Grass Carp Advisory Committee (GCAC)

Annual Report 2024

GCAC Overview

The Grass Carp Advisory Committee (GCAC) is a technical committee reporting to the Council of Lake Committees. It coordinates regional efforts to seek eradication of Grass Carp in Lake Erie, if possible, while also maintaining surveillance where appropriate in other lakes to: 1) Coordinate actions that address specific Lake Erie Committee (LEC) Grass Carp Adaptive Response Strategy priorities, 2) Develop coordinated approaches to address uncertainties identified by the LEC, 3) Provide recommendations about additional uncertainties that should be addressed, and 4) Coordinate surveillance throughout the Great Lakes.

GCAC updates

The GCAC welcomed a new co-chair, Mike Rucinski, who graciously stepped into the vacancy left by the departing Lucas Nathan. Mike's experience with the USFWS Invasive Species Program is very helpful as the Committee begins to discuss recommendations for certain methodologies, particularly the use of eDNA in monitoring and surveillance.

The GCAC held two meetings this past year, both located in Ann Arbor. Meetings included updates from each task group as well as project-specific updates and discussions. Over the past year the GCAC continued to evaluate metrics for tracking progress towards the response plan objectives. This work, led by Lucas Nathan, has made significant headway in 2024 and will be completed during 2025. Environmental DNA was also a topic of discussion at both meetings, with a panel of eDNA experts from several laboratories across the region invited to present to the Committee on the current status and direction of eDNA for Grass Carp detection. A small 'working group' has been formed to further define the role and uses of eDNA, ultimately to inform the GCAC for future recommendations. The August meeting also included updates on the use of otolith microchemistry to identify sources of fish from Dr. Greg Whitledge (Southern Illinois University), which were very informative to the Committee. The GCAC continues to discuss these results and will be assembling a small group to set direction and priorities for future otolith microchemistry work in the Great Lakes.

Lastly, the GCAC provided the CLC with the 2023 Annual Report and the Outside Western Lake Erie Grass Carp Control Effort Summary and Future Direction document at the fall 2024 CLC meeting.

Field Work Task Group

During the 2024 field season crews captured 265 grass carp in the Lake Erie basin and three grass carp in the Lake Michigan basin. Captures were higher in Lake Erie than the previous year but lower in Lake Michigan, however Lake Michigan tributaries always produce few captures. The Western Basin continues to account for most of the captures in the Great Lakes with most captures coming from the Sandusky and Maumee rivers, where 121 and 114 grass carp were captured, respectively. No other Lake Erie tributary produced more than five captures all year, but it should be noted that effort was low in these other locations. Most of the targeted grass carp captures in the Lake Michigan basin came from the St. Joseph River in southwest

Michigan. The St. Joseph accounted for most Lake Michigan basin captures in 2023 as well, and all grass carp captures there have been determined to be triploid.

Removal efforts over the last two years have shifted towards more electrofishing and less electrofishing combined with trammel nets as recommended by Hunter et al. 2025. Exploration of new areas of the two focus rivers has resulted in additional captures, while captures in previously exploited locations have been decreasing. During 2024 field crews experimented with passive, overnight gill net sets in both the Maumee and Sandusky rivers. Overnight gill net sets were immediately successful and caught more grass carp than electrofishing in both rivers (Maumee River: electrofishing = 35, gill nets = 79; Sandusky River: electrofishing = 18, gill nets = 102). Setting and retrieving gill nets is relatively quick with an average set time of three minutes and an average pull time of 39 minutes. Additionally, gill nets were successful in areas where previous methods were not successful such as the lower Sandusky River and middle portions of the Maumee River. Therefore, a collaborative study comparing hoop nets and gill nets has been planned to find the best passive gear option moving forward. The gear comparison study will also coincide with increased deployment of gill nets throughout the Western Basin during the 2025 field season.

