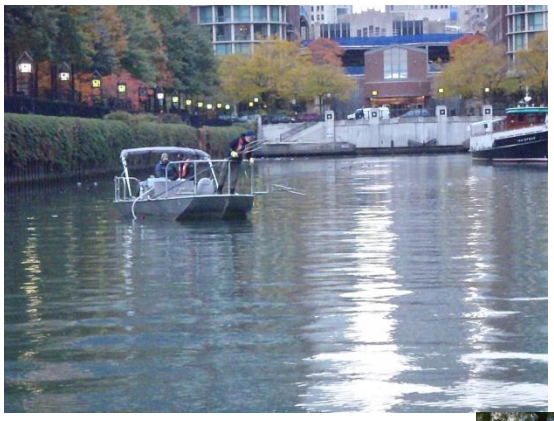
Asian Carp Regional Coordinating Committee

Monitoring and Response Workgroup

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

April 2014



ILLINOIS DEPARTMENT OF NATURAL RESOURCES

United States Coast Guard
U.S. Department of Homeland Security

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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, P. Herman, M. Shanks, E. Monroe, R. Simmonds, S. Finney, J. Stewart, N. Bloomfield, T. Hill, W. Doyle, S. Jensen, K. Irons, M. McClelland, 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. K. Irons, B. Caputo, M. O'Hara and B. Ruebush 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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Monitoring and Response Plan for Asian Carp in the Upper Illinois River and Chicago Area Waterway System

EXECUTIVE SUMMARY

The 2014-2016 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 2014-2016 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 and 2013; however the plan will utilize a multiyear approach. This plan will be considered a living document and, 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 the purpose of this plan, 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 2013 MRP. The interim reports document is considered a companion document to this 2014 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. The interim summary report may be found at: www.asiancarp.us.

Highlights of major initiatives in the 2014 MRP include:

- Refocusing of sampling effort- 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. This conclusion and the need to further investigate the leading edge of the Asian carp population, suggest that the sample size for fixed sites and random areas in this area above the electric dispersal barrier will be reduced during the 2014 sampling season. Seasonal Intensive Sampling will take the place of monthly fixed site/random area monitoring, reducing the frequency of sampling upstream of the electric dispersal barrier. This reduction in would provide an opportunity to further increase sampling downstream of the electric dispersal barrier. Furthermore, better understanding of Asian carp populations downstream of the electric dispersal barrier should prove to be valuable for reducing their numbers, thus mitigating the risk of individuals moving upstream to Lake Michigan in the event of a failure at the electric dispersal barrier.

- Increased barrier defense effort- 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. 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, by refocusing monitoring efforts downstream of electric dispersal barrier, commercial fisherman can expend more effort in the target areas of Marseilles and Dresden Island pools which have high abundances of Asian carp. Overall harvest should improve with this increased effort.

- Heightened telemetry program near and downstream of the electric dispersal barrier - With 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 movement of fish approaching electric dispersal barrier can be evaluated. Currently, United States Army Corp of Engineers (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 Southern Illinois University-Carbondale (SIUC) for data sharing and recovery downstream. In order to increase the chances of future tagged fish approaching the electric dispersal barrier, additional tagged fish within the Lockport Pool should be captured on the opposite side of the electric dispersal barrier than their release. Also, it is recommended that a portion of our fish released in vicinity of the electric dispersal barrier should contain depth sensor tags to begin analyzing how fish use the entire water column in response to the electric dispersal barrier, barge traffic and clearing events between the electric dispersal barriers.

- Monitoring fish at the Electric Barrier System- Fixed Dual Frequency Identification SONAR (DIDSON) monitoring of the electric dispersal barrier using a telescopic boom lift will continue when abundances of small fish at the electric dispersal barrier are at their greatest. Further evaluation of operational protocols of the electric dispersal barrier 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.

- Asian carp detection probability- Additional analyses will continue to explore factors that affect the probability of detecting Asian carp. 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.

- Continued water gun research- The effects of water gun seismic pressure waves on in-water structures needs to be completed before this technology can be employed in critical navigational waters where critical in-water structures may be affected. Potential structural test locations have been identified in the Illinois River and are being evaluated for potential use in 2014. Additional research using seismic technology to affect fish behavior as a deterrent and control strategy is warranted. Additional testing of this technology with alternative seismic sources (e.g. hydraulic water guns) is recommended based on the logistical obstacles associated with pneumatic water guns (e.g. requires a ~1,600 kg, 4-stage air compressor). Thus, additional controlled tests should be completed in the Upper Midwest Environmental Sciences Center (UMESC) test pond to further clarify the response of Silver Carp and Bighead Carp to alternative sources of seismic energy. Additional field trials should be completed to establish water gun barriers in open water environments. Low light conditions appear to increase fish detections and schooling patterns appeared to relax. This information should be considered for future testing of deterrent technologies. It is recommended that the Integrated Pest Management evaluation be repeated in 2014 to observe if 2013 results can be repeated.

More detailed analyses and justifications for changes to sampling protocols are included in the MRWG 2013 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 electric dispersal barrier 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 projects are proposed to achieve the overarching goal and objectives of the 2014-2016 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 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 in the CAWS (20) – 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 9 and 16th) and the fall season (Week of September 15 and 22nd). This project includes standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at sites in the CAWS upstream of the electric dispersal barrier. 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 this event pulsed-DC electrofishing, tandem trap nets, Lake Michigan pound nets and contracted commercial fishers will be utilized. The two week event in the fall will focus on the North Shore Channel/Chicago River. Although no Asian carp have been collected in this focus area, numerous Rapid Response events have been initiated due to eDNA positive results. In this event, pulsed-DC electrofishing, Lake Michigan pound nets and contracted commercial fishers will be utilized to sample the area. This project provides information on relative abundance and distribution of Asian carp, if captured or observed, and other fish species that can be compared among sites and across time.

Strategy for eDNA Monitoring in the CAWS (27) –In 2014, eDNA monitoring in the CAWS will include two comprehensive events in the spring and fall. The comprehensive events will include sample collection at multiple sites in the CAWS during a relatively short period of time.

Larval Fish and Productivity Monitoring (28) –Larval fish sampling will occur at approximately biweekly intervals at sites throughout the Illinois River Waterway 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, chlorophyll, 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 (31) – 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 (33) – 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 Carp 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 (38) – This project includes standardized monitoring with pulsed-DC electrofishing gear and contracted commercial fishers at four fixed sites downstream of the electric dispersal barrier in Lockport Pool, Brandon Road Pool, Dresden Island Pool and Marseilles 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 13, 13, 24 and 4 random sites in the Lockport Pool, Brandon Road Pool, Dresden Island Pool and Marseilles 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 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 (44) – This project includes a threshold framework to support decisions for response actions to remove any Asian carp from the CAWS upstream of the electric dispersal barrier with conventional gear. 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 (48) – This project provides a fish suppression plan to support USACE maintenance operations at the electric dispersal barrier. 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 (60) – This program was established to reduce the numbers of Asian carp downstream of the electric dispersal barrier 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. Primary areas that will be fished include Starved Rock and Marseilles pools.

Optimal Harvest Strategies to Minimize Asian Carp Propagule Pressure on the Electric Dispersal Barrier (62) –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. Furthermore, 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 hydroacoustic surveys and side scan sonar) 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 (> 1000 tons removed since 2010). 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. 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.

BARRIER EFFECTIVENESS EVALUATIONS

Telemetry Monitoring Plan (68) – This project uses ultrasonically tagged Asian carp and surrogate species to assess if fish are able to challenge and/or penetrate the electric dispersal barrier 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 (78) **–** This project will investigate the movements and distribution of tagged surrogate fish species in the Dresden Island, Brandon Road, and Lockport pools along with target areas such as Rock Run Rookery Lake. 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, Identification, and Fish-Barge Interactions at the Electric Dispersal Barrier, Chicago Sanitary and Ship Canal, Illinois (80)- Results from our past fish monitoring work at the electric dispersal barrier have revealed that fish abundances in that area fluctuate throughout the year. The accumulation of feral fish immediately below the operating barrier has raised concerns about the fish opportunistically moving upstream during a planned or unplanned barrier outage, swimming upstream during a barge passage or

involuntarily being moved upstream by a passing barge vessel. This project will identify fish species and determine abundances immediately below Barrier IIB, between Barrier IIB and the Demonstration Barrier before and after required monthly barrier maintenance shutdowns. Fish behavior will be evaluated during monthly shutdowns to determine if feral fish opportunistically swim upstream during the planned outages. Also, determine fish behavior between the narrow arrays where the highest-voltage electrical field is located and where barges traverse the barriers.

Monitoring Fish Abundance and Spatial Distribution in Lockport, Brandon Road, and Dresden Island Pools and the Associated Lock and Dam Structures (83) – 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 sampling will continue thru April. Seasonal (spring, summer, and fall) scans will be preformed 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 to maximize coverage of the water column. Diel sampling will take place in order to assess fish distribution patterns near the electric dispersal barrier throughout a 24-hour period. Complete electric dispersal barrier scans will take place three consecutive times every three hours. This information will be especially useful given that 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 electric dispersal barrier, most likely in the summer and fall.

Des Plaines River and Overflow Monitoring (87) – 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 (89) – 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 as 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 (92) – All gears have had trials performed and been shown to be effective. Prototypes of all gears are on station and a contractor is available to modify gear as needed. The Paupier trawl can sample Silver Carp in areas of high density and can effectively sample carp as they exist in a variety of habitats including sizes from young-of-

year to large adults. The Mamou trawl was effectively tested in a backwater of the Illinois River and a Missouri River tributary 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 (94) – 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 capture rates and size ranges of Asian carp and other fishes and compared to 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 (97) – Pneumatic water guns that emit high pressure underwater sound waves have potential to deter or kill fishes depending on 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 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 (101) – 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 (104) - 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 in shipments of stocked sport fish). Revisits of affected ponds and further monitoring and surveillance efforts will continue in the Chicago Metropolitan Area including Cook and the collar counties.

A broad range of sampling and removal tools are available to the MRWG action agencies to accomplish the plan objectives outlined above. They include traditional sampling gears (e.g., electrofishing, trammel nets, experimental gill nets, mini fyke or trap nets, larval push nets, trawls, and seines), chemical piscicide (e.g., rotenone), high-tech sonic detection and imaging devices (e.g., ultrasonic telemetry and hydroacoustics, DIDSON, and side-scan SONAR), and newly developed or developing techniques (e.g., eDNA, pneumatic water guns, and attraction pheromones). Whereas many of these gears and techniques are part of on-going monitoring and removal efforts, new tools are continually being added to the MRP as it is periodically revised and new techniques are developed. In many cases, multiple tools are being used to accomplish individual objectives and provide sufficient intelligence to allow for adaptive management decisions. This strategy of addressing questions from multiple fronts with a combination of gears and techniques has helped to increase the level of confidence in results provided by monitoring and removal projects to date. In addition, gear evaluations have been on-going (see gear development and evaluation projects below) and have been expanded in this revised MRP (e.g., see Optimal Harvest Strategies to Minimize Asian Carp Propagule Pressure on the Electric Dispersal Barrier and Water Gun Development and Testing Project). Research on calibration and further refinement of eDNA monitoring is also being pursued outside of this plan. Upon completion, these assessments should lead to improved Asian carp monitoring and removal outcomes, better understanding of the effectiveness of in-place barriers built to prevent Asian carp from gaining access to the CAWS and Lake Michigan, and improved interpretation of sampling results.

2013 ACCOMPLISHMENTS

- *Total area sampled:*
    - 200 miles (321.9 km) of waterway from Starved Rock Lock and Dam to Lake Michigan including 76 miles (122.3 km) of CAWS

- *Estimated total effort, capture, and removal upstream of the electric dispersal barrier:*
    - Estimated over 12,030 person-hours spent sampling at fixed sites upstream of the electric dispersal barrier in 2010 – 2013.
    - 636.5 hours spent electrofishing and 261.1 miles (420.2 km) of trammel/gill net deployed at fixed sites in 2010 – 2013 and random areas in 2012 – 2013.
    - Sampled 227,181 fish representing 72 species and two hybrid groups during electrofishing and trammel/gill netting at fixed sites in 2010 – 2013 and random sites in 2012 – 2013.
    - 103.5 hours spent electrofishing and 95.2 miles (153.2 km) of trammel/gill net deployed at fixed sites and random areas in 2013.
    - Sampled 34,418 fish representing 57 species and two hybrid groups during fixed and random electrofishing and trammel/gill netting in 2013.
    - No Bighead Carp or Silver Carp captured or observed during fixed site and random area electrofishing and netting in 2013.

- *Estimated total effort, capture, and removal during Planned Intensive Surveillance events upstream of electric dispersal barrier:*
    - Completed three planned intensive surveillance events with conventional gears in the CAWS upstream of the electric dispersal barrier during 2013.
    - Estimated 1,165 person-hours were spent to complete 45.8 hours of electrofishing, set 9.1 miles (14.6 km) of trammel/gill net and 0.7 miles (1.1 km) of deep water gill net, make three 800-yard (731.5 m) long commercial seine hauls, and deploy three tandem trap nets and eight hoop nets equal to 25.2 net-days of effort.
    - Across all response actions and gears, sampled 22,896 fish representing 50 species and 3 hybrid groups.
    - Examined 4,757 YOY Gizzard Shad and found no Asian carp YOY.
    - No Bighead Carp or Silver Carp were captured or observed during response actions.

- *Estimated total effort, capture, and removal downstream of the* electric *dispersal barrier:*
    - Estimated 7696.5 person-hours spent sampling at fixed, random, and additional sites and netting locations downstream of the electric dispersal barrier from 2010-2013.
    - 222.5 hours spent electrofishing and 146.7 miles (236.1 km) of trammel/gill net deployed.
    - Sampled 105,477 fish, representing 92 species and seven hybrid groups.
    - No Bighead Carp or Silver Carp were captured by electrofishing or netting in Lockport and Brandon Road pools.
    - Thirty Bighead Carp and two Silver Carp were collected in the Dresden Island Pool during fixed, random, and additional commercial netting from 2010-2013.
    - One Bighead Carp and no Silver Carp were captured at Dresden Island Pool while electrofishing from 2010-2013.
    - Detectable population front of mostly Bighead Carp located just north of I-55 Bridge at river mile 280 (47 miles (75.6 km) from Lake Michigan). No appreciable change in upstream location of the population front in past seven years.

- *eDNA sampling upstream of the electric dispersal barrier*
    - Two eDNA comprehensive sampling events took place in the CAWS at four regular monitoring sites in 2013
    - June event: 18 positive detections for Silver Carp DNA, zero positive detections for Bighead Carp DNA
    - November event: 3 positive detections for Silver Carp DNA, zero positive detections for Bighead Carp DNA
    - Positive detections consistent with previous patterns of eDNA distribution in the CAWS

*Results of eDNA sampling must be interpreted with care because a relation between the number of positive detections and fish population abundance has not been established to date, or that eDNA indicates the presence of a live fish

Further details on work conducted and results of the 2013 MRP are available in the 2013 MRP Interim Summary Report document available at www.asiancarp.us.

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

April 2014

INTRODUCTION AND BACKGROUND

Asian carp were first sampled from the Illinois River during the 1990's and populations have since progressed upstream (Conover et al. 2007; Irons et al. 2009). For the purpose of this plan, 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*). Monitoring for Bighead Carp and Silver Carp was originally incidental to standard routine sampling by the Illinois Department of Natural Resources (IDNR) and the Illinois Natural History Survey (INHS). Sampling directed toward Asian carp in the upper Illinois Waterway began with the US Fish and Wildlife Service's (USFWS) annual Carp Corral & Goby Roundup. Subsequently, the US Army Corps of Engineers (USACE) adopted a plan specifically to monitor Asian carp downstream of the electric dispersal barrier located near Romeoville, Illinois. This electric dispersal barrier is designed to repel fish using an electric field to prevent fish movement between the Great Lakes and Mississippi River basins. Monitoring efforts and the need to perform maintenance work on the barrier precipitated a rotenone action in Lockport Pool during December 2009. This action resulted in the collection of a Bighead Carp in Lockport Pool downstream of the electric dispersal barrier. Monitoring also resulted in the sighting of a single Silver Carp in Brandon Road Pool and the capture of numerous Bighead Carp in Dresden Island Pool.

Environmental DNA (eDNA) is a surveillance method for use in aquatic environments that is being used to test for the genetic presence of Bighead Carp and Silver Carp (Jerde et al. 2011). The use of eDNA as an invasive species management tool is currently being refined through ongoing research to improve the understanding and interpretation of eDNA results (ACRCC 2012). The USACE began using eDNA in cooperation with the UND in August 2009 to monitor for Asian carp DNA in the Chicago Area Waterway System (CAWS). In 2013, the US Fish and Wildlife Service took over the leadership of applying eDNA as a genetic monitoring method in the Midwest region, to include the CAWS. Early eDNA monitoring resulted in the discovery of Asian carp DNA in areas upstream of the electric dispersal barrier and prompted additional monitoring and rapid response actions. The additional monitoring resulted in the discovery of Asian carp DNA at several other locations in the CAWS. Intensive targeted use of conventional capture gear resulted in the capture, through commercial netting, of a single live Bighead Carp in Lake Calumet upstream of the electric dispersal barrier.

An Asian Carp Regional Coordinating Committee (ACRCC) was established to provide coordinated communication and response to accomplish the goal of preventing Asian carp from becoming established in the Great Lakes. To facilitate the accomplishment of the goal, the ACRCC formed multiple workgroups, including the Monitoring and Rapid Response Workgroup (MRRWG). A variety of response actions (rapid and planned) led to a more precise re-branding of the group as the Monitoring and Response Work Group (MRWG). The MRWG is co-led by the IDNR and the Great Lakes Fishery Commission (GLFC) and is comprised of liaisons from key state and federal agencies as well as independent technical specialists (see Appendix A for membership). The MRWG was assigned the task of developing and implementing a Monitoring and Response Plan (MRP) for Asian carp that were present or could gain access to the CAWS. Specifically, the group was asked to determine how best to identify the location and abundance of Asian carp in the CAWS, lower Des Plaines River, and upper Illinois River, and to identify appropriate response actions to address such findings. Many of the actions included in this plan were informed by recommendations presented in the National Asian Carp Control Plan (Conover et al. 2007).

The MRP has gone through several annual versions and periodically will be revisited and modified as more information becomes available on Asian carp distribution and abundance and as response needs change. Herein, we review plan development to date, present overarching strategic objectives, identify tools available to complete necessary work, and present 20 specific project plans detailing tactics and protocols that will allow us to accomplish strategic objectives and achieve the overall goal of preventing Asian carp from establishing populations in the CAWS and Lake Michigan.

MRP DEVELOPENT PROCESS AND BACKGROUND

The purpose of the MRP is to identify the best strategy for conducting monitoring and response actions that will accomplish the goal of preventing Asian carp from establishing self-sustaining populations in the CAWS and Lake Michigan. The MRRWG initially (2009-2010) considered a multitude of actions and then more fully developed a dual approach that was considered to be the most promising to determine distribution and abundance of Asian carp. The initial approach was: 1) use eDNA testing of waterway samples to identify areas containing Asian carp DNA, and then use conventional sampling gears or rotenone to intensively sample those areas; and 2) use conventional netting and electrofishing gear to intensively sample fixed locations where Asian carp are most expected to be present if any existed, and to less intensively sample wider waterway reaches throughout the CAWS. Taking a conservative approach, the MRWG considered positive eDNA detections as an indicator of the presence of Asian carp in the waterway for purposes of management and response strategies.

Initial sampling with conventional gear was completed in the CAWS upstream of the electric dispersal barrier during February and March 2010. Sampling targeted warm water discharges and backwater habitats where Asian carp were expected to congregate if present, and included reach-wide electrofishing runs along the entire waterway upstream of the electric dispersal barrier. No Asian carp were collected or observed during initial sampling efforts. As a follow-up to the initial sampling, the MRWG was expanded to include the independent technical specialists listed in Appendix A.

The expanded workgroup met in April 2010 to discuss the results of initial monitoring, and the outcome of the meeting was a decision to: 1) proceed initially with eDNA sampling and rotenone treatments at locations where sufficient evidence of the possible presence of Asian carp existed; and 2) reconsider netting, electrofishing, and other potential monitoring techniques, once information on Asian carp abundance was gathered from rotenone treatments. A consensus on general triggers to initiate response actions was not reached by the workgroup, but specific triggers were developed for the Little Calumet River downstream from O'Brien Lock and Dam and the North Shore Channel downstream from Wilmette Pumping Station. Both sample reaches had multiple positive eDNA detections for Asian carp on one or more sample dates during 2009 and displayed physical characteristics conducive to response actions. The MRWG determined that another positive detection at either location would trigger a conventional gear or rotenone sampling response to determine Asian carp presence and abundance.

Initial eDNA monitoring in 2010 took place from March through May and targeted areas of the CAWS upstream of the electric dispersal barrier that either had positive detections for Asian carp DNA during 2009 or lacked surveillance altogether. Of the 543 water samples analyzed for Bighead Carp and Silver Carp, none contained Bighead Carp DNA and eight contained Silver Carp DNA; one each in the Calumet/Little Calumet River, North Shore Channel, and Chicago River and five in the Chicago Sanitary and Ship Canal (CSSC)/South Branch Chicago River (SBCR) near Bubbly Creek. These results elicited conventional gear response actions at North Shore Channel (May) and CSSC/SBCR (June), and a combined rotenone and conventional gear response at Calumet/Little Calumet River downstream of O'Brien Lock and Dam (May). No Bighead Carp or Silver Carp were captured or observed during any of these response actions.

The MRWG met after the spring 2010 response actions and concluded that whereas eDNA detections suggested Asian carp may be present in the CAWS upstream from the electric dispersal barrier, results of intensive sampling with conventional gear and rotenone indicated that if any Asian carp were present in the waterway, they were present in low numbers. It also was noted that eDNA samples taken within block netted areas of the North Shore Channel and Calumet/Little Calumet River prior to response actions were negative for Bighead Carp and Silver Carp DNA, which was in agreement with conventional gear and rotenone sampling results for these actions. The work group recommended continued monitoring with eDNA and conventional gears and implementation of additional rapid response actions as needed to bolster abundance estimates and remove Asian carp from the system.

One additional response action was initiated after an adult Bighead Carp (mature male 34.6 inches (878.8 mm) long and 19.6 pounds (8.9 kg)) was captured by contracted commercial netters in Lake Calumet on June 22, 2010, which was the first day of sampling at designated fixed sites upstream of the electric dispersal barrier. This capture confirmed the presence of live Asian carp in the CAWS above the electric dispersal barrier and resulted in 11 days of sampling in Lake Calumet, the Calumet River, and Calumet Harbor from 23 June – 9 July. No Asian carp were captured or observed during the response. Additional water samples from Lake Calumet (N = 114), Calumet River and Harbor (N = 95), and Indiana ports and harbors (N = 125) were collected during July and August and analyzed for Asian carp DNA. None of the DNA testing indicated the presence of Bighead Carp or Silver Carp DNA in any of the regions surveyed.

Fixed site sampling continued on a twice monthly schedule throughout summer and fall 2010. Sampling resulted in the catch of >40,000 fish and no additional Bighead Carp or Silver Carp.

In addition to sampling in the upper waterway, monitoring and removal of Asian carp took place downstream of the electric dispersal barrier in order to track the upstream progression of the detectable population front and reduce its abundance. The detectable population front is defined as the farthest upstream location where multiple Bighead Carp 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. Downstream monitoring and removal efforts suggested the location of the detectable population front was in the lower Dresden Island Pool about 55 miles (88.5 km) from Lake Michigan. Monitoring also provided preliminary evidence that commercial netting may be useful for reducing Asian carp abundance within localized areas.

The MRWG met again in September 2010 to discuss the results of all monitoring to that point and to modify the plan accordingly. A new plan was developed and reviewed over winter. It incorporated preliminary results of 2010 monitoring and removal efforts, discussions among action agency staff and technical experts at the September meeting, and numerous written comments provided by workgroup members, Great Lakes state's natural resource agencies, and non-governmental organizations. The plan included 18 project plans categorized geographically as occurring either upstream or downstream of the electric dispersal barrier and grouped into five categories: Monitoring Projects, Removal Projects, Barrier Effectiveness Evaluations, Gear Effectiveness Evaluations and Development Projects, and Alternative Pathway Surveillance. The 2011 MRRP was officially released and posted on the Asiancarp.org website in May 2011.

Implementation of the 2011 MRRP resulted in extensive sampling of 200 miles (321.9 km) of waterway from Starved Rock Lock and Dam to Lake Michigan, including 76 miles (122.3 km)of the CAWS. Further details of 2011 project results can be found in the 2011 MRRP Interim Summary Reports document (MRRWG 2012) prepared by the workgroup and posted on asiancarp.us.

The workgroup met in January 2012 to review summary information from the past year's monitoring and removal efforts and consider recommendations for projects in the updated plan. A plan for 2012 was developed and reviewed that provided comments by workgroup members, Great Lakes state's natural resource agencies, and non-governmental organizations. The plan 2012 again included 18 project plans categorized geographically as occurring either upstream or downstream of the electric dispersal barrier and grouped into five categories: Monitoring Projects, Removal Projects, Barrier Effectiveness Evaluations, Gear Effectiveness Evaluations and Development Projects, and Alternative Pathway Surveillance. The 2012 MRRP was released and posted on the Asiancarp.org website in May 2012.

The 2012 MRRP again called for a considerable sampling effort covering the Illinois Waterway from Starved Rock Lock and Dam to Lake Michigan, including the CAWS. Monitoring for eDNA upstream of the electric dispersal barrier provided a collection of 1,210 samples resulting in 4 positives for Bighead Carp DNA and 153 positives for Silver Carp DNA. Consecutive eDNA positives triggered two Level I Rapid Response actions in Lake Calumet during July and

October 2012 and one Level I Rapid Response action in the North Shore Channel during October 2012. For the first time in three years, eDNA samples collected prior to rapid response actions returned positive detections for Asian carp DNA, but intensive conventional gear efforts during the actions resulted in no Asian carp observed or captured. An estimated 7,518 person-hours were spent to complete 192 hours of electrofishing and deploy 82 miles (132 km) of net during 2012 monitoring upstream of the electric barrier system. The combined catch during these efforts was 99,234 fish representing 63 species; none of which were Bighead Carp or Silver Carp.

An estimated 10,401 person-hours, 36 hours of electrofishing, 328 miles (527.9 km) of gill/trammel nets, 128 net-nights of hoop netting, and 68 net nights of mini-fyke netting were expended during monitoring and removal efforts downstream of the electric dispersal barrier during 2012. The catch included 96,309 fish representing 68 species. No Bighead Carp or Silver Carp were captured or observed in Lockport or Brandon Road pools. Sampling efforts removed 80 Bighead Carp and 13 Silver Carp from Dresden Island Pool 15-24 miles (24.1-38.6 km) downstream of the electric dispersal barrier and 16,643 Bighead Carp and 28,773 Silver Carp (>284 tons) from Marseilles and Starved Rock pools 24-65 miles (38.6-104.6 km) downstream of the electric dispersal barrier. As in previous years, extensive monitoring downstream of the electric dispersal barrier confirmed that the detectable population front was indeed located in the lower Dresden Island Pool about 47 miles (75.6 km) from Lake Michigan and that its location had not changed.

Other highlights from 2012 MRRP projects included: the absence of Asian carp eggs, larvae, young-of-year and juveniles <12 inches (305 mm) long from all samples collected upstream of Henry, Illinois (a single Asian carp egg was collected at Henry, but not upstream - over 100 miles (160.9 km) from the electric dispersal barrier); higher productivity and zooplankton abundance in Lake Calumet and the Little Calumet River compared to other areas of the CAWS and Illinois Waterway; successful clearings of fish >12 inches (305 mm) long from the electric dispersal barrier and assessment of clearing success with remote sensing gears (split-beam hydroacoustics, DIDSON, and side scan sonar), which allowed barrier maintenance operations to occur without a breach in barrier effectiveness; assessments with telemetry, DIDSON, and other techniques to test effectiveness of barriers designed to keep Asian carp from gaining access to Lake Michigan; evaluation of the effectiveness of established gears used to sample Asian carp and development of new or modified gears (e.g., 6-foot (1.8 m) diameter hoop nets, surface-to-bottom experimental gill nets, modified purse seine, customized Lake Michigan style pound (trap) nets, and a modified push trawl called a paupier net); establishment of a law enforcement Invasive Species Unit; and the detection and removal of large adult Bighead Carp in urban fishing ponds located in the Chicago area and other parts of Illinois thought to be the result of contaminated shipments of Channel Catfish from the late 1990s and early 2000s.

The work group met again in December 2012 and January 2013 to begin preparation of the 2013 MRP. Information from the 2012 monitoring and removal efforts was used to guide recommendations for projects to be conducted in the 2013 plan. Projects for the 2013 MRP were developed and reviewed, with comments provided by workgroup members from Great Lakes state's natural resource agencies and non-governmental organizations. The 2013 MRP includes

21 project plans categorized geographically as occurring either upstream or downstream of the electric dispersal barrier.

The interim reports document is considered a companion document to this updated 2013 MRP and includes recommendations for modifications and enhancements to project plans based on past results and experiences. It contains preliminary results and analysis of actions completed during 2012 (and in some cases 2010 and 2011) for each of the 18 projects described in the 2012 MRRP. Knowledge gaps also were identified and informed recommendations for new project plans were included in the updated MRP. This compilation of summary reports was intended to foster an adaptive management approach to Asian carp monitoring and removal. Although individual project plans have been designed as standalone plans, they all support one or more of the overarching strategic objectives of the MRP. Because multiple plans have been developed for some objectives, care has been taken to ensure that related plans provide complimentary rather than duplicative information. In many cases, field sampling can be coordinated or data shared to optimize personnel effort and reduce overall project costs.

