Waterway (IWW) from Dresden Island downstream. To date, the farthest upstream extent of small (≤ 300mm TL) Asian carp recorded in the Illinois River has been near the town of Henry, Illinois (Peoria County) at river mile 194 where young of year (YOY) Silver Carp were collected in June 2012 (USFWS unpublished data).

Introduction:
The bigheaded carps herein referred to as Asian carp, include the Silver Carp (*Hypophthalmichthys molitrix)* and Bighead Carp (*H. nobilis)* as well as hybrids between these species. Populations of these two introduced aquatic nuisance species are spreading throughout the Mississippi River Basin (Conover et al. 2007; Chapman and Hoff 2011; O'Connell et al. 2011). Kolar et al. (2007) rated the probability of Silver Carp and Bighead Carp spreading to previously uncolonized areas as "high" and assigned this rating a "very certain" degree of certainty. Asian carp are highly invasive species that have been expanding their range in the U.S. since the early 1980's when they first began to appear in public waters (Freeze and Henderson 1982; Burr et al 1996). Populations of Asian carp have grown exponentially because of their rapid growth rates, short generation times, and dispersal capabilities (DeGrandchamp 2003; Peters et al. 2006; DeGrandchamp et al. 2008). Asian carp have been shown to exhibit very high reproductive potential with high fecundity and the potential for a protracted spawning period (Garvey et al. 2006). Garvey et al. (2006) stated that high reproductive capacity of both species, in particular Silver Carp ensure that attempts to exclude or remove individuals will require a massive undertaking that targets young small-bodied fish as well as adults.

Populations of Asian carp have become well established in the lower and middle reaches of the Illinois River. Because of the connection of the upper IWW to Lake Michigan, natural resource managers are concerned about the potential invasion of Asian carps into the Great Lakes (Conover et al. 2007). If Asian carp gain entry into Lake Michigan they could pose a significant threat to fisheries by competing with established, economically and recreationally important species for limited plankton resources (Sparks et al. 2011). Kolar et al. (2007) noted that the most probable pathway for gaining access to the Great Lakes is through the Chicago Sanitary and Shipping Canal (CSSC). Therefore, the CSSC is also the key to stopping large numbers of Asian carp from expanding their range into Lake Michigan and the Great Lakes (Conover et al. 2007).

At present an electric dispersal barrier operated by the U.S. Army Corps of Engineers (USACE) is intended to block the upstream passage of Asian carp through the CSSC. Laboratory testing has shown that the operational parameters currently in use at the barrier are sufficient to stop large bodied fish from passing through (Holliman 2009). However, recent testing of operational

parameters using small Bighead Carp (51 to 76 mm total length) revealed that operational parameters may be inadequate for blocking small fish passage (Holliman 2011). Recent work by USFWS has shown that tethered Gizzard Shad (*Dorosoma cepedianum*) can be entrained by barges and transported upstream through the electric dispersal barrier (Parker and Finney 2013). Additionally, work completed in 2013 by USFWS using a pair of Dual Frequency Identification Sonar units (DIDSON) showed that small fish (unknown species observed on sonar) are able to move upstream through the electric dispersal barrier (Parker et al. 2013). For this reason there exists some concern that small sized Asian carp, if present, might represent a threat to breach the electric barrier. This highlights the need to better define the distribution and demographic characteristics of small Asian carp in the middle and upper IWW allowing us to fully characterize and assess the risk they may pose to the barriers. Additionally, there is an ongoing need to understand the reproduction of these species in the IWW so that managers might better target small sized fish for eradication or other management actions in the future.

The purpose of this study is to establish where young (YOY to age 2) Asian carp occur in the IWW through intensive, directed fish sampling that targets these life stages. For the purposes of this study, fish specimens less than 300mm total length will be considered "small fish" based on previously published estimates of age-one and age-two Bighead Carp (Shrank and Guy 2005) and Silver Carp (Williamson and Garvey 2005). Sampling will employ the best known methods for detection and collection of Asian carp (Irons et al. 2011). Gears used will include small-mesh fyke nets, pulsed-DC boat electrofishing, and surface, mid-water and benthic trawls. In isolated off channel backwater areas seines may be used when appropriate. Medium sized gill nets may also be utilized to capture age-1and age-2 individuals. The use of small-mesh fyke nets and boat electrofishing has been shown to provide complimentary information when employed in shallow water areas (Ruetz et al. 2007). Results from 2012 sampling indicate that trawls provide complimentary information to the above methods.

Status:
This is a continued MRP project for 2015. Sampling conducted during 2014 using mini-fyke nets, push trawls, and electrofishing gears produced a total catch of 39,409 fish with 82 species represented in the Dresden Island, Marseilles, and Starved Rock reaches of the IWW. No YOY or age-1 Asian carp were captured or observed.

Objectives:

1) Determine the distribution, abundance, and age structure of any small Asian carp that may be present in the middle and upper IWW.
2) Use distribution and abundance data to characterize the risk that small Asian carp pose to the Great Lakes via the Chicago Area Waterway System.

Methods:
Fish Capture
Site/Habitat Selection - Sites selected will be in areas off of the navigation channel. These areas may include backwaters, isolated pools, side channels, side channel borders, and/or tributary mouths. Efforts will be made to sample areas which are difficult to sample using traditional fisheries boats (traditional fisheries boats are already collecting small fishes on other projects in the area). Shallow backwaters and isolated pools disconnected from the main channel, except

during flooding events are areas that small Asian carp likely occupy but are rarely, if ever sampled. Sample sites will be determined from analysis of LTRMP GIS data. Final in-field site selection will be left ultimately to the discretion of the biologist in the field subject to on-site realities (e.g. a given site may be dry so an alternative nearby site would be chosen instead).

Fyke Netting - Nets used will be Wisconsin type mini-fyke nets set and fished overnight. Mini-fyke nets will be set in both single and tandem configurations depending on site characteristics. Single nets are set with the end of the lead staked against the shoreline or some other obstruction to fish movement. Tandem nets (with leads attached end to end) are fished in open water areas.

Seining - In areas with wade-able depths and sufficiently firm substrate for seining, small meshed seines may be used. Examples of habitats to be sampled by seining include isolated pools, or other areas inaccessible to boats. Seines will include 4.6 m x 1.8 m, 4.8 mm mesh straight seine, and a 9.1 m x 1.8 m, 4.8 mm mesh bag seine.

Electrofishing - Fifteen minute daytime pulsed-DC electrofishing sampling will be conducted. Asian carp specific electrofishing settings will be used with the Midwest Lakes Electrofishing System Infinity control box. All fish will be collected and at the end of each 15 minute run fish will be processed. Common carp and adult Silver Carp observed will be counted but not netted.

Push-trawl and/or Mini-mamou Trawl Sampling - Push-trawl and/or Mini-mamou Sampling surface/mid-water will be employed concurrently with netting and electrofishing sampling. Trawl runs will be made in shallow water (0.5 m to 2.0 m water depth habitats). Sampling effort will be quantified by length of trawl haul and number of hauls. Quantification of catch per unit effort (CPUE) will be the number of individuals per species per square meter trawled. Target lengths of trawl hauls will be between 25 and 100 meters but will vary with the amount of fishable habitat present at a given location. The push-trawl employed has a skate balloon trawl net of 4mm mesh, 1.8 m body length, 0.76x0.38 m otter boards, 2.4 m foot rope, and an effective net fishing width 1.8 m across. The Mini-mamou net is 8m wide, 0.75 m deep, 38 mm stretch mesh, with a 6 mm mesh liner and mullet doors. Gear selection will depend on habitat characteristics.

Experimental Tri-trawl and/or Paupier Net Sampling
The Tri-trawl is a variation of Missouri Trawl that incorporates a wider size range of mesh that will target YOY carp from 20 mm to 150 mm in size. The net is deployed from the front of a small (18 ft) boat that has a deployable fixed frame measuring 2 meters wide X 1.5 meters deep. This net will be tested this year and potentially be electrified. As the net is proven to catch Asian carp in high density areas, it may be used in conjunction with CAWS sampling as described in the document. CPUE will be measured as square meters trawled.
Paupier Net sampling has proven to be effective for all size ranges of Silver Carp. The boat that deploys the net can be used in water around 1 meter deep. The net used will consist of 23 mm mesh that tapers back 6 m to a 4 mm cod bag. The net will be supported around a 4 m wide X 1.7 m deep electrified frame on both sides of the boat. Although this small size net has yet to be tested, it is expected to not only catch the smallest size carp, but also juvenile and adults. Nets will be deployed in 7 minute tows in open water as habitat conditions allow. Catch (CPUE) will be calculated as number of individuals captured by minute.

Medium size gill netting
During spring and fall sampling medium mesh (2.5 -3.5" square mesh) gillnets will be utilized to capture any age-1 individuals that may be present in sampling areas. This gear is not typically utilized during standard sampling or commercial removal efforts. Sampling this segment of the population will allow us to make generalized assumptions about recruitment from the previous year and provide subjects that may be tagged for telemetry studies of small Asian carp.

Fish Identification and Archiving - All fish other than Asian carp collected will be identified to species, counted, and most native fish will be released. Large collections of small bodied fishes will necessarily be preserved and returned to the laboratory for identification and enumeration. Asian carp will be identified, measured for total length (mm), weighed to the nearest gram, and destroyed or given to researchers for ageing, or other life history data collection. A subsample of any small Asian carp specimens captured will be preserved as vouchers and retained to provide a permanent record. Vouchers of any additional exotic species collected will be preserved for archiving. Exotic fish species not preserved for voucher specimens will be destroyed. Any preserved voucher specimens will be deposited into one or more fish collections including Southern Illinois University at Carbondale, Illinois Natural History Survey, and the Field Museum of Natural History. Any Illinois state threatened or endangered species incidentally taken will be deposited at Southern Illinois University at Carbondale (SIUC). Element Occurrence and Sighting Report Forms for all T&E species incidentally collected will be submitted to the Illinois Natural Heritage Program.

Asian Carp Aging and Natal Water Determination - Lapilli otoliths and post-cleithrum bones will be removed from a subsample of Asian carp collected from each site. Otoliths and post-cleithra from up to 30 fish will be removed, placed in individually marked envelopes and returned to the lab for ageing. Asian carp less than 300 mm TL will be aged and Asian carp collected from isolated habitats will be aged to determine when they may have become entrained in those areas. Lapilli will be processed and aged following procedures of Maceina and Sammons (2006). Two independent readers will make annuli counts and a third reader will resolve disagreements between readers. Postcliethral bones will be sectioned with a Buhler isomet low speed saw and aged under a dissecting microscope.

Habitat Measurements - Macro habitat information will be recorded for each sampling location (e.g. backwater, side channel border, tributary mouth). Physical and chemical habitat measurements will be made at each collection site. Habitat measurements will be recorded at the time of each net retrieval, electrofishing run, or seine haul. Global Positioning System (GPS) coordinates will be recorded for all net sets, beginning and end of electrofishing runs and trawl hauls, and locations of seine hauls. Physical measurements will include: depth, Secchi depth, and substrate composition (i.e. mud, sand, silt, vegetation, gravel, etc.). Water quality measurements will include: temperature, salinity, specific conductance, dissolved oxygen, and pH. Water quality measurements will be taken with an analytical instrument (YSI Professional Series multi-meter).

Data Analyses - Descriptive statistics such as presence/absence and mean counts from fish capture data will be presented. Graphs of raw numbers of Asian carp caught using the different

gear types will be used to determine which method is most effective at capturing small fish. Chemical/physical variables will be summarized at each site using principal components analysis (PCA). The PC scores will be plotted on a PCA bi-plot and the scores labeled by pre-assigned categories related to Asian carp (zero carp, low carp, med carp, and high carp). Fish capture data will be used to determine if certain environmental conditions are associated with their presence/absence or relative abundance. Fish age data will be presented graphically.

Fish Sampling Frequency and Effort - Sampling will occur beginning with a targeted effort to capture age-1 individuals in April. During the months of June through September one week per month will be spent sampling areas which are difficult to access with traditional fisheries boats but can be sampled with our shallow drive (mud motor) boat. Nets will be set and run in the morning (overnight sets) and electrofishing done in the afternoons. Experimental net testing will be conducted as time and resources permit. In addition to boat accessible areas, two weeks will be devoted to sampling five isolated areas which are disconnected from the main channel of the river except in times of overtopping floods. This sampling will take place between May and the end of September.

Small Asian Carp Sampling

Gear Type	Time Frame	Duration	Locations
Gill netting	April	Two weeks	Peoria and Starved Rock Pools
Boat Electrofishing	June-September	One Week/Month	Starved Rock, Marseilles, Dresden Pools
Mini-fyke Netting	June-September	One Week/Month	Starved Rock, Marseilles, Dresden Pools
Push Trawl/Mamou	June-September	One Week/Month	Starved Rock, Marseilles, Dresden Pools
Experimental Net testing	June-September	As opportunities present	Starved Rock, Marseilles, Dresden Pools
Isolated Backwater Sampling	June-September	Two weeks between May and October	Starved Rock, Marseilles, Dresden Pools

Project Schedule:

February - March 2015

Gear preparation, field logistics planning, crew scheduling

April - September 2015

Fish sampling, fish identification in lab, aging, data entry, fish data analysis

October - November 2014

Complete fish identification and aging, data entry

December 2014 - January 2015

Data analyses and draft annual report generation

Deliverables:

Annual report to the MRWG in winter 2014-2015, as requested. Any findings of small carp in areas significantly upstream towards the electric barrier will be reported immediately to Todd Turner, USFWS Assistant Regional Director-Fisheries or Charlie Wooley, USFWS Deputy Regional Director - Region 3 and the MRWG. A final report will be given to the MRWG upon completion of this work, pending future year funding.

Fixed Site Monitoring Downstream of the Dispersal Barrier

Participating Agency: IDNR (lead); USACE and USFWS (field support)

Location: Monitoring will take place in the CSSC, lower Des Plaines River and upper Illinois River. Specifically, we will sample the Lockport Pool downstream of the Dispersal Barrier and the Brandon Road, Dresden Island, and Marseilles Pools.

Introduction and Need: Standardized sampling can provide useful information to managers tracking population growth and range expansion of aquatic invasive species. Information gained from regular monitoring (e.g., presence, distribution, and population abundance of target species) is essential to understanding the threat of possible invasion upstream of the Electric Dispersal Barrier. For this project, we use pulsed-DC electrofishing, hoop and minnow fyke netting, and contracted commercial netters to sample for Asian carp in the four pools below the Electric Dispersal Barrier. A goal of this monitoring effort is to identify the location of the detectable population front of advancing Asian carp in the Illinois Waterway and track changes in distribution and relative abundance of leading populations over time. The detectable population front is defined as the farthest upstream location where multiple Bighead or Silver Carp have been captured in conventional sampling gears during a single trip or where individuals of either species have been caught in repeated sampling trips to a specific site. Monitoring data from 2010-2014 has contributed to our understanding of Asian carp abundance and distribution downstream of the Electric Dispersal Barrier and the potential threat of upstream movement toward the CAWS. Based on data collections from 2010-2014, sampling efforts upstream of the Electric Dispersal Barrier will continue with the two seasonal sampling events in June and September, to allow an increase in sampling efforts downstream of the Electric Dispersal Barrier. This plan of effort will allow the opportunity to better assess Asian carp abundances and distributions downstream of the electric dispersal barrier.

Objectives: Standardized sampling will consist of DC electrofishing, hoop and minnow fyke netting, and contracted commercial netting to:

1) Monitor for the presence of Asian carp in the four pools below the Electric Dispersal Barrier;
2) Determine relative abundance of Asian carp in locations and habitats where they are likely to congregate;
3) Supplement Asian carp distribution data obtained through other projects (e.g., Asian Carp Barrier Defense Project); and
4) Obtain information on the non-target fish community to help verify sampling success, guide modifications to sample locations, and assist with detection probability modeling and gear evaluation studies.

Status: This project began in 2010 and is on-going. Samples were taken at four fixed sites in each of the four pools once monthly from April through November 2010 and March through November 2011, 2012, 2013, and twice monthly in 2014 with pulsed-DC electrofishing gear and from July through September 2010, April through November 2011, March through November 2012, March through December 2013, and April through December 2014 with trammel and gill nets. In total, 9,983.5 estimated person-hours of labor were expended to complete 409 hours of

electrofishing and deploy 398.84 miles of trammel/gill net over the five years. A total of 306 hoop and 144 minnow fyke nets were set in the four downstream pools from August through December 2012 and April through November 2013 - 2014. No Bighead or Silver Carp have been captured by electrofishing or netting in Lockport and Brandon Road pools, although one adult Bighead Carp was observed in Brandon Road Pool by a net crew in October 2011. Monitoring indicated higher abundance of Bighead and Silver Carp in Marseilles Pool than Dresden Island Pool. For more detailed results see 2014 interim summary report document (MRWG 2015).

Methods: Fixed and random electrofishing and contracted netting effort will remain the same in 2015. Seasonal sampling events will take place in the CAWS in June and September. During those two months contracted commercial fishing efforts will target locations above the electric dispersal barrier.

The sample design includes intensive electrofishing and netting at four fixed sites and8 random sites in each of the four pools below the electric dispersal barrier (Figure 6). Fixed and random site electrofishing will take place bi-weekly from March through November. Contracted commercial netting will take place bi-weekly from March through December, except during June and September, and will include four fixed sites and 13, 13, and 24 random sites in the Lockport, Brandon Road, and Dresden Island pools, respectively. Hoop netting and contracted commercial netting in the Marseilles Pool will be removed from the schedule in 2015 as the Barrier Defense Project is actively targeting and collecting adult Asian Carp in this pool.

An additional change to the contracted commercial fishing plan is to have the fisherman fish for a predetermined number of hours with no minimum yardage. Each fisherman will fish in a different pool each day, and target fishing areas instead of using computure generated random sites. This will allow for greater potential for catching Asian carp. Also fishing will occur in Rock Run Rookery Preserve Lake each Friday schedule fishing takes place.

The fixed sites in each of the four pools are located primarily in the upper ends below lock and dams structures, and in habitats where Asian carp are likely to be located (backwaters and side-channels). Random electrofishing and contracted commercial fishing sites could occur anywhere within each pool, including the lower portion of each pool. The Kankakee River from the Des Plaines Fish and Wildlife Area boat launch downstream to the confluence with the Des Plaines River, are included in the Dresden Island Pool random sites. Hoop and minnow fyke netting will take place at four fixed sites in each pool on a monthly schedule from April through December. No sampling at fixed sites is planned for January or February because several of the sites are typically ice covered during these months.

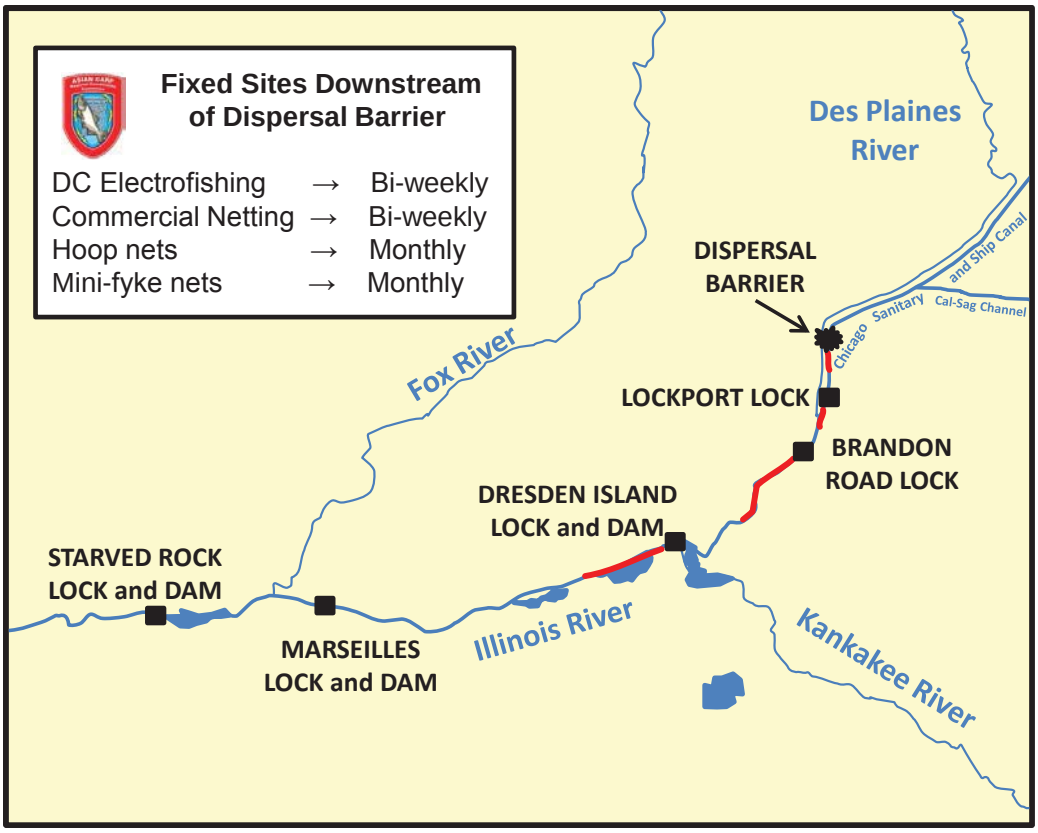


Figure 6. Map of fixed sites for electrofishing and commercial net sampling for Asian carp downstream of the Dispersal Barrier.

Fixed Sites Downstream of the Dispersal Barrier Description and Effort: A description of fixed site locations and sampling effort targets is summarized below. There are four (4) 15 minute electrofishing runs, four (4) 200-yard trammel/gill net sets, eight (8) hoop net nights with 6-foot diameter hoop nets, and four (4) mini-fyke net nights planned for each of the four pools. Hoop and mini-fyke nets will be deployed at or near trammel/gill net sites. See Appendix B for detailed maps of each site.

Lockport Pool

- 1E1 starts at the Romeo Road Bridge on the east side of the canal and goes downstream
- 1E2 starts at the north end of the large haul slip of Hanson Material Services on the west side of the canal and goes downstream
- 1E3 starts at the upstream end of the MWRD Controlling Works and goes downstream
- 1E4 starts at the Rt. 7 Bridge on the west shore and goes downstream

- 1G1 is in the big haul slip of Hanson Material Services.
- 1G2 is upstream of Rt. 7 Bridge on the west side of the canal
- 1G3 is just downstream of the Rt. 7 Bridge on the west side of the canal
- 1G4 is just downstream of Cargill Grain Elevator on the west side of the canal

Brandon Pool

- 2E1 is in the bay below the Lockport Hydropower Plant
- 2E2 starts just above the confluence of the CSSC and Des Plaines River and goes downstream
- 2E3 starts just above the confluence of the Des Plaines River and the Illinois Michigan Canal and goes up the canal
- 2E4 starts at the I-80 Bridge and goes downstream along the east shore

- 2G1 just downstream of the confluence of the Des Plaines River
- 2G2 at the confluence of the Illinois Michigan Canal
- 2G3 just downstream of I-80 on the east shoreline
- 2G4 between I-80 and the Brandon Road Lock & Dam

Dresden Island Pool

- 3E1 in the bay on east side of river below the Brandon Road Dam
- 3E2 starts at the lower end of Treats Island and goes up into the side channel
- 3E3 is in Mobil Oil Corporation Cove
- 3E4 starts at I-55 Bridge on southeast shoreline and goes downstream

- 3G1 is in the bay on east side of river below the Brandon Road Dam
- 3G2 downstream of the casino on the west side of the river
- 3G3 in the lower end of the Treats Island side channel
- 3G4 is in Mobil Oil Corporation Cove

Marseilles Pool

- 4E1 along the west side of Big Dresden Island
- 4E2 along the east shoreline across form Big Dresden Island
- 4E3 at the back end of the north portion of Peacock Slough
- 4E4 is the south portion of Peacock Slough

- 4G1 is just upstream of the mouth of Aux Sable Creek
- 4G2 is at the mouth of the Commonwealth Edison Co. Cove
- 4G3 is just inside the north portion of Peacock Slough
- 4G4 is in the back of the south portion of Peacock Slough

Electrofishing Protocol - All electrofishing will use pulsed-DC current and include 1-2 netters (two netters preferred). Locations for each electrofishing transect will be identified with GPS coordinates. Electrofishing transects should begin at each coordinate and continue for 15 minutes in a downstream direction in waterway channels (including following shoreline into off channel areas) or in a clockwise direction in backwater sloughs. Fixed site sampling locations will remain the same throughout the year and should be sampled with each site visit. This represents a change from past years when exact sampling areas within the sites were left to the discretion of the field crews and should lead to more consistent monitoring results.

While electrofishing, operators may switch the safety pedal on and off at times to prevent pushing fish in front of the boat and increasing the chances of catching an Asian carp. All fish

will be netted and placed in a tank where they will be identified, counted and check for floy tags, after which they will be returned live to the water. Periodically, a subsample of 10 fish of each species per site will be measured in total length and weighed to provide length-frequency data for gear evaluations. Schools of young-of-year gizzard shad <6 inches (152.4 mm) long will be subsampled by netting a portion of each school encountered and placing them in a holding tank along with other captured fish. Young-of-year shad will be examined closely for the presence of Asian carp and counted to provide an assessment of young Asian carp in the waterway. We will count all captured Asian carp, as well as those observed but not netted. We may observe more Asian carp than we net because of the difficulty in capturing these fish with electrofishing gear. Sample data sheets are included in Appendix F. Crew leaders should fill in as much information on the data sheets as possible for each station/transect and record the location for the start of each run either with GPS coordinates (decimal degrees preferred) or by marking on attached maps.

Netting Protocol – Contracted commercial fishers will be used for net sampling at fixed sites and nets used will be large mesh (3.0-4.0 inches (76.2-101.6 mm)) trammel or gill nets 8-10 feet (2.4-3 m) high and in lengths of 200 yards (182.9 m). Locations for each net set will be identified with GPS coordinates. Net sets will take place within 500 yards (457.2 m) of a designated coordinate at a specific location agreed upon by the commercial fisher and attending IDNR biologist. Sets will be of short duration and include driving fish into the nets with noise (e.g., plungers on the water surface, pounding on boat hulls, or racing tipped up motors). In an effort to standardize netting effort, sets will be 15-20 minutes long and ―pounding‖ will extend no further than 150 yards (137.2 m) from the net. Nets will be attended at all times. Captured fish will be identified to species and tallied on standard data sheets. Periodically, a subsample of 10 fish of each species per site will be measured in total length and weighed. Locations of net sets should be recorded with GPS coordinates (decimal degrees preferred) or by marking on attached maps. An IDNR biologist or technician will be assigned to each commercial net boat to monitor operations and record data.

Single hoop nets will be deployed by IDNR biologists at four locations in the Lockport, Brandon Road, and Dresden Island pools, where they will be fished for two days each month. Specific set locations will vary, but nets typically will be set offshore, in current, and parallel to the navigation channel. Four mini-fyke nets will be set at four locations in each of the four pools and fished for one net-night per month. Mini-fyke nets will be set in shallow off-channel areas with leads affixed to the shoreline and running perpendicular to shore. Though hoop and mini-fyke nets will be left unattended, care will be taken to set them in locations that will not interfere with commercial navigation or recreational boat traffic.

Suggested boat launches for fixed site sampling.
Lockport Pool – Cargill Launch – Inform Martin Castro of MWRD.

Brandon Road Pool –Ruby Street Launch in Joliet on the west side of the river.

Dresden Island Pool – Big Basin Marina under the I-55 Bridge on north side of the river. Contact Russ to get let in without paying. If you have to pay you can take the receipt to Office to get reimbursed.

Marseilles Pool – Stratton State Park Launch in Morris on the north side of the river.

Sampling Schedule: A tentative sampling schedule for electrofishing and netting for 2015 is shown in the table below. Hoop and mini-fyke netting will occur monthly either the week before or after the week of scheduled electrofishing and netting.

Electrofishing Downstream of Barrier

Week	Agency
16-Mar	IDNR/USACE
30-Mar	USFWS/USACE
13-Apr	IDNR/USACE
27-Apr	USFWS/USACE
11-May	IDNR/USACE
25-May	USFWS/USACE
8-Jun	SIS
15-Jun	SIS
13-Jul	USFWS/USACE
27-Jul	IDNR/USACE
10-Aug	USFWS/USACE
17-Aug	IDNR/USACE
31-Aug	USFWS/USACE
14-Sep	SIS
21-Sep	SIS
12-Oct	IDNR/USACE
26-Oct	USFWS/USACE
16-Nov	USFWS/USACE
23-Nov	IDNR/USACE

Contracted Netting Below Barrier

Week	Agency	Week	Agency
16-Mar	IDNR	27-Jul	IDNR
30-Mar	IDNR	10-Aug	IDNR
13-Apr	IDNR	17-Aug	IDNR
27-Apr	IDNR	31-Aug	IDNR
11-May	IDNR	14-Sep	IDNR (SIS)
25-May	IDNR	21-Sep	IDNR (SIS)
8-Jun	IDNR (SIS)	12-Oct	IDNR
15-Jun	IDNR (SIS)	26-Oct	IDNR
13-Jul	IDNR	16-Nov	IDNR
		30-Nov	IDNR

Fixed Site Hoop and Mini-Fyke Netting Below Barrier

Week	Agency
30-Mar	IDNR
27-Apr	IDNR
18-May	IDNR
22-Jun	IDNR
13-Jul	IDNR
10-Aug	IDNR
28-Sep	IDNR
26-Oct	IDNR

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

Response Actions in the CAWS

Participating Agencies: IDNR (lead); INHS, USFWS, and USACE (field support), USCG (waterway closures when needed), USGS (flow monitoring and dye tracking when needed), MWRD (waterway flow management and access), USEPA and GLFC (project support)

Location: Rapid response removal actions will take place in the CAWS upstream of Brandon Road Lock and Dam.

