Asian Carp Regional Coordinating Committee

Monitoring and Rapid Response Workgroup

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

May 2011

ACKNOWLEDGEMENTS

The Asian Carp Monitoring and Rapid 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 Rapid Response Work Group and staff from the Illinois Department of Natural Resources Division of Fisheries, U.S. Army Corps of Engineers Chicago District and Rock Island District, and U.S. Fish and Wildlife Service offices at Carterville, Columbia, and La Crosse. R. Sulski, S. Mackey, P. Moy, J. Rogner, T Minarik, J. Dettmers, D. Keller, C. Bullard, J. Brammeier, K. Smith, T. Newcomb, D. Einhouse provided many helpful comments and suggestions. K. Baerwaldt, S. Finney, P. Thiel, W. Doyle, S. Morrison, V. Santucci, G. Lutterbie, K. Irons, S. Butler, D. Wahl, S. Robillard, and J. Dettmers contributed project write-ups for the plan. Data summaries were compiled by K. Baerwaldt, V. Santucci, S. Finney, G. Lutterbie, S. Butler, J. Mick, and S. Herleth-King. G. Dumas helped prepare tables and figures. V. Santucci assembled this most recent draft of the plan.

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EXECUTIVE SUMMARY

The 2011 Monitoring and Rapid Response Plan (MRRP) incorporates preliminary results of 2010 monitoring and removal efforts, extensive discussions among action agency staff and Monitoring and Rapid Response Work Group (MRRWG) technical experts, and numerous written comments provided by workgroup members, Great Lakes state's natural resource agencies, and non-governmental organizations. The current plan includes a review of plan development in light of 2010 sampling results, updated and more focused goal and strategic objectives, discussion of tools available to complete necessary work, and individual project plans detailing tactics and protocols that will allow us to achieve the overall goal and accomplish strategic objectives.

The overall goal is to prevent Asian carp from establishing self-sustaining populations in the Chicago Area Waterway System (CAWS) and Lake Michigan. Five strategic objectives have been identified to accomplish the overall goal. These objectives are:

1) Determine the distribution and abundance of any Asian carp in the CAWS, and use this information to inform rapid response removal actions;
2) Remove any Asian carp in the CAWS to the maximum extent practicable;
3) Identify, assess, and react to any vulnerability in the current system of barriers to exclude Asian carp from moving into the CAWS;
4) Determine the leading edge of major Asian carp populations and reproductive success of those populations; and
5) Improve understanding of the likelihood that Asian carp could become established in the Great Lakes.

Eighteen project plans have been prepared to achieve the overarching goal and objectives of the MRRP. We included in this MRRP 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.

Project plans can be categorized geographically as occurring either upstream or downstream of the Dispersal Barrier and grouped into five categories: Monitoring Projects, Removal Projects, Barrier Effectiveness Evaluations, Gear Effectiveness Evaluations and Development Projects, and Alternative Pathway Surveillance.

Individual plan details, including maps can be found within the 2011 MRRP and are marked by a page number in parentheses next to the plan name. A brief summary of individual project plans follows.

MONITORING PROJECTS

Fixed Site Monitoring Upstream of the Dispersal Barrier (14) – This project includes twice monthly standardized monitoring with DC electrofishing gear and contracted commercial fishers at five fixed sites in the CAWS upstream of the Dispersal Barrier. It provides information on

relative abundance and to a lesser degree distribution of Asian carp, if captured or observed, and other fish species that can be compared among sites and across time. Acquired data will inform rapid response removal actions.

Reach Monitoring Upstream of the Dispersal Barrier (19) – This project expands monitoring coverage to areas of the CAWS that are outside the fixed sites. Four reaches that include nearly all of the CAWS upstream of the Dispersal Barrier will be sampled with DC electrofishing gear on a seasonal basis (spring, summer, and fall). Reach monitoring may enhance chances of detecting Asian carp, provide information on distribution of Asian carp and other fishes in the CAWS, and inform rapid response removal actions.

Strategy for eDNA Monitoring in the CAWS and Upper Des Plaines River (22) – This project presents a strategy for weekly eDNA monitoring in the CAWS upstream and downstream of the Dispersal Barrier and in the upper Des Plaines River downstream from Hoffman Dam. Sampling is focused on areas nearest Lake Michigan (i.e., North Shore Channel, Chicago River and South Branch Chicago River to Bubbly Creek, Little Calumet River, and Lake Calumet), but the strategy allows flexibility for sampling at other strategic locations, as needed. With a long term view of results, we will use eDNA sampling to detect the presence of Asian carp DNA in the waterway, inform rapid response removal actions, and guide decisions regarding the success of removal efforts and when individual actions should be terminated.

Larval Fish and Productivity Monitoring (28) – Sampling for fish eggs and larvae and productivity sampling will occur seasonally (spring, summer and fall) at nine sites downstream of the Dispersal Barrier (LaGrange to Brandon Road pools) and 3-5 sites in the CAWS upstream of the barrier. Sampling may occur more frequently when Asian carp eggs or larvae are more likely to be present (e.g., during spring months, a period of rising water levels, and shortly after peak flows). Information may be used to assess timing and extent of Asian carp reproduction in the Illinois River, Des Plaines River, and CAWS, provide early detection in the CAWS, examine relations between Asian carp and productivity variables, and inform possible control strategies targeting Asian carp spawning and early life history.

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 MRRP (e.g., Larval Fish and Productivity Monitoring, Fixed Site Monitoring Upstream of the Dispersal Barrier, Fixed Site Monitoring Downstream of the Dispersal Barrier, Reach Sampling Upstream of the Dispersal Barrier, Gear Efficiency and Detection Probability Study, Des Plaines River and Overflow Monitoring Project, and Barrier Maintenance Fish Suppression 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.

Fixed Site Monitoring Downstream of the Dispersal Barrier (36) – This project includes monthly standardized monitoring with DC electrofishing gear and contracted commercial fishers at four fixed sites downstream of the Dispersal Barrier (in Lockport Pool and downstream from the Lockport, Brandon Road, and Dresden Island locks and dams). It provides information on the location of major 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.

REMOVAL PROJECTS

Rapid Response Actions in the CAWS (33) – This project proposes a threshold framework to support decisions for response actions to remove any Asian carp from the CAWS upstream of the Dispersal Barrier with conventional gear or rotenone.

Barrier Maintenance Fish Suppression (57) – This project provides a preliminary fish suppression plan to support USACE maintenance operations at the Dispersal Barrier. The plan includes fish sampling to detect juvenile or adult Asian carp presence in the Lockport Pool downstream of the barrier, surveillance of the barrier zone with DIDSON imaging sonar, and operations to clear fish from between barriers by mechanical or chemical means.

Barrier Defense Asian Carp Removal Project (41) – This program was established to reduce the numbers of Asian carp downstream of the Dispersal Barrier through controlled commercial fishing. We anticipate that reducing Asian carp populations will lower propagule pressure and the chances of Asian carp gaining access to waters upstream of the Dispersal Barrier. Primary areas that will be fished include Marseilles and Dresden Island pools, though additional effort may be expended in Brandon Road, Lockport, and Starved Rock pools.

BARRIER EFFECTIVENESS EVALUATIONS

Telemetry Master Plan (43) – This project uses ultrasonically tagged Asian carp and surrogate species to assess if fish are able to challenge and/or penetrate the 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.

DIDSON Barrier Efficacy Project (51) – This project uses Dual-Frequency Identification Sonar (DIDSON) and caged fish experiments to assess the effectiveness of the Dispersal Barrier to prevent fish passage between Mississippi River and Great Lakes basins. Caged fish experiments will describe behavior of various-sized fish (not Asian carp) subjected to the barrier's electric field and DIDSON surveys will determine relative abundance of fish upstream, in, near, and downstream of the Dispersal Barrier.

Des Plaines River and Overflow Monitoring (55) – This project provides a plan to monitor for Asian carp spawning activity, if any exists, in the upper Des Plaines River downstream of the Hoffman Dam. It also will assess efficacy of the Asian carp barrier fence constructed between the Des Plaines River and 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

Asian Carp Gear Efficiency and Detection Probability Study (64) – This project will assess efficiency and detection probability of gears currently used for Asian carp monitoring (DC electrofishing, gill nets, and trammel nets) by sampling at 10 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 (hydroacoustics, midwater trawls, purse seines, trap nets, mini-fyke nets, hoop nets, cast nets, and seines) 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.

Exploratory Gear Development Project (67) – A professional net designer will be consulted to develop and build enhanced purse seines, pound (trap) nets, and gill nets for more effective harvest of Asian carp. Enhanced gears will be evaluated in areas known to have abundant Asian carp populations. If effective, they may be used in place of rotenone for removal actions in the CAWS and for commercial fishing in the lower Illinois River or other Asian carp infested waterways.

Unconventional Gear Development Project (70) – A panel of experts will be convened to discuss nontraditional gear development and available Asian carp attractants or repellants. Alternative trap and net designs and combinations of gears and repellants/attractants will be developed and two or three of the best alternatives will be tested in areas with low to moderate densities of Asian carp. The goal is to develop an effective trap or netting method capable of capturing low densities of Asian carp in the deep-draft canal and river habitats of the CAWS, lower Des Plaines River, upper Illinois River, and possible Great Lakes spawning rivers.

Fish Population Estimation Project (72) – This project is a pilot study to determine the feasibility of using standard mark-recapture techniques (e.g., Petersen or Schnabel methods) to estimate abundance of targeted species at various locations in the CAWS. Estimates of actual population abundance will be useful for gear efficiency evaluations and detection probability modeling. If effective, mark-recapture efforts may be expanded to include Asian carp in Dresden Island and Marseilles pools.

Hydrogun Development and Testing (74) – Pneumatic hydroguns that emit high pressure underwater sound waves have potential to deter fishes or kill them if they are in close enough proximity to the wave source. This technology is being evaluated to determine its effects on structural components of the CAWS (e.g., canal walls and in-water equipment) and as an alternative tool to rotenone for fish suppression in support of Dispersal Barrier maintenance. If proven successful, hydroguns 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.

ALTERNATIVE PATHWAY SURVEILLANCE

Surveillance of Bait, Sport, and Food Fish Trade in Illinois (76) – This project will create 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. Surveillance efforts will take place in the Chicago metropolitan area including Cook and collar counties.

A broad range of sampling and removal tools are available to the MRRWG 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 hydroacoustic, DIDSON, and side-scan sonar), and newly developed or developing techniques (e.g., eDNA, hydro-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 MRRP 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. 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.

2010 ACCOMPLISHMENTS

- Total area sampled:
    - 200 miles of Waterway from Starved Rock Lock and Dam to Lake Michigan
        - Including 76 miles of CAWS
- Estimated minimum effort expended:
    - 16,141 person-hours; 154,000 fish collected, > 64 species
    - 135 miles of trammel-gill nets fished
    - One bighead carp collected from Lake Calumet above Dispersal Barrier
    - 6,028 Asian carps removed 33 miles downstream of Dispersal Barrier
- 1,395 eDNA samples processed above Dispersal Barrier in 2010
    - 4 positives for bighead carp DNA above the Dispersal Barrier*
    - 17 positives for silver carp DNA above the Dispersal Barrier*

* 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. See Strategy for eDNA monitoring in the CAWS and Upper Des Plaines River (page 22 of 2011 MRRP; Table B5) for more details.

Further details on work conducted and results of the 2010 MRRP are available within the 2011 MRRP full plan document available at www.asiancarp.org.

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

May 2011

INTRODUCTION AND BACKGROUND

Bighead and silver carp (hereafter, Asian carp) were first sampled from the Illinois River during the 1990s and populations have since progressed upstream (Irons et al. 2009). Monitoring for these species 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 Aquatic Nuisance Species Dispersal Barrier (Dispersal Barrier) located near Romeoville, Illinois. This 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 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 new and emerging surveillance tool for use in aquatic environments that tests for the genetic presence of bighead and silver carp (Jerde et al. 2011). The USACE began using eDNA in cooperation with the University of Notre Dame (UND) in August 2009 to monitor for Asian carp DNA in the Chicago Area Waterway System (CAWS). Early eDNA monitoring resulted in the discovery of Asian carp DNA in areas upstream of the 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 live bighead carp in Lake Calumet upstream of the Dispersal Barrier.

A Regional Coordinating Committee (RCC) 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 RCC formed multiple work groups, including the Monitoring and Rapid Response Work Group (MRRWG). The MRRWG 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 MRRWG was assigned the task of

developing and implementing a Monitoring and Rapid Response Plan (MRRP) 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.

The MRRP has gone through several versions and periodically will be revisited and modified as more information becomes available on Asian carp distribution and abundance and as rapid response needs change. Herein, we review plan development in light of 2010 sampling results, update overarching strategic objectives, identify tools available to complete necessary work, and present 18 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.

INITIAL MONITORING AND PLAN DEVELOPMENT PROCESS

The purpose of the MRRP is to identify the best strategy for conducting monitoring and rapid response actions that will accomplish the goal of preventing Asian carp from establishing self-sustaining populations in the Great Lakes. The plan is intended to strike a balance between taking immediate action(s) to gather data for better up front decisions and taking time to fully explore all potential actions that will best inform near and long term strategies. The MRRWG initially 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 exist, and to less intensively sample wider waterway reaches throughout the CAWS. Taking a conservative approach, the MRRWG 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 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 above the barrier. The sampling team consisted of both government biologists and contracted commercial netters. A total of 100 person-days was expended to complete 132 electrofishing runs (effort = 72 hours) and124 trammel/gill net sets (effort = 10,600 yards of net). No Asian carp were collected or seen during initial sampling efforts.

As a follow-up to the initial sampling, the MRRWG was expanded to include the independent technical specialists listed in Appendix A. The group 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 rapid 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 MRRWG 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 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 and silver carp, none contained bighead carp DNA and eight contained silver carp DNA; one each in the 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 rapid response actions at the North Shore Channel (May) and CSSC/SBCR (June), and a combined rotenone and conventional gear response at the Little Calumet River downstream of O'Brien Lock and Dam (May). A total of 721 person-days were expended to sample 2.6 miles (173 acres) of river with rotenone and complete 26 electrofishing runs (32 hours) and 61 trammel/gill net sets (9,533 yards of net) combined among the three actions. More than 70,000 fish representing 44 species and 2 hybrid groups were sampled, none of which were Asian carp (see Appendix B for provisional data summaries on individual actions).

The MRRWG met after the spring rapid response actions and concluded that whereas eDNA detections suggested Asian carp may be present in the CAWS upstream from the 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 Little Calumet River prior to rapid response actions were negative for bighead 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.

An additional rapid response action was initiated after an adult bighead carp (mature male 34.6 inches long and 19.6 pounds) was captured by contracted commercial netters in Lake Calumet on 22 June, 2010, which was the first day of sampling at designated fixed sites upstream of the Dispersal Barrier. This capture confirmed the presence of live Asian carp in the CAWS above the barrier and resulted in 11 days of sampling in Lake Calumet, the Calumet River, and Calumet Harbor from 23 June – 9 July. Federal, state, tribal, and university crews combined for an estimated 117 person-days of effort and completed 17 electrofishing runs (54.5 hours), 83 trammel net sets (16,900 yards of net), and two commercial seine hauls (seine length = 800 yards). No Asian carp were captured in a combined catch among gears of nearly 17,000 fish representing 32 species and 2 hybrid groups. An additional 334 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 or silver carp DNA in any of the regions surveyed. Fixed site sampling continued on a twice monthly schedule throughout the summer and fall. Through September 30, combined effort for electrofishing and netting at the fixed sites was 231 person-days. Over 400 electrofishing runs (95.75 hours) and 200 net sets (41,600 yards of net) caught over 25,000 fish (56 species and 4 hybrid groups) and no additional Asian carp.

In addition to sampling in the upper waterway, monitoring and removal of Asian carp took place downstream of the Dispersal Barrier in order to track the upstream progression of the major population front (uppermost aggregation of fish vs. individual wanderers or scouts moving upstream) and reduce its abundance. Electrofishing (effort = 22.5 hours) and trammel/gill netting (4,600 yards of net) at four fixed sites downstream of the Dispersal Barrier caught no Asian carp in Lockport and Brandon Road pools, low numbers of bighead carp ($N = 2$) in the Dresden Island Pool, and moderate numbers of bighead carp ($N = 34$) and silver carp ($N = 65$) farther downstream in the Marseilles Pool. Additionally, contracted commercial fishers targeting areas off of the main channel in the lower Dresden and Marseilles pools with trammel and gill nets (82 miles of net fished between 22 June and 28 September 2010) successfully removed over 6,000 bighead and silver carp that had a combined weight of just over 65 tons. In one Marseilles Pool backwater, consistent fishing by commercial netters resulted in a decline in catch from >100 fish/net-set in late June and early July to <25 fish/net-set during August. Combined, these efforts suggest the location of the major population front was in the lower Dresden Pool about 55 miles from Lake Michigan and provided preliminary evidence that commercial netting may be useful for reducing Asian carp abundance within localized areas.

The MRRWG met again in September 2010 to discuss the results of all monitoring thus far and to modify the plan accordingly. This current version of the MRRP incorporates 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. Although preliminary results of 2010 monitoring informed the current updated plan, a more desirable approach would be to use completed annual summary reports of previous years monitoring efforts – reports that include more in-depth data analysis and interpretation – to inform plan modifications and enhancements. Completing annual summary reports before future MRRP updates is a priority of the workgroup.

The workgroup takes an adaptive management approach to Asian carp monitoring and removal and considers the MRRP to be a working document that is continually open to modification and enhancement. An adaptive management approach combined with the need to include several new project plans in the latest plan update precipitated a change to a project-based format. This format allows new plans to be added, old plans to be deleted, and existing plans to be modified as needed. Although individual project plans have been designed as standalone plans, they all support one or more of the overarching strategic objectives of the MRRP. 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.

If and 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 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) 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.

LOCATION OF PRIMARY TARGET AREAS COVERED BY THE MRRP

The area covered by this plan (Figure 1) encompasses over 200 miles of waterways stretching from Starved Rock Lock and Dam to Lake Michigan and includes two target areas: 1) all waterways upstream of the Dispersal Barrier; and 2) waterways downstream of the Dispersal Barrier to Starved Rock Lock and Dam. The area upstream of the barrier includes approximately 76 miles 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 Dispersal Barrier are: CSSC (18.3 miles); South Branch Chicago River (3.9 miles); Chicago River (1.6 miles); North Branch Chicago River (7.7 miles); North Shore Channel (7.6 miles); Calumet-Sag Channel (16.0 miles); Little Calumet River, including the South Leg (40 miles); Grand Calumet River to sheet pile obstruction (3 miles); Calumet River (7.5 miles); and Lake Calumet. Waterways downstream of the Dispersal Barrier include: CSSC, including the reach of CSSC downstream of Lockport Lock (6.0 miles); lower Des Plaines River (42 miles); and Illinois River (43 miles). Areas upstream of the Dispersal Barrier are a higher priority for monitoring and rapid 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) Determine the distribution and abundance of any Asian carp in the CAWS, and use this information to inform rapid response removal actions;
2) Remove any Asian carp in the CAWS to the maximum extent practicable;
3) Identify, assess, and react to any vulnerability in the current system of barriers to exclude Asian carp from moving into the CAWS;
4) Determine the leading edge of major Asian carp populations and reproductive success of those populations; and
5) Improve understanding of the likelihood that Asian carp could become established in the Great Lakes.

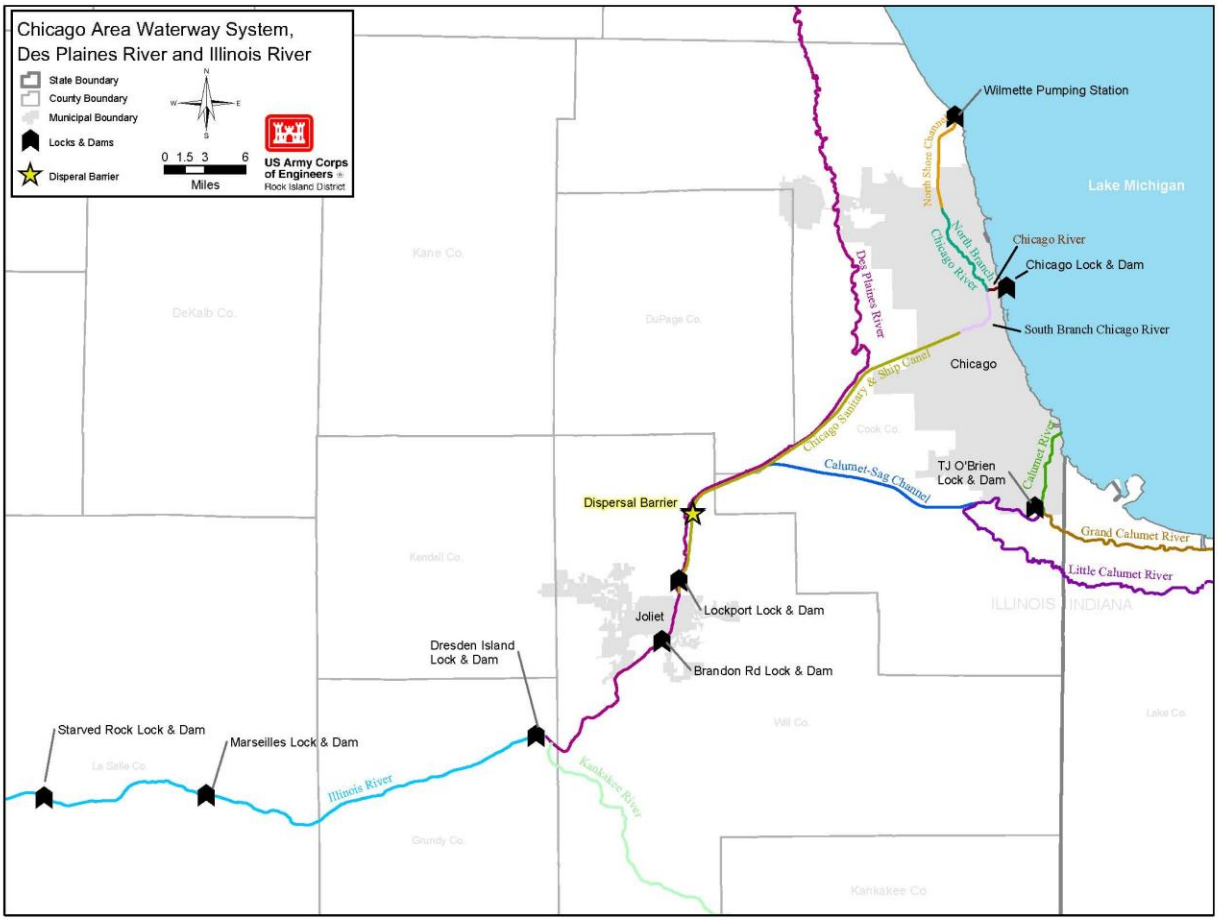


Figure 1. Map of the Chicago Area Waterways System (CAWS), Des Plaines River, and upper Illinois River.

Objective 1: Determine the distribution and abundance of any Asian carp in the CAWS, and use this information to inform rapid 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., hydro gun barrier, chemical barriers, or oxygen depletion zones), and/or other appropriate actions. Projects developed to meet this objective include eDNA, reach, and fixed site monitoring upstream of the Dispersal Barrier.

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 rapid 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 new projects have been developed to assist with determination of Asian carp abundance in the CAWS (see larval fish and juvenile Asian carp monitoring, Fish Population Estimation Project, and Gear Efficiency and Detection Probability Study).

Objective 2: Remove any Asian carp in the CAWS to the maximum extent practicable. The MRRWG is taking a cautious approach by attempting to remove all known Asian carp upstream of the Dispersal Barrier, including those that may be trapped between Barrier IIA and Barrier IIB after completion of barrier maintenance operations (see Barrier Maintenance Fish Suppression). Removal may occur incidentally when Asian carp are captured during routine monitoring or during rapid response actions targeting specific areas of the CAWS. Rapid-response teams will be mobilized when Asian carp have been captured or observed or when repeated patterns of eDNA detections suggest possible recurring presence of Asian carp (see Rapid Response Project plan below for more detailed discussion of response triggers).

Objective 3: Identify, assess, and react 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 Dispersal Barrier in the CSSC by constructing new barriers IIA (operational in 2009) and IIB (proposed completion in early 2011) and operating barriers at appropriate operating parameters (see Holliman 2011) to better repel fish; constructing a rip-rap barrier to isolate the Illinois and Michigan Canal from the CSSC (completed in September 2010); constructing a 13-mile long concrete barrier/small-mesh fence to prevent the movement of Asian carp from the Des Plaines River to the CSSC upstream of the 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 MRRWG will provide necessary monitoring data and coordinate with partners to assist control efforts relative to the Dispersal Barrier and other Asian carp exclusion measures. The following projects have been developed to enhance assessment and reaction to any barrier vulnerabilities: Telemetry Master Plan, DIDSON Barrier Efficacy Project, Des Plaines River Monitoring, Barrier Maintenance Fish Suppression, and Hydro-gun Development and Testing.