The MRWG assembled in January 2014 to present and share results from the 2013 MRP. Data from the 2013 Fixed and Random Site Monitoring Upstream of Barrier was used to guide recommendations for new projects and refined monitoring to be conducted in the 2014. With the group recommendations, the projects for the 2014 MRP were developed and reviewed, with comments provided by workgroup members from Great Lakes state's natural resource agencies and non-governmental organizations. The 2014 MRP includes 20 project plans categorized geographically as occurring either upstream or downstream of the electric dispersal barrier.

As necessary, near shore areas of Lake Michigan will be addressed in a future version of the plan. However, it should be noted that INHS and IDNR Lake Michigan programs currently have ongoing near shore monitoring projects that could detect any Asian carp that might gain access to the Lake. The INHS currently samples three Lake Michigan sites with plankton nets and small-mesh gill nets, both of which may provide early detection of Asian carp larvae or juveniles. Sampling sites are located north of Waukegan, north of downtown Chicago, and near Jackson Harbor on the City's south side. These sites are located in the general vicinity of CAWS connections with Lake Michigan (i.e., Wilmette Pumping Station, Chicago Lock, and Calumet Harbor). The IDNR Lake Michigan program samples with gill nets (1- to 6-inch mesh (25.4 – to 152.4 mm mesh) off of Chicago and Waukegan during spring, and again off Waukegan during fall. Electrofishing samples are made at three harbors, including Calumet Harbor, during summer and fall; the furthest southern harbor sampled in fall is Jackson Harbor. Beach seining for juvenile fish occurs at five sites along the Illinois shoreline from the Wisconsin state line south to Jackson Harbor during summer.

Additional monitoring in Lake Michigan is currently being developed and coordinated by USFWS through a separate project funded, in part, by the Great Lakes Restoration Initiative (GLRI) and outlined in the 2012 Asian Carp Framework (ACRCC 2012).

LOCATION OF PRIMARY TARGET AREAS COVERED BY THE MRP

The area covered by this plan (Figure 1) encompasses over 200 miles (321.9 km) of waterways stretching from Starved Rock Lock and Dam to Lake Michigan and includes two target areas: 1) all waterways upstream of the electric dispersal barrier; and 2) waterways downstream of the electric dispersal barrier to Starved Rock Lock and Dam. The area upstream of the electric dispersal barrier includes approximately 76 miles (122.3 km) of the Chicago Area Waterway System (CAWS). The downstream limit of the CAWS is the confluence of the Chicago Sanitary and Ship Canal (CSSC) and the Des Plaines River within the Brandon Road Pool (Figure 1). Waterways included in the area upstream of the electric dispersal barrier are: CSSC (18.3 miles; 29.5 km); South Branch Chicago River (3.9 miles; 6.3 km); Chicago River (1.6 miles; 2.6 km); North Branch Chicago River (7.7 miles; 12.4 km); North Shore Channel (7.6 miles; 12.2 km); Calumet-Sag Channel (16.0 miles; 25.7 km); Little Calumet River, including the South Leg (40 miles; 64.4 km); Grand Calumet River to sheet pile obstruction (3 miles; 4.8 km); Calumet River (7.5 miles; 12.1 km); and Lake Calumet. Waterways downstream of the electric dispersal barrier include: CSSC, including the reach of CSSC downstream of Lockport Lock (6.0 miles; 9.7 km); lower Des Plaines River (42 miles; 67.6 km); and Illinois River (43 miles; 69.2 km). Areas upstream of the electric dispersal barrier are a higher priority for monitoring and response actions than areas downstream due to their closer proximity to Lake Michigan.

OVERALL GOAL AND OBJECTIVES OF PLAN

Overall Goal: *Prevent Asian Carp from establishing self-sustaining populations in the CAWS and Lake Michigan.*

Five objectives have been identified to accomplish the overall goal. These objectives 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.

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Objective 1: Determination of the distribution and abundance of any Asian Carp in the CAWS, and use this information to inform response removal actions. Knowledge of the distribution of Asian carp in the CAWS will inform decision makers on where and what actions are most needed and appropriate to keep Asian carp from moving into Lake Michigan. Patterns may be identified that would facilitate removal actions (e.g., commercial netters or rotenone), placement of additional barriers (e.g., water gun barrier, chemical barriers, or oxygen depletion zones), and/or other appropriate actions. Projects developed to meet this objective include eDNA, fixed and random site monitoring upstream of the electric dispersal barrier, rapid response actions, and seasonal intensive monitoring upstream of electric dispersal barrier in the CAWS.

Knowledge of the abundance of Asian carp in the CAWS also will guide removal action and barrier placement decisions. In addition, it is a key piece of information required to determine the risk of Asian carp populations becoming established in the CAWS or Lake Michigan. Fixed site monitoring and response actions have provided general information on Asian carp abundance in the CAWS and these standardized sampling efforts will provide for comparisons of relative abundance over time. Owing to the current presumed low numbers and difficulty of catching Asian carp, actual abundance will be quite challenging to determine. On-going gear evaluation projects may provide for enhanced abundance estimates by determining efficiencies of gears used to sample Asian carp and identifying new gears or techniques to enhance capture rates. In addition, several projects have been developed to assist with determination of Asian carp abundance in the CAWS (see Larval Fish and Juvenile Asian Carp Monitoring Projects, and Gear Efficiency and Detection Probability Study).

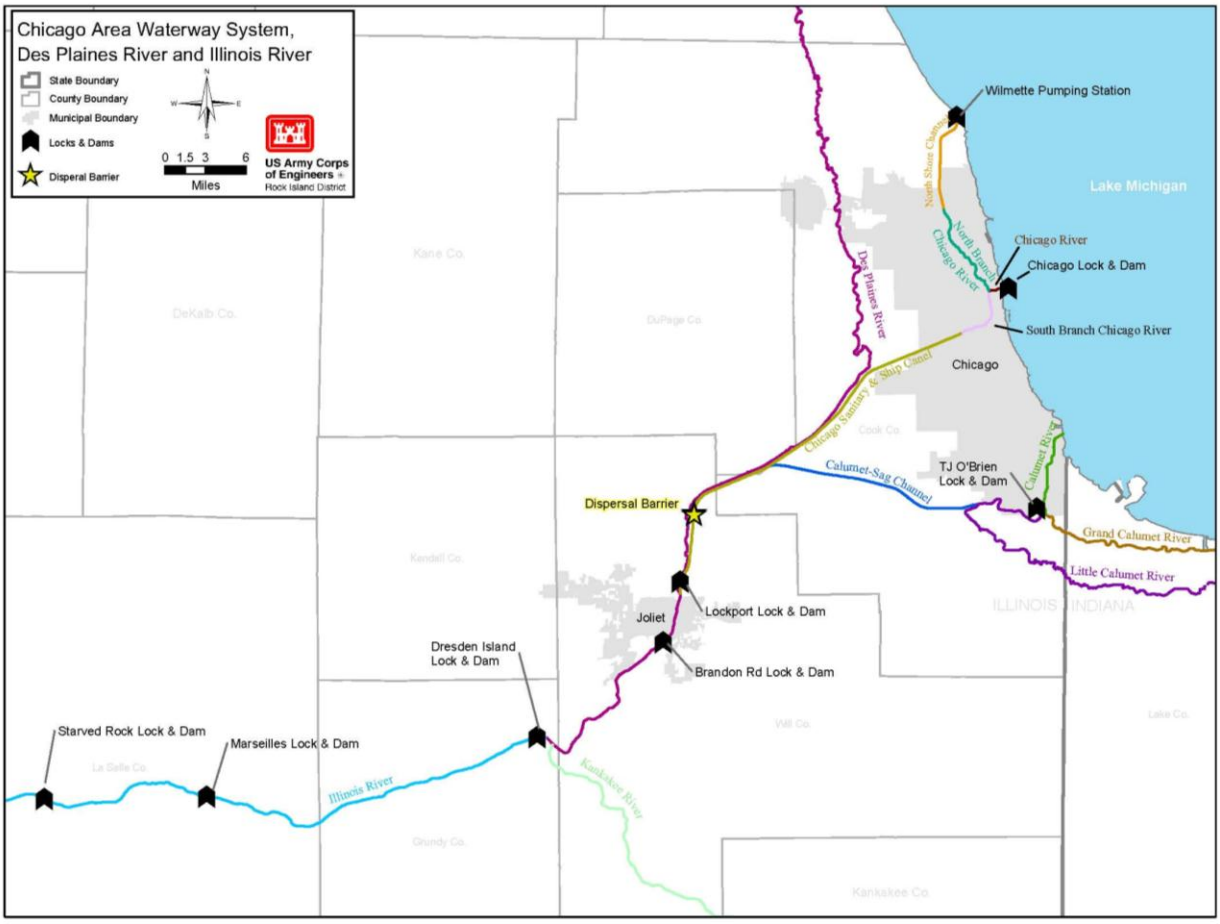


Figure 1. Map of the Chicago Area Waterways System (CAWS), Des Plaines River, and upper Illinois River.

Objective 2: Removal of any Asian Carp found in the CAWS to the maximum extent practical. The MRWG is taking a cautious approach by attempting to remove all known Asian carp upstream of the electric dispersal barrier, including those that may be trapped between Barrier 2A and Barrier 2B before completion of barrier maintenance operations (see Barrier Maintenance Fish Suppression). Removal may occur incidentally when Asian carp are captured during routine monitoring or during seasonal intensive monitoring actions targeting specific

areas of the CAWS. Response teams will be mobilized when Asian carp have been captured or observed (see Response Actions in the CAWS project plan below for more detailed discussion of response triggers).

Objective 3: Identification, assessment, and reaction to any vulnerability in the current system of barriers to exclude Asian Carp from moving into the CAWS. Many measures have been undertaken or are being considered to prevent Asian carp from entering the CAWS and ultimately Lake Michigan. Some of these measures include: improving the electric dispersal barrier in the CSSC by constructing new barriers 2A (operational in 2009) and 2B (operational in early 2011) and operating barriers at appropriate operating parameters (see Holliman 2011) to better repel small and large fish; constructing a rip-rap barrier to isolate the Illinois and Michigan Canal from the CSSC (completed in September 2010); constructing a 13-mile (20.9 km) long concrete barrier/small-mesh fence to prevent the movement of Asian carp from the Des Plaines River to the CSSC upstream of the electric dispersal barrier during extreme flooding events (completed in September 2010). The USACE has been and continues to be the lead agency for most completed and proposed actions. The MRWG will provide necessary monitoring data and coordinate with partners to assist control efforts relative to the electric dispersal barrier and other Asian carp exclusion measures. The following projects have been developed to enhance assessment and reaction to any barrier vulnerabilities: Telemetry Monitoring Plan, Monitoring Fish Abundance and Spatial Distribution in Lockport, Brandon Road, and Dresden Island Pools and the Associated Lock and Dam Structures, Understanding Surrogate Fish Movement with Barriers, Des Plaines River Monitoring, Barrier Maintenance Fish Suppression, and Water Gun Development and Testing.

Objective 4: Determination of the leading edge of major Asian Carp populations in the Illinois River and the reproductive success of those populations. It is critical to gather information on carp densities in the area downstream of the electric dispersal barrier in order to effectively assess the risks of Asian carp passing the electric dispersal barrier, to formulate response actions to reduce fish passage risks, and to implement downstream population control measures. For example, the presence of Asian carp between the electric dispersal barrier and the Lockport Lock may necessitate the use of rotenone to remove fish when barriers are shut down for maintenance or if they experience emergency failures. In addition, harvesting Asian carp downstream of Lockport Lock with contracted commercial fishers should reduce the number of fish attempting to challenge or bypass the electric dispersal barrier. It is also important to know where reproduction is occurring because the greatest overall reduction in numbers of Asian carp can most effectively be accomplished by removing individuals that are members of the breeding population. Projects developed to address this objective include: Fixed Site Monitoring Downstream of the Barrier, Barrier Defense Asian Carp Removal Project, Larval Fish and Productivity Monitoring, Young-of-Year and Juvenile Asian Carp Monitoring, Telemetry Monitoring Plan, Gear Efficiency and Detection Probability, Barrier Maintenance Fish Suppression, and Distribution and Movement of Small Asian Carp and Monitoring Asian Carp Population Metrics and Control Efforts.

Objective 5: Improvement of our understanding of factors behind the likelihood that Asian Carp could become established in the Great Lakes. Understanding the combination of environmental and biological variables that could lead to the introduction of Asian carp

populations in the Great Lakes is important to the overall project goal and may inform decisions regarding appropriate responses to Asian carp detected or captured in the CAWS. Central to this objective are two questions, both challenging to address: 1) how many Asian carp would it likely take to establish a reproducing population in Lake Michigan; and 2) how many fish are currently in the CAWS and Lake Michigan?

Answers to question 1 above are beyond the scope of this plan, but may be forthcoming upon completion of a bi-national risk assessment convened by the Great Lakes Fishery Commission and designed to assess the risk of establishment and potential effects of Asian carp in the Great Lakes.

Sampling during 2010-2013 has helped to provide an answer to the second question posed above. The capture of only one Bighead Carp in thousands of person-days of sampling effort throughout the CAWS upstream of the electric dispersal barrier suggests Asian carp abundance in the waterway currently is low (see MRWG 2013 Interim Summary Reports for more detailed data summaries). Additional sampling in the lower Des Plaines River and upper Illinois River has placed the detectable Asian carp population front at more than 45 miles (72.4 km) and successfully reproducing populations at more than 130 miles (209.2 km) from Lake Michigan. Combined, these results suggest the current level of risk of establishment is lower than expected prior to the initiation of sampling in February 2010. However, upstream movements may occur at some point in time so timely and consistent monitoring combined with rapidly deployed removal actions are needed should the level of risk increase.

TOOLS AVAILABLE TO ACCOMPLISH OBJECTIVES

A broad range of sampling and removal tools are available to MRWG action agencies to accomplish the plan objectives outlined above. They include traditional sampling gears (e.g., electrofishing, trammel nets, experimental gill nets, fyke or trap nets, tow nets, and seines), chemical piscicide (e.g., rotenone), high-tech sonic detection and imaging devices (e.g., sonic telemetry and hydroacoustics, DIDSON, and side-scan SONAR), and newly developed or developing techniques (e.g., eDNA, water guns, chemical barriers and feeding attractants). Whereas many of these gears and techniques are part of on-going monitoring and removal efforts, new tools are continually being added to the MRP as it is periodically revised and new techniques are developed. In many cases, multiple tools are being used to accomplish individual objectives and provide sufficient intelligence to allow for sound management decisions. This strategy of addressing questions from multiple fronts with a combination of gears and techniques has helped to increase the level of confidence in results provided by monitoring and removal projects to date. In addition, gear evaluations have been on-going (see gear development and evaluation projects below) and have been expanded in this revised MRP (e.g., see Monitoring Asian Carp Population Metrics and Control Efforts and Water Gun Development and Testing Project). Research on calibration and further refinement of eDNA monitoring is also being pursued outside of this plan. Upon completion, these assessments should lead to improved Asian carp monitoring and removal outcomes, better understanding of the effectiveness of in-place barriers built to prevent Asian carp from gaining access to the CAWS and Lake Michigan, and improved interpretation of sampling results.

The following are general discussions of the gears and techniques included in this plan and current status of existing or developing techniques. Detailed protocols on the use of each gear are included in the Project Plans section below.

eDNA - The eDNA monitoring project has been used to identify the possible presence of Asian carp (Bighead Carp and Silver Carp) DNA throughout the CAWS, Des Plaines River, and near shore waters of Lake Michigan. Because eDNA is a sensitive and powerful tool, combined with other traditional gears will help form a more complete understanding of the status of Asian carp. This technique maybe useful for early Asian carp detection and to determine distribution patterns of DNA in the waterway because it can presumably detect the presence of DNA in water when fish populations are at very low levels of abundance (Jerde et al. 2011). Although our current understanding of positive eDNA detections cannot be directly correlated with the presence of a live fish, the MRWG values it as an informative method to help characterize the abundance, distribution, and persistence of genetic material from Bighead Carp and Silver Carp above the electric dispersal barrier in the CAWS. Additional research (e.g., the ECALS study; ACRCC 2012) to improve the understanding of eDNA results, and refine eDNA monitoring and processing procedures was conducted in 2012, and is ongoing. Results of ECALS relevant to sampling and interpretation of eDNA results are incorporated into this version of the MRP.

The 2014 plan as will remain consistent with 2013 MRP and decouples eDNA positive results as a trigger for response actions. Data from the 2012 ECALS report indicate findings that suggest other sources, in addition to a live Asian carp, may be vectors of Asian carp DNA (ECALS 2012). These sources include storm sewers, piscivorous birds, sediments, barges, Asian carp carcasses, and fishing gear (e.g. gill/trammel nets). Additionally, response actions in 2012 and 2013 yielded no live Asian carp when eDNA samples collected immediately prior to the events indicated genetic material of the fish were present. Persistent positive detections from a single area still offer some indication that a source of DNA occurs, but until probability can be assigned to the source (proposed for ECALS work in FY14); the MRWG has decided to remove eDNA detections as a trigger for response actions. This data continues to have relevance and eDNA monitoring will remain in the MRP as a monitoring tool. When viewed over the long term (e.g. multiple positive hits on consecutive sample dates at the same location), these data will be used to guide decisions on the location and timing of planned response actions.

Monitoring efforts for Asian carp eDNA in the CAWS will continue in 2014, but will be reduced to two comprehensive events - one occurring in summer and one in fall. With the insights from ECALS, as well as a developing record and surveillance of fish in the CAWS, the MRWG believes that excluding eDNA from the trigger for responses is prudent and consistent with our knowledge to date of Asian carp distributions. To maintain the highest vigilance, the MRWG will be scheduling Seasonal Intensive Monitoring in areas most efficiently sampled and most highly thought of as being areas where Asian carps may linger. With these modifications the MRWG believes surveillance these areas will be consistent to years past and allow more effort to be expending near the electric dispersal barrier and the adult population front. This will give us more ability to determine the leading edge of Asian carp and if the Asian carp are probing the electric dispersal barrier.

Electrofishing - Electrofishing is an important fish sampling tool incorporated in nearly every sampling action outlined in this plan. We will continue to use electrofishing to monitor for adult, juvenile and young-of-year Asian carp at fixed and random sites throughout the waterway and during response/planned intensive surveillance events and barrier maintenance actions. In addition, electrofishing will be used to salvage sport fish and obtain sentinel fish during rotenone events, and to collect fish for implantation of sonic transmitters, as part of the on-going Telemetry Monitoring Plan, Monitoring Asian Carp Population Metrics and Control Efforts, and Distribution and Movement of Small Asian Carp projects. As an active sampling technique, electrofishing provides coverage of large areas of the waterway with moderate effort. Thus, it can provide information on fish distribution in the waterway, as well as relative estimates of abundance when standardized samples are compared spatially or temporally.

Electrofishing efficiency for capturing Asian carp has come into question, especially in the CAWS where these fish may be present in low numbers and waters are often deeper than 9 feet (2.7 m). However, recent electrofishing in the upper Illinois Waterway (upper Dresden Island and Brandon Road pools) has resulted in the visual observation of a single Silver Carp (2009) and the capture of a Bighead Carp (2010), both in areas where Asian carp populations are thought to be low. Furthermore, gear evaluation study results have shown electrofishing to be one of the most productive gears for sampling Silver Carp (MRRWG 2012). We incorporate two approaches to maximize the potential usefulness of electrofishing as a sampling tool during standard monitoring and rapid response events. First, we utilize high frequency and duration sampling effort to increase the likelihood of encountering a rare fish; and second, we concentrate effort in areas where the likelihood of capture is greatest (i.e., where multiple eDNA detections occur, below electric dispersal barrier, or in areas with shallow water habitats, such as main channel borders, barge slips, or non-navigable portions of the waterway).

This plan includes on-going and proposed studies to enhance our understanding of electrofishing efficacy and the relation between electrofishing catch rates and estimates of Asian carp population size (see Asian Carp Gear Efficiency and Detection Probability Study). Changes to monitoring and response protocols were made in this plan as results from research efforts have become available.

Trammel/Gill Nets - Large-mesh trammel or gill nets (bar mesh = 2.0-5.0 inches(50.8-127 mm) are frequently used in combination with electrofishing during fixed site monitoring and removal actions in the CAWS, lower Des Plaines River, and upper Illinois Waterway. These nets target large juveniles and adult Asian carp and are typically fished in deeper, side channel or offshore habitats not effectively sampled with electrofishing gear. Net dimensions vary depending on need from 6-15 feet (1.8-4.6 m) high and 100-600 yards (91.4-548.6 m) long, but are standardized for monitoring at 8-10 feet (2.4-3 m) high, 200 yards (182.9 m) long, and mesh sizes of 3.0-4.5 inches(76.2-114.3 mm). Sets may be of short or long duration. Short duration sets are typically 15-20 minutes long and include driving fish into the nets with electrofishing gear or noise (e.g., plungers on the water surface, pounding on boat hulls, or racing tipped up motors). Short duration sets can take place in main channel habitats during active navigation because nets are not left unattended. Long duration sets range from 3-24 hours and must take place out of the navigation channel or during planned navigation closures because the gear is left unattended. These methods have been shown to be effective at capturing Asian carp, but

overnight sets are preferred during response actions in the CAWS to maximize chances of capturing an Asian carp when population abundance is low.

New net designs will be incorporated into sampling programs as they become available. In 2011, tied-down gill nets made of high strength material (e.g., braided nylon, multi-strand monofilament and Dyneema) were included in sampling and removal efforts to improve capture rates for large adults that tend to break through standard monofilament mesh nets, particularly during warm summer months. In 2012, newly developed surface-to bottom experimental gill nets were field tested as part of the gear evaluation study.

Contract Commercial Fishers - The IDNR has contracted with commercial fishers to assist with monitoring and removal actions throughout the waterway upstream and downstream of the electric dispersal barrier. Commercial fishers benefit the program by providing extensive knowledge of Asian carp habits in large Illinois rivers, hands-on experience at capturing Asian carp for commercial harvest, and appropriate-sized boats and specialized equipment to conduct effective netting operations (e.g., large-mesh trammel nets in lengths ≥300 feet (91.4 m), tied-down gill nets of similar lengths, 800 yard (731.5 m) commercial seines, and large diameter hoop nets). Commercial fishers collected the first Asian carp in Illinois waters from the Illinois and Ohio rivers. In addition, commercial fishing is recognized as one of the most effective tools to reduce Asian carp numbers in higher carp density areas in a cost effective manner (Conover et al. 2007), and it produced the only known capture of a live Asian carp upstream of the electric dispersal barrier. Commercial fishers have and will continue to be hired to conduct trammel/gill net sampling during Fixed and Random Site Monitoring Upstream of the Barrier, Fixed and Random Site Monitoring Downstream of the Barrier, Response Actions in the CAWS and Seasonal Intensive Monitoring Upstream of Barrier and harvest efforts to reduce population size in the upper Illinois River as part of the Barrier Defense Asian Carp Removal Project. In each instance, IDNR biologists or technicians will be assigned to commercial net boats to monitor netting operations and record data.

Rotenone - Rotenone is a valuable Asian carp eradication tool and it may be the best available sampling technique for determining fish population abundance, especially in the deep waters that comprise much of the CAWS. When applied in confined areas with appropriate water temperatures, most treated fish float to the water surface within 3-4 days where they can be gathered, identified, and enumerated. Unpublished data from the USGS suggests that Asian carp will sink initially after exposure to rotenone, but will float sooner than some other species. Efficacy of individual rotenone actions may be evaluated by employing caged sentinel fish to assess treatment effects and diver transects or lift-nets to estimate recovery rates. Rotenone actions also provide opportunities to assess effectiveness of conventional gears and eDNA when sample data collected from within a treatment zone is compared to rotenone results.

While valuable, recent experience with two rotenone events that sampled 2.6 (4.2 km) and 6.7 miles (10.8 km) of the CAWS has shown that rotenone actions require extensive planning (1-2 months), labor (>250 workers), and financial expenditures (>$1.5 million). Several factors contributed to the enormity of these rotenone actions, including: logistics in a large urban center; state and federal regulatory requirements (e.g., NEPA, FIFRA, NPDES, and CERP; notice for waterway closures); need to stand up an Incident Command Structure (ICS); State procurement

requirements and high costs of chemicals, specialized equipment, and contractual services; and fertile waters with abundant non-target fish populations. Pre-event planning and logistical requirements alone make rotenone ineffective as a response tool. However, the MRWG supports rotenone use for emergency eradication of Asian carp populations in the CAWS and for fish suppression during barrier maintenance operations after other removal options (e.g., electrofishing, commercial netting, and newly developed pneumatic water gun technology) have been implemented and shown to be unsuccessful.

Rotenone applications will be limited to targeted treatment areas within the CAWS. Treating the entire waterway is considered impractical due to costs, logistics, and availability of chemical. The technique also is considered overly aggressive for use in the lower Des Plaines and upper Illinois rivers downstream of the CAWS due to the lower threat of establishment in Lake Michigan, high labor and financial costs, and negative impact on non-target fish communities. A multitude of factors may influence decisions of when and where rotenone actions should occur, including:

a) Nature of available evidence for the presence of Asian carp (e.g., re-occurring eDNA detections, fish in hand, visual observation);
b) Number of lines of evidence identifying Asian carp presence and timeframe that evidence was gathered;
c) Precise location(s) where evidence was collected (e.g., main channel vs. below structural barrier vs. off-channel or backwater);
d) Results of previous rotenone and other sampling methods at a particular location;
e) Water temperature, chemistry, and flow characteristics;
f) Size of necessary treatment area;
g) Disturbance to public stakeholders;
h) Presence of one or more Asian carp species;
i) Season and anticipated weather conditions;
j) Existence of an emergency and the urgency surrounding such an emergency (e.g., loss of power at the electric dispersal barrier); and
k) Need for closure of commercial and/or recreational navigation.

Whereas decisions on use will be based on multiple lines of evidence and best professional judgment of biologists, scientists, and managers from participating action agencies, the ultimate decision to use rotenone will be made by managers within agencies who have jurisdiction over rotenone application (i.e., IDNR for Illinois waters and Indiana DNR for Indiana waters).

Experimental Gill Nets - Experimental gill nets are one of the gears being evaluated by INHS for use in monitoring Asian carp populations. Experimental nets with mesh sizes >2.0 inches (50.8 mm) have produced limited catches to date. However, nets with panels having mesh sizes from 0.75- 2.0 inches (19.1-50.8 mm)have shown promise as a monitoring tool for young-of-year and early juvenile fishes. Poor recruitment years for Asian carp in the Illinois Waterway the past two years has prevented rigorous evaluations of gears targeting young-of-year and juvenile fish. We will continue to assess small mesh experimental nets in Asian carp young-of-year and juvenile monitoring efforts at stations throughout the Illinois Waterway and CAWS. If proven

effective, we will use experimental nets to supplement targeted monitoring for young Asian carp by electrofishing that began during summer/fall 2010.

Mini-Fyke Nets - Small frame fyke nets have been used successfully to sample for small fishes by USFWS and INHS to sample for young-of-year Asian carp in the lower Illinois River and should prove useful in the upper waterway in areas where shallow, near shore habitat can be found. Enhanced monitoring to detect successful Asian carp reproduction or movements of young-of year from the lower river to the CAWS is important because risk of barrier passage and population establishment in Lake Michigan increase if either occurs. Mini-fyke nets were included in gear evaluations at stations in the CAWS and Illinois Waterway during 2011 and were added to monitoring efforts for young Asian carp at downstream fixed sites in 2012.

Larval Push Nets - Over the past four years, INHS has used boat-mounted, 0.5-meter diameter larval push nets to sample for Asian carp eggs and larvae at stations located throughout the Illinois Waterway from the LaGrange Pool upstream through the CAWS (including the confluence of the Des Plaines River and CSSC). During 2010 – 2013, Asian carp eggs and larvae were only collected from the lower Illinois River (LaGrange and Peoria pools). No eggs or larvae have been collected at any location upstream of Henry, IL. Monitoring for fish eggs and larvae will continue at stations throughout the waterway during 2014 and will begin when water temperatures are first suitable for Asian carp spawning. In addition to routine biweekly monitoring, additional samples will be taken throughout the Illinois Waterway following flooding events to monitor Asian carp spawning that may be triggered by high flow conditions.

Trawls and Purse Seines - The INHS and USFWS-Columbia Fish and Wildlife Conservation Office have been evaluating trawls and purse seines as methods to sample and remove Asian carp juveniles and adults from the waterway. Results of modifications to gears in 2013 have been encouraging, however, minor modifications and evaluations will continue in 2014. These gears will be included in future monitoring and removal plans if and when they are shown to be effective. A modified shrimper's push trawl (Paupier Trawl) and a floating/midwater stern trawl (Mamou Trawl) have been developed and tested by USFWS. The trawls demostrate potential for sampling juvenile Asian carp and additional field trials will be conducted in the Illinois Waterway in 2014.

Ultrasonic Telemetry - The USACE began a telemetry monitoring project during 2010 to determine: 1) if fish are able to challenge and/or penetrate the electric dispersal barrier; 2) if Asian carp are able to navigate through lock structures in the upper Illinois River, lower Des Plaines River, and CAWS; and 3) upstream movement of the leading Asian carp population front. The project includes surgically implanting individually coded ultrasonic transmitters (approximate battery life = 2.5 years) in ~200 fish (Bighead Carp, Silver Carp, and surrogate species) and monitoring tagged fish movements with a series of stationary and mobile hydrophones. A total of 238 tags have been implanted from 2010-2012. To date, 5.5 million detections have been recorded with a 66% detection rate. Results from 2012 monitoring reported the first inter-pool movement by a single Bighead Carp between the Dresden and Marseilles pools and Common Carp continue to navigate through the locks on the upper Illinois Waterway.