Introduction and Need: Preventing Asian carp from gaining access to Lake Michigan via the CAWS requires monitoring to detect and locate potential invaders and removal efforts to reduce population abundance and the immediate risk of invasion. Removal actions that capture or kill Asian carp once their location is known may include the use of conventional gears (e.g., electrofishing, nets, and commercial fishers), experimental gears (e.g., Great Lake pound nets, and deep water gill nets), and chemical piscicides (e.g., rotenone), or all strategies. Decisions to commence removal actions, particularly rotenone actions, often are difficult due to high labor, equipment, and supply costs. Furthermore, a one-size-fits-all formula for rapid response actions is not possible in the CAWS because characteristics of the waterway (e.g., depth, temperature, water quality, morphology, and habitat) are highly variable. A threshold framework for response actions with conventional gear or rotenone was developed in the 2011 MRRP. Proposed thresholds were meant to invoke consideration of removal actions by the MRWG, and were not intended to be rigid triggers requiring immediate action. Final decisions to initiate response actions and the type and extent of each action were ultimately based on the best professional judgment of representatives from involved action agencies.

Objectives: The plan objectives are:

1) Remove Asian carp from the CAWS upstream of Brandon Road Lock and Dam to Lake Michigan when warranted; and

2) Determine Asian carp population abundance through intense targeted sampling efforts at locations deemed likely to hold fish.

Status: Response actions to capture and remove Asian carp from the CAWS began in February 2010 and will continue as needed. Since 2010, an estimated 19,388 person-hours were expended monitoring fixed and random sites in the CAWS upstream of the Electric Dispersal Barrier. Total effort was 769.4 hours of electrofishing (3,064 transects), 524 km (325.6 mi) of gill/trammel net (2,695 sets), 3.7 km (2.3 mi) of commercial seine hauls and 25.2 net-days of hoop and trap nets (11sets) from 2010-2014 (Table 1). The use of hoop nets and trap nets was suspended after 2013 due to low gear efficiency. A total of 278,991 fish representing 72 species and 6 hybrid groups have been sampled since 2010. Three planned intensive surveillance events were conducted in 2013: Lake Calumet, North Shore Channel and Chicago River. The Lake Calumet event was preceded by eDNA sampling, which yielded 6 positive detections for Silver Carp DNA. North Shore Channel and Chicago River planned intensive surveillance events were not preceded by eDNA sampling due to government furlough. Planned intensive surveillance was labor intensive and employed extensive sampling effort targeting any Asian carp that might be present in the waterway. An estimated 1,165 person-hours during 2013 was spent on planned

intensive surveillance. Effort for all events in 2013 was 45.8 hours of electrofishing (174 transects), 9.1 miles (14.6 km) of trammel/gill net (110 sets), 0.7 miles (1.1 km) of deep gill net (12 sets), 1.4 miles (2.3 km) of commercial seining (3 hauls), 8.8 trap net-days and 16.4 hoop net-days. Across all events and gears in 2013, we sampled 22,896 fish representing 50 species and 3 hybrid groups. Gizzard Shad, Common Carp, Bluegill and Freshwater Drum were the predominant species sampled. In addition, we examined 4,757 YOY Gizzard Shad and found no Asian carp YOY.

In the 2014 Seasonal Intensive Monitoring, an estimated 2,205 person-hours were utilized to complete 87.1 hours of electrofishing (348 transects), set 77.7 km (48.3 mi) of trammel/gill net (440 sets) and 1.4 km (0.9 mi) of commercial seine. Across all locations and gears, 27,678 fish representing 57 species and 2 hybrid groups were sampled in 2014. In addition, we examined 9,837 YOY Gizzard Shad and found no YOY Asian carp. Since 2010 only one Bighead Carp has been captured above the Electric Dispersal Barrier, all additional monitoring and response efforts have yielded no Bighead Carp or Silver Carp being captured or observed.

Methods: We will use radio telemetry, conventional gears, experimental gears and/or rotenone to locate, capture and remove Asian carp from CAWS upstream of Brandon Road Lock and Dam to Lake Michigan. Each response action will be unique to location, perceived severity of the threat, and likelihood of successfully capturing an Asian carp. For example, observation of a live Asian carp from a credible source at the shallow North Shore Channel might elicit a 2- to 3-day conventional gear response with two electrofishing and netting crews. Capture of a live Asian carp at the same location might initiate a 2-week response with 5-10 sampling crews and additional types of gear. Furthermore, capture or credible observations of multiple Asian carp in a deep-draft channel, such as the Little Calumet River below O'Brien Lock, might call for an emergency rotenone action to eradicate the local population. In general, small-scale removal actions will require fewer sampling crews and gear types than larger events, although all events will include multiple gears for more than one day of sampling and participation by commercial fishers, if available.

New methods to drive, capture, and kill Asian carp are constantly being developed and evaluated as part of the ACRCC Framework (see water gun, gear evaluation, and alternative gear projects in this plan). Such techniques may allow biologists to drive or attract Asian carp to barge slips or other backwater areas where they can be captured more easily or killed. We will incorporate new technologies in response actions when they have been sufficiently vetted and shown to be of practical use.

Threshold Framework-
Data from ECALS has revealed the uncertainty of eDNA positive detections originating from a live, free swimming fish, and several vectors have been identified as potential sources in addition to a live fish. Intensive sampling over the several years, including response actions triggered by detection of Asian carp DNA, has resulted in no Asian carp being observed or captured. At present, the detection of eDNA evidence within a sampled reach cannot verify whether live Asian carp are present, whether the DNA may have come from a dead fish, or whether water containing Asian carp DNA may have been transported from other sources such as boat hulls,

storm sewers, sediment, piscivorous birds or nets used by contracted commercial fishers. It is also not fully understood how environmental variables (e.g. temperature, conductivity, pH, etc.) impact the detection rate, degradation rate, or persistence of DNA in the environment. In light of this information, the MRWG proposes this framework to guide management decisions on response actions in the CAWS where eDNA is no longer a response trigger. Therefore, the observation, capture or a detection of a radio tagged live Asian carp by a credible source would be triggers for initiating a response.

The proposed thresholds for response actions with conventional gears and rotenone apply to monitoring efforts from the CAWS upstream of Brandon Road Lock and Dam. Again, this threshold framework is meant to inform decisions to initiate response actions and guide the level of sampling effort put forth during such actions. Actual decisions to respond and the type, duration, and extent of response actions will be made by agency representatives with input from the MRWG. Action agencies also may conduct targeted response actions at selected locations in the CAWS outside the rapid response threshold framework when information gained from such actions may benefit monitoring protocols, research efforts, or Asian carp removal and control efforts.

The threshold framework includes three levels of response triggers and a feedback loop that advises for continued sampling or an end to the action (Figure 1). The first threshold level (Level 1) includes the observation of live Asian carp by a credible source (i.e., fisheries biologist or field technician). A suggested response for Level 1 might include 2-4 electrofishing boats and crews and 1-2 commercial fishing boats and crews sampling for 2-3 days. A Level 2 threshold

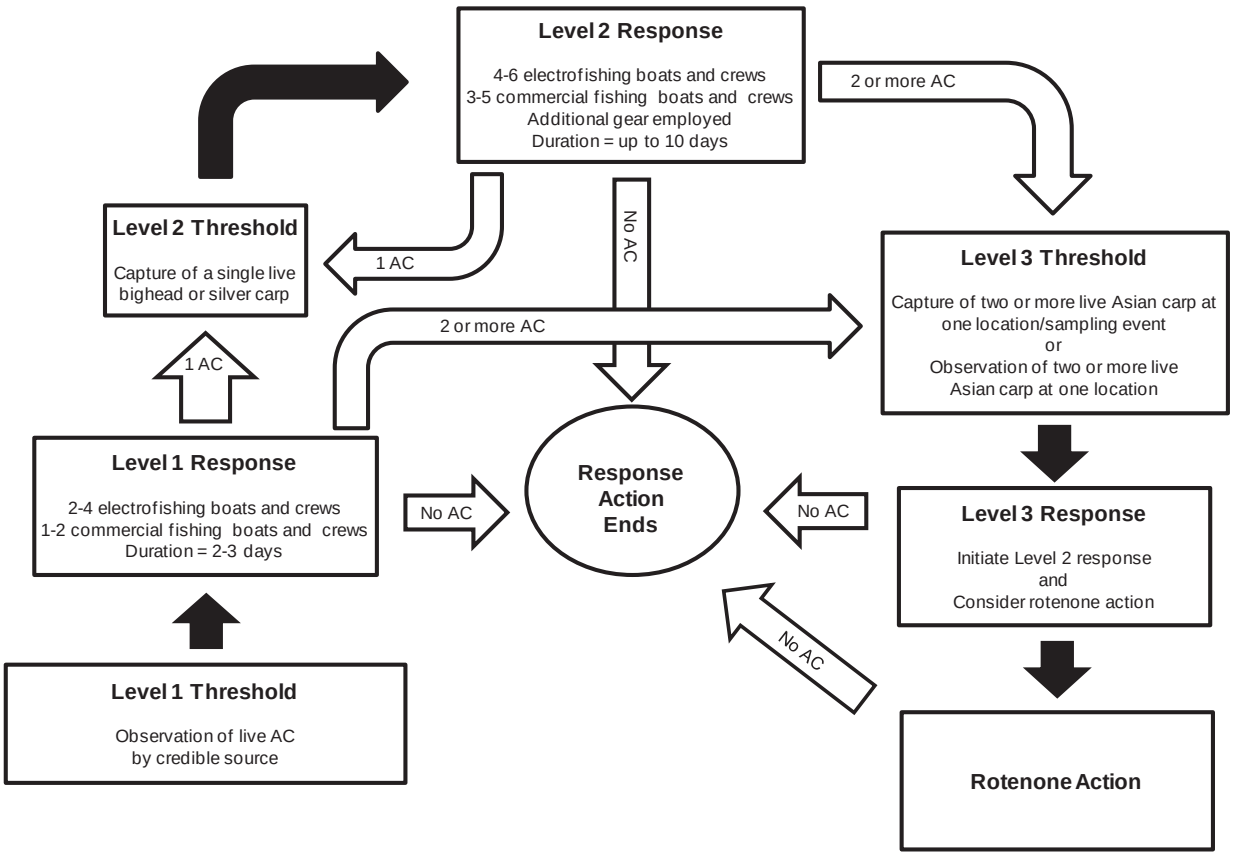


Figure 1. Thresholds for Asian carp (AC) response actions with conventional gears and rotenone.

would include the capture of a single live Bighead Carp or Silver Carp. A Level 2 response might employ 4-6 electrofishing boats and crews, 3-5 commercial fishing boats and crews, and additional gears (e.g., hydroacoustics, commercial seines, and trap or fyke nets). Level 2 events might last up to 10 days. The capture of two or more Asian carp from a single sampling event-location or the credible observation of two or more Asian carp at one location would signify a Level 3 threshold. Crossing the Level 3 threshold would trigger an immediate Level 2 conventional gear response action and consideration of a rotenone response. Where feasible (e.g., non-navigation reaches, barge slips, backwater areas), block nets will be used in an attempt to keep Asian carp in the area being sampled. The final decision to terminate a response will rely on best professional judgment of participating biologists, managers, and agency administrators.

Sampling Schedule: Response actions will be dependent upon the credible observation, capture or radio tagged detections of live Asian carp and recommendations from the MRWG.

Deliverables: Results for each removal action will be reported daily during events and compiled in monthly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

Barrier Maintenance Fish Suppression

Participating Agencies: IDNR (lead);, INHS, USFWS, USACE and USGS (field support); USCG, USEPA and MWRD (project support)

Location: Sampling to assess abundance of Asian carp may take place in the Lockport Pool of the CSSC between Lockport Lock and Power Station and the Electric Dispersal Barrier System (RM 291.0-296.1). Fish clearing activities using a variety of both traditional and novel techniques and surveillance utilizing both hydroacoustic and sonar based surveys will occur between the demonstration barrier and barrier 2A. The work area will be extended about 0.25 miles (0.4 km) in both upstream and downstream directions if a backup rotenone action is necessary to allow for chemical application and detoxification stations.

Introduction and Need: The USACE operates three electric aquatic invasive species barriers (Demonstration Barrier, Barriers 2A and 2B) in the CSSC at approximate river mile 296.1 near Romeoville, Illinois. The Demonstration Barrier is located farthest upstream (800 feet (243.8 m) above Barrier 2B) and is operated at a setting that has been shown to repel adult fish. Barrier 2A is located 220 feet (67.1 m) downstream of Barrier 2B and both of these barriers now operate at parameters that have been shown to repel fish as small as 3.0 inches (76.2 mm) long in the laboratory (Holliman 2011). Barrier 2A and 2B must be shut down annually for maintenance and the IDNR has agreed to support maintenance operations by providing fish suppression at the barrier site. Fish suppression can vary widely in scope and may include application of piscicide (rotenone) to keep fish from moving upstream past the barriers when they are shut down. This was the scenario for a December 2009 rotenone operation completed in support of Barrier 2A maintenance, which was before Barrier 2B was constructed. With Barrier 2A and 2B now operational, fish suppression actions will be smaller in scope because one barrier can remain on while the other is taken down for maintenance.

The Demonstration Barrier (Demo Barrier), Barrier 2B and Barrier 2A have previously been operated with the Demo Barrier in continuous operation and only Barrier 2B or Barrier 2A in concurrent operation. Since January 2014, all three electric dispersal barriers have operated concurrently to increase redundancy in the event of an unplanned shutdown. With this barrier operation protocol, IDNR will lead fish surveillance and suppression at the barrier whenever the barriers system experiences a planned or unplanned shutdown that creates an opportunity for fish passage in the upstream direction. Fish suppression is necessary because, based on 3 years of conventional fish sampling and eDNA monitoring in the CAWS upstream and downstream of the Dispersal Barrier, there is a possibility that Asian carp could be present in this reach of the waterway, potentially immediately below the barrier system. Fish passage opportunities may occur when the furthest downstream active barrier experiences a loss of power in the water allowing fish to move upstream to the next active barrier. Those fish may then be entrained between two electric fields until the next upstream barrier allows passage during an outage or they are flushed downstream. This creates an unacceptable level of risk that Asian carp could gain access to the upper CAWS and Lake Michigan, and reduces the redundancy that is considered an essential feature of the entire barrier system. The intent is to drive fish below the barrier system after repairs and/or maintenance have been completed and normal operations have been resumed.

Following is a generalized plan to provide fish suppression at the barriers in support of Barrier maintenance. Operations to clear fish may take from 1-5 days and may include any combination of traditional and novel collecting and driving techniques and, if necessary, a small-scale rotenone action. A plan is also included for intensive fish sampling to detect presence and assess abundance of Asian carp that may be in the canal immediately downstream of the barrier.

By selecting a cut-off of 305 mm (12 inches) in total length for fish clearing activities, sub adult and adult Asian carp are targeted. Excluding young-of-year Asian carp from the assessment is based on over three years of sampling in the Lockport Pool with no indication of any young of the year Asian carp present or any known location of spawning. Additionally, eggs, larvae, or young-of-year have not been observed upstream of Starved Rock Lock and Dam in a decade.

A key factor to any response is risk of Asian carp being at or in the barrier. The MRWG (Monitoring and Response Workgroup) has taken a conservative approach to barrier responses in that there is little evidence that Asian carp are directly below the barrier, but with the understanding that continued work and surveillance below the electric barriers is necessary to maintain appropriate response measures. With budgetary costs, responders safety and surveillance findings in mind the MRWG will direct response needs as best professional judgment suggests. A barrier maintenance clearing event will be deemed successful when all fish >305 mm (12 in) in total length are removed from the barrier or until MRWG deems the remaining fish in the barrier as a low risk.

Objectives: The IDNR will work with federal and local partners to:

1) Remove fish >305 mm (12 in) in total length between Barrier arrays before maintenance operations are initiated by collecting or driving fish from the area with mechanical technologies or, if needed, a small-scale rotenone action; and
2) Assess the success of fish clearing operations by surveying the area between Barrier arrays with remote sensing gear (split-beam hydroacoustics and side-scan sonar). Success is defined as no fish >305 mm (12 in) in total length located between barrier arrays, as determined with remote sensing gear or the MRWG deems the remaining fish in the barrier as a low risk.

Status: Fixed and Random Sampling downstream of the Electric Dispersal Barrier has revealed that Asian carp abundances in the Lockport and Brandon Road Pool are very low or nonexistent currently. Hydroaucostic sampling continues to demonstrate overall fish densities in these pools are also low.

Methods:

- *Project Overview* – Our current approach to fish suppression at the barrier is to first survey the area with remote sensing gears to assess the need for fish clearing operations either in support of planned barrier maintenance or after an unplanned power loss. If fish >305 mm (12 in) in total length are present, then mechanical collection or driving techniques will be used to move fish downstream out of the target area. A request for no flow conditions will be made to MWRD for a 2-hour period during surveillance and clearing operations. If mechanical clearing fails and there is a high risk for Asian carp to

be in the barrier, response actions may be elevated to a small-scale rotenone to clear fish from the area. Finally, a plan is included for intensive sampling in the Lockport Pool downstream of the barrier to further measure the risk of Asian carp presence at the barrier during maintenance.

Remote Sensing and Mechanical Clearing Operations- Surveys will be conducted with split beam hydroacoustics and side scan sonar to determine if fish are present in the target area and to evaluate the success of mechanical fish clearing actions. Clearing will be considered successful when no fish larger than 305 mm (12 in) are observed between the barriers or the MRWG deems the remaining fish in the barrier as a low risk. By selecting a cut-off of 305 mm, we will be targeting sub adult and adult Asian carp, and excluding young-of-year fish. Excluding young-of-year Asian carp from the assessment is appropriate because there is no indication of their presence in the Lockport Pool based on over three years of intensive physical monitoring. Currently, the known location of spawning adults is downstream of the Starved Rock Lock and Dam (MRWG 2014). Additionally, Asian carp eggs, larvae, and young-of-year fish have not been captured or observed upstream of Starved Rock Lock and Dam since targeted sampling began in 2006. Our approach may be considered conservative because sub adult and young-of-the-year Asian carp have never been captured upstream of the Starved Rock Pool.

Multiple surveys are necessary to enhance confidence in results that fish are either present or absent from the area between the barriers. The principal remote sensing tools are split-beam hydroacoustics and side scan sonar. These gears are operated simultaneously and provide about 98% coverage of the waterway with just three passes of the barrier area (10- to 15-minute survey duration; see 2014 Barrier Maintenance Fish Suppression final report in MRWG 2014).

During a typical maintenance shutdown, a request will be sent to the MWRDGC to reduce or halt canal flows and then remote sensing gears will be deployed to survey the target area. The detection of fish >305 mm (12 in) in total length within the target area will initiate mechanical suppression actions. Mechanical suppression will begin with surface pulsed-DC electrofishing in conjunction with noise generation to drive fish from the area and may include additional clearing techniques such as a surface to bottom 30 foot (9.1 m) gill net set across the canal in the designated safety zone area, US Geologic Survey water guns, and/or a deep-water pulsed-DC electrofishing boat. Figure 1 provides a map and description of a mechanical fish clearing operation at the Dispersal Barrier.

A second set of surveys will occur after mechanical removal operations have taken place with both barriers operational to assess the effectiveness of mechanical removal efforts. It is beneficial to have low flow conditions during remote sensing surveys to reduce interference with hydroacoustics scans caused by air bubbles entrained in the water column. Operators at MWRDGC have been helpful in modifying flows to assist with fish clearing operations. A third set of surveys will take place before recommendations are given to shut down Barrier 2B. The presence of any large juveniles or adult fish (>12 inches (305mm) long) between the barriers MRWG deems a high risk for Asian carp, signifies a rotenone action likely will be necessary to eliminate fish from the area. In contrast, a pre-planned rotenone action may be cancelled if mechanical suppression is shown to be successful.

Canal closures may not be necessary for remote sensing surveys when one barrier is operating (2A or 2B); however, they will be needed for mechanical fish suppression activities. Typically, IDNR will make a request to USCG for safety zone closures to navigation in the vicinity of the barriers for 5 hours each morning (7:00 a.m. to 12:00 p.m.) on 4-5 days during the week of barrier maintenance fish clearing. A contingency week should also be planned in case equipment failure or inclement weather precludes operations. All closure requests will be made 45 days prior to a planned event.

Barrier Defense Asian Carp Removal Project

Participating Agencies: IDNR (lead)

Location: The Barrier Defense Project will target the area between the Starved Rock Lock and Dam up to the Dispersal Barrier at Romeoville. The primary focus area will be the Starved Rock and Marseilles Pools.

Introduction and Need: This project uses controlled commercial fishing to reduce the numbers of Asian carp in the upper Illinois and lower Des Plaines rivers downstream of the Dispersal Barrier. By decreasing Asian carp numbers, we anticipate decreased migration pressure towards the barrier and reduced chances of carp gaining access to upstream waters in the CAWS and Lake Michigan. Trends in harvest data over time may also contribute to our understanding of Asian carp population abundance and movement between pools of the Illinois Waterway. The project was initiated in 2010 and is ongoing using ten contracted commercial fishing crews to remove Asian carp with large mesh (3.0 - 5.0 inch)(76.2 – 127mm) trammel nets, gill nets and other gears on occasion (e.g., seines and hoop nets).

Objectives: Ten commercial fishers will be employed to:

1) Harvest as many Asian carp as possible in the Starved Rock and Marseilles Pools. Harvested fish will be picked up and utilized by private industry for purposes other than human consumption; and
2) Gather information on Asian carp population abundance and movement in the Illinois Waterway downstream of the Dispersal Barrier as a supplement to fixed site monitoring.

Status: Contracted commercial fishers and assisting IDNR biologists deployed 1359.2 miles (2186.9 km) of gill and trammel net, 3.1 miles (5.0 km) of commercial seine and 196 hoop net sets in the upper Illinois Waterway since 2010. A total of 70,882 Bighead Carp, 191,031 Silver Carp, and 1,718 Grass Carp were removed by contracted netting. The total weight of Asian carp removed was 1493.94 tons. For more detailed results see the 2014 interim summary report document (MRRWG 2014).

Methods: Contract Commercial fishing will take place from March through December. Contract commercial fishing will occur in the target area of Marseilles and Starved Rock Pools. This target area is closed to commercial fishing by Illinois Administrative Rule; therefore an IDNR biologist will be required to accompany commercial fishing crews working in this portion of the river. Five commercial fishing crews per week with assisting IDNR biologists will fish Tuesday through Friday of each week, 1-2 weeks each month of the field season. Due to fishing pressure driving fish out of areas and greatly reducing catches, harvest events will be scheduled at every-other week intervals to allow fish to repopulate preferred habitats in between events. Fishing will occur in backwater areas known to hold Asian carp, main channel, and side channel habitats. Specific netting locations will be at the discretion of the commercial fishing crew with input from the IDNR biologist assigned to each boat. Large mesh (3.0 – 5.0) (76.2 – 127mm) trammel and gill net will be used and typically set 20-30 minutes with fish being driven to the nets with noise (e.g., pounding on boat hulls, hitting the water surface with plungers, running with motors tipped up). Nets will be occasionally set overnight off the main channel, and non-

public backwaters with no boat traffic. Biologists will enumerate and record the catch of Asian carp and identify the by-catch to species. Asian carp and common carp will be checked for ultrasonic tags and ultrasonic tagged fish and by-catch will be returned live to the water. All harvested Asian carp will be removed and transferred to a refrigerated truck and taken to a processing plant where they will be used for non-consumptive purposes (e.g., converted to liquid fertilizer). Each harvest event a representative sample of up to 30 of each Asian carp species (Bighead, Silver, and Grass carp) from each pool will be measured in total length and weighed in grams to provide estimates of total weight harvested.

Suggested Boat Launches for Barrier Defense Harvesting:

Marseilles Pool – Stratton State Park Launch in Morris on the north side of the river.

Starved Rock Pool – Allen Park Launch in Ottawa off Route 71 on the south side of the river or Starved Rock Marina off of Dee Bennett Road on the north side of the river.

Sampling Schedule: A tentative sampling schedule for 2015 is shown in the table below.

Week of	Agency	Week of	Agency	Week of	Agency
Mar 9	IDNR	Jun 1	IDNR	Oct 19	IDNR
Mar 23	IDNR	Jul 6	IDNR	Nov 2	IDNR
Apr 6	IDNR	Aug 3	IDNR	Nov 16	IDNR
Apr 20	IDNR	Aug 24	IDNR	Nov 30*	IDNR
May 4	IDNR	Sep 7	IDNR		
May 18	IDNR	Oct 5	IDNR		

* Weather permitting.

Deliverables: Results of each sampling event will be reported for weekly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

Identifying Movement Bottlenecks and Changes in Population Characteristics of Asian Carp in the Illinois River

Participating Agencies: SIU (lead)

Introduction:

Recent evidence has suggested that the Electric Dispersal Barrier in the Chicago Area Waterway System (CAWS) may not be as effective as once thought to inhibit all fish movement (e.g., Parker et al. 2013). Although the risk of an Asian carp breach is currently considered to be low due to the absence of Asian carp in the area of the Electric Dispersal Barrier, harvest of Asian carp downstream of the electric barrier may help to reduce the probability of Asian carp challenging the barrier during a chance event that could allow them to successfully breach the barrier. However, the extent to which the intensive efforts of Asian carp removal are curtailing the probability of upstream movement is largely unknown.

A previously developed Asian carp population model (Tsehaye et al. 2013) provided a reasonable first step at determining the efficacy of Asian carp harvest as a control option. The results from this model suggested requirements of an exploitation rate of 70% on all sizes of Asian carp (both bighead and silver carp) to overfish the population to functional extinction within the lower three reaches of the Illinois River (i.e., Alton, La Grange, and Peoria pools). The results from recent commercial harvest experiments conducted by SIUC suggest that we are not meeting these requirements, at least in terms of size selectivity (past reports). Despite the observed size selectivity, field information collected in intensively harvested areas has yielded promising results that are consistent with demographic changes expected to occur in heavily fished populations.

Prior studies at SIUC have also shed light on the movement of Asian carp, showing that upstream movement of Asian carp occurs in the spring of each year with carp moving upstream as far as the Starved Rock pool from the confluence with the Mississippi River. Immigration rates from the Mississippi River to Illinois River were measured at 30% in 2010, and up to 57% in 2013 (during a flood year). Movement corresponded with elevated flow in the river during spring through summer for all years fish have be monitored with acoustic transmitters. Asian carp that moved upstream typically returned to downstream locations in late summer or early fall. Our newest data suggest that the probability of Asian carp moving between the Peoria and Starved Rock pools and the Starved Rock and Marseilles pools is relatively low, suggesting that these area may act as natural barriers to carp movement. However, results from mark-recapture studies (prior SIU reports) suggest that immigration into the Marseilles pool is high throughout spring, summer and fall, contributing to a continuous stream of immigrants to that pool. Where these immigrants are coming from and how fish are passing upstream is unclear.

Need:

First, there is a need to address the inadequacies of the previous Asian carp population model (Tsehaye et al. 2013) to make it more useful in terms of decision making relative to the spatial allocation of harvest to minimize propagule pressure on the Electric Dispersal Barrier. As such,

an updated model is needed that includes necessary spatially explicit components that incorporate empirically derived probability of movement across the entire Illinois River. A more refined model should also make use of all available demographic data that has been, and will be, collected from various sources, including investigating the use of Long Term Resource Monitoring Program (LTRMP) data and other standardized sampling programs to develop stock-recruitment relationships for silver and bighead carp.

To inform the population model, additional hydroacoustic surveys need to be completed to measure changes in the Asian carp population with controlled fishing. Additional monitoring of fish densities (via hydroacoustics) and movement is necessary to determine the success of control efforts, advise control efforts, and monitor the progress (i.e., invasion front) of Asian carp toward the CAWS. Control efforts of Asian carp are still underway in the Illinois River. Because removal could affect density, size, biomass, age structure, and movement of Asian carp throughout the river, many pertinent questions still need to be answered relative to fish movement. Specifically, is movement related to lock and dam structure, leading to a partially isolated population in the upper Illinois River (likely between Peoria and Starved Rock, also Starved Rock and Marseilles)? If so, can this population be further isolated with barrier technology and reduced? Furthermore, if fish are moving through the Starved Rock and Marseilles Lock chambers, which fish are moving (e.g., small fish, large fish, Bighead Carp, Silver Carp) and when?
Finally, hybridization may influence the movement, spawning, and feeding ecology of fish. The degree to which silver carp and bighead carp are hybridizing throughout the river has implications for invasibility in the CAWS and the Great Lakes. Thus, continuous monitoring of hybridization rates throughout the Illinois River is necessary.

Objectives and Benefits Expected:

Spatially explicit population model

1. *Update reach-specific Asian carp demographic parameter estimates (abundance, age and size distribution, growth, survival, condition, maturation schedule) using Bayesian methodology by summer 2015.* The predictions from the model will benefit from the additional years of collected data and a Bayesian approach will provide a more realistic understanding of our uncertainty in model predictions.
2. *Refine silver and bighead carp stock-recruitment relationships by summer 2015; the uncertainty in the stock-recruitment relationships were found to be the largest source of variation in the Tsehaye et al. 2013 model.* A more refined stock-recruitment relationship will provide a more realistic depiction of how Asian carp populations will respond to intense harvest and reduce the uncertainty related to various harvest strategies evaluated.
3. *Develop a spatially explicit Asian carp population model for the Illinois River waterway that incorporates inter-reach movement probabilities by summer 2015.* This will facilitate switching of the models objective function from the goal of fishing the Asian carp population to extinction to long-term minimization of Asian carp propagule pressure on the Electric Dispersal Barrier.

4. *Use the newly developed model to predict the number of Asian carp that would reach the Electric Dispersal Barrier on the Chicago Sanitary and Ship Canal under various harvest scenarios during fall and winter 2015.* The results of this modeling endeavor will facilitate management decisions regarding the spatial allocation of harvest to maximize the effectiveness of Asian carp removal efforts.