Objective 4: Determine the leading edge of major Asian carp populations and reproductive success of those populations. It is critical to gather information on carp densities in the area downstream of the barrier in order to effectively assess the risks of Asian carp passing the Dispersal Barrier, to formulate rapid response actions to reduce fish passage risks, and to implement downstream population control measures. For example, the presence of Asian carp between the 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 barriers. 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 Dispersal Barrier, Barrier Defense Asian Carp Removal Project, Larval and Small Fish Monitoring, and Barrier Maintenance Fish Suppression.

Objective 5: Improve understanding of 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. The bi-national risk assessment is scheduled to take about 18 months and will be completed in December 2011.

Sampling during 2010 has helped to provide an answer to the second question posed above. The capture of only one bighead carp in over 1,300 person-days of sampling effort throughout the CAWS upstream of the Dispersal Barrier (373 hours of electrofishing, 45 miles of trammel/gill net, 173 acres treated with rotenone, and other gears) suggests Asian carp abundance in the waterway currently is low (see Appendix B for individual project data summaries). Additional sampling in the lower Des Plaines River and upper Illinois River has placed the leading Asian carp population front at more than 50 miles and successfully reproducing populations at more than 100 miles 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 MRRWG 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 hydroacoustic, DIDSON, and side-scan sonar), and newly developed or developing techniques (e.g., eDNA, hydro-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 MRRP 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 MRRP (e.g., see Population Estimation Project, and Hydrogun 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.

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 - For the past two years, eDNA has been used to monitor for the possible presence of Asian carp DNA throughout the CAWS, Des Plaines River, and near shore waters of Lake Michigan. This technique is potentially useful for early Asian carp DNA detection and to identify 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). A positive eDNA sample indicates the presence of Asian carp DNA and the possible presence of live fish. At present, eDNA evidence cannot verify whether live Asian carp are present, whether the DNA may have come from a dead fish, the number of Asian carp in an area, or whether water containing Asian carp DNA may have been transported from other sources (e.g., translocation by vessel, birds, or through subterranean cracks and fissures). Furthermore, eDNA cannot provide precise, real-time information on where Asian carp might be due to the requisite two-week sample processing time. These and other unknowns about eDNA still need to be evaluated.

This plan calls for the use of eDNA, in combination with other techniques, during regular monitoring, barrier maintenance fish suppression, and rapid response removal actions. At this point in time and taking a conservative approach, we consider positive detections as an indicator of the presence of Asian carp in the waterway for purposes of management and response strategies. However, based on sampling experiences in 2010, eDNA cannot reliably serve as a sole "trigger" of rapid response actions nor does it appear justifiable to deploy rapid response teams for each reported positive eDNA result. Viewed over a longer time frame, results can and have been used to guide our sampling efforts with conventional gears and rotenone and should continue to be used in this way.

Additional research to refine and modify eDNA sampling procedures is presently being considered to guard against false positive and false negative results, which must be minimized when the purpose of sampling is to make comparisons over time and between different sites. Calibration studies also are planned to assess whether this technique has potential to provide estimates of population abundance. How eDNA is used to determine presence and abundance of Asian carp and how it informs response actions will continue to be evaluated as we gain more experience through research.

DC 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 sites and reaches throughout the waterway and during rapid response 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 Barrier Efficacy Project. As an active sampling technique, electrofishing provides for 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 are present in low numbers and waters are often deeper than 9 feet. However, recent electrofishing in the upper 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. 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 migration barriers, 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 Evaluation Study, Fish Population Estimation Project, and Rare Fish Capture Modeling). Changes to monitoring and rapid response protocols will be made in future versions of this plan as results from research efforts become available.

Trammel/Gill Nets - Large-mesh trammel or gill nets (bar mesh = 2.0-5.0 inches) 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 high and 100-600 feet long, but are standardized for monitoring at 8.0 feet high, 300 feet long, and mesh sizes of 3.0 – 4.5 inches. 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. Both methods have been shown to be effective at capturing Asian carp, but overnight sets are preferred during rapid response actions in the CAWS to maximize chances of capturing an Asian carp when population abundance is low.

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 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, tie- down gill nets of similar lengths, ½ mile long commercial seines, and large diameter hoop nets). Commercial fishers collected the first Asian carp in Illinois waters of 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 and it produced the only known capture of a live Asian carp upstream of the Dispersal Barrier. Commercial fishers have and will continue to be hired to conduct trammel/gill net sampling during fixed site monitoring in the CAWS, fixed site monitoring downstream of the Dispersal Barrier, rapid response removal events in the CAWS, 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 and 6.0 miles 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 rapid response tool. However, the MRRWG 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 possibly newly developed hydro-cannon 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 River and upper Illinois Waterway 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 electrical barriers); 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 have produced limited catches to date. However, nets with panels having mesh sizes from 0.75 to 2.0 inches have shown promise as a monitoring tool for young-of-year and early juvenile fishes. In this coming year, we will include smaller mesh experimental nets in Asian carp young-of-year and juveniles monitoring efforts at stations throughout the waterway upstream of Starved Rock Lock and Dam. Experimental nets will 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 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 will be included in monitoring efforts for young Asian carp during 2011 to further supplement sampling with electrofishing gear and experimental gill nets.

Larval Push Nets - From June through September 2010, INHS 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). Asian carp eggs and larvae were sampled only from the lower Illinois River downstream from the Peoria Lock and Dam, but the June start of sampling may have precluded capture of eggs and larvae from earlier spawning events. Monitoring for fish eggs and larvae will continue at stations throughout the waterway during 2011 and will begin in late April or May when water temperatures and flow conditions are first suitable for Asian carp spawning. In addition to routine monitoring, additional samples will be taken in the CAWS and Des Plaines River confluence with the CSSC within a week after spring

or summer flooding events to monitor Asian carp spawning that may be triggered by high flow conditions.

Midwater Trawls and Purse Seines - The INHS and USFWS have been evaluating trawls and purse seines as methods to sample and remove Asian carp juveniles and adults from the waterway. Results to date have been largely discouraging, but modifications to gears are being made and evaluations will continue this coming year. We will include these gears in future monitoring and removal plans if and when they are shown to be effective.

Ultrasonic Telemetry - The USACE began a telemetry monitoring project during 2010 to determine: 1) if fish are able to challenge and/or penetrate the 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 105 tags were implanted during 2010 and the remaining 95 tags will be implanted during spring/summer 2011. To date, no tagged fish have moved through the Dispersal Barrier, nor has there been documented movement by tagged Asian carp through upper waterway locks.

Dual-Frequency Identification Sonar (DIDSON), Hydroacoustic, 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 the 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 barrier, it is assumed that an Asian carp could too. Even with the species-specific limitation, sonar devices have proved useful for locating fish near the Dispersal Barrier and we continue to evaluate them as a potential monitoring tool or an aid 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 barriers in the CSSC with DIDSON during 2010 and preliminary results showed schools of smaller fish above and below Barrier I. Some schools appeared to be located over the electrode array of this barrier. Schools of smaller fish were observed above and below Barrier IIA and several larger fish also were observed below Barrier IIA. Additional DIDSON surveys will be conducted by USFWS in the coming year to evaluate fish behavior at the electric barriers and examine for the presence of fish between barriers IIA and IIB after completion of Barrier IIA maintenance (see DIDSON Barrier Efficacy Project and Barrier Maintenance Fish Suppression).

Split-beam hydroacoustic sonar 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 Dispersal Barrier. The INHS has been evaluating split-beam hydroacoustics as a potential Asian carp monitoring tool over the past year and this research will continue in the coming field season.

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 rapid response action at Lake Calumet this past year 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 Dispersal Barrier.

PROJECT PLANS

Eighteen project plans have been prepared to achieve the overarching goal and objectives of the MRRP. These plans are in various stages of development due to the continuing expansion of efforts to prevent Asian carp from establishing populations in the Great Lakes. Several plans were prepared and implemented during 2010, others are newly developed and have been approved by the MRRWG, and still others are newly proposed and only recently scoped out. We included in this MRRP 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. New projects or additions to existing plans currently under development are: comprehensive instantaneous eDNA sampling (snapshot sample) throughout the CAWS, evaluation of the effects of hydrogun technology on canal walls and equipment in the CSSC, and continuous surveillance of fish behavior at the Dispersal Barrier with stationary hydroacoustic sonar. These plans will be vetted through the MRRWG, and if approved, they will be amended to the current version of the MRRP or included in the next revision, tentatively scheduled for release in March 2012. Projects and schedules are included as a guideline for implementation, however actual plans may vary depending upon logistics and funding.

FIXED SITE MONITORING UPSTREAM OF THE DISPERSAL BARRIER

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

Location: Monitoring will take place in the CAWS at the CSSC, South Branch Chicago River, North Branch Chicago River, North Shore Channel, Little Calumet River, and Lake Calumet.

Introduction and Need: Frequent and 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 invasion and informs management decisions and actions to reduce the risk of population establishment. Detections of Asian carp DNA upstream of the Dispersal Barrier during 2009 initiated the development of a

monitoring plan that will use electrofishing and contracted commercial fishers to sample for Asian carp at five fixed sites upstream of the Dispersal Barrier. Sampling results will contribute to our understanding of Asian carp population abundance in the CAWS and guide conventional gear or rotenone rapid response actions designed to remove fish from areas where they have been captured or observed.

Objectives: We will use standardized DC electrofishing and contracted commercial netters to:

1) Monitor for the presence of Asian carp in the CAWS upstream of the 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., reach and eDNA monitoring); 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 the five fixed sites twice monthly from June through September with DC electrofishing gear and trammel or gill nets. Three additional electrofishing trips were made during October and November. Net sampling did not take place during late fall because commercial fishing contracts expired in late September. Early onset of winter precluded monitoring during December. In total, 264 person-days of labor were expended to complete 559 electrofishing runs (139.75 hours) and 208 trammel/gill net sets (41,600 yards). See Appendix B - Table B1 for fixed site sampling provisional data summaries.

Methods: The sample design includes intensive electrofishing and netting at five fixed sites where we expected to find Asian carp (Figure 2). Sampling will take place monthly during March and December (weather permitting) and twice monthly from April through November. No sampling at fixed sites is planned for January and February because several of the sites are typically ice covered during these months. To maximize the potential usefulness of netting and electrofishing, particularly given the apparent low densities of Asian carp in the generally deep-water habitat of the CAWS, stations were located in areas where the likelihood of capture is greatest (i.e., where eDNA has been detected, below migration barriers, or both). The five fixed sites are mostly located at the upstream-most areas of the CAWS near Lake Michigan. These areas were identified for intensive sampling under the assumption that Asian carp upstream of the Dispersal Barrier would swim upstream and congregate below the next existing barriers, namely the T.J. O'Brien and Chicago Locks and the Wilmette Pumping Station. Habitat and collection conditions were taken into consideration in the selection of the locations and boundaries of the fixed sites. For example, Lake Calumet (Site 1) was included because it possesses backwater-like conditions favored by Asian carp and is known to contain bigmouth buffalo, a species thought to favor habitat similar to Asian carp. The Little Calumet River (Site 2) was extended downstream to include favorable habitat near the Acme Bend. Finally, Site 3 was shifted downstream of the Chicago Lock in order to include more favorable habitat and collection conditions (e.g., less boat traffic and resulting wave action).

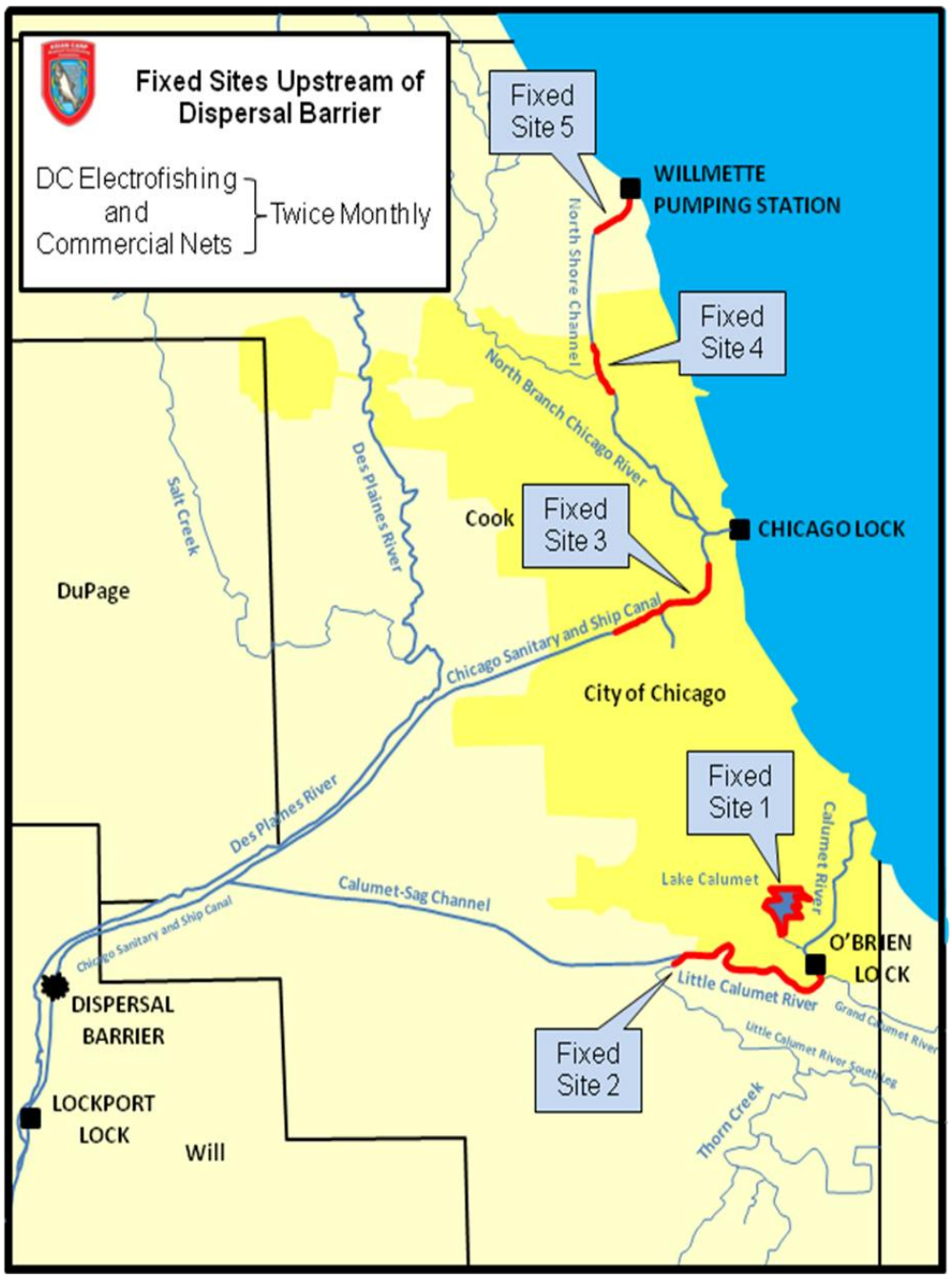


Figure 2. Fixed sites for electrofishing and commercial net sampling for Asian carp in areas upstream of the Dispersal Barrier.

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 either 100 or 200 yards. See Appendix C for detailed maps of each site.

Site 1 - Lake Calumet. Sampling will be limited to shallower area 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).

- six electrofishing runs
- 2,000 yards of trammel or gill net

Site 2 - Little Calumet River O'Brien Lock to farthest point possible up Little Calumet River South Leg (RM 319 – 327).

- 16 electrofishing runs
- 2,000 yards of trammel or gill net

Site 3 - CSSC and South Branch Chicago River from Western Avenue upstream to Jackson Street (RM 320.5 – 325).

- 14 electrofishing runs
- 1,000 yards of trammel or gill net

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

- six electrofishing runs
- 400 yards of trammel or gill net (minimum of four sets)

Note: Bridges are not identified so it may be best to travel downstream to Montrose and work upstream)

Site 5 - North Shore Channel from Golf Road north to Wilmette Pumping Station (~2 miles).

- six electrofishing runs
- 400 yards of trammel or gill net (minimum of four sets)

Electrofishing Protocol - All electrofishing will use DC current and include 1-2 netters (two netters preferred). For each site except Lake Calumet, there will be a targeted effort of three 15-minute electrofishing runs per mile of waterway. Exact sampling areas within the sites will be left to the discretion of the field crews; however, this level of effort in trial runs covered a high percentage of the waterway shoreline. Electrofishing will be completed in a downstream direction in areas with noticeable current velocity and runs will be generally parallel to shore (including following shoreline into off channel areas). The operator may switch the pedal on and off at times to prevent pushing fish in front of the boat and increasing the chances of catching an Asian carp. Common carp will be counted without capture and all other fish will be netted and placed in a tank where they will be identified and counted, after which they will be returned live to the water. 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 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. It is very likely that we will observe more Asian carp than we net because of the difficulty in capturing Asian carp with electrofishing gear. Refer to Appendix D for detailed protocols on reporting, handling, and chain-of-custody for captured

Asian carp. Sample data sheets are included in Appendix E. Crew leaders should fill in as much information on the data sheets as possible for each station/run and record the location for the start of each run either with GPS coordinates (preferred) or by marking on attached maps.

Netting Protocol – Contracted commercial fishers will be used for net sampling at the fixed sites and nets used will be large mesh (3.0-4.0 inches) trammel or gill nets 8 feet high and in lengths of 100 or 200 yards. Set locations within each fixed site will be left to the discretion of the commercial fishers. 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 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 (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.

Suggested boat launches for fixed site sampling.

Site 1 – O'Brien Lock Launch – Contact the Lockmaster for permission.

Site 2 – Launch at O'Brien Lock and lock through to sample below.

Site 3 – Western Avenue Launch – No contact necessary. Limited number of parking passes available (State and Federal trucks exempt).

Site 4 and 5 – Oakton St. Launch in Skokie (or Western Ave. launch and motor 1.5 hrs. to sites). Contact Scott Runkle at Skokie Park District if problems arise.

Sampling Schedule: A tentative sampling schedule for 2011 and the agency responsible for electrofishing is shown in the table below.

Week of	Agency	Week of	Agency
Mar 21	IDNR	Aug 8	USFWS
Apr 4	USFWS	Aug 22	IDNR
Apr 18	IDNR	Sep 5	USACE
May 9	USFWS	Sep 19	IDNR
May 23	IDNR	Oct 3	USFWS
Jun 6	USACE	Oct 17	IDNR
Jun 20	IDNR	Nov 1	USFWS
Jul 11	USFWS	Nov 14	IDNR
Jul 25	IDNR	Dec 5	USACE

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

REACH SAMPLING UPSTREAM OF THE DISPERSAL BARRIER

Participating agencies: IDNR and INHS (co-leads); USFWS and USACE (as needed field support)

Location: Monitoring will occur throughout the CAWS in the CSSC, South Branch Chicago River, Chicago River, North Branch Chicago River, North Shore Channel, Calumet-Sag Channel, Little Calumet River, Lake Calumet Connecting Channel, and Calumet River.

Introduction and need: Extending sampling beyond designated fixed sites can increase the chance of encountering Asian carp in the CAWS and provide useful information on distribution patterns of target and non-target fish species. Fish distribution data can, in turn, inform site selection for removal actions or other sampling and control measures. In addition, these data may contribute to the evaluation and possible adjustment of fixed site locations. We will use electrofishing gear to periodically sample four waterway reaches that essentially encompass all 76 miles of waterway upstream of the Dispersal Barrier. Electrofishing was selected for reach sampling because it allows for extensive coverage of the waterway with moderate effort. The four reaches were originally scheduled to be sampled monthly, but the MRRWG supported a reduced level of sampling effort after results of rotenone and conventional gear actions indicated low Asian carp abundance in the CAWS and a reduced threat of invasion.

Objectives: We will use DC electrofishing to:

1) Seasonally monitor for the presence of Asian carp throughout the CAWS upstream of the Dispersal Barrier;
2) Determine Asian carp distribution in the CAWS; and
3) Obtain information on the non-target fish community to help verify sampling success, guide modifications to sample locations, and assist with rare fish capture modeling and gear evaluation studies.

Status: This project began in 2010 and is on-going. Three complete circuits of the four reaches were sampled by electrofishing between 11 July and 31 October. Each circuit required about 7 days to complete for one boat and crew. In all, 69 person-days were expended to complete 292 electrofishing runs (total shock time = 70.3 hours). See Appendix B - Table B1 for a summary of provisional data for reach electrofishing.

Methods: The entire CAWS upstream of the Dispersal Barrier has been divided into four reach segments (Figure 3) that will be sampled three times per year on a seasonal basis (spring, summer, and fall). Sampling will include DC electrofishing gear only; commercial netting will not be utilized for reach sampling. Reach electrofishing will exclude areas of the waterway designated as fixed sites, because these areas are sampled by electrofishing twice each month as part of fixed site monitoring. Crews will complete a targeted three 15-minute electrofishing runs per mile. A GPS will be useful for designating waterway miles sampled. Selection of run locations will be at the discretion of the sampling crews.

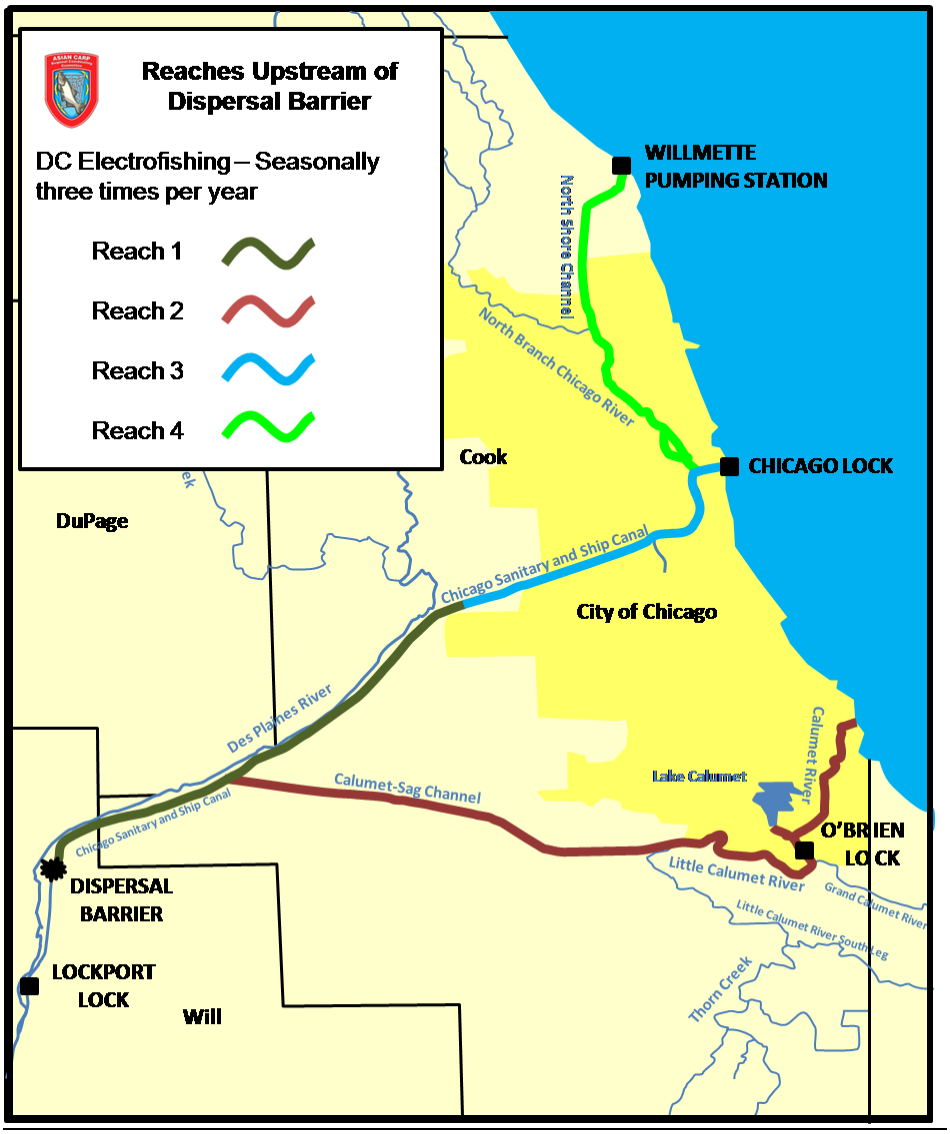


Figure 3. Reaches for electrofishing for Asian carp upstream of the Dispersal Barrier.

Electrofishing Protocol - The electrofishing protocol for reach sampling will be similar to the protocol used for fixed site sampling. Electrofishing will be completed in a downstream direction in areas with noticeable current velocity and runs will be generally parallel to shore (including following shoreline into off channel areas). The operator may switch the pedal on and off at times to prevent pushing fish in front of the boat and increasing the chances of catching an Asian carp. Common carp will be counted without capture and all other fish will be netted and placed in a tank where they will be identified and counted, after which they will be returned live to the water. Once a year, a subsample of 10 fish of each species per reach 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 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. It is very likely that we will observe more Asian carp than we net because of the difficulty in capturing Asian carp with electrofishing gear. Refer to Appendix D for detailed protocols on reporting, handling, and chain-of-custody for captured Asian carp. Sample data sheets are included in Appendix E. Crew leaders should fill in as much information on the data sheets as possible for each station/run and record the location for the start of each run either with GPS coordinates (preferred) or by marking on attached maps.