Dual-Frequency Identification SONAR (DIDSON), Split-Beam Hydroacoustics, and Side-scan SONAR - Several types of SONAR devices are available for locating individuals or groups of fish, monitoring localized fish movements and behavior, and mapping underwater structures and habitat. Each type of SONAR has inherent benefits, but an important limitation of all SONAR devices is the inability to identify marked fishes to species, genus, or even family. None the less, the species of fish being observed with these tools may not be of great consequence; if a fish of a certain size and similar form is penetrating the electric dispersal barrier, it is assumed that an Asian carp could too. Even with the species-specific limitation, SONAR devices have proved useful for locating and enumerating fish near the electric dispersal barrier, estimating fish population abundance, and verifying success of fish clearing activities in support of barrier maintenance. We continue to evaluate these remote sensing gears as potential monitoring tools or aids to improve effectiveness of other sampling gears.

Imaging SONAR, such as DIDSON, can provide detailed video images of fishes and underwater objects. However, these devices lack vertical resolution because they track in two dimensions and may be range limited under certain conditions. The USACE conducted a survey of the electric dispersal barrier in the CSSC with DIDSON during 2010 and preliminary results showed schools of smaller fish above and below Barrier I and above and below Barrier 2A. Several larger fish also were observed below Barrier 2A. The DIDSON camera was used in 2011 and 2012 to conduct wild fish evaluations at, in, and around the electric dispersal barrier and to view behavior of fishes in cages dragged through the barriers. The use of DIDSON will be continued for additional fish counts at the electric dispersal barrier and to evaluate presence of fish between barriers after barrier maintenance fish clearing operations (see Monitoring Abundance, Behavior, and Fish/Barge Interactions at the Barrier and Barrier Maintenance Fish Suppression).

Split-beam hydroacoustics has been used to locate fish and collect data on fish abundance, size distribution, and behavior at ranges in excess of 100 meters. Higher-end hydroacoustic devices track in three dimensions, so they have the ability to provide distance, bearing, and vertical locations of objects or fish in the water column within the area surveyed by the transducer beam. This can be particularly useful when a fixed-position monitoring system is used to monitor fish locations and behavior near anthropomorphic structures, such as dams, fishways, navigation locks, or potentially the electric dispersal barrier. The INHS has been evaluating split-beam hydroacoustics as a potential Asian carp monitoring tool over the past two years and this research will continue in the coming field season. The USGS will use a fixed-site hydroacoustics unit to monitor fish movement and response to water gun operations during a field experiment in the Illinois River near Morris, Illinois. Hydroacoustics data in combination with conventional data for species verification has been used to estimate Asian carp abundance in the Illinois River (Garvey et al. 2012). This work will continue in the upper Illinois Waterway during the coming year. In addition, success of fish clearing operations in support of barrier maintenance have and will continue to be evaluated with split beam hydroacoustics, as well as DIDSON and side-scan SONAR.

Multi-beam side-scan SONAR offers wide angle coverage of a water body, but lacks fine scale resolution. These systems are typically used for mapping bottom morphology and detecting underwater objects and bathymetric features. Side scan SONAR was used to determine water depths and survey for bottom obstructions prior to commercial seining in the response action at Lake Calumet in 2010 and likely will be used to obtain similar information in the future. At

present, there are no plans to use side-scan SONAR for fish monitoring or to examine fish behavior at the electric dispersal barrier, but it has proved useful in evaluating success of fish clearing operations at the electric dispersal barrier.

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*:

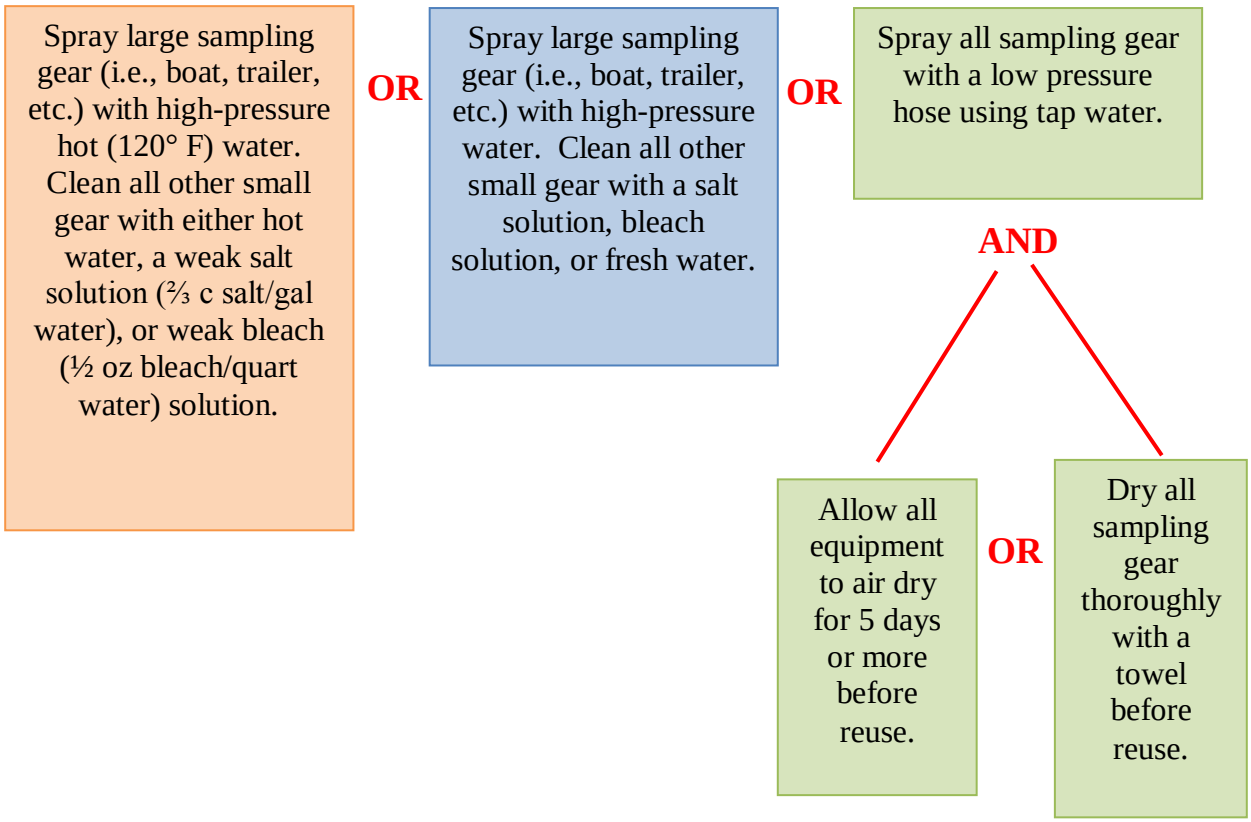
The following steps should occur before gear is transported away from the waterbody in order to be compliant with Illinois' Public Act 097-0850, which prevents transport of aquatic plants and animals by boats, trailers, and vehicles on Illinois' roadways, and Administrative Code Title 17 Section 875.50, 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, and 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.)

PROJECT PLANS

Twenty-one project plans have been prepared for 2014 to achieve the overarching goal and objectives of the MRP. These plans are in various stages of development due to the continuing expansion of efforts to control Asian carp. Several plans were prepared and implemented during 2010, others were newly developed in 2011, 2012, and 2013 and still others are newly proposed and only recently scoped out. We included in this MRP project plans from various stages of development to showcase the full range of work that will be on-going or initiated during the coming year. Consequently, the type and amount of information included in the project plans below will vary with the level of plan development to date. Work to improve existing plans and create new projects will be on-going throughout the year. Projects and schedules are included as a guideline for implementation; however actual plans may vary depending upon logistics and funding.

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 DNA 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 electric dispersal 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, and only one Bighead Carp being collected in Lake Calumet in 2010, fixed site and random area sampling efforts will be reduced upstream of the electric dispersal barrier to two seasonal intensive monitoring events in 2014. These monitoring events will take place at key locations where Asian carp eDNA has been detected consistently over the past few years. Seasonal intensive monitoring will be preceded by eDNA sampling events. This coordination of monitoring for Asian carp using eDNA and traditional fishery sampling techniques (electrofishing and netting) will enhance the understanding and interpretation of eDNA results for management decisions. The reduction of effort upstream of the electric dispersal barrier will allow for increased monitoring efforts downstream of the electric dispersal 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 seasonal intensive monitoring 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 fish from areas where Asian carp have been captured or observed.

Objectives:

1) Vigilant monitoring for the presence Asian carp upstream of the electric dispersal barrier in CAWS; 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 seasonal intensive monitoring activities, including pulsed DC-electrofishing, trammel and gill nets, deep water gill nets, a commercial seine nets 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.

Best Management Practices to Prevent the Spread of Aquatic Invasive Species during Asian carp Monitoring and Response Field Activities- These best management practices are designed to be effective, easy to implement, and realistic, and if followed, should reduce or potentially eliminate the threat of AIS spread by MRP activities. Any best management practices 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. The BMP's are outlined on page 17 of the 2014-16 MRP.

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. All fish will be netted and placed in a tank where they will be identified, counted and checked for floy tags, after which they will be returned live to the water. 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 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 preferred).

Netting Protocol – Contracted commercial fishers will be used for net sampling at fixed and random 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). 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- to 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 enumerated. Locations of net sets should be recorded with GPS coordinates (decimal degrees preferred). An IDNR biologist or technician 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 9th and September 15th)*

The sampling design includes intensive electrofishing and netting at five fixed sites and at four random site sampling areas (Figure 1). Random area sampling will exclude areas of the waterway designated as fixed sites. A total of 75 pulsed-DC electrofishing runs (30 fixed site runs, 45 random site runs) and 75 commercial nets (27 fixed site nets, 48 random site nets) at fixed and random sites will be accomplished during the first week of each seasonal monitoring

event. 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 lengths of each net set will be 200 yards (182.9 m).

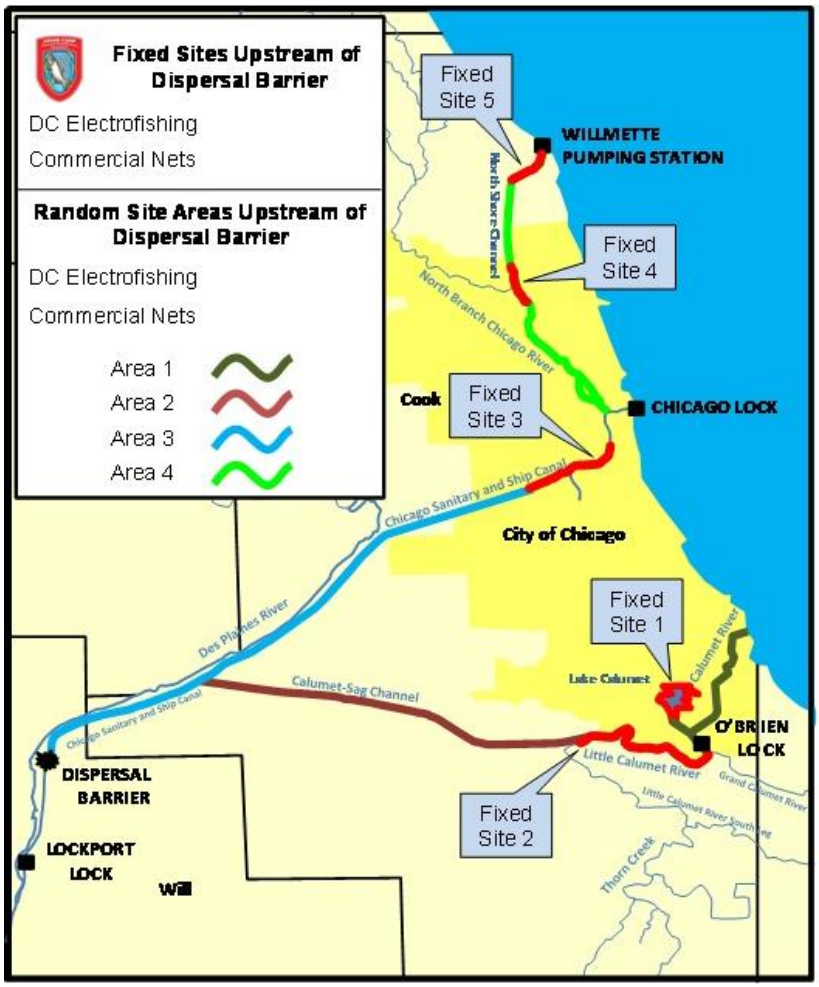


Figure 1. Fixed site and random site sampling areas for electrofishing and commercial netting upstream of the electric dispersal barrier.

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 O'Brien Lock to its confluence with the Little Calumet River South Leg (~7 miles; 11.3 km).

Site 3 – CSSC and South Branch Chicago River from Western Avenue upstream to Harrison Street (~4 miles; 6.4 km).

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

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

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 lengths of each net set will be 200 yards (182.9 m). Four random areas have been identified to facilitate coordination with fixed site sampling.

Area 1 – Lake Calumet Connecting Channel and Calumet River from O'Brien Lock and Dam to Calumet Harbor.
Area 2 – Calumet-Sag Channel from its confluence with the CSSC to 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 16th)*

Lake Calumet - Prior to sampling, INHS crews will set Great Lake pound nets at the entrance to Lake Calumet to prevent fish immigration/emigration (Figure 2). Commercial seining will occur in the North section for two days, then in the South section for one day. 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 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. A total of 75 pulsed-DC electrofishing runs and 75 commercial nets at random sites will be accomplished during the second week of the seasonal monitoring.

North Shore Channel, Chicago River and Random Area Sites Upstream of the Electric Dispersal Barrier - *(week of September 22nd)*

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 a net boat

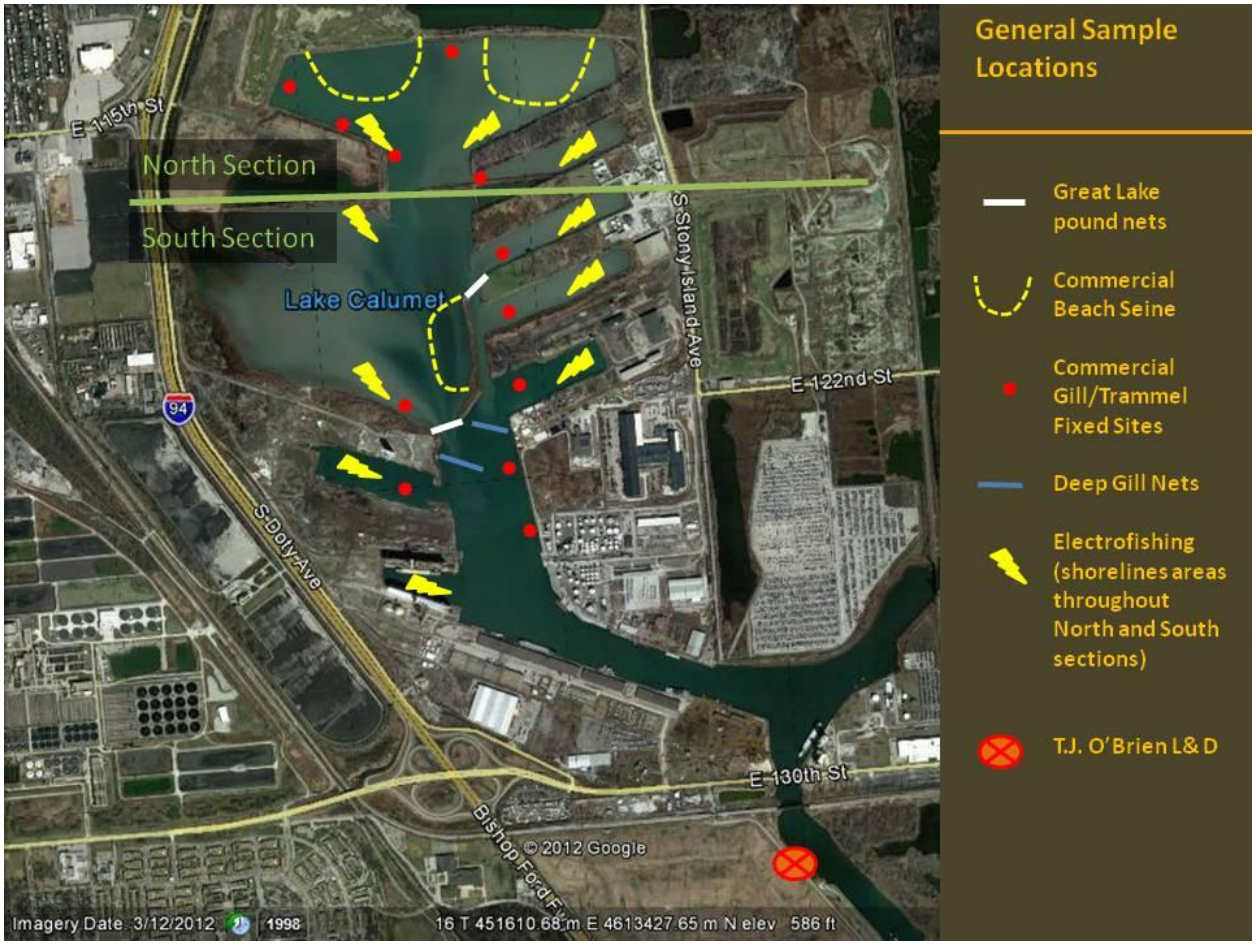


Figure 2. Sampling locations in Lake Calumet.

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 racing trimmed up motors. Three nets will be set across the channel at 500- to 800-yard (457.2-731.52 m) intervals 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 500 to 800 yards (457.2-731.52 m) 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 nets after each electrofishing and fish driving episode so that each team gradually moves toward the site midpoint, where we will trap any possible rogue Asian carp.

Chicago River and South Branch Chicago River/Bubbly Creek - Electrofishing will occur around the entire shoreline of the basin segmented into 15 minute runs 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 30-foot (9.1 m) 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 racing trimmed up motors will be used to drive fish into the nets. Electrofishing boats will also be used to drive fish into the nets.

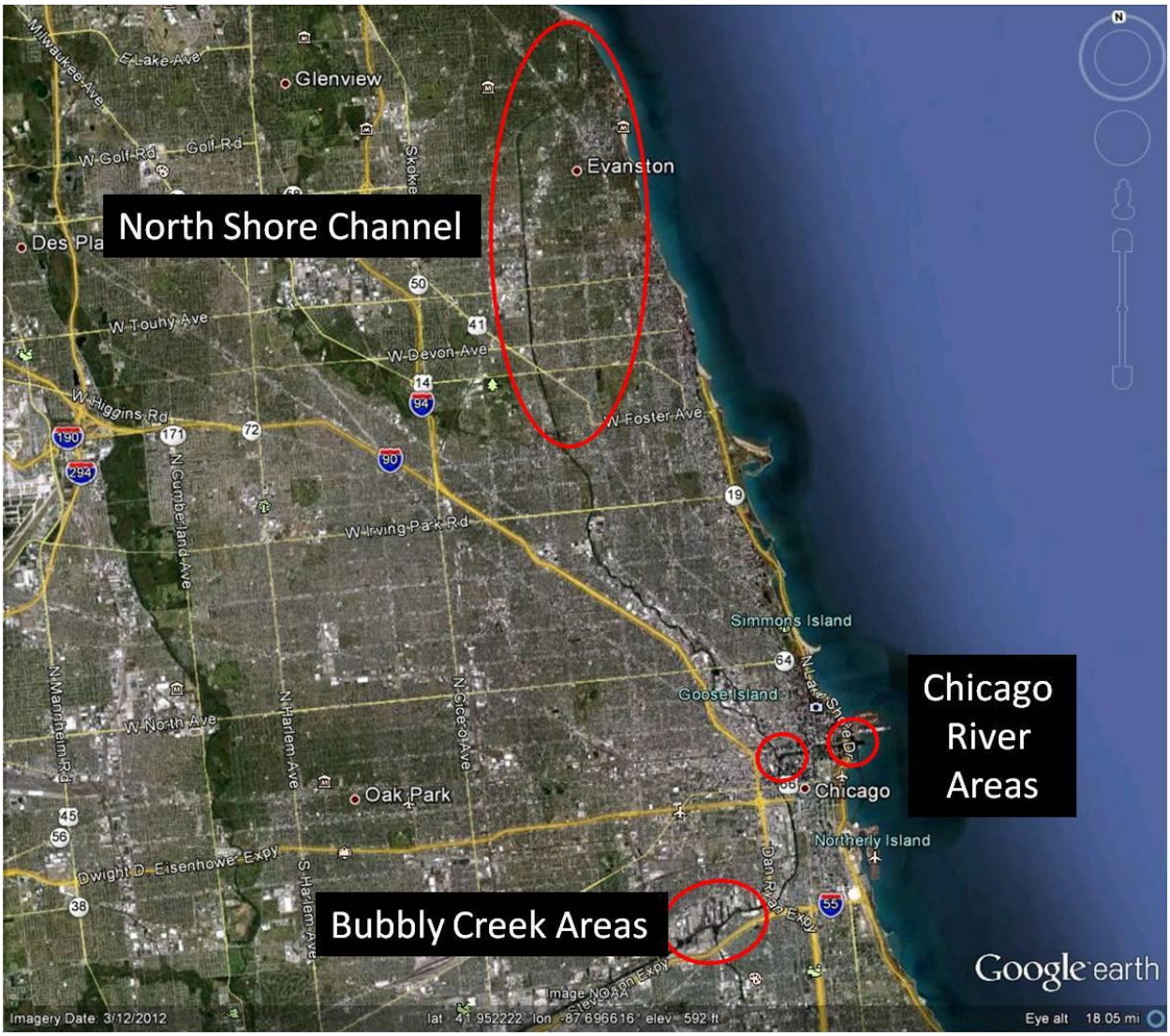


Figure 3. Sampling locations in the North Shore Channel, Chicago River and South Branch Chicago River/Bubbly Creek area.

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.

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. A total of 75 pulsed-DC electrofishing runs and 75 commercial nets at random sites will be accomplished during the second week of the seasonal monitoring

For all seasonal intensive monitoring events accurate sampling time (net soak/electrofishing time) will be recorded with all fish identified to species. GPS coordinates will be taken at the

location of all net sets and at the beginning of electrofishing runs (decimal degrees preferred). 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 2014 MRP. Furthermore, capture of a Bighead Carp or Silver Carp would initiate a level 2 rapid response upon conferring with MRWG members, additional effort or time frame could change.

2014 Sampling Schedule:

Spring Event

Week of June 9th

Fixed and random area sites upstream of the electric dispersal barrier.

A total of 75 pulsed-DC electrofishing runs (30 fixed site runs, 45 random site runs) and 75 commercial nets (31 fixed site nets, 46 random site nets) at fixed and random sites will be accomplished.

Week of June 16th

Lake Calumet, Calumet River and random area sites upstream of the electric dispersal barrier

A total of 75 pulsed-DC electrofishing runs and 75 commercial nets at random sites will be accomplished.

Great Lake pound nets in place at the entrance to Lake Calumet to prevent fish immigration/emigration.

Fall Event

Week of September 15th

Fixed and random area sites upstream of the electric dispersal barrier

A total of 75 pulsed-DC electrofishing runs (30 fixed site runs, 45 random site runs) and 75 commercial nets (31 fixed site nets, 46 random site nets) at fixed and random sites will be accomplished.

Week of September 22nd

North Shore Channel, Chicago River and random area sites upstream of the electric dispersal barrier

A total of 75 pulsed-DC electrofishing runs and 75 commercial nets at random sites will be accomplished.

2015-2016 Sampling Schedule: Similar to 2014 sampling schedule; Sampling protocols, duration and location of seasonal intensive monitoring may change as needed through adaptive management strategies to enhance sampling efficiency and the likelihood of capturing Asian carp.

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

Strategy for eDNA Monitoring in the CAWS

Lead Agency: US Fish and Wildlife Service

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 which may inform future work in the CAWS

Two Events: June and September, 2014; 240 samples per event (480 samples total). Estimated sampling weeks are June 2 and Sept 9, 2014; preceding the Seasonal Intensive Monitoring Events. The events will take place the week prior to the Seasonal Intensive Monitoring in the CAWS. The USFWS Whitney Genetics lab will process all eDNA samples. USFWS FWCO's will be responsible for the field collection of eDNA samples. All samples will be filtered using the FWCO mobile trailer on site.

Similar to the 2013 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 2014 eDNA results will be made available to the MRWG at the end of the year.

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

All samples will be collected in accordance with the Quality Assurance Project Protocol (QAPP) available at: http://www.fws.gov/midwest/fisheries/eDNA.html. Results will also be posted to this site.

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

Larval Fish and Productivity Monitoring in the Illinois Waterway

Steven E. Butler, Matthew J. Diana, Scott F. Collins, David H. Wahl (Illinois Natural History Survey), Robert E. Colombo (Eastern Illinois University)
Participating Agencies: INHS (lead), Eastern Illinois University (field and lab support)

Location: Larval fish sampling will take place at 10 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 near the mouths of the Sangamon, Salt Fork of the Sangamon, Spoon, and Mackinaw Rivers to assess potential Asian carp spawning in Illinois River tributaries. Productivity and zooplankton sampling in future years will occur at these and additional sites in collaboration with the Ecosystem Responses to Barrier Defense project. Sites may be dropped, or additional sites added as needed in order to complete study objectives.

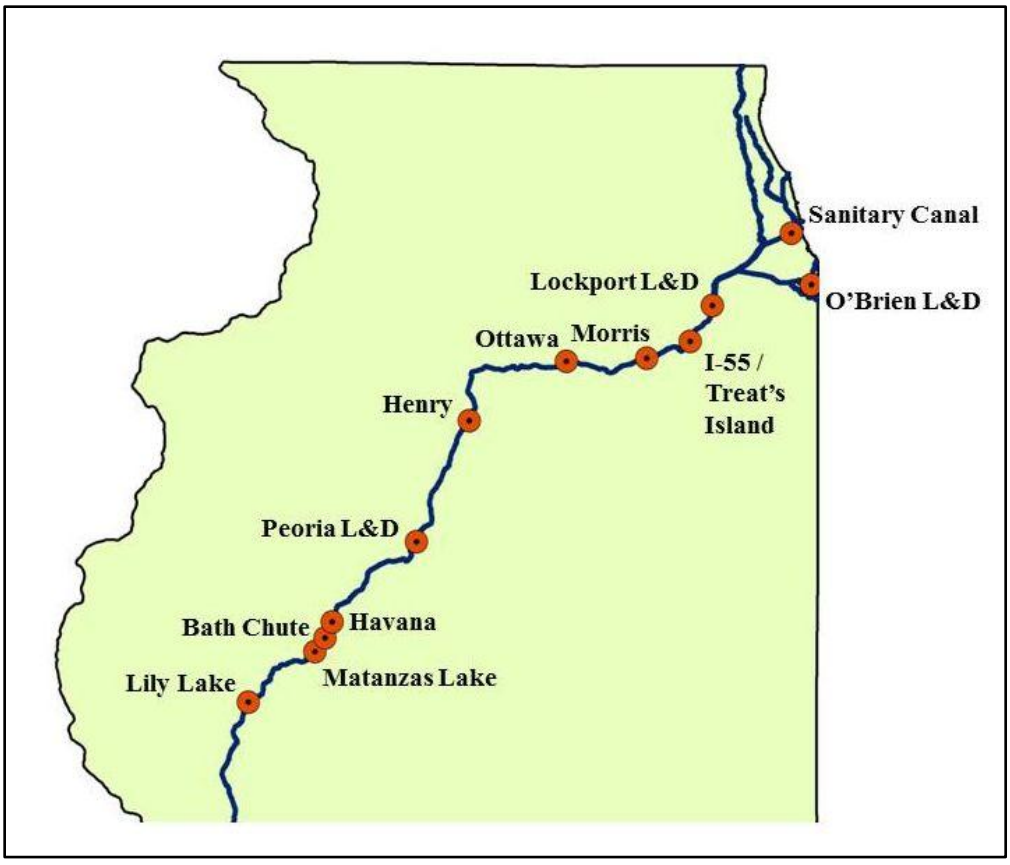


Figure 1. Map of larval fish and productivity sampling sites in the Illinois Waterway.

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. 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, with consistently poor recruitment observed in recent years. 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.

Asian carp are filter-feeding planktivores that have the ability to deplete plankton densities and alter zooplankton community composition. Because Asian carp require sufficient food resources to optimize feeding and sustain their growth, they may associate with areas of higher productivity. Phytoplankton and zooplankton densities are expected to vary considerably both across the longitudinal gradient of a large river and among habitats within river segments. Therefore, identifying patterns in nutrient concentrations, phytoplankton densities, and zooplankton abundance may indicate locations where Asian carp are most likely to be located. Examining relationships between the abundance of Asian carp, other planktivorous fishes, and productivity variables will provide information on Asian carp foraging ecology and will help focus sampling and removal efforts. This information will also be useful for examining relationships among nutrients, phytoplankton, and zooplankton abundance in a large river system.

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

1) Identify the spatial extent of Asian carp reproduction;
2) Determine the timing of Asian carp spawning in this system;
3) Determine the detectability of larval fish in standard ichthyoplankton sampling gear; and
4) Examine relationships between environmental variables (e.g., temperature, discharge, habitat type) and Asian carp reproduction and recruitment.