Probability of movement and dam passage – telemetry, tagging, and hybridization

1. *Identify control points or immigration pathways for Asian carp that will inform removal efforts, specifically between the Starved Rock, Marseilles, and Dresden Island pools of the Illinois River by spring of 2016 by intensifying tracking efforts around lock an dams and in backwater areas.* This work will be completed by an incoming MS student at SIUC and will allow us to identify areas where further isolation of Asian carp populations is possible and where removal efforts should be concentrated.
2. *Test the alternative hypothesis that fish are moving through the lock chamber at Starved Rock, but we are not detecting them.* Are we "missing" fish because we don't have enough tagged or are small fish (that we have been unable to catch) moving, and if so, when are they moving?
3. *Determine the probability of movement between Illinois River pools and relate this movement to commercial fishing activity, fish density, temperature, river discharge, or other environmental parameters to inform the spatially explicit population model (v2.0) by winter 2015.* This will allow us to inform movement parameters in the Asian carp population model, make predictions about times when the probability of carp migrations will be greatest, and identify areas of high Asian carp use (or preference by correlating movement with environmental variables and productivity measurements (Casper; IRBS-Havana).
4. *Refine survival, immigration, and exploitation rates for backwaters of the Illinois River using all acoustic derived information and jaw tag returns by May 2015.* These additional parameters will inform the spatially explicit population model and provide a way to measure the success of control efforts in backwaters.
5. *Measure changes in the rate of Asian carp hybridization throughout the river by genetically identifying up to 50 fish per pool (completed on all fish that are tagged with acoustic transmitters as of July 2014), and relate to movement of these fish to determine how hybridization impacts movement and invasion (by September 2015).* This will allow us to measure changes in hybridization relative to movement, fish density, commercial fishing (fish reduction), and additional demographic data that has been collected since 2012.

Abundance and Demographics

1. *Determine the current density, biomass, species composition, and size structure of Asian carp in the Illinois River.* This will allow us to identify natural barriers to movement and inform commercial fishing efforts (e.g., additional locations of fish congregations). This

will also provide baseline population data necessary for parameterization of the spatially explicit population model. Population estimates necessary for model parameterization (prior years: 2012-2014) will be completed during 2015. Additional hydroacoustic surveys will be completed in summer/ fall of 2015.

2. *Detect changes in the Asian carp population in response to the ongoing removal efforts in the upper reaches of the Illinois River.* This will allow us to quantify the effect that removal efforts are having on Asian carp populations in areas of differing densities, and provide an additional tool to help locate fish congregations for targeted removal.

Approach:

Spatially explicit population model

Asian carp demographic parameters will be updated using existing Asian carp data from all possible sources (state and federal agencies and universities). Data from the LTRMP and any other sources with reliable standardized approaches will be used to investigate the development of species-specific stock recruitment relationships. Catch per unit effort data may at the very least facilitate the scaling of stock-recruitment parameters. Additional explanatory variables, such as river discharge, will be evaluated in these relationships to explain additional recruitment variation. If the catch per unit effort data prove to be inadequate for the development of stock-recruitment relationships, an alternative approach would be to use a similar approach that was used in Tsehaye et al. 2013, but narrow the pool of stocks down to similar species rather than the all-encompassing approach previously used. If this approach is adopted, it will be necessary to explore varying annual recruitment to capture the boom and bust nature of Asian carp recruitment patterns. Similar to the Tsehaye et al. 2013 model, a Bayesian approach will be used for parameter estimates to allow for the incorporation of individual variability and parameter uncertainty in model simulations.

Re-parameterization and a refined population model will be applied to each reach of the Illinois River (i.e., Alton, La Grange, Peoria, Starved Rock, Marseilles, Dresden, Brandon Road, and Lockport pools) to develop a *spatially explicit* Asian carp population model. The upper reaches (upstream of the Peoria pool) will be distinct in that adult Asian carp will be assigned a very low probability of successful reproduction such that this rare possibility is at least included in the model for conservative measures. Movement probabilities of Asian carp among all reaches based on empirical data will be incorporated and will likely include other explanatory variables regarding the probability of movement, including size, temperature, and hydrography (see *Probability of Movement and Dam Passage*).

Harvest scenarios evaluated will include, but will not be limited to: 1) a baseline strategy of no harvest, 2) harvest Asian carp from only the upper reaches, 3) harvest of Asian carp from only the downstream reaches, 4) harvest along the entire Illinois River waterway, 5) spatially dynamic strategy in which commercial fisherman are responding to changes in catch rates in an effort to maximize their catch per effort, 6) and an optimization approach that can facilitate an adaptive management approach (i.e., the best place to fish may change seasonally). Other goals would be to define the exploitation levels or target density levels required to minimize movement

probabilities of Asian carp to the electric barrier and how size-selectivity influences our results. Other reasonable harvest scenarios will be obtained through discussions with the Illinois Department of Natural Resources. Under each harvest strategy, the probability of Asian carp making it to Lockport pool will be determined with confidence bounds based on individual variability, environmental variability, and parameter uncertainty. An odds ratio approach will be adopted to examine the relative improvement of one strategy relative to others.

Probability of movement and dam passage-telemetry and tagging

To identify control points or immigration pathways that will inform removal efforts, specifically between the Starved Rock, Marseilles, and Dresden Island pools of the Illinois River, we plan to increase active tracking in the upper Peoria, Starved Rock, Marseilles, and Dresden Island (assisted by USACE) pools. Additional stationary VR2W receivers will also be deployed around the Starved Rock and Marseilles Locks and Dams to measure 3-dimensional movement patterns. We will increase active tracking in backwaters and between main channel receivers to correspond with removal efforts and plankton sampling (Illinois River Biological Station-Havana) and hydroacoustic surveys (SIUC) to determine where fish are located between VR2W detections. Because some acoustic transmitters are expiring this year, we will tag up to 50 additional fish (25 bighead carp and 25 silver carp) per pool of the Illinois River to continue to monitor how fish movement is influenced by control efforts and environmental variables. Finally, to bolster estimates of survival, exploitation, and immigration from 2012-2013 (and further inform the spatially explicit population model) mark-recapture models will be run and completed by May 2015 to incorporate all acoustic tagging and jaw tagging information. Additional fish (up to 1000) will be tagged with jaw tags and acoustic transmitters (up to 50) in the upper Peoria pool just below Starved Rock and Dam to determine if we are missing fish moving with the low number of active receivers in the Peoria pool. Any 2015 jaw-tagged fish that are recaptured by commercial fishermen above the Starved Rock Lock and Dam will indicate more fish passage than we were detecting with acoustic receivers. We will attempt to focus our tagging efforts (with the help of contracted commercial fishermen) on small Asian carp. Increased hydroacoustic surveys will also be added to this area of the river in 2015 to correspond to observed movement patterns of tagged fish.

Hybridization may influence the movement, spawning, and feeding ecology of fish, with implications for invasibility in the CAWS and the Great Lakes. A subset of Asian carp will be vouchered and tissue samples sent to Western Illinois University (J. Lamer) where genetic tests will be used to determine the rate of hybridization. All genotypes will be assigned by posterior probabilities computed by NewHybrids hybrid assignment algorithm. Resulting products are genetic identities, allele frequencies, and maternal contributions of up to 400 Asian carp per year. Fin clips from up to 50 fish from each pool sampled (all fish tagged with acoustic transmitters) will be analyzed for genetic hybridization.

Abundance, Demographics, and Hybridization

We will use the approaches developed in previous years (2010-2014) to determine Asian carp density, biomass, species composition, and size structure in the Illinois River. To quantify fish targets, a combination of side-looking and down-looking hydroacoustics and side-scan sonar techniques will be used. Surveys transects will be conducted in main channel, tributaries, side channels, and connected backwater lakes from Dresden Lock and Dam downstream to the purported source of the Asian carp population near the confluence of the Mississippi River.

To inform hydroacoustic surveys and determine the relative species composition, size/age structure, and sex ratio of Asian carp and other species in the lower river, electrofishing will be conducted by SIUC in the Alton, La Grange and Peoria pools. A subsample of Asian carp from each reach of the Illinois River will be retained by SIUC and used for estimation of sex ratio, gonadal condition, and age (with sectioned post-cleithra). Information about fish in the upper reaches will be obtained from multiple ongoing efforts (e.g., IDNR subsampling, INHS Havana LTEF sampling). Post-processed hydroacoustic data will be combined with fish sampling data to estimate Asian carp densities, biomass, species composition and size structure.
In the upper river, we will undertake hydroacoustic surveys in conjunction with commercial fishing events, to assess changes in the Asian carp population. These surveys will be performed in areas of high density (Starved Rock reach), medium density (Marseilles reach), low density (Dresden reach) and possibly in no Asian carp areas (Brandon Road reach). This would allow us to "ground truth" hydroacoustic estimates and correlate population estimates with harvest catch rates.

Deliverables:

- Quarterly reports on progress as available
- Annual report for 2015-2016, including all information gathered with conclusions
- Continuous patterns of movement throughout the entire Illinois River, to enhance movement probability parameters for the overall model
- Providing a risk assessment for movement toward the CAWS and Great Lakes in collaboration with the USACE by the end of this project.
- Relationship of movement in the Illinois River relative to total discharge and temperature, again contributing to risk assessments for movement into the Great Lakes
- Movement of fish through locks versus gates allowing us to assess whether these structures might be used as barriers
- Fine scale patterns of movement around lock and dam structures with particular focus on Starved Rock, Marseilles and Dresden Lock and Dams.
- Annual (2014-2015) density and biomass estimates for Asian carp in the Illinois River
- Comparisons of Asian carp biomass from 2010 to 2015.
- Quantitative assessment of the efficacy of removal efforts in the upper reaches of the Illinois River.

Timeline: The proposed timeline for this project is 2 years (2014-2015 and 2015-2016). More details about the timeline for each project are outlined in the *Objectives*.

Integration with other Grants: The deliverables will integrate with several of the related GLRI and Asian carp framework projects including; Ecosystem Responses to Barrier Defense via Asian Carp Removal: Fine tuning the effort based on data from the Chicago Area Waterways System (Casper; IRBS), the determination of attributes for the best CAWS-Illinois River-Great Lakes locations for aggressive removal teams (IL DNR/USFWS/Commercial fishermen) as well as prior monitoring Asian carp projects (2011-2014).

TELEMETRY MONITORING PLAN

Participating Agencies: USACE (lead)

Overview

The Asian Carp Regional Coordinating Committee (ACRCC) developed the Asian Carp Control Strategy Framework to protect the Great Lakes from two species of Asian carp present in the Illinois Waterway (IWW). As part of this Framework, the ACRCC formed a sub-committee, the Asian Carp Monitoring and Response Work Group (MRWG), to develop and implement a Monitoring and Response Plan (MRP) for these invasive species. The plan consists of a series of scientific studies to detect, monitor, and respond to the invasion before reproducing populations of Asian carp become established in Lake Michigan. Telemetry has been identified as one of the primary tools to assess the efficacy of the barrier as well as investigating inter-pool movements and invasion front habitat use.

In summer 2010, an acoustic telemetry sampling strategy was initiated using a network of acoustic receivers supplemented by mobile surveillance to track the movement of tagged Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*H. molitrix*), and associated surrogate fish species in the area around the Aquatic Nuisance Species Electric Dispersal Barriers (Barriers) in the Chicago Sanitary and Ship Canal (CSSC) and Upper IWW. This network has been maintained to date through a partnership between the U.S. Army Corps of Engineers (USACE), the U.S. Fish and Wildlife Service (USFWS), the Metropolitan Water Reclamation District of Greater Chicago (MWRD), Southern Illinois University of Carbondale (SIUC) and the Illinois Department of Natural Resources (ILDNR) as part of the MRWG's monitoring plan. Although the telemetry monitoring plan is scheduled as a five year program, it is important to note that a certain level of monitoring should be maintained throughout the life of the Barriers project. This work plan will outline the major goals of the telemetry program and identify key objectives for the 2015 sampling season. Although working estimates are also projected for the 2016 sampling season, these priorities may change based on new information collected by the MRWG in 2015.

Introduction

The telemetry monitoring plan includes the tagging of fish with individually coded ultrasonic transmitters in the Upper IWW. The acoustic network proposed is comprised of stationary receivers and supplemented by a mobile hydrophone unit to collect information from acoustic transmitters (tags) implanted into free-swimming Asian carp (Bighead Carp and Silver Carp) and surrogate species. Acoustic receiver coverage within the Upper IWW is primarily focused at the electric dispersal barriers with secondary coverage surrounding lock and dams and emigration routes such as tributaries and backwater areas. In 2013, the receiver network was expanded to cover the Marseilles Pool in conjunction with SUIC. From the data collected within the Marseilles Pool it was decided that too few receivers were deployed and a more focused approach would be required to better understand Asian carp habitat use and patterns of

movement at the leading edge. This plan recommended shifting that focus to the Dresden Island Pool and the Kankakee River by re-allocating receivers from Marseilles. There were a total of 28 stationary receivers deployed in 2014 that will remain at their respective locations from the Dresden Island Lock to the Cal-Sag confluence, sites shown in green in Figure 1. A receiver will be deployed within the Kankakee River in 2015 to assess approaches of Asian Carp to the Wilmington Dam in Wilmington, IL, site shown in red in Figure 1. An additional receiver will be added to the inside of the lock chamber at the Lockport Lock.

Since 2010, 93 Asian carp have been collected and tagged from the Dresden Island and Marseilles Pools in the IWW while 327 surrogate species have been collected and tagged from the Lockport and Brandon Road Pools closer to the Barriers. Tagged surrogate fish have been released above and below the Barrier; however, no tagged Asian carp have been released upstream of the previously known leading population front (Rock Run Rookery, Des Plaines River, RM 281.5). Tagged fish deployment at the electric dispersal barriers has varied in the species, total length, and deployment methods to account for potential bypass mechanisms identified by outside projects. Potential bypass mechanisms include small fish (less than 4 inches) challenging the barriers as well as barge interactions causing entrainment through the barriers. There have been two observations of tagged fish released below the Barriers which were later detected upstream. These tags were not detected on receivers in proximity to the Barriers however and further investigation suggests that these tags may have been transported by barge entrainment although it has not yet been verified. No fish have been observed to swim through an active electric barrier field in the upstream direction to date.

Goals and Objectives

The overall goal of this telemetry monitoring plan is to assess the effect and efficacy of the Barrier on tagged fish in the Chicago Area Waterways (CAWS) and Upper IWW using ultrasonic telemetry. The goals and objectives for the 2015 season have been identified as:

Goal 1: Determine if fish are able to approach and/or penetrate the electric dispersal barrier system (Barrier Efficacy);

- **Objective** Monitor the movements of tagged fish (large and small) in the vicinity of the electric dispersal barrier system using receivers (N=8) placed immediately upstream, within, and immediately downstream of the barriers, in addition to mobile tracking.
- **Objective** Utilize depth sensor transmitters in surrogate species at the barriers to further refine the understanding of barrier challenges and the efficacy of clearing actions between the barriers utilizing traditional (i.e. electrofishing, driving fish with noise) and/or non-traditional methods (i.e. water guns, deep water electrofishing)
- **Objective** Analyze behavior and movement patterns of fish near the barriers as they interact with barge traffic.

Goal 2: Determine if and how Asian carps and surrogate species pass through navigation locks in the Upper IWW;

- **Objective** Monitor the movements of tagged fish at Dresden Island, Brandon Road, and Lockport Locks and Dams using stationary receivers (N=8) placed above and below and within each lock.

Goal 3: Determine the leading edge of the Asian carp range expansion;

- **Objective** Determine if the leading edge of the Asian carp invasion (currently RM 281.5) has changed in either the up or downstream direction.
- **Objective** Describe habitat use and movement in the areas of the Upper IWW and tributaries where Asian carp have been captured and relay information to the population reduction program undertaken by IDNR and commercial fishermen.
- **Objective** Further develop and refine a presence/absence model for tagged Asian carp in the Kankakee River and Rock Run Rookery backwater

Additional objectives of the telemetry monitoring plan:

- **Objective** Integrate information between agencies conducting related acoustic telemetry studies.
- **Objective** Download, analyze, and post telemetry data for information sharing.
- **Objective** Maintain existing acoustic network and rapidly expand to areas of interest in response to new information.

Work Plan

Sample size and distribution – Sample size was selected through review of similar studies, past catch data and expert opinion from the MRWG. In 2010, the workgroup decided that a baseline minimum of 200 transmitters be implanted for telemetry monitoring in the vicinity of the electric dispersal barriers and that this level of tags be maintained as battery life expires or specimens exit the study area. At the conclusion of the 2014 sampling season there were 179 live, tagged fish within the study area with varying expiration dates. It is expected that 74 of these transmitters will expire within the 2015 sampling season. Additional tagging will be required to sustain recommended minimum levels of the sampling size.

Analysis of data collected since 2010 suggests that in addition to replacing expired fishes throughout the system, the telemetry plan should increase transmitter saturation surrounding the Brandon Road lock and dam. To date, inter-pool movement has been documented for tagged fish between all pools within the study area. This is the first year that upstream passage between the Dresden Island and Brandon Pools has been documented accounting for only 12.5% of the total observed upstream passage at all three locks. Brandon Road lock is approximately 5.5 miles upstream of the Asian carp invasion front and has been identified as a potential control point by the USACE Great Lakes and Mississippi River Inter-basin Study (2014). The Asian carp range expansion has also stalled at this location since first captures in the area in 2006. While exact reasons for this stalled range expansion have yet to be determined, poor passage at

the Brandon Road lock may be a contributing factor. The telemetry study will seek to increase the density of tags particularly below the Brandon Road Lock to increase chances of detecting inter-pool movement.

Another modification to the existing program in 2015 will be the introduction of depth sensor transmitters to those fish released in proximity of the barriers as well as within the Brandon Road Lock. A total of 21 depth sensors will be implanted into surrogate fishes which will be released in groups of three between Barriers IIB and IIA or below Barrier IIA. The tag and release schedule will include two release groups per week over a three week period. Within each week, the first group will be released either Monday or Tuesday below Barrier IIA and the second group will be released either Thursday or Friday between Barrier IIA and IIB. This release schedule will be implemented in the spring and should occur under similar environmental parameters. Significant variation in the water temperature, conductivity or discharge will cause a delay of that group's release until water quality stabilizes back to acceptable conditions. The seventh group of the last three depth sensor tagged fishes will be released immediately prior to a clearing event between the barriers. This last group will help inform response agencies of the efficacy of barrier clearing actions and assist in determining fish responses to those actions.

An additional 9 depth sensor tags will be implanted into Common Carp and released within the Brandon Road Lock chamber in three groups of three. These groups would be released into the lock chamber one at a time only after verifying the chamber is clear of all previously tagged fish. These lock chamber trials will also be coordinated with outside agency efforts to maximize efficiency of field work and benefits of the results. In addition to the depth sensor tags, supplemental V16 transmitters will be implanted into Asian carp and surrogate species below the barriers. This effort will focus on increasing the number of tagged Asian carp in the Dresden Island Pool in the spring and then Common Carp in the Brandon Road and Lockport Pools below the barrier in the fall. Table 1 below displays the location and number of replacement and new tags recommended for implantation in various fish species in 2015 as well as the total tag distribution for the study per pool.

Release Pool/Location	Species	Spring Supplement tags	Fall Supplement tags	Total tag distribution
Upper Lockport/RM300	Surrogate species	0	0	15
Lower Lockport/RM292.7	Surrogate species	21*	5	68
Brandon Road/RM286.5	Surrogate species	0	20	40

Dresden Island/RM276	Asian carps	41**	5	76

*Table 1: Recommended transmitter implementation for the 2015 sampling season. Supplemental tags are required to maintain existing level of coverage within the study area while exact ratios per pool may be changed slightly to account for new focus areas (i.e. Brandon Road Lock). *21 depth sensor transmitters **9 depth sensor tags*

The proposed distribution of tags across the study area is influenced by several factors including the carrying capacity for the receiver network array per pool, the small number of previously tagged Asian carp and available source populations of the target species. All except 33 tags implanted and released prior to 2014 into surrogate fish species within the Lockport pool will have expired by early spring 2015 and will need to be replaced. Similarly, only 20 of the tags released prior to 2014 in the Brandon pool will be active through the 2015 sampling season. An additional 92 tagged fish (depth sensor and V16) will be added to the Lockport, Brandon and Dresden Island Pools in 2015. These additional tags will double existing transmitter densities within the Brandon Road and Dresden Island Pools in an effort to provide more focus at the Brandon Road Lock. As in previous years, surrogate species will be used throughout the study area while Asian carps will only be released downstream of the known population front in order to reduce the risk of assisting any upstream advance of the invasive species.

Species selection (primary and surrogate) - Asian carps (Bighead and Silver Carp) are the primary species of concern, and their behavioral response to the barriers is of the greatest importance. However, as mentioned previously, populations of both species vary and are considered rare to absent near the Barriers. Therefore, in order to test the direct response of fish and maintain target density levels within all pools, surrogate species have been tagged and monitored within the Dresden Island, Brandon Road and Lockport pools. Dettmers and Creque (2004) cited the use of Common Carp (*Cyprinus carpio*) as a surrogate species for use in telemetry in the CSSC because "Common Carp are naturalized and widespread throughout the CSSC and Illinois water bodies in general. Common Carp are known to migrate relatively long distances and they grow to large sizes that approximate those achieved by invasive carps. Based on these characteristics, tracking of Common Carp should provide a good indicator of how Asian carp would respond to the dispersal barrier if they were in close proximity to this deterrent." These characteristics could also justify the use of other species such as buffalo (smallmouth and black), Grass Carp (another species of Asian carp), and Freshwater Drum.

In addition to the type of species being tagged, 2015 surgery efforts will also account for the capture location of fishes targeted. Preliminary results from our telemetry study thus far, along with published literature (ACRCC, 2013; Jones and Stuart, 2009) indicate that captured fish display high site fidelity upon release and tend to return to the area of capture. By adjusting the target area for capture in relation to the electric dispersal barriers or lock systems, it may be possible to induce a higher probability of those fishes attempting to move through those barriers. For example, fishes to be released in Lower Lockport pool will be captured upstream of the

electric dispersal barriers and tagged and released downstream. These fishes will have a greater propensity to return to their capture site, hence, challenging the barriers more often. This same technique will be employed at the Dresden Island pool with fishes captured in the Brandon Road pool. When this technique was first implemented in the 2014 sampling season there had been 176 barrier challenges made between May 2011 and 31-Dec, 2013. During 2014, the first year of the modified release, there were 525 barrier challenges between 1-Jan and 31-Oct alone. It is being shown that when fishes are released downstream of the pool they were captured they will likely have a higher propensity toward returning to their capture site. This practice will continue in 2015 in order to gain a higher resolution of data to support barrier effectiveness and lock passages.

Tag specifications and Implantation procedure – Tagging efforts will be focused during spring (April-May) and fall (October-November) and will follow the surgical and recovery procedures outlined in *Telemetry Master Plan Summary of Findings* by Baerwaldt and Shanks (2012). Adult Asian carp will be collected from the IWW; in the Dresden Island (RM 271.5 to 286) pool. Surrogate species will be collected from the Lockport Pool upstream of the electric dispersal barriers (upstream of RM 296) and the Brandon Road pool (RM 286 to 291). The primary method of capture will be electrofishing; although supplemental gear such as fyke and trammel nets may also be used to harvest fish for tagging. Fish collected will be weighed, measured, and sex will be identified if possible. Water quality parameters such as dissolved oxygen, pH, and conductivity will be taken at each release site using a water quality probe (Pro Plus Instrument, Yellow Springs Inc.)

In an attempt to reduce the amount of tagged fish losses due to harvesting, all Asian carp undergoing surgery will also be fitted with a single jaw tag (provided by SIUC). Commercial fishermen and action agencies working with the MRRWG will be made aware of the project and will be requested to release any jaw tagged Asian carp if they are suitable for release, otherwise they will be requested to save the fish and return it to USACE so we can save the transmitter and tag a replacement fish. No Asian carp caught in Lockport or Brandon Road pools will be tagged and returned as these areas are upstream of the known invasion front. Any Asian carp captured in Lockport or Brandon Road will be turned over to the IL DNR for species voucher.

Acoustic Network Array

Stationary Receivers – A system of passive, stationary receivers (Vemco VR2W and VR4 Receivers) are placed throughout the IWW in order to monitor movement of tagged fishes. The receivers log data from tagged fish when they swim within the detection range of the receiver (typically at least one quarter mile from the receiver). Test transmitters will be used to test the detection range of each receiver. In previous years, VR2W's were placed from the Marseilles Lock and Dam (RM 245 of Marseilles Pool, Illinois Waterway) to the confluence of the Cal-Sag Channel with the CSSC upstream of the electric dispersal barriers within the Lockport Pool. In some areas, two VR2W's were placed to increase the detection capability in high noise or wider

riverine settings, or to duplicate monitoring efforts in high risk environments (where receivers may be subject to damage or loss). VR2W's were deployed by attaching receivers to stationary objects (canal walls, mooring cells, lock guide walls) or bottom deployed using a lead line or marked buoy. Vinyl coated steel cable is used to moor all deployments to minimize loss due to vandalism. In the immediate vicinity of the barrier, receivers are placed inside the canal walls in manhole covers constructed for previous telemetry studies for protection against barge traffic. At the conclusion of each field season, late November to early December, a minimized network of receivers (n=10) are left in place at strategic choke points throughout the study area while the remaining receivers are removed to prevent damage from winter conditions. The receiver network is re-established to its full capacity at the commencement of the following season, typically late March.

Emergence of a new technology enabled USACE to deploy Vemco VR4 model receivers at the Barrier site from 2011 to 2012. These receivers work together as a Vemco Positioning System (VPS) to triangulate the position of the fish in the water to give precise location and movement data. They are submersible for at least 5 years and data is downloaded via wireless modem, thus eliminating the need for manual retrieval (improving safety for the workers in the electrical field environment created by the barriers). These receivers are deployed to the bottom of the canal using a specialized float collar to keep them upright and protected from passing vessels. Currently, we have 8 VR4 receivers covering the areas around barriers 2A and 2B. VR4 data is sent to Vemco for processing. Data processing typically takes about 5-6 weeks for full analysis.

Changes to the receiver network will be made in 2015 to integrate lessons learned from previous data. Stationary receivers from the Marseilles pool were reallocated to the Dresden Island pool and Kankakee River to increase resolution on tagged Asian carp movements in 2014. The increase in resolution was able to better assist researchers in pinpointing fine scale habitat use and seasonal movement patterns. Receiver coverage was expanded within the Dresden Island pool to cover areas of interest such as the Moose Island backwater, DuPage River confluence and Rock Run Rookery areas. The receiver network was also supplemented within the Kankakee River in order to better understand the dynamics of emigration to, and immigration from the tributary as well as how far Asian carp are penetrating upstream. The two receivers deployed last year were within 5 miles of the Kankakee confluence with the Des Plaines in such a way as to discern directional movements. An additional third receiver, furthest upstream, will be placed in 2015 and will have a 'floating' location to determine the advancement of Asian carps into this tributary. It will initially be deployed just downstream of the Wilmington Dam at the beginning of the sampling season. The receiver will be checked for detections of Asian carp and progressively moved upstream as long as detections continue.

The receiver network has undergone modifications around the Brandon Road Lock to increase the efficiency of inter-pool pathway detection. Additional receivers were deployed within the lock chamber, below the dam and within connecting tributaries nearby. Hickory Creek provides an alternate route for fishes attempting to continue upstream once they encounter the

lock and dam impediment. Expanded receiver coverage around the Brandon Road Lock is helping to identify the basis for a lack of upstream passage by tagged fish as well as improve the understanding of Asian carp habitat use in the area. This expanded coverage will be continued into the 2015 and 2016 sampling seasons.

Figure 1 shows the general strategy of VR2W placement for 2015 (N=29 receivers) with existing receivers displayed in green and new deployments shown in red. Figure 2 depicts a close up view of VR2W and VR4 receivers at the Barriers. The priority is to achieve the most coverage (detection capacity) in the immediate vicinity of the Barrier, where most fish will be tagged, and to determine if fish are challenging or passing through (upstream or downstream directional movement) the Barrier. The network will expand throughout the system to track overall movement, and to determine what type of movement occurs from fish negotiating lock structures. Receivers will also be deployed at possible escape routes from the telemetry network such as tributary confluences. Movement through lock structures will be compared to USACE lockage data from Marseilles, Dresden Island, Brandon Road, and Lockport. Leading edge movements will be monitored by the downstream receivers. Other significant movement patterns will also be compared to river stage and temperature data.

Receivers will be downloaded bi-monthly to retrieve data for analysis, and for maintenance of the acoustic network (i.e. decrease risk of vandalism, ensure operation of device, check battery life, replacement if necessary). Receivers may be downloaded more frequently if needed. Bi-monthly field visits will also allow for flexibility in receiver position adjustments near the leading edge of the invasion front. All receivers will be downloaded via Bluetooth-USB capability. The software is available free online from the Vemco website (http://www.vemco.com/support/vue_dload_form.php). Water quality parameters (DO, pH, conductivity, and temperature) will be recorded at each station during downloads.