Reach Locations - A description of reach locations and targeted number of electrofishing runs is summarized below. The duration of each electrofishing run will be 15 minutes.

1. Reach 1. CSSC from Dispersal Barrier to the Stickney Water Reclamation Plant (WRP; RM 296-316; ~30 runs).
2. Reach 2. CSSC and Calumet – Sag Channel junction to Calumet Harbor (RM 303.5-333; ~20 runs).
3. Reach 3. CSSC from Stickney WRP (RM 316) to Chicago Lock (RM 327; ~20 runs)
4. Reach 4. North Branch Chicago River (RM 326.5) to Wilmette Pumping Station (~30 runs).

Suggested boat launches for reach sampling.
Reach 1 – MWRD's Cargill Elevator Launch or Hanson Materials Romeoville Barge Slip – Use of these launches requires property owner permission. For the MWRD launch, contact Martin Castro or Phil Nieman at Lockport Power Station. For the Hanson Materials launch contact Darren Melvin. Samplers will need to motor through the Regulated Navigation Area (RNA) at barriers to get to site. No activity is allowed in RNA (transport directly through area); boats longer than 20 feet and type-1 PFDs required.

Reach 2 – Worth Boat Launch (no contact needed) and O'Brien Lock Launch – Contact the O'Brien Lockmaster for permission. May launch at O'Brien Lock and lock through to sample downstream of lock and dam.

Reach 3 – Western Avenue Launch – No contact needed.

Reach 4 – Oakton Street Launch in Skokie. Contact Scott Runkle at Skokie Park if problems arise.

Sampling schedule: A tentative sampling schedule for 2011 is shown in the table below.

Season	Month	Agency
Spring	Apr/May	INHS
Summer	Jul/Aug	INHS
Fall	Oct/Nov	INHS

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 MRRP.

STRATEGY FOR eDNA MONITORING IN THE CAWS AND UPPER DES PLAINES RIVER

Participating Agencies: USACE (lead), USFWS and IDNR (field support), USEPA (field and lab support)

Location: Monitoring will take place in the CAWS upstream of Lockport Lock and Power Station and in the Des Plaines River upstream of its confluence with the CSSC.

Introduction and Need: Monitoring is essential to determine the effectiveness of efforts to prevent self-sustaining populations of Asian carp from establishing in the Great Lakes. Where Asian carp are insufficiently abundant to be regularly detected by electrofishing and netting, sampling for Asian carp DNA in the environment (eDNA) may be able to detect their presence. With a long term view of eDNA sampling results, we will use these data in combination with conventional gear monitoring results to guide rapid response actions designed to remove Asian carp from the waterway. Because management decisions are based on sample results through time, there is a need to collect as many samples as possible to inform decisions. Results of eDNA sampling also will be used to inform decisions regarding the success of removal efforts and when individual actions should be terminated.

At present, the capacity to process eDNA is 120 samples per week. The sampling strategy outlined below takes into account the current level of sample processing, but the number of samples required was determined based on individual site characteristics and the need to gather information from several strategically important reaches of the waterway. Additional sample processing capabilities are currently being evaluated and developed by the USFWS. At such time that additional eDNA processing capacity may be available, additional eDNA sampling may be considered.

Objectives: We will use eDNA sampling to:

1) Determine whether Asian carp DNA is accumulating in Lake Calumet and below structures that impede fish passage into Lake Michigan;
2) Detect Asian carp DNA in areas targeted for rapid response actions, as a measure of the effectiveness of conventional gear or rotenone removal efforts;
3) Determine the instantaneous distribution of Asian carp DNA in the CAWS (Note: This objective is supported by the workgroup, but is pending results of research into sources of additional funding and enhanced filtering and sample processing capacity.); and
4) Monitor for the presence of Asian carp DNA in other strategically important areas, such as the upper Des Plaines River below Hoffman Dam, confluence of the CSSC and Calumet-Sag Channel, and the Lockport Pool of the CSSC immediately upstream and downstream of the Dispersal Barrier.

Status: Sampling for Asian carp DNA began during June 2009 in the upper Illinois River and continued through August 2010 at other locations, including the Des Plaines River, CAWS, and near shore areas of Lake Michigan (see Appendix B - Tables B3 and B4 for 2009 results summary). Sample analysis transitioned from the UND laboratory in South Bend, Indiana to USACE's Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi during

summer 2010. Sampling for eDNA began again on October 6 and continued through December 7, 2010. During fall, a total of 520 water samples were taken from the CAWS upstream of the Dispersal Barrier and 107 were taken from the Lockport Pool downstream of the barrier. An additional 114 samples were collected from the Des Plaines River between Hoffman Dam and the Lemont Road Bridge. Each sample was analyzed for bighead carp and silver carp DNA for a total of 1,482 analyses (Appendix B - Table B5).

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. Until completion of additional research to calibrate eDNA results and assess potential alternative sources of DNA in the waterway, the MRRWG views positive eDNA results as an indicator of the possible presence of live Asian carp. 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 targeted rapid response removal actions.

Methods: In general, IDNR and USFWS will collect 120 water samples on Monday or Tuesday of each week from locations outlined below. Samples will be transferred to USACE biologists at the USEPA laboratory in Chicago where they will be filtered and preserved on dry ice. Preserved samples will be shipped overnight to the ERDC for analysis. Results will be posted on a USACE web site after analysis of each sampling event is complete (about 10 days). A general description of eDNA methods is given below. Detailed field, laboratory, and reporting protocols are available in the eDNA Quality Assurance Project Plan (USACE 2011).

Locations-Samples will be collected weekly from April through November (weather permitting) such that Lake Calumet and each partial barrier to Lake Michigan are sampled once each month (N = 114 samples and 6 cooler blanks per week for 3 weeks; Figure 4). This sampling is complementary to fixed site sampling conducted with conventional gears in the locations listed below.

- North Shore Channel from the Wilmette Control Works to the North Branch Chicago River (120 Samples)
- Chicago Lock to Bubbly Creek, including the Chicago River and South Branch Chicago River (120 samples)
- Little Calumet River downstream of O'Brien Lock (60 samples) and Lake Calumet (60 samples)

An additional 120 samples will be available each month (4^{th} week). These samples will be used for sampling associated with rapid response actions or to monitor the Upper Des Plaines River, CSSC and Calumet-Sag Channel confluence, the CSSC upstream and downstream of the Dispersal Barrier, or other locations determined to be strategically important (e.g., re-sampling a site with previous positive detections for Asian carp DNA). The USACE will provide site maps with specific sampling locations for each weekly sample 1-2 weeks prior to each sampling event. Accessing the Des Plaines River by boat is limited in this section of river due to the shallow and often braided channel. Locations that provide access by small motor boat include the Riverside Station, Columbia Woods Station, and Lemont Road Station (see Appendix C for maps of Station locations). Riverside Station is located in the upstream portion of this reach immediately

below the Hoffman Dam. Columbia Woods Station is located mid reach and Lemont Road is located in the lower portion of the reach. Forty samples will be collected at each Des Plaines River station. Likewise, sampling at the CSSC location will be split so that 60 samples will be collected from upstream and 60 samples from downstream of the Dispersal Barrier. Samples from Lake Calumet (N = 60) will be distributed around the lake in backwater slips/bays and open water areas.

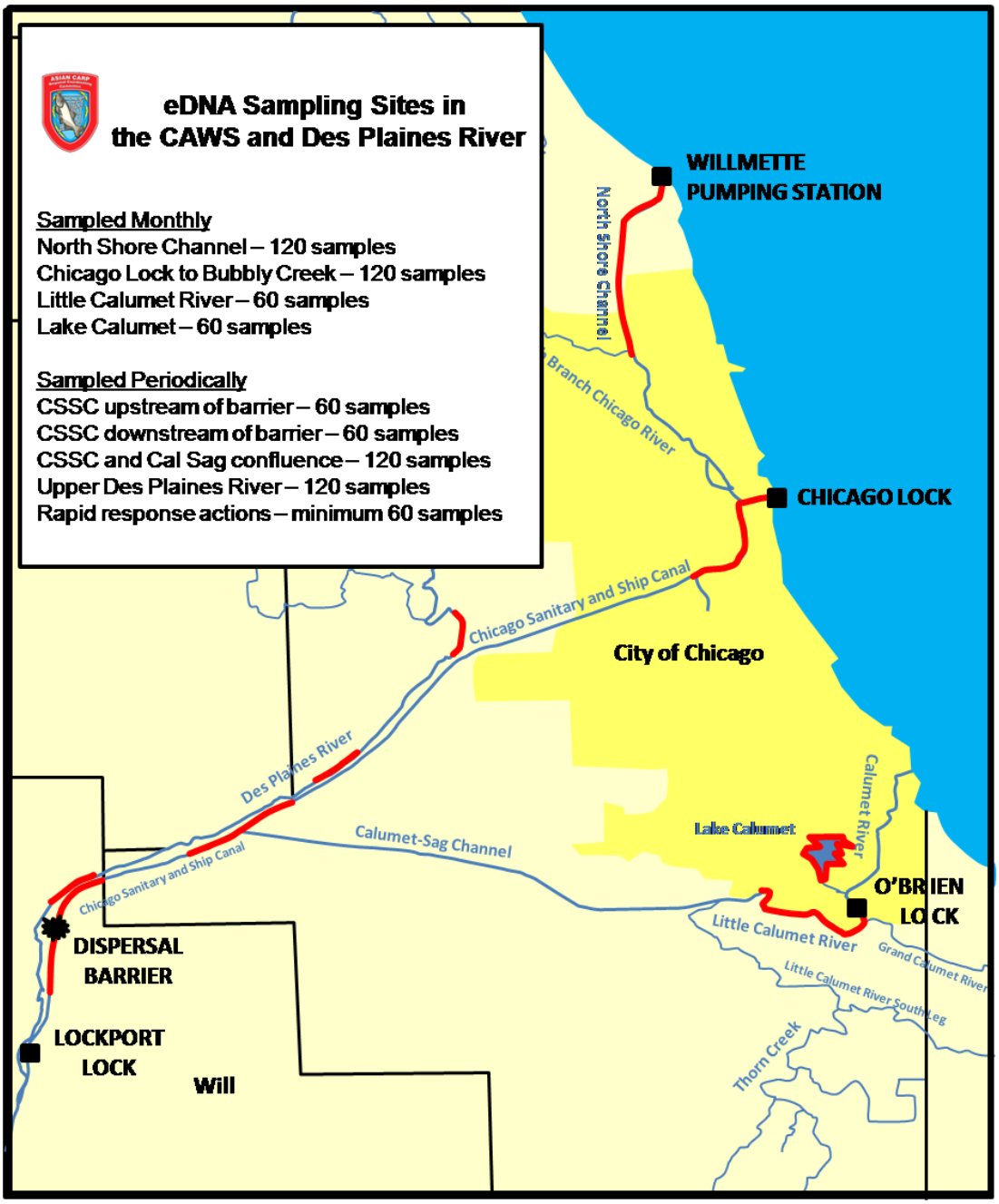


Figure 4. Locations for eDNA sampling in the CAWS and Upper Des Plaines River.

The proposed strategy allows for eDNA sampling to take place in support of conventional gear or rotenone rapid response actions or other evaluations that might occur at locations other than those identified above. Sampling priority has been established from high to low to facilitate scheduling and is: 1) rapid response action support; 2) Lake Michigan barriers and Lake Calumet; 3) CSSC upstream and downstream of the Dispersal Barrier; 4) CSSC and Calumet-Sag Channel confluence; and 5) upper Des Plaines River. A minimum of 60 samples is recommended for each eDNA sampling events to reduce the probability of obtaining false negative results. Changes to the sampling frequency and/or procedures may be made by the MRRWG, as needed to minimize the risk of Asian carp entering the CAWS upstream of the barrier.

In addition to long term eDNA monitoring outlined above, there is a desire by the workgroup to sample multiple stations throughout the CAWS in single 2- to 3-day sampling events (600-900 samples; Objective 3). This "snap-shot-in-time" sample of the entire system will provide the best available data to draw rough inferences of instantaneous Asian carp DNA distribution and answer basic questions of Asian carp abundance in the CAWS, assuming DNA indicates the presence of a live fish (e.g., Is one fish producing all positive eDNA detections?). Logistical concerns and limitations in sample filtering and processing capacity prevent a snap shot eDNA sample from being obtained at this time. However, research is currently underway to identify possible sources of additional funding and potential opportunities for expanded filtering and sample processing capacity. System-wide eDNA sampling may be pursued pending favorable results of current research efforts and a final decision by the MRRWG.

eDNA Sample Collection Protocol.

1) The sampling boat and transport trailer must be disinfected prior to launching by spraying the outer surfaces (i.e., hull, motor, etc.) with a hand-held sprayer containing a prepared 10% bleach/water solution.

   Caution: Lifejackets are to be worn at all times in transport vessels (boats). Additionally, disposable latex or nitrile gloves are to be worn when collecting water samples and measuring water depth and temperature. Be aware of pollutants in the aquatic environment and related health hazards.

2) Prior to launch, crew members will be given their specific duties for the sampling trip. One crew member will be designated as the boat operator and will be in charge of driving the vessel to sample locations. A second crew member will be designated as the lead sampler and will be in charge of collecting all water samples and measuring water depth and temperature. A third crew member will record GPS locations and habitat measurements for each water sample on a datasheet.
3) Sampling will begin at the first transect located at the upstream end of the reach to be sampled and will proceed in a downstream direction.
4) When arriving at a sample site, the lead sampler will put on sterile exam gloves (powderless latex or nitrile).
5) Going in consecutive order, the lead sampler will remove a labeled 2L sample bottle from the sample cooler.

6) Just prior to collecting the sample, the lead sampler will unscrew and remove the lid from the sample bottle.
7) The lead sampler will then reach over the upstream side or the bow of the boat with the 2L sample bottle and fill the bottle by skimming the water surface. The sample bottle should not be submerged or dipped beyond the upper 2 inches of the surface water for sample collection.
8) Once the sample bottle is completely filled (approximately 1 inch of space should be left within the sample bottle) the lead sampler will screw the lid back on to the bottle until it is tight. The closed bottle then will be returned to the sample cooler from which it was removed.
9) The lead sampler will take a surface water temperature and depth measurement at the sample site. The data recorder will record the bottle ID number, GPS location, time of sample, water temperature, and water depth on the data sheet.
10) If the lead sampler pulls a transport blank (2L of DI water filled prior to trip) from the cooler, the sampler will unscrew and remove the lid to expose the bottle contents to the atmosphere for 5 seconds, reseal the bottle, fully submerge the bottle in the field water, and return the bottle to the sample cooler from which it was removed. The lead sampler should relay to the data recorder that the sample was a blank, so that it can be recorded on the data sheet next to the appropriate ID number. The next regular water sample then will be collected at the same site where the blank sample was taken.
11) Steps 3 through 10 should be repeated until sampling has been completed for the targeted reach.
12) Once sampling is complete, ice will be added to the sample coolers as soon as possible. Enough ice should be added to each cooler to completely surround each sample bottle and maintain an inside temperature of 40°F. If at any time during transport the inside temperature of the cooler(s) rises above 40°F, additional ice should be added.
13) Chain-of-custody (COC) forms will be completed for every sample. All samples, including blanks, will be logged onto COC forms. The forms will be collected and signed whenever the coolers are transferred between parties.

Suggested boat launches for eDNA sampling.
North Shore Channel – Oakton Street Launch in Skokie. Contact Scott Runkle at Skokie Park District if problems arise.

Chicago Lock to Bubbly Creek – Western Avenue Launch – No contact needed.

Little Calumet River – O'Brien Lock Launch – Contact the O'Brien Lockmaster for permission. Will need to launch at O'Brien Lock and lock through to sample downstream of lock and dam.

Lake Calumet – O'Brien Lock Launch – Contact the O'Brien Lockmaster for permission.

CSSC and Calumet-Sag Channel confluence – Worth Boat Launch – Contact Village of Worth Police Department to gain access when gate is locked.

Des Plaines River stations – Difficult launches over river bank requiring a small johnboat (<15-foot) and motor. For Riverside Station, access river from park west of Riverside Public Library.

For Columbia Woods Station, access Columbia Woods Forest Preserve from Willow Springs Road. For Lemont Road Station, access river from Canal Bank Road east of Lemont Road.

CSSC near Dispersal Barrier – MWRD's Cargill Elevator Launch or Hanson Materials Romeoville Barge Slip – Use of these launches requires property owner permission. For the MWRD launch, contact Martin Castro or Phil Nieman at Lockport Power Station. For the Hanson Materials launch contact Darren Melvin. Samplers may need to motor through the Regulated Navigation Area (RNA) to access the canal upstream of the barriers. No activity is allowed in RNA (transport directly through area); boats longer than 20 feet and type-1 PFDs required.

Sampling Schedule: A tentative sampling schedule for 2011 is shown in the table below. Date and agency assignments will remain fixed, whereas the station sampled will be assigned for each week by USACE following monitoring plan protocols described above.

Date	Agency	Date	Agency	Date	Agency
Apr 4/5	IDNR	Jul 5	IDNR	Oct 3/4	IDNR
Apr 11/12	USFWS	Jul 11/12	USFWS	Oct 11	IDNR
Apr 18/19	IDNR	Jul 18/19	USFWS	Oct 17/18	USFWS
Apr 25/26	USFWS	Jul 25/26	IDNR	Oct 24/25	USFWS
May 2/3	IDNR	Aug 1/2	USFWS	Oct 30/1	IDNR
May 9/10	USFWS	Aug 8/9	IDNR	Nov 7/8	USFWS
May 16/17	IDNR	Aug 15/16	USFWS	Nov 14/15	IDNR
May 23/24	USFWS	Aug 22/23	IDNR	Nov 21/22	No Sample
May 31	IDNR	Aug 29/30	USFWS	Nov 28/29	USFWS
Jun 6/7	USFWS	Sep 6	IDNR	Dec 5/6	IDNR
Jun 13/14	IDNR	Sep 12/13	USFWS	Dec 12/13	USFWS
Jun 20/21	USFWS	Sep 19/20	IDNR		
Jun 27/28	IDNR	Sep 26/27	USFWS		

Deliverables: Results of each sampling event will be reported on the USACE website http://www.lrc.usace.army.mil/AsianCarp/eDNA.htm within 2 weeks of sample collection. Data will be summarized and project plans updated for annual revisions of the MRRP.

LARVAL FISH AND PRODUCTIVITY MONITORING IN THE ILLINOIS WATERWAY

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

Location: Larval fish and productivity sampling will take place at nine sites in the Illinois and Des Plaines River downstream of the Dispersal Barrier (LaGrange, Peoria, Starved Rock, Marseilles, Dresden, and Brandon Road Pools), and at three sites in the CAWS upstream of the Dispersal Barrier. Productivity sampling will also occur at two additional sites in the CAWS.

Introduction and Need: Factors affecting the early life stages of fish strongly affect recruitment to adult populations. The rapid establishment and continued spread of bighead carp and silver carp in the Illinois Waterway is in part due to their ability to reproduce and for their young to survive under the prevailing environmental conditions found in this system. Information on the distribution of Asian carp larvae and eggs across space and time is needed to identify adult spawning areas, determine reproductive cues, and characterize relationships between environmental variables and survival of young Asian carp. Larval fish sampling will be used to assess the timing and extent of Asian carp reproduction in the Illinois River, and may prove to be an early detection method in the CAWS. This information may also be useful for designing future control strategies that target Asian carp spawning and early life history.

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 are likely to associate with areas of higher productivity. Identifying such areas by sampling nutrient concentrations, chlorophyll *a* concentrations, 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 areas where Asian carp are reproducing;
2) Determine the timing of 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 abundance of Asian carp eggs and larvae.

Productivity variables are being measured to;

1) Identify high-productivity areas where Asian carp are likely to be located;
2) Determine relationships between productivity and the abundance of Asian carp and other planktivorous fishes; and
3) Examine relationships among nutrients, phytoplankton, and zooplankton density in the Illinois Waterway.

Status: In 2010, larval fish and productivity sampling was conducted from June 3 – October 2. Overall, 94 person-days of labor were expended to collect 238 larval fish samples and 109 nutrient, chlorophyll, and zooplankton samples. Larval and early-juvenile Asian carp were only collected in early June, from the Illinois River at Havana (See Appendix B - Table B1 and B2). Future sampling will need to occur earlier in the year to correspond with peak spawning times for Asian carp and other fish species. Processing of nutrient, chlorophyll, and zooplankton samples is ongoing. Preliminary data suggests that nutrient and chlorophyll *a* concentrations vary considerably within the CAWS, with Bubbly Creek, the Calumet-Sag Channel, and Lake Calumet being more eutrophic than other areas. Lake Calumet in particular appears to be highly eutrophic, and anecdotal observations indicate very high zooplankton densities in this area.

Methods: Four larval fish samples are being collected at each of the nine sites downstream of the electric barrier, and at the three sites in the CAWS (see table below). Samples are collected using a 0.5 m-diameter ichthyoplankton push net with 500um mesh. Sampling transects are 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 is pushed upstream using an aluminum frame mounted to the front of the boat. Boat speed was adjusted to obtain 1.0 – 1.5 m/s water velocity through the net. Flow is measured using a flow meter mounted in the center of the net mouth and is used to calculate the volume of water sampled. Fish eggs and larvae are collected in a meshed tube at the tail end of the net, transferred to sample jars, and preserved in 90-percent ethanol. The presence of any fish eggs is being noted and all eggs will be retained for future analyses. Larval fish are being identified to the lowest possible taxonomic unit in the laboratory.

Pool	Waterbody	Location	Larval Fish	Productivity
LaGrange	Illinois River	Lilly Lake	X	X
LaGrange	Illinois River	Bath Chute	X	X
LaGrange	Illinois River	Havana	X	X
LaGrange	Illinois River	Peoria Dam Tailwater	X	X
Peoria	Illinois River	Henry	X	X
Starved Rock	Illinois River	Ottawa	X	X
Marseilles	Illinois River	Morris	X	X
Dresden Island	Des Plaines River	Treats Island / I-55	X	X
Brandon Road	Des Plaines River	Des Plaines/CSSC confluence/	X	X
Lockport	Cal-Sag Channel	Worth Boat Ramp		X
Lockport	Little Calumet River	I-57 to Indiana Ave. (Fixed Site 2)	X	X
Lockport	Chicago Sanitary & Ship Canal	Kedzie Ave. to Damen Ave. (Fixed Site 3)	X	X
Lockport	North Branch Chicago River	Wilson Ave. (Fixed Site 4)		X
Not applicable	Lake Calumet	several sites w/in lake (Fixed Site 1)	X	X

Productivity patterns are being evaluated by measuring total phosphorus and chlorophyll *a* concentrations, as well as zooplankton abundance. Water samples are collected at each site using an integrated tube sampler lowered to twice the secchi depth. Chlorophyll *a* concentrations are estimated fluorometrically with an acetone extraction, and total phosphorus

concentrations are determined by measuring sample absorbance with a spectrophotometer after an acid molybdate extraction. Zooplankton are being collected by obtaining vertically-integrated water samples using a diaphragmatic pump. At each site, 90 L of water is filtered through a 63 μm mesh to obtain crustacean zooplankton, whereas 10 L of water is filtered through a 20 μm mesh to obtain rotifers. Organisms are transferred to sample jars and preserved in Lugols solution (4%). In the laboratory, individual organisms are being be separated into major taxonomic groups, counted, and measured using a digitizing pad. Densities are being calculated as the number of individuals per liter of water sampled.

Sampling Schedule: In 2011, sampling will occur seasonally (spring, summer, and fall) at all sites. Multiple visits to each site will occur each season. Sampling may occur more frequently during periods when Asian carp eggs and larvae are likely to be present (e.g., during spring months, during periods of rising water levels, or shortly after peak flows).

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

YOUNG-OF-YEAR AND JUVENILE ASIAN CARP MONITORING

Participating Agencies: IDNR, INHS, USFWS, and USACE

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

Introduction and Need: Bighead 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 and 30 ºC 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 that 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 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 mesh fencing used for the separation project. Whereas larvae washed into the CSSC likely would be transported downstream past the 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 long might be capable of swimming upstream past the Dispersal Barrier at the current settings (Holliman 2011). An additional threat may occur if juvenile Asian carp from spawning events in downstream pools migrate 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 was incorporated in other monitoring projects during summer and fall 2010. Electrofishing protocols for fixed site monitoring upstream and downstream of the Dispersal Barrier were modified to include small fish sampling. Small mesh experimental gill nets (mesh sizes = 0.75-2.0 inches) were added to the gear evaluation study and fished at several stations in the Illinois River, Des Plaines River, and CAWS. In addition, we used mini-fyke nets in combination with electrofishing and experimental gill nets during two fall sampling events in the Lockport Pool downstream of the Barrier (see Barrier Maintenance Fish Suppression Project and Appendix B - Tables B1 and B2).