Status: In 2013, over 600 larval fish samples were collected from April 30 to October 9, capturing over 30,000 larval fish. Larval fish densities were highest in June, but declined substantially from August to October. Clupeids dominated the ichthyoplankton drift at most sites, although Cyprinid larvae (excluding Asian carp) were abundant in the Starved Rock and Marseilles pools. Centrarchid larvae, primarily *Lepomis* species, were common in and upstream of the Starved Rock Pool. Lesser numbers of Catostomids, Sciaenids, Moronids, Percids, Ictalurids, and Atherinids were also captured in larval fish samples. Larval Asian carp (n = 327) were collected from Henry (Peoria Pool; river km 306) in May, and from multiple sites in the LaGrange Pool (river km 134 – 251) during June. No evidence of Asian carp reproduction was observed at any upstream pools, and no Asian carp eggs or larvae were collected in the CAWS. No larval Asian carp were collected in the Illinois River tributaries during 2013.

Productivity sampling coincided with larval fish sampling during 2013. Total phosphorus concentrations appear to increase with increasing distance upriver, reaching their highest levels in the Des Plaines River and in the lower CAWS, but decline to their lowest observed levels at sites closest to Lake Michigan. Phosphorus and chlorophyll concentrations do not appear to be correlated, with the highest chlorophyll concentrations occurring in the lower Illinois River. Cladoceran and copepod densities vary little among sites in the Illinois River, but increase in abundance in the Des Plaines River and are highest in the CAWS. Dreissenid veligers occur in

their highest densities in the CAWS, but decline with increasing distance downstream, occurring in low densities in the Illinois River. Densities of all macrozooplankton groups are highest in the Little Calumet River and in Lake Calumet. Rotifer densities are highest in the lower Illinois River and decline with increasing distance upriver, but attain high densities in Lake Calumet.

Methods: Larval fish samples will be collected using a 0.5 m-diameter ichthyoplankton push net with 500um mesh. Sampling transects will be located on either side of the river channel, parallel to the bank, at both upstream and downstream locations within each study site. 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. The presence of any fish eggs will be noted and all eggs will be retained for future analyses. Larval fish will be identified to the lowest possible taxonomic unit in the laboratory. Larval fish densities will be calculated as the number of individuals per m^3 of water sampled.
Productivity patterns will be evaluated by measuring total phosphorus and chlorophyll *a* concentrations, as well as zooplankton abundance at all sampling locations. Productivity sampling in future years will be conducted in collaboration with the Ecosystem Responses to Barrier Defense project.

Sampling Schedule: In 2014 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). Sampling for phosphorus, cholorophyll, and zooplankton will continue in collaboration with the Ecosystem Responses to Barrier Defense project.

Deliverables: Results of each sampling event will be reported for weekly 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 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 electric dispersal 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 dispersal 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 which 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. 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 2014.

Objectives:

1) Determine the distribution, abundance, and age structure of small Asian carp 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 4.6m x 1.8m, 4.8mm mesh straight seine, and a 9.1m x 1.8m, 4.8mm mesh bag seine.

Electrofishing - Fifteen minute daytime pulsed-DC electrofishing samples will be made. 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 (0.5m to 2.0m 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, 1.8m body length, 0.76x0.38m otter boards, 2.4m foot rope, and an effective net fishing width 1.8 m across. The Mini-mamou net is 8m wide, .75m deep, 38mm stretch mesh, with a 6mm 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 20mm to 150mm in size. The net is deployed from the front of a small (18ft) 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 23mm mesh that tapers back 6 meters to a 4mm cod bag. The net will be supported around a 4 meter wide X 1.7 meter 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.

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 - Lapillus 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 300mm 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. In addition to ageing, a subset of otoliths will be provided to Dr. Gregory Whitledge at SIUC for stable isotope analysis of fish natal origin.

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 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.

Small Asian Carp Sampling

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

Project Schedule:

February - April 2014

Gear preparation, field logistics planning, crew scheduling

May - September 2014

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 dispersal 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 Electric 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 electric 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 Carp 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 2010-2013 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 2010-2013, sampling efforts upstream of the electric dispersal barrier will be reduced to two seasonal sampling events in June and September 2014, to allow an increase in sampling efforts downstream of the electric dispersal barrier. This shift in 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 pulsed-DC electrofishing, hoop and mini-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, and 2013 with pulsed-DC electrofishing gear and from July through September 2010, April through November 2011, March through November 2012, and March through December 2013 with trammel and gill nets. In total, 7,696.5 estimated person-hours of labor were expended to complete 222.5 hours of electrofishing and deploy 146.7 miles (236.1

km) of trammel/gill net over the four years. A total of 172 hoop and 112 minnow fyke nets were set in the four downstream pools from August through December 2012 and April through November 2013. No Bighead Carp 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 Carp and Silver Carp in Marseilles Pool than Dresden Island Pool. For more detailed results see 2013 interim summary report document (MRWG 2014).

Methods: Fixed and random electrofishing and contracted netting will be increased in 2014, due to a reduction in fixed and random electrofishing and contracted netting above. 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 and will increase from four to 12 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. Contracted commercial netting in the Marseilles Pool will occur at four fixed sites and four random sites. Effort in the Marseilles Pool will remain the same as effort in 2013, to better evaluate the leading edge of the Asian carp population in the Dresden Island Pool.

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, will be added to 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.

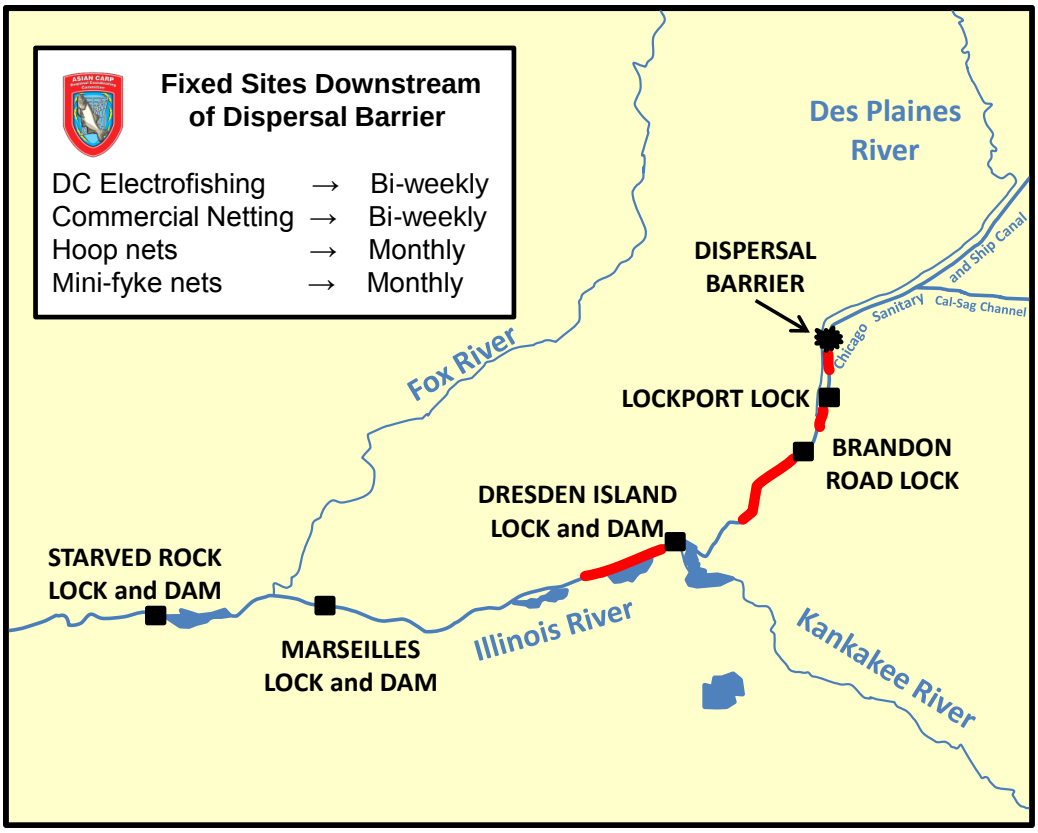


Figure 6. Map of fixed sites for electrofishing and commercial net sampling for Asian Carp downstream of the electric dispersal barrier.

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 (182.9 m) trammel/gill net sets, eight (8) hoop net nights with 6-foot (1.8 m) 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 each pool, 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 pool 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 2014 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 Below Barrier

Week	Agency
17-Mar	IDNR/USACE
31-Mar	USFWS/USACE
14-Apr	IDNR/USACE
28-Apr	USFWS/USACE
12-May	IDNR/USACE
27-May	USFWS/USACE
9-Jun	IDNR/USACE
7-Jul	USFWS/USACE
21-Jul	IDNR/USACE
4-Aug	USFWS/USACE
18-Aug	IDNR/USACE
2-Sep	USFWS/USACE
15-Sep	IDNR/USACE
29-Sep	USFWS/USACE
14-Oct	IDNR/USACE
5-Nov	USFWS/USACE
24-Nov	IDNR/USACE

Contracted Netting Below Barrier

Week	Agency	Week	Agency
17-Mar	IDNR	4-Aug	IDNR
31-Mar	IDNR	18-Aug	IDNR
14-Apr	IDNR	1-Sep	IDNR
28-Apr	IDNR	13-Oct	IDNR
12-May	IDNR	27-Oct	IDNR
26-May	IDNR	17-Nov	IDNR
21-Jul	IDNR	8-Dec	IDNR

Fixed Site Hoop and Mini-Fyke Netting Below Barrier

Week	Agency
21-Apr	IDNR
19-May	IDNR
23-Jun	IDNR
14-Jul	IDNR
25-Aug	IDNR
22-Sep	IDNR
20-Oct	IDNR
1-Dec	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 Lockport Lock and Power Station.

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 MRRWG, and were not intended to be rigid triggers requiring immediate action. Final decisions to initiate rapid 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 Lockport Lock and Power Station 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. 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. No Bighead Carp or Silver Carp were captured or observed

during any of the surveillance events to date. In addition, we examined 4,757 YOY Gizzard Shad and found no Asian carp YOY.

Methods: We will use conventional gears, experimental gears and/or rotenone to capture and remove Asian carp from the CAWS upstream of Lockport Lock and Power Station. 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 and pheromone research outlined in the 2012 Framework). 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 past two 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 a new framework to guide management decisions on response actions in the CAWS where eDNA is no longer a response trigger. Therefore, the observation or capture of a live Asian carp by a credible source would be the lone trigger for initiating a response.

The proposed thresholds for response actions with conventional gears and rotenone apply to monitoring efforts in the CAWS upstream of Lockport Lock and Power Station. 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

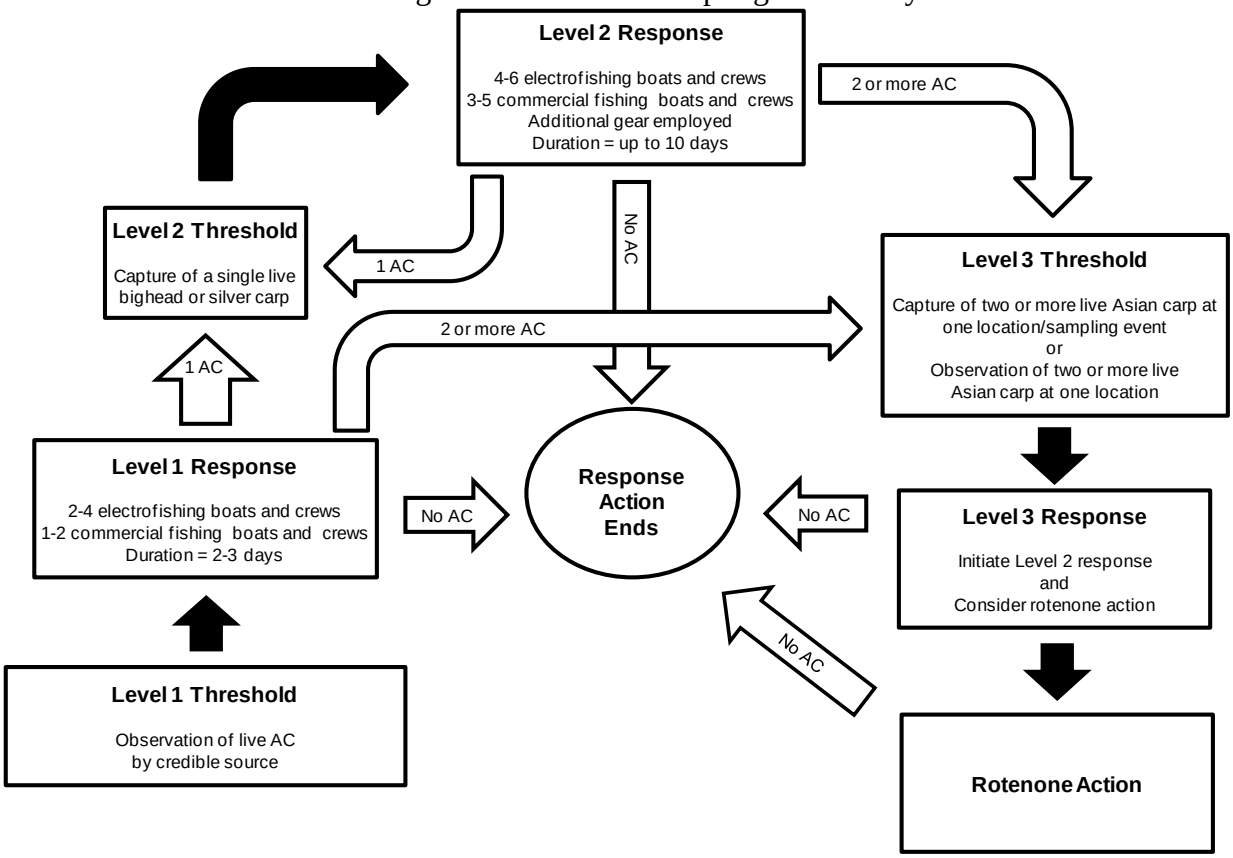


Figure 1. Thresholds for Asian carp (AC) response actions with conventional gears and rotenone.

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 results of conventional gear monitoring 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); SIUC, WIU, 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 (RM 291.0-296.1). Fish clearing with surface to bottom gill nets, pulsed-DC electrofishing, and deep-water AC electrofishing and surveillance with split-beam hydroacoustics, side scan sonar, and DIDSON will occur between Barrier 1 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 (Barrier 1, 2A and 2B) in the CSSC at approximate river mile 296.1 near Romeoville, Illinois. Barrier 1 (formerly 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 for maintenance approximately every 6 months and the IDNR has agreed to support maintenance operations by providing fish suppression at the electric dispersal barrier site. Fish suppression can vary widely in scope and may include application of piscicide (rotenone) to keep fish from moving upstream past the electric dispersal barrier 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.

Barrier 2B has been designated the primary barrier in the electric dispersal barrier and is operational most of the time. In contrast, Barrier 2A is typically held in warm standby mode until it is needed. With this barrier operation protocol, IDNR will lead fish surveillance and suppression at the electric dispersal barrier whenever Barrier 2B is scheduled for maintenance or if Barrier 2B shuts down unexpectedly due to mechanical or electrical problems. Fish suppression is necessary because, based on 3 years of conventional fish sampling and eDNA monitoring in the CAWS upstream and downstream of the electric dispersal barrier, there is a strong possibility that Asian carp could be present in this reach of the waterway, potentially immediately below Barrier 2B. If this is the case, when Barrier 2B is powered down for maintenance or loses power, any Asian carp immediately below Barrier 2B could move upstream with only the original demonstration barrier between the fish and Lake Michigan. 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 electric dispersal barrier. The intent is to drive fish below Barrier 2A, which would then be brought online and would serve as the primary barrier until Barrier 2B maintenance activities are completed and it resumes normal operations.

Following is a generalized plan to provide fish suppression at the electric dispersal barrier in support of Barrier 2B maintenance. Operations to clear fish may take from 1-5 days and will include netting, collecting and driving techniques and, if necessary, a small-scale rotenone action. We also include a plan for intensive fish sampling to detect presence and assess abundance of any Asian carp that may be in the canal immediately downstream of the electric dispersal barrier.

By selecting a cut-off of 300 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 based on over two 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 electric dispersal barrier. The MRWG (Monitoring and Response Workgroup) has taken a conservative approach to electric dispersal barrier responses in that there is little evidence that Asian carp are directly below the electric dispersal barrier, but with the understanding that continued work and surveillance below the electric dispersal barrier is necessary to maintain appropriate response measures. With budgetary costs and responders safety in mind and continued monitoring in reaches directly below the electric dispersal barrier, the MRWG will continue to consider the surveillance findings in response needs as best professional judgment suggests. A barrier maintenance clearing event will be deemed successful when all fish >12 inches (305 mm) are removed from the electric dispersal barrier or until MRWG deems the remaining fish in the electric dispersal barrier as a low risk.

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

1) Remove fish >12 inches (305 mm) long between Barrier 2A and 2B before maintenance operations are initiated by collecting or driving fish into the net or from the area with mechanical technologies (surface noise, surface pulsed-DC electrofishing and surface to bottom gill nets) or, if needed, a small-scale rotenone action; and
2) Assess the success of fish clearing operations by surveying the area between Barrier 2A and 2B with remote sensing gear (split-beam hydroacoustics and side-scan sonar). Success is defined as no fish >12 inches (305 mm) long in the between-barrier area, as determined with remote sensing gear or MRWG deems the remaining fish in the electric dispersal barrier as a low risk.

Status: Fish suppression in support of barrier maintenance began in 2009 and is on-going. Three multi-agency fish clearing actions occurred in 2013. An estimated 258 person-hours were spent sampling in the electric dispersal barrier during barrier maintenance events. Effort for each gear across all three maintenance events was 5.75 hours of surface pulsed-DC electrofishing, 2.3 hours of hydroacoustics transects and 200 yards (182.9 m) of surface to bottom gill nets. Across all gears and all events, we sampled a total of 115 fish representing 12 species with 1 hybrid collected.

On June 17, hydroacoustics and side scan sonar were taken between Barrier 1 and 2A to enumerate fish >12 inches (305 mm) in length prior to and after clearing actions to evaluate the

success of fish clearing. The gill net was 300 feet (91.4 m) long x 30 feet (9.1 m) deep with bar mesh ranging from 2.75-3.5 inches (69.85-88.9 mm). The net was dead set (stationary set as opposed to drifting) across the canal between Barrier 1 and the most upstream barrier parasitic structure. A boat was used to drive fish into the net with noise (pounding on the boat hull and revving the motor in a tipped up position). In addition to netting, two surface water shock boats operating with pulsed-DC current were used to target and stun or drive fish towards the stationary gill net that was in place across the canal.

On August 26 and 27, two surface water shock boats operating with pulsed-DC current were used to target and stun or drive fish downstream of the electric dispersal barrier. After the two day event, hydroacoustics and side scan sonar were taken between Barrier 1 and 2A to enumerate fish >12 inches (305 mm) in length to evaluate the success of fish clearing.

On November 4, hydroacoustics and side scan sonar were taken between Barrier 1 and 2A to enumerate fish >12 inches (305 mm)in length prior to and after clearing actions to evaluate the success of fish clearing. The gill net was 300 feet (91.4 m) long x 30 feet (9.1 m) deep with bar mesh ranging from 2.75-3.5 inches (69.85-88.9 mm). The net was dead set (stationary set as opposed to drifting) across the canal between Barrier 1 and the most upstream barrier parasitic structure. A boat was used to drive fish into the net with noise (pounding on the boat hull and revving the motor in a tipped up position). In addition to netting, two surface water shock boats operating with pulsed-DC current were used to target and stun or drive fish towards the stationary gill net that was in place across the canal.

For more detailed results of fish clearing and sampling relative to barrier maintenance see the 2013 interim summary report document (MRWG 2014) and the Monitoring Asian Carp Population Metrics and Control Efforts Plan.

Methods:

- *Project Overview* – Our current approach to fish suppression at the electric dispersal barrier is to first survey the area with remote sensing gears to assess the need for fish clearing operations either to support barrier maintenance or after an unplanned power loss at Barrier 2B. If fish >12 inches (305 mm)long are present, then we will use a surface to bottom 30 foot (9.1 m) gill net set across the canal in the designated safety zone area and pulsed-DC electrofishing boats to drive fish into the net or downstream out of the target area. A request for no flow conditions will be made to MWRD for a 2-hour period during netting operations. If mechanical clearing fails and there is a high risk for Asian carp to be in the electric dispersal barrier, we will invoke a small-scale rotenone to clear fish from the area. Finally, we include a plan for intensive sampling in the Lockport Pool downstream of the electric dispersal barrier as a measure of the risk that Asian carp might pass the barrier during maintenance and a gauge of the level of fish suppression activities needed to eliminate the possibility of upstream fish passage.

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 physical fish clearing actions. Clearing will be considered successful when no fish larger than 305 mm (12 inches) are observed between the barriers or MRWG

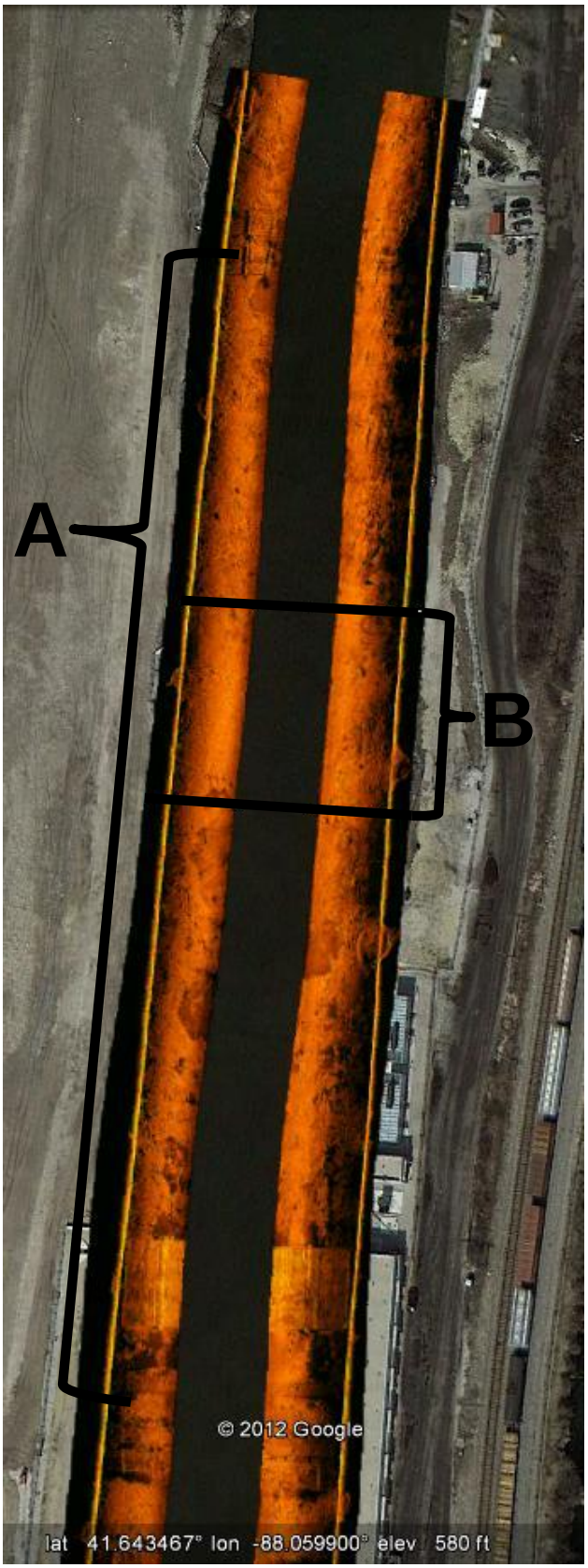
deems the remaining fish in the electric dispersal barrier as a low risk, after which Barrier 2B can be taken down for maintenance. By selecting a cut-off of 300 mm, we will be targeting sub adult and adult Asian carp, and excluding young-of-year fish. Excluding young-of-year Asian carp from the assessment is appropriate because there is no indication of their presence in the Lockport Pool based on 3+ years of sampling and the known location of spawning adults (i.e., downstream of Starved Rock Lock and Dam; see 2013 interim report document for more detailed information). Additionally, eggs, larvae, or young-of-year have not been observed upstream of Starved Rock Lock and Dam in the past decade. Our approach may be considered conservative because sub adult and young-of-the-year Asian carp have never been captured upstream of the Marseilles 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 2013 Barrier Maintenance Fish Suppression final report in MRWG 2014).

During a typical maintenance shutdown, we will first ask USACE to power up Barrier 2A so that both barriers are operating simultaneously and then conduct the first surveys with all three remote sensing gears. The detection of fish >12 inches (305 mm)long in the target area will initiate mechanical suppression actions. Mechanical suppression will include a surface to bottom 30 foot (9.1 m) gill net set across the canal in the designated safety zone area and pulsed-DC electrofishing boats to drive fish into the net or downstream out of the target area. Figure 1 provides a map and description of a mechanical fish clearing operation at the electric 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 or whenever both barriers are operating simultaneously. 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 Outage Electrofishing and Netting Fish Clearing Methods Site Map

A Electrofishing Area

- **The electrofishing area is located from Barrier 1 to the Barrier 2B narrow array.**
- **Two electrofishing boats will be used: one deep water shocker (USFWS) and one standard shocker (USACE).**
- **Fish will be initially located with hydroacoustics and side-scan sonar (SIUC boat) and tracked with DIDSON imaging sonar (USFWS boat).**
- **Electrofishing boats will target located fish and response of fish will be observed with the DIDSON. Stunned fish will be captured with non-conductive long handled dip nets and removed.**

B Gill Netting Area

- **The gill netting area is located about 300 feet downstream from Barrier 1 and 300 feet upstream from the uppermost parasitic structure in a section of the canal with little debris as indicated by side-scan imagery (courtesy of Dave Glover at SIUC).**
- **A request for no flow conditions will be made to MWRDGC for a 2-hour period during netting operations.**
- **One 100-yard long x 30-foot deep tied-down gill net will be dead set from an IDNR net boat in the netting area and fish will be driven into the net with noise by pounding on boats and revving motors. The net will be pulled and captured fish will be removed. The net may be reset several times.**

Safety Procedures

- **Standard safety procedures for working in the barrier area will be followed.**
- **Two spotters will be located on the east and west bank of the canal, a safety boat with AED will be located below the Romeo Road Bridge, and work will occur during an existing USACE requested canal closure date and time.**

Figure 1. Map and descriptions of a fish clearing operation at the electric dispersal barrier.

Small Scale Rotenone Action - Rotenone is considered the fallback method for fish suppression should other clearing efforts prove to be unsuccessful. If necessary, rotenone will be applied from boats at a location just upstream of the arched overhead pipe that designates the upstream boundary of the electric dispersal barrier Regulated Navigation Area (RNA) Safety Zone enforced by the USCG (Figure 2). This will create a rotenone slug that will travel downstream and mix throughout the water column driving fish from the target area between barriers or killing them. The rotenone slug will be detoxified with liquid sodium permanganate pumped from boats at a location south of the Romeo Road Bridge (Figure2). Unlike fish clearing methods discussed above, the effect of rotenone on fish is well known and has been documented, precluding the need for on-site evaluation. Barrier 2B will be turned down for maintenance once stable operation of Barrier 2A has been confirmed.

Although rotenone is an effective technique for controlling fish populations, there are several reasons for attempting physical removal of fish prior to rotenone application. Even the proposed small-scale rotenone action will be costly (estimated 150-250K), require extensive labor and permitting (minimum 40-50 persons; NEPA, NPDES, IDNR CERP, and Special Local Needs labeling), and require a longer duration canal closure than physical fish clearing (estimated 8-10 hours vs. 0-5 hours). In addition, barrier maintenance must occur regularly at approximately 6 month intervals. Developing methods that are less expensive and disruptive to canal users is beneficial to all involved stakeholders. In contrast to rotenone, physical clearing methods will not pollute waters or kill fish. Fish killed with rotenone must be collected and disposed of in an EPA approved toxic waste landfill. Perceptions that rotenone actions "poison" the water have been expressed by potential purchasers of commercially harvested Asian carp from down river locations. These perceptions may adversely affect the success of Asian carp commercial market development projects. Furthermore, while rotenone is used and neutralized successfully in most cases, there is the possibility that mechanical or environmental factors could allow rotenone to travel outside of the treatment area where additional aquatic resources could be unintentionally harmed. Finally, the USACE telemetry program to assess effectiveness of the barriers will be adversely impacted should tagged fish in the vicinity of the electric dispersal barrier be eradicated by rotenone.

A small-scale rotenone action will take place if remote sensing surveys indicate fish >12 inches (305 mm) long may be present between Barriers 2A and 2B and mechanical suppression measures fail to collect or drive fish from the area unless MRWG deems the remaining fish in the electric dispersal barrier as a low risk. All operations will occur between Hanson Material Service's large barge slip (~RM 295.2) and a point approximately 0.25 miles (0.4 km) upstream of the arched pipeline (up to RM 297). No work is planned in the designated RNA, although it will be necessary for some boats to pass through the RNA to get to upstream chemical application stations (see Safety and Communication section below for RNA restrictions). IDNR will stand up an Incident Commend Structure (ICS) for a rotenone action and will work closely with USCG and USACE (possibly in Unified Command) during all phases of project planning and implementation to ensure a safe and successful event. Detailed plans for a rotenone action will be prepared by IC staff, but a general overview of possible operations is presented here. In all, we anticipate a 3-4 day operation with 12-15 boats, 45-50 field crew, and 15-20 IC staff and support crew. This estimate does not include security and safety zone enforcement boats and

crews. Day 1 will include travel to the site, gear preparation, and the collection of sentinel fish for detoxification monitoring.