Figure 1: VR2W receiver network within the Upper IWW and CAWS

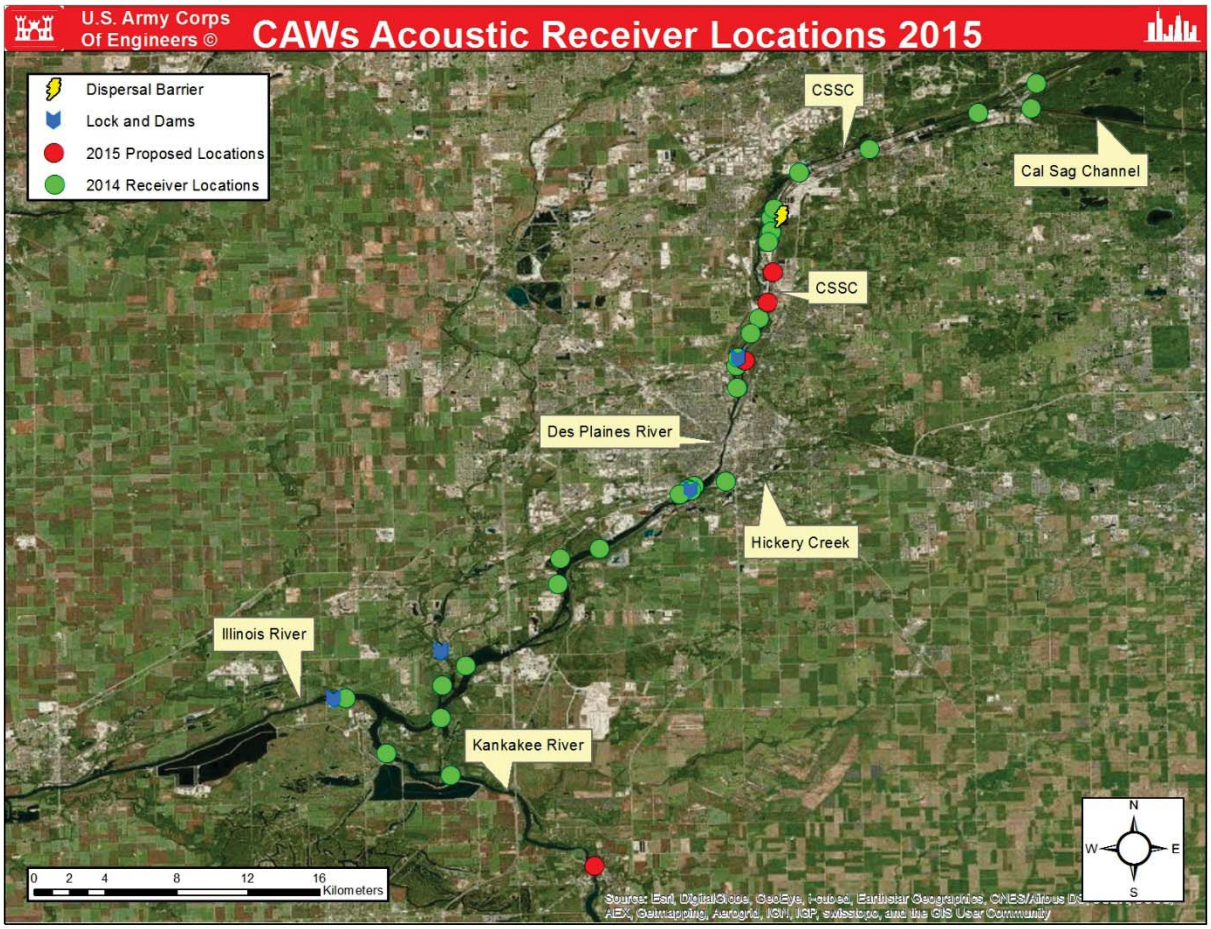
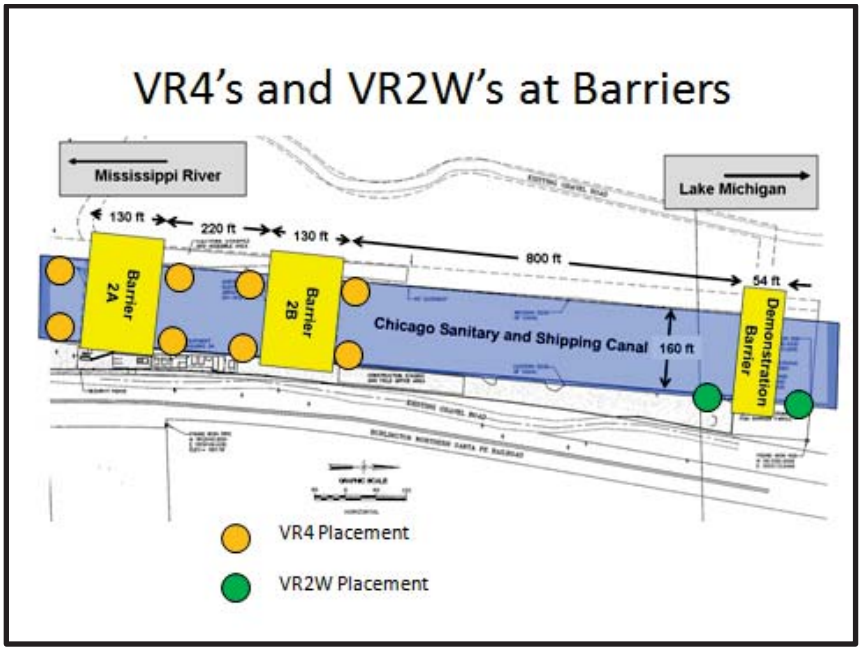


Figure 2: VR2W and VR4 receiver network at the Dispersal Barriers



Mobile Tracking – The use of a mobile unit (Vemco VR-100 unit with a portable directional and omni-directional hydrophone operated out of a boat) enables a crew to manually locate any tagged fish using the signal emitted from the transmitter inside the fish. The mobile unit will be used to locate all fish in the study area to ensure an adequate number of active tags in the system are being monitored. Since the stationary receivers give an approximation of where a tagged fish is, the mobile unit can be used to identify the exact location of any fish of interest. This is useful if the stationary receiver data indicate a tagged fish has crossed the barrier, or to locate a fish the receivers have not been able to detect (can confirm viability of fish). The uni-directional hydrophone will be used in 2015 to further refine the habitat preferences of tagged Asian carp. Due to the time consuming task of triangulating the position of an individual fish, every third Asian carp detected using the omni-directional hydrophone will be positioned. The mobile unit may also be used to locate fish in an area where other monitoring tools (commercial harvest, sonic barriers, etc) are planned to be used that may impact a tagged fish. Mobile tracking will occur simultaneous with bi-monthly receiver downloads as the research boat traverses the system. Mobile tracking will occur within the Dresden Island pool monthly however during the peak movement season (April-June) for Asian carp. These additional mobile tracking trips will help to identify spawning related movements and to track new pathways of range expansion.

Contingency Measures

Tagged fish crossing barrier – As described above, any suspicion (indicated by stationary receiver data) of a tagged fish crossing the barrier can be confirmed by the mobile tracking unit. This will enable crews to locate the exact location of a fish, instead of the approximation detected by a stationary receiver. All agency leads involved with the telemetry plan, as well as the MRWG, will be notified immediately of any suspected barrier breach. In some cases, it may be necessary to implement a 24-hr track to confirm if the fish of interest is indeed viable. This may be done using the mobile tracking device or by placing a stationary receiver in the vicinity.

Other Relevant Studies

An ancillary benefit of this project will be the enhancement of the regional capability of fish tracking at a basin scale. This project will complete the IWW basin acoustic receiver network which extends from the Mississippi River to Lake Michigan and will enable cooperating researchers to document large scale movements of Asian carp and other fish species within the system. The information gathered from this system will enhance the understanding of systemic movement in the basin. Additionally, any fish tagged from this effort that disperse outside of the USACE telemetry network detection area have the probability of being detected on another researcher or agencies network. A list of tagged fish and receiver locations will be available to other researchers, and will be registered with the Great Lakes Acoustic Telemetry Observation System. Points of contact for other studies in the region using the Vemco acoustic telemetry system include:

- Dr. Jim Garvey and Matt Lubejko, Southern Illinois University. Species tagged in Illinois and Mississippi Rivers include: silver carp, paddlefish, shovelnose sturgeon, blue catfish, white bass, walleye, sauger, and hybrid striped bass.
- Jeff Stewart and Sam Finney, USFWS Region 5, Carterville Field Office. Species to be tagged in middle IWW include: silver carp and bighead carp. This study was started in early summer of 2013 and will focus on the early life stages of Asian carp (year-0 and year-1 age classes).
- Dr. Reuben Goforth and Alison Coulter, Purdue University. Species tagged in Wabash River: silver carp. The study is ongoing and tracks silver carp movements in the Wabash River, a tributary to the Ohio River.

Sampling Schedule: A tentative work schedule is presented below.

March – May 2015	VR2W network inspected and new receivers installed and range tested. Tagging efforts of Asian carp in the Dresden Island Pool and surrogate fish in Lockport and Brandon Road pools at Barriers. Depth sensor tags implemented at Barriers.
ONGOING	VR2W network maintenance, downloads and mobile tracking
Oct – Nov 2015	Tagging efforts of Asian carp in the Dresden Island Pool and surrogate fish in Lockport and Brandon Road Pools
December 2015	Prepare receiver array within the IWW and CAWS for winter months

Reporting of Results

All agency leads involved with the telemetry plan, as well as the MRWG, will be notified immediately of any suspected barrier breach or detection of Asian carp above the Brandon Road Lock. Periodic updates will be given to the MRWG in the form of briefings at regular meetings, and the year-end summary report will be compiled after the 2015 sampling season.

Understanding Surrogate Fish Movement with Barriers

Participating Agencies: IDNR (lead); USACE and USFWS (field support)

Location: Sampling will take place in the Lockport Pool downstream of the Electric Dispersal Barrier, Brandon Road Pool, Dresden Island Pool, and Rock Run Rookery.

Introduction and Need: Based on the results of extensive monitoring using traditional fishery sampling techniques (electrofishing, trammel nets, gill nets, hoop nets and fyke nets), Asian carp are rare to absent in the area between the Electrical Dispersal Barrier and the Brandon Road Lock and Dam. Brandon Road Lock and Dam is a crucial pinch point to stop all movement of Asian Carp from moving upstream to the Electric Dispersal Barrier. More effort will be placed in the lower Brandon Pool and the upper Dresden Pool to get a better understanding of fish movement and passage around Brandon Lock and Dam. Based on Monitoring data, the most upstream an Asian Carp has been caught or observed is in Dresden Island Pool near river mile 278, which is 18 river miles downstream of the Electric Dispersal Barrier. Given the close proximity, Asian Carp pose a real threat to the Electric Dispersal Barrier. The goal of this project is to use surrogate species to assess the potential risk of Asian carp movement through barriers (i.e. lock chambers and the Electric Dispersal Barrier). In addition, recapture rates of surrogate species will be used to determine sampling efficiency in the area between the Electric Dispersal Barrier and the Dresden Island Lock and Dam. In order to test the potential risk of Asian carp movement through barriers, surrogate species will be tagged in the Rock Run Rookery, Dresden Island, Brandon Road and Lockport Pools. Common Carp (*Cyprinus carpio*), Black Buffalo (*Ictiobus niger*), Smallmouth Buffalo (*Ictiobus bubalus*) and Bigmouth Buffalo (*Ictiobus cyprinellus*) will be used as surrogate species because they are naturalized and widespread throughout the Chicago Sanitary Ship Canal (CSSC) and the upper Illinois River. Common Carp are known to migrate relatively long distances and grow to large sizes that are approximate to those achieved by invasive carps (Dettmers and Creque 2004). Based on these characteristics, Common Carp should provide a good indicator of how Asian carp would respond to the various barriers if they were present. Similarly, *Ictiobus* spp. (Smallmouth, Bigmouth and Black) make good surrogates due to their migration pattern and large body sizes (Becker 1983).

Objectives: The IDNR will work with federal and local partners to:

1) Monitor the movements of tagged surrogate species in Dresden Island, Brandon Road and Lockport Pools and Rock Run Rookery to assess fish movement between barrier structures; and
2) Obtain information on recapture rates of surrogate species to help verify sampling success using multiple gear types.

Status: Sampling and fish tagging for 2015 will begin in March and end in December.

Methods: Sampling for Common Carp, Bigmouth Buffalo, Smallmouth Buffalo and Black Buffalo will be obtained through Fixed and Random Site Monitoring Downstream of the Barrier and Barrier Maintenance Fish Suppression projects (see Monitoring and Response Plan for Asian Carp in the Upper Illinois River of Chicago Area Waterway 2014). The sample design includes electrofishing at four fixed sites and eight random sites in each of the three pools below the

Electric Dispersal Barrier. Contracted commercial netting will include four fixed sites in each pool, twelve random sites in Brandon Road and Lockport Pools, and twenty four random sites in Dresden Island Pool each week sampled. Contracted commercial netting will also include two sets in Rock Run Rookery two times a month from March to November. Hoop and minnow fyke netting will take place at four fixed sites in each pool once per month. The fixed sites in each of the three pools are located primarily in the upper end of each pool below lock and dam structures, in habitats where Asian carp are likely to be located (backwaters and side-channels), or both. Random electrofishing and contracted commercial fishing sites occur throughout each pool, including the lower portions of each pool as well as in the Kankakee River, from the Des Plaines Fish and Wildlife Area boat launch downstream to the confluence with the Des Plaines River.

Floy tagging and external marking procedure – Floy Tags will be anchored to all Common Carp, Bigmouth Buffalo, Smallmouth Buffalo and Black Buffalo collected. The length of each fish will be recorded in millimeters along with date, location, coordinates and an individual tag reference number. Floy Tags will be anchored by inserting the tag gun needle into a fleshy area below the dorsal fin on the left side of the fish. The needle should be inserted at an acute angle to the body, angling the needle towards the anterior portion of the fish to allow the tag to lie along the side of the fish. The needle should pass the midline of the body but not penetrate the opposite side of the fish. If the T-bar is only held in by the fish's skin, the tag will be removed and the fish will be retagged. A secondary mark on the caudal fin will be given to all fish collected in case of a Floy Tag malfunction. A fin clip will be given to all fish in the lower portion of the caudal fin at an angle to increase recognition upon recapture. In the event of a recapture, fish species and tag number will be recorded. If a Floy Tag is missing from a recaptured fish possessing a fin clip, a new tag will be inserted and the new number will be recorded.

Sampling Schedule: Fixed and random site electrofishing in Dresden Island, Brandon Road and Lockport Pools will take place bi-weekly from March through November. Contracted commercial netting in Dresden Island Pool, Brandon Road Pool, Lockport Pool and Rock Run Rookery will take place bi-weekly from March through December. Hoop and minnow fyke netting will take once per month from March through November.

Deliverables: Results of fish sampling events will be compiled for monthly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

Monitoring Fish Abundance, Behavior, and Barge Interactions at the Electric Dispersal Barrier, Chicago Sanitary and Ship Canal, Illinois

Participating Agencies: U.S. Fish and Wildlife Service, Carterville Fish and Wildlife Conservation Office, Marion, Illinois (lead), USACE-Chicago District (field support), USACE-CERL-Champaign (field support), USACE-Rock Island District (Field support), USFWS Columbia, MO and La Crosse, WI FWCOs (field support).

Location: Work will take place in Lockport Pool including at the electrical dispersal barrier, at Brandon Road Lock and Dam, and in areas downstream in the Illinois River with high abundances of Asian carp.

Introduction and Need: The electric dispersal barrier system in the Chicago Sanitary and Ship Canal (CSSC) operates with the purpose of preventing upstream fish migration from the Mississippi River Basin to Lake Michigan. A demonstration barrier that was operational between 2002 and 2014, operated at 4 ms, 5 Hz, 1 V/in. Sparks et al. (2010) and Dettmers et al. (2005) were the first to directly test the effectiveness of the Demonstration Barrier. Sparks et al. (2010) recorded a radio-tagged Common Carp (*Cyprinus carpio*) breaching the barrier in April 2003. This breach was later determined to have coincided with the passage of a barge. During November 2003, Dettmers et al. (2005) passed encaged fish alongside a barge through the Demonstration Barrier. Dettmers et al. (2005) found that the effects of the electrical field were delayed when fish swam alongside the conductive (steel) barge hulls and some fish were never incapacitated as they swam through the barrier. Dettmers et al. (2005) attributed the delayed and non-incapacitations to a distortion of the electrical field by the barges. Following the Dettmers et al. (2005) study, design modifications were made to two additional electrical barriers that were constructed; Barriers IIA and IIB, to account for the barge-induced electrical warping. Barriers IIA and IIB were implemented in 2009 and 2011, respectively. The newer barriers cover a much larger area than the Demonstration Barrier and are capable of generating electrical fields of much higher intensity. Intensive laboratory work done by Holliman (2011) on Bighead Carp that were 1.8-3.2 in TL showed that current operating parameters (2.5 ms, 30 Hz, 2.3 V/in.) incapacitated 100% of small Bighead Carp that were exposed to gradual increases in voltage in a Brett swim tunnel.

Results from our past fish monitoring work at the barrier system have revealed that fish abundances in that area fluctuate throughout the year. Our work showed that fish were able to swim up to the highest electrical field before upstream progress was inhibited in some cases, but in other cases we identified smaller fish swimming past the barriers. The accumulation of feral fish immediately below the operating barrier has raised concerns about fish swimming upstream during a barge passage, or involuntarily being moved upstream by a passing barge vessel. Specifically, our objectives for this year's studies are to:

1) Evaluate fish behavior between the narrow arrays where the highest-voltage electrical field is located.
2) Evaluate behavior of fish near the barrier as barges traverse the barriers.

3) Evaluate behavior of fish near barges near the Brandon Road Lock and Dam and in downstream areas of high Asian carp abundance.
4) Determine the species of fish present in and directly adjacent to the barrier system.

Status: The Carterville Fish and Wildlife Conservation Office has wrapped up major portions of the field work for DIDSON, barge, and hydroacoustics projects performed at the barrier. During July and August 2013 we deployed a fixed dual DIDSON deployment at the electric dispersal barrier. We observed small (50-100mm) fish breach the area of highest field strength of Barrier IIB. Interim reports for this work can be found in the 2012, 2013, and 2014 MRWG interim study reports and on the Carterville FWCO website at http://www.fws.gov/midwest/fisheries/carterville/didson-barge.html. Final agency reports and potentially peer reviewed publications are also forthcoming.

Methods for 2015

DIDSON and Fish Identification

Fixed DIDSON recordings during times of normal barrier operation will take place solely within the narrow array of Barrier IIB, where the strongest electrical field is located. DIDSON footage will focus on the water surface along the western canal wall. In order to ensonify the entire 8 m of canal wall within the narrow array electrodes, two DIDSON units will be used simultaneously while both are synced to a single laptop computer. The DIDSON units will be mounted off of a fixed crane unit extending into the canal. DIDSON data will be processed using EchoView® software, which can record fish abundance, size, and direction; however, due to the irregular swimming patterns and often dense schools of fish, manual counting will likely be required (Higginbottom 2005; Boswell et al. 2008; Kang 2011). These fixed DIDSON recordings will take place for 5 days straight, three times during the year (contracts pending), likely in the July and August when previous studies have shown fish abundances at the barrier to be the highest.

Concurrently with the timeframe when fixed DIDSON data collections are made, fish sampling will take place at the barrier to determine the species of fish present at the barrier. This sampling will be done using paupier butterfly trawls. Timing and amount of the sampling will depend on fish presence and abundance at the barrier as identified with the DIDSON and as safety dictates.

Barge-Fish Interaction Studies

Fish barge interaction studies will occur this field season with several goals. First, we will evaluate behavior of fish near and in the barge junction wedges as they traverse the electric dispersal barriers. Secondly, we will quantify the length of time and distance fish may be entrained within barge junction wedges. Third, we will evaluate fish barge interactions that take place during lockage operations at Brandon Road Lock and Dam. And finally, we will evaluate fish barge interactions in areas of known high Asian carp abundance.

To answer questions related to the possibility of wild fish (free swimming; non-tethered) entering areas around barges and becoming entrained through the electric dispersal barrier we will deploy a fish observation system into barge junction wedges. This system will consist of a combination of DIDSON (Dual-frequency identification sonar) units, a split beam hydroacoustic system, and underwater video cameras. The data from the fish observation system will be used to view and count wild and stocked free swimming fish in barge junctions. Additional data on

temperature, flow, speed of the barges, location, electrical measurements, and distances traveled by the barges will also be collected and compared to the video and sonar data. Surrogate live, untethered fish may also be collected and dropped into the void spaces in order to collect additional data on fish behavior under simulated entrainment conditions if warranted. We have six weeks of testing scheduled to take place in two week segments in the late spring, early summer, and late summer. During the spring segment, methods will be refined and trials will take place in Lockport Pool and at the electric dispersal barrier using stocked fish (golden shiners and gizzard shad). During the first summer segment, observations of wild fish entrainment and behavior will be made at the electric dispersal barrier. During late summer, trials will take place at the Brandon Road Lock to better understand barge fish interactions during lockage operations and in downstream areas of high carp abundance to understand specifically how Asian carp react to barges since there are few if any in upstream study areas.

Sampling Schedule: Fixed DIDSON sampling will take place over a three week period during late July/early August. Barge-fish interaction study work will take place in three two week segments during late spring, early summer, and late summer.

Deliverables: Various reports and publications on our findings will be completed throughout 2014 and 2015 and distributed to interested parties.

Monitoring Fish Density and Spatial Distribution in Lockport, Brandon Road, and Dresden Island Pools and the Associated Lock and Dam Structures

Participating Agencies: U.S. Fish and Wildlife Service, Carterville Fish and Wildlife Conservation Office, Marion, Illinois (lead), USACE-Chicago District (field support), USACE-Rock Island District (field support), USFWS Columbia, MO and La Crosse, WI FWCOs (field support)

Location: All work will take place in the Lockport, Brandon Road, and Dresden Island Pools between the electric dispersal barrier near Romeoville, IL and Dresden Island Lock and Dam. Special focus and efforts will be near the Brandon Road Lock and Dam.

Introduction and Need: The electric dispersal barrier system in the Chicago Sanitary and Ship Canal (CSSC) operates with the purpose of preventing upstream fish migration from the Mississippi River Basin to Lake Michigan. Barriers IIA and IIB were built and brought online in 2009 and 2011, respectively. The newer barriers cover a much larger area than the older Demonstration Barrier and they are capable of generating electrical fields of much higher intensity. Initially, Barrier IIA had the same operating parameters as the Demonstration Barrier. However, the operating parameters of Barrier IIA were increased to 6.5 ms, 15 Hz, 2.0 V/in in August, 2009. Barrier IIB operated at 2.0 V/in until 11/29/2011, when parameters were increased to 2.5 ms, 30 Hz, 2.3 V/in. Signal interference with local utilities caused a change in operating parameters (2.2 ms, 34 Hz, 2.3 V/in.) during 2014 for Barriers IIA and IIB. Fish are known to "stack up" below the barrier system at different times throughout the year, primarily during the summer and fall (Parker et al. 2013). Monthly maintenance, daily barge traffic, and other regular maintenance operations have been shown to have the potential to allow fish to pass the barrier system (see http://www.fws.gov/midwest/fisheries/carterville/didson-barge.html for reports). If and when fish congregate below the barrier on a diel basis is not known and fine-scale quantification of fish abundance dynamics throughout the year is also unknown. Having a greater understanding of the spatial, temporal, and size distributed patterns of fish congregation patterns may lend helpful information to the USACE on when and how to schedule and perform routine maintenance activities.

The "major population front" (where fish can be captured with some regularity) of Asian carp in the Upper Illinois Waterway is in the Dresden Island Pool. In Brandon Road Pool, the next pool upstream, no Asian carp have been captured in spite of substantial sampling efforts (electrofishing and netting; one credible Asian carp visual observations have occurred). In Lockport Pool, one Bighead Carp was captured during a 2009 rotenone sample of the pool, but none have been captured or observed during robust sampling efforts similar to those in Brandon Road Pool. In spite of this lack of captures, it is not certain that Asian carp do not exist in upper Dresden Island Pool, Brandon Road Pool, or Lockport Pool, nor that they might not exist there in the future should populations expand into these pools from downstream where they are abundant. It is also possible that the robust sampling efforts may be better targeted towards areas in those pools identified by hydroacoustics as having more large fish targets than areas currently being sampled. Identifying large fish targets, will likely lead to an increase in the ability of management agencies to target, sample, and remove the difficult to sample Asian carp in these difficult to sample pools.

The Great Lakes Mississippi River Interbasin Study (GLMRIS) was released in January 2014 and presents a comprehensive range of options and technologies available to prevent the interbasin transfer of aquatic nuisance species (ANS) between the Great Lakes and Mississippi River through aquatic pathways. The most substantial of these pathways is the Chicago Area Waterways System and the Upper Illinois Waterway, or Focus Area 1. GLMRIS presents eight alternatives to stopping ANS, and identifies five aquatic pathways between the Great Lakes and Mississippi River Basin in Focus Area 1. Brandon Road Lock and Dam is the common connection point of all five of these pathways. Additionally, of the eight GLMRIS alternatives identified, three (Alternatives 4, 7, and 8) call for implementation of ANS control measures at Brandon Road Lock and Dam. Having a greater understanding of fish abundance, behavior, and movements in and adjacent to Brandon Road Lock and Dam will help to inform potential GLMRIS actions at Brandon Road.

Objectives:

1) Determine the density and distribution of fish in the Upper Illinois River pools throughout the year.
2) Evaluate the diel abundances of fish around and within the electric dispersal barrier system.
3) Evaluate size structure of fish communities in the Upper Illinois River pools.
4) Quantify fish utilization patterns at the Brandon Road Lock structure.
5) Quantify upstream fish passage rates through the Brandon Road Lock under varying operational and abiotic conditions.
6) Identify large fish targets in the subject suspected of being Asian carp, to direct targeted sampling efforts at these fish for removal.

Status: A complete year of monthly sampling related to this project has been completed in the Lockport Pool. Diel surveys directly below the electric dispersal barrier were completed during spring, summer, and fall 2014. Seasonal surveys were also completed in Lockport, Brandon Road, and Dresden Island Pools in 2014. Additionally, preliminary remote sensing surveys of the fish community present within the Brandon Road Lock structure were conducted during summer and fall 2014.

Fish densities in the Upper Illinois River were relatively low in all project pools during the spring. Increases in density were observed during summer in the Lockport and Brandon Road pools. Increases in density in the Dresden Island pool were not observed until fall. Densities of fish directly below the electric dispersal barrier followed the seasonal patterns observed in Lockport pool. Significant increases in fish density were observed at night during spring at the electric dispersal barrier. During summer and fall fish densities were again higher at night but these differences were not significant. Densities of fish within the Brandon Road Lock structure were an order of magnitude greater than those observed in the other project pools during summer surveys. Large fish targets showing behavioral characteristics consistent with Asian carp were observed in Dresden Island Pool during spring 2014 surveys. These observations were reported to state partners. Asian carp were subsequently captured in the area of the report. For more detailed results see the 2014 interim summary report document (MRWG 2015).

Methods:

Diel electric dispersal barrier survey

Diel sampling will take place to assess fish distribution and density patterns near the electric dispersal barrier throughout 24-hour periods during spring, summer, and fall. Complete barrier surveys will take place three consecutive times every three hours. This information will be especially useful given that some evidence exists that Bighead Carp move more in the evening hours than during daylight hours (Schultz 2006). Surveys will be performed using two 200 kHz split-beam transducers and one 1200 kHz side-scan SONAR unit. The two split-beam transducers will be mounted next to each other on the starboard side of the boat 0.15 m below the water surface. One transducer will be set to -3.3˚ and the other set to -9.9˚ below the water surface. Each complete survey will consist of three replicate transits through the barrier on eight separate occasions throughout a twenty four hour period. Each transect will require driving the boat about 1 m away from the west and east walls to complete a circuit of the barrier and the area to 300 m below the lowest parasitic structure. Acoustic data will be collected using Visual Acquisition 6® from 1.15 to 55-m range at a ping rate of 5 pings per second and a 0.40 ms pulse duration. Data collection will be set to begin at 1 m from the transducer face in order to avoid the near-field effect (Simmonds and MacLennon 2005; Garvey et al. 2011). Temperature will be recorded with a Hydrolab unit and input into Visual Acquisition 6® prior to data collection to compensate for the effect of water temperature on two-way transmission loss via its effect on the speed of sound in water and absorption coefficients. The split-beam acoustic transducers will be calibrated on-axis with a 200 kHz tungsten carbide sphere before each sampling event following Foote et al. (1987). Post-processing of remote sensing data will be performed using EchoView 6.0® and SonarWiz software.

Upper Illinois River fish density, size, and distribution

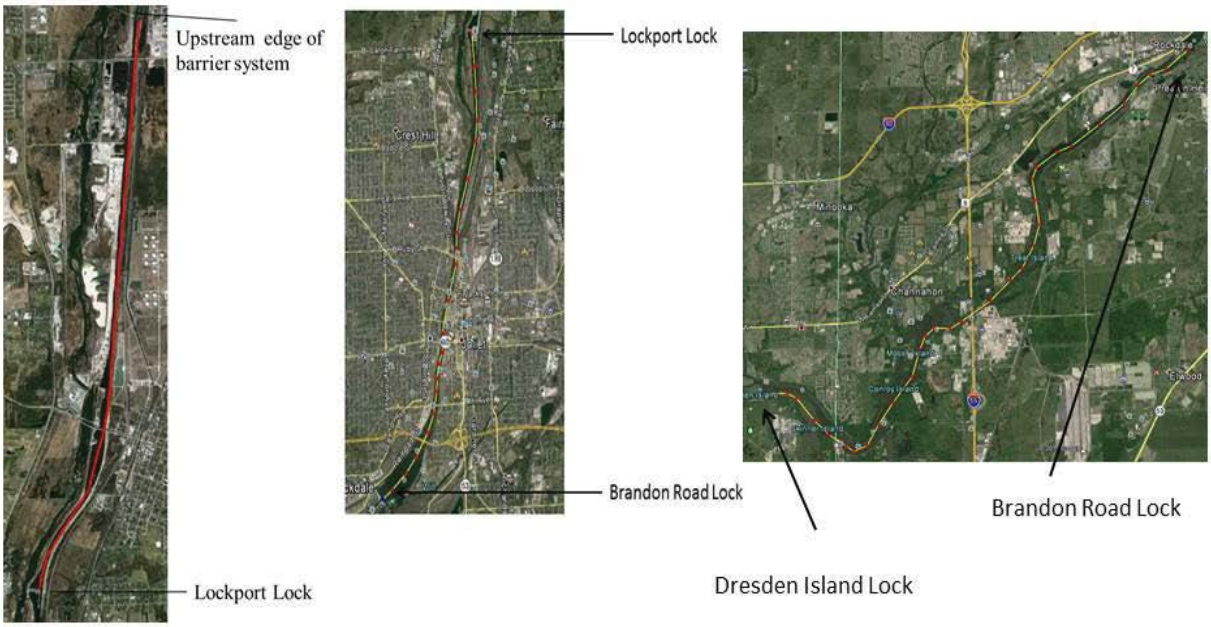
Fish density and distribution from the electric dispersal barrier to Dresden Island Dam (Figure 1) will be estimated using hydroacoustic sampling following the same methods as the diel surveys which were adapted from Garvey et al. (2011). Seasonal (spring, summer, and fall) surveys will be conducted in Lockport, Brandon Road, and Dresden Island pools. Additional surveys may be added at the discretion of project biologists. Transects will be made parallel to the flow of the river and spaced close enough together to maximize coverage area. In widened areas of each pool, such as the area near the Cargill Boat Launch in Lockport Pool, near the Brandon Road Dam in Brandon Road Pool, and near the Kanakakee River confluence in Dresden Island Pool, extra transects may need to be conducted in order to ensure that the entire area is covered.