Methods: In 2011, sampling for young-of-year and juvenile Asian carp will take place through other projects of the MRRP. Projects included are Larval Fish and Productivity Monitoring, Fixed Site Monitoring Upstream of the Dispersal Barrier, Fixed Site Monitoring Downstream of the Dispersal Barrier, Reach Sampling Upstream of the Dispersal Barrier, Gear Efficiency and Detection Probability Study, Des Plaines River and Overflow Monitoring Project, and Barrier Maintenance Fish Suppression Project. DC electrofishing protocols will be modified such that schools of small fish <6 inches long (typically gizzard shad) will be subsampled by netting a portion of each school encountered during each electrofishing run. 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.

Mini-fyke nets and small mesh experimental gill nets will be fished at several stations in the Illinois Waterway and CAWS (see Gear Efficiency Study) and in the Lockport Pool (see Barrier Maintenance Fish Suppression). These gears will be set in shallower habitats off of the main navigation channel and fished for periods of 3-4 hours, or in some cases overnight. Small mesh gill nets and mini-fyke nets will be incorporated into fixed site monitoring plans if successful spawning and recruitment of young Asian carp progresses up the waterway closer to Lake Michigan.

Additional sampling gears that target small fish, such as midwater trawls, purse seines, and cast nets are currently being evaluated. We will add new gears to our arsenal of sampling tools pending results and recommendations of current researchers. Incorporating additional gears in sampling protocols should be possible within the existing set of projects outlined in the MRRP.

Sampling Schedule: Small fish sampling will take place from April through November 2011, as part of other monitoring projects in the MRRP.

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 MRRP.

RAPID RESPONSE ACTIONS IN THE CAWS

Participating Agencies: IDNR (lead), INHS and USFWS and USACE (field support), USCG (waterway closures when needed), USGS (flow monitoring 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), chemical piscicides (e.g., rotenone), or both 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. In this plan, we propose a threshold framework for response actions with conventional gear or rotenone. The proposed thresholds are meant to invoke consideration of removal actions by the MRRWG, and are not intended to be rigid triggers requiring immediate action. The final decision to initiate a rapid response action and the type and extent of the action ultimately will be 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 the Dispersal Barrier when warranted;
2) Develop a threshold framework for response actions with conventional gears and rotenone to guide management decisions; and
3) Determine Asian carp population abundance through intense targeted sampling efforts at locations deemed likely to hold fish.

Status: Actions to capture and remove Asian carp from the CAWS began in May 2010 and will continue as needed. This past year, we completed three removal actions with conventional gears (North Shore Channel, CSSC/Bubbly Creek, and Lake Calumet) and one with rotenone (Little Calumet River). Three of the actions took place at locations that had positive detections of Asian carp DNA on multiple sampling trips and one, the Lake Calumet action, was triggered by the capture of a live bighead carp during fixed site monitoring. Sampling effort combined across actions included 86.5 hours of electrofishing (49 runs), 26,433 yards of trammel or gill net (144 sets), two 800 foot commercial seine hauls, 458 eDNA samples (916 analyses), and treatment of 173 acres (2.6 miles) of river with rotenone (see Appendix B -Table B1 for conventional gear data summaries and Table B5 for 2010 eDNA data summaries).

Methods: We will use conventional gears and/or rotenone to capture and remove Asian carp from the CAWS upstream of Lockport Lock and Power Station, and eDNA testing to inform decisions regarding the success of removal efforts and when individual actions should be terminated. Each response action will be unique to location, perceived severity of the threat, and

likelihood of successfully capturing an Asian carp. For example, consecutive positive DNA detections 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 bighead or silver 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 RCC Asian Carp Framework (see hydro-gun, gear evaluation, and alternative gear projects in this plan and pheromone research outlined in the 2011 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 rapid response actions when they have been sufficiently vetted and shown to be of practical use.

Threshold Framework-The proposed thresholds for response actions with conventional gears and rotenone apply to monitoring efforts in the CAWS upstream of the Dispersal Barrier. 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 MRRWG.

The framework includes three levels of response triggers and a feedback loop that advises for continued sampling or an end to the action (Figure 5). The first threshold level (Level 1) includes either three consecutive eDNA sampling events with positive detections for bighead carp, silver carp, or both species, or 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 would include the capture of a single live bighead 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. Collecting water samples for eDNA analysis at the completion of each response action will determine whether Asian carp eDNA is still present in the targeted sampling area and inform decisions to continue sampling or terminate the response. The final decision to terminate a response will rely on best professional judgment of participating biologists, managers, and agency administrators.

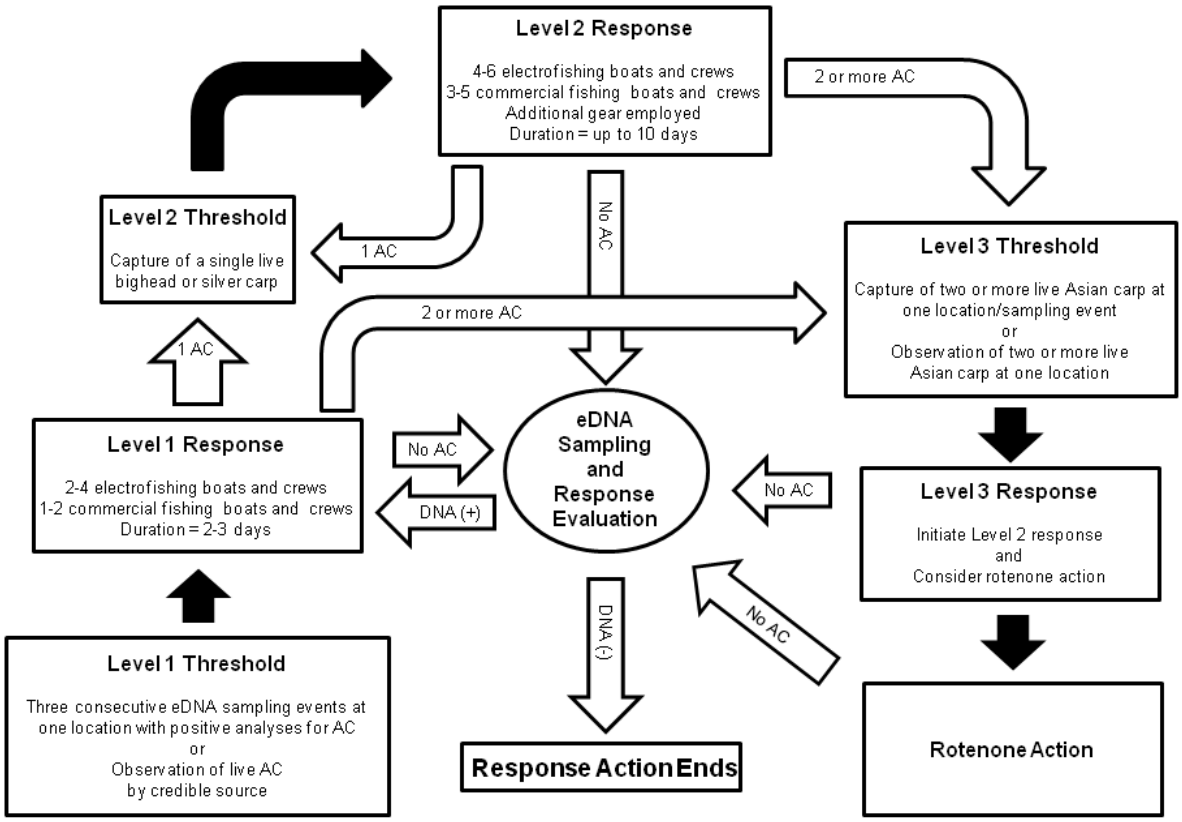


Figure 5. Thresholds for Asian carp (AC) response actions with conventional gears and rotenone.

Sampling Schedule: It is not possible to provide a detailed sampling schedule for this project because removal actions are dependent upon results of conventional gear and eDNA monitoring and recommendations of the MRRWG. Five commercial fishing crews and IDNR observers will be deployed to several locations in the CAWS upstream of the Dispersal Barrier for 2 weeks in March to search for live Asian carp where eDNA evidence suggests they might be. Additional sampling events will likely take place in the CAWS during the 2011 field season.

Deliverables: Results for each removal action will be reported daily during events and compiled for weekly sampling summaries. Data will be summarized and project plans updated for annual revisions of the MRRP.

FIXED SITE MONITORING DOWNSTREAM OF THE DISPERSAL BARRIER

Participating Agency: IDNR

Location: Monitoring will take place in the CSSC below the dispersal barrier downstream to the Des Plaines River; the Des Plaines River down to the confluence with the Kankakee River; and the Illinois River downstream to the Starved Rock Lock and Dam.

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 above the Dispersal Barrier. In 2010 it was determined that it would be advantageous to know the distribution and abundance of Asian carp below the Dispersal Barrier. A monitoring plan was developed using electrofishing and contracted commercial fishers to sample for Asian carp in the four (4) pools below the Dispersal Barrier. Sampling results will contribute to our understanding of Asian carp population abundance below the Dispersal Barrier and possible threats to moving upstream in the CAWS.

Objectives: Standardized sampling will consist of DC electrofishing and contracted commercial netters to:

1) Monitor for the presence of Asian carp in the four pools below the 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 with DC electrofishing gear and July through September using trammel or gill nets. Net sampling did not take place during late fall because commercial fishing contracts expired in late September. In total, 42 person-days of labor were expended to complete 131 electrofishing runs (32.75 hours) and 59 trammel/gill net sets (6,950 yards; Appendix B – Table B2).

Methods: The sample design includes intensive electrofishing and netting at four fixed sites in each of the four pools below the Dispersal Barrier (Figure 6). Sampling will take place monthly from March through November. No sampling at fixed sites is planned for December, January, and February because several of the sites are typically ice covered during these months. 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 (backwater and side-channels).

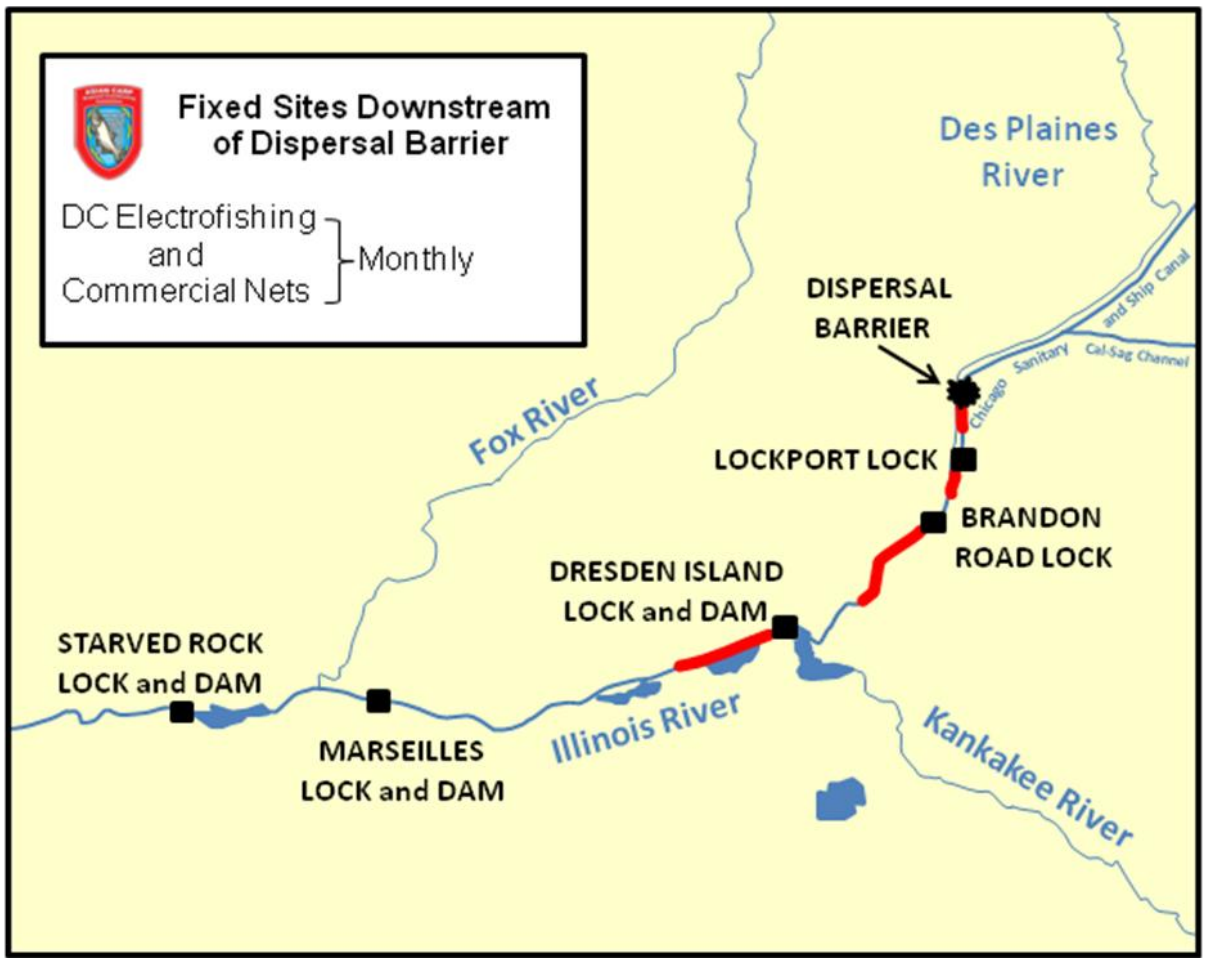


Figure 6. Fixed sites for electrofishing and commercial net sampling for Asian carp downstream of the Dispersal Barrier.

Fixed Sites Downstream of the Dispersal Barrier Description and Effort: A description of fixed site locations and sampling effort targets is summarized below. There are four (4) 15 minute electrofishing runs and four (4) 100 yard net sets in each of the four pools.

Lockport Pool –

- 1E1 starts at the Romeo Rd 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 Service Corp on the west side of the canal and goes downstream
- 1E3 starts at the upstream end of the Control 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 Service Corp.
- 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 start 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 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 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 DC current and include 1-2 netters (two netters preferred). Electrofishing will be completed in a downstream direction in areas with noticeable current velocity and runs will be generally parallel to shore (including following shoreline into off channel areas). The operator may switch the pedal on and off at times to prevent pushing fish in front of the boat and increasing the chances of catching an Asian carp. Common carp will be counted without capture and all other fish will be netted and placed in a tank where they will be identified and counted, after which they will be returned live to the water. 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 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. It is very likely that we will observe more Asian carp than we net because of the difficulty in capturing Asian carp with electrofishing gear. Sample data sheets are included in Appendix E. Crew leaders should fill in as much information on the data sheets as possible for each station/run and record the location for the start of each run either with GPS coordinates (preferred) or by marking on attached maps.

Netting Protocol – Contracted commercial fishers will be used for net sampling at the fixed sites and nets used will be large mesh (3.0-4.0 inches) trammel or gill nets 8 feet high and in lengths of 100 or 200 yards. Set locations within each fixed site will be left to the discretion of the commercial fishers. 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 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 (preferred) or by marking on attached maps. An IDNR biologist or technician will be assigned to each commercial net boat to monitor operations, record data, and check for ultrasonically-tagged Asian carp and common carp (left pelvic fin clips or telemetry surgery wounds on the ventral left area of the fish, posterior to the pelvic fin and anterior to the anal opening).

Suggested boat launches for fixed site sampling.

Lockport Pool – boat ramp below Rt. 7 Bridge at the old Cargill Grain Elevator

Brandon Road Pool – Boat launch just upstream of Ruby Street Bridge in Joliet on the west side of the river.

Dresden 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 – launch at Stratton State Boat Ramp below the Rt. 47 Bridge in Morris on the north side of the river.

Sampling Schedule: A tentative sampling schedule for electrofishing and netting for 2011 is shown in the table below.

Week of	Electrofishing	Week of	Netting
Mar 21	IDNR	Mar 21	IDNR
Apr 18	IDNR	Apr 18	IDNR
May 9	IDNR	May 9	IDNR
Jun 6	IDNR	Jun 6	IDNR
Jul 11	IDNR	Jul 11	IDNR
Aug 22	IDNR	Aug 22	IDNR
Sep 5	IDNR	Sep 5	IDNR
Oct 3	IDNR	Oct 3	IDNR
Nov 14	IDNR	Nov 14	IDNR

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 MRRP.

BARRIER DEFENSE PROJECT DOWNSTREAM OF THE DISPERSAL BARRIER

Participating Agencies: IDNR (lead) and USFWS (possible field assistance)

Location: The Barrier Defense Project includes the area between the Starved Rock L&D up to the Dispersal Barrier at Romeoville. Primary areas that will be fished include Marseilles and Dresden pools, though effort will be expended in Brandon, Lockport and Starved Rock pools.

Introduction and Need: This program was established to reduce the numbers of Asian carp below the Dispersal Barrier through controlled commercial fishing. Reducing the number of Asian carp below the Dispersal Barrier will hopefully reduce the chances of the carp gaining access to waters upstream of the Barrier. The program will also allow us to monitor over time population densities of Asian carp in the four (4) pools immediately below the Dispersal Barrier.

Objectives: Five to ten commercial fishers will be employed to:

1) Harvest as many Asian carp as possible in the area between the Starved Rock Lock and Dam and the Dispersal Barrier. Harvested fish will hopefully be picked up and utilized by private industry; and
2) Gather information that will allow us to determine the movement of Asian carp up the waterway, as a supplement to fixed site monitoring.

Status: Harvest of Asian carp from the Des Plaines and Illinois rivers by contracted commercial fishers occurred from 22 June – 28 September 2010. Most of the sampling effort was concentrated in the Marseilles and Dresden Island pools, although some netting took place in the Lockport Pool downstream of the Dispersal Barrier and in the Brandon Road Pool. See Appendix B – Table 2 for effort and harvest summaries.

Methods: Five to ten commercial fishers will be deployed during at least twenty weeks from March through December 2011. There will be a week of no fishing between weeks of fishing to allow the fish to repopulate the habitats the Asian carp prefer. Constantly fishing the same area drives the fish out and greatly reduces catches. Commercial fishers will arrive on Monday of each week and fish Tuesday through Friday. Each boat will set a minimum of 1000 yards of 3" to 4" mesh trammel/gill nets each day. The nets will be set at the discretion of the commercial fisher with input from the IDNR biologist assigned to each boat to supervise daily activities. The biologist also will check the catch for ultrasonically-tagged Asian carp and common carp (left pelvic fin clips or telemetry surgery wounds on the ventral left area of the fish, posterior to the pelvic fin and anterior to the anal opening). The number of silver and bighead carp harvested will be enumerated at each location fished. A representative sample of each species will be weighed to estimated total pounds harvested. Common carp will also be harvested with the remaining by-catch being released immediately to the water where taken. At the end of the day the catch will be transported to the boat ramp where the fish will be transferred to a refrigerated truck or dumpster depending on the disposal contract.

Suggested boat launches for barrier defense harvesting.

Lockport Pool – boat ramp below Rt. 7 Bridge at the old Cargill Grain Elevator

Brandon Road Pool – Boat launch just upstream of Ruby Street Bridge in Joliet on the west side of the river.

Dresden 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 – launch at Stratton State Boat Ramp below the Rt. 47 Bridge in Morris on the north side of the river.

Starved Rock Pool – launch at Allen Park Boat Access across from Ottawa off Route 71 on the south side of the river.

Sampling Schedule: A tentative sampling schedule for deploying commercial fishers in 2011 is shown in the table below.

Week of	Agency	Week of	Agency
Apr 11	IDNR	Aug 1	IDNR
Apr 25	IDNR	Aug 15	IDNR
May 9	IDNR	Aug 29	IDNR
May 16	IDNR	Sep 12	IDNR
Jun 6	IDNR	Oct 17	IDNR
Jun 20	IDNR	Oct 24	IDNR
Jul 11	IDNR	Nov 14	IDNR
Jul 18	IDNR	Dec 5*	IDNR

* Weather permitting.

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 MRRP.

TELEMETRY MASTER PLAN

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

Location: Telemetry monitoring will take place in the Marseilles, Dresden Island, Brandon Road, and Lockport pools, CSSC, South Branch Chicago River, and the Calumet-Sag Channel.

Introduction and Need: The telemetry master plan includes the tagging of fish with individually coded ultrasonic transmitters in the Upper Illinois Waterway; the acoustic network proposed is comprised of 32 acoustic receivers and supplemented by a mobile hydrophone unit to collect information from tags (N=200) implanted into free-swimming Asian carp (bighead carp and silver carp) and surrogate species. The acoustic receivers are to be deployed at sites shown in Figure 1. The purpose of the telemetry plan is to monitor fish movements in the immediate vicinity of the Dispersal Barrier to determine if fish are able to challenge and/or penetrate the barrier; if Asian carp are able to navigate through lock structures in the Upper Illinois Waterway; and to determine the leading edge of the Asian carp population.

Asian carp will be collected from the Dresden Island and Brandon Road pools of the Illinois Waterway; surrogate species will be collected from the Lockport and Brandon Road pools of the Illinois Waterway. Tagged surrogate fish will be released both above and below the Dispersal Barrier. However, no tagged Asian carp will be transported to an upstream pool, nor will any Asian carp caught in Lockport Pool be tagged and returned to the pool. All fish will be released at or near point of capture.

Assessing the Dispersal Barrier effectiveness is paramount, but cannot be determined by telemetry alone. Instead, we propose a relationship where individual probabilities of detection of telemetry (derived from the adequate number of fish to be tagged, the detection rate using stationary and mobile tracking) are added to the probabilities of detection for other monitoring tools (electrofishing, netting, eDNA surveillance, DIDSON imagery). Using telemetry as a parameter with the other monitoring tool parameters will give us a confidence range of describing barrier effectiveness.

Objectives: The purpose of this Telemetry Master Plan is to assess the effect and efficacy of the Dispersal Barrier on tagged fish in the upstream and downstream environment of the CSSC of the Illinois Waterway using ultrasonic telemetry. The goals and objectives have been identified as:

Goal 1: Determine if fish are able to challenge and/or penetrate the Dispersal Barrier (Barrier Efficacy)

- **Objective** Monitor the movements of tagged fish in the vicinity of the Dispersal Barrier using receivers (N=8) placed immediately upstream, within, and immediately downstream of the Dispersal Barrier, in addition to mobile tracking.
- **Objective** Determine if there is adequate detection coverage to effectively assess efficacy of the Dispersal Barrier.

Goal 2: Determine if Asian carp pass through navigation locks in the Upper IWW;

- **Objective** Monitor the movements of tagged fish at Dresden, Brandon Road, and Lockport Locks and Dams using stationary receivers (N=6) placed above and below each dam.

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

- **Objective** Describe existing conditions of habitat use and movement in the areas of the Upper IWW and tributaries where Asian carp have been captured and compare to areas in the CAWS where Asian carp are not currently present.
- **Objective** Integrate information between related studies (MWRD and Southern Illinois University).
- **Objective** Download, analyze and share telemetry data.
- **Objective** Maintain existing acoustic network and rapidly expand to areas of interest in response to new information.

Status: This ongoing project began in July 2010 with the installation of a VR2W receiver network in the upper Illinois Waterway, Des Plaines River, and CAWS. A total of 105 sonic tags were implanted into adult Asian carp and surrogate species during July – November 2010. The distribution of tagged fish is listed below.

- CSSC/SBCR (above Barrier): 20 surrogates
- Lockport Pool above Barrier: 20 surrogates
- Lockport Pool below Barrier: 29 surrogates
- Brandon Road pool: 19 surrogates
- Dresden Island pool: 17 Asian carp

Additional fish will be tagged during spring 2011. Monitoring tagged fish movements with fixed receivers and a mobile unit has shown that to date no fish have moved past the Dispersal Barrier or through local navigation locks.

Work Plan:

Sample size - Based on MRRWG expert opinion, it is recommended that 200 tags be implanted for telemetry monitoring. An existing resource of 100 tags was proposed to be implanted in 2010; and another 100 tags are proposed to be procured to enhance our monitoring capability (goal of 105 tags implanted by November 2010; 200 total tagged fish by spring 2011). To increase our confidence that we are adequately describing the behavior of an entire population, a power analysis is needed to ensure we are using an accurate number of fish to draw conclusions from. However, we are operating under many constraints and confounding factors in the Dispersal Barrier environment. Specifically, the exact population size of Asian carp is unknown, and varies greatly within the study limits. In Dresden Island pool, bighead carp are moderately abundant, yet silver carp seem to be rare (95 bighead carp and 1 silver carp were sampled from Dresden Island Pool during 2010 by electrofishing and contracted commercial netting). In Brandon Road pool, there has not been any live capture of either bighead or silver carp. In Lockport pool below the Barrier, one bighead carp was captured during the December 2009 rotenone event. In June 2010, one bighead carp was captured from above the Barrier in Lake Calumet, off the Calumet River. For surrogate species, the upper Illinois Waterway also has a

limited number of adequate species to select from (surrogate species selection is described in the next section), and often these fish are found in low abundance, especially below the Barrier. Tentatively, 200 tags is an estimate to implant to increase our confidence of adequately describing the behavior of populations in the upper Illinois Waterway. Better estimates of Asian carp populations is needed to determine the minimum number of tags to be used, and may need to be evaluated on a pool-by-pool basis.