The trend of few or no annual spawning events continued during 2024, highlighting why a focus on irregular conditions leading to spawning events, despite high CPUE, may not be a viable long-term plan. Collaboration between field crews and other researchers, especially the Telemetry Task Group, has improved the ability to capture grass carp outside of spawning events, resulting in more consistent captures at all river flows. The shift away from a short burst of coordinated, rapid response effort during spawning events to longer term, lower effort passive netting could be a more efficient way to remove the most grass carp from the system. This strategy also removes any dependence on weather or environmental conditions. Spawning events still warrant a coordinated response; however, the bulk of captures and effort comes from conditions outside of spawning events and improvements to these efforts have the potential to increase catch and enhance removal efforts.

Early Life History Task Group

Ichthyoplankton collection

Ichthyoplankton surveys to understand when and where grass carp spawning occurs in Great Lakes tributaries were completed on both sides of the international border in 2024. Fisheries and Oceans Canada sampled eight, high-risk tributaries in Canadian waters. Similarly, U.S Geological Survey and University of Toledo sampled six Great Lakes tributaries. Grass carp ichthyoplankton were only observed on one occasion in 2024 with genetically confirmed grass carp eggs collected from the Sandusky River on May 1, 2024. The 2024 field season expanded the known spawning period to May 1–August 25. As of the 2024 field season, grass carp spawning has been documented in the Huron (Ohio), Maumee, and Sandusky rivers.

Published results

Several research projects were completed, and results were published in 2024. One study found the probability of collecting grass carp eggs was lower during electrofishing on the spawning grounds during spawning periods and may indicate that removal efforts could temporarily disrupt

spawning activity (https://doi.org/10.3391/mbi.2024.15.4.04). Documentation of grass carp eggs from the Huron River near Milan, Ohio confirmed a third grass carp spawning river in the Great Lakes Basin and the first tributary to Lake Erie's Central Basin was also published in 2024 (https://doi.org/10.1016/j.jglr.2024.102350). Several studies were completed using the Fluvial Egg Drift Simulator (FluEgg) to understand various aspects of grass carp early life history and reproductive biology. A study simulated the transport of eggs collected in the Sandusky River to compare simulated egg age variability to observed egg age variability in field samples. FluEgg performed well when reproducing observed egg age variability, supporting its validity as a tool to estimate grass carp spawning locations and interpret age variability in egg samples (https://doi.org/10.1016/j.jglr.2024.102376). Two analyses examined the Maumee River to improve understanding of spawning locations and the fate and transport of grass carp eggs and larvae. Researchers estimated at least 12 potential spawning locations in the Maumee River (https://doi.org/10.1016/j.jglr.2024.102347) and that low and high discharge periods would be less suitable than intermediate flow periods for maintaining suspension to support in-river hatching (https://doi.org/10.1016/j.jglr.2024.102345).

Next Steps

Members of the Early Life History Task Group have many projects in progress to understand grass carp early life history and aid removal efforts. USGS SpawnCast (https://il.water.usgs.gov/proj/spawncast/) is a spawning forecast dashboard for rivers and aids crews in planning of research and removal efforts. SpawnCast has been updated to include additive degree days over 15°C and photoperiod to index grass carp spawning readiness. A broad-coverage, reach-based version of USGS SpawnCast is in development. To support research aimed at identifying origins of captured adult grass carp, crews collected trace element data from Sandusky Bay during July and August of 2024 for comparison with otolith microchemistry results. Sample processing and data interpretation are on-going. Another project is examining grass carp behavior and space use during known spawning events. The work will identify exploitable patterns related to spawning aggregations and movements, as well as aid interpretation of ichthyoplankton collections. Another project is using known ichthyoplankton collections to aid identification of characteristics of invasive carp spawning rivers. The results could aid prioritization of sampling Great Lakes tributaries based on information collected from the four invasive carp species, which have similar reproductive life histories. Finally, an analysis looked at changes in the Sandusky River spawning areas and ichthyoplankton drift following removal of Ballville Dam and predicted that a new spawning area in the Sandusky likely exists between 11 to 15 km upstream of the former Ballville Dam site (manuscripts in preparation). In response to observed ichthyoplankton collections prior to reaching the previously estimated thermal requirements for spawning readiness, crews are working to collect grass carp earlier in the year to describe annual gonad developmental cycles to better understand spawning risk.

Data Management Task Group

Prior to the 2022 field season, we reconfigured Survey123 for the submission of Grass Carp removal data to create a relational database that automatically connects all data collected as part of each removal attempt by a unique identifier. The five tables associated with this database are:

1) event_operations, considered the “parent” table that all other tables relate to, 2) effort, 3) environment, 4) bycatch, and 5) grass_carp_harvest.

Updates

All data collection entries must be submitted within 48 hours of the removal event and the identified field crew lead for each agency will quality control (QC) check their respective organization’s entries within 10 business days of submission. Before the start of the 2024 season, all organizations agreed that one vessel would enter tandem survey data to ensure data were automatically linked. This alleviates the issue of entering data separately where it’s difficult to link data together on the backend. Additionally, minor updates were made to the primary data collection form based on user input and an application was developed by U.S. Fish and Wildlife Service (USFWS) to streamline the QC process. The new QC application allows users to view their data entries on a map, verify, and submit data edit requests from the same place instead of having to use different applications for each of these tasks. Data collection and QC app training were given before the field season started. The University of Toledo/Michigan DNR sent out weekly reports during the field season summarizing submission statuses for each agency. We added Survey123 data collection forms for 1) lab dissections, 2) ploidy results, 3) incidental captures, and 4) aging, which all feed into the same relational database described above. Additionally, a new chain of custody form was developed and beta tested in 2024 to track details of biological samples being sent between organizations and replaced the physical Reporting Ploidy Form. Chain of custody form feedback was positive, and the form will be used during the 2025 field season. All collection forms were fully operational, and used, in 2024.

Integrating data formats (old and new)

The change to a relational database in 2022 required integrating 2020 and 2021 data into our current format. To do so, the University of Toledo manually linked combination (electrofishing and net set) events and their associated data together. After linking events together with unique identifiers, the University of Toledo and USFWS worked together to organize the older data and match field types and names to our current relational database. We then combined the two datasets (2020–2021 & 2022–2023), maintained table relationships, and published them to ArcGIS Online as a feature layer. All Suvey123 data collection forms were updated so new collections feed directly into the integrated database. Metadata documentation was started in 2023 and finished in 2024. Additionally, a README document with standardized summaries from the integrated database was finalized in 2024. Several standard operating procedures (SOP) were also created by University of Toledo and USFWS for grass carp dissections, aging structure preparation, and aging. These were distributed to all partners for reference. An ArcGIS StoryMap was created by Michigan DNR in 2024 that displays adult removal and early life history dashboards, overviews the grass carp response program in the Great Lakes, contains early life history data releases, and new publications, articles, and stories about grass carp in the Great Lakes.

Next Steps

Action items for 2025 include finishing standardized summaries for 2018-2019 data, publishing the grass carp StoryMap to the Great Lakes Fishery Commission grass carp website, updates to all surveys based on user input, development of a QC application for verifying dissection and laboratory information, and additional data collection and QC training. Additionally, we aim to

start the process of publishing the first public data release for adult removal data at the end of 2025 with the goal of it being available in early 2026.

Modeling Task Group

The Modeling Task Group continues to develop and increase communication with the Field Work Task Group, Telemetry Task Group, and Data Task Group. Communication between these groups is meant to identify questions and needs of those directly working in the field collecting grass carp and make use of the data that have been acquired across GCAC members. Two new peer-reviewed publications were released over the past year and two others were submitted for review. The following are updates related to projects that Modeling Task Group members were involved in:

Great Lakes Basin-wide Distribution Modeling

A model has been developed to predict probability of grass carp occurrence throughout Great Lakes tributaries. The model leverages presence information from the joint Grass Carp capture database, Fisheries and Oceans Canada, Illinois Natural History Database, Indiana DNR, and non-indigenous aquatic species (NAS) database, and habitat information form the National Hydrography Dataset High Resolution (NHDplus HR) dataset for the northeast United States and Canadian tributaries to the Great Lakes. Preliminary results were disseminated to the GCAC in February 2024. The results of this model are meant to guide the exploratory sampling, identify large