Lock mediated fish passage at the Brandon Road Lock

Mobile split beam hydro-acoustic assessments of fish density and location within and near the Lockport, Brandon Road, and Dresden Island lock structures will be conducted to determine the density and size frequency distributions of fish that are present within each lock chamber under a range of abiotic conditions. These surveys will take place on a monthly to bi-monthly basis (March, May, June, July, Aug., Sept., and Nov) in order to detect seasonal differences in fish density patterns. The mobile surveys will consist of a series of replicate transects within, above, and below each lock chamber.

A stationary side looking split beam hydroacoustic system will be deployed in the upstream approach channel near (≈20m) the lock doors at Lockport and Brandon Road Locks to assess and compare the rates of lock mediated fish passage at each structure. This work will take place during spring, summer, and fall 2015. It will provide large amounts of data that quantify both the upstream and downstream immigration and emigration rates of fish through each of the Upper Illinois lock chambers. It will also provide insights into diel aspects of lock mediated fish passage and the effects that commercial traffic may have on lock mediated fish transport and behavior.

High intensity fish sampling within each lock chamber will take place using electrofishing and netting methods during periods of high fish abundance to determine species composition of the fish community within each lock chamber. Work will take place in May, July, and September 2015 at Lockport and Brandon Road Locks



A **B** **C**

Figure 1. 5.4 mile (8.7 km) stretch of the CSSC (A) 4.8 mile (7.7 km) stretch of the Brandon Road (B) and 14.5 mile (23.3 km) stretch of Dresden Island Pool (C) where hydroacoustic remote sensing surveys will take place.

Sampling Schedule:
Winter 2015- Gear preparation, field logistics planning, crew scheduling
Spring, Summer, and Fall 2015- Collect and analyze hydroacoustic data in the project pools and lock chambers
Spring, Summer, and Fall 2015- Diel sampling events
Winter 2015/2016- Final data analyses and draft annual report generation

Deliverables: Annual report to the MRWG in winter 2014/2015, as requested. Any findings of suspected carp targets, in novel locations, will be reported to the MRWG co-chairs. A final report will be given to the MRWG upon completion of this work, pending future year funding.

Monitoring for Asian Carp in the Upper Des Plaines River and Upper Des Plaines River Overflow

Participating Agencies: USFWS – La Crosse Fish and Wildlife Conservation Office (lead): IDNR and MWRD (field support)

Introduction and Need: Fish can freely move into and out of the upper Des Plaines River via the confluence with the CSSC, and Asian carp have been observed in the Brandon Road Pool near the confluence. Asian carp eDNA also has been detected in the Des Plaines River above the confluence. There is potential risk that Asian carp could gain access to the CSSC upstream of the dispersal barrier during certain high-water events when water from the upper Des Plaines River flows laterally into the CSSC, although that possibility has been reduced by the construction of a physical barrier described below.

A physical barrier made of concrete barriers and small-meshed fencing was erected by USACE along 13.5 miles of the upper Des Plaines River to prevent Asian carp from infiltrating the CSSC above the electric dispersal barrier and then Lake Michigan. The physical barrier was designed to prevent adult and juvenile Asian carp from moving between waterways, but during flood events eggs and fry could pass through the 0.25 in mesh fencing. Following overflow events in 2011 and 2013, modifications have been made to reduce the possibility of fish larger than eggs or fry from passing. Understanding the population status of Asian carp and if their reproductive status in this reach of the Des Plaines River, and monitoring the effectiveness of the physical barrier, will inform management decisions and direct fish removal actions.

Objectives: There are two major objectives for this study plan:
1) Monitor Bighead and Silver Carp and their spawning activities in the upper Des Plaines River above the confluence with the CSSC; and
2) Monitor Bighead and Silver Carp around the physical barrier when water moves laterally from the upper Des Plaines River into the CSSC during high flows.

Status: This project was proposed in 2010 and initiated in 2011, and was reviewed and accepted by the MRRWG. From 2011-2013, sampling has consisted of 30.5 hours of electrofishing, 82 gill/trammel net sets (6,284 yards), and monitoring two overflow events. For more detailed results see the 2013 interim summary report document (MRWG 2014).

Methods: For Objective 1, sampling will occur in the Des Plaines River above the confluence with the CSSC (Figure 1). Areas with the most suitable Asian Carp habitat will be emphasized. Monitoring will include electrofishing and short-term sets of gill and trammel nets. Monitoring in 2014 will expand to include young-of-year sampling with gear types selected based on their efficacy in the system's habitats.

For Objective 2, critical USGS and USACE gauges will be remotely monitored to help determine pending high flow events. USACE personnel will alert USFWS staff of pending

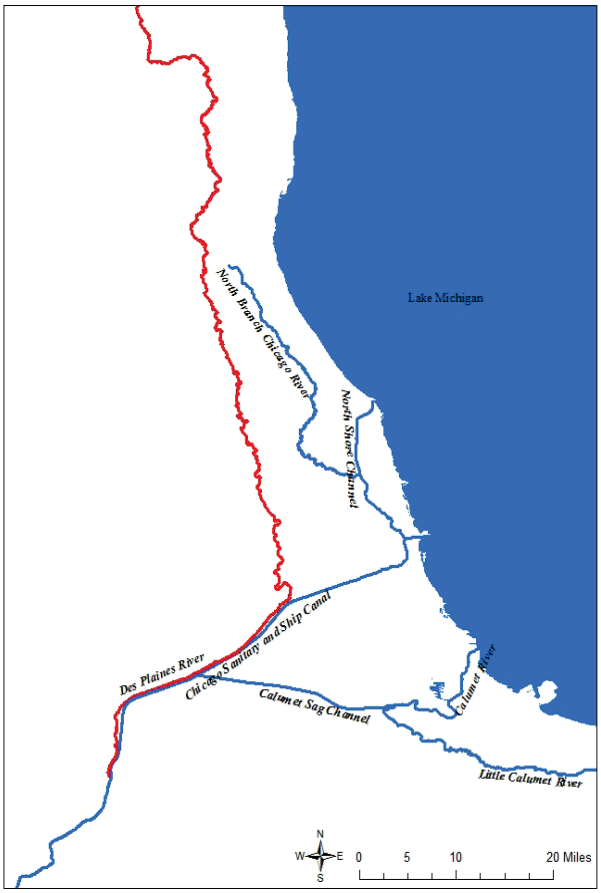


Figure 1. Map of Chicago area waterways. The red represents the portion of the Des Plaines River identified for sampling. The area running parallel to the CSSC will be emphasized.

overflow events and monitoring will be initiated. The barrier itself will be utilized as a sampling device by serving as a hardened gill net. Staff will walk along the barrier after the water has receded to collect and identify impinged fish and also sample on the CSSC side of the fence if the fence has been breached. Block nets will be used to reduce likelihood of passage through potential breaches until patches can be placed.

These actions are expended to continue into 2015-2016 dependent upon funding. Reduced funding will result in a proportional reduction in sampling effort.

Sampling Schedule: Monitoring will be initiated in the upper Des Plaines River in spring of 2014 and continue throughout the sampling season. Sampling will coincide with increased flows to provide better access. Additional sampling will be conducted if: Bighead Carp or Silver Carp eggs are collected at the confluence of the upper Des Plaines River and CSSC; if tagged fish are tracked in this reach of the Des Plaines River; or if Bighead Carp or Silver Carp are captured or observed during sampling. All over-topping events will be monitored.

Deliverables: Results of each sampling event will be reported for monthly sampling summaries. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

Evaluation of Gear Efficiency and Asian Carp Detectability

Participating Agencies: INHS (lead), Eastern Illinois University (field and lab support)

Location: Evaluation of sampling gears will take place through targeted sampling at multiple sites in the Illinois and Des Plaines Rivers, and the Chicago Area Waterway System (CAWS). Select sites on Illinois River tributaries (Sangamon, Salt Fork of the Sangamon, Spoon, and Mackinaw Rivers) will also be sampled with a subset of gears. Sites may be dropped, or additional sites added as needed in order to complete study objectives.

Introduction and Need: Multi-agency sampling and removal efforts, using a variety of sampling gears, are currently ongoing in the Illinois River and the CAWS to monitor and control populations of Asian carp. Different sampling gears may vary widely in their ability to capture fish in proportion to their abundance, and may select for different sizes of fish. Evaluating the relative ability of traditional and alternative sampling gears to capture both juvenile and adult Asian carp will help improve the efficiency of monitoring programs and allow managers to more effectively assess Asian carp relative abundance. Data gathered from gear evaluations can also be used to calculate detection probabilities for Asian carp, which would allow for determination of appropriate levels of sampling effort and help improve the design of existing monitoring regimes. Results of this study will help improve Asian carp monitoring and control efforts in the Illinois River and the CAWS, and will contribute to a better understanding of the biology of these invasive species in North America.

Objectives: We are using a variety of sampling gears to:

1) Evaluate the effectiveness of traditional and alternative sampling gears at capturing both juvenile and adult Asian carp;
2) Determine site characteristics and sampling gears that are likely to maximize the probability of capturing Asian carp;
3) Estimate the amount of effort required to detect Asian carp at varying densities with each gear;
4) Supplement Asian carp sampling data being collected by other agencies; and
5) Gather data on abundances of other fish species found in the Illinois River and CAWS to further assess gear efficiency, and examine potential associations between Asian carp and native fishes.

Status: Evaluation of sampling gears during 2011 – 2013 was only possible for adult Asian carp, as juvenile Asian carp were scarce or absent in the Illinois Waterway during these years. These efforts determined that pulsed-DC electrofishing was the most effective gear for capturing adult Silver Carp, whereas hoop nets and trammel nets were the most effective methods for capturing adult Bighead Carp. Hybrid Asian carp appeared to be vulnerable to both electrofishing and passive gears. Detection probability was found to be highly correlated with Asian carp catch-per-unit-effort, with substantially lower probabilities of detecting both Silver Carp and Bighead Carp at upstream sites. Modelling exercises suggest that extremely large sampling efforts would be required to detect either Asian carp species in areas of very low abundance.

During 2014, Asian carp appear to have successfully reproduced, as large numbers of juveniles were present in the Illinois River in this year. Pulsed-DC electrofishing monitoring was conducted in the LaGrange, Peoria, Starved Rock, and Marseilles Pools during July and August 2014, capturing 3,730 juvenile Asian carp. Juvenile Silver Carp were captured in the LaGrange (n = 3,694) and Peoria (n = 36) Pools, but none were captured or observed in the Starved Rock or Marseilles Pools. Subsequent evaluation using all sampling gears resulted in the capture of 101,191 fish, including 67,882 juvenile Silver Carp. The vast majority of these were captured in the LaGrange Pool (n = 67,869), with only small numbers being captured in the Peoria Pool (n = 12). No juvenile Asian carp were captured or observed by gear evaluation sampling in the Marseilles Pool. Most juvenile Silver Carp were captured during sampling in late July or early August (n = 67,714), with substantially lower numbers being collected during late September (n = 167) despite equivalent sampling effort. Mini-fyke nets captured the highest numbers of juvenile Silver Carp (n = 56,054, average = 637.0 per net-night), followed by beach seines (n = 7,211, average = 163.9 per haul), purse seines (n = 4,063, average = 92.3 per haul), electrofishing (n = 419, average = 9.5 per 15-minute transect), and cast nets (n = 135, average = 3.1 per throw). Gill nets failed to capture any juvenile Asian carp. Gear types targeting juvenile Asian carp in 2014 were also found to capture different size distributions of these fish. Beach seines captured the smallest juvenile Silver Carp (mean = 38.0 mm), and captured the highest proportion of Silver Carp in the 20-29 mm (38% of catch) and 30-39 mm (23% of catch) size ranges. Purse seines captured the largest average sizes of juvenile Silver Carp (mean = 52.5 mm), likely because they rarely captured any Silver Carp smaller than 40 mm. Cast nets (mean = 40.6 mm), pulsed-DC electrofishing (mean = 48.1 mm), and mini-fyke nets (mean = 48.6 mm) were more effective for the intermediate sizes of juveniles, capturing primarily 30 – 60 mm Silver Carp. Electrofishing, however, was the only gear type that consistently captured juvenile Silver Carp larger than 90 mm.

During 2014, a total of 796 Asian carp (6 Bighead Carp, 790 Silver Carp) were captured during 12.25 hours of pulsed-DC electrofishing in tributary rivers. Silver Carp were captured at both upstream and downstream sites in all tributaries. Bighead Carp were only captured in the Sangamon (n = 3) and the Salt Fork of the Sangamon River (n = 3). The highest catch-per-unit-effort of Asian carp was obtained in the Mackinaw River (mean ± SE = 65 ± 19 per hour), whereas the lowest was from the Spoon River (48 ±13 per hour). Only adult Asian carp (440 – 880 mm) were captured by electrofishing in tributaries. No juvenile Asian carp were captured or observed with this gear type in tributary rivers during 2014. Higher numbers of male than female Silver Carp were observed in all tributary rivers, and both upstream and downstream sites were male-dominated. The highest Silver Carp gonadosomatic indices (GSI) were observed in June, and GSI declined considerably, particularly for female fish, after July.

Methods: During 2015 and subsequent years, sampling activities will continue to focus on juvenile Asian carp. Because Asian carp less than 400 mm were scarce in the Illinois Waterway prior to 2014, and juveniles captured in 2014 were largely less than 100 mm, we will be specifically targeting individuals in the 100 – 400 mm size range in 2015. Smaller size classes will also be further evaluated pending another successful year of Asian carp reproduction.

Sampling will occur opportunistically during spring, summer, and fall at multiple sites throughout the Illinois Waterway. Pulsed-DC electrofishing will be used at select locations to monitor for the presence of juvenile Asian carp. Additional sampling gears will be utilized at sites where juvenile Asian carp are found to be present:

- Floating experimental gill nets (45.8 m long x 3.05 m deep, 1.9, 2.5, 3.2, 3.8, and 5.1 cm mesh panels)
- Wisconsin-type mini-fyke nets (4.5 m x 0.6 m lead, 0.6 m x 1.2 m trap, 3 mm mesh)
- Beach seines (various lengths, 3 mm mesh)
- Small-mesh purse seines (122 m x 3.05 m, with 2.5 cm mesh)
- Cast nets (2 m radius, various mesh sizes)
- Hydroacoustic surveys, using a 200 kHz split-beam transducer mounted to the front of the boat and connected to a computer with acquisition software

All captured fish will be identified to species, and measured for total length and weight. Comparisons of catch-per-unit-effort and length-frequency data will be used to evaluate relative gear efficiency.

Detection probability modeling will continue to examine the probability of capturing Silver Carp and Bighead Carp with various gears using PRESENCE software. Future work will examine detection probabilities for juvenile Asian carp, investigate additional gear types, assess multi-gear models, attempt to incorporate other sources of data, and explore detection probability for various native species.

Sites in the Mackinaw, Spoon, Sangamon, and the Salt Fork of the Sangamon Rivers will continue be sampled in 2015 to assess the demographics of Asian carp populations in tributaries of the Illinois River. Upstream and downstream sites on each tributary will be sampled monthly during spring, summer, and fall. Pulsed-DC electrofishing will be used to capture Asian carp for age analyses, and mini-fyke nets and/or beach seines will be used to sample for juveniles.

Sampling Schedule: In 2015, gear evaluation sampling will occur monthly from spring through fall for electrofishing and opportunistically with other gears throughout the Illinois Waterway and in tributary rivers. Additional sampling may occur on an as-needed basis in cooperation with other sampling and monitoring efforts.

Deliverables: Preliminary results will be reported for monthly sampling summaries. Data will be summarized and project plans updated for annual revisions of the MRP.

Asian Carp Gear Development and Evaluation

Participating Agencies: U.S. Fish and Wildlife Service, Columbia Fish and Wildlife Conservation Office

Location: Work will take place in pools within the Chicago Sanitary and Ship Canal and the Illinois River system; tributaries of the Missouri and Mississippi rivers;; the White River in Arkansas;; and on small Midwest reservoirs.

Introduction and Need: Researchers have had difficulty assessing spawning success and recruitment of Asian carp due to an inability to effectively collect age zero sizes. Additionally, because of the threat of electric dispersal barrier breach by small carp, it is important to assess the abundance and risk of carp downstream of the electric dispersal barrier. State agencies are searching for additional means to reduce and monitor all sizes of carp as invasive carps continue to expand their range.

Silver Carp of all sizes within a variety of habitat types have effectively been captured with high efficiency using a new invention called the electrified Butterfly Frame Trawl (Paupier). Development of this gear has been ongoing for several years and 2015 will2015 will continue to contribute knowledge in the development of protocols for incorporatingincorporation the Paupier in regular monitoring of Invasive Carps.

A custom designed surface trawlwas debuted in 2013 with encouraging results. The net could effectively sample open water within backwaters and tributaries of the Illinois and Missouri rivers. In our sampling, thousands of Asian carp along with other species of similar sizes were collected. This gear promises to be an answer to the agency'sy's need for an inexpensive and easily used gear to assess young-of-year carp.

Large densities of carp still plague many reservoirs and backwater lakes in the Midwest. An efficient means to collect and dispose of these carp would be a potential advantage. Trammel and gillnets are currently used for large removals, but are dependent on the fish moving and not avoiding the net. Marginal success has been shown using a modified purse seine (Lampara seine) on a small Iowa reservoir. The Lampara Seine shows application for deployment in conjunction with the Mamou and Paupier trawls by using the same custom boat. In this way, this type of boat with multiple gears could be deployed to assess areas above the electric dispersal barrier while having a tool to sample any habitat type encountered.

Specifically, our objectives for this year's studies are to:

- Conduct paired electrofishing trials between the Paupier Trawl and traditional electrofishing techniques to determine efficiency of the Paupier Trawl relative to low, moderate and high density populations of carp from age zero to adult sizes.
- Understand variables (net design, electricalelectrical settings, speed of boat) important to Paupier effectiveness and deliver a protocol for boat operation.
- Continue development on Surface Trawls to target early life stages of Asian carp.
- Deploy Lampara Seine in high density population of Asian Carp to test feasibility as a method for mass removal
- Build a new shallow- water boat outfitted with dual mud motors capable of deploying multiple gear configurations in shallow, off- channel habitats. Utilize the new boat with

innovative gears to sample shallow waters for small (<300 mm) invasive carps of all sizes.

Status: All gears have had trials performed and been shown to be effective. Prototypes of all gears are on station and we are working with a contractor to modify designs as needed. The Paupier can sample up to 500 pounds (226.8 kg) of Silver Carp in areas of high density and can effectively sample carp as they exist in a variety of habitats including sizes from age zero to 20 pound (9.1 kg) adults. The Mamou was effectively proven in a backwater of the Illinois River and a Missouri River tributary catching over 10,000 YOY Asian carp along with other native fishes in one trawl. The Lampara seine effectively corralled schools of carp, but could not capture fish due to a lack of mechanical power and speed. New winches have been installed that will provide a remedy for this problem

Methods: A net designer will be contracted to consult for on-site visits during prototype net deployments. The Paupier will be deployed along with other electrofishing boats in the CAWS and other tributaries of the Illinois and Missouri rivers each month throughout the year. Net design and electrode comparisons will be made by pairing two varying designs on each side of the boat. Two Paupier boats are available to do these comparisons. The Paupier will also be tested in tributaries of the Missouri as well as Midwest lakes and reservoirs where high densities of Silver Carp are known to exist. Sampling schedule will consist of bi-monthly efforts from April through December.
A Mamou net will be deployed in tributaries, and backwaters of the Illinois River where young carp are known to exist. Data will be collected to describe effectiveness of the net in capturing carp and other like-sized native species. A second larger Mamou will be deployed in a reservoir and tributaries to target larger juvenile size carp and document potential size of collection based on the mesh and design of the net. Sampling schedule will be bi-monthly from May-September. The Lampara seine will be tested in an Iowa reservoir with moderate densities of juvenile and adult carp. The net will also be tested in a tributary of the White River in Arkansas where exceptionally large Silver Carp are abundant. The seine will be deployed in collaboration with barrier defense efforts in the Illinois River system. Sampling schedule will include at least three events between March and December.

Unconventional Gear Development

Participating Agencies: INHS (lead), USGS and IDNR (project support)

Location: Great Lakes trap (pound) nets will be deployed at select sites in Illinois River backwaters. Additional new gears or combination systems may be evaluated at appropriate sites as needed. Additional sites may be added as necessary in order to complete study objectives.

Introduction and Need: Traditional sampling gears vary widely in their ability to capture Asian carp. The ability of some of these gears to capture Asian carp in deep-draft channels or in areas of low density is questionable. Evaluation of novel sampling gears and capture methods is warranted to enhance the efficiency of monitoring programs and increase capture rates of Asian carp for control efforts. Capture efficiency and size selectivity of these new methods is being evaluated and compared with selected traditional gears to determine the utility of these techniques for monitoring and controlling Asian carp populations.

Objectives: To enhance sampling success for low density Asian carp populations, and increase harvest of Asian carp for control efforts, we will:

1) Investigate alternative techniques to enhance capture of Asian carp in deep-draft channels, backwater lakes, and other areas of interest for Asian carp monitoring and control purposes; and
2) Evaluate unconventional gears, capture methods, and combination system prototypes in areas with varying Asian carp population densities.

Status: During 2011 – 2013, large hoop nets were found to capture fewer fish of all species, as well as fewer numbers of all Asian carp taxa compared to standard (1 m) hoop nets. We therefore recommended against the use of large hoop nets for Asian carp monitoring purposes. Surface-to-bottom gill were found to capture higher numbers of all Asian carp taxa than standard gill net configurations during four-hour sets, and experiments testing the effectiveness of driving fish into surface-to-bottom gill nets suggested that drives using pulsed-DC electrofishing captured higher numbers of Silver Carp and Bighead Carp than either control sets or drives using traditional pounding. During 2014, additional experiments were conducted to test the effectiveness of driving Asian carp into surface-to-bottom gill nets. Analysis of combined 2013 and 2014 data indicates that drives using pulsed-DC electrofishing captured more total fish (all taxa) than drives using traditional pounding or control sets. Catch rates of Silver Carp were highest in electrofishing treatments, which were nearly 4 times higher than control sets, but similar to traditional pounding treatments. Bighead Carp catch rates were highest in traditional pounding treatments, although these were not significantly different than control or electrofishing treatments. A majority of all fish and of Silver Carp captured in surface-to-bottom gill nets were captured in the smaller mesh panels, particularly the 6.4 cm mesh size. However, Bighead Carp appear to be more vulnerable to larger mesh sizes, and drives using pounding in particular captured higher numbers of Bighead Carp in the 10.2 cm mesh panel. Driving fish into surface-to-bottom gill nets therefore appears to be an effective method for capturing Asian carp and other fishes.

Great Lakes trap (pound) nets were set at Lake Calumet, the Hanson Material Service Pit, and at Lily Lake during 2012 – 2014. Pound nets captured large numbers of fish at all sites, including large catches of Asian carp at the Material Service Pit and Lily Lake. No Asian carp were captured at Lake Calumet, and pound nets were repeatedly vandalized at this location. Analysis of combined 2012 - 2014 data indicated that catch rates of fishes, including Asian carp taxa, were consistently higher in pound nets in comparison to traditional entrapment gears set in backwater habitats. Average nightly catch of all fish species was, on average, 134 times higher in pound nets than in hoop nets and 5-6 times higher than in fyke nets. Overnight catch rates of Bighead Carp were 113 times higher in pound nets than in hoop nets, and 41 times higher than in fyke nets. Average Silver Carp catch rates were 3200 times higher in pound nets than in hoop nets, and 360 times higher in pound nets than in fyke nets. Pound nets tended to capture larger Bighead Carp (mean ± SD = 829 ± 103 mm) than hoop nets (619 ± 99 mm) or fyke nets (681 ± 140 mm). However, sizes of Silver Carp did not differ significantly among pound nets (582 ± 62 mm), hoop nets (572 ± 75 mm), and fyke nets (557 ± 78 mm). These data suggest that the use of pound nets in backwater habitats is an effective means of capturing large numbers of Asian carp relative to conventional approaches.

Methods: In 2015, pound nets will be set at the Hanson Material Service Pit and/or at Lily Lake in collaboration with USGS personnel testing the effectiveness of feeding attractants for Asian carp. Experiments will involve comparisons of pound nets set with and without the feeding attractant. All captured fish will be identified to species, and measured for total length and weight. Sex and reproductive condition of Asian carp will be determined by removal of gonads in the field. Additional new gears and gear combinations may also be incorporated into sampling efforts as they become available.

Sampling Schedule: In 2015, pound nets will be set opportunistically at the Material Service Pit and/or Lily Lake during spring through fall. Additional sampling may occur at other sites on an as-needed basis in cooperation with other sampling and monitoring efforts. Sampling in subsequent years will be conducted as required to meet future research and monitoring objectives.

Deliverables: Preliminary results will be reported for monthly sampling summaries. Data will be summarized and project plans updated for annual revisions of the MRP.

Water Gun Development and Testing

Participating Agencies:

US Geological Survey (Lead) – Illinois Water Science Center and Upper Midwest Environmental Sciences Center; Northern Illinois University (Support); Southern Illinois University (Support); Ohio State University (Support); Illinois Department of Natural Resources (Support); Hanson Material Service (Support); USACoE, USCG, and MWRD (project coordination).

Location:

Seismic water guns are being considered as a fish suppression tool to be used in the Chicago Sanitary and Shipping Canal (CSSC), the Illinois River; south of Brandon Road Lock and Dam, and Wabash River system near West Lafayette, Indiana. Potential uses of water guns in these locations include: fish exclusion from defined zones during routine maintenance of the electric dispersal barrier, integrated pest management (IPM) activities to control Asian carp in Illinois River backwaters, and to obstruct Asian carp spawning activity in the Wabash River. Water guns may be operated in either fixed or mobile deployments to create fixed barriers to deter fish movement or to herd fish out of specific locations. In addition, the effects of water guns on navigational structures will be assessed in locations near Brandon Road Lock and Dam on the Illinois River near Joliet, IL.

Introduction:

Pneumatic water guns have been successfully deployed in multiple scenarios to affect fish behavior and for establishing barriers to fish movement Results look promising for on-going applications of water gun technology to be IPM activities. In 2013 and 2014, water guns were used to create a barrier to Asian carp movement between areas in an Illinois backwater. These trials demonstrated that Asian carp behavior could be modified when water guns were firing. However, the 10 second gap between firings appeared to be sufficient enough to allow for Asian carp to breach the 2 water gun array. Following the difficulties with equipment failures in 2014, it is recommended reassessment of water guns as a barrier in 2015. The goal of this study is to evaluate the use of water guns as a barrier for Asian carp. These trials are expected validate the use of water guns as a tool for pest.

Status:

Pneumatic water guns have been successfully deployed in several locations to observe their effects on Asian carp behavior and man-made structures, and also to measure the seismic energy they produce at various firing pressures. In 2010, a pneumatic water gun was used during maintenance of the electric dispersal barrier. In October 2011, preliminary pressure monitoring was completed in the CSSC, and seismic energy transferred by the water gun was reported to be an order of magnitude greater than that of background noise. Video surveillance indicated no alteration of the canal wall (i.e. no visible removal of rock from the wall) nor was any disturbance to green vegetative growth on the wall. In addition, some fish were excluded from an area within the CSSC using a water gun. In 2012, Asian carp held in a quadrangular net enclosure in an Illinois River backwater were exposed to water guns. Results were inconclusive due to the handling stress associated with using wild adult fish for the study; however, during this study acoustic telemetry and sonar technology were found to be beneficial monitoring fish

movement. Studies to assess fish behavior to water gun use were completed in 2012 in a controlled test pond at the USGS Upper Midwest Environmental Sciences Center (UMESC). Results indicated that: 1) Asian carp schooling behavior relaxed during dark or low light hours, 2) fish responded to water guns at firing pressures ranging from 1000 to 2000 PSI and 3) fish avoided areas with pressure greater than 5 PSI. Pressure mapping was also accomplished within the test pond in 2012 to characterize the dissipation (horizontally and vertically) of the seismic energy in the water column. Pressure maps indicated that positioning two 80 in^3 water guns approximately 33 m apart could create a 5 PSI barrier zone. In 2013, seven trials were conducted in the UMESC test pond. Guns (80 in^3) were positioned based on pressure mapping data gathered in 2012. Fish were tracked with acoustic telemetry and sonar to evaluate diurnal response of fish. In addition to Asian carp, native juvenile fishes (Bigmouth Buffalo, Channel Catfish, Paddlefish, and Yellow Perch) were included in three trials to observe the behavior of non-target fish in response to water gun operation. In general, all fish species exhibited avoidance behavior in response to the operation of the water gun. Rupture of the swim bladder was only observed in paddlefish. Also in 2013, water guns were deployed in two different field applications in an off-channel site of the Illinois River. The first site demonstrated the utility of water guns as a fixed barrier to fish movement through a 100 m wide channel. Limited pressure gradient data were also collected at this site. The second field application was an integrated pest management demonstration where a water gun barrier was integrated with algal attractant zones and commercial fishing was used to deplete the localized Asian carp population. Results from this trials suggested that the combination of water guns, algal attractants and commercial fishing can decrease Asian carp populations in partially confined areas. In 2014, the integrated pest management trial of 2013 was repeated. However, with the combination of water gun and compressor malfunctions, the 2014 trail had limited success. Asian carp appeared to occupy areas away from the water guns more frequently than areas near the water guns. Using telemetered Asian carp, several fish were observed passing through the water gun barrier. However, this barrier consisted of a two 80 in^3 pneumatic water gun array where guns fired simultaneously every 10 seconds for 24 hours. The 10 second interval between firings appeared to be insufficient when attempting to deter fish passage. Despite the failure in 2014, pneumatic water guns have been successfully deployed in multiple scenarios to affect fish behavior and establish seismic barriers to fish movement. Results look promising for on-going applications of water gun technology to be integrated into pest management and/or control activities.