Species selection (primary and surrogate) - Asian carp (bighead and silver carp) are the primary species of concern, and their direct response to the Dispersal Barrier is of the greatest importance. However, as mentioned previously, populations of both species vary and are considered rare near or at the Dispersal Barrier. Therefore, in order to test the direct response of fish, surrogate species are also selected for tag implantation and monitoring. Dettmers and Creque (2004) cited the use of common carp (*Cyprinus carpio*) as a surrogate species for use in telemetry in the CSSC because "common carp are naturalized and widespread throughout the CSSC and Illinois water bodies in general. Common carp are known to migrate relatively long distances and they grow to large sizes that approximate those achieved by invasive carps. Based on these characteristics, tracking of common carp should provide a good indicator of how Asian carp would respond to the dispersal barrier if they were in close proximity to this deterrent." These characteristics could justify the use of other species; we propose buffalo (smallmouth and black), grass carp (another species of Asian carp), and freshwater drum. Research on this topic is recommended and could be conducted at the USACE Engineer Research and Design Center (ERDC) in Vicksburg, MS. Using the flumes constructed to mimic the Dispersal Barrier environment to test bighead and silver carp response, the same set up could be used to test the environment on proposed surrogate species.

This recent testing of voltage parameters at ERDC indicated voltage settings may not be as effective on smaller fish from 2-3 inches long (Holliman 2011). To investigate this in the field setting, it is proposed that a number of smaller fish (TL less than 6 inches) be tagged in the immediate vicinity of the Dispersal Barrier and their movement monitored. In order to apply some of the lab based tests in the field, it is recommended that small fish (fish less than 6 in TL) should be released below and between Barriers 2A and 2B in two batches: one batch in spring 2011 during higher river stages, and the second in late summer 2011 during low flow conditions. Each batch will have between 10 and 15 tagged fish released, divided evenly between release below 2A and between 2A and 2B. Fish will be collected from nearby waterways (availability will decide fish species). Additionally, battery life of tags will be sacrificed (smaller tags to accommodate smaller fish have less battery life), so it may be prudent to implement daily mobile tracking on these fish.

Location selection - Based on MRRWG expert opinion, allocation of the 200 tags is proposed as:

Fall 2010

- 105 tags to be implanted into adult Asian carp and surrogate species (July - Nov 2010)

Spring 2011

- 60 tags into adult surrogate species (Lockport Pool) and Asian carp and surrogate species (Brandon Road Pool)

- 5 tags into Asian carp in Island Dresden Pool and 30 additional tags to be implanted into small fish (species to be determined) in Lockport pool below and between individual Dispersal Barriers
    - -15 tags in spring (high water)
    - -15 tags in late summer (low water)

The allocation of effort and resources for Oct-Nov 2010 and spring 2011 follows the strategy outlined in the priority areas. Tagged surrogate fish will be released both above and below the Dispersal Barrier at or near their point of capture; however, it is important to note that no tagged Asian carp will be released above the Lockport Lock and Power Station. The USACE, USFWS, INHS, and IDNR will assist in fish tagging and supply electrofishing boats and crews to capture and return fish to release points.

Tag specifications and Implantation procedure - V16 ultrasonic transmitters (69 kHz; 10 g in water and 65 mm in length; Vemco) for remote individual identification will be surgically implanted into adult bighead carp, silver carp, grass carp, freshwater drum, common carp, and buffalo species (smallmouth, black, bigmouth) during 2010 and 2011. Tagging efforts will be focused in July-August, and October-November of 2010; no tags will be placed into fish if extreme water temperatures (above 90°F) are present. Extreme water temperatures associated with the IWW increase chances of infection and add excessive stress on fish, increasing mortality.

Ultrasonic transmitters should be less than 2% of body weight (Winter 1996); adult fish implanted with V16 transmitters will be $\geq$ 1.1 lbs (500g) in weight. The V16 transmitters have a minimum life expectancy of 870 days. Smaller fish will be implanted with V6 transmitters (180kHz; 0.5g in water and 16.5 mm in length; Vemco); these transmitters have a life expectancy of 155 days. Small fish need to be a minimum of 0.09 ounces (2.5 grams) in weight.

Each transmitter will be tested for recognition prior to its use with a portable hydrophone and receiver (Vemco Model VH110 hydrophone, and Vemco Model VR100 receiver, respectively), supplied by USACE.

Asian carp will be collected from the Illinois Waterway, in Dresden Island pool (RM 271.5 to 286), Brandon Road Pool (RM 286 to 291), and Lockport Pool below the Dispersal Barrier (RM 291 to 296). Surrogate species will be collected from the Brandon Road Pool (RM 286 to 291), Lockport Pool below the Dispersal Barrier (RM 291 to 296) and above the barrier (RM 297 to 303). The primary method of capture will be electrofishing; although supplemental gear such as nets may also be used to harvest fish for tagging. Fish collected will be weighed, measured, and sex will be identified if possible.

Once captured, the fish will be moved to a holding tank with buffered (sodium bicarbonate) river water and carbon dioxide (CO_2) gas will be diffused into the tank for anesthetization or treated with clove oil for anesthetization (Summerfelt and Smith 1990). Once fish are anesthetized they will be measured (total length, TL, mm), weighed (kg), and placed in a V-board. Untreated river water will be circulated over their gills. Scales will be removed from the ventral left area of the fish, posterior to the pelvic fin and anterior to the anal opening. For the silver carp, the surgical

incision will be made further dorsally to account for the displacement of the body cavity due to the well-developed ventral keel. After the removal of scales, the area will be disinfected with betadine. All surgical utensils will be sanitized in 70% ethanol.

A scalpel (no. 22) and curved hemostats will be used to insert the tag and avoid damage to organs. The transmitter will be pushed down and away from the incision site to alleviate any added stress on the wound. Incisions will be closed with Ethilon® monofilament suture material attached to a FS-2 curved cutting needle using 5 to 7 simple interrupted sutures, as documented by Summerfelt and Smith (1990). The incision and sutures will also be sealed with cyanoacrylate resin (superglue gel) to prevent infection and to hold the wound and suture knots together securely. Fish will receive left pelvic fin clips to assist sampling crews in later identification of tagged fish. Immediately following the surgical procedure, fish will be placed in a recovery tank supplemented with oxygen. After the fish regains control of buoyancy and orientation, they will be released at the capture site (all capture sites will be identified with GPS coordinates). Fish will only be released if they are able to swim independently.

Acoustic Network:

Stationary Receivers - A system of passive receivers (Vemco VR2W Receiver) will be placed throughout the IWW in order to monitor movement. The receivers log data from tagged fish when they swim within the detection range of the receiver (typically at least one quarter mile of the receiver). The detection limits of each receiver will be tested with a test tag. VR2W's will be placed from below Dresden Island Lock and Dam (RM 271 of Marseilles Pool, Illinois Waterway) to above the Dispersal Barrier in the CSSC, Calumet-Sag Canal, Calumet River, and Chicago River (collectively referred to as the CAWS). In some areas, two VR2W's may be 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 will be deployed using a variety of methods: stationary deployment using a lead line or marked buoy, deployment on fixed structures (canal walls, mooring cells, lock guide walls), or USCG navigation marker buoys (USACE has secured agreement with USCG for this option). If needed, alternative deployments may be used (bridge or railroad structures) with the proper permissions. In the immediate vicinity of the Dispersal Barrier, receivers will be placed inside the canal walls in manhole covers constructed for previous telemetry studies. It is recommended the Dispersal Barrier environment have additional receivers deployed to ensure data recovery if one or more receivers are damaged. Given the need for heavy armoring, a bottom deployment may be necessary here.

Figure 7 shows the general strategy of VR2W placement (N=32 receivers). The priority is to achieve the most coverage (detection capacity) in the immediate vicinity of the Barrier, where most fish will be tagged, to determine if fish are challenging or passing through (upstream or downstream directional movement) the Dispersal 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. Movement through lock structures will be compared to USACE lockage data from Dresden Island, Brandon Road, Lockport, TJ O'Brien, and Chicago Lock structures. Leading edge movements will be monitored by the downstream receivers. Other significant movement patterns will also be compared to river stage and temperature data.

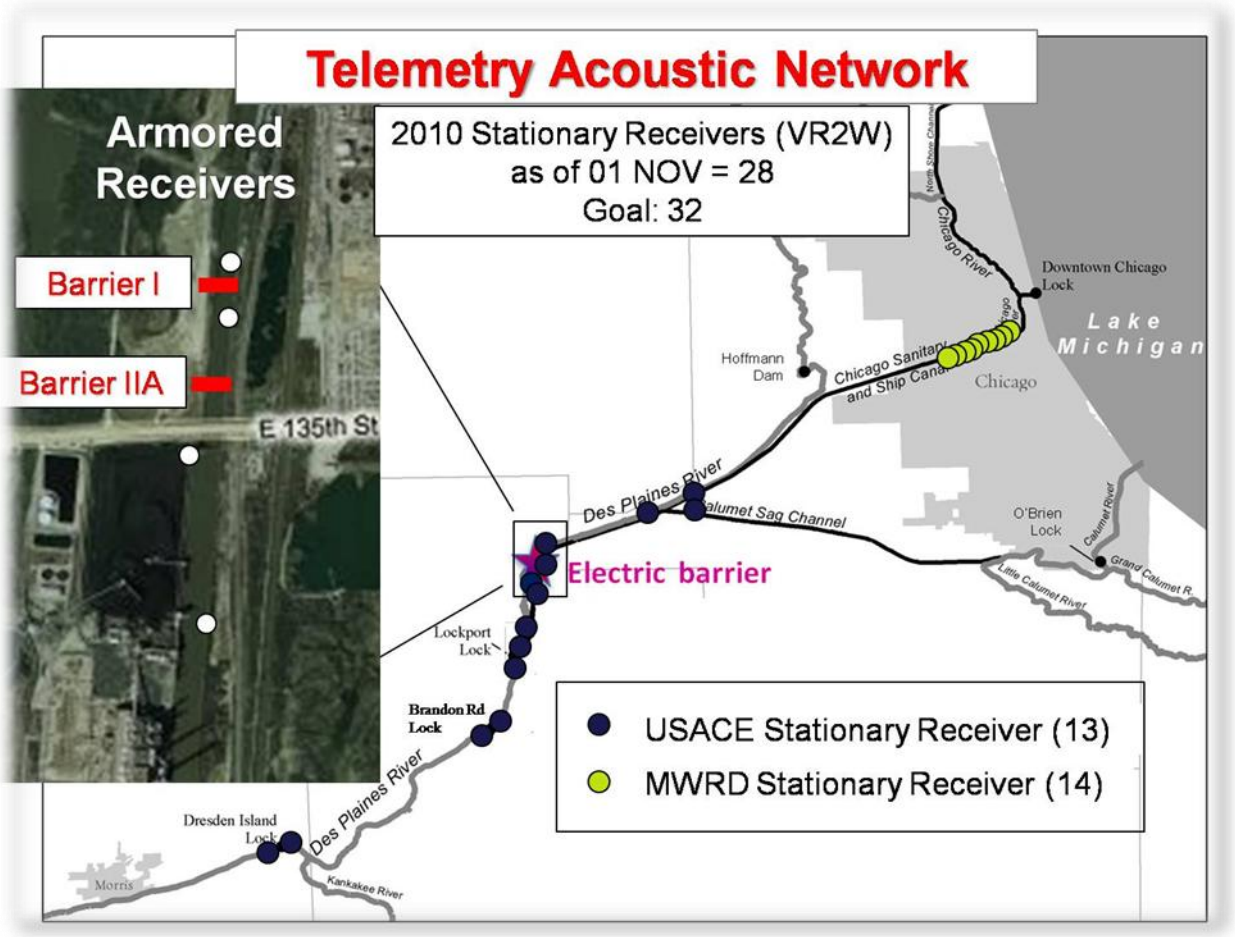


Figure 7. Overview map of VR2W receiver placement (as of 01 November 2010).

Receivers will be downloaded monthly to retrieve data for analysis, and for maintenance of the acoustic network (decrease risk of vandalism, ensure operation of device, check battery life, replacement if necessary). Receivers may be downloaded more frequently if needed. The USACE, USFWS, IDNR, and INHS will assist in downloading of receivers. All receivers can be downloaded with either a serial port and/or Bluetooth-USB capability. The software is available free from the Vemco website http://www.vemco.com/support/vue_dload_form.php. All files will be downloaded and sent to the USACE and USFWS Points of Contacts upon retrieval. A master tracking spreadsheet will be kept at http://www.lrc.usace.army.mil/ to record when receivers were downloaded and the condition of the receiver.

Mobile Tracking - The use of a mobile unit (portable hydrophone and receiver that is 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 should be used to occasionally locate all fish in the study area to ensure we still have the adequate number of active tags in the system being monitored. Since the stationary receivers give us an approximation of where a tagged fish is, the mobile unit can identify the exact location of any fish. This is useful if the stationary receiver data indicate a tagged fish has crossed the Dispersal Barrier, or to locate a fish that the receivers

have not been able to detect (can confirm viability of fish). The mobile unit should also be used when tagging small fish, with the decreased battery life, and to monitor fine scale movements. 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.

Contingency Measures:
Fish crossing Dispersal Barrier - As described above, any suspicion (indicated by stationary receiver data) of a tagged fish crossing the Dispersal Barrier can be confirmed by the mobile unit that 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 MRRWG, should 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.

Other Significant Movements - Other significant movements are defined as movements through lock structures, movements that extend the leading edge upstream or movements that do not coincide with the detection data from stationary receivers. In all cases, other significant movements should be verified by a mobile unit, and results communicated to agency leads and to the MRRWG.

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 because everyone will use compatible equipment and share data. The information gathered from this system will enhance the understanding of systemic movement in the basin. Additionally, any fish tagged from this effort that happen to move outside of our detection area may also be detected on other researcher's networks. A list of tagged fish will be available to other researchers.

Points of contact for other studies in the region using the Vemco acoustic telemetry system include:

- Dr. Jim Garvey and Sara Tripp, 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.
- Doug Bradley, LimnoTech, Tom Minarik, MWRD, Dr. Dave Wahl, University of Illinois. Species tagged in CAWS: largemouth bass. This study has immediately enhanced the acoustic network by deploying 14 VR2W receivers in the CSSC/Chicago River near Chicago Lock.

Sampling Schedule: A tentative work schedule is presented below.

July 2010	VR2W network installed; Tagging efforts focused in Lockport Pool (above and below Barrier), Dresden Island and Brandon Road Pools.
August 2010	Tagging efforts in the CSSC/SBCR; VR2W downloads
September 2010	VR2W network maintenance and downloads
October – November 2010	Tagging efforts in Lockport, Brandon Road, and Dresden Island pools; VR2W network maintenance and downloads; Mobile tracking
Spring 2011	Tagging efforts in Lockport and Brandon Road pools; VR2W network maintenance and downloads; Mobile tracking

Deliverables: Email updates to the MRRWG and agency leads will be provided before and after each trip (tagging or downloading efforts). All data will be available for sharing and reported out to the MRRWG.

EFFICACY OF THE AQUATIC NUISANCE SPECIES BARRIER IN THE CSSC, AS DETERMINED BY DUAL-FREQUENCY IDENTIFICATION SONAR

Participating Agencies: USFWS – Carterville (lead); USACE and USCG (project support)

Location: Surveys will take place in the CSSC at the Dispersal Barrier.

Introduction and Need: The aquatic nuisance species barrier system on the CSSC has been operating in some capacity since April 2002. At that time only a single barrier (Barrier I), commonly referred to as the Demonstration Barrier, was constructed and operational. In 2009 Barrier IIA began operation. Barrier IIA is a more robust barrier that is capable of producing electric fields greater in intensity than those created by Barrier I. A third barrier, Barrier IIB, is scheduled to come online in 2011.

Laboratory experiments that mimic the Dispersal Barrier and study fish behavior related to various electrical settings were used to determine the optimum operating parameters for the barriers subsequent to the installation of Barrier I based on Smith Root's patented design (Holliman 2011). Research and testing has included exposing juvenile silver carp 5.4 to 11 inches in length to barrier electric fields in a tank at various combinations of the three operating parameters (pulse frequency, pulse duration, and voltage). Results indicated that all of the fish tested were immobilized by the electric field currently in use since August of 2009 at Barrier IIA. Subsequent phases of testing have focused on smaller carp to determine whether small fish, 2-3 inches in length, will be immobilized or deterred by the current Barrier IIA settings. This information will be fully analyzed in USACE's Interim II Efficacy Study, in combination with other relevant information such as information regarding the safety implications of operating the Dispersal Barrier at higher parameters.

While the results of initial laboratory trials are sound, additional field trials are warranted, particularly with the new and presumably final barrier nearly complete and operational. We will conduct surveys with Dual-Frequency Identification Sonar (DIDSON) to examine abundance and behavior of fishes located in and around the Dispersal Barrier. In addition, DIDSON will be used to monitor the response to the barrier of various-sized fish (not Asian carp) placed in non-conductive cages dragged through the barrier field. These *in situ* assessments will add to our understanding of the effectiveness of the Dispersal Barrier in preventing fish passage between the Mississippi and Great Lakes basins.

Objectives: The objectives of this study are to:

1) Determine if fish are passing through the barrier(s) or if a possibility may exist for a passage event or events;
2) Determine relative abundances of fish above, in, near, and below the barrier to add ancillary evidence of any affinity, or lack thereof, of fishes to the barriers and barrier area.
3) Describe the behavior of known (caged) fish within the barrier.
4) Determine if debris is on the barrier hardware (e.g. arrays) and provide insight to the placement of future permanent sonar or other hydroacoustic units.

Status: This project was proposed in 2010 and has been reviewed and accepted by the MRRWG.

Methods: *Data Collection and Equipment Limitations*- DIDSON is an acoustic camera that can be used in turbid water to observe fish behavior and location in real time, with minimal disturbance. All field observations in this study will be taken with a DIDSON and all of the data gathered will be spatially and temporally referenced. Other data gathered during each recording or sampling event will include information on the settings of the DIDSON, water quality parameters (e. g. temperature and depth), and weather conditions. Observations will be made of wild fish and fish that are contained in cages.

As with all hydroacoustic technologies, the DIDSON has some technical limitations. DIDSON can measure the length of fish (Burwen et al. 2010) but is rarely able to determine species (Zeigler et al. 2009). Given this, any fish of a particular size observed during field measurements will be considered a surrogate for Asian carp when determining barrier efficacy. A single DIDSON unit will not provide complete cross-section coverage in the CSSC. The DIDSON can be set in a variety of ways to gather high quality images in close proximity to the unit, or to gather images of decreasing quality from a greater distance. Operating parameters of the DIDSON will be changed accordingly depending on the objective of the data being collected. Recent pilot studies have shown the Dispersal Barrier has no effect on the electronic components (Cornish et al 2010).

Caged Fish Behavior- Fish behavior in the barrier system will provide valuable information about the efficacy of the barrier for fish of different sizes. The DIDSON will be used to view the behavior of known surrogate fish (common carp, buffalo) that we place into non conductive cages.

Fish will be placed in cages for a 10 minute acclimation period to the cage before testing begins. The behavior exhibited at the end of the acclimation period will be used as the baseline "no reaction" behavior. Caged fish will then be moved through the barrier system and cage movement parameters (duration, location across the canal and distance traveled) will be recorded. We will also observe the behavior of fish in the cage at locations away from the Dispersal Barrier (control). For comparison, control fish will be put through the same process as the test fish where there is no electric input.

Fish behaviors will be documented by recording four simple behavioral observations including no response, fright/flight response, incapacitation, and recovery. Attempting to record more detailed behaviors would not be practical based on the limitations of the DIDSON, however we will take general notes on observed behavior.

In-Barrier Observations- To determine if fish are passing into or through the Dispersal Barrier, we will take DIDSON recordings at known locations at, and in, the barriers' electric field. Observations made in the field will consist of time marking of any significant, unusual, or unexpected events in the recordings so that they can easily be located during post processing. All other data will be recorded as above. Data will be viewed and cross referenced with a map of

the electric field to determine if, and where, fish are repelled by the electric field and the fields corresponding strength.

Dispersal Barrier Site Affinity by Fishes - Relative abundance of fish near, in, and at adjacent areas of the Dispersal Barrier will provide valuable information about affinity or lack of affinity of fishes to the barrier area. The DIDSON will be used to gather fish count data at randomly and systematically selected sites above and below the Dispersal Barrier. These data will be used for comparisons of fish count data at or near the barrier to determine if a significant difference exists.

Data Handling and Storage - All raw data collected in the field will be stored at the Carterville Fish and Wildlife Conservation Office in Carterville Illinois. The hard drives are backed up nightly to Minneapolis, Minnesota. Data will be shared openly with the USACE and any other interested parties.

Study Site and Safety Issues: The study site includes the area around the Dispersal Barrier and any adjacent areas in Lockport pool from Lockport Lock and Dam to the confluence of the CSSC and the Calumet-Sag Channel (Figure 8).

The USCG has designated the water around the barriers as a Regulated Navigation Area and enforces strict regulations for mariners operating in the area because of the high risks to human safety.

Close operation, communication and coordination with the USCG and the USACE will be essential to making this a successful project. We will seek a permit to "loiter" within the barrier area to carry out our field activities. Human health and safety is our number one concern.

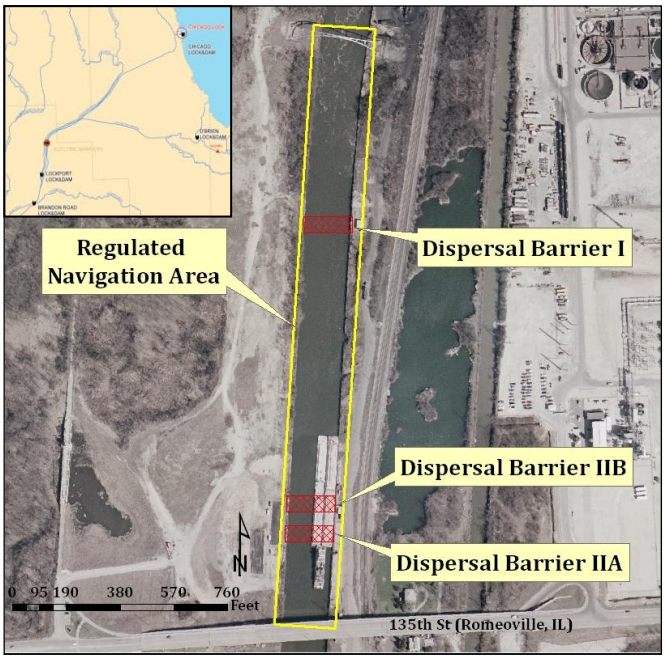


Figure 8. Location of the Dispersal Barrier in the CSSC.

Sampling Schedule: Surveys will be conducted during spring and summer 2011 at a yet to be determined date.

Deliverables: At the conclusion of this project, a written report and supporting video evidence of our findings will be produced and provided to the RCC, MRRWG, and any other interested parties. Based on our findings the study plan may be modified in order to serve as part of a longer term monitoring program.

MONITORING FOR ASIAN CARP IN THE DES PLAINES RIVER AND DES PLAINES RIVER OVERFLOW

Participating Agencies: USFWS – La Crosse (lead); IDNR (as needed field support)

Location: Monitoring will take place in the Des Plaines River downstream from Hoffman Dam to its confluence with the CSSC.

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

A physical barrier made of concrete barriers and small-meshed fencing was erected by USACE along 13.5 miles of the Des Plaines River to prevent Asian carp from infiltrating the CSSC and then Lake Michigan. The barrier/fence was designed to prevent adult and juvenile Asian carp from moving between waterways, but eggs and fry likely could pass through the 1/4–inch mesh fencing with flood waters. Knowing the population status of Asian carp and if they are spawning in this reach of the Des Plaines River, and determining the effectiveness of the physical barrier, will inform management decisions and direct fish removal actions.

Objectives: There are two major objectives for this study plan:

1) Monitor bighead and silver carp and their spawning activities in the Des Plaines River above the confluence with the CSSC; and
2) Monitor bighead and silver carp eggs and larvae around the physical barrier when water moves laterally from the Des Plaines River into the CSSC during high flows.

Status: This project was proposed in 2010 and has been reviewed and accepted by the MRRWG.

Methods: For Objective 1, three sites on the Des Plaines River will be monitored: downstream from the Hoffman Dam; the Columbia Woods area; and in the vicinity of the Lemont railroad bridge landing. Monitoring will include electrofishing and short-term sets of gill or trammel nets.