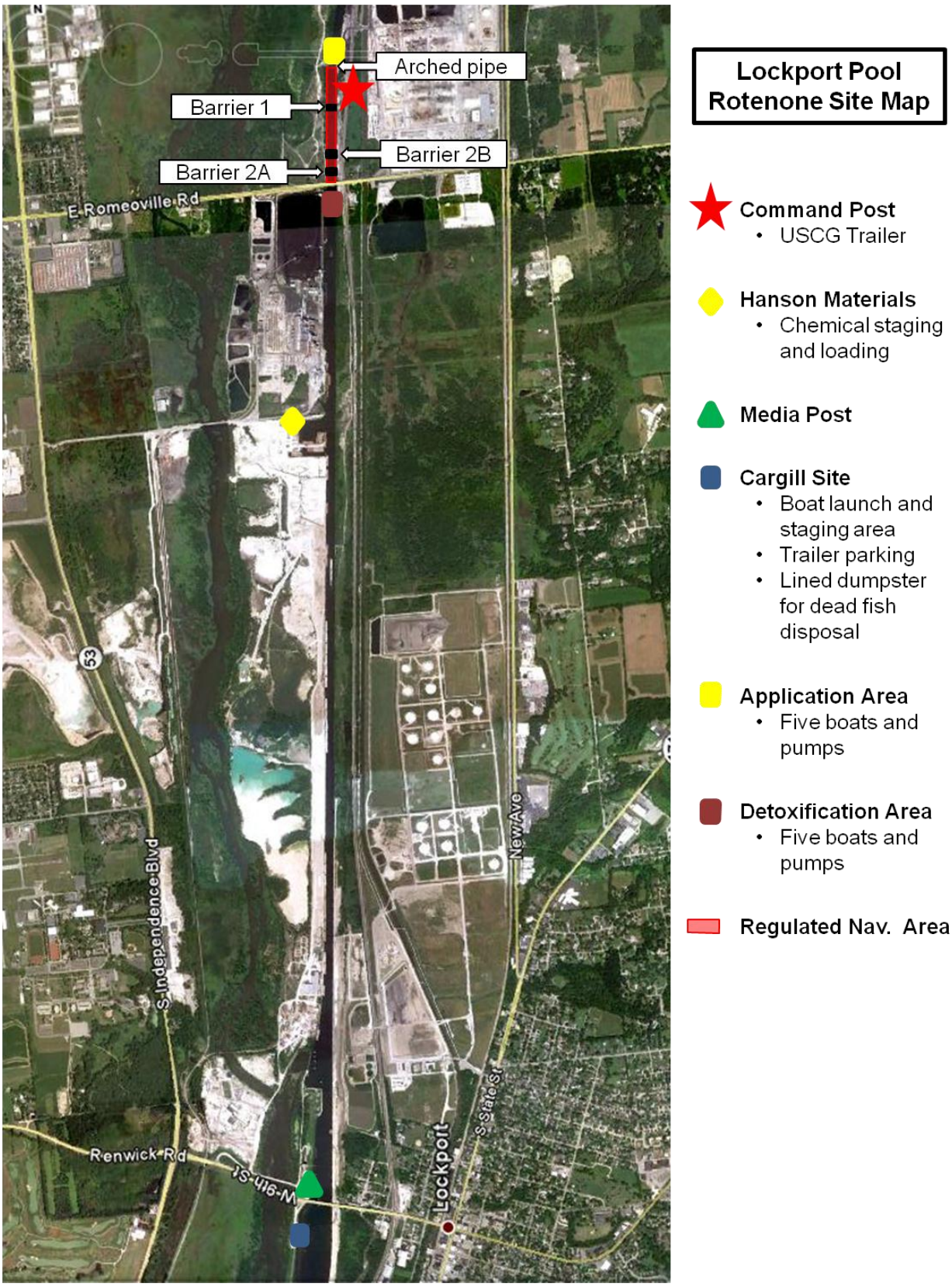


Figure 2. A map of a small-scale rotenone operation to clear from the electric dispersal barrier.

The bulk of the work will occur on the second day of operations and a 10-hour daytime canal closure will be necessary on this day. During Day 2, we will apply approximately 125 gallons of rotenone from boats (N = 5) located at a station upstream of the RNA. The chemical will be allowed to mix and flow downstream over the barriers killing fish or forcing them out of the area. Dye will be used to track the leading and trailing boundaries of the rotenone slug. Reactivation of Barrier 2A must be synchronized with the passing of the tail end of the rotenone slug through the barrier area to prevent movement of fish back into the treatment zone. Detoxification with approximately 750 gallons of sodium permanganate applied from boats (N = 3-4) will take place downstream of the barrier RNA. The exact location of the detoxification station will be based on consultations with personnel from the Midwest Generation power plant and their level of concern over permanganate entrainment through the plant cooling system. Cages with sentinel fish will be placed at several downstream locations in the Lockport Pool to ensure that detoxification was successful. Although a large kill is not anticipated, we will have 2-3 recovery boats and crews and one dumpster on hand for the collection and disposal of dead fish. Fish recovery will continue on the third and fourth day of the event, as needed.

Lockport Pool Sampling - Fish sampling may take place in the CSSC from Lockport Lock and Power Station to the downstream boundary of the barrier RNA (Figure 3) when deemed necessary by the MRRWG. Sampling has been shown to be effective without waterway closures, but closures can be requested if sampling is to take place in the main navigation channel for extended periods of time. An example of sampling gears and anticipated effort from a fall 2010 multi-gear operation is included in the following table and text. All captured fish will be identified to species, counted, and a subsample of 20 fish per species per gear type will be measured (mm total length). Except for Asian carp, all captured fish will be returned live to the waterway. Any captured Asian carp will be held and immediately reported to the operations coordinator.

Methods	Boat/crew	Number of sets, runs, or samples	Duration
eDNA sampling	1 boat; 3 crew	120 samples total; 60 upstream and 60 downstream of barrier	5-6 hours collection time
Pulsed DC-electrofishing	2 boats; 6 crew**	6 hours total; 12 runs @ 30 min. per run	2 partial days; three 30-min. runs/boat/day
Commercial fishers - trammel/gill nets @ 8' x 600'; 3-5 in. mesh	2 boats; 4 crew, and 2 IDNR observers	1,000 yards (914.4 m) of net set and run/boat/day	2 nights; 13-14 hour set
Experimental gill nets 6 @ 6' x 300'; 0.75-5.0 in. mesh 3 @ 10' x 150'; 0.75-2.0 in. mesh	1 boat, 3 crew*	6 nets set overnight in off channel areas	1-2 nights; 13-14 hour set
Mini fyke nets (10)	1 IDNR boat, 3 crew**	10 nets set overnight	2 partial days; 13-14 hour set
Telemetry	2 boats, 4 crew	NA	1-2 days

*Same boat doing different sampling.

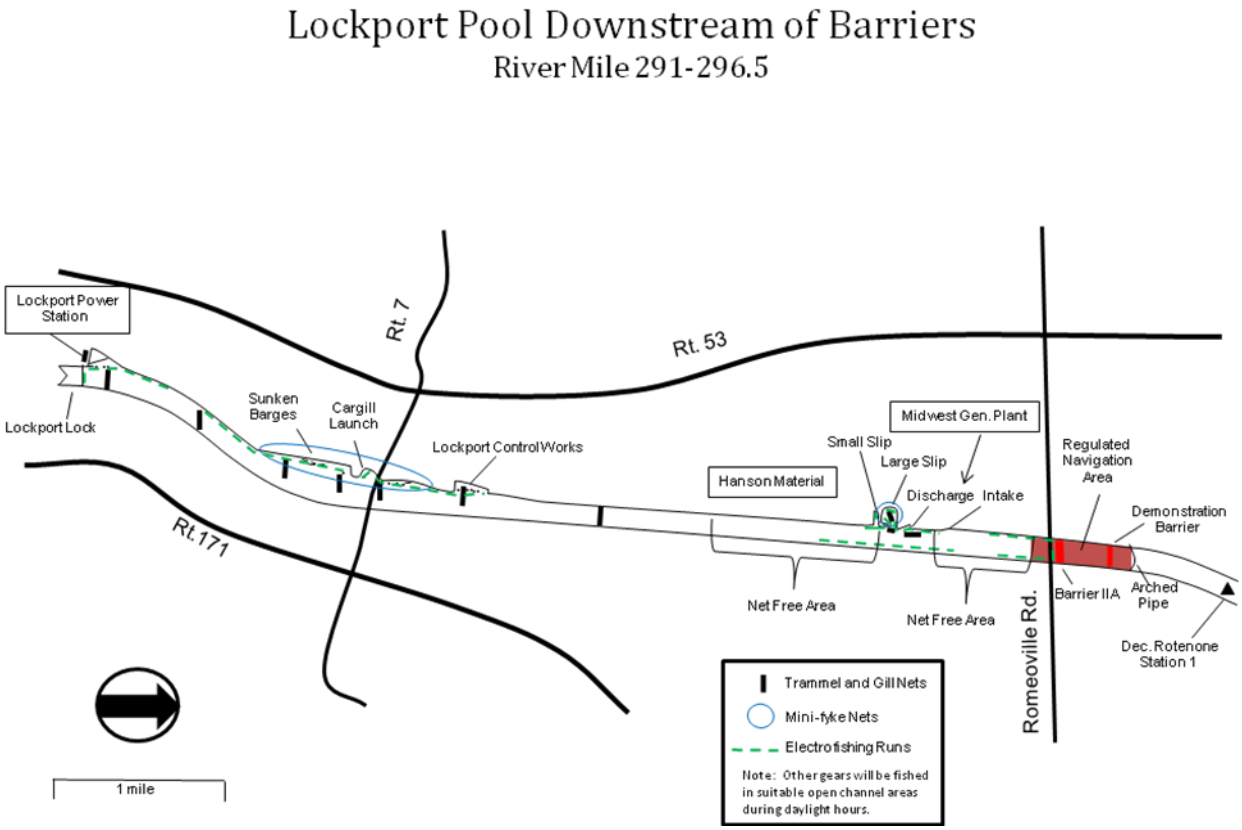


Figure 3. Lockport Pool downstream of the electric dispersal barrier showing target areas for fish sampling operations.

Sampling will require eight open deck aluminum boats that range in size from 18-24 feet (5.5 – 7.3 m) long. The staging, boat launch, and overnight boat storage area will be located at the Cargill Launch site on the west bank of the canal just south of the Route 7 (9th Avenue) Bridge (a.k.a. Carp Camp 1). Mini-fyke nets and experimental gill nets will be fished in shallower near shore areas away from the navigation channel and in a portion of Hanson Material Services large slip during day and night hours. Daytime trammel net sets will be of short duration (15-20 minutes) and will have fish driven into the nets by "pounding," a method commonly used by commercial netters. Short term sets will always be attended by a net boat crew and target areas throughout the reach known to hold concentrations of fish. Trammel nets may be set overnight in backwater and off channel areas to increase chances of catching fish.

Safety and Communication - Safety is a primary objective when operating in the electric field created by the barrier. Boats will be equipped with required safety equipment and floatation devices. Operators and crews will wear personal flotation devices while working on the water. For fish sampling operations, no work is scheduled to take place in or upstream of the barrier RNA. However, all requirements of the RNA will be adhered to should a crossing be necessary. The RNA extends from the arched pipe downstream to a point 450 feet (137.2 m) below the Romeo Road Bridge (designated by Sampson post #2 on the west bank).

First, any vessel crossing the electric dispersal barrier or entering the RNA will provide advance notification to the Coast Guard Captain of the Port Representative on scene at (630) 336-0296 or VHF-16. Additional RNA requirements include:

a. The vessel cannot be less in than 20 feet (6.1 m) in length.

b. The vessel must proceed directly through the RNA, and may not conduct any fishing operations, loiter, or moor within the RNA boundaries. Special permits will be requested for remote sensing surveys and mechanical fish suppression operations planned to take place within the RNA (see below).

c. All personnel must remain inside the cabin, or as far inboard as practicable. If personnel must be on open decks, they must wear a Coast Guard approved Type I personal floatation device.

The CSSC is a working ship canal and sampling crews should be aware of potential hazards in the waterway. Note that no boats should operate near barges that are being loaded. In addition to the hazard of being hit by material that misses the target, there are cables that move barges along the wall during loading. These cables may be under the water surface when slack, but can rapidly rise 4-5 feet (1.2-1.5 m) above the water when tightened. A rising cable could cause severe bodily injury or catch and easily flip a sampling boat. Crews should be aware of their surroundings and avoid potential safety hazards while sampling.

Communication among boats, staff, security, and shore command will be by marine radio or cell phone. A briefing before any crew enters the water will be held and will include a handout of crew leaders and cell phone numbers for each participating boat/crew. This handout will include a map of the sample reach. All boats will be equipped with numbered flags for identification on the water and hand-held marine radios operating on Channel 12 for the operation, unless

emergency communication with USCG or Lockmaster is necessary (Channel 16, 14). Emergency contact numbers (local ambulance, fire/rescue service, Lockmaster, USGC contact information, and MWRD) will be included on the handout if needed for unforeseen reasons, yet the primary communicator to these services will be the operations coordinator or Incident Commander.

Sampling Schedule: Barrier maintenance may be required every six months to a year. The USACE determines the need for barrier maintenance and when maintenance will occur. The IDNR has requested that USACE provide a notice of maintenance dates 60 days in advance to allow time for planning and preparation. The USCG requires that Safety Zone applications be submitted 45 days prior to requested canal closure dates. By law, mariners must be informed about any non-emergency canal closures 30 days before the closure is to occur. Canal closures are required for the safety of mariners and operation crews and whenever both Barrier 2A and 2B are operating simultaneously.

Deliverables: Results of fish sampling events will be compiled for weekly sampling summaries. Fish suppression updates will be provided daily during operations. Data will be summarized for an annual interim report and project plans updated for annual revisions of the MRP.

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 electric dispersal barrier. By decreasing Asian carp numbers, we anticipate decreased dispersal pressure towards the electric dispersal 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 has continued through 2013 using ten contracted commercial fishing crews to remove Asian carp with large mesh (3.0 - 5.0 inch (76.2-127 mm)) 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 electric dispersal barrier as a supplement to fixed site monitoring.

Status: Contracted commercial fishers and assisting IDNR biologists deployed 1054.66 miles (1697.3 km) of gill and trammel net and 1.8 miles (2.9 km) of commercial seine in the upper Illinois Waterway since 2010. A total of 59,087 Bighead Carp, 100,375 Silver Carp, and 1,194 Grass Carp were removed by contracted netting. The total weight of Asian carp removed was 1068.82 tons. For more detailed results see the 2013 interim summary report document (MRWG 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) 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 Carp, Silver Carp, 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 2014 is shown in the table below.

Week of	Agency	Week of	Agency	Week of	Agency
Mar 10	IDNR	Jun 2	IDNR	Oct 6	IDNR
Mar 24	IDNR	Jun 23	IDNR	Oct 20	IDNR
Apr 7	IDNR	Jul 7	IDNR	Nov 17	IDNR
Apr 21	IDNR	Aug 4	IDNR	Dec 8*	IDNR
May 5	IDNR	Sep 1	IDNR		
May 19	IDNR	Sep 8	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.

Optimal Harvest Strategies to Minimize Asian Carp Propagule Pressure on the Electric Dispersal Barrier

Participating Agencies: SIUC (lead); WIU

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 electric dispersal barrier area, harvest of Asian carp downstream of the electric dispersal barrier may help to reduce the probability of Asian carp challenging the electric dispersal barrier during a chance event that could allow them to successfully breach the electric dispersal 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 Carp 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 flood years), likely similar to what is expected in 2014. Movement corresponded with elevated flow in the river during spring through summer. Asian carp that moved upstream typically returned to downstream locations in late summer or early fall. The probability of Asian carp moving between the Starved Rock and Marseilles pools is relatively low, suggesting that this area may act as a natural barrier to carp movement. However, results from mark-recapture studies (prior SIU reports) suggest that immigration into the Marseilles Pool is high throughout the summer, spring 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 Carp and Bighead Carp.

Furthermore, 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 hydroacoustic surveys and side scan sonar) 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 (> 350 tons removed in 2011). 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 Starved Rock and Marseilles)? If so, can this population be further isolated with barrier technology and reduced?
Finally, hybridization may influence the movement, spawning, and feeding ecology of fish. The degree to which Silver Carp and Bighead Carp are hybridization 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 Carp 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 winter of 2015 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. *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 summer 2015.* This will allow us to inform movement parameters in the Asian carp population model, make predictions about times when the probability of carp movements 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).
3. *Refine survival, immigration, and exploitation rates for backwaters of the Illinois River using all acoustic derived information and jaw tag returns by February 2015.* These additional parameters will inform the spatially explicit population model and provide a way to measure the success of control efforts in backwaters.
4. *Measure changes in the rate of Asian Carp hybridization throughout the river by genetically identifying up to 50 fish per pool (to be completed on all fish that are tagged with acoustic transmitters by July 2014).* 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: 2011-2012) will be completed in spring 2015. Additional hydroacoustic surveys will be completed in late summer/early fall of each year (2014 and 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 dispersal 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 Starved Rock, Marseilles, and Dresden Island pools. Additional stationary VR2W receivers will also be deployed around the Marseilles L&D and throughout the upper portion of the Starved Rock Pool 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 VR2 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 during 2014 (to be completed by February 2015) incorporating all acoustic tagging and jaw tagging information to date.

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 (2010-2013) 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 and trammel netting will be conducted by SIUC in the Alton, La Grange and Peoria pools. A subsample of at least 150 individuals per species (if possible) of Asian carp from each reach of the Illinois River will be returned to SIUC and used for estimation of sex ratio, gonadal condition, body condition (lipid content), and age (with sectioned post-cleithra). Information about fish in the upper reaches will be obtained from multiple ongoing efforts (e.g., contracted removal upstream, commercial harvest downstream, and INHS (Wahl lab) sampling upstream). Post-processed sonar and fish sampling data combined will be used to interpolate Asian carp densities, biomass, species composition and size structure. Total density will be calculated based on the volume of the river using bathymetric data recorded during sonar survey transects.

In the upper river, we will undertake sonar surveys before and after 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 (Brandon Road and Lockport reaches). This would allow us to

"ground truth" sonar estimates and correlate population estimates with harvest catch rates. Additionally, the sonar surveys will be used in combination with active tracking telemetry in areas of little or no Asian carp (i.e. Dresden, Brandon Road, and Lockport reaches) to locate fish congregations for targeted removal.

Deliverables:

- Quarterly reports on progress as available
- Annual report for 2014-2015 and 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); SIUC

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.

By mid-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 2014 sampling season. Although working estimates are also projected for the 2015 and 2016 sampling seasons, these priorities may change based on new information collected by the MRWG in 2014.

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 barrier 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 recommends shifting that focus to the Dresden Island Pool and the Kankakee River by re-allocating receivers from Marseilles. There will be 22 stationary receivers that will remain at their respective 2013 locations from the Dresden Island Lock to the Cal-Sag confluence, sites shown in green in Figure 1. An additional nine receivers will be deployed within the Dresden Island Pool, Kankakee River and Des Plaines River, sites shown in red in Figure 1.

Since 2010, 56 Asian carp have been collected and tagged from the Dresden Island and Marseilles pools in the IWW while 259 surrogate species have been collected and tagged from the Lockport and Brandon Road pools closer to the electric dispersal barrier. Tagged surrogate fish have been released above and below the electric dispersal 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 barrier 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(101.6 mm)) challenging the electric dispersal barrier as well as barge interactions causing entrainment through the electric dispersal barrier. There have been no occurrences of tagged fish moving upstream through the electric dispersal barrier date.

Goals and Objectives

The overall goal of this telemetry monitoring plan is to assess the effect and efficacy of the electric dispersal barrier on tagged fish in the Chicago Area Waterways (CAWS) and Upper IWW using ultrasonic telemetry. The goals and objectives for the 2014 season have been identified as:

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

- **Objective** Monitor the movements of tagged fish (large and small) in the vicinity of the electric dispersal barrier 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
- **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 each dam.

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.

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, it was decided that a baseline minimum of 200 transmitters be implanted for telemetry monitoring in the vicinity of the electric dispersal barrier and that this level of tags be maintained as battery life expires or specimens exit the study area. At the conclusion of the 2013 sampling season there were 230 live, tagged fish within the study area with varying expiration dates. It is expected that 95 of these transmitters will expire within the 2014 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 with the exception of upstream passage from Dresden Island Pool to the Brandon Road Pool. Brandon Road Lock and Dam is approximately 5.5 miles (8.8 km) 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 and Dam 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 telemetry program to be introduced in 2014 will be the inclusion of depth sensor transmitters to those fish released in proximity of the electric dispersal barrier. A total of 30 depth sensors will be implanted into surrogate fishes which will be released in equal quantities up and downstream of the active permanent barrier (IIA or IIB). Fishes will be released in three groups of ten to reduce the amount of tags present with the

barrier's VPS at any one time. Table 1 below displays the location and number of replacement and new tags recommended for implantation in various fish species in 2014 as well as the total tag distribution for the study per pool.

Release Pool/Location	Species	Number of replacement tags	Number of New tags	Total tag distribution
Upper Lockport/RM300	Surrogate species	40	0	40
Lower Lockport/RM292.7	Surrogate species	55*	0	75
Brandon Road/RM286.5	Surrogate species	0	20	40
Dresden Island/RM276	Surrogate & Asian carps	0	40	75

*Table 1: Recommended transmitter implementation for the 2014 sampling season. Replacement tags are required to maintain existing level of coverage while new tags are proposed for deployment to refine study methods. *30 depth sensor transmitters to be released equally above and below active permanent barrier*

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 tags implanted and released prior to 2013 into surrogate fish species within the Lockport Pool will have expired by early spring 2014 and will need to be replaced. Similar replacement tagging occurred on a decreased level in the Brandon and Dresden Island pools during the 2013 sampling season. An additional 60 tagged fish will be added to the Brandon and Dresden Island pools in 2014 as the study focus is elevated at the Brandon Road Lock and Dam for inter-pool movement. These additional tags will double existing transmitter densities at those locations. 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 Carp and Silver Carp) are the primary species of concern, and their behavioral response to the electric dispersal barrier is of the greatest importance. However, as mentioned previously, populations of both species vary and are considered rare to absent near the electric dispersal barrier. 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 electric 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 Buffalo and Black Buffalo), Grass Carp (another species of Asian carp), and Freshwater Drum.

In addition to the type of species being tagged, 2014 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 barrier 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 barrier and tagged and released downstream. These fishes will have a greater propensity to return to their capture site, hence, challenging the electric dispersal barrier more often. This same technique will be employed in the Dresden Island Pool with fishes captured in the Brandon Road Pool.

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 pools will be turned over to the Illinois Department of Natural Resources 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 bouy. Vinyl coated steel cable was used for all deployments to minimize loss due to vandalism. In the immediate vicinity of the electric dispersal barrier, receivers were 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) were 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. These 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 electric dispersal barrier). 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 2014 to integrate lessons learned from previous data. Stationary receivers from the Marseilles Pool will be reallocated to the Dresden Island Pool and Kankakee River to increase resolution on tagged Asian carp movements. The increase in resolution will better assist researchers to pinpoint fine scale habitat use and seasonal movement patterns. Receiver coverage will be 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 will also be supplemented within the Kankakee River in order to better understand the dynamics of immigration to, and emigrations from the tributary as well as how far Asian carp are penetrating upstream. Two receivers will be placed within 5 miles (8 km) of the Kankakee confluence with the Des Plaines in such a way as to discern directional movements. A third receiver, furthest upstream, 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 will also undergo modifications around the Brandon Road Lock to increase the efficiency of inter-pool pathway detection. Additional receivers will be deployed within the lock chamber, below the dam and within connecting tributaries nearby. These tributaries, Hickory Creek and Sugar Run, provide 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 will help 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.

Figure 1 shows the general strategy of VR2W placement for 2014 (n=31 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.

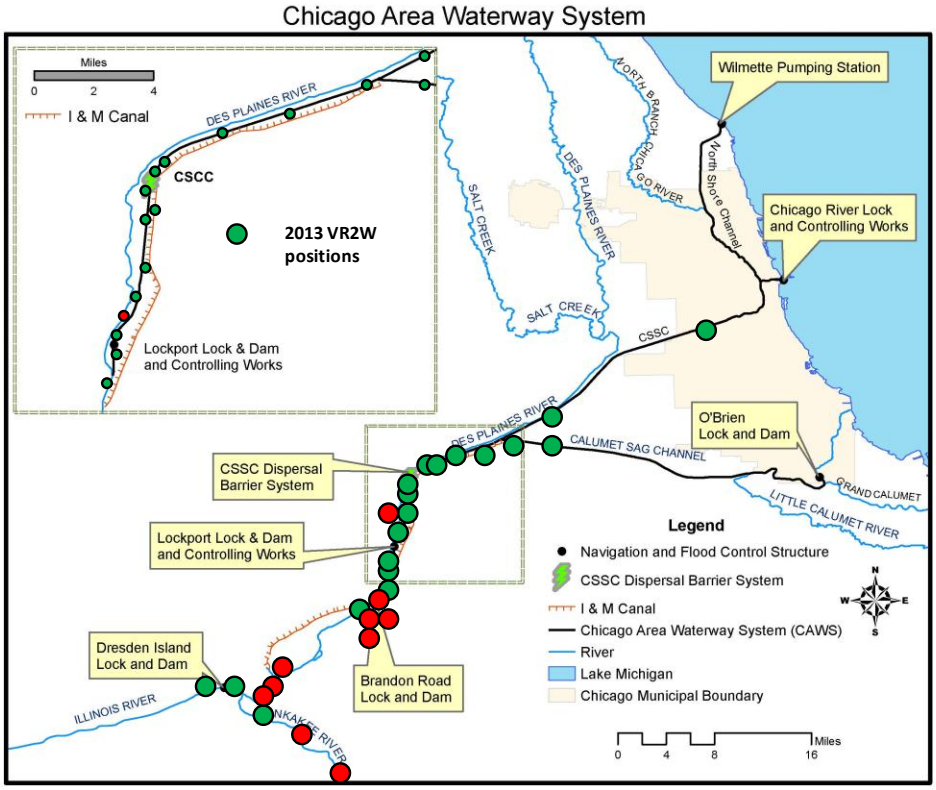


Figure 1: VR2W receiver network within the Upper IWW and CAWS

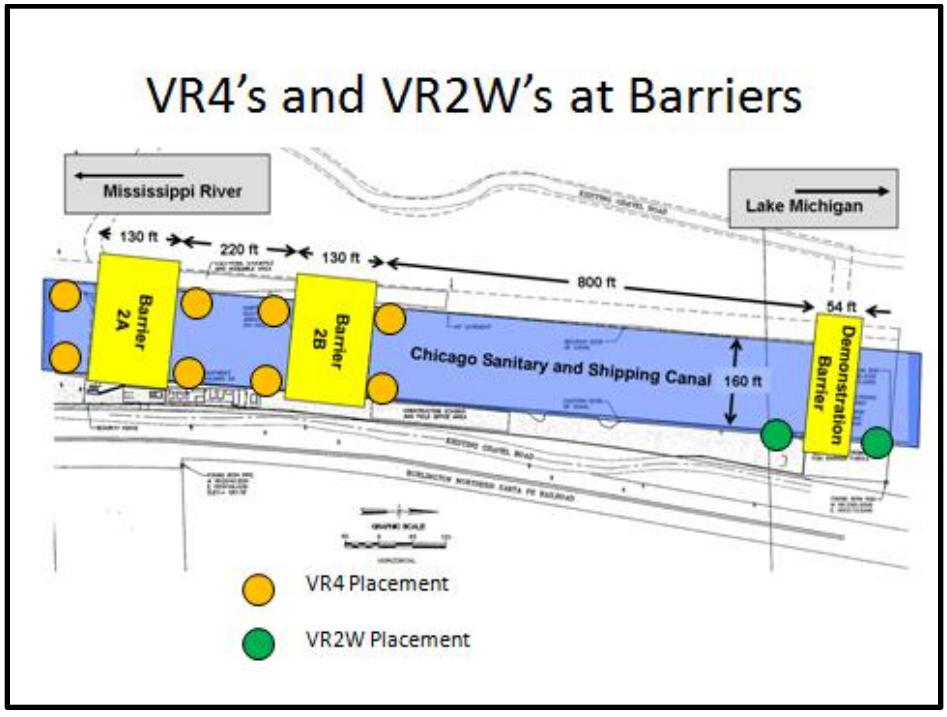


Figure 2: VR2W and VR4 receiver network at the electric dispersal barrier

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 electric dispersal 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 2014 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 electric dispersal 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 Marybeth Brey, 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 2014	VR2W network inspected and new receivers installed and tested
April & May 2014	Tagging efforts of Asian carp in the Dresden Island and Marseilles pools and surrogate fish in Lockport and Brandon Road pools at Barriers
May & June 2014	Tagging efforts of surrogate fishes with depth sensor tags at the Barriers location
ONGOING	VR2W network maintenance, downloads and mobile tracking
December 2014	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. 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 2014 sampling season.

Understanding Surrogate Fish Movement with Barriers

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

Location: Sampling will take place in the Lockport Pool downstream of the electric dispersal barrier, Brandon Road Pool and Dresden Island Pool.

Introduction and Need: Based on extensive monitoring efforts using traditional fishery sampling techniques (electrofishing, trammel and gill nets, hoop nets and fyke nets), Asian carp are very rare to absent in the area between the electric dispersal barrier and the Brandon Road Lock and Dam. The most upstream location that Asian carp has been caught or seen is in Dresden Island Pool below river mile 278, which is 18 river miles (29 km) downstream of the electric dispersal barrier With such a close proximity, Asian carp pose a real threat to the electric dispersal barrier. The goal of this project is to use surrogate species to identify 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. Rock Run Rookery and Army Lake are connect to Dresden Island Pool and so, will be considered an area of concern. In order to test the potential risk of Asian carp movement through barriers, surrogate species will be tagged in the Rock Run Rookery, Army Lake, 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 common and widespread throughout the Chicago Sanitary Ship Canal (CSSC) and the upper Illinois River. Common Carp are known to migrate relatively long distances and can grow to large sizes that are approximate to those achieved by Asian 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 buffaloes) 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 and Army Lake 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 will begin in March 2014 and end in December 2014.

Methods: Sampling for Common Carp, Bigmouth Buffalo, Smallmouth Buffalo and Black Buffalo will take place through Fixed and Random Site Monitoring Downstream of the Barrier and Barrier Maintenance Fish Suppression projects (see MRWG 2014). The sample design includes electrofishing at four fixed sites and twelve 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 random sites

in Dresden Island Pool each week sampled. Contracted commercial netting will also include two sets placed in Rock Run Rookery and Army Lake each month. Hoop and mini-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 tag reference/identification number. Floy Tags will be anchored by inserting 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 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 partial clip will be given to all fish in the upper portion of the caudal fin at an angle from the middle of the caudal fin to the upper portion of the caudal fin to increase later recognition. In the event of a recapture, fish will be identified by species and tag number then, recorded. If a Floy Tag missing, 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 will take place bi-weekly from March through December. Hoop and mini-fyke netting will take once per month from March through December.

Deliverables: Results of fish sampling events will be compiled for weekly 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, Identification, and Fish-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), USFWS Columbia, MO and La Crosse, WI FWCOs (field support).

Location: All work will take place at the electric dispersal barrier near Romeoville, IL.

Introduction and Need: The electric dispersal barrier in the Chicago Sanitary and Ship Canal (CSSC) operates with the purpose of preventing upstream fish dispersal from the Mississippi River Basin to Lake Michigan. A demonstration barrier has been operational since April 2002 and currently operates 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 electric dispersal 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 electric dispersal 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. 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 (referred to as 2.0 V/in hereafter) in August, 2009 as a result of a pilot laboratory study performed by Holliman (2011) on Silver Carp ranging in size from 5.4-11 in TL. Holliman (2011) found that at those parameters, 100% of Silver Carp specimens were incapacitated. Barrier IIB began operation in April 2011 at 2.0 V/in. Typically only one of the larger barriers (IIA or IIB) operates at one time along with the Demonstration Barrier. 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 (referred to as 2.3 V/in hereafter), which is what operating parameters remain at for Barriers IIA and IIB. The increase to 2.3 V/in was in response to intensive laboratory work done by Holliman (2011) on Bighead Carp that were 1.8-3.2 in TL. Holliman (2011) found that those parameters incapacitated 100% of small Bighead Carp that were exposed to gradual increases in voltage in a Brett swim tunnel. Those parameters were about 90% effective at preventing fish from swimming through a simulated barrier that small Bighead Carp were allowed to challenge.

Results from our past fish monitoring work at the electric dispersal barrier have revealed that fish abundances in that area fluctuate throughout the year and that at times. 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 electric dispersal barrier. The accumulation of feral fish immediately below the operating barrier has raised concerns about the fish opportunistically moving upstream during a planned or

unplanned barrier outage, 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) Determine fish abundances immediately below Barrier IIB and between Barrier IIB and the Demonstration Barrier before and after required monthly barrier maintenance shutdowns.
2) Evaluate fish behavior during monthly shutdowns to see if feral fish opportunistically swim upstream during the planned outages.
3) Evaluate fish behavior between the narrow arrays where the highest-voltage electrical field is located.
4) Evaluate behavior of fish near the electric dispersal barrier as barges traverse the barriers.
5) 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. Interim reports for this work can be found in the 2012 and 2013 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 2014:

DIDSON and Fish Identification

Fixed DIDSON recordings during times of normal barrier operation will take place solely between the narrow arrays of the operating barrier, 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 between the narrow arrays, 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 Echo View 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 3-4 consecutive days, between four and seven times during the year (contracts pending), likely in the summer and fall.

Within the nearest possible timeframe to when fixed DIDSON recordings are made (potentially almost concurrently, but maybe in the subsequent week), fish sampling will take place at the electric dispersal barrier to determine the species of fish present at the electric dispersal barrier This sampling will be done using Paupier or Mamou trawls. Timing and amount of the sampling will depend on fish presence and abundance at the electric dispersal barrier as identified with the DIDSON, and as safety dictates.

Barge-Fish Interaction Studies

As of the time of this writing, no barge contracts are in place to do barge related work in 2014, however this may change as planning activities continue within USACE. Potential barge interaction work at the electric dispersal barrier includes using DIDSON to observe fish behavior and abundances at the ultimate field strength of the barrier as a barge traverses the electric dispersal barrier, repeating caged fish and tethered fish studies if new operating parameters need

testing, and deploying DIDSON cameras in barge junction spaces in an attempt to view and count feral fish in barge junctions, and placing novel gears in barge junctions to attempt capture and quantification of fishes in barge junctions.

Monthly Maintenance

Scans of the electric dispersal barrier will continue to take place in conjunction with planned monthly barrier maintenance shutdowns at the beginning of each month, through April (concluding a full year of monthly data collection). Three full scans will be performed before the generator testing and three scans after the testing. After all data have been post-processed, a thorough analysis of the data will be conducted, which could be used to inform partners about the effects of generator testing on fish movement.

Sampling Schedule: Hydroacoustic SONAR scans before and after barrier maintenance events will take place monthly, typically during the first Tuesday of each month into April 2014. Fixed DIDSON sampling will take place during four to seven weeks in the summer season and fall seasons. Barge-fish interaction study work is pending.

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

Monitoring Fish Abundance 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), 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.

Introduction and Need: The electric dispersal barrier in the Chicago Sanitary and Ship Canal (CSSC) operates with the purpose of preventing upstream fish dispersal from the Mississippi River Basin to Lake Michigan. A demonstration barrier has been operational since April 2002 and currently operates at 4 ms, 5 Hz, 1 V/in. Barriers IIA and IIB were built and brought online 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. 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, which is what operating parameters remain at for Barriers IIA and IIB. Fish are known to aggregate below the barrier system at different times throughout the year, primarily the summer and fall (Parker et al. 2013). Monthly maintenance, daily barge traffic, and other regular maintenance operations have been shown to have a potential to allow fish to pass the barrier system (see http://www.fws.gov/midwest/fisheries/carterville/didson-barge.html for reports). If and how fish aggregate behind the electric dispersal barrier on a diel basis is not known and fine-scale quantification of how fish aggregate throughout the year and how fish aggregate by size class is also unknown. Having a greater understanding of the spatial, temporal, and size distributed patterns of how fish aggregate 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 reside in the lower end of 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; two 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 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, and if other research attempting to discover a unique hydroacoustic signal for Asian carp is successful, 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. It is anticipated that the early implementation of ANS Buffer Zone measures at Brandon Road would allow for the timely evaluation of the implementability and efficacy of the measures in GLMRIS. Having a greater understanding of fish abundance, behavior, and movements in, around, and adjacent to Brandon Road Lock and Dam will help to inform potential GLMRIS actions at Brandon Road.

Status: Almost a complete year of monthly sampling related to this project has been completed in the Lockport Pool, however, more samples may be taken. Scans in Brandon Road and Dresden Island pools are new for 2014.

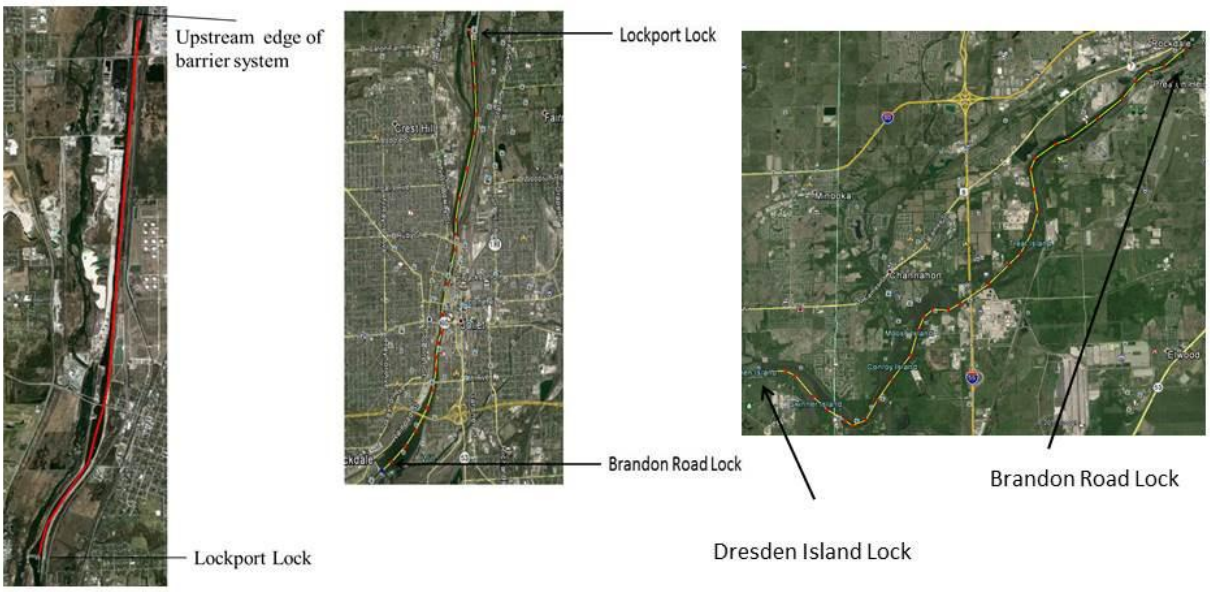
Objectives:

1) Determine the abundance and distribution of fish in the project pools.
2) Evaluate the diel abundances of fish around and within the electric dispersal barrier and potentially other structures (e.g., Brandon Road L & D).
3) Evaluate size structure of fish in the subject pools.
4) Identify large fish targets in the subject pools (particularly pending results of the SIU/USFWS Pond SONAR project), suspected of being Asian carp, to direct targeted sampling efforts at these fish for removal.

Methods:

Fish abundance, size and distribution

Fish abundances and distributions from the electric dispersal barrier to Dresden Island Dam (Figure 1) 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. 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 done across small areas in order to ensure that the entire area is covered.



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 SONAR sampling will take place.

Diel barrier scans

Diel sampling will take place in order to assess fish distribution patterns near the electric dispersal barrier throughout a 24-hour period. Complete electric dispersal 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 electric dispersal barrier, most likely in the summer and fall. Three, seasonal (spring, summer, fall) diel samples are tentatively planned for the year. Scans 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 a -3.5˚ and the other set to -10.5˚ below the water surface. Each complete scan will consist of three transits through the electric dispersal barrier. The side-scan SONAR unit will be deployed 1 m below the water surface. The first two transits along the walls will require driving the boat about 1 m away from the west and east walls. The final transit will be through the middle of the channel. The mid-channel transit will only require operation of the side-scan SONAR unit.

Acoustic data will be collected using the BioSonics software Visual Acquisition 6® from 1.15 to 15-m depth 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 throughout the duration of sampling following Foote et

al. (1987). Post-processing of SONAR data will be performed using EchoView® and SonarWiz® software.

Sampling Schedule:

Winter 2014- Gear preparation, field logistics planning, crew scheduling
Spring, Summer, and Fall 2014- Collect and analyze hydroacoustic data in the project pools
Spring, Summer, and Fall 2014- Diel sampling events
Winter 2014/2015 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 electric 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 (21.7 km)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 inch (6.4 mm) 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 Carp and Silver Carp and their spawning activities in the upper Des Plaines River above the confluence with the CSSC; and
2) Monitor Bighead Carp 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 (5.7 km)), 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

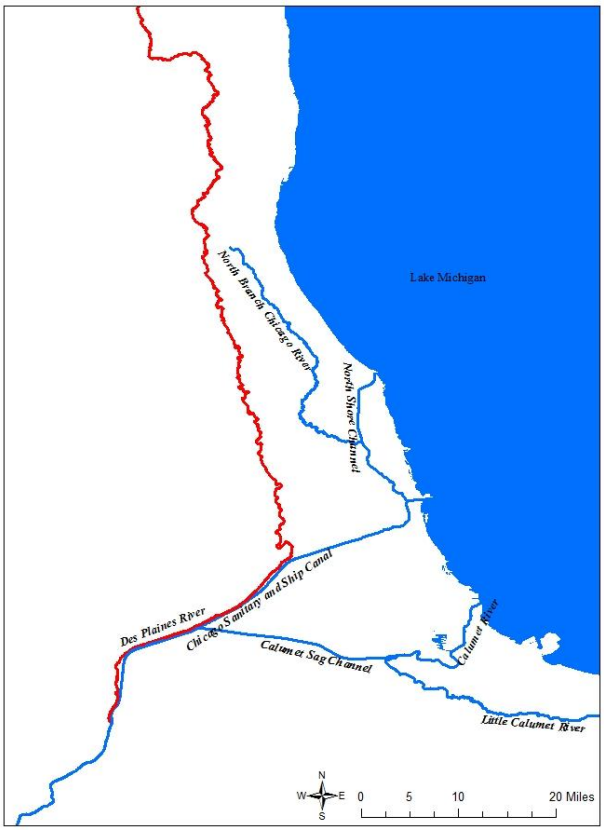


Figure 1. Map of Chicago area waterways. The red represents the portion of the Des Plaines River identified for sampling. The area running parallel to the CSSC will be emphasized.

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

Steven E. Butler, Matthew J. Diana, Scott F. Collins, David H. Wahl (Illinois Natural History Survey), Robert E. Colombo (Eastern Illinois University)

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, 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: In 2013, each site was sampled two to three times with a variety of sampling gears. A total of 1,837 Asian carp were captured, consisting of 1,693 Silver Carp, 94 Bighead Carp, and 50 hybrid Asian carp. Pulsed-DC electrofishing was the most effective gear for sampling Silver Carp (84.1% of Silver Carp), followed by hoop nets (10.3%). Hybrids were also most effectively captured by hoop nets (56.0%), followed by electrofishing (28.0%), and trammel nets (12.0%). Bighead Carp were most effectively captured using hoop nets (79.8%) and trammel nets (11.7%). Gears targeting juvenile Asian carp (beach seines, small mesh gill nets, and mini-fyke nets) were generally effective at capturing small fishes. However, no age-0 Asian carp

were captured in our sampling during 2013. All taxa of Asian carp were most abundant in the LaGrange and Peoria pools; relative abundance decreased through the Starved Rock, Marseilles, and Dresden Island pools, and no Asian carp were captured or observed upstream of the electric dispersal barrier in the CAWS. Tributary sampling during 2013 captured 513 Asian carp, including 506 Silver Carp and 7 Bighead Carp. No Asian carp were captured in the Kankakee River, but similar catch-per-unit-effort was attained in the Mackinaw, Spoon, and Sangamon Rivers. All Asian carp in tributaries ranged between 2 and 6 years old (mean = 4.4 years). Detection probabilities for Asian carp in the Illinois River were generally lower at upstream sites than for downstream sites, and were found to be strongly correlated with catch-per-unit-effort for both pulsed-DC electrofishing and hoop nets. Given the lowest estimates of detection probability for sites where Asian carp were captured, a minimum of 17 pulsed-DC electrofishing transects (15-minute duration) are necessary to achieve a 95 percent probability of capturing at least one Silver Carp, whereas a minimum of 42 hoop net-nights would be required to achieve this same cumulative detection probability for Bighead Carp in areas with similar habitat characteristics and Asian carp densities. Even higher sampling efforts are likely necessary to achieve these same levels of confidence at sites with lower Asian carp abundance.

Methods: During 2014 and subsequent years, the focus of sampling activities will shift towards evaluating gears for capturing juvenile Asian carp. 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. If age-0 Asian carp are captured or reported by other observers, additional sampling gears will be utilized:

- 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 normalized 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 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 be sampled in 2014 to assess the demographics of Asian carp populations in tributaries of the Illinois River. Upstream and downstream sites on each tributary will be sampled bi-monthly

during summer and fall. Pulsed-DC electrofishing will be used to capture Asian carp for age analyses, and mini-fyke nets will be used to sample for juveniles.

Sampling Schedule: In 2014, gear evaluation sampling will occur monthly from spring through fall for electrofishing and opportunistically with other gears throughout the Illinois Waterway. Tributary sites will be sampled bi-monthly during summer and fall. Additional sampling may occur on an as-needed basis in cooperation with other sampling and monitoring efforts.

Deliverables: Preliminary results will be reported for weekly 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 tributaries of the Missouri and Mississippi river, White River, Arkansas, pools within the Chicago Sanitary and Ship Canal, 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 2014 should be the culmination of the final design from a dozen prototypes.

A custom designed surface trawl or "Mamou Trawl" was 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 were collected along with a multitude of other species of similar sizes. This gear promises to be an answer to the agencies' 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:

6) 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.
7) Understand variables (net design, electricial settings, speed of boat) important to Paupier effectiveness and deliver a protocol for boat operation.
8) Continue development on two Mamou Surface Trawls to target early life stages of Asian carp.
9) Develop a Lampara Seine capable of mass removal for Asian carp at high densities

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 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 for 2014: 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 Missouri River 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. Sampling schedule will include at least three events between March and December.

Unconventional Gear Development

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

Location: Driving Asian carp into surface-to-bottom gill nets will be tested opportunistically at multiple sites in the Illinois and Des Plaines Rivers. Great Lakes trap (pound) nets will be deployed at Lake Calumet (CAWS), and at select sites in Illinois River backwaters. Additional new gears or combination systems may be evaluated at appropriate sites as they become available. Sites may be dropped, or additional sites added as needed in order to complete study objectives.

Introduction and Need: Traditional sampling gears vary widely in their ability to capture Asian carp, and many are far more successful at capturing non-target species. Additionally, the ability of some of these gears to capture Asian carp in the conditions found in the CAWS is questionable. A working group composed of fisheries scientists and commercial fishers was convened in 2011 to discuss development of gears specifically targeting Asian carp in areas of low density and in the deep-draft channels of the CAWS. This committee decided to pursue evaluation of three new sampling gears: large (2 m diameter; 6.4 cm square mesh) hoop nets, surface-to-bottom gill nets (91.4 m long x 8.5 m tied down to 6.1 m depth; 6.4, 7.6, 8.9, and 10.2 cm mesh panels), and Great Lakes style trap (pound) nets (100 m lead, 6.1 x 3.0 x 3.0 m pot, 7.6-9.1 m wings, 3.8-7.6 cm mesh). Evaluating these and other gears/methods alongside traditional sampling gears (see Evaluation of Gear Efficiency Plan) is necessary for understanding the potential utility of these new techniques as tools for monitoring and controlling Asian carp in the upper Illinois/Des Plaines River and the CAWS.

Objectives: To enhance sampling success for low density Asian carp populations, we will:

1) Investigate alternative techniques to enhance capture of rare Asian carp in deep-draft canals, such as in the CAWS; and
2) Evaluate gear and combination system prototypes in areas with low to moderate Asian carp population densities.

Status: In 2013, large hoop nets were set for 6-8 net-nights at eight sites during spring, summer, and fall, in conjunction with standard (1 m diameter) hoop nets. During this time, large hoop nets underperformed relative to standard hoop nets, capturing fewer fish of all species (mean ± SE: large hoops = 0.65 ± 0.10 fish/net-night; standard hoops = 1.85 ± 0.19 fish/net-night), as well as fewer Silver Carp (large hoops = 0.13 ± 0.04 Silver Carp / net-night; standard hoops = 0.66 ± 0.14 Silver Carp / net-night), Bighead Carp (large hoops = 0.11 ± 0.06 Bighead Carp / net-night; standard hoops = 0.28 ± 0.07 Bighead Carp / net-night), and hybrid Asian carp (large hoops = 0.04 ± 0.02 hybrid Asian carp / net-night; standard hoops = 0.11 ± 0.02 hybrid Asian carp / net-night).

Surface-to-bottom gill nets were set for 2-4 four-hour sets at eight sites during spring, summer, and fall of 2013, in conjunction with small-mesh floating gill nets (45.7 m x 3.0 m; 1.9, 2.5, 3.2, 3.8, 5.1 cm mesh) and large-mesh sinking gill nets (45.7 m x 1.8 m; 6.4, 7.6, 8.9, 10.2, 12.7 cm mesh). Small-mesh floating gill nets were found to produce higher average catches of all fish taxa (mean ± SE: 11.77 ± 1.13 fish / set) relative to surface-to-bottom gill nets (8.64 ± 1.23 fish /

set) and large-mesh sinking gill nets (1.98 ± 0.25). However, surface-to-bottom gill nets captured higher numbers of Silver Carp (1.58 ± 0.32 Silver Carp / set), Bighead Carp (0.15 ± 0.06 Bighead Carp / set), and hybrid Asian carp (0.06 ± 0.03 hybrid Asian carp / set) than either small-mesh floating (0.09 ± 0.03 Silver Carp / set; 0.02 ± 0.02 Bighead Carp / set; 0.02 ± 0.02 hybrid Asian carp / set) or large-mesh sinking gill nets (0.26 ± 0.07 Silver Carp /set; 0.06 ± 0.03 Bighead Carp / set; 0.00 ± 0.00 hybrid Asian carp / set).

Experiments testing the effectiveness of driving fish into surface-to-bottom gill nets were also conducted at eight sites during summer and fall of 2013. Fifteen-minute drives using pulsed-DC electrofishing were found to capture higher numbers of Silver Carp (mean ± SE: 3.74 ± 1.16 Silver Carp / set) and Bighead Carp (0.21 ± 0.14 Bighead Carp / set) than either control sets (0.50 ± 0.27 Silver Carp / set; 0.06 ± 0.06 Bighead Carp / set) or drives using pounding (1.69 ± 0.71 Silver Carp / set; 0.06 ± 0.06 Bighead Carp / set). However, control sets captured higher numbers of hybrid Asian carp (0.19 ± 0.14 hybrid Asian carp / set) than drives using pounding (0.13 ± 0.09 hybrid Asian carp /set) or drives using pulsed-DC electrofishing (0.05 ± 0.05 hybrid Asian carp / set).

In 2013, Great Lakes trap (pound) nets were set for 18 net-nights at Lake Calumet, capturing 263 fish (14.6 fish/net-night). No Asian carp were captured at Lake Calumet during these efforts. Pound nets at Lake Calumet were vandalized again in 2013, resulting in nets that were not fishing properly and therefore producing lower catch rates. Pound nets were set at the Materials Service Pit at Morris for 46 net-nights, capturing 1,470 fish (32.0 fish/net-night), including 194 Silver Carp, 223 Bighead Carp, and 99 hybrid Asian carp. Pound nets were set at Lily Lake for 8 net-nights, capturing 229 fish (28.6 fish/net-night), including 72 Silver Carp, 66 Bighead Carp, and 2 hybrid Asian carp.

Methods: In 2014, 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. 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.

- Different methods of driving Asian carp into surface-to-bottom gill nets will continue to be evaluated at select sites on a seasonal basis. All sets will occur for 15 minutes. Treatments will include a control set (no driving), driving fish using traditional pounding methods, and driving fish using pulsed-DC electrofishing. At the end of each set, nets will be retrieved and all captured fish will be identified and measured.

- Great Lakes trap (pound) nets will be set for extended periods (1-2 weeks) at select sites. Pound nets will be checked periodically (1-7 day intervals, based on catch rates) during each set, at which times all captured fish will be removed from the pots for identification and measurement.

Additional new gears and gear combinations may also be incorporated into sampling efforts as they become available.

Sampling Schedule: In 2014, additional evaluation of methods for driving fish into surface-to-bottom gill nets will occur opportunistically at multiple sites throughout the Illinois Waterway. Pound nets will be set at Lake Calumet for one week in spring and fall of 2014, and opportunistically at additional sites in the Illinois River. Additional sampling may occur 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 weekly 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 exploring the potential to use water guns 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 mobilized 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:

There is an immediate need to prevent Asian carp from entering the Great Lakes Ecosystem from the Illinois River. Seismic water guns may be useful as a physical deterrent to carp movement through the emission of high pressure acoustic energy underwater. Water guns produce acoustic energy with a high pressure (1000-2000 PSI) air driven shuttle that expels water from a water filled chamber. The resulting burst of water induces cavitation which generates a pulsed sound-pressure wave as the cavity collapses. The sound-pressure wave may deter or kill fish depending on proximity to the wave source. Additionally, there exists the potential that water guns may have adverse effects on underwater structures. If water guns are going to be used near sensitive navigational structures (e.g. dam locks, canal walls) the impact of water guns on underwater structures must be explicitly evaluated to determine safe operating parameters.

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 visible. 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 of this study were inconclusive due to the handling stress associated with using wild adult fish for the study; however, acoustic telemetry and sonar technology were used successfully to monitor fish movement. Additional behavioral studies were completed in 2012 in a controlled test pond at the USGS Upper Midwest Environmental Sciences Center. Six trials were conducted in an earthen 0.2 ha test pond to evaluate the response of juvenile Asian carp (Bighead Carp averaged 68 g, 192 mm and Silver Carp averaged 117 g, 233 mm) to water guns. Two different sized water guns were used (1 in^3 and 80 in^3). Multiple firing pressures and water gun positioning strategies were employed. Results indicated that Asian carp schooling behavior relaxed during dark or low light hours (sonar detections increased at night compared to day) and fish responded to water guns at firing pressures ranging from 1000 to 2000 PSI. Pressure mapping was also done within the test pond in 2012 to begin to understand how the seismic energy dissipates (horizontally and vertically) from the water guns. Several pressure maps were generated and it was determined that positioning two 80 in^3 water guns approximately 33 m apart could create a 5 PSI barrier zone within the confines of the test pond. In 2013, seven pond trials were conducted in the USGS test pond. Only 80 in^3 guns were used in 2013 and guns were positioned based on pressure mapping data gathered in 2012. Fish were tracked with acoustic telemetry and sonar detection lanes for all 2013 pond trials and trials evaluated the response of fish in both day and night periods. 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 the primary gross pathology observed and was only observed in paddlefish. Additional pressure mapping was conducted in the test pond using refined data collection strategies and maps of pressure gradients emanating from a single 80 in^3 water gun were generated. Measurements of the interaction of pressure waves between two 80 in^3 water guns were also made. Following pond trials, 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. Thus, pneumatic water guns have been successfully deployed in multiple scenarios to affect fish behavior, establish seismic barriers to fish movement, and results look promising for on-going applications of water gun technology to be integrated in pest management and/or control activities.

Objectives:

1) Assess Structural Effects of Water Guns: A primary 2014 priority is to determine safe operating distances of water guns that avoid structural damage to sensitive navigational structures (e.g. canal walls and lock chambers) and associated equipment. Recognizing potential concerns of the USACE about possible structural impacts from water gun operation near operating waterway structures, USGS will complete additional analyses of the existing data, further develop pressure gradient maps, and demonstrate the safety of water guns near Brandon Road Lock and Dam, Joliet, IL. Pressure gradient mapping will seek to refine previously developed maps for the operation of the 80 in^3 water gun. Maps

developed will characterize the gradient generated during single and multiple gun operations (synchronous or asynchronous operation).

2) Repeat Integrated Pest Management (IPM) Strategies to Control Asian Carp: Following the success of the 2013 IPM demonstration in an Illinois backwater, it is recommended to repeat the 2013 IPM demonstration in 2014 to evaluate if the results of the IPM can be repeated. If the results can be repeated it may improve fishery manager confidence and scientific integrity of this style of pest management. Thus, the Asian carp control IPM will include: algal attractants, water gun barrier, and commercial fishing to show localized populations of Asian carp can be depleted. In addition, alternative barrier technologies are of interest. Carbon Dioxide (CO2) has shown promise as a non-physical barrier in controlled laboratory studies. We recommend including an additional IPM demonstration with a CO2 barrier as an alternative to water guns. The CO2 IPM would not include the algal feeding attractants. Local fish population monitoring for both IPM strategies will follow similar methods employed in 2013 to include mobile and static sonar to detect fish of the relative size of adult Asian carp and quantify relative frequency distributions and fish abundance. In addition, pending equipment acquisition and installation, acoustic telemetry will be used to track fish movements to determine presence/absence in specific zones and to observe if fish will move past the select barriers.

1) *Investigate the potential to clear fish out of an off-channel lagoon and inhibit fish access using water guns*: The Wabash River (e.g. near West Lafayette, Indiana) has a well-known population of adult Asian carp of which >200 have been fitted with acoustic telemetry tags since 2012. Movements of these fish are tracked by an acoustic receiver network in the Wabash River. One potential test location is a borrow pit adjacent and connected to the Wabash River near West Lafayette, IN. The site has an acoustic receiver and is known to contain large numbers of Asian carp which left the borrow pit in response to a major spawning event in 2013. The approach at this site is being developed but will include operation of a fixed barrier at the connection with the Wabash River to deny entry/exit to the borrow pit. Work at this test site may also include a mobile water gun deployment strategy to clear fish from the borrow pit. This borrow pit and other similar off-channel habitats are thought to be important pre-spawning staging and feeding areas for Asian carp.

2) *Investigate the response of native aquatic organisms to pneumatic water guns and fish behavior in the presence of novel hydraulic water guns:* Fish and some other aquatic invertebrates have the capacity to avoid the potential negative effects of mobile or fixed water gun operation. Native mussels, however, likely have minimal capacity to rapidly move to avoid the pressure gradients resulting from water gun operation. Understanding the potential risk to juvenile native mussels will be important to resource management agencies as they evaluate potential locations where water guns might be deployed. Three species of freshwater mussels (species to be determined based on availability) will be exposed to water guns at varying appositions to investigate the short term effects on mussel survival. Trials will be completed in the USGS test pond with caged mussels exposed to 1,500 PSI at pre-determined distances. Survival of exposed mussels will be monitored for up to 60 days post-exposure. The behavioral response of Asian carp and native fishes to the operation of hydraulic water guns (operated with hydraulic pressure rather than air pressure) recently

developed by Smith-Root, Inc. may also be assessed using the procedures previously used to assess the behavioral response of fishes to pneumatically operated water guns. The lethal and sublethal effects of water guns on small (<10 cm) Asian carp will also be assessed.

Questions to be addressed include:

1) What are the water gun operating parameters needed to follow to minimize the risk of underwater structure damage; including recommendations for distance needed to keep water guns away, and firing pressures to use, that will deter fish yet not damage structures?

2) Can the results of the 2013 IPM Asian carp control framework be repeated and produce the same results to improve fisheries managers confidence that this style of management strategy is a viable option to control localized Asian carp populations?

3) Does water gun operation alter the spatial occupancy (number of fish contained within known distances of the water gun / total number of fish within the system [off channel lagoon]) or the direction of movement of fish within lentic or lotic systems in areas where fish reside pre- and post-spawning and during active spawning?

4) Will native mussel species survive water gun exposures, and will hydraulic water guns produce the same fish behavioral responses compared to pneumatic water guns?

Schedule:
Investigating the structural effects of water guns is expected to occur between May and June 2014. Coordination with USACE, IL DNR and others is required. Field trials in the Illinois River near Morris, IL, and Wabash River near West Lafayette and/or Lockport, Indiana, for behavioral response work are expected to occur between June and July 2014. Repeating the IPM strategy for Asian carp control in an Illinois River backwater will occur in August 2014. Experimental pond trials will begin following field trials in August and September 2014. Adequate advance notice is required to establish contracts and prepare boats and equipment.

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 zebra mussels, round goby, and other invasive fish and invertebrate species.

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 determined through previous surveillance as "target areas", and additional states.

Introduction and Need: Many commercial fishermen in Illinois continue to 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 and other countries. Asian carp must be dead before they are sold or transported. There is a demand and market for Asian carp in the Chicago metropolitan area, and the fish can legally be sold if they are dead. The Lacey Act prohibits the interstate movement of live organisms that are on a list of injurious species. Currently, three species of Asian carp—Silver Carp , Bighead Carp , and Black Carp - are on that list. Despite the Lacey Act and state laws, the movement of live Asian carp persists. 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 essential in regulating the movement of fish throughout the State and other places.

In 2012, the Invasive Species Unit operations in the Chicago area gained preliminary intelligence into illegal fish importation and invasive species trade. Expanding upon this intelligence, the IDNR Invasive Species Unit conducted numerous surveillance operations which ultimately resulted in many arrests of individuals and businesses. These cases were successfully prosecuted through the court system with fines and restitution from one fish transporter totaling over $24,000.

The 2013 cases made by the unit fully support the need for further enforcement efforts focusing on invasive species and the aquatic life industry. The arrests made were not specific to Asian carp, but revealed violations regarding the following: aquaculture, bait dealers, commercial fishing, commercialization of protected species, fraud, illegal selling and stocking of an invasive species in private ponds, VHS, unlawfully releasing fish into Illinois waters, illegal selling of aquatic life parts, and transporting a restricted species without a permit.

Objectives: Continue to build on the IDNR Invasive Species Unit activities. Also, collaborate with other agencies for intelligence gathering and combined enforcement efforts on invasive species issues and illegal fish importation we propose to:

- Invasive Species Unit (ISU) will continue to attend training opportunities in order to better equip the unit with the skills and knowledge necessary to effectively conduct investigations and operations.

- Educate and train officers throughout the State utilizing previously developed standardized inspection procedures in order to maximize the detection and interdiction of illegally transported aquatic life.
- Organize and implement details focusing on fish truck inspections in the Chicago metropolitan area and document these inspections on the newly created fish truck inspection form.
- Conduct follow-up compliance checks on fish markets that were previously inspected and determined to be in violation of laws. Charge and seek harsher penalties for repeat violators.
- Expand the search for fish markets in the Chicago metropolitan area operating in violation and conduct surveillance of these markets and record searches to gain information on wholesale aquatic life dealers and transporters.
- Conduct surveillance and enforcement operations within the commercial fishing industry, especially those areas determined from previous operations to be considered "areas of interest."
- Increase enforcement efforts focusing on the illegal bait trade in Chicago metropolitan area. Document any violations and ensure bait suppliers transporting bait within the State or in compliance of all regulations.
- Manage and review all ongoing cases by determining what resources are needed and then allocating the time to further the case or bring it to a conclusion.
- Conduct details to be implemented at boat launches which will focus on enforcing laws and educating fishermen on regulations established to prevent the spread of invasive species by them. The details will document violations and enforcement actions.
- Network with members of the multi-agency invasive species task force for the sharing of intelligence, resources, and strategies related to preventing the spread of Asian carp.
- 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 2014. Some cases have been resolved in court; others are currently going through the court process. Investigations are active and range from the preliminary stage to near completion with new leads being formed monthly. Being sensitive in nature, surveillance activities, operations and arrests cannot be discussed in this document.

Methods:
Intelligence gathering and Surveillance - In 2013 the Invasive Species Unit continued the impromptu inspections of fish markets to gain additional intelligence and to educate market owners on the current laws. An unexpected discovery of illegal shark fin being sold was discovered during one of these inspections. This initiated an investigation of several markets in the Chicago area and ultimately resulted in over 20 citations being issued to 8 different markets.

Some leads have been developed by relationships built from people within the industry or even from previous violators. The network developed by the Asian carp Task Force has allowed the sharing of information throughout multiple states. 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. Additional surveillance equipment and methods will be utilized as the need arises.

Sampling Schedule: Surveillance 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.

2015 – 2016 ISU Work Activities: The unit will prioritize time and resources based upon the needs of the Task Force and current information of illegal activities associated with Asian carp. Fish dealers and transporters will continue to be monitored and inspected. The ISU will use methods to locate live boxes on the rivers used to store fish (possibly Asian carp) by commercial fishermen. 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)

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

Introduction and Need: 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 the wild. 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 large Bighead Carp (>48 pounds (21.8 kg)) were captured by electrofishing and netting in Flatfoot Lake and Schiller pond, both urban fishing ponds located in Cook County once supported by the IDNR Urban Fishing Program (See report: Bighead Carp in Illinois Urban Fishing Ponds 2011).

As a further response to the Bighead Carp in Flatfoot Lake and Schiller Pond, IDNR reviewed Asian carp captures in all fishing lakes included in the IDNR Urban Fishing Program located in the Chicago Metropolitan area. Of the 21 urban fishing lakes in the program, six have verified captures of Bighead Carp either from sampling, pond rehabilitation, or natural die-offs; one has reported sightings of Asian carp that were not confirmed by sampling (Table 1). The distance from urban fishing ponds to Lake Michigan ranges from 0.1 (0.2 km) to 25.7 miles (41.4 km). The distance from ponds to the Chicago Area Waterway System (CAWS) upstream of the Electric
Dispersal Barrier ranges from 0.01 (0.02 km) to 5.1 miles (8.2 km). Although some ponds are located near Lake Michigan or the CAWS, most are isolated and have no surface water connection to the Lake or the CAWS upstream of the electric dispersal barrier (Table 1). Lagoons 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 in 2008, after which it was dropped as a Chicago urban stocking site. Gompers Park Lagoon and Jackson Park Lagoon 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 the CAWS or Lake Michigan is of importance due to the increased likelihood of human transfers of fish between waters within close proximity to one another.

In addition to ponds once supported by the IDNR Urban Fishing Program, ponds that yielded positive detections for Asian carp eDNA were also reviewed. A total of 8 ponds had positive detections for Asian carp eDNA, two of which were IDNR urban fishing ponds (Jackson Park and Flatfoot Lake; Table 2). The distance from these ponds to Lake Michigan ranged from 3 to 19.5 miles (31.4 km). The distance from ponds to the Chicago Area Waterway System (CAWS) upstream of the electric dispersal barrier ranged from 0.03 (0.05 km) to 2.7 miles (4.3 km).

Table 1. A list of Chicago area urban fishing ponds, reported and verified occurrence of Bighead 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 pulsed-DC electrofishing and TN/GN is trammel/gill net. Waterways are: LM=Lake Michigan; CALSC = Cal-Sag Channel; CALR = Calumet River; CSSC = Chicago Sanitary and Ship Canal; NBCR = North Branch Chicago River; LCALR = Little Calumet River; BUBCR = Bubbly Creek; NSC = North Shore Channel; 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	4.1-CSSC	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	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, none sampled	3.8	0.9-CSSC	None
Sherman Park Lagoon	Cook	Chicago	NR	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	4.8-NBCR	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	1.3-CSSC	None
Lake Shermerville	Cook	Northbrook	NR	6.6	4.8-NBCR	None
Schiller Pond	Cook	Schiller Park	3 DCEL-2011	10.1	7.1-NBCR	None
Elliot Lake	DuPage	Wheaton	NR	25.7	14.5-CSSC	None
Community Park Pond	Lake	Mundelein	NR	9.2	22.7-NSC	None

Though positive eDNA detections do not necessarily represent the presence of a live fish (e.g., DNA from dead fish, or 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 their proximity to the CAWS.

The source of Bighead Carp in urban fishing ponds has not been confirmed to date and identifying a specific source may prove impossible. However, there is building evidence that young Bighead Carp may have been unintentionally stocked in urban fishing ponds with shipments of desirable fish species. Analysis of otolith microchemistry data by Dr. Gregory Whitledge at SIUC concluded that Sr:Ca ratios from Bighead Carp in Chicago area ponds were not consistent with transplanted adult fish or bait bucket introductions of juveniles from nearby rivers. The most plausible explanation for this data is that the carp were contaminants in shipments of other fish that were stocked in the ponds. The fact that all Bighead Carp obtained

from Chicago area ponds to date have been large fish of similar size and age also points towards stocking as a potential source.

Table 2. A list of Chicago area ponds with positive detections for Asian carp eDNA, verified occurrence of Bighead 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 pulsed-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

These demographics indicate that stocking probably occurred during a limited number of events sometime before 2005 and 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 in ponds with Channel Catfish in certain regions of the U.S. (Kolar et al. 2007). Contaminated shipments of Channel Catfish are a likely source of Bighead Carp in urban fishing ponds as catchable-sized catfish are stocked frequently in these waters throughout the State (IDNR 2010).

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. In 2011, four Chicago area ponds were sampled. Seventeen large Bighead Carp (> 48 pounds (21.8 kg)) were removed from Flatfoot Lake and 3 Bighead Carp, with a mean weight of 59.5 pounds (27 kg), were removed from Schiller pond. Nineteen Chicago area ponds were sampled in 2012. A total of 6 Bighead Carp were removed from three ponds (Humboldt Park, Garfield Park, and Joe's Pond). Three carp were removed from Humboldt Park with weights of 62 (28.1 kg), 34 (15.4 kg) and 46 (21 kg) pounds. Two Bighead Carp were captured and removed from Garfield Park weighing 53 (24.0 kg) and 46 (21 kg) pounds. One carp was removed from Joe's Pond with a weight of 34 pounds (15.4 kg). The Bighead Carp from Humboldt Park are currently on exhibit at the John G. Shedd

Aquarium in Chicago. Four Chicago area ponds were sampled in 2013. Five Bighead Carp were removed from Humboldt Park ranging in weight from 48-66 pounds (21.8- 29.9 kg), with a mean weight of 58.7 pounds (26.6 kg). One Bighead Carp was captured and removed from Flatfoot Lake with a length of 53.3 inches (1353.8 mm) and a weight of 82 pounds (37.2 kg), which is the largest Bighead Carp collected during urban pond monitoring to date; a replica of this fish has been made for outreach and educational events. For more detailed results see 2013 interim summary report document (MRRWG 2014).

Methods: The sample design includes intensive electrofishing and netting in all ponds in the IDNR Urban Fishing Program that Asian carp were collected from in 2011-2013 to ensure that no additional carp remain. We also recommend repeat sampling of ponds that had positive detections for Asian carp DNA. Sampling will take place in the spring and fall from 2014 through 2016.

Sampling Protocol - Pulsed DC-electrofishing and trammel/gill nets will be used to sample urban fishing ponds in 2014 through 2016. Trammel and gill nets used are 10 feet (3 m) deep x 300 feet (91.44 m) long in bar mesh sizes ranging from 3.5-4.25 inches (88.9-108 mm); multiple nets will be set simultaneously to increase the likelihood of capturing fish. Electrofishing, along with pounding on boats and racing 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 aging.

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

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Appendix A. Participants of the Monitoring and Rapid 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

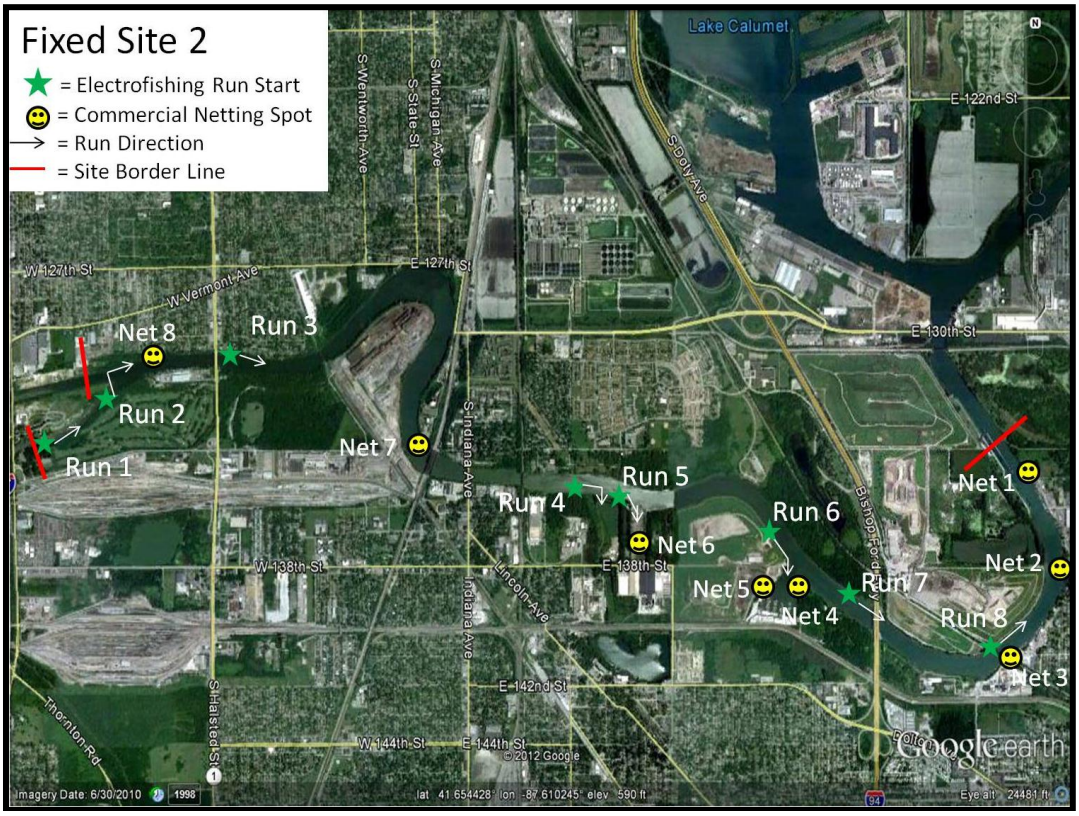
Agency Representatives
Matt O'Hara, IDNR
Kevin Irons, IDNR
Kelly Baerwaldt, USFWS
Sam Finney, USFWS

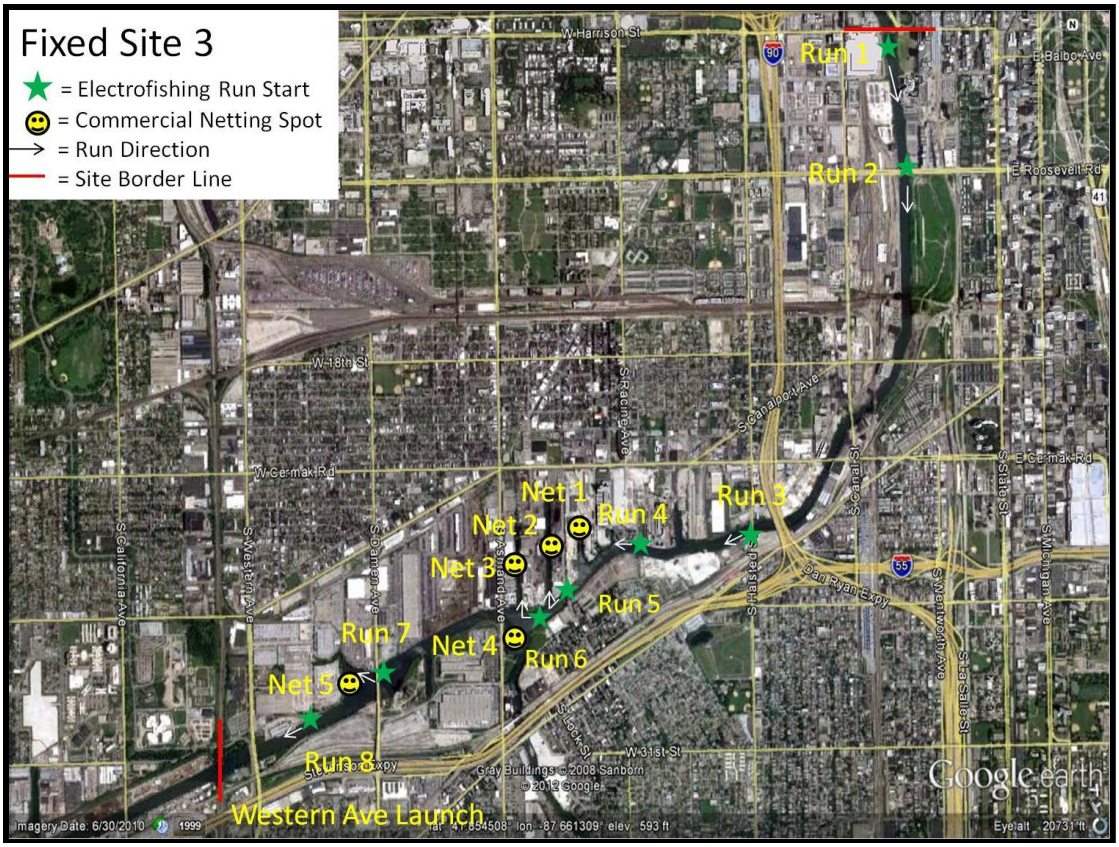
Independent Technical Experts
Scudder Mackey, Habitat Solutions NA/University of Windsor
Irwin Polls, Ecological Monitoring and Associates
Phil Moy, Wisconsin Sea Grant
Duane Chapman, US Geological Survey
John Epifanio, University of Illinois

Agency Participants
Jon Amberg, USGS
Kelly Baerwaldt, USACE
Nick Barkowski, USACE
Nick Bloomfield, USFWS
Bill Bolen, USEPA
James Bredin, CEQ
Marybeth Brey, SIU
Steven Butler, INHS
Brennan Caputo, IDNR
Andy Casper, INHS
Jason Deboer, INHS
Matt Diana, INHS
Wyatt Doyle, USFWS
Brandon Fehrenbacher, IDNR
Jeff Finley, USFWS
Mark Gaikowski, USGS
Maureen Gallagher, USFWS
Jim Garvey, SIU
Robert Gaugush, USGS
John Goss, CEQ
Patty Herman, USFWS
Nathan Jensen, USGS
Richard Lance, USACE
Rurairi Macnamara, SUI

Mark Brouder, USFWS
Emy Monroe, USGS
Rich Pendleton, INHS
Blake Ruebush, IDNR
Ann Runstrom, USFWS
Martin Schultz, USACE
Steve Shults, IDNR
Rob Simmonds, USFWS
Dan Stephenson, IDNR
Cory Suski, INHS
Heath Tepovich, IDNR
David Wahl, INHS
Greg Whitledge, SIU
Tristan Widloe, IDNR
David Wyffels, IDNR
John Zeigler, IDNR
Matt Shanks, USACE
Felicia Kirksey, USACE
Shawna Herleth-King, USACE
Chuck Shea, USACE
Mark Cornish, USACE
Doug Keller, Indiana DNR
Jim Mick, IDNR
Steve Pescitelli, IDNR
Rob Maher, IDNR
Rob Sulski, ILEPA
Rob Simmonds, USFWS
Tracy Hill, USFWS
Mike Hoff, USFWS
Aaron Woldt, USFWS
Jeff Stewart, USFWS
Janet Pellegrini, USEPA

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

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= 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 Canalport Ave
S Canal St
S Halsted St
S State St
S Dan Ryan Expy
S Wentworth Ave
S La Salle St
S Michigan Ave
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Gray Buildings © 2008 Sanborn
© 2012 Google
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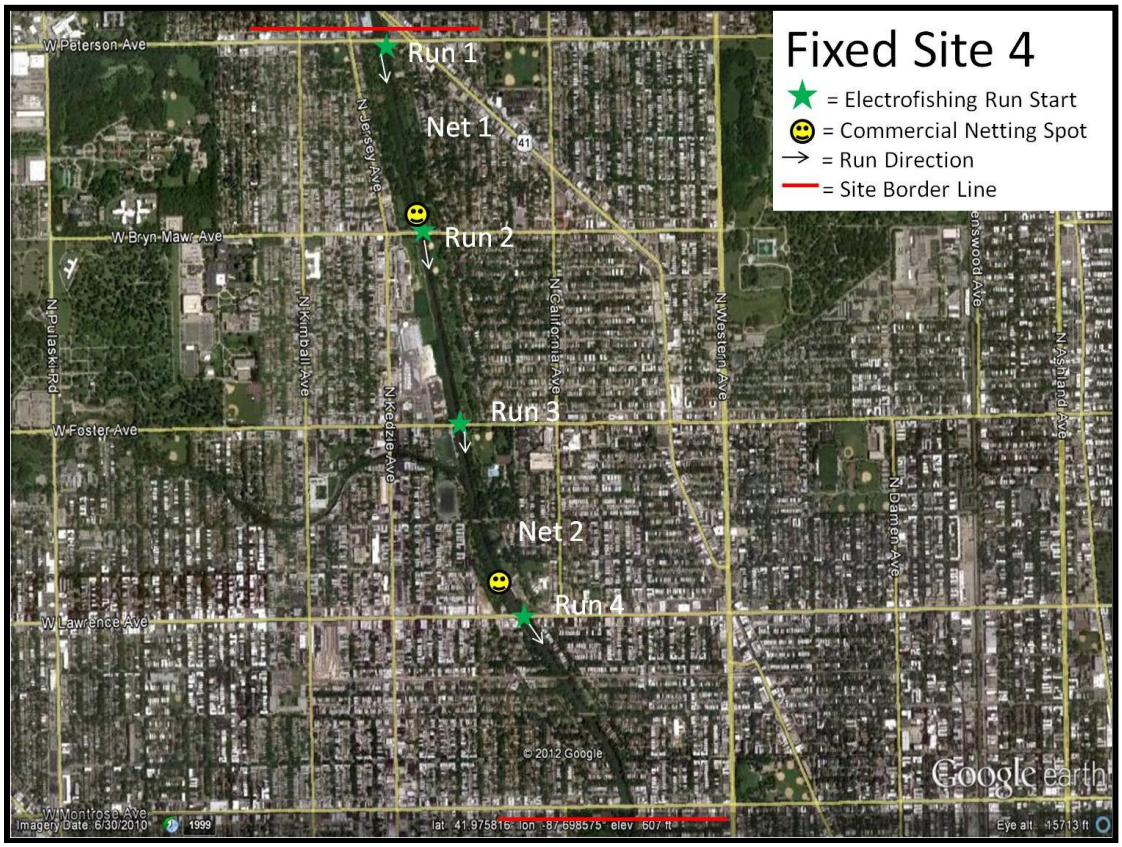
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= Run Direction
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Run 1
Run 2
Run 3
Run 4
Net 1
Net 2
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W Bryn Mawr Ave
W Foster Ave
W Lawrence Ave
W Montrose Ave
N Jersey Ave
N Kimball Ave
N Kedzie Ave
N California Ave
N Western Ave
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N Ashland Ave
N Elston Ave
N Pulaski Rd
© 2012 Google
Google earth
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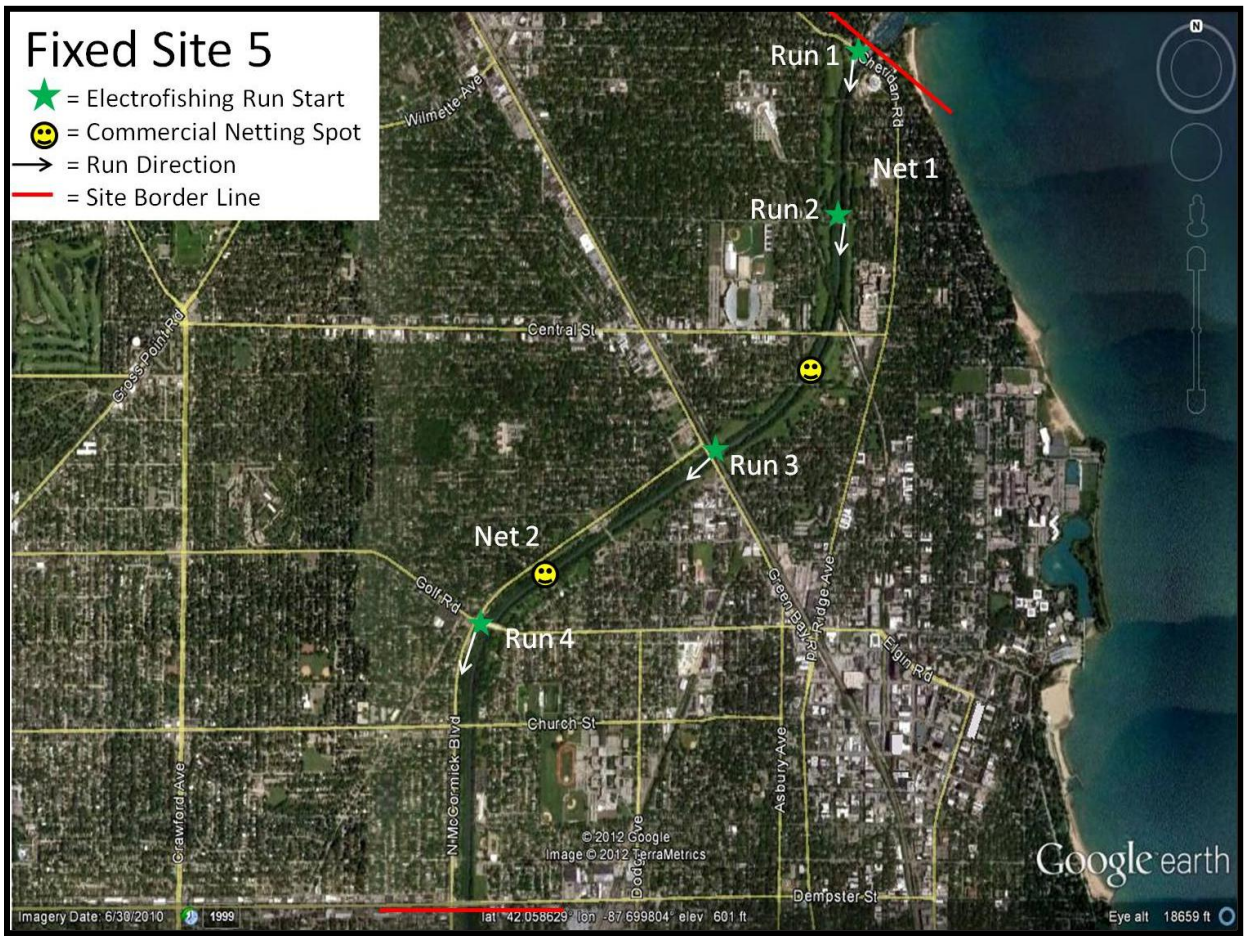
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= Commercial Netting Spot
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= Site Border Line
Run 1
Net 1
Run 2
Run 3
Net 2
Run 4
Wilmette Ave
Sheridan Rd
Central St
Gross Point Rd
Golf Rd
Green Bay Rd
Ridge Ave
Elgin Rd
Church St
Crawford Ave
N McCormick Blvd
Dodge Ave
Asbury 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
E 87th St
Chicago Skyway
Highway 12
Bishop Ford Fwy
S Halsted St
Random Site Area
Lake Calumet
Wolf Lake
Calumet Ave
© 2012 Google
Image © 2012 TerraMetrics
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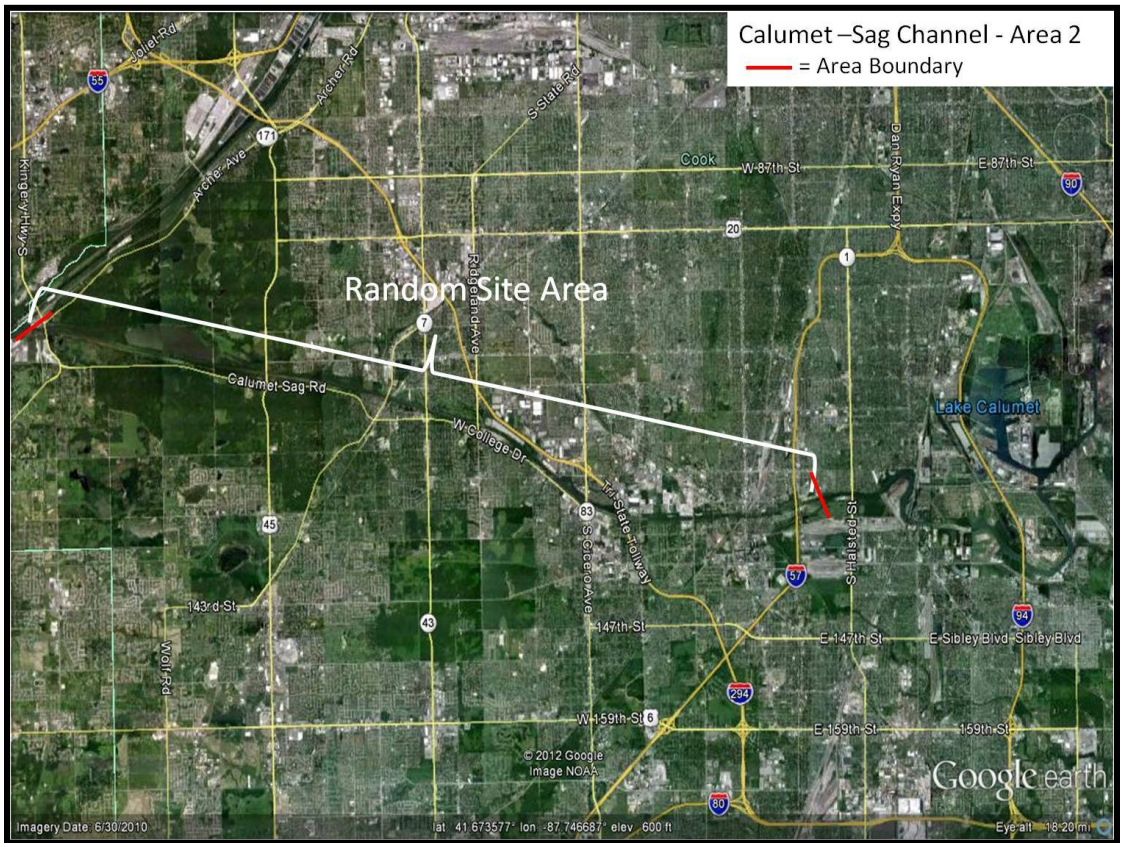
Calumet –Sag Channel - Area 2
= Area Boundary
Joliet Rd
Archer Rd
S State Rd
Archer Ave
Kingery Hwy S
Cook
W 87th St
E 87th St
Dan Ryan Expy
Random Site Area
Ridgeland Ave
Calumet Sag Rd
W College Dr
Lake Calumet
Tri State Tollway
S Halsted St
S Stoney Island Ave
143rd St
147th St
E 147th St
E Sibley Blvd
Sibley Blvd
Wolf Rd
W 159th St
E 159th St
159th St
© 2012 Google
Image NOAA
Google earth
Imagery Date: 6/30/2010
lat 41.673577° lon -87.746687° elev 600 ft
Eye alt 18.20 mi


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
Cook
W 87th St
Highway 12
Archer Ave
South La Grange Road
S Harlem Ave
Ridgeland Ave
S Cicero Ave
S Halsted St
Main St
Lincoln Ave
N Bolingbrook Dr
S Bolingbrook Dr
Veterans Memorial Tollway S
Lemont Rd
© 2012 Google
Google earth
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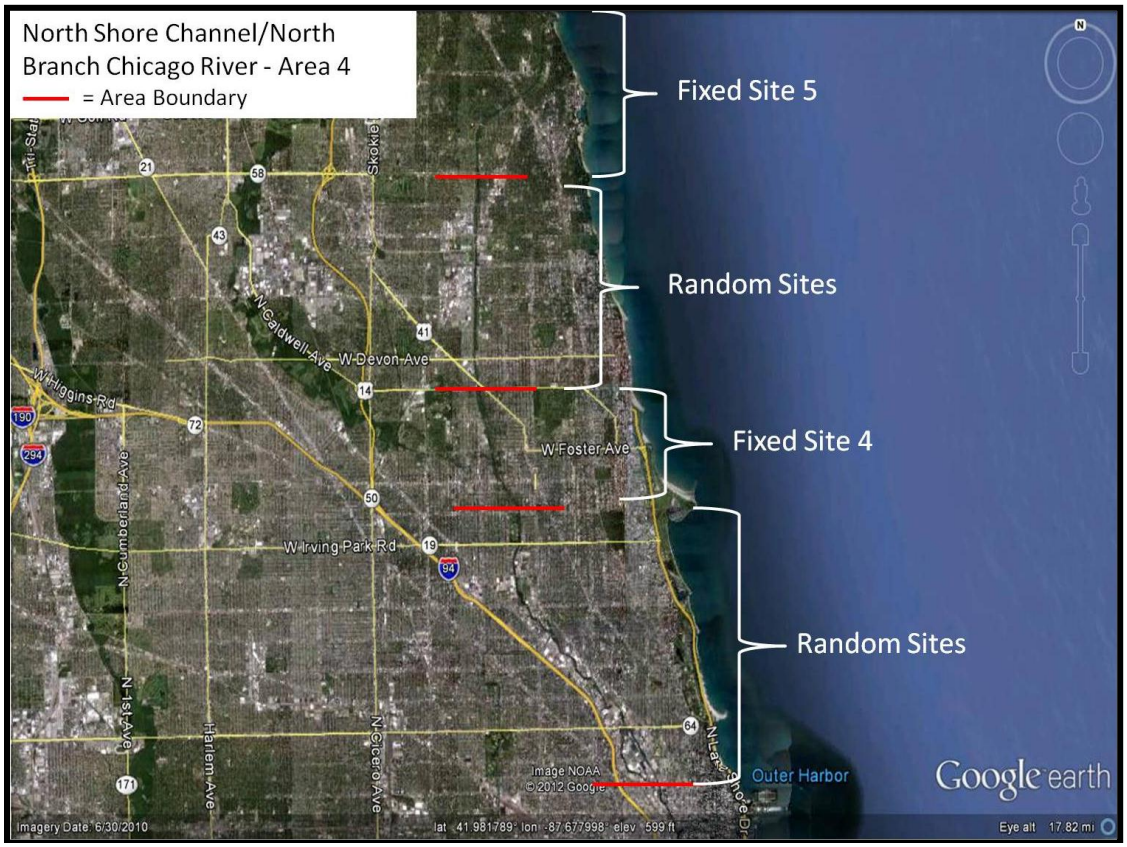
Eye alt 22.58 mi


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 Caldwell Ave
N Cumberland Ave
N Harlem Ave
N Cicero Ave
N Lake Shore Dr
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
Run 1
Run 2
Net 1
E Romeoville Rd
W 135th St
S Independence Blvd
Archer Ave
W 151st St
N Weber Ave
© 2012 Google
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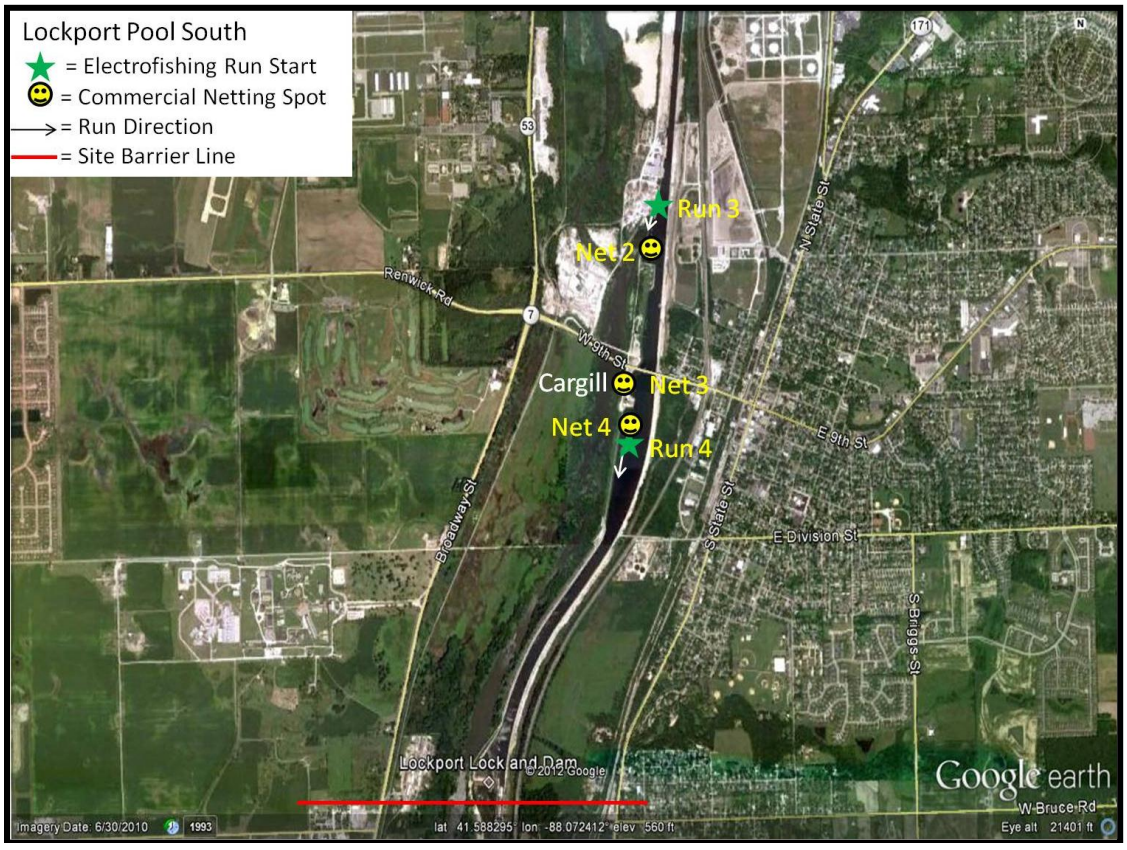
Lockport Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Run 3
Net 2
Renwick Rd
W 9th St
Cargill
Net 3
Net 4
Run 4
N State St
E 9th St
Broadway St
S State St
E Division St
S Bridge St
Lockport Lock and Dam
© 2012 Google
W Bruce Rd
Google earth
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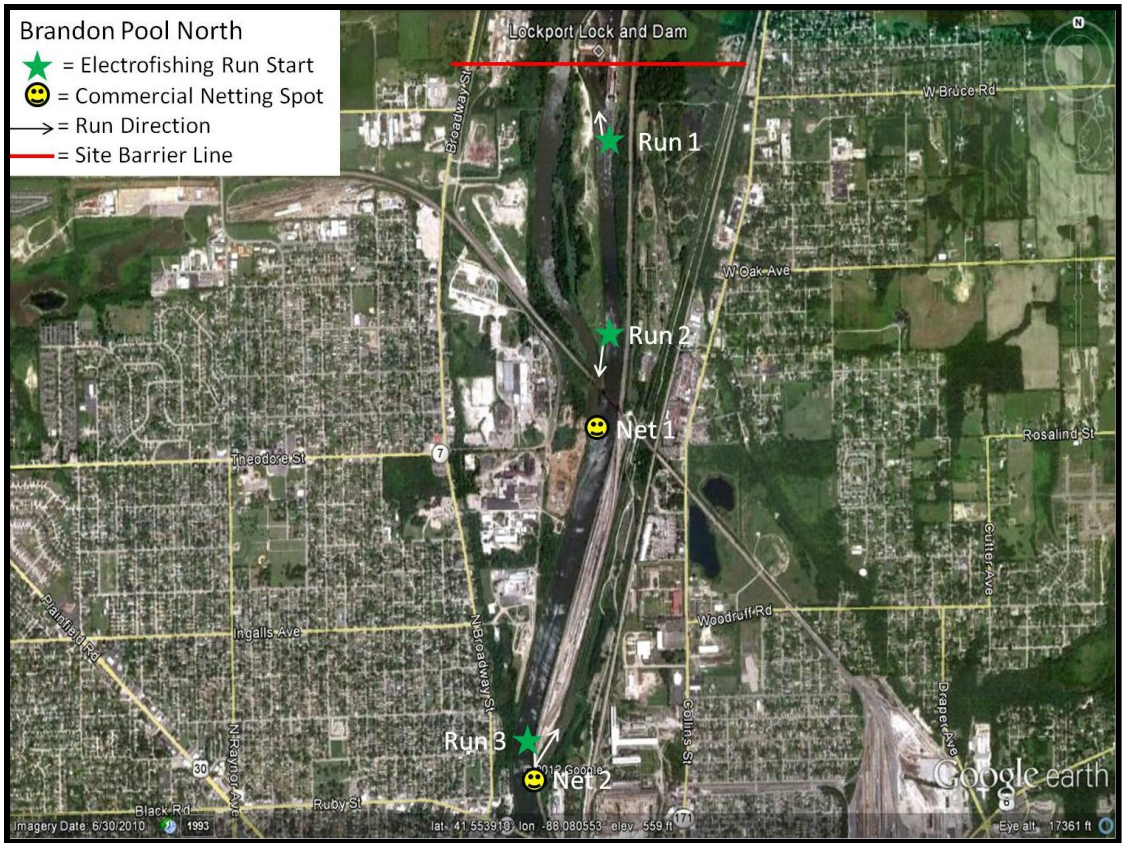
Brandon Pool North
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= Run Direction
= Site Barrier Line
Lockport Lock and Dam
Run 1
Run 2
Net 1
Run 3
Net 2
Broadway St
W Bruce Rd
W Oak Ave
Rosalind St
Cutler Ave
Draper Ave
Woodruff Rd
Collins St
Theodore St
Plainfield Rd
Ingalls Ave
N Broadway St
N Raynor Ave
Black Rd
Ruby St
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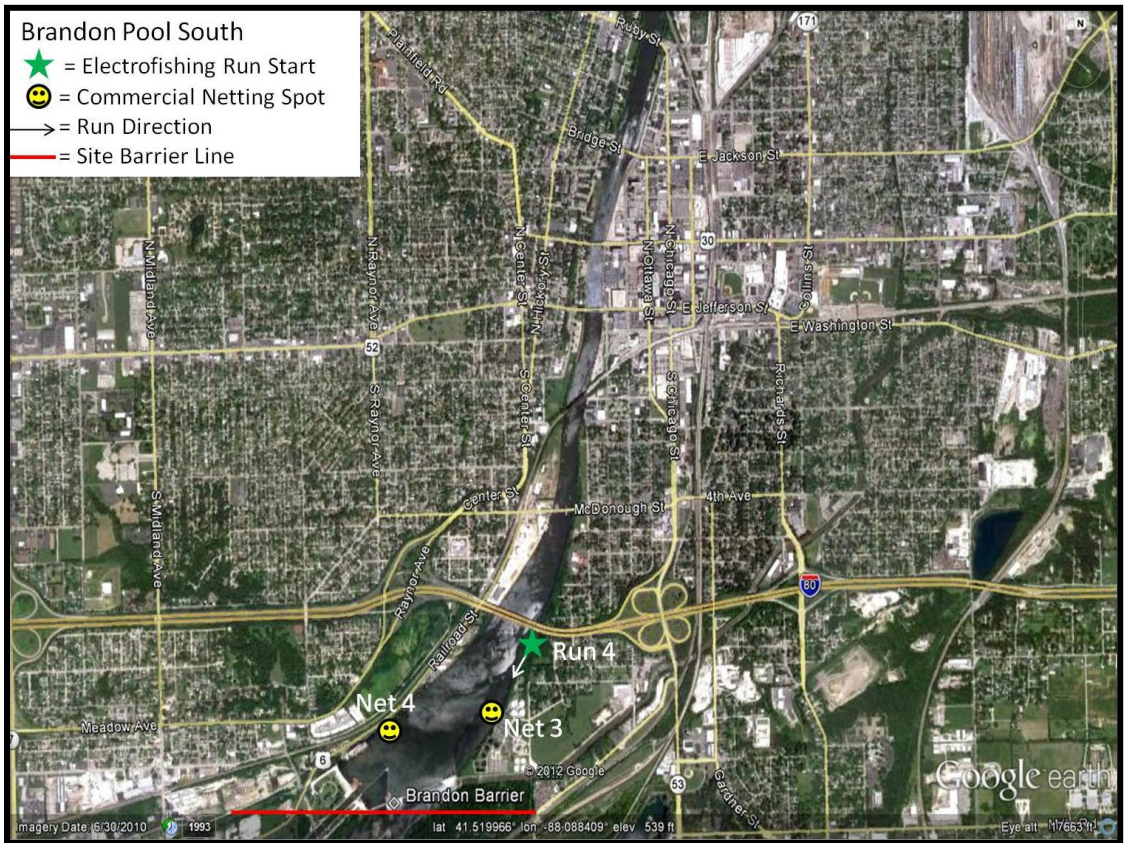
Brandon Pool South
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= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Run 4
Net 4
Net 3
Brandon Barrier
Ruby St
Plainfield Rd
Bridge St
E Jackson St
N Midland Ave
N Raynor Ave
N Center St
S Center St
N Chicago St
N Ottawa St
E Jefferson St
S Chicago St
S Ottawa St
E Washington St
Richards St
Center St
McDonough St
4th Ave
S Midland Ave
S Raynor Ave
Raynor Ave
Railroad St
Meadow Ave
Gardner St
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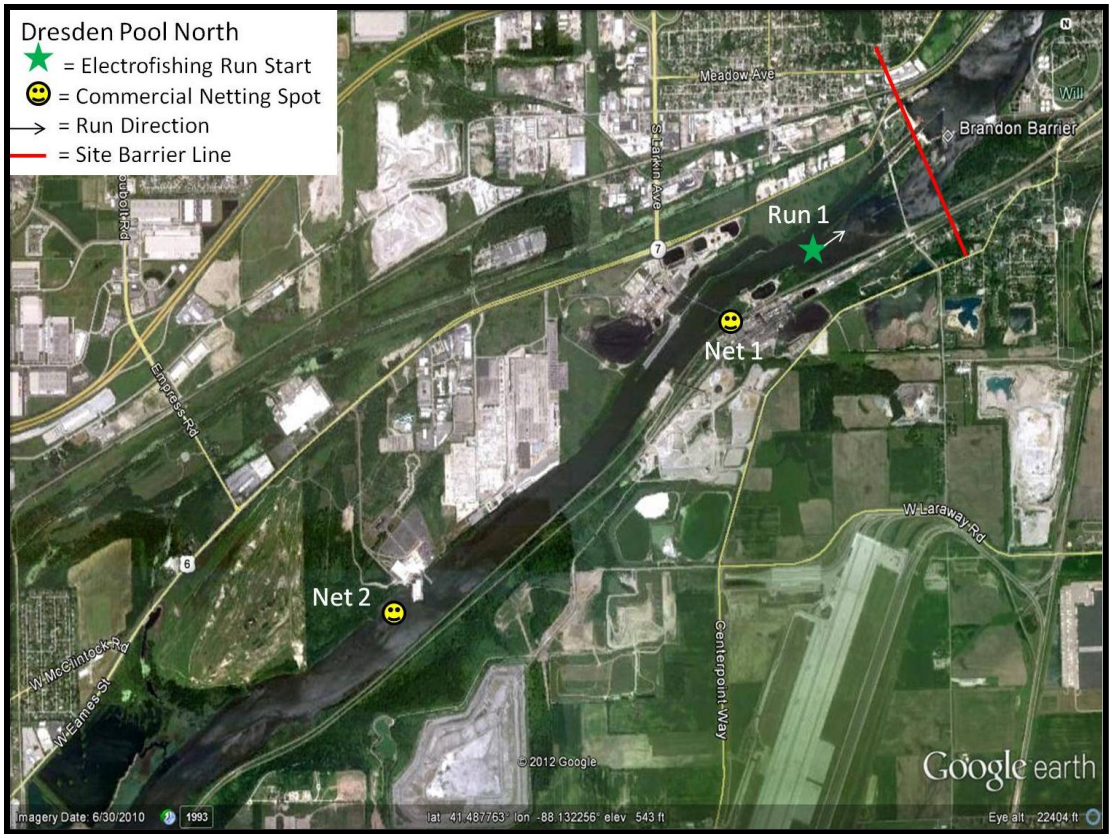
Dresden Pool North
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= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Meadow Ave
St Patrick Ave
Brandon Barrier
Run 1
Net 1
Empress Rd
W Laraway Rd
Net 2
W McClintock Rd
W Eames St
Centerpoint Way
© 2012 Google
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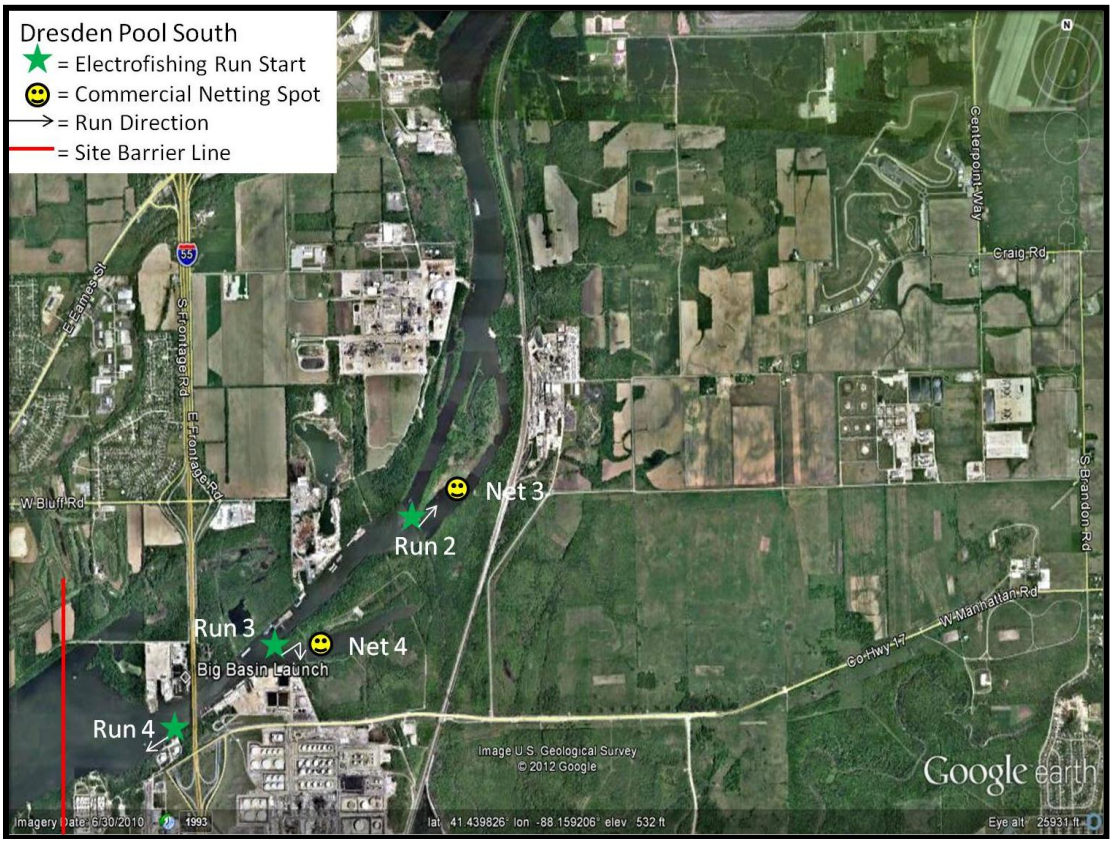
Dresden Pool South
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= Run Direction
= Site Barrier Line
Centerpoint Way
Craig Rd
E Eames St
S Frontage Rd
E Frontage Rd
W Bluff Rd
Net 3
Run 2
S Brandon Rd
Run 3
Net 4
Big Basin Launch
W Manhattan Rd
Go-Hwy-17
Run 4
Image U.S. Geological Survey
© 2012 Google
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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
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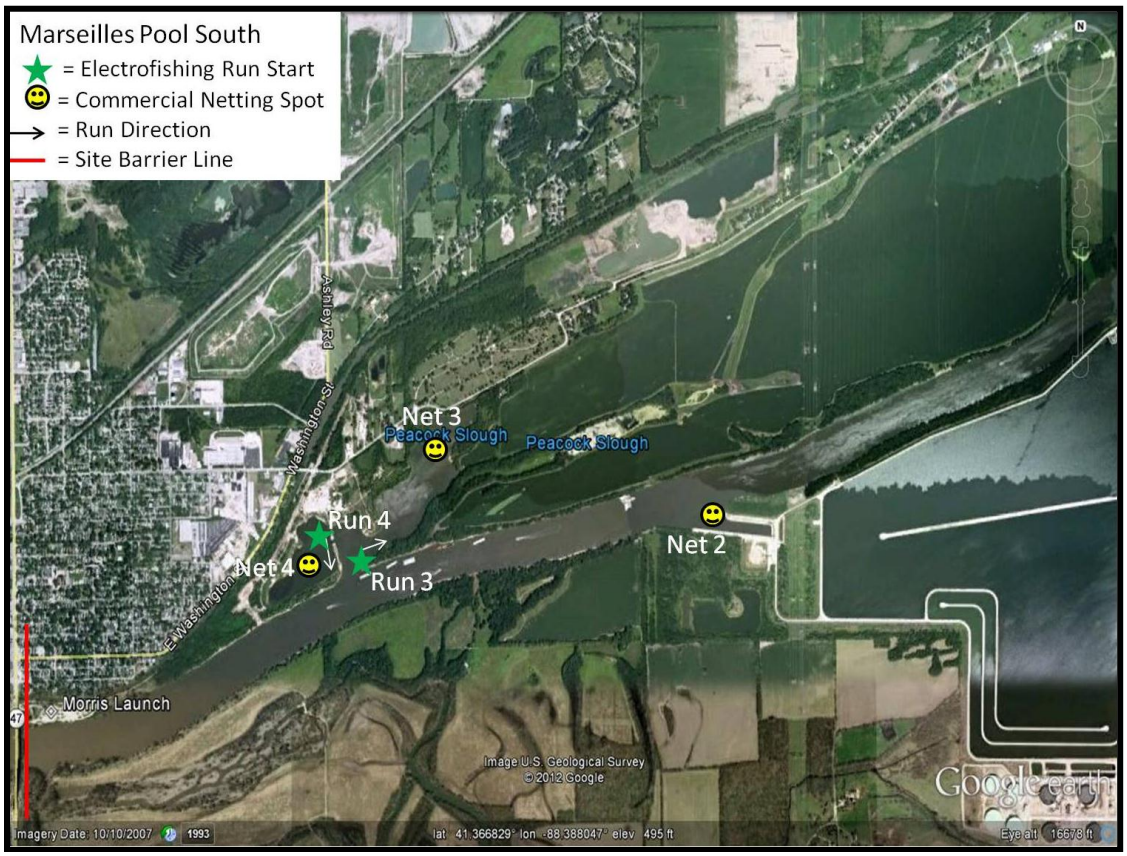

Marseilles Pool South
= Electrofishing Run Start
= Commercial Netting Spot
= Run Direction
= Site Barrier Line
Net 3
Peacock Slough
Peacock Slough
Run 4
Net 4
Run 3
Net 2
Morris Launch
Image U.S. Geological Survey
© 2012 Google
Google earth

Appendix C. 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 Carp 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., USFWS-WGL), 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 USFWS Whitney Genetics Lab 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 (USFWS will provide vials and preservative). Samples will be transported to USFWS-WGL for sequencing and comparison to the eDNA found in the pool.

CHAIN OF CUSTODY RECORD

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

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

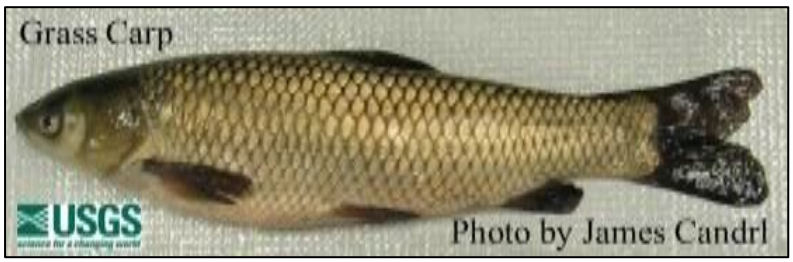
Any suspect black carp collected in the wild in the United States and grass carp collected in the Great Lakes Basin, or other novel locations in the U.S., should be immediately reported to the appropriate resource management agency in the state where the fish was collected. Do ***not*** release suspect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

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

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

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 E. Fish Species Computer Codes.

Species Codes For Fixed Sited Above and Below The Barrier

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 F. 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:

Floy tag 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										
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30										

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

Spawn Patch Preservation/Analysis:

Bighead Carp 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 Carp 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 Carp 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 Carp and Silver Carp. Although external features are useful in identifying the sex of a captured Bighead Carp 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.

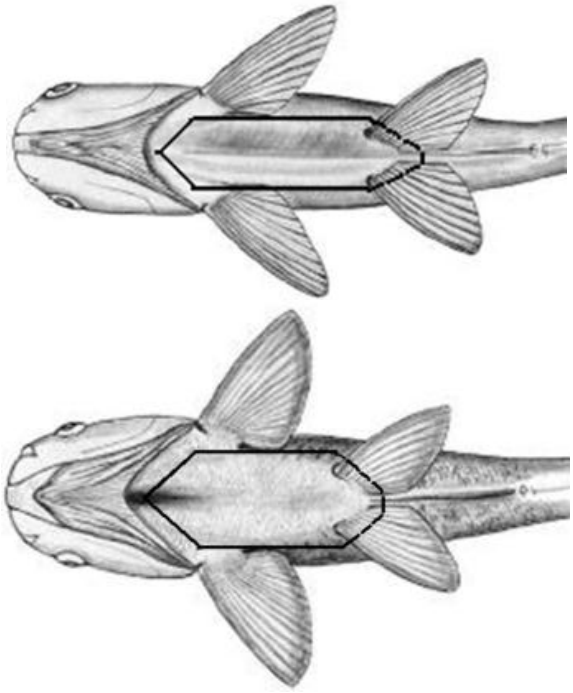

Figure 2. Areas to be preserved for analysis. Silver Carp on left, Bighead Carp on right. (FIRST FOLLOW ALL PROTOCOLS IN THIS MANUAL See: **Appendix C. Handling Captured Asian Carp and Maintaining Chain-of-Custody Records** for fish collected in the CAWS or the Great Lakes; **managers may not allow dissection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