Objectives:

1. Develop a “mock” approach channel to a lock chamber: Due to considerable interest in the use of alternative barrier technologies at Brandon Road Lock and Dam (BRLD), an artificial channel will be created that has similar dimensions as the approach channel at BRLD. A channel will be created using two impermeable membranes spaced 32 m apart. Passage of fish around this channel will minimized by using block nets extending from the membranes to shore. Additional block nets will be placed approximately 200 m on both ends of the artificial channel across the backwater. These block nets will be used to block fish from leaving the study area and allow testing of barriers.
2. Evaluate the effectiveness of a six 100 in^3 water gun array: A six water gun array will be deployed within the artificial channel. Six water guns will allow for two water guns to be fired every 3-4 seconds. Asian carp behavior near the water gun barrier will be assessed using sonar and telemetry.

3. Determine if the pressure or just sound are affective barriers: Deploy speakers playing a recording of the six 100 in^3 water guns firing every 3-4 seconds within the artificial channel. Information from this study will help to determine if pneumatic water guns are necessary to modify fish behavior.
4. Determine the distance at which Asian carp avoid the water guns: Monitor fish behavior with static sonar to detect adult Asian carp around the barrier to quantify relative fish frequency distributions and calculate fish abundance in relation to the barrier.
5. Determine how affective water guns are as a barrier for Asian carp: Acquire and install an acoustic telemetry system to track select fish movements during trials to determine fish positions throughout the trials and observe in near real time if fish will move past an active water gun barrier firing every 3-4 seconds at 2000 PSI.
6. Evaluate non-target effects of firing the water guns: Conduct daily fish mortality surveys to estimate the number of fish killed by the water gun barrier, identify those fish species, and conduct gross necropsies on a portion of each fish species to observe and characterize tissue and organ damage associated with this type of water gun barrier.

Questions:

1. Does water gun operation alter the spatial occupancy (number of fish contained within known distances of the water gun / total number of fish) of fish within the system and/or alter their direction of movement?
2. Does the pressure, sound or both have the greatest impact on spatial distribution of Asian carp?
3. What fish species and relative abundance of those fish species will be adversely affected by the seismic energy produced by a static water gun barrier?

Schedule:

Field behavioral trials performed in the west pit of the backwater of the Illinois River on Hansen Material Service near Morris, IL, are expected to occur between May and July 2014. Set up for trail will begin in April 2015. A trial will consist of tagging 50 Asian carp and placing them within the study area. Fish behavior will be monitored for 24 hours without an active barrier and 24 hour with an active barrier for each water gun, water gun sound and complex sound. A trial is expected to last approximately one week. We plan to repeat the same trial 3 times. Therefore, a minimum of 3 weeks of active study time in May, June and/or July will be required for these trials.

Deliverables:

Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP. A final report of experimental results will be prepared and submitted to the MRWG.

Long Term Objectives (1-3 years):

1) Develop deployment guidelines for use in permanent (fixed) or temporary (mobile) water gun arrays. Permanent arrays, for example, could be used to defend locks in the CSSC to keep Asian carp from moving into the Great Lakes.
2) Examination and documentation of physiological impacts of water guns on fish and aquatic invertebrates to address NEPA and other environmental impact concerns.
3) Consider application to other invasive species such as round goby, and other invasive fish and invertebrate species.
4) Conduct engineering studies of acoustic energy on navigation and other in-water structures.

Alternative Pathway Surveillance in Illinois – Law Enforcement

Participating Agencies: IDNR (lead);

Location: Surveillance and enforcement efforts will focus in the Chicago Metropolitan area, areas throughout Illinois categorized as "target areas", and additional states.

Introduction and Need: The illicit trade and transportation of live invasive species increases the potential threat of them being introduced in the CAWS. Enforcement of laws regulating the movement of live aquatic species is essential to preventing them from establishing in the Great Lakes basin. The Invasive Species Unit (ISU) is the Illinois Department of Natural Resources' specialized law enforcement unit formed two and a half years ago dedicated to detecting and apprehending those individuals or companies involved in the illegal trade and/or transportation of invasive species. The unit consists of two officers with over twenty-two years of combined law enforcement experience with the Illinois Conservation Police who work directly with the Division of Fisheries. The Invasive Species Unit is a member of the multi-agency Asian Carp Task Force established in 2012 to combine enforcement efforts throughout the United States in preventing the spread of invasive species.

Many commercial fishermen in Illinois harvest Asian carp for profit, and there are several processing plants in the State that purchase these fish. Aquatic life transporters travel to Illinois to purchase Asian carp and transport the fish throughout the United States and other countries. There is a demand in Illinois fish markets to sell Asian Carp. Enforcement of U.S. and Canadian laws regulating the movement of live fish is essential to prevent establishment of invasive species which includes Asian carp in the Great Lakes basin. The inspections and surveillance of fish markets, wholesale fish dealers, fish transporters, bait dealers, and commercial fishermen is crucial in regulating the movement of fish throughout the State and other places.

The ISU conducted a successful operation with members of the Asian Carp Task force and arrested an Illinois commercial fisherman in 2014 for illegally selling approximately 1800 pounds of live Bighead and Silver Carp. Another commercial fisherman was arrested for possessing live Bighead and Silver Carp in holding tanks on his property in 2014.

Objectives: Continue to increase the capabilities and effectiveness of the IDNR Invasive Species Unit. Work in partnership with other agencies and field personnel for intelligence gathering and combined enforcement efforts on invasive species issues and the movement of illegal aquatic species we propose to:

- Develop and implement an annually updated training course to educate officers throughout the State of the positive impact invasive species enforcement can have and teach the techniques necessary to prevent and interdict the illegal transportation of aquatic life.
- Utilize the newly created Webcrawler system to expand the Unit's ability to search for illegal sales of injurious species on the Internet.

- Dedicate enforcement efforts focusing on the illegal sales or importation of invasive species within the bait industry and employ new technology as is comes available to search for contaminated bait stock (i.e. eDNA testing equipment).
- Initiate commercial inspections of aquaculture facilities licensed in the State.
- Conduct surveillance on commercial fishermen, transportation companies, and fish dealers who have been identified as potential risks based upon gathered intelligence.
- Recognize new threats as they develop within the aquatic life industry and develop a quick response plan to eliminate the threat.
- Seek out and complete training relevant towards invasive species enforcement to build the Unit's capacity to conduct successful investigations.
- Represent Illinois, the IDNR, and the Invasive Species Unit at various conferences, meetings, and seminars which discuss topics related to Asian carp and law enforcements responses and experiences.

Status: This project is on-going and has been extended into 2015. Significant arrests and dispositions in court have been made on fish transportation companies, commercial fishermen, and a non-resident bait dealer. Word is quickly spreading within the industry that Illinois takes the laws related to preventing the spread of invasive species seriously. The Invasive Species Unit has taken an active role in the Asian Carp Task Force and various committees related to invasive species enforcement. The ISU has successfully completed valuable training to better the Unit and increase productivity.

Methods:
Intelligence gathering and Surveillance - Being sensitive in nature, surveillance activities, operations and specific arrest details cannot be discussed in this document. The ISU utilized internet searches, leads provided through networking with other agencies and the public, surveillance, on-site observations, and information provided by those within the aquatic life industry. The ISU uses un-marked vehicles for everyday operations and surveillance. The ISU does not wear an identifiable "police uniform", but gets assistance from uniformed Conservation Police Officers when needed. Commercial inspections and detailed records searches proved beneficial for securing evidence to prove known violations, and it also was useful in locating other violations and violators. The education of field officers on invasive species and the aquatic life industry has enabled officers to recognize and document suspicious activity which may be an interest to the Unit. The Accurint search database and IDNR Point of Sale licensing system were often accessed for investigation purposes. Membership in the Great Lakes Fishery Commission Law Enforcement Committee and the Asian Carp Task Force have allowed for the sharing of information, tactics, and related concerns. This communication has fast forwarded progress and strengthened protection measures.

Sampling Schedule: Surveillance and enforcement activities will take place at yet to be determined times throughout the year.

Deliverables: Results of inspections and enforcement activities will be summarized and reported to the MRWG, as they become available. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

2016 – 2017 ISU Work Activities: The Unit will prioritize time and resources based upon the current concerns and newly developed information of illegal invasive species activities. Fish dealers and transporters will continue to be monitored and inspected. Results of 2015 efforts on inspecting bait dealers will be analyzed and future activities will be based of those results. ISU will use the newly created Webcrawler system designed to search the Internet for advertisements selling or trading invasive species. Investigations into illegal activities associated with any invasive species will be conducted as they are encountered.

Alternative Pathway Surveillance in Illinois – Urban Pond Monitoring

Participating Agencies: IDNR (lead), SIUC (otolith chemistry analysis)

Location: Monitoring will occur in Chicago area fishing ponds supported by the IDNR Urban Fishing Program.

Introduction: The Illinois Department of Natural Resources (IDNR) fields many public reports of observed or captured Asian carp. All reports are taken seriously and investigated through phone/email correspondence with individuals making a report, requesting and viewing pictures of suspect fish, and visiting locations where fish are being held or reported to have been observed. In most instances, reports of Asian carp prove to be native Gizzard Shad or stocked non-natives, such as trout, salmon, or Grass Carp. Reports of Bighead Carp or Silver Carp from valid sources and locations where these species are not known to previously exist elicit a sampling response with boat electrofishing and trammel or gill nets. Typically, no Bighead Carp or Silver Carp are captured during sampling responses. However, this pattern changed in 2011 when 20 Bighead Carp (> 21.8 kg (48 lbs)) were captured by electrofishing and netting in Flatfoot Lake and Schiller Pond, both fishing ponds located in Cook County once supported by the IDNR Urban Fishing Program.

As a further response to the Bighead Carp in Flatfoot Lake and Schiller Pond, IDNR reviewed Asian carp captures in all fishing ponds included in the IDNR Urban Fishing Program located in the Chicago Metropolitan area. To date, seven of the 21 urban fishing ponds in the program have verified captures of Asian carp either from sampling, pond rehabilitation with piscicide, or natural die offs; one pond had reported sightings of Asian carp that were not confirmed by sampling (McKinley Park) (Table 1). The distance from Chicago area fishing ponds to Lake Michigan ranges from 0.2 to 41.4 km (0.1 to 25.7 mi). The distance from these ponds to Chicago Area Waterway System (CAWS) waterways upstream of the Electric Dispersal Barrier ranges from 0.02 to 23.3 km (0.01 to 14.5 mi). Although some ponds are located near Lake Michigan or CAWS waterways, most are isolated and have no surface water connection to the Lake or CAWS upstream of the Dispersal Barrier (Table 1); ponds in Gompers Park, Jackson Park, and Lincoln Park are the exceptions. The Lincoln Park South Lagoon is no longer a potential source of Asian carp because the fish population was rehabilitated with piscicide in 2008, after which it was dropped as a Chicago pond stocking site. Lagoons in Gompers Park and Jackson Park have never had a report of Asian carp, nor have any been captured or observed during past sampling events. Nevertheless, examining all urban fishing ponds close to CAWS waterways or Lake Michigan continues to be of importance due to the potential of human transfers of Asian carp between waters within close proximity to one another.

In addition to Chicago area ponds once supported by the IDNR Urban Fishing Program, ponds with positive detections for Asian carp eDNA were also reviewed. Eight of the 40 ponds sampled for eDNA resulted in positive detections for Asian carp, two of which are also IDNR urban fishing ponds (Jackson Park, Flatfoot Lake) (Table 2). Asian carp have been captured and removed from two of the eight ponds yielding positive eDNA detections. The distance from ponds with positive eDNA detections to Lake Michigan ranges from 4.8 to 31.4 km (3 to 19.5 mi). The distance from these ponds to Chicago Area Waterway System (CAWS) waterways

Table 1. A list of Chicago area urban fishing ponds, reported and verified occurrence of Asian Carp, distance to Lake Michigan (LM) and the Chicago Area Waterway System (CAWS), and surface water connection to LM and CAWS. NR indicates none reported or observed/captured during routine electrofishing samples. DCEL is DC electrofishing and TN/GN is trammel/gill net. Waterways are: LM=Lake Michigan; CALSC = Cal-Sag Channel; CALR = Calumet River; DESPL = Des Plaines River; CSSC = Chicago Sanitary and Ship Canal; NBCR = North Branch Chicago River; LCALR = Little Calumet River; BUBCR = Bubbly Creek; DH = Diversey Harbor; and JH = Jackson Harbor.

Urban Fishing Pond	County	Town	Presence of Bighead Carp (number-year)	Distance to LM (miles)	Distance to CAWS (miles-waterway)	Surface water connection to LM and CAWS
Commissioner's Park Pond	Cook	Alsip	NR	9.7	0.9-CALSC	None
Auburn Park Lagoon	Cook	Chicago	NR	3.7	5.1-CALR	None
Columbus Park Lagoon	Cook	Chicago	3 winterkill-2011	7.8	2.9-DESPL	None
Douglas Park Lagoon	Cook	Chicago	NR	4.2	1.8-CSSC	None
Garfield Park Lagoon	Cook	Chicago	1 summerkill-2010 2 TN/GN-2012	5.0	3.2-NBCR	None
Gompers Park Lagoon	Cook	Chicago	NR	4.1	0.01-NBCR	Overflow to NBCR
Humboldt Park Lagoon	Cook	Chicago	3 TN/GN-2012 5 TN/GN-2013 1 winterkill-2014	3.8	2.2-NBCR	None
Jackson Park Lagoon	Cook	Chicago	NR	0.1	4.7-CALR	Overflow to JH
Lincoln Park South Lagoon	Cook	Chicago	3 pond rehab-2008	0.1	1.3-NBCR	Overflow to DH
Marquette Park Lagoon	Cook	Chicago	NR	6.3	4.2-CSSC	None
McKinley Park Lagoon	Cook	Chicago	Reported, NR	3.8	0.9-CSSC	None
Sherman Park Lagoon	Cook	Chicago	1 winterkill-2014	3.6	1.9-BUBCR	None
Washington Park Lagoon	Cook	Chicago	NR	1.7	3.3-BUBCR	None
Riis Park Lagoon	Cook	Chicago	NR	7.7	2.3-DESPL	None
Flatfoot Lake	Cook	Dolton	15 DCEL-2011 2 TN/GN-2011 1 TN/GN-2013	5.0	0.2-LCALR	None
Lake Owens	Cook	Hazelcrest	NR	12.2	4.8-LCALR	None
Cermak Quarry	Cook	Lyons	NR	10.7	0.2-DESPL	None
Lake Shermerville	Cook	Northbrook	NR	6.6	0.8-DESPL	None
Schiller Pond	Cook	Schiller Park	3 DCEL-2011	10.1	0.9-DESPL	None
Elliot Lake	DuPage	Wheaton	NR	25.7	14.5-CSSC	None
Community Park Pond	Lake	Mundelein	NR	9.2	3.8-DESPL	None

upstream of the Electric Dispersal Barrier ranges from 0.05 to 7.6 km (0.03 to 4.7 miles). Though positive eDNA detections do not necessarily represent the presence of live fish (e.g., may represent live or dead fish, or result from sources other than live fish, such as DNA from the guano of piscivorous birds) they should be examined for the presence of live Asian carp given the proximity to CAWS waterways.

Objectives:

1) Monitor for the presence of Asian carp in Chicago area fishing ponds supported by the IDNR Urban Fishing Program;
2) Obtain life history, age and otolith microchemistry information from captured Asian carp

Status: This project began in 2011 and is on-going. Thirty-two Bighead Carp have been removed from five Chicago area ponds using electrofishing and trammel/gill nets since 2011.

Table 2. A list of Chicago area ponds with positive detections for Asian carp eDNA, verified occurrence of Asian carp, proximity to Lake Michigan (LM) and the Chicago Area Waterway System (CAWS), and surface water connection to LM and CAWS. NR indicates none reported or observed/captured during routine electrofishing samples. DCEL is DC electrofishing and TN/GN is trammel/gill net. Waterways are: LM = Lake Michigan; CALSC = Cal-Sag Channel; CALR = Calumet River; GCALR = Grand Calumet River; LCAL = Lake Calumet; LCALR = Little Calumet River; JH = Jackson Harbor. (*) denotes IDNR urban fishing ponds.

Pond	County	Town	Presence of Bighead carp (number-year)	Distance to LM (miles)	Distance to CAWS (miles-waterway)	Surface water connection to LM and CAWS
Jackson Park*	Cook	Chicago	NR	0.1	4.7-CALR	Overflow to JH
Powderhorn Lake	Cook	Chicago	NR	3.5	0.5-GCALR	None
Harborside Lake	Cook	Chicago	NR	3.0	0.03-LCAL	Overflow to LCAL
Flatfoot Lake*	Cook	Dolton	15 DCEL-2011 2 TN/GN-2011 1 TN/GN-2013	5.0	0.2-LCALR	None
Sag Quarry West	Cook	Lemont	NR	19.5	0.06-CALSC	None
Horsetail Lake	Cook	Palos Park	NR	18.0	1.2-CALSC	None
Tampier Lake	Cook	Palos Park	NR	19.5	2.7-CALSC	None
Joe's Pond	Cook	Willow Springs	1 TN/GN-2012	17.0	0.9-CALSC	None

Eighteen of the 21 IDNR Chicago Urban Fishing Program ponds have been sampled to date. The remaining three ponds have been visited and visually inspected. All eight Chicago area fishing ponds with positive Asian carp eDNA detections have also been sampled. In 2014, four winterkill Asian carp were removed from Illinois urban fishing ponds: one Bighead Carp and one Silver Carp from Humboldt Park and Sherman Park in Chicago, respectively, and one Bighead Carp and one Silver Carp from Crystal Lake in Urbana. As with a majority of the Bighead Carp removed from Chicago area ponds in previous years, age estimation and otolith chemistry analysis of both Bighead Carp as well as the Silver Carp from Sherman Park Lagoon will be conducted Dr. Greg Whitledge at SIUC. This will be the first analysis of a Silver Carp otolith from a Chicago area pond.

To date, analysis of otolith chemistry data by Dr. Whitledge indicates that Sr:Ca from Bighead Carp in Chicago area ponds are not consistent with transplanted adult fish or bait bucket introductions of juveniles from nearby rivers. Higher Sr:Ca near the otolith core suggests these fish were transferred into the lagoons during age-0 or age-1. These data indicate that the fish spent their early life in water(s) with higher Sr:Ca ratios and the remainder of their life as residents of the urban ponds. In addition, the otolith core Sr:Ca values are high when compared to that of Bighead Carp of Illinois River origin as well as other sites previously examined in northern Illinois (Whitledge 2009). Given the size (age) of these fish at the time of introduction its plausible that they were contaminants in shipments of desirable fish species stocked in the lagoons, likely before the State of Illinois banned transport of live Bighead Carp in 2002-2003. This corresponds to a time when Bighead Carp were raised for market in ponds with Channel Catfish in certain regions of the U.S. (Kolar et al. 2007). Shipments of Channel Catfish may be the most likely source of contamination in Illinois urban fishing ponds as catchable-sized catfish

are stocked frequently and extensively in these waters throughout the State (IDNR 2010). For more detailed results see 2014 interim summary report document (MRWG 2015).

Methods: The sample design includes pulsed DC-electrofishing and netting in ponds in the IDNR Urban Fishing Program that Asian carp were collected from to ensure that no additional carp remain (Figure 3).

Sampling Protocol - Pulsed DC-electrofishing and trammel/gill nets will be used to sample urban fishing ponds in 2015. Trammel and gill nets used are approximately 3 m (10 ft) deep x 91.4 m (300 ft) long in bar mesh sizes ranging from 88.9-108 mm (3.5-4.25 in). Multiple nets will be set simultaneously to increase the likelihood of capturing fish. Electrofishing, along with pounding on boats and revving tipped up motors, will be used to drive fish from both shoreline and open water habitats into the nets. Upon capture, Asian carp will be removed from the pond and the length in millimeters and weight in grams of each fish will be recorded.

Otolith Microanalysis and Aging- Asian carp captured in urban fishing ponds will have head, vertebrae, and post-cleithra removed and sent to SIUC for otolith microchemistry analysis and age estimation.

Deliverables: Results of each sampling event will be reported for monthly sampling summaries. An annual report summarizing sampling results will be provided to the MRWG, agency partners, and any other interested parties.

Appendix A. Participants of the Monitoring and Response Workgroup, Including Their Roles and Affiliations.

Co Chairs
Kevin Irons, Aquatic Nuisance Species and Aquaculture Program Manager, Illinois Department of Natural Resources
John Dettmers, Senior Fishery Biologist, Great Lakes Fishery Commission

Agency Representatives
Matt O'Hara, IDNR
Kevin Irons, IDNR
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Jim Bredin, IWF
Jim Duncker, USGS
Jim Garvey, SIU
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Nathan Jensen , USGS
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Nick Barkowski, USACE
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Matt O'Hara, IDNR
Rob Simmonds, USFWS
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Ryan Manning, USCG
Scott Collins, INHS
Skyler Schlick , UFWS
Steve Butler INHS
Heath Tepovich, IDNR
Widloe, Justin , IDNR

Appendix B. Best Management Practices to Prevent the Spread of Aquatic Nuisance Species during Asian Carp Monitoring and Response Field Activities

The Asian carp monitoring and response activities of the MRP pose a risk of transporting and introducing aquatic nuisance species (ANS), including fish, plants, invertebrates, and pathogens. These best management practices (BMPs) are designed to be effective, easy to implement, and realistic; their use should reduce or potentially eliminate the threat of ANS spread by MRP activities. Further, BMPs combined with diligent record keeping can benefit the organizations participating in MRP activities by demonstrating that they are taking effective actions to prevent the spread of AIS.

For the purposes of these BMPs, all gear utilized in the process of field work that comes in contact with Illinois waters, including but not limited to those in the list below will be referred to as "sampling gear".

boats	eDNA collection gear	cast/beach/purse seines	hoop nets
trailers	personal gear	trammel nets	pound nets
electrofishing gear	ichthyoplankton nets	fyke nets	gill nets
hydroacoustic gear	cast nets	trawl nets	fish collection tubs

Field activities that have location-specific gear may need to do less to ensure that they are not transporting ANS. Examples might include boats, electrofishing gear, nets, or personal gear that are only used to sample one location. If potentially contaminated gear does not travel, the possibility of that equipment transporting ANS is reduced or eliminated. Maintaining duplicate gear for use in contaminated vs. non-contaminated locations or sampling all non-contaminated locations before moving on to contaminated locations may also reduce or eliminate the possibility of ANS spread.

Before traveling to a sampling location:

- ☑ ***Check*** gear and determine if it was previously cleaned. Accurate record-keeping can eliminate the need for inspecting or re-cleaning prior to equipment use. If you do not know if the sampling gear was cleaned after its last use, inspect and remove any plant fragments, animals, mud, and debris, and drain any standing water. If necessary, follow the appropriate "Clean" step(s) listed below.

After each sampling event, *before leaving waterbody*:

The following steps should occur before gear is transported away from the waterbody in order to be compliant with Illinois' Public Act 097-0850, which prevents transport of aquatic plants and animals by boats, trailers, and vehicles on Illinois' roadways, and Administrative Code Title 17 Section 875.50, which makes it unlawful to transport natural waters of the State without permission.

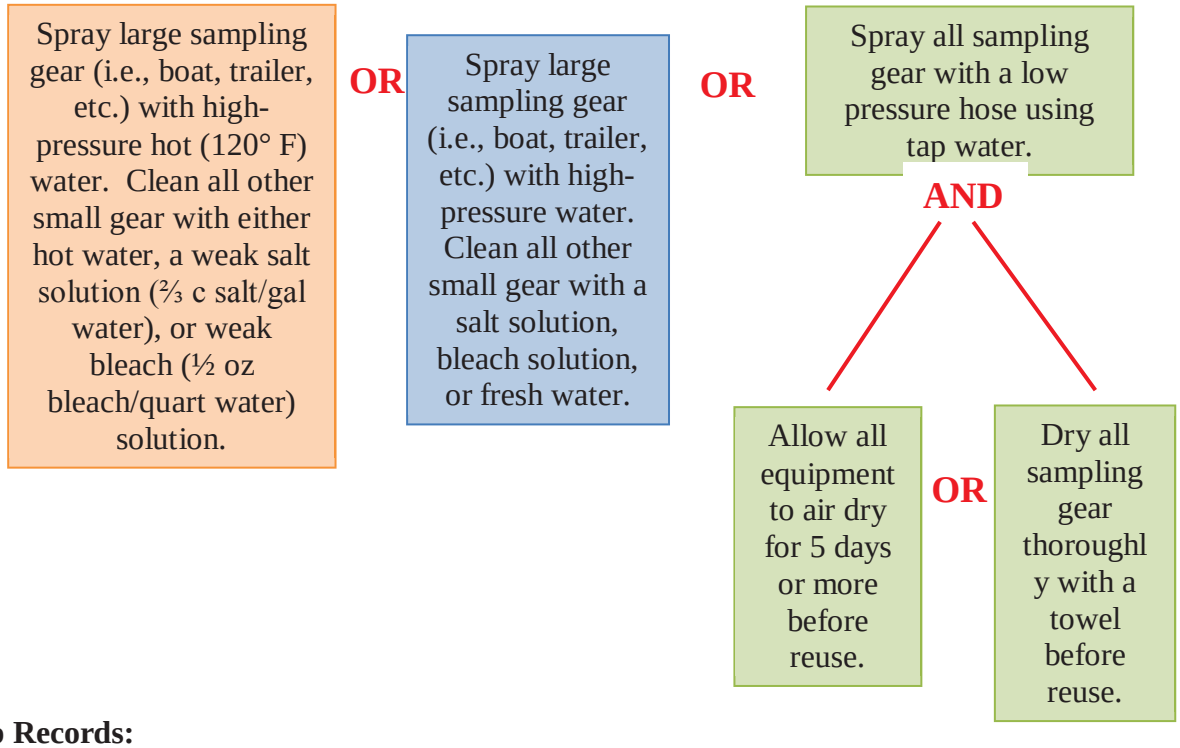
- ☑ ***Remove*** plants, animals, and mud from all sampling gear.

- ☑ ***Drain*** all water from boat and sampling gear.

After each sampling event, *before using gear at another location*:

The following cleaning/decontamination steps may occur either at the water access point (preferred, if possible) or may be completed at the gear storage location.

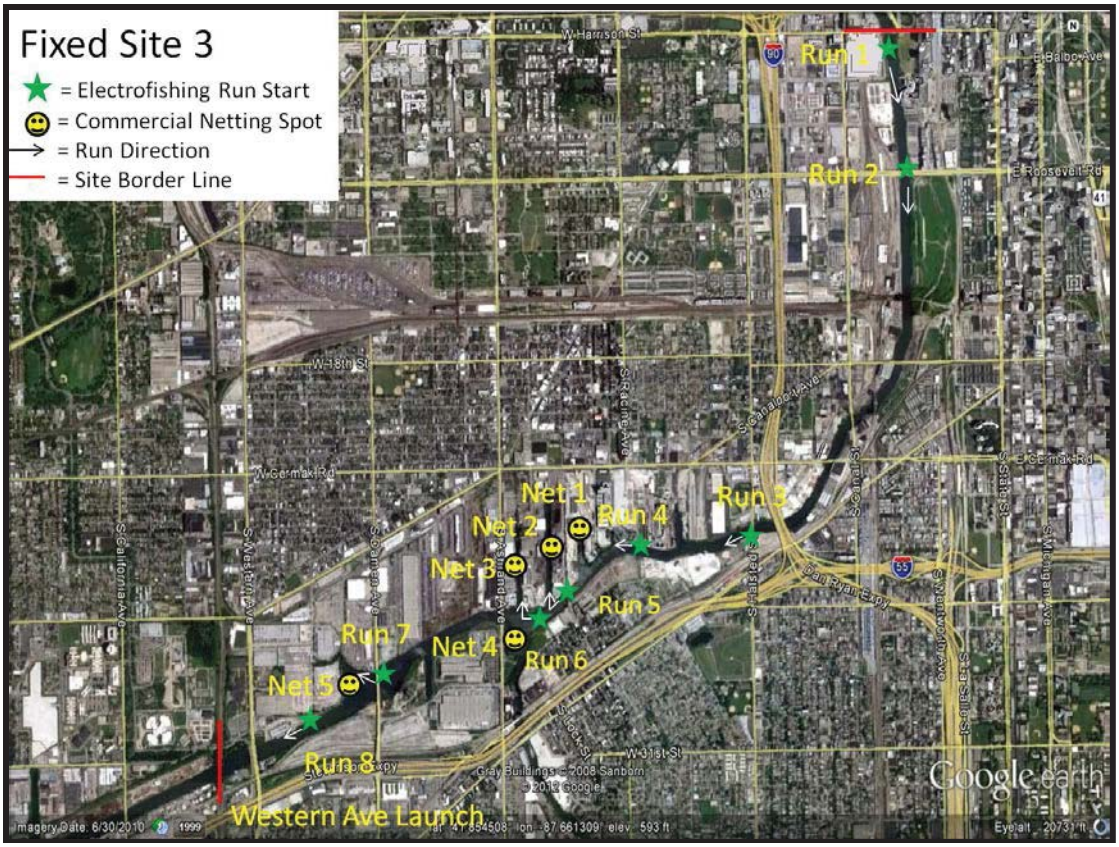
- ☑ ***Clean*** all sampling gear. Select an option below based on the available equipment (i.e., high-pressure hot washer, pressure washer, low-pressure hose). In general, pressure wash removes organisms while high temperatures will kill organisms. A three-minute pressure wash is effective at removing zebra mussel larvae and other microscopic organisms. Keep nozzle at a 90 degree angle to the boat and at least 12 inches away from the boat to prevent removing decals.