For Objective 2, prior to high-water events, larval fish nets will be attached to the CSSC side of the barrier fence where overtopping occurred prior to barrier fence construction. Critical USGS/USACE gauges will be remotely monitored to help determine pending high flow events. The barrier itself will also be utilized as a sampling device. It will serve as a hardened gill net. Staff will walk along the barrier after the water has receded to collect and identify impinged fish.

Sampling Schedule: Monitoring will be initiated in the upper Des Plaines River pools during April to determine Asian carp population status and again in the May-June period to look for

spawning fish. Additional sampling will be conducted if larval Asian carp are collected at the confluence of the Des Plaines River and CSSC; if tagged fish are tracked in this reach of the Des Plaines River; or if there are two consecutive eDNA sampling trips in the Des Plaines River with positive detections for either bighead or silver carp DNA >5% of the number of water samples collected. All over-topping events will be monitored.

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

BARRIER MAINTENANCE FISH SUPPRESSION

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

Location: Sampling to assess abundance of Asian carp will take place in the Lockport Pool of the CSSC between Lockport Lock and Power Station and the Dispersal Barrier (RM 291.0-296.1). Fish surveillance (DIDSON) and suppression operations will take place at the barriers and may include the canal reach bounded by RM 295 and 297.

Introduction and Need: The USACE operates two electric aquatic invasive species barriers (I and IIA) in the CSSC near Romeoville, Illinois and they are in the process of completing a third barrier (Barrier IIB). Barrier I operates at lower settings than Barrier IIA. Barrier IIB will operate at similar settings as Barrier IIA and will be located about 220 feet upstream. These barriers must be periodically shut down for maintenance and IDNR has agreed to support maintenance operations by providing fish suppression at the barrier site. Fish suppression can vary widely in scope and may include application of piscicide (rotenone) to keep fish from moving upstream past the barriers when they are down. This was the scenario for a December 2009 rotenone operation completed in support of previous barrier maintenance operations. With barriers IIA and IIB operational, future fish suppression actions should be smaller in scope and less costly than the 2009 event because one barrier can remain operational while the other is taken down for maintenance. In this case, fish suppression will be limited to clearing fish from between barriers IIA and IIB after maintenance is complete.

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

1. Determine abundance of Asian carp juveniles and adults in the CSSC between the electric barriers and Lockport Lock and Power Station;
2. Assess the need for fish suppression actions at the barriers through surveillance with DIDSON imaging equipment; and
3. Eliminate fish from between Barrier IIA and IIB after maintenance is complete by driving fish from the area with mechanical technologies, or if needed, a small-scale rotenone action.

Status: Fish surveillance and suppression components of this project were recently developed and are shown here for the first time. The pre-maintenance fish assessment portion (Objective 1) was proposed in 2010 and supported by the MRRWG. Pre-maintenance sampling events took place during fall 2010 (October and November) and an additional sampling event is planned for April 2011.

October and November sampling used a variety of conventional gears to assess abundance of adult and juvenile Asian carp during 3 days and 2 nights each month. Conventional gears were fished in the CSSC between Barrier IIA and Lockport Lock. October sampling included DC electrofishing, trammel netting, experimental gill netting, mini fyke netting, mid-water trawling, purse seining, and hydroacoustic sonar imaging. In November, we used DC electrofishing gear, trammel nets, experimental gill nets, mini fyke nets, and tandem trap nets. It took a combined 108 person-days to complete multiple runs, sets, tows, and hauls of the various gears. In

addition, eDNA samples were taken from 2-mile canal reaches upstream (N = 57) and downstream (N = 57) of the barrier's Regulated Navigation Area to reevaluate the consistent presence of Asian carp DNA relative to the barriers. See Appendix B – Table B2 for individual gear effort and catch summaries and Table B5 for eDNA data summaries.

Methods:

Project Overview- Maintenance of Barrier IIA is tentatively scheduled for spring 2011. In this plan, we propose to survey the barrier site with DIDSON imaging equipment to assess the need for fish suppression actions. If necessary, we will then attempt to drive fish out from the area between the barriers with mechanical and new technologies as available (e.g., hydro-guns, plungers on the water surface, pounding on boat hulls, or racing tipped up motors). Should a series of these efforts fail, a small-scale rotenone operation will be employed to clear the area of fish (specific dates for barrier maintenance and subsequent fish suppression operations is yet to be determined). The timing of a rotenone action is not tied to barrier maintenance operations because a continuously operating Barrier IIB is available to prevent upstream fish passage. In addition to fish surveillance and suppression activities, we will conduct a third pre-maintenance sampling event with eDNA and conventional gears in the Lockport Pool downstream of the barriers. This sampling will provide another 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.

Lockport Pool Sampling- April 2011 fish sampling will take place in the CSSC from Lockport Lock and Power Station to the downstream boundary of the barrier Regulated Navigation Area (RNA; Figure 9). Sampling will be similar to the November event in that it will take place without waterway closures. However, commercial fishers will be employed to fish large mesh trammel or gill nets this spring. Commercial fishers may conduct additional netting operations in Lockport Pool this spring to ensure adequate sampling prior to fish suppression actions. Sampling gears and anticipated effort are included in the table below. All captured fish will be identified to species and enumerated. A subsample of 20 fish per species per gear will be measured (mm total length) in support of the INHS study evaluating the effectiveness of different gears used to capture Asian carp. Except for Asian carp and surrogate species suitable for tagging, all captured fish will be returned live to the waterway. Suitable surrogate species will be transferred to a transport boat and returned to a shore station for surgical implantation of sonic transmitters. Any captured Asian carp will be held and immediately reported to the operations coordinator. Handling and chain-of-command protocols for captured Asian carp will follow those outlined in Appendix D.

Sampling will require eight open deck aluminum boats that range in size from 18-24 feet long. The staging, boat launch, and overnight boat storage area will be located at the old Cargill grain elevator site on the west bank of the canal just south of the Route 7 (9^{th} Avenue) Bridge (a.k.a. Carp Camp 1). Minnow 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 Materials large slip during day and night hours. Daytime trammel net sets will 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 and crew and target areas

throughout the reach known to hold concentrations of fish. Trammel nets may be fished overnight in backwater and off channel areas to increase chances of catching fish.

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
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 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.

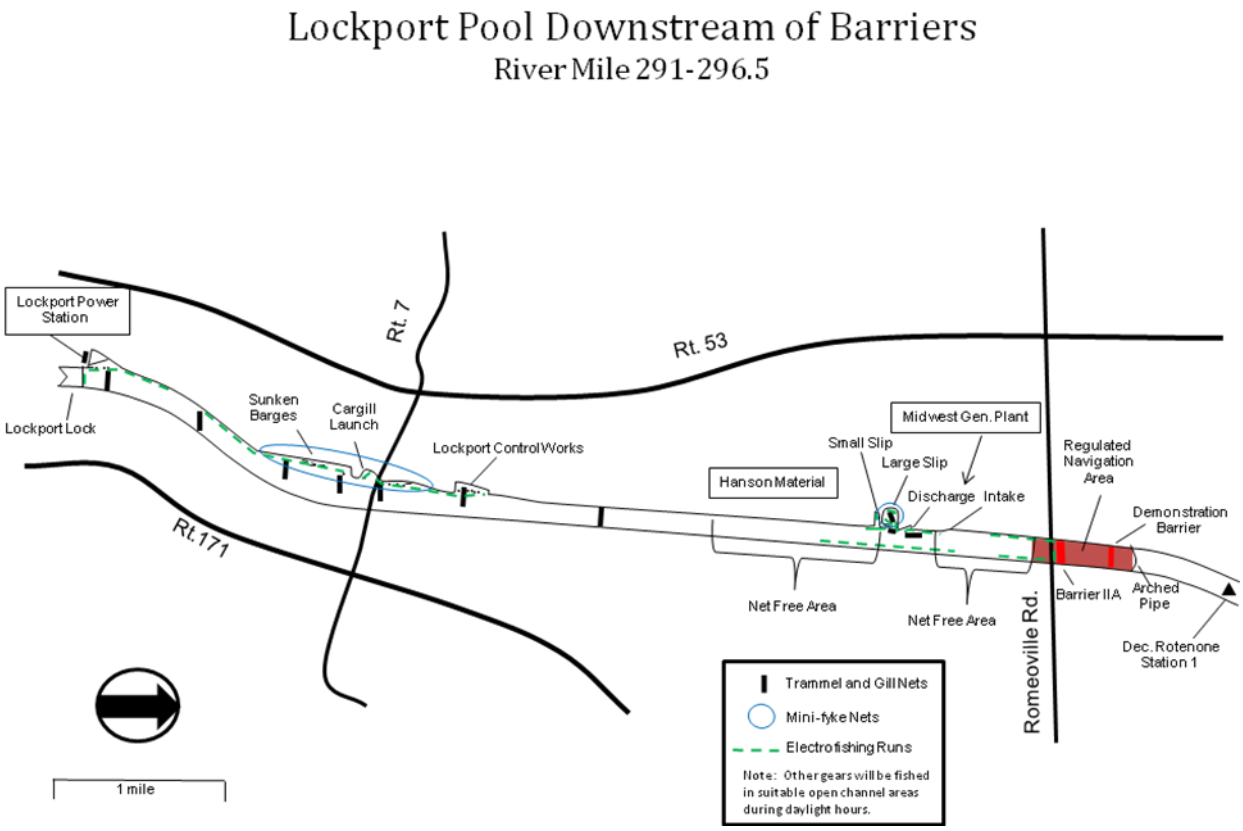


Figure 9. Lockport Pool downstream of the Dispersal Barrier showing target areas for fish sampling operations.

Safety and Communication.
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 below the Romeo Road Bridge (designated by Sampson post #2 on the west bank).

First, any vessel crossing the 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 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 DIDSON 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 above the water when tightened. A rising cable could cause severe bodily injury or catch and easily flip a sampling boat. Be aware of your 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 info, 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.

Fish Surveillance and Mechanical Clearing Operations-We propose up to three DIDSON surveys at the barriers in association with barrier maintenance and fish suppression actions. These surveys will take place in additions to surveys planned for barrier efficacy assessments (see DIDSON Barrier Efficacy Project above). Multiple surveys are necessary to enhance

confidence in results that fish are either present or absent from the area between barriers IIA and IIB.

The first survey will take place soon after Barrier IIA is turned off to assess whether fish from below the barrier move upstream to stage below Barrier IIB. The presence of fish in this area will initiate mechanical suppression actions. Mechanical suppression will include several methods to drive fish downstream out of the between-barrier area and will require synchronization with reactivation of Barrier IIA. We will drive fish with hydro-cannons if pre-testing shows that this technology can successfully deter fish and will not negatively affect canal walls and nearby equipment and structures. Low technology noise-making driving techniques will be employed if hydro-cannons cannot be used at this time.

A second survey should take place between the barriers after mechanical removal operations have occurred and both barriers are operational to assess the effectiveness of mechanical removal efforts. The planned rotenone action may be cancelled if mechanical suppression is successful. A third DIDSON survey is scheduled for about 3 weeks before the tentative rotenone action to further assess fish abundance between the barriers. The presence of large juveniles or adult fish (> 6 inches long) between the barriers signifies that a rotenone action likely will be necessary to eliminate fish from the area. Small fish are not a concern because sampling to date has produced no Asian carp larvae or juveniles in the CAWS or lower Des Plaines River pools. Canal closures are not anticipated for DIDSON survey work or mechanical fish suppression activities, but a 4-hour closure likely will be required for hydro-gun deployment. Requests to USCG for safety zone closures to navigation in the vicinity of the barriers will be made 35 days prior to a planned event.

Small Scale Rotenone Action-A small-scale rotenone action will take place if DIDSON surveys indicate Asian carp may be present between barriers IIA and IIB and mechanical suppression measures fail to drive fish from the area. All operations will occur between Hanson Material Service's large barge slip (~RM 295.2) and a point about 0.25 miles 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 this 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 forthcoming from 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.

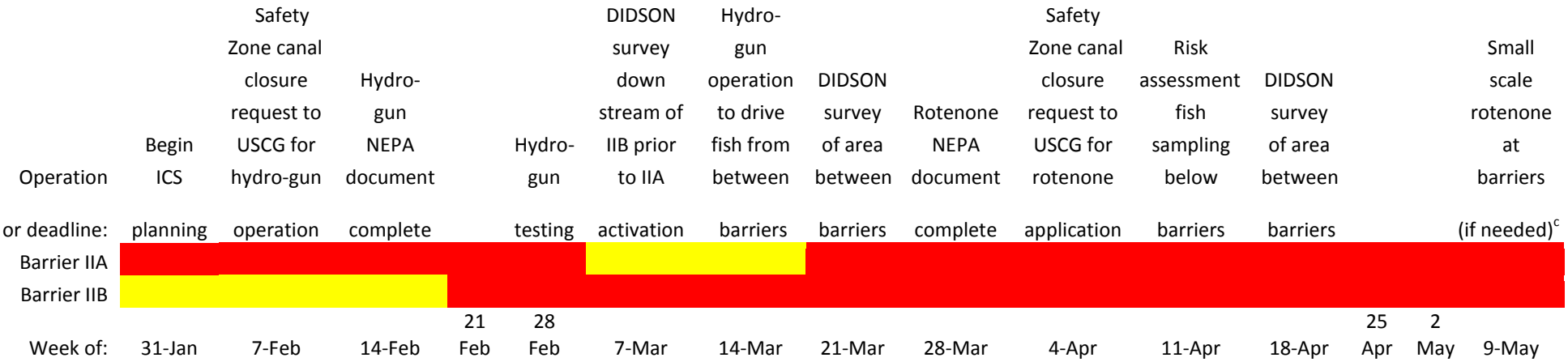
The bulk of the work will occur on the second day of operations and a 6-8 hour daytime canal closure will be necessary on this day. During Day 2, we will apply 250-450 gallons of rotenone from boats (N = 3-4) located at a station upstream of the RNA. The chemical will be allowed to mix and flow downstream 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 IIA 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. Commercial fishing crews (*N* = 2-3) will stage netting operations immediately downstream of the RNA to examine whether fish forced out of the barrier area are Asian carp or non-target species. Detoxification with sodium permanganate applied from boats (N = 3-4) will take place downstream of the commercial netting operation. 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.

Sampling Schedule: A hypothetical project timeline for a spring (May) fish suppression operation is presented below (Figure 10). The timeline is based on an early March date for Barrier IIA maintenance. Event timing may be modified should barrier maintenance occur at a different time of year.

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 and project plans updated for annual revisions of the MRRP.

Barrier Maintenance Fish Suppression Timeline



[a] Hydro-gun operation must be synced with restart of Barrier IIA.

[b] DIDSON survey as soon as possible after hydro-gun operation and with both barriers on.

[c] Barrier IIA turned off on 11 May during rotenone application and restarted before rotenone slug passes.

Note: Dates are hypothetical and offered as a guide.

Figure 10. Hypothetical timeline for barrier maintenance fish sampling and suppression operations in the Lockport Pool of the CSSC.

EVALUATION OF GEAR EFFICIENCY AND ASIAN CARP DETECTABILITY

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

Location: Evaluation of sampling gears will take place in three segments of the Illinois River and CAWS. Five sites in the middle Illinois River (LaGrange and Peoria Pools), two sites in the upper Illinois/Des Plaines River (Starved Rock and Dresden Pools), and two sites in the CAWS (above the Dispersal Barrier) will be sampled as part of this evaluation. Sites may be added or dropped as necessary to meet data requirements of project objectives and fall within time and personnel constraints.

Introduction and Need: Multi-agency sampling and removal efforts are currently ongoing in the Illinois River and the CAWS to monitor and control the spread of Asian carp. A variety of traditional sampling gears (electrofishing, gill nets, trammel nets) are being employed by various agencies to capture Asian carp, but the relative efficiency of each of these gears, and the amount of effort required to detect Asian carp when they are present in low densities, has not been evaluated. The presence of a species at a given sampling location is only certain when the species is actually captured in the field. If the species is not detected, it may be truly absent, or it may be present and not detected. Non-detection is more likely in areas with small population sizes and habitat features that interfere with species detection. Determining detection probabilities for Asian carp, and examining factors that contribute to variation in detection probabilities, would allow for determination of appropriate levels of sampling effort and help improve the design of existing monitoring regimes. Additionally, testing new techniques for detecting the presence of Asian carp is warranted in order to enhance monitoring efforts. A variety of alternative sampling gears (hydroacoustics, midwater trawls, purse seines, trap nets, mini-fyke nets, hoop nets, cast nets, seines) are available that may potentially be more effective at detecting Asian carp than methods currently being used. Evaluating the ability of these methods to detect both juvenile and adult Asian carp will allow managers to customize monitoring regimes and more effectively determine abundances of Asian carp. 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 will use a variety of sampling gears to:

1) Determine site characteristics and sampling gears that are likely to maximize the probability of capturing Asian carp;
2) Estimate the amount of effort required to detect Asian carp at varying densities with each gear;
3) Evaluate the effectiveness of alternative sampling gears at detecting both juvenile and adult Asian carp;
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 2010, we began assessment of electrofishing, gill nets, purse seines, midwater trawls, and a hydroacoustics system. In addition to electrofishing efforts conducted as part of other ongoing projects, DC electrofishing specifically for gear efficiency evaluation took place at stations upstream and downstream of the Dispersal Barrier in areas with Asian carp population abundance that ranged from low to high. See Appendix B Tables B1 and B2 for effort and catch summaries. Analysis of hydroacoustic data is ongoing, but field observations suggested that concentrations of Asian carp occurred at numerous locations near the edges of the navigation channel in the Illinois River. Analysis of data collected from the other gears is also ongoing. Based on variability in presence-absence data obtained from 2010 sampling, we are evaluating what level of sampling effort will be required in 2011 to obtain detection probabilities with reasonable confidence intervals.

Methods: The design of this project involves evaluating all sampling gears at multiple sites in three segments of the Illinois River and the CAWS: the middle Illinois River (where Asian carp are present in high densities), the upper Illinois/Des Plaines River (where Asian are present in low to moderate densities), and the CAWS (where Asian carp are either absent or present in very low densities). All sampling gears will be tested seasonally (spring, summer, and fall) at each site (see table below), and gears will be evaluated for their ability to detect both juvenile and adult Asian carp.

Pool	Waterbody	Location
LaGrange	Illinois River	Lilly Lake
LaGrange	Illinois River	Bath Chute
LaGrange	Illinois River	Havana
LaGrange	Illinois River	Peoria Dam Tailwater
Peoria	Illinois River	Henry
Starved Rock	Illinois River	Ottawa
Marseilles	Illinois River	Morris
Dresden Island	Des Plaines River	Treats Island / I-55
Lockport	Little Calumet River	I-57 to Indiana Ave.
Lockport	Chicago Sanitary & Ship Canal	Kedzie Ave. to Damen Ave.

- Four 15-minute electrofishing transects will be conducted at each site on each sampling date using a pulsed-DC electrofishing boat.
- Both surface (45.8 m long x 6.1 m deep, 1.9, 2.5, 3.2, 3.8, and 5.1 cm mesh panels) and bottom experimental gill nets (45.8 m long x 3.05 m deep with experimental mesh panels of 9.1 m length) with either small experimental mesh (1.9, 2.5, 3.2, 3.8, and 5.1 cm mesh panels) or large experimental mesh (6.4, 7.6, 8.9, 10.2, and 12.7 cm mesh panels) will be used at all sites, with a minimum of four nets set at each site on each sampling trip (3 hour sets).
- Trammel nets (91.4 m length, 10.2 cm mesh with 0.46 m walling #139 twine) will be deployed to supplement IDNR efforts.
- Hydroacoustic surveys will be conducted during each season at each site. A 200 kHz split-beam transducer will be mounted to the front of the boat and connected to a computer with

acquisition software. Multiple 15-minute transects will be driven into the river current, and the entire width of the river will be surveyed.

- A midwater trawl (5 m x 1 m with 6 mm mesh) is being evaluated for its ability to capture fish in the middle of the water column. Multiple 5-minute trawls will be conducted at each site by towing the trawl from the bow of the boat with the boat running in reverse, with various depth ranges and towing speeds being evaluated in the process.
- Both large- (100 m x 5 m with 6 mm mesh) and small-mesh (122 m x 3.05 m, with 2.5 cm mesh) purse seines will be employed at each site. Multiple purse seine hauls will be performed at each site by encircling the area to be sampled by boat and then cinching the net at the bottom before pulling it into the boat.
- In 2011, we will begin evaluating trap nets (15 m x 1.3 m lead, 0.9 x 1.8 m frame, 1.8 cm mesh) and hoop nets (1.2 m x 4.8 m, 3.7 cm mesh) for their ability to capture Asian carp in various habitats.
- In 2011, we will also begin using cast nets (up to 4 m), Wisconsin type mini-fyke nets (4.5 m x 0.6 m lead, 0.6 m x 1.2 m trap, 3 mm mesh) and seines to sample for juvenile Asian carp in tributaries, backwaters, and other shallow-water habitats. Numerous samples will be taken at each site with each of these gears, although the exact numbers of samples are not yet known.

All captured fish will be identified to species, measured for total length and weight, and released. Catch-per-unit-effort and presence-absence data will be used to evaluate gear efficiency and determine detection probabilities. Using data collected from electrofishing, gill net, and trammel net samples taken on multiple occasions at target sites, the probability of detecting Asian carp species will be calculated for each segment of the Illinois River and the CAWS using maximum-likelihood or Bayesian methods (Bayley and Peterson 2001, MacKenzie et al. 2002). These rare fish capture modeling methods allow for the inclusion of site-specific and time-specific covariates (habitat type, depth, current velocity, season, temperature, etc.) into candidate models that can be ranked using information theoretic approaches (Burnham and Anderson 2002). These analyses will be used to determine site characteristics and sampling gears that are likely to maximize the probability of capturing Asian carp and estimate the amount of effort required to detect Asian carp at varying densities.

Sampling Schedule: In 2011, sampling will occur seasonally (spring, summer, and fall) at all sites. Multiple visits to each site will occur each season, although not every gear type will be used on every sampling date.

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

EXPLORATORY GEAR DEVELOPMENT FOR USE IN DETECTION, MONITORING AND CONTROL OF ASIAN CARP POPULATIONS

Participating Agencies: USFWS- Columbia (lead); IDNR (as needed field support)

Location: Testing will be done in the CSSC, below locks on the Mississippi River, and in big river backwaters.

Introduction and Need: Future action plans for controlling carp in the CAWS and CSSC include the ultimate use of rotenone. Due to the indiscriminate lethality to all species of fish, the use of rotenone is highly scrutinized by the public and is inordinately expensive compared to mechanical removal methods. Therefore it is imperative to develop methods and gear types which are more effective in capturing Asian carp, detecting population increases and reducing Asian carp densities where they threaten native fisheries. In addition, non-entanglement gears have an advantage in reducing bi-catch mortality in native fishes like paddlefish who occupy similar habitats as Asian carp.

Current gears used for monitoring large juvenile and adult Asian carp include electrofishing and entanglement netting (gill and trammel nets). However, there are other fishing gears not commonly used in the Midwest that may have an application for these fish. Large mid-water trawls, oceanic purse seines, large diversion and mechanical trap nets, and ultra fine twine gill nets are all potentially effective alternatives to capture Asian carp in lieu of rotenone and should be explored further. Ultimately, gears would be developed that could be employed by commercial fishermen and would be manageable by a traditional sized boat and crew.

Asian carps seem to be more sensitive to entanglement gear than other fishes and have been known to jump over nylon, cotton and monofilament nets. New high-strength, low-diameter net twine materials are now available through select distributors and net manufacturers. These materials have been widely used in benthic trawls in our rivers and we anticipate adapting them to other traditional (gill and trammel nets) and exploratory gears (pound and purse seines) to increase catch rates and allow smaller crews to manage bigger gear.

In 2008, the Columbia FWCO contracted a net designer to develop a 125 ft trawl pulled between two large boats. The adult carp were corralled by the net but were too quick to be captured in the bag (though there may be some application for juveniles). The net was modified on location and tested as a small purse-seine. When this pseudo-purse seine was used behind dikes on the Missouri River it effectively herded dozens of carp in each haul while also capturing rarely seen juvenile paddlefish. This field testing provided valuable feedback for net modification. Conceptually tested, the net designer has been working on a purse seine prototype that can be used by researchers and commercial fishermen to target Asian carp. The net contains a unique spook curtain feature that should allow it to be used over a wide range of depths and benthic conditions (snags) without becoming entangled. The net will have easily detachable zippered panels that will enable deployment in tight or wide spaces and will ultimately be designed out of high tensile strength Dyneema mesh to make it light and easily deployed. Conceptually, this custom riverine design should provide greater flexibility for net deployment.

Pound nets (large traps) are used on the Great Lakes by commercial fishermen with great success. In oceanic conditions around Japan and the Mediterranean Sea similar nets, in some cases several miles long, are floated in a maze that entraps migrating fish. The scale of these nets can be adapted to specific habitat conditions and constructed using a variety of materials that will lend the gear for different management goals. We anticipate nets could be permanent (steel mesh and poles) semi-permanent (large traps, nylon or poly material with long leads, segmented sections for repair or cleaning and detachable bags) or transportable materials (high-tech Dyneema twine, floating with segmented sections and towable bags). If proven to be effective, nets could be permanently built in parts of the canal that didn't interfere with navigation and fished through a monitoring protocol or reactively when eDNA indicated fish DNA presence. Given the sensitive nature of Asian carps to drive and herd, it is also likely that large scale pound nets could be employed in backwaters or tributaries on the Mississippi, Illinois and Missouri rivers to corral and capture huge numbers of fish without mortal effects on bi-catch (through use of sorting or excluder traps). We would expect commercial fishermen to readily adapt these gears because they are passive, semi-fixed and would have the potential to remove exponentially more fish per day than traditional trammel nets with less effort expended.

Objectives:
There are two major objectives for this study plan:

1) Develop gears to be used in place of rotenone to target Asian carp upstream of the Dispersal Barrier.
2) Develop supplemental gears for the commercial fishery that will be more target-specific to Asian carp with less fish by-catch.

Status: This is a new project for the MRRP. A net designer is currently building the purse seine and gill net. Evaluations will begin this spring after gear construction is completed.

Methods: Work with net designer to consult and build nets:

1) *Purse-seine:* Net builder will spend several days working with biologists employing prototype which will be 20 ft deep with detachable sections up to 600 ft long. A second net will be purchased for additional testing based on initial prototype observations and it will be made of high grade materials for weight reduction. Production would be available from the net-maker after adequate design and material is tested.
2) *Pound (trap) nets:* Two nets would be built initially which could either float or sink. One smaller net to be used in the canal with 75 ft leads about 15 ft deep and one large to be used on backwaters of big rivers with 200 ft leads of the same depth. The net designer will work with biologists testing and observing reaction of fish to net in a variety of habitats. Production would depend on ability of net to capture fish and whether additional prototype testing would be needed.
3) *Gill net:* Use a lightweight Dyneema material with high hanging coefficient to capture carp compared to traditional monofilament and nylon nets

Sampling Schedule: Testing of the purse seine and gill net will occur in late spring 2011 and pound net deployment will occur in late summer to early fall. Second revision of nets would be available in spring 2012 however prototypes could be used as needed throughout the year to continue to inform design.

Deliverables: A video log of deployment efficacy will be used to describe their fishing effectiveness and their method of deployment. Catch rates and species capture will be summarized for each gear deployment in an annual report and information will be presented at annual basin river meetings.

UNCONVENTIONAL GEAR DEVELOPMENT PROJECT

Participating Agencies: IDNR (lead), INHS and USFWS (workgroup participants, field assistance as needed, and co-developers of alternative gears),

Location: A workgroup will be convened in Chicago or Springfield and developed prototypes will be evaluated in the Marseilles, Dresden Island, and Brandon Road pools. Successful techniques will then be used in the CAWS.

Introduction and Need: Successful control or eradication of Asian carp requires that the rate of removal exceeds the rate of increase and that there is an ability to target individuals from low density populations. The use of piscicides, such as rotenone and Antimycin, is the best method to capture or kill low densities of Asian carp that are likely present upstream of the leading edge of an invasion front. However, high cost, chemical availability, regulatory requirements and non-target impacts limit piscicide use to occasional applications over short sections of the CAWS. Traditional sampling tools, like static nets, seines and electrofishing are less effective especially in deep (> 2m depth) and flowing waters characteristic of much of the CAWS and other rivers in the Great Lakes basin where Asian Carp are likely to successfully spawn. There is a need to develop new trap or netting methods that can capture low densities of Asian carp in the canal and river habitats of the CAWS, lower Des Plaines and upper Illinois rivers, and possible Great Lakes spawning rivers.

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

1) Convene a panel of experts to discuss nontraditional gear development and available attractants or repellents;
2) Develop alternate traps and net designs and combinations of gears and attractants/repellents to enhance Asian Carp capture rates; and
3) Evaluate gear and combination system prototypes in areas with low to moderate Asian carp population densities.

Status: This is a new project that is closely related to other gear design and assessment projects included in the MRRP (see Gear Efficiency and Exploratory Gear Development projects above). We will communicate and coordinate with researchers from these other projects to prevent duplication of efforts.

Methods: A working group of net makers, fisheries biologists, Great Lakes and large river commercial fishers, and hydroacoustic and pheromone experts will be established to design a set of alternative nets and traps. The panel also will be tasked with identifying available chemical and sound attractants and/or repellants that could be used in combination with developed gears to increase Asian carp capture rates. We anticipate that these efforts will lead to the design and construction of systems that would more effectively drive or herd Asian carp into net or trap designs. Prototypes of one or two of these systems will be built and refined for optimum performance in the Marseilles, Dresden Island and Brandon Road pools downstream of the Dispersal Barrier where low to moderate density Asian carp populations exist. The best designs and methods would then be deployed upstream of the Barrier in the CAWS and/or Great Lakes rivers where eDNA technology indicates the likely presence of Asian Carp.

Sampling Schedule: The working group will be convened this spring, prototypes developed during spring and summer, and gear evaluations will occur during summer and fall.

Deliverables: Outcomes from the panel of experts will be made available to the MRRWG and evaluation results will be reported for weekly summaries.

FISH POPULATION ESTIMATION PROJECT

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

Location: Population estimates for targeted fish species will take place at suitable locations in the CAWS.

Introduction and Need: Understanding the effectiveness of various techniques used for sampling and removal of Asian carp requires estimation of population abundance in a given area. In evaluating rare species, it is likely that quick or accurate numerical or biomass standing stock estimates will be very difficult or impossible to determine. Therefore, as a pilot study, we will use standard mark-recapture techniques to estimate standing stocks of relatively abundant surrogate species in specific locations within the CAWS (e.g., Lake Calumet, Lockport Pool of the CSSC downstream of the Dispersal Barrier, and North Shore Channel). Targeted surrogate species may include various sizes of common carp, buffalo spp., and gizzard shad, as well as other species that are similar in size and thought to occur in habitats similar to those used by bighead or silver carp.

Objectives: We will conduct a pilot study to:

1. Determine the feasibility of using standard mark-recapture techniques (e.g., Petersen or Schnabel methods) to estimate abundance of targeted surrogate species of various sizes; and, if successful
2. Provide population data for use in evaluation of gear efficiencies and detection probability modeling.

Status: This is a new project that will provide fish population abundance information useful to gear evaluation efforts.

Methods: Population estimates within La Grange Reach, Illinois River suggest over 4,100 silver carp were present in 2008. This reach-wide estimate took considerable time and effort; however, smaller focused studies in the CAWS will be more manageable and useful to evaluate our ability to assess CAWS fish population abundance in specific gears and areas of the CAWS. These on-the-ground estimates may fuel an enhanced estimate of standing stocks throughout the CAWS over time. Additional effort will be required for intensive marking and recapture of fish through commercial netting operations and electrofishing at fixed sites. Added field time and cooperation with partners will be necessary to achieve estimates as increased handling time for marking will exist. The use of floy tags will add to the data on fish movement within the CAWS and can strengthen longer term mark-recapture efforts as well. Fin clips likely will be used on the smallest fishes for localized population assessment. The use of DIDSON or Hydroacoustic sonar to estimate total fish abundance before and after mark-recapture population estimates may be valuable to calibrate those techniques, but is not essential for success of the pilot project.

Sampling Schedule: Population estimates will be conducted during spring and fall as time allows.

Deliverables: Preliminary results will be reported for weekly sampling summaries. Data will be entered into a database and made available to researchers for gear evaluations and detectability modeling.

HYDROGUN DEVELOPMENT AND TESTING

Participating Agencies: USGS (lead); IDNR (field support); USACE, USCG, MWRD (project coordination)

Location: Water guns are being considered for use in fish suppression activities in the CSSC associated with maintenance of Barrier IIA. Evaluations of the technology are being planned for the Illinois River near Morris and Havana, IL and possibly in the Lockport Pool of the CSSC (or US Bureau of Reclamation in Denver, CO).

Introduction and Need: There is an immediate need to develop and implement control strategies to prevent the migration of Asian carps from entering the Great Lakes Ecosystem from the Mississippi River. Seismic technology may provide one possible solution by emitting high pressure underwater sound waves as a physical deterrent. These sound waves are produced by a pneumatic water gun that compresses water with a piston through a cylinder inducing cavitations of water, whereas upon the cavities collapse a pulsed sound pressure wave is generated. The sound wave may deter fishes or kill them if they are in close enough proximity to the wave source. The water gun may be operated as either a stationary or mobilized barrier as a means to deter invasive fishes.

Status: Water gun evaluations with Asian carp took place during September 2010 at the Hansen Material backwater near Morris, IL. While studies have not definitively answered all questions concerning the use of water gun technologies scientifically, this technique was shown to have negative consequences on fish health and behavior. Based on initial trials, water guns have been recommended for use as a tool for integrated fish suppression management during barrier maintenance for spring 2011. These could include netting, electricity from electro-shocking boats, water guns and possibly chemical application as a last resort. Recommendations also included additional experiments to further assess the effects of water guns on Asian carp health and behavior and the integrity of structures in areas proposed for use.

FY2011 Objectives

1) Assess Structural Effects of Hydroguns: Any potential impact of the deployment of a hydrogun(s) within the CSSC on structures (such as the controlling works, electric barrier, etc.) and canal walls is unknown. USGS has proposed an assessment of the seismic energy emitted when the hydrogun(s) is used within the CSSC so that engineers can determine potential impacts on the structures and canal walls, and advise management on safe hydrogun usage. This assessment would take place prior to barrier maintenance. Funding to be determined.

2) Provide Electric Barrier Shutdown Support: As part of the monitoring plan for the electric barrier maintenance this spring (date o be determined), several tools may be used to remove fish from the area between Barriers IIA and IIB and to keep fish from moving upstream past the barrier. The hydroguns would be strategically deployed to repel and/or herd all fish in the canal between Barriers IIA and IIB in a downstream direction. Sound wave frequencies will be used that have been recommended from earlier tests as effective for moving fish and that will not damage CSSC walls. Methods for verifying the effectiveness of the hydroguns in removing fish

from between barriers IIA and IIB may include acoustic tagging of fish to track movement, and the use of DIDSON sonar technology to view fish movement under the water.

3) Begin hydrogun calibration FY2011: Using the dose response results, develop guidelines for hydrogun utilization that describe the most effective levels of energy and duration for moving fish away from the area of interest.

Questions to be addressed include:

- Do the hydroguns repel fish (chase them away) and at what doses of energy?
- Would placing guns at fixed sites be an effective strategy or is it better for the guns to be mobile?
- How do the sound waves move in the canal and what effect does this have on fish movement?
- What is the most effective sound wave frequency and duration and number of hydroguns needed for repelling fish?

Sampling Schedule: Assessment of structural effects will take place in advance of the electric barrier shutdown. Coordination with USACE is required. Hydrogun monitoring support during the shutdown will be scheduled in collaboration with IDNR and other partners. As much advance notice as possible is required to set up needed contracts and prepare boats and equipment.

Deliverables: A final report of experimental results will be prepared and submitted to the MRRWG.

Long Term Objectives (1-3 years)

1) Continue calibration to maximize hydrogun efficiency: Develop guidelines for potential use of a permanent array of hydroguns for defending the locks in the CSSC to keep Asian carp from moving into the Great Lakes. For example:
   - Setting up a permanent array facing downstream of the Electric Barrier 2B that would provide the first line of defense against Asian carp and other invasives.
   - This strategy could also be used at Lockport Lock with hydroguns facing both upstream and down to keep invasives from moving into or out of both Lake Michigan and the CSSC.

2) Continued examination and documentation of physiological impacts of hydroguns on fish in order to address NEPA regulations and other environmental impact concerns

3) Apply technology to other invasive species such as zebra mussels and other invasive fish.

4) Find novel uses for this technology for other aquatic invasive species.

SURVEILLANCE OF BAIT, SPORT, AND FOOD FISH TRADE IN ILLINOIS

Participating Agencies: IDNR

Location: Surveillance efforts will take place in the Chicago metropolitan area including Cook and collar counties.

Introduction and Need: Juvenile Asian carp have been included in the live bait trade in the past, and are similar in appearance to species used as bait (e.g., gizzard shad and threadfin shad), which may be inadvertently transported along with more typical bait fish species (i.e. fathead minnows, golden shiners, and white suckers). Given that sources of many bait stocks are from regions of the United States where bighead and silver carp have established populations, the possibility exists that fisherman are unintentionally distributing Asian carp throughout the Great Lakes region through contaminated bait stocks. One potential source for Asian carp presence in the CAWS is through unintentional release of Asian carp in contaminated bait stocks when fisherman discard unused bait into rivers and streams. Other anthropogenic distribution pathways also exist, including the unintentional transport and stocking of Asian carp with introduced sport species and/or the deliberate transport of carp to live fish markets and retail food establishments.

Screening of fish tanks at wholesale and retail bait supply facilities and increased enforcement activities related to fish hauling and stocking are direct approaches to evaluating alternative introduction pathways. In addition to continuing surveillance efforts at bait shops, IDNR staff and Conservation Police Officers (CPOs) will perform education and enforcement activities at 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.

Objectives: To create a more robust and effective enforcement component of IDNR's invasive species program, we propose to:

1. Continue visual and eDNA surveillance of fish tanks at wholesale and retail bait suppliers in the Chicago metro region;
2. Increase surveillance of fish haulers stocking local water bodies, area fish production facilities, and live fish markets and food establishments;
3. Perform administrative import and export audits and inspections to ensure compliance with the federal Lacey Act and Illinois Injurious Species Rule; and
4. Increase checks on commercial fishers and other personnel working on GLRI funded programs.

Status: This project is on-going and has been expanded for 2011 to include increased surveillance and education efforts**.** In 2010, 57 wholesale and retail establishments that sold live minnows were identified in Cook, Lake, McHenry, Kane, DuPage, Kendall, Kankakee, Will, and Grundy counties. The list included all known bait shops in the Chicago metro area. IDNR staff and CPOs inspected shops operating over winter (N = 43 shops; February/March) and again during summer (N = 52 shops; August/September; staff only). No Asian carp were identified in visual inspections of minnow tanks made during both seasons. Additionally, 2-L water samples taken from minnow tanks during August (N = 139 samples) for eDNA screening produced no positive detections for bighead or silver carp DNA. A questionnaire completed by bait shop

owners/operators indicated all minnows were purchased from one of three regional minnow distributors and no live wild-caught bait was collected or sold. Asian carp education and outreach literature was disseminated to bait shop personnel to increase awareness and reduce chances of future contamination.

Methods: IDNR Fisheries staff and CPOs will continue inspections of bait shops and/or wholesale distributors and expand inspections to include truck inspections of minnow haulers. Administrative audits of import, export, and transport permits will be undertaken by program staff and potential violators will be targeted for field inspections by CPOs. Visual inspections of live fish sales and brokers will be conducted in northeastern Illinois (Chicago/Chinatown) to identify illegal transport of live Asian carp. Administrative rules associated with Asian carp import, transport, and use in Illinois will be reviewed and field inspections of commercial fisher catch and reporting will take place to ensure compliance with contracting and administrative rules.

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 MRRGW.

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Appendix A. Participants of the Monitoring and Rapid Response Workgroup, including their roles and affiliations.

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Appendix B. Provisional 2010 data summary tables.

Table B1. Summary of Asian carp sampling with conventional gears in the CAWS upstream of the Dispersal Barrier, 2 February - 18 November 2010.

			Labor Expended		Sample Effort		Catch (captured and observed)				
Operation and gear	Dates	Location	Person-days	Estimated person-hours	Runs/sets/tows/ hauls/samples (*N*)	Total effort (unit varies by gear)[a]	All fish (*N*)	Species (*N*)	Hybrids (*N*)	Bighead carp (*N*)	Silver carp (*N*)
Warm Water Discharge Sampling											
Electrofishing (AC and DC)	2 Feb - 25 Mar	CAWS	70	700	132	72	12,875	40	0	0	0
Trammel/gill nets	2-26 Feb	CAWS	30	300	126	10,601	420	3	0	0	0
North Shore Channel Rapid Response											
Electrofishing (DC)	12 May	CAWS	36	360	6	20	NC	--	--	0	0
Trammel/gill nets	11-13 May	CAWS	6	60	21	3,333	575	9	1	0	0
Little Calumet River Rapid Response											
Rotenone	20-26 May	CAWS	601	5,371	1	173	67,224	38	2	0	0
Electrofishing (DC)	21 and 23 May	CAWS	4	40	4	2.0	633	27	1	0	0
Trammel/gill nets	20-23 May	CAWS	32	320	33	4,800	946	9	1	0	0
Electrofishing sport fish salvage	20 May	CAWS	18	180	6	6.0	126	15	0	0	0
Bubbly Creek Rapid Response											
Electrofishing (DC)	15-16 Jun	CAWS	12	120	16	4.0	1,086	26	1	0	0
Trammel/gill nets	15-16 Jun	CAWS	12	120	7	1,400	139	3	1	0	0
Lake Calumet Rapid Response											
Electrofishing (DC)	25 Jun - 9 Jul	CAWS	51	510	17	54.5	5,247	23	1	0	0
Trammel/gill nets	23 Jun - 9 Jul	CAWS	46	460	83	16,900	2,915	12	1	0	0
Commercial seine	29 Jun - 1 Jul	CAWS	20	200	2	1,760	6,835	10	0	0	0
Fixed Site Sampling											
Electrofishing (DC)	22 Jun - 18 Nov	CAWS	138	1,380	559	139.8	33,907	64	4	0	0
Trammel/gill nets	22 Jun - 16 Sep	CAWS	126	1,260	208	41,600	2,267	18	1	1	0
Reach Sampling											
Electrofishing (DC)	11 Jul - 31 Oct	CAWS	69	692	292	73.0	2,734	33	3	0	0

Table B1. Continued.

Operation and gear	Dates	Location	Labor Expended		Sample Effort		Catch (captured and observed)				
			Person-days	Estimated person-hours	Runs/sets/tows/ hauls/samples (*N*)	Total effort (unit varies by gear)[a]	All fish (*N*)	Species (*N*)	Hybrids (*N*)	Bighead carp (*N*)	Silver carp (*N*)
Larval Fish and Productivity											
Larval fish push nets	3 Jun - 2 Oct	CAWS	31	250	78	6.5	384	4[b]	--	0	0
Zooplank./chloro./phosphorus	3 Jun - 2 Oct	CAWS			53	NA	NA	NA	NA	NA	NA
Gear Comparisons											
Hydroacoustics	1 - 2 Oct	CAWS			4	1.0	NA	NA	NA	NA	NA
Electrofishing (DC)	1 - 2 Oct	CAWS			8	2.0	521	17	0	0	0
Experimental gill nets	28 Aug - 2 Oct	CAWS	21	166	15	750	208	14	2	0	0
Purse seine	28 Aug - 29 Aug	CAWS			10	867	50	8	0	0	0
Midwater trawl	28 Aug - 29 Aug	CAWS			8	1.0	8	3	0	0	0

[a]Effort is hours for electrofishing, push nets, hydroacoustics, and midwater trawl; yards for trammel nets, gill nets, and commercial seine; acres for rotenone; m^2 for purse seine; and net-nights for mini fyke and tandem trap nets.

[b]Larval fish were identified to family.

Table B2. Summary of Asian carp sampling with conventional gears downstream of the Dispersal Barrier in the CAWS, lower Des Plaines, and Illinois River, 19 April - 18 November 2010.

			Labor Expended		Sample Effort		Catch (captured and observed)				
Operation and gear	Dates	Location	Person-days	Estimated person-hours	Runs/sets/tows/ hauls/samples (*N*)	Total effort (unit varies by gear)[a]	All fish (*N*)	Species (*N*)	Hybrids (*N*)	Bighead carp (*N*)	Silver carp (*N*)
Fixed Site Sampling											
Electrofishing (DC)	19 Apr - 1 Nov	Lockport/Brandon Pool	20	200	38	10.2	1,005	32	1	0	0
	20 Apr - 27 Oct	Dresden/Marseilles Pool	22	220	49	12.2	4,283	56	2	7	64
Trammel/gill nets	29 Jul -27 Sep	Lockport/Brandon Pool	9	90	26	2,600	34	3	0	0	0
	9 Mar - 12 Aug	Dresden/Marseilles Pool	15	150	33	4,350	507	10	2	29	1
Barrier Defense											
Trammel/gill nets	22 Jun - 28 Sep	Illinois/Des Plaines River	142	1,163	1,441	143,500	NA	NA	NA	4,952	1,076
Larval Fish/Productivity											
Larval fish push nets	16 Jun - 1 Oct	Illinois/Des Plaines River	63	500	160	13.3	1,669	6[b]	--	79[c]	
Zooplank./chloro./phosphorus	16 Jun - 1 Oct	Illinois/Des Plaines River			56	NA	NA	NA	NA	NA	NA
Barrier Maintenance											
Electrofishing (DC)	19 Oct - 18 Nov	CSSC - Lockport Pool			24	12.0	4,120	21	2	0	0
Trammel nets	19 Oct - 18 Nov	CSSC - Lockport Pool			36	5,000	64	2	1	0	0
Experimental gill nets	19 Oct - 18 Nov	CSSC - Lockport Pool			30	2,000	785	21	1	0	0
Mini fyke nets	19 Oct - 18 Nov	CSSC - Lockport Pool	108	1,080	40	40	1,181	24	0	0	0
Midwater trawl	19 - 21 Oct	CSSC - Lockport Pool			10	1.7	9	3	1	0	0
Purse seine	19 - 21 Oct	CSSC - Lockport Pool			10	867	21	2	0	0	0
Hydroacoustics	19 - 21 Oct	CSSC - Lockport Pool			3	1.5	NA	NA	NA	NA	NA
Tandem trap nets	16 - 18 Nov	CSSC - Lockport Pool			4	8	135	13	1	0	0
Gear Comparisons											
Hydroacoustics	28 Sep - 1 Oct	Illinois/Des Plaines River			9	2.2	NA	NA	NA	NA	NA
Electrofishing (DC)	28 Sep - 1 Oct	Illinois/Des Plaines River			18	4.5	692	36	1	2	150
Experimental Gill Nets	25 Aug - 1 Oct	Illinois/Des Plaines River	31	249	36	1,800	336	21	1	4	12
Purse Seine	25 - 27 Aug	Illinois/Des Plaines River			25	2,166	170	19	0	2	8
Midwater Trawl	25 - 27 Aug	Illinois/Des Plaines River			18	1.5	5	3	0	0	0

[a]Effort is hours for electrofishing, push nets, hydroacoustics, and midwater trawl; yards for trammel nets, gill nets, and commercial seine; acres for rotenone; m^2 for purse seine; and net-nights for mini fyke and tandem trap nets.

[b]Larval fish were identified only to family. [c]Value is the combined the number of larvae for all Asian carp species. All larval Asian carp were caught in the LaGrange Pool.

Table B3. Summary of Asian carp eDNA sampling in the CAWS upstream of the Dispersal Barrier, 25 August - 8 December 2009.

			Labor Expended		Sample Effort		Results (Negative or Positive)			
					Samples	Total	Bighead Carp		Silver Carp	
Operation and gear	Dates	Location	Persons	Estimated person-hours	Collected (*N*)	Effort (Liters)	Negative (*N*)	Positive (*N*)	Negative (*N*)	Positive (*N*)
Lockport Pool										
eDNA Sampling	1-Oct	CAWS	3	7.5	49	98	49	0	48	1
eDNA Filtering	1-Oct	CAWS	4	24.0	49	98				
CSSC										
eDNA Sampling	1-Oct	CAWS	3	7.5	53	106	53	0	52	1
eDNA Filtering	1-Oct	CAWS	4	26.0	53	106				
Chicago River										
eDNA Sampling	1-Dec	CAWS	3	21.0	79	158	79	0	79	0
eDNA Filtering	1-Dec	CAWS	4	28.0	79	158				
North Branch Chicago River										
eDNA Sampling	10-Sep	CAWS	3	1.5	20	40	20	0	20	0
eDNA Filtering	10-Sep	CAWS	4	4.0	20	40				
North Shore Channel										
eDNA Sampling	22-Oct	CAWS	3	7.5	48	96	48	0	44	4
eDNA Filtering	22-Oct	CAWS	4	20.0	48	96				
Cal-Sag Channel										
eDNA Sampling	24-Nov	CAWS	3	9.0	57	114	53	4	55	2
eDNA Filtering	24-Nov	CAWS	4	30.0	57	114				
Little Calumet River North										
eDNA Sampling	8-Dec	CAWS	3	15.0	137	274	109	28	134	3
eDNA Filtering	8-Dec	CAWS	4	40.0	137	274				
Lake Calumet										
eDNA Sampling	8-Dec	CAWS	3	1.5	19	38	19	0	19	0
eDNA Filtering	8-Dec	CAWS	4	8.0	19	38				
Calumet River										
eDNA Sampling	8-Dec	CAWS	3	15.0	90	180	90	0	86	4
eDNA Filtering	8-Dec	CAWS	4	24.0	90	180				

Table B3. Continued.