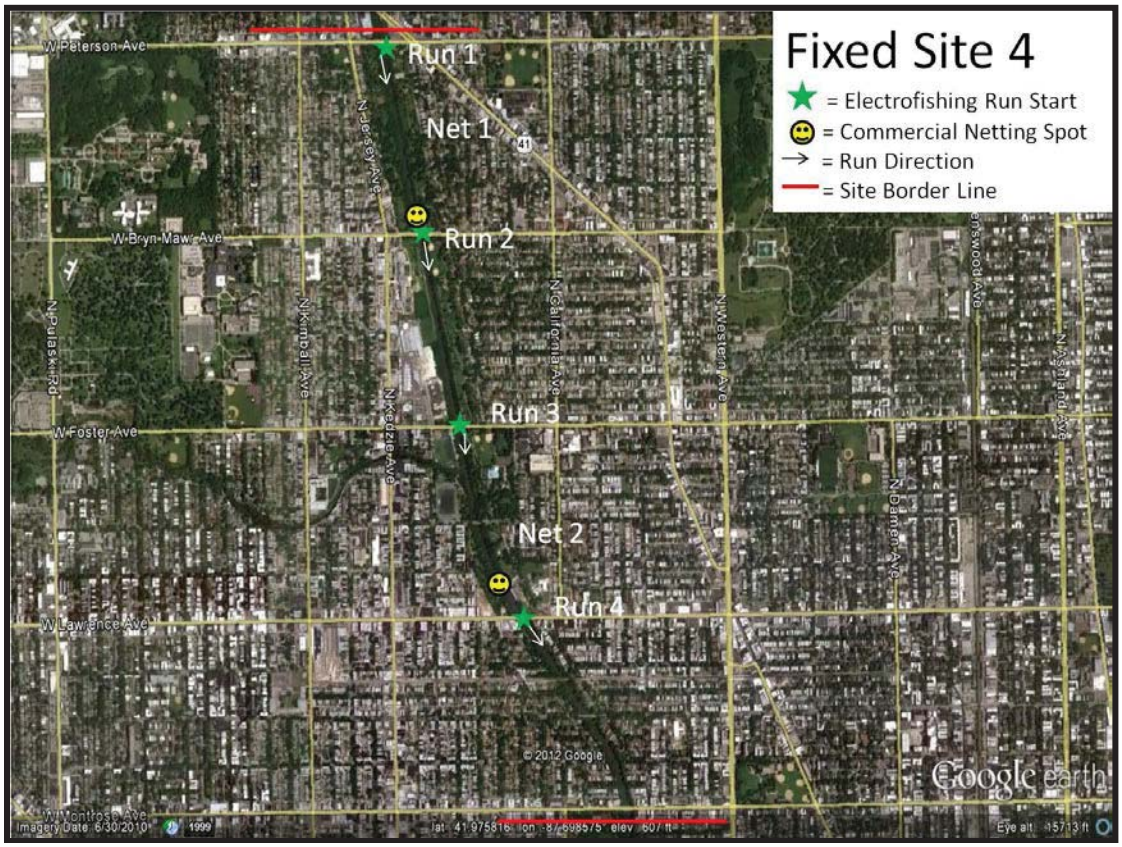


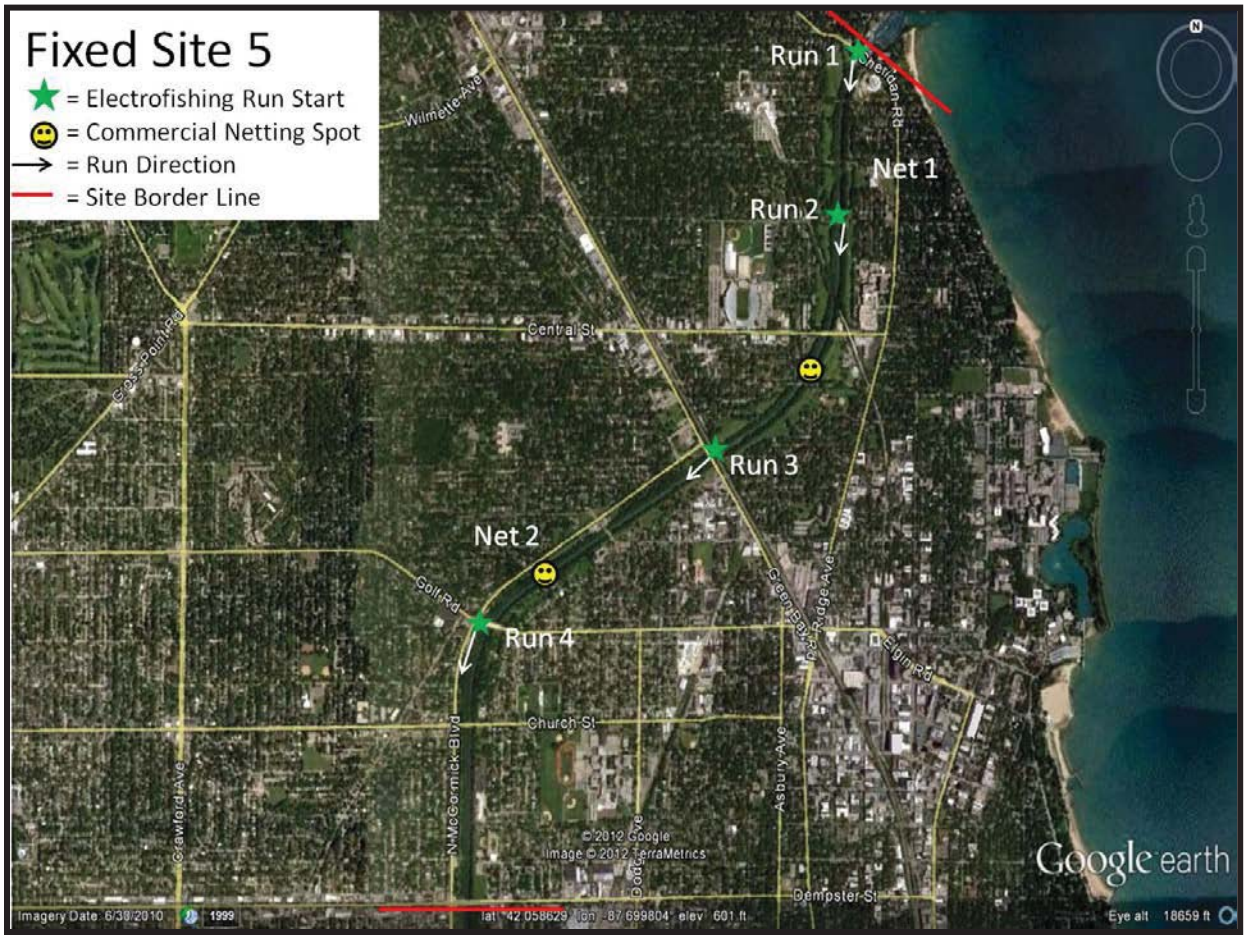
Keep Records:
Develop a Standard Operating Procedure (SOP) or checklist for cleaning equipment to make ANS prevention steps easy to follow and documentable. Complete the checklist for each sampling event with date, location, the recorder's name and what was done. These records over time demonstrate a solid commitment to AIS prevention, will help build a standard cleaning protocol, and will eliminating wasted time spent re-checking or re-cleaning equipment.

(Adapted by Illinois-Indiana Sea Grant from BMPs created by the Great Lakes Sea Grant Network.)

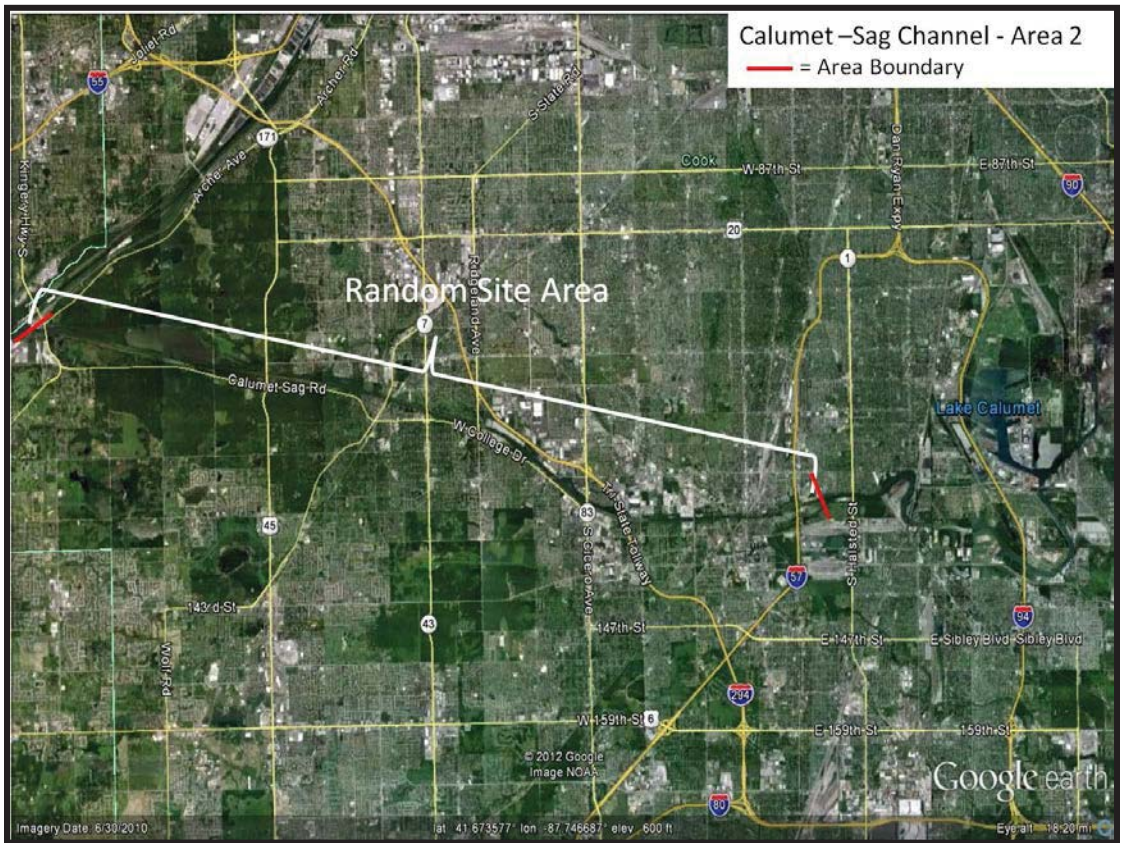
Appendix C. Detailed Maps of Fixed and Random Site Sampling Locations.


Fixed Site 3
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Border Line
Run 1
Run 2
Run 3
Run 4
Run 5
Run 6
Run 7
Run 8
Net 1
Net 2
Net 3
Net 4
Net 5
Western Ave Launch
W Harrison St
W 18th St
W Cermak Rd
W 31st St
S California Ave
S Western Ave
S Damen Ave
S Ashland Ave
S Racine Ave
S Halsted St
S State St
Dan Ryan Expy
Google earth

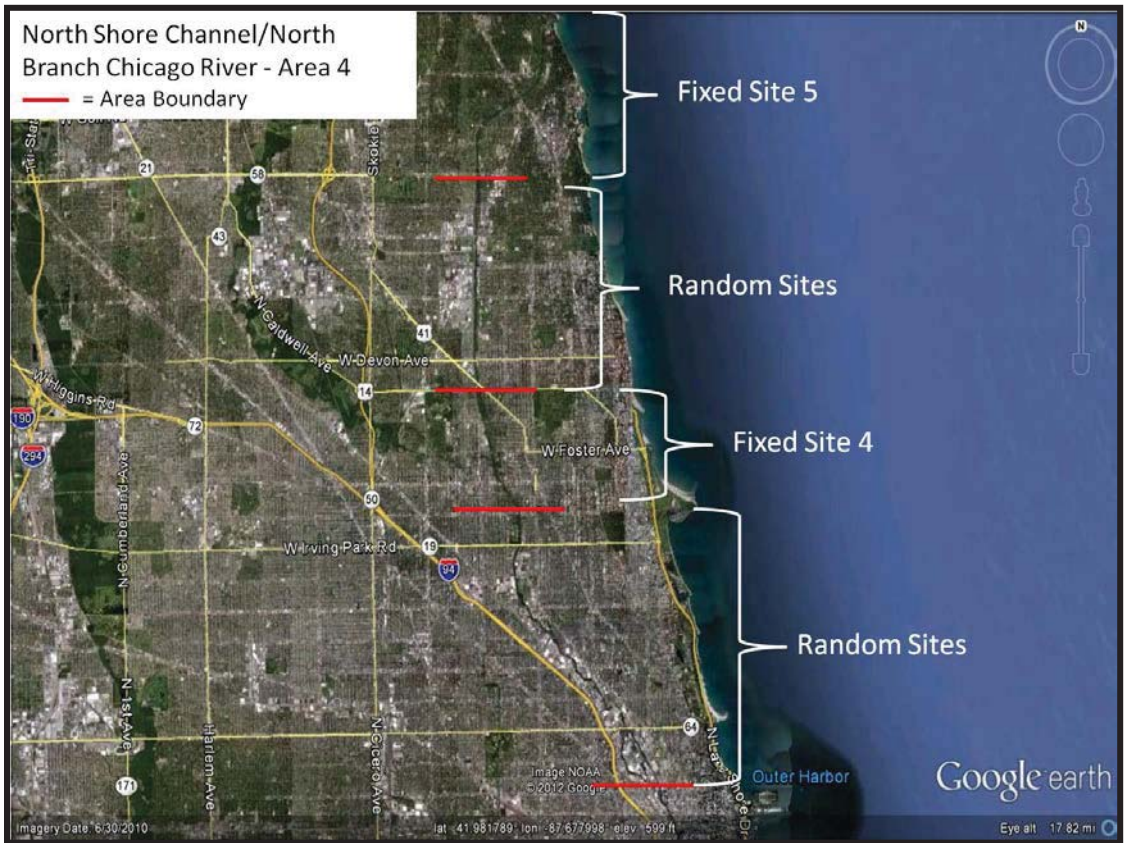

Fixed Site 4
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Border Line
Run 1
Run 2
Run 3
Run 4
Net 1
Net 2
W Peterson Ave
W Bryn Mawr Ave
W Foster Ave
W Lawrence Ave
W Montrose Ave
N Jersey Ave
N Pulaski Rd
N Kedzie Ave
N California Ave
N Western Ave
N Damen Ave
N Ashland Ave
© 2012 Google
Google earth


Fixed Site 5
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Border Line
Run 1
Run 2
Run 3
Run 4
Net 1
Net 2
Wilmette Ave
Sheridan Rd
Central St
Cross Point Rd
Golf Rd
Green Bay Rd
Ridge Ave
Elgin Rd
Church St
Crawford Ave
N McCormick Blvd
Asbury Ave
Dodge Ave
Dempster St
© 2012 Google
Image © 2012 TerraMetrics
Google earth
Imagery Date: 6/30/2010
1999
lat 42.058629 lon -87.699804 elev 601 ft
Eye alt 18659 ft

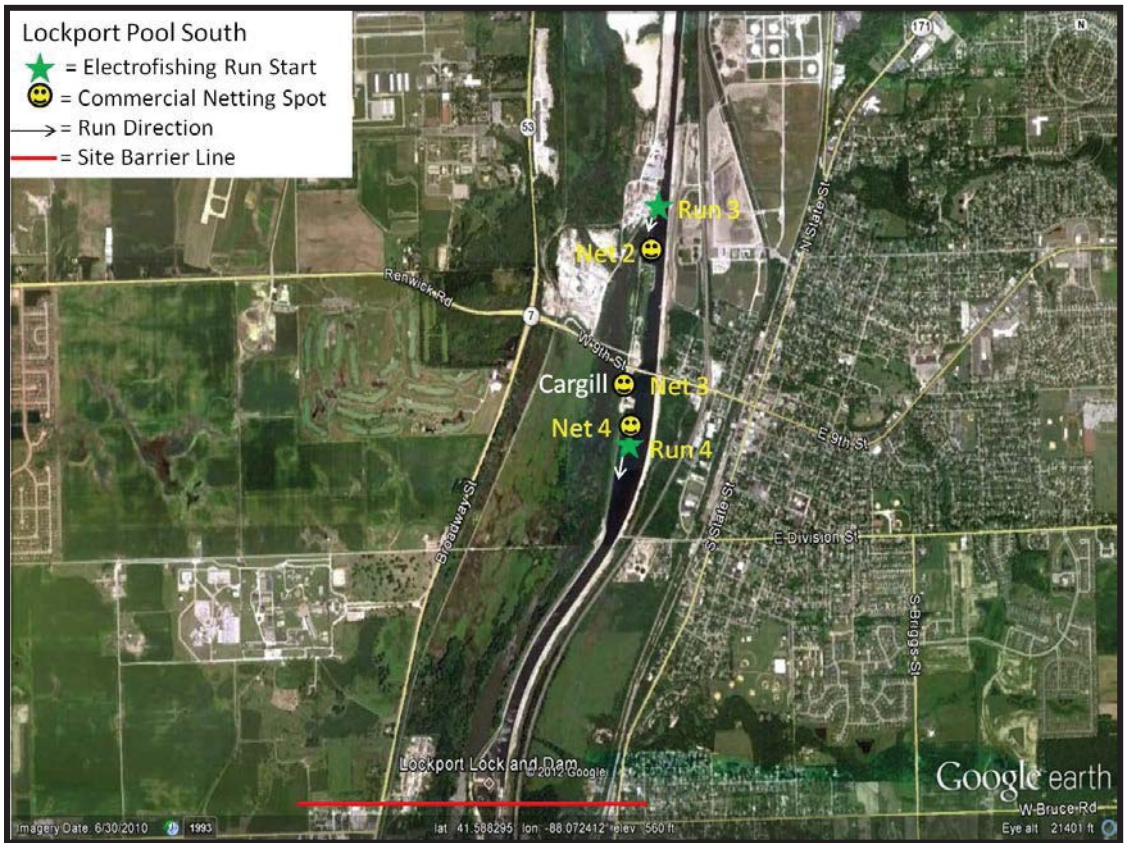

Calumet River - Area 1
= Area Boundary
Random Site Area
Lake Calumet
Wolf Lake
Google earth

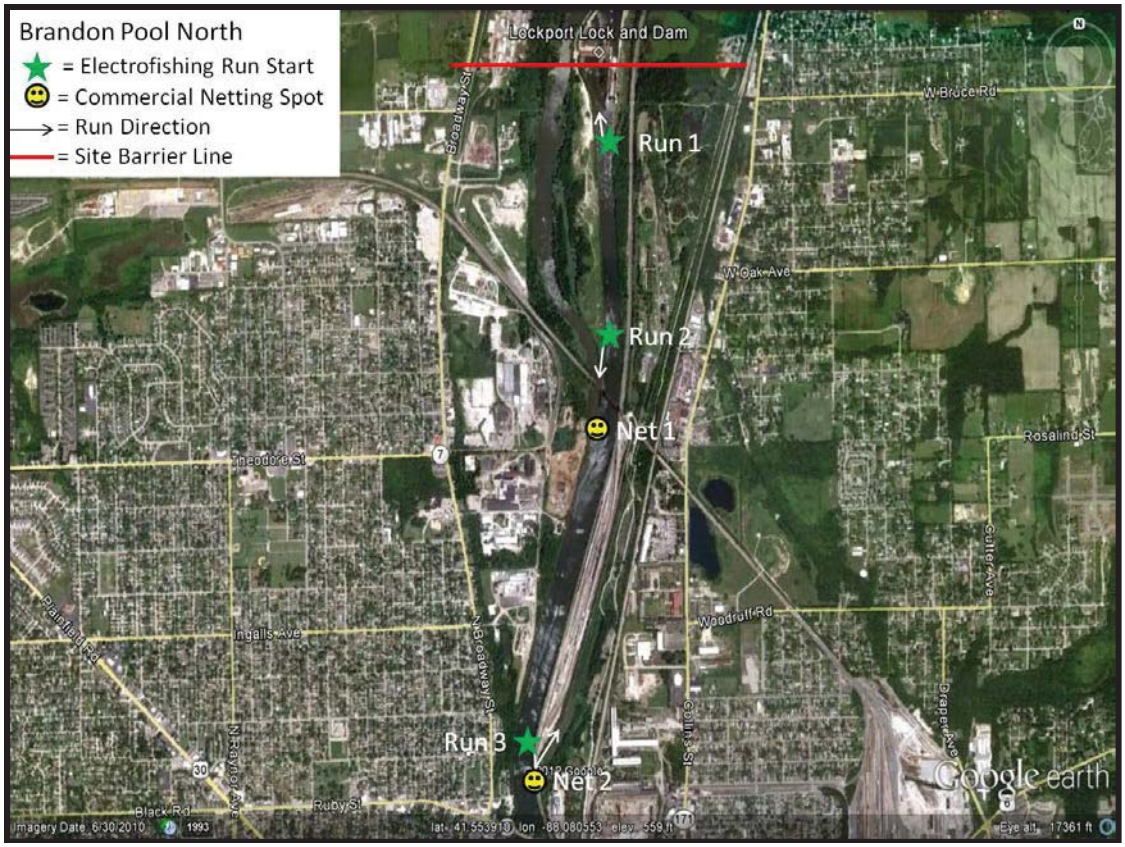

Calumet –Sag Channel - Area 2
= Area Boundary
Random Site Area
Lake Calumet
Google earth

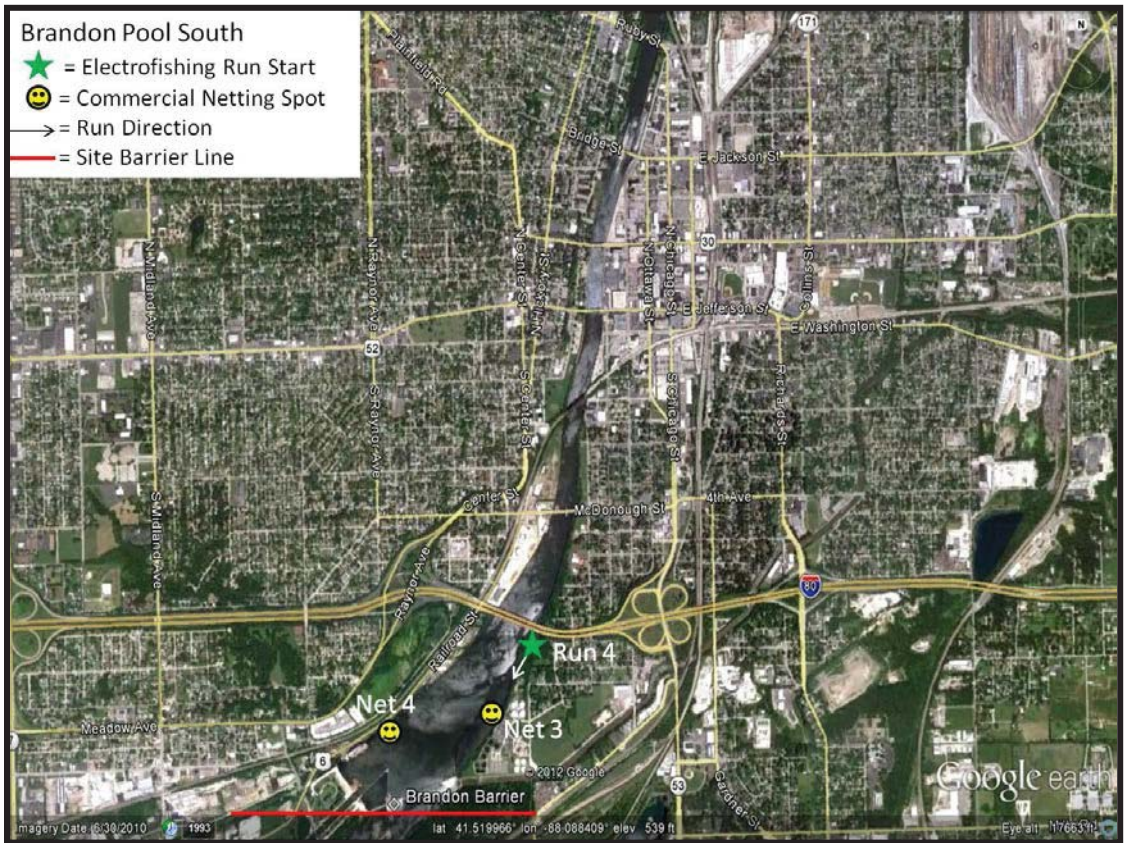

CSSC - Area 3
= Area Boundary
Random Sample Area
Roosevelt Rd
Butterfield Rd
DuPage
E Ogden Ave
W Ogden Ave
Stevenson Expy
Archer Rd
State Rd
W 87th St
Highway 12
Cook
Main St
Naperville Rd
Lemont Rd
South La Grange Road
S Harlem Ave
Ridgeland Ave
S Cicero Ave
S Halsted St
© 2012 Google
Google earth
Imagery Date 6/30/2010
lat 41.776242 lon -87.857290 elev 631 ft
Eye alt 22.58 mi

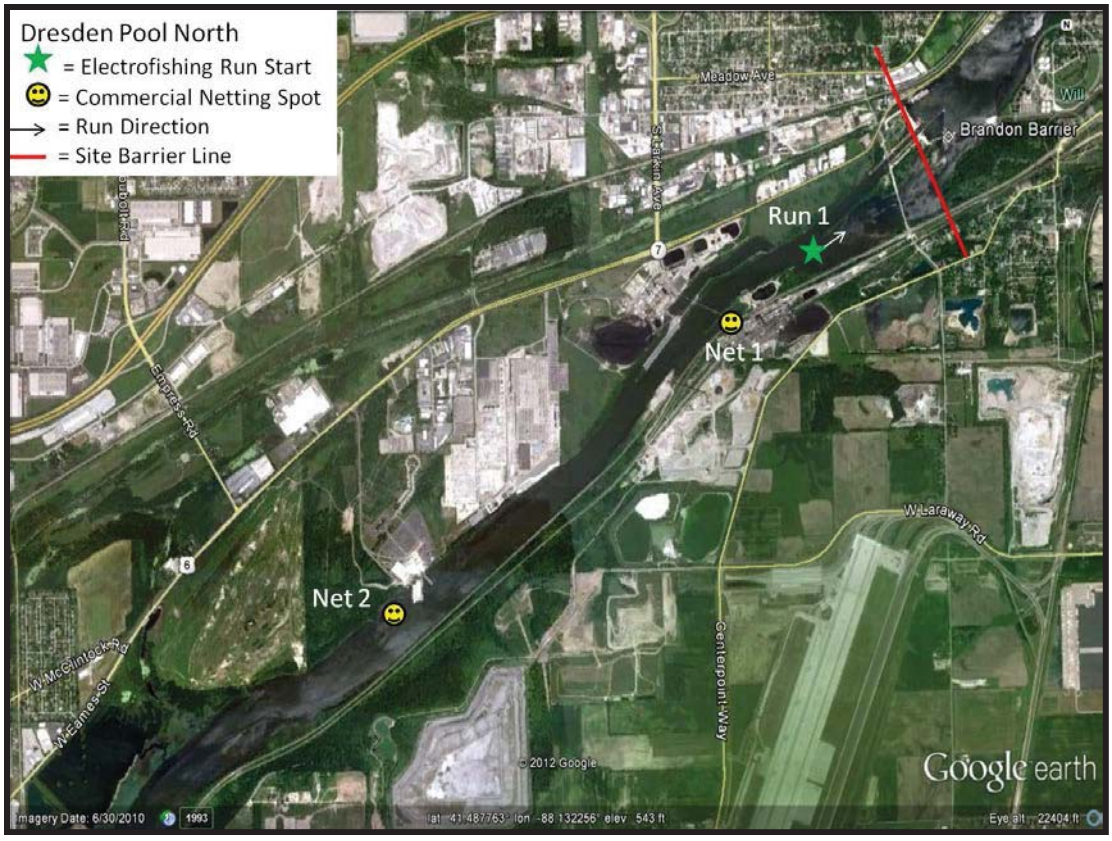

North Shore Channel/North Branch Chicago River - Area 4
= Area Boundary
Fixed Site 5
Random Sites
Fixed Site 4
Random Sites
W Devon Ave
W Higgins Rd
W Foster Ave
W Irving Park Rd
N Cumberland Ave
N Harlem Ave
N Central Ave
Outer Harbor
Image NOAA
© 2012 Google
Google earth
Imagery Date 6/30/2010
lat 41.981789 lon -87.677998 elev 599 ft
Eye alt 17.82 mi


Lockport Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Dispersal Barrier
E Romeoville Rd
Run 1
Run 2
Net 1
Independence Blvd
W 135th St
W 151st St
Archer Ave
NB IL Rte 53
171
© 2012 Google
Google earth
Imagery Date: 6/30/2010
1993
lat 41.625414 lon -88.054803 elev 584 ft
Eye alt 18091 ft


Lockport Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Run 3
Net 2
Renwick Rd
W 9th St
Cargill
Net 3
Net 4
Run 4
Broadway St
S State St
N State St
E 9th St
E Division St
S Prospect St
Lockport Lock and Dam
© 2012 Google
W Bruce Rd
Google earth
Imagery Date: 6/30/2010
1993
lat 41.588295 lon -88.072412 elev 560 ft
Eye alt 21401 ft

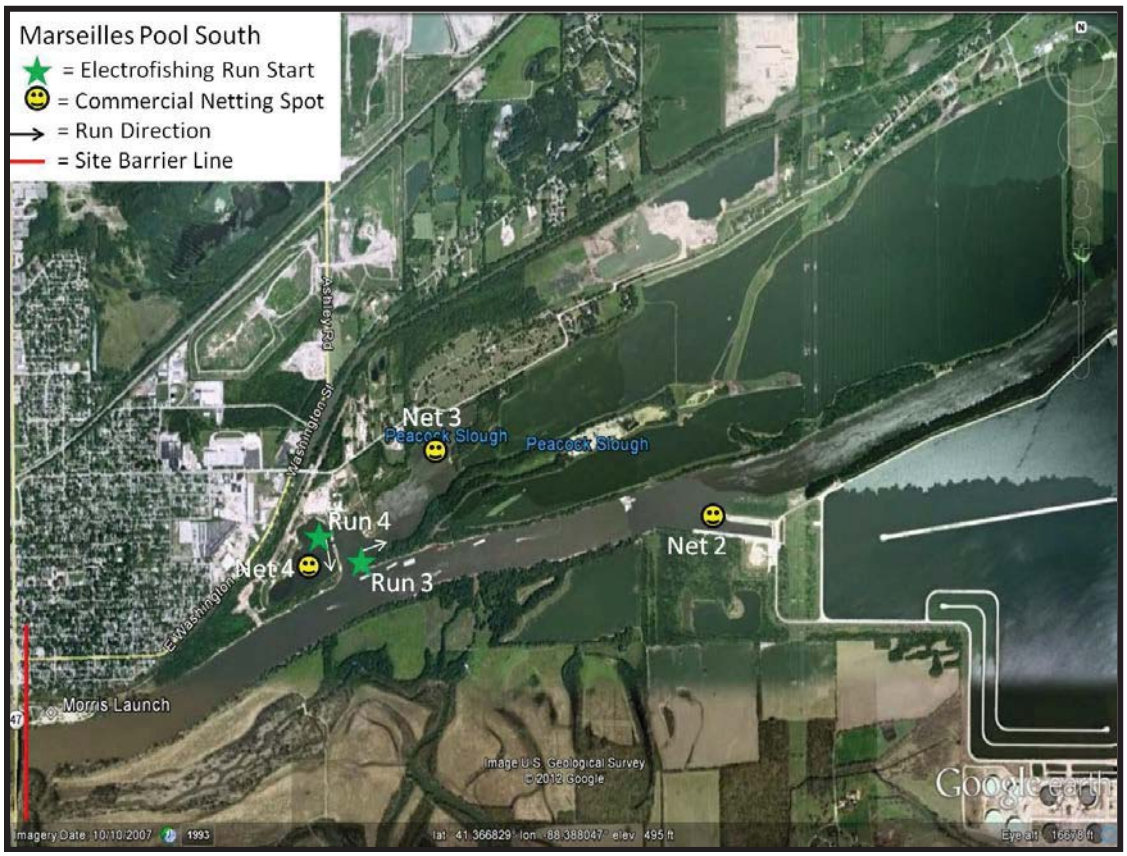

Brandon Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Lockport Lock and Dam
Run 1
Run 2
Net 1
Run 3
Net 2
W Bruce Rd
W Oak Ave
Rosalind St
Theodore St
Ingalls Ave
Woodruff Rd
Ruby St
Black Rd
Broadway St
Collins St
Draper Ave
Shiller Ave
Plainfield Rd
Google earth


Brandon Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Run 4
Net 4
Net 3
Brandon Barrier
Ruby St
Bridge St
E Jackson St
E Jefferson St
E Washington St
McDonough St
4th Ave
Center St
Meadow Ave
Railroad St
Taylor Ave
Gardner St
Collins St
Plainfield Rd
Google earth


Dresden Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Meadow Ave
Brandon Barrier
Run 1
Net 1
Net 2
Centerpoint Way
W Laraway Rd
W McClintock Rd
W Eames St
Empress Rd
© 2012 Google
Google earth
Imagery Date: 6/30/2010
1993
lat 41.487763 lon -88.132256 elev 543 ft
Eye alt 22404 ft


Dresden Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Centerpoint Way
Craig Rd
E Eames St
S Frontage Rd
E Frontage Rd
W Bluff Rd
Net 3
Run 2
Run 3
Net 4
Big Basin Launch
Run 4
S Brandon Rd
W Manhattan Rd
Image U.S. Geological Survey
© 2012 Google
Google earth
Imagery Date: 6/30/2010
1993
lat 41.439826 lon -88.159206 elev 532 ft
Eye alt 25931 ft


Marseilles Pool North
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Run 2
Run 1
Negro Slough
Net 1
Image U.S. Geological Survey
© 2012 Google
Google earth


Marseilles Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Net 3
Peacock Slough
Peacock Slough
Run 4
Net 4
Run 3
Net 2
Morris Launch
Image U.S. Geological Survey
© 2012 Google

Appendix D. Handling Captured Asian Carp and Maintaining Chain-of-Custody Records

Chain-of-custody is a legal term that refers to the ability to guarantee the identity and integrity of a sample from collection through reporting of the test results. The following are general guidelines to keep chain-of-custody intact throughout the fish collection process.

These procedures should be followed when any Bighead or Silver carp is collected in the Chicago Area Waterway (from Lockport Lock and Dam to Lake Michigan, but also areas where they have not previously been collected (e.g. Brandon Road Pool, Des Plaines River, or Lake Michigan).

1. Keep the number of people involved in collecting and handling samples and data to a minimum.

2. Only allow authorized people associated with the project to handle samples and data. Always document the transfer of samples and data from one person to another on chain-of-custody forms. No one who has signed the chain-of-custody form shall relinquish custody without first having the chain-of-custody form signed by the next recipient.

3. Always accompany samples and data with their chain-of-custody forms. The chain-of -custody form must accompany the sample.

4. Ensure that sample identification and data collected are legible and written with permanent ink.

Specific Instructions for Handling Asian Carp:

1. A. If the boat crew believes they have collected an Asian carp, they should cease further collection and take a GPS reading of the location at which the Asian carp was found or mark the location on a map provided.

   B. The boat crew leader should immediately notify a lead operations coordinator or chief, who will immediately notify the Incident Commander and the Conservation Police Commander, if present. If a command structure is not in place, then immediately contact an Illinois Conservation Police Officer (CPO) by contacting the IDNR Region 2 law office at 847-608-3100 x 2056.

   C. The boat crew will then take the fish to a staging area for identification by the fish biologist stationed at the site. If a staging area has not been designated, the boat crew should proceed to a predetermined meeting location and await the arrival of the CPO. The boat crew will not leave until the CPO arrives and they have recorded the GPS reading on a chain-of-custody form and signed the form over to the CPO. The CPO is to remain with the fish at all times.

   D. Once a fish biologist at the staging area makes a positive visual identification, he/she will identify the fish with a fish tag; take pictures of the tagged fish (See spawn patch

preservation and analysis appendix for photo request, Appendix H); measure its total length (mm) and weight (g); determine the fish's gender; identify reproductive status and gonad development as immature, mature – green, mature – ripe, mature - running ripe, and mature – spent; place the fish in a plastic bag; and seal the fish in a cooler with wet ice. The fish biologist at the staging area will place evidence tape across the opening of the cooler and initial it. The fish biologist at the staging area or when no staging area has been designated, the boat crew leader will give the sealed cooler to the IDNR CPO. The fish is to remain under IDNR control at all times.

E. The CPO will then deliver the sealed fish and chain-of-custody form to the sampling laboratory on site or make arrangements for transport to the genetics laboratory at the University of Illinois (contact: Dr. John Epifanio). Soft tissue for genetic testing and hard tissue for aging and/or chemical analysis will be removed at the UIUC laboratory. Additional soft tissue samples will be collected for other cooperating genetics laboratories (e.g., ERDC), as needed. Hard tissue will be transported to SIUC for analysis (contact: Dr. Jim Garvey). Chain-of-custody will be maintained when transporting hard tissue between university laboratories.

2. Only authorized IDNR tissue samplers or persons designated by an operations coordinator or chief will unseal the fish and remove the tissue samples from the fish for preservation and delivery to the lab. The lab samples will maintain the same sample ID as the subject fish but will also include an additional sequential letter (AC 001a, AC001b, AC002a, AC002b, etc) for multiple tissue samples from one fish. While sampling is occurring, the fish and samples will remain under supervision of the IDNR CPO who will maintain the chain-of-custody form.

3. All Asian carp captured during rapid response actions should be treated with care, handled minimally (no photo ops prior to tissue sampling), and transported to the staging area where they will be stored on ice in a cooler (no plastic bags). Captured fish cannot be frozen or preserved with chemicals, as these techniques distort the DNA. The USACE Engineer Research and Development Center (ERDC) has been designated to obtain a tissue sample from any Bighead Carp or Silver Carp collected during a rapid response action. The preferred tissue for DNA analysis is a pectoral fin (the entire fin) removed with a deep cut in order to include flesh and tissue of the fin base. The fin and tissue sample will be stored in a vial containing ethanol preservative (USACE will provide vials and preservative). Samples will be transported to ERDC for sequencing and comparison to the eDNA found in the pool.

CHAIN OF CUSTODY RECORD

File No.
Inv.

Date and Time of Collection:	River Reach:	Collected By:

Notes:

Collection No.	Description of Collection (include river reach, river mileage (if known), and any serial numbers):

Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:
Collection No.	From: (Print Name, Agency)	Release Signature:	Release Date:	Delivered Via:
	To: (Print Name, Agency)			□ U.S. Mail □ In Person □ Other:

Appendix E. Shipping, Handling, and Data Protocols for Wild Captured Black Carp and Grass Carp.

Any suspect black carp collected in the wild in the United States and grass carp collected in the Great Lakes Basin, or other novel locations in the U.S., should be immediately reported to the appropriate resource management agency in the state where the fish was collected. Do ***not*** release suspect black or grass carp unless required by state laws or instructed to do so by the resource management agency.

Differentiating black carp from grass carp using diagnostic external characteristics can be very challenging, especially when the two species are not being compared side-by-side. An identification fact sheet is attached for your reference. Careful attention should be given in waters where grass carp are known to occur to confirm that captured individuals are indeed grass carp and not black carp. If you are not positive of the species identification you should report the collection to the appropriate resource management agency to get assistance and further instructions.

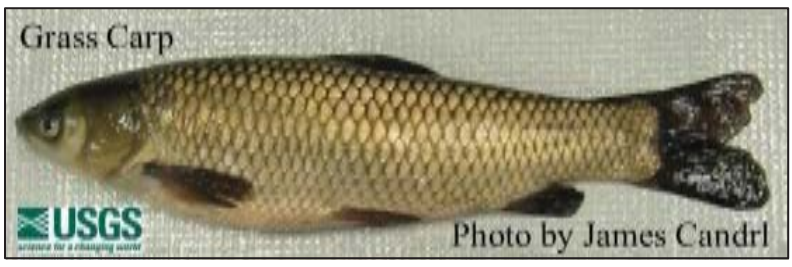
Collection information, basic biological data, and digital images should be collected for any suspect black or grass carp as soon as possible after capture. In addition to collection and basic biological data, we are interested in collecting multiple structures and organs from each fish for management and research purposes. Protocols are provided for 1) collection information, basic biological data, and digital images; 2) removal, preparation, and shipment of eyes for ploidy analysis; and 3) preparation and shipment of black and grass carp carcasses. These protocols are intended to provide resource management agencies, or authorized personnel, with streamlined instructions for the proper collection, preparation, and shipping of data, samples, and carcasses. It is important that all collections of black and grass carp (from the identified locations above) are immediately reported to the appropriate resource management agency in the state where the fish was collected before collecting more than collection information, basic biological data, and digital images.

Step 1: Data Collection

1. Record GPS Location (if available, otherwise a description of collection location);
2. Record date and time of capture, method of capture, and collecting individual or agency;
3. Record fish weight, girth, length, and species (number samples if necessary);
4. Take high resolution digital pictures (see examples below):

a. Lateral view of fish's entire left side,
b. Close-up lateral view of head,
c. Dorsal view of head with mouth ***fully*** closed (taken from directly above the fish's head).

5. Record name, telephone number, and/or email address for point of contact;
6. E-mail data and digital images to Sam Finney at sam_finney@fws.gov.
7. Proceed to Step 2.



Example of 4.a: Lateral view of fish's entire left

Example of 4.b: Close-up lateral view of

Example of 4.c: Dorsal view of head with mouth fully

Step 2: Eyeball Removal, Sample Preparation, and Shipping Procedures for Ploidy Analysis

Materials:

- Forceps; scalpel; blunt or curved scissors
- 50-100 ml plastic containers with leak-proof screw top cap
- Sealable plastic bags to fit several 50-100 ml containers
- Contact lens solution or saline (0.8-1.0% NaCl in DI water)
- Permanent marking pen
- Cooler or insulated container with ice packs, packing tape to seal cooler
- Optional: methanol if freezing and storing samples longer than 8 days.

Procedure for Removing Carp Eyeballs**:**

1. Euthanize fish with an overdose of tricaine methanesulfonate (MS-222) or sharp blow to head.
2. Label small plastic container with collection date, species and sample number if applicable (e.g. 25MAR13, black carp, #12)
3. Insert scalpel blade between the eyeball and socket wall. Taking care not to puncture the eyeball, cut around the circumference of the eyeball, keeping the blade pointed toward the socket wall. You may use forceps to hold the eyeball steady. The goal is to cut the tissue responsible for holding and moving the eye.
4. Once you feel confident all the tissue around the eye is cut, use the blunt or curved scissors to reach behind the eyeball and cut the optic nerve. Once the optic nerve is cut, you should be able to pop the eye out and trim off any excess tissue.
5. Place eye in labeled container, fill to top with buffer solution, and put on ice or refrigerate at 4 to 8°C.
6. Follow Eyeball Sample Preparation and Shipping Procedures below.

Sample Preparation for Overnight Shipment or Storage 1 to 8 Days:

This option will provide the highest quality of samples for analysis.

1. Label a small, plastic container with collection date, species, and sample number if applicable (e.g. 25MAR13, black carp, #12)
2. Remove both eyeballs without puncturing from fish and place in labeled container. (See removal procedures above.) Fill to top with contact lens solution or saline.
3. Place container(s) in a sealable plastic bag to contain leaks and place on ice or in a cooler with ice packs.
4. Ship immediately following shipping procedures for Whitney Genetics Lab (below) or keep refrigerated (4°C - 8°C) up to 8 days.
5. Proceed to Step 3.

Eyeball Sample Preparation for Storage Longer than 8 Days:

If samples cannot be shipped within 8 days, or if many samples will be collected over a known period of time, you can store and ship all together.

1. Label a small, plastic container with collection date, species, and sample number if applicable (e.g. 25MAR13, black carp, #12)

2. Remove both eyeballs without puncturing from fish and place in labeled container. (See removal procedures above.) Fill to top with 20% methanol in contact lens solution or saline.
3. Place container(s) in a sealable plastic bag to contain leaks and place on ice or in a cooler with ice packs. Refrigerate (4°C - 8°C) overnight to allow methanol to diffuse into fish eyes.
4. Move samples to a freezer (-20°C). Store frozen until overnight shipment can be arranged. Sample quality will not degrade as long as sample remain frozen (-20°C) until shipment.
5. Ship to Whitney Genetics Lab following procedures below.
6. Proceed to Step 3.

Shipping Procedures:

1. Contact Whitney Genetics Lab personnel to make Overnight Priority (for morning delivery) shipping arrangements. If possible, ship samples on same day of catch.
2. Do ***NOT*** ship samples until arrangements have been made for receipt of package.
3. Pack samples in a Ziploc bag to prevent leakage and then enclose in a sealed, insulated container with ice packs to maintain 4 to 8°C. Do ***NOT*** use dry ice for shipping. Include collection data (and sample number if necessary) with package. If using a cooler for shipping, make sure lid is taped securely.
4. Ship priority overnight to the attention of Whitney Genetics Lab Contact.
5. Email confirmation of shipment and tracking numbers to recipient.

Contact Information:

Jennifer Bailey – fish biologist
608-783-8451
608-397-4416 (mobile)
jennifer_bailey@fws.gov

Maren Tuttle-Lau – fish biologist
608-783-8403
maren_tuttle-lau@fws.gov

Shipping Address:

Whitney Genetics Lab – La Crosse Fish Health Center
U.S. Fish and Wildlife Service Resource Center
555 Lester Ave, Onalaska, WI, 54650
608-783-8444

Step 3: Carcass Preparation and Shipping Procedures

Carcass Sample Preparation for Overnight Shipment:

If possible, *ship samples immediately on ice on same day of catch*. Otherwise, freeze the carcass before shipping.

1. Pack entire specimen (with eyes extracted) in an insulated container with plenty of ice packs, frozen water bottles, or ice to keep cool. Do ***NOT*** use dry ice for shipping.
2. Include collection data (and sample number if necessary) in double ziplock bag in container.
3. Seal container to contain leaks. If using a styrofoam cooler within a box, make sure the lid is taped and sealed securely.
4. Ship immediately or keep frozen until Overnight Priority shipping arrangements are made.

Shipping Procedures:

1. Contact Columbia Environmental Research Center personnel to make Overnight Priority (for morning delivery) shipping arrangements.
2. Do ***NOT*** ship samples until arrangements have been made for receipt of package.
3. Ship specimen in sealed, insulated container (see sample preparation instructions above) priority overnight to the attention of Duane Chapman or Joe Deters.
4. Email confirmation of shipment and tracking numbers to (dchapman@usgs.gov).

Contact Information:

Duane Chapman
573-875-5399
573-289-0625 (mobile)
dchapman@usgs.gov

Joe Deters
573-875-5399
573-239-9646 (mobile)
jdeters@usgs.gov

Shipping Address:

Duane Chapman or Joe Deters
Columbia Environmental Research Center
U.S. Geological Survey
4200 New Haven Road
Columbia, MO 65201
573-875-5399

Appendix F. Fish Species Computer Codes.

Species Codes Asian Carp Monitoring

Alewife	ALE	Highfin Carpsucker	HFC	Spotted Sucker	SDS
				Spring Chinook Salmon	SCS
Banded Darter	BAD	Lake Trout	LAT	Suckermouth Minnow	SUM
Banded Killifish	BAK	Largemouth Bass	LMB		
Bigeye Chub	BGC	Logperch	LOP	Threadfin Shad	THS
Bighead Carp	BHC	Longear Sunfish	LOS	Trout Perch	TRP
Bigmouth Buffalo	BGB	Longnose Gar	LOG		
Black Buffalo	BKB			Walleye	WAE
Black Bullhead	BLB	Mosquitofish	MOF	Warmouth	WAM
Black Carp	BCP			White Bass	WHB
Black Crappie	BLC	Northern Hog Sucker	NHS	White Crappie	WHC
Blackside Darter	BLD	Northern Pike	NOP	White Perch	WHP
Blackstripe Topminnow	BLT			White Sucker	WHS
Bluegill	BLG	Orangespotted Sunfish	ORS		
Bluntnose Minnow	BLS	Oriental Weatherfish	OWF	Yellow Bass	YLB
Bowfin	BOW			Yellow Bullhead	YEB
Brook Silverside	BRS	Paddlefish	PAH	Yellow Perch	YEP
Brown Bullhead	BRB	Pumpkinseed	PUD		
Brown Trout	BRT				
Bullhead Minnow	BUM	Quillback	ULL		
Central Mudminnow	CEM	Rainbow Smelt	RAS		
Channel Catfish	CCF	Rainbow Trout	RBT		
Coho Salmon	CHO	Redear Sunfish	RSF		
Common Carp	CAP	Redfin Shiner	RDS		
Common Shiner	CMS	River Carpsucker	RVC		
Creek Chub	CRC	River Redhorse	RVR		
		River Shiner	RVS		
Emerald Shiner	EMS	Rock Bass	ROB		
		Round Goby	ROG		
Fall Chinook Salmon	FCS				
Fathead Minnow	FHM	Sand Shiner	SAS	**Hybrid Codes**	
Flathead Catfish	FCF	Sauger	SAR	Bluegill x Green Sunfish	BGH
Freshwater Drum	FRD	Shorthead Redhorse	SHR	Bighead x Silver Carp	BSH
		Shortnose Gar	SHG	Common Carp x Goldfish	CGH
Ghost Shiner	GHS	Silver Carp	SCP	Striped Bass x White Bass	SBH
Gizzard Shad	GZS	Silver Chub	SVC	Yellow Perch x White Bass	YWH
Golden Redhorse	GOR	Silver Redhorse	SVR	White Perch x Yellow Perch	WYH
Golden Shiner	GOS	Skipjack Herring	SKH		
Goldeye	GOL	Smallmouth Bass	SMB	**Other Codes**	
Goldfish	GOF	Smallmouth Buffalo	SAB	Unidentified Sunfish	SUN
Grass Carp	GRC	Spotfin Shiner	SFS	Unidentified Minnow	MIN
Grass Pickerel	GRP	Spottail Shiner	SPS	Unidentified Fish	UID
Green Sunfish	GSF	Spotted Gar	SPG	No Fish Code	NFH

Appendix G. Sample data sheets.

Asian Carp Monitoring Project - Electro Date: _____

Area Surveyed: _____ Biologist (Crew): _____

Wisc Unit DC: Rate: _____ Duty:_____ Range: High or Low Volts:_____ Amps:_____

Smith Root DC: Percent of Setting:_____Pulse Per Second Setting:_____Amps:_____

Other (Describe): _____

Rate Gear Efficency (circle one): Good Moderate Poor

Air Temp: _____ Water Temp: _____ Conductivity: _____ Others: _____

	Run No._____ Lat._____ Lon._____ Start Time: _____ Shock Time: _____	Run No._____ Lat._____ Lon._____ Start Time: _____ Shock Time: _____	Run No._____ Lat._____ Lon._____ Start Time: _____ Shock Time: _____	
Fish Species	No. of Fish	No. of Fish	No. of Fish	Total No. Fish
Gizzard shad >6 in.				
Gizzard shad juv.<6 in.				
Alewife				
Common carp				
Goldfish				
Carp x Goldfish hybrid				
Freshwater drum				
Smallmouth buffalo				
Bigmouth buffalo				
Black buffalo				
River carpsucker				
Quillback				
White sucker				
Channel catfish				
Yellow bullhead				
Black bullhead				
Largemouth bass				
Smallmouth bass				
Bluegill				
Green sunfish				
Pumpkinseed				
Hybrid sunfish				
Rock bass				
White crappie				
Black crappie				
Golden shiner				
Bluntnose minnow				
Fathead minnow				
Spotfin shiner				
Emerald shiner				
Spottail shiner				
Round goby				
White perch				
White bass				
Yellow bass				

Asian Carp Monitoring Project - Nets

Date: _____

Area Surveyed: _____ Biologist (Crew): _____

Air Temp: _____ Water Temp: _____ Conductivity: _____ Others: _____

Set No._____ Lat._____ Lon._____ Total Yds._____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	
Fish Species	**No. of Fish**	**No. of Fish**	**No. of Fish**	**Total**
Gizzard shad >6.0 in.				
Common carp				
Goldfish				
Carp x goldfish hybrid				
Freshwater drum				
Bighead carp				
Silver carp				
Grass carp				
Smallmouth buffalo				
Bigmouth buffalo				
Black buffalo				
River carpsucker				
Quillback				
Channel catfish				

Set No._____ Lat._____ Lon._____ Total Yds._____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	Panel No._____ Type (circle): Tra or Gill Length (yds.)_____ Height (ft.)_____ Mesh (in.)_____ Start Time: _____ End Time: _____	
Fish Species	**No. of Fish**	**No. of Fish**	**No. of Fish**	**Total**
Gizzard shad >6.0 in.				
Common carp				
Goldfish				
Carp x goldfish hybrid				
Freshwater drum				
Bighead carp				
Silver carp				
Grass carp				
Smallmouth buffalo				
Bigmouth buffalo				
Black buffalo				
River carpsucker				
Quillback				
Channel catfish				

Asian Carp Monitoring Project

Date: _____

Area Surveyed: _____ Biologist (Crew): _____

Gear Type (circle one): DC, AC, Nets

Nets (Describe Nets): _____

Fish Species	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm	TL mm
Gizzard shad >6 in.										
Gizzard shad juv.<6 in.										
Alewife										
Common carp										
Goldfish										
Carp x Goldfish hybrid										
Freshwater drum										
Smallmouth buffalo										
Bigmouth buffalo										
Black buffalo										
Quillback										
White sucker										
Channel catfish										
Yellow bullhead										
Black bullhead										
Largemouth bass										
Smallmouth bass										
Bluegill										
Green sunfish										
Pumpkinseed										
Hybrid sunfish										
Rock bass										
White crappie										
Black crappie										
Golden shiner										
Bluntnose minnow										
Fathead minnow										
Spotfin shiner										
Emerald shiner										
Round goby										
White perch										
Yellow Bass										

eDNA Field Data Sheet

DATE_____ NAME_____ START TIME_____ SHEET ____of_____

ID	Volume	Latitude	Longitude	Temp	Depth	Habitat	Collect Time	Filter Time

Notes/Comments:

Appendix H. Understanding Surrogate Fish Movement with Barriers Floy tagging data sheet.

Asian Carp Monitoring - Floy Tag Data Sheet **Date:**_____

Area Surveyed:_____ **Biologist (Crew):**_____

	Species	Length(mm)	Time	Tag #	Recap.	Clip Loc.	Latitude(Dec. Deg.)	Longitude(Dec. Deg.)	Gear	Comments(dead/alive)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
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27										
28										
29										
30										

Appendix I. Analysis of Bighead and Silver Carp Spawn Patches.

Spawn Patch Preservation/Analysis:

Bighead and Silver Carp males use their pectoral fins to irritate the ventral margin of females during the spawning season (Figure 1). Recent spawning or prespawning interactions between males and females will leave an irritated patch on the breast of the female fish, and scales are often lost. Presence of regenerated scales is evidence that a female fish may have been courted by a male fish (although it is impossible to tell from this feature if spawning actually occurred). The number of annuli in regenerated scales may also be useful in determining the number of years since spawning activity occurred. It is as yet unclear how many scales are lost on average or if scales are lost each time the fish spawns. However, in order to preserve potential information on spawning activity or presence of male fish where a female fish is captured, it is prudent to preserve the breast of Bighead and Silver Carp caught from areas where the presence of Asian carps caught is being investigated if allowable by the state and regulatory bodies. For the 2013 Monitoring and Response Plan participants, fish collected in the CAWS or the Great Lakes should follow the chain of command and custody protocols is of primary importance with biological data being collected after securing the fish. Fish collected in Brandon Road Pool require a voucher per the 2013 MRP. Additional biological data will be processed after those protocols have been followed and likely in a lab setting. For fish collected below Brandon Road Lock and Dam, it is permissible to follow the procedures as long as it would not interfere with ongoing tracking/telemetry.

Figure 1. Spawn patch of a female Bighead Carp, located on the breast of the fish between the pelvic and pectoral fins.

If a Bighead or Silver Carp is caught from the Great Lakes or the CAWS, FIRST FOLLOW ALL PROTOCOLS IN THIS MANUAL; See: **Appendix C. Handling Captured Asian Carp and Maintaining Chain-of-Custody Records**. If there is no conflict with existing protocol, the portion of the fish illustrated in Figure 2 should be photographed as soon as possible after capture, to document abrasions from recent sexual activity. In areas outside of the CAWS and the Great Lakes sections should be preserved from damage to ensure scale regeneration can be analyzed if required by state and regulatory agencies.

Protocols for analysis of scale regeneration in this area are not yet prepared, but care should be taken to preserve the scales and skin in this area. This technique is only useful when employed on female Bighead and Silver Carp. Although external features are useful in identifying the sex of a captured Bighead or Silver Carp, none of these features are 100% reliable in identification of sex. Therefore this portion of the fish should be preserved at least until the sex is determined by the examination of the gonads. When the gonads are examined, care should be taken to avoid cutting through the area of the spawn patch. Note that histological examination of gonads may also be useful in evaluating recent spawning activity.

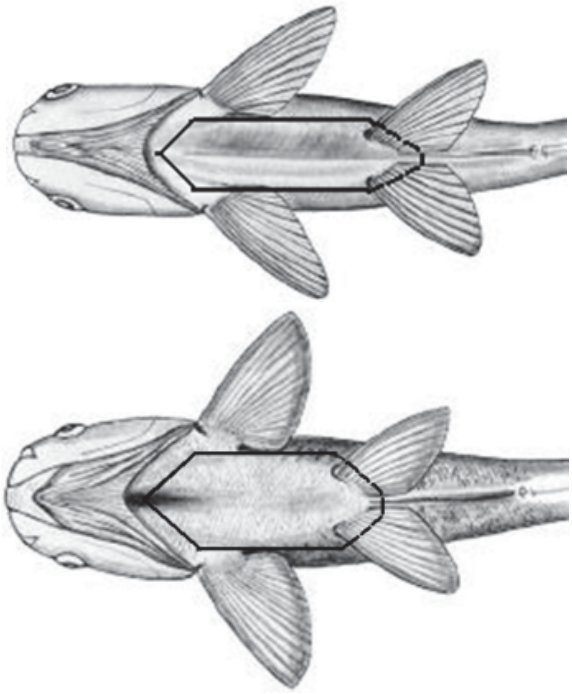

Figure 2. Areas to be preserved for analysis. Silver Carp on left, Bighead Carp on right. (FIRST FOLLOW ALL PROTOCOLS IN THIS MANUAL See: **Appendix C. Handling Captured Asian Carp and Maintaining Chain-of-Custody Records** for fish collected in the CAWS or the Great Lakes; **managers may not allow dissection of fish collected in these areas and need to be consulted about any physical samples being taken**).