Operation and gear	Dates	Location	Labor Expended		Sample Effort		Results (Negative or Positive)			
							Bighead Carp		Silver Carp	
			Persons	Estimated person-hours	Samples Collected (*N*)	Total Effort (Liters)	Negative (*N*)	Positive (*N*)	Negative (*N*)	Positive (*N*)
Lake Michigan										
eDNA Sampling	8-Dec	Lake Michigan	3	1.5	13	26	13	0	12	1
eDNA Filtering	8-Dec	Lake Michigan	4	4.0	13	26				
Des Plaines River[a]										
eDNA Sampling	12-Oct	Des Plaines River	3	9.0	39	78	39	0	38	1
eDNA Filtering	12-Oct	Des Plaines River	4	24.0	39	78				
I&M Canal[a]										
eDNA Sampling	29-Oct	I&M Canal	3	15.0	59	118	26	5	20	6
eDNA Filtering	29-Oct	I&M Canal	4	36.0	59	118				
Grand Calumet River										
eDNA Sampling	23-Sep	CAWS	3	1.5	5	10	4	1	4	1
eDNA Filtering	23-Sep	CAWS	4	4.0	5	10				
Lockport Lock										
eDNA Sampling	25-Aug	CAWS	3	3.0	13	26	1	0	9	0
eDNA Filtering	25-Aug	CAWS	4	4.0	13	26				
Chicago Lock										
eDNA Sampling	10-Sep	CAWS	3	1.5	5	10	5	0	5	0
eDNA Filtering	10-Sep	CAWS	4	2.0	5	10				
O'Brien Lock										
eDNA Sampling	24-Sep	CAWS	3	1.5	5	10	5	0	5	0
eDNA Filtering	24-Sep	CAWS	4	2.0	5	10				

[a]Des Plaines River and I and M Canal samples were classified as upstream of the Dispersal Barrier in 2009 because physical barriers preventing direct access to the CSSC were not completed until summer/fall 2010.

Table B4. Summary of Asian carp eDNA sampling in the CAWS downstream of the Dispersal Barrier, 29 June - 2 December 2009.

			Labor Expended		Sample Effort		Results (Negative or Positive)			
					Samples	Total	Bighead Carp		Silver Carp	
Operation and gear	Dates	Location	Persons	Estimated person-hours	Collected (*N*)	Effort (Liters)	Negative (*N*)	Positive (*N*)	Negative (*N*)	Positive (*N*)
Dresden Island Pool										
eDNA Collection	29-Jun	Des Plaines River	3	6	28	56	15	13	12	16
eDNA Filtering	29-Jun	Des Plaines River	4	12	28	56				
Brandon Road Pool										
eDNA Collection	2-Dec	Des Plaines River	3	21	107	214	36	3	31	18
eDNA Filtering	2-Dec	Des Plaines River	4	32	107	214				
Lockport Pool										
eDNA Collection	2-Dec	CAWS	3	27	171	342	107	6	126	16
eDNA Filtering	2-Dec	CAWS	4	48	171	342				
Des Plaines River										
eDNA Collection	4-Sep	Des Plaines River	3	6	17	34	17	0	17	0
eDNA Filtering	4-Sep	Des Plaines River	4	8	17	34				
Deep Run Creek										
eDNA Sampling	29-Oct	CAWS	3	3	5	10	5	0	5	0
eDNA Filtering	29-Oct	CAWS	4	4	5	10				
Brandon Road Lock										
eDNA Sampling	19-Aug	Des Plaines River	3	2	7	14	4	1	3	1
eDNA Filtering	19-Aug	Des Plaines River	4	4	7	14				

Table B5. Summary of Asian carp eDNA sampling in the CAWS upstream and downstream of the Dispersal Barrier, 30 March - 7 December 2010.

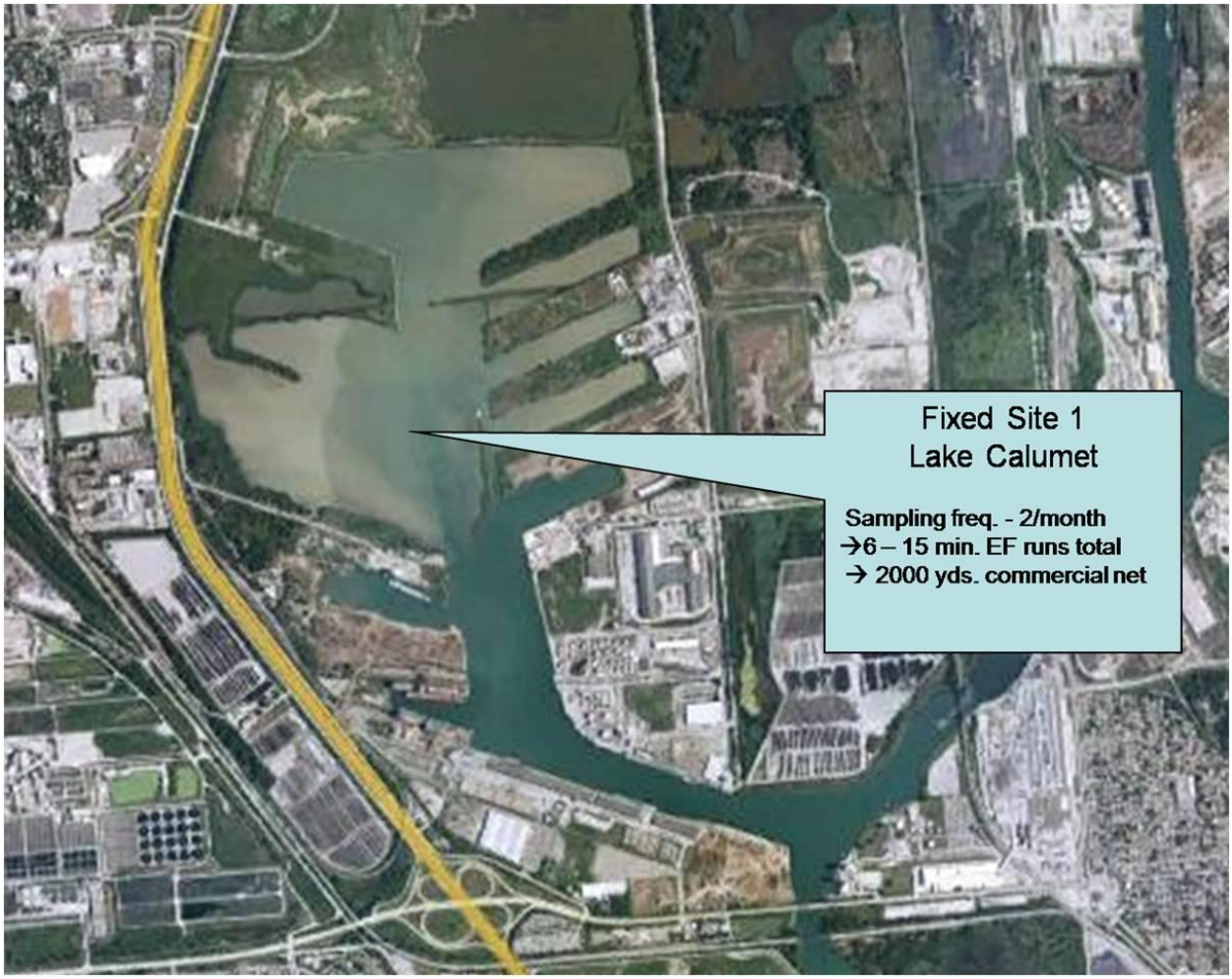
			Labor Expended		Sample Effort		Results (Negative or Positive)			
							Bighead Carp		Silver Carp	
Operation and gear	Dates	Location	Persons	Estimated person-hours	Samples Collected (*N*)	Total Effort (Liters)	Negative (*N*)	Positive (*N*)	Negative (*N*)	Positive (*N*)
Upstream of Electric Barrier										
Calumet Harbor										
eDNA Sampling	20-Jul	Lake Michigan	3	12	19	38	19	0	19	0
eDNA Filtering	20-Jul	Lake Michigan	4	8	19	38				
Calumet River										
eDNA Sampling	30-Mar; 20-Jul	CAWS	6	38	138	276	138	0	138	0
eDNA Filtering	30-Mar; 20-Jul	CAWS	8	48	138	276				
Lake Calumet										
eDNA Sampling	30-Mar; 22-Jul	CAWS	6	30	109	218	109	0	109	0
eDNA Filtering	30-Mar; 22-Jul	CAWS	8	80	109	218				
Lockport Pool										
eDNA Sampling	13-Oct; 30-Nov	CAWS	6	12	107	214	107	0	102	5
eDNA Filtering	13-Oct; 30-Nov	CAWS	8	56	107	214				
Southern CSSC										
eDNA Sampling	7-Dec	CAWS	3	15	76	152	74	2	76	0
eDNA Filtering	7-Dec	CAWS	4	32	76	152				
Chicago Lock to Bubbly Creek										
eDNA Sampling	27-May; 2-Nov	CAWS	6	54	194	388	193	1	190	4
eDNA Filtering	27-May; 2-Nov	CAWS	8	104	194	388				
O'Brien Lock to Acme Bend										
eDNA Sampling	30-Mar; 15-Apr; 20 May; 8-Nov	CAWS	6	60	270	540	270	0	268	2
eDNA Filtering	30-Mar; 15-Apr; 20 May; 8-Nov	CAWS	6	108	270	540				
North Shore Channel										
eDNA Sampling	20-Apr; 12 May; 15-Nov	CAWS	6	57	241	482	240	1	241	0
eDNA Filtering	20-Apr; 12 May; 15-Nov	CAWS	8	144	241	482				
Northern CSSC										
eDNA Sampling	27-May	CAWS	3	6	35	70	35	0	31	4
eDNA Filtering	27-May	CAWS	4	12	35	70				

Table B5. Continued.

Operation and gear	Dates	Location	Labor Expended		Sample Effort		Results (Negative or Positive)			
							Bighead Carp		Silver Carp	
			Persons	Estimated person-hours	Samples Collected (*N*)	Total Effort (Liters)	Negative (*N*)	Positive (*N*)	Negative (*N*)	Positive (*N*)
Upstream of Electric Barrier										
North Branch Chicago River										
eDNA Sampling	20-Apr	CAWS	3	3	18	36	18	0	18	0
eDNA Filtering	20-Apr	CAWS	4	8	18	36				
Lake Michigan										
eDNA Sampling	30-Mar	Lake Michigan	3	2	6	12	6	0	6	0
eDNA Filtering	30-Mar	Lake Michigan	4	4	6	12				
Little Calumet River South Leg										
eDNA Sampling	30-Mar; 6-May	CAWS	6	48	51	102	51	0	51	0
eDNA Filtering	30-Mar; 6-May	CAWS	8	96	51	102				
Grand Calumet River										
eDNA Sampling	15-Apr	CAWS	3	1	6	12	6	0	6	0
eDNA Filtering	15-Apr	CAWS	4	4	6	12				
Indiana Harbors										
eDNA Sampling	6-Aug; 11 Aug; 18 Aug	Lake Michigan	3	24	125	250	125	0	125	0
eDNA Filtering	6-Aug; 11 Aug; 18 Aug	Lake Michigan	4	32	125	250				
Downstream of Electric Barrier										
Lockport Pool										
eDNA Collection	13-Jul; 13-Oct; 30-Nov	CAWS	10	52	148	296	143	5	122	26
eDNA Filtering	13-Jul; 13-Oct; 30-Nov	CAWS	11	143	148	296				
Dresden Island & Brandon Road pools										
eDNA Sampling	29-Jun	Des Plaines River	3	18	60	120	60	0	29	31
eDNA Filtering	29-Jun	Des Plaines River	4	80	60	120				
Des Plaines River[a]										
eDNA Sampling	6-Oct	Des Plaines River	3	16	114	228	113	1	109	5
eDNA Filtering	6-Oct	Des Plaines River	4	44	114	228				

[a]Des Plaines River samples were classified as downstream of the Dispersal Barrier after completion of the barrier/fence separating the river from the CSSC in early fall 2010.

Appendix C. Detailed maps of fixed site sampling locations.


Fixed Site 1
Lake Calumet
Sampling freq. - 2/month
→6 – 15 min. EF runs total
→ 2000 yds. commercial net

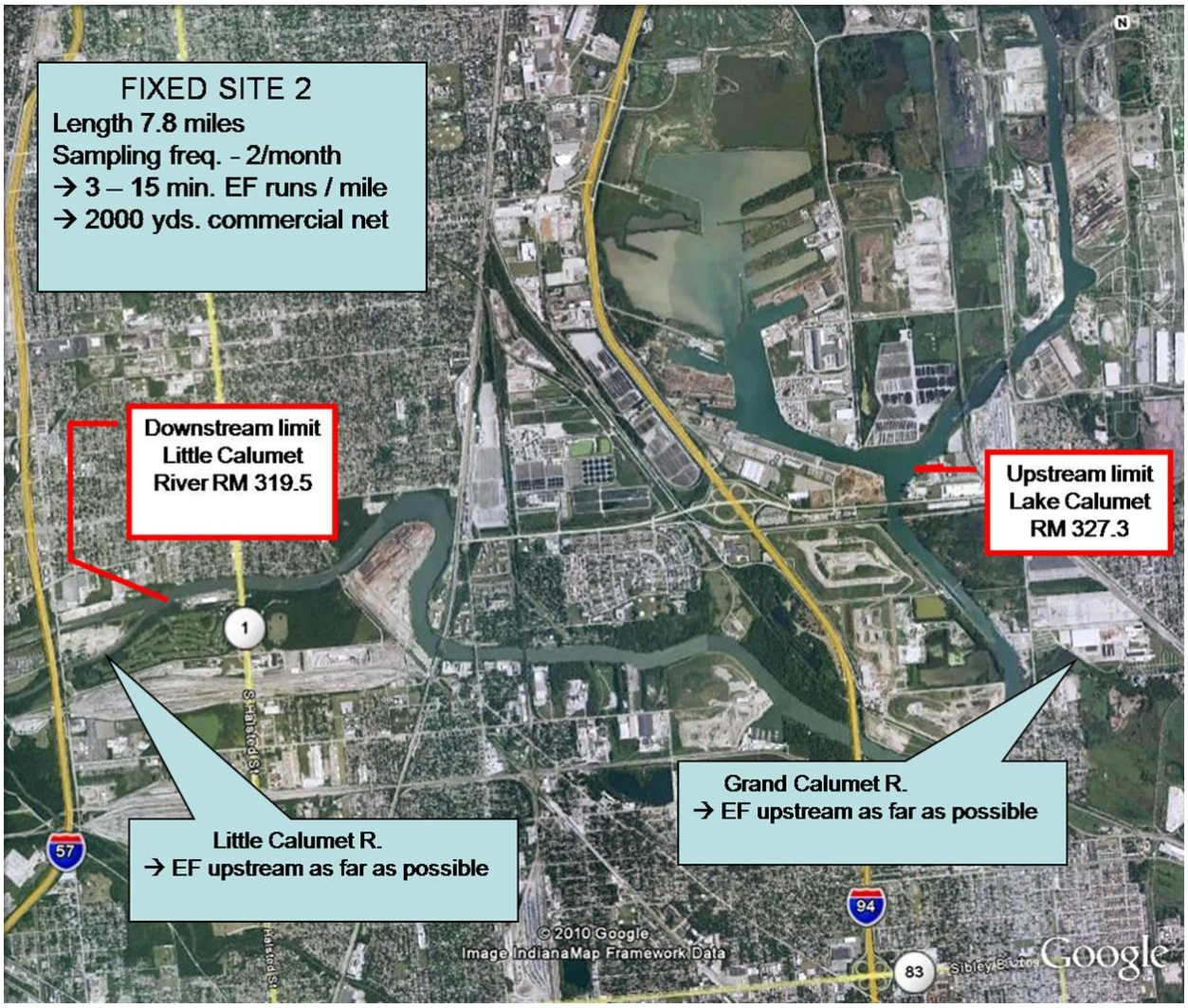

FIXED SITE 2
Length 7.8 miles
Sampling freq. - 2/month
→ 3 – 15 min. EF runs / mile
→ 2000 yds. commercial net
Downstream limit
Little Calumet
River RM 319.5
Upstream limit
Lake Calumet
RM 327.3
Grand Calumet R.
→ EF upstream as far as possible
Little Calumet R.
→ EF upstream as far as possible
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Image IndianaMap Framework Data
Google


FIXED SITE 3
Length 4.5 miles
Sampling freq. 2/month
→ 3 – 15 min. EF runs / mile
→ 1000 yds. commercial net
Upstream limit
Jackson Blvd
RM 325.0
Downstream
limit
Western Ave
RM 320.5
W Adams St
W Jackson Blvd
W Van Buren St
W Congress Pkwy
W Harrison St
290
Congress Pkwy
Wacker Dr
W Roosevelt Rd
W Ogden Ave
W Cermak Rd
S Canal St
S Wentworth Ave
S State St
S Halsted St
90
W 26th St
S Ashland Ave
S Western Ave
Stevenson Expy
Archer Ave
© 2010 Google
W 31st St
55
Google


Upstream limit
Peterson Ave.
FIXED SITE 4
Length 2 miles
Sampling freq. 2/month
→3– 15 min. EF runs / mile
→ 400 yds. commercial net
Minimum of four sets
West River Park Dam
Downstream limit
Montrose Ave
W Peterson Ave
W Bryn Mawr Ave
W Foster Ave
W Lawrence Ave
W Montrose Ave
N Pulaski Rd
N Kimball Ave
N Kedzie Ave
N Damen Ave
N Lincoln Ave
©2010 Google
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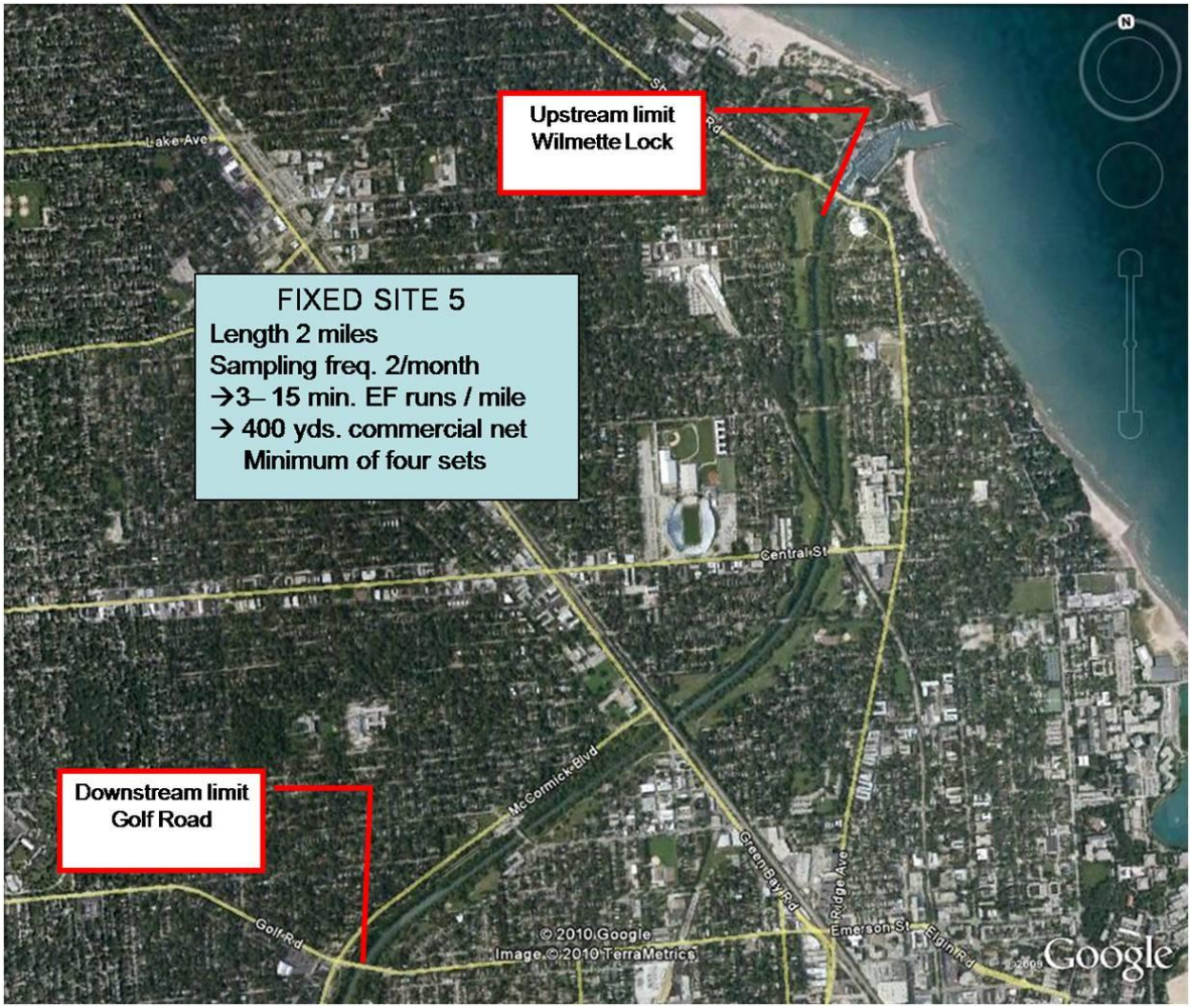
Upstream limit
Wilmette Lock
FIXED SITE 5
Length 2 miles
Sampling freq. 2/month
→3– 15 min. EF runs / mile
→ 400 yds. commercial net
Minimum of four sets
Downstream limit
Golf Road
Lake Ave
Central St
McCormick Blvd
Green Bay Rd
Ridge Ave
Emerson St
Elgin Rd
Golf Rd
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Google

Appendix D. Protocol for handling and maintaining chain-of-custody records for captured bighead or silver carp.

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

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

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

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

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

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

Specific Instructions for Handling Asian Carp:

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

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

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

   D. Once a fish biologist at the staging area makes a positive visual identification, he/she will identify the fish with a fish tag; take pictures of the tagged fish; measure its total

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

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

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

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

   Samples are to be collected following the protocol below per University of Notre Dame, SOP# UNDCAC-05, dated May 11, 2010.

   This procedure will utilize gloves, scalpel blades and preservation tubes filled with 95% ethanol to preserve genetic materials from individual Asian carp. Do not reuse instruments-change instruments with every fish.

   A. Wearing disposable latex gloves use a sharp, sterile scalpel blade to cut a small (~3cm) slit on the right dorsal side of the fish. This incision should be just to the right of the dorsal fin.

B. Using a pair of sterile forceps, tear a small piece of the muscle tissue from inside of the incision. The piece of tissue should be ~1 cm^3 in volume.
C. Place the tissue in a labeled vial (2 ml; vial size not important) that contains ample 95% or greater ethanol.
D. If muscle tissue is not desirable or if there are numerous fish to sample in a short amount of time, fin clips can be utilized. Using a sterile scalpel (scissors will also work), cut a fragment of any fin (dorsal, pectoral, pelvic, tail) that is approximately the size of a U.S. quarter and place it in a labeled collection tube containing 95% ethanol (or greater).
E. Measure the weight, length, fish condition and record with the photographs.
F. Record collected fish sample identification on the chain of custody form. Maintain the fish on wet ice until delivery to University of Illinois. The IDNR CPO will then reseal the cooler and secure both the fish and the samples.
G. Under the supervision of an IDNR CPO and after the tissue (or fin clip) has been in ethanol for >48 hours, an IDNR biologist will pour off all residual liquid in the tube and replace it with fresh 95% ethanol. This will ensure proper preservation of the genetic material. When the alcohol has been replaced, the CPO will reseal the containers and again secure both the fish and the samples. The fish is to be maintained on wet ice until it and the tissue sample can be delivered to University of Illinois.

4. The IDNR CPO will deliver the fish and samples to Dr. John Epifanio, Illinois Natural History Survey, University of Illinois, at 1816 South Oak Street, Champaign, IL 61820. Chain of custody will be maintained, and the CPO should retain the final signed custody form and leave a copy with Dr. Epifanio. The final form should be presented in person to the Incident Commander.

	# 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 E. Sample data sheets.

Asian Carp Monitoring Project

Date: _____

Area Surveyed: _____ Biologist (Crew): _____

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

Smith Root DC: Rate: _____ Duty:_____ Range: High or Low Amps:_____ Volts:_____

Wis. Unit DC: Percent of Setting:_____Pulse Per Second Setting:_____Amps:_____

Nets (Describe Nets): _____

Rate Gear Efficency (circle one): Good Moderate Poor

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

	Run/Net No._____ Lat._____ Lon._____ Start Time: _____ Shock/set Time: _____	Run/Net No._____ Lat._____ Lon._____ Start Time: _____ Shock/set Time: _____	Run/Net No._____ Lat._____ Lon._____ Start Time: _____ Shock/set 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				
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				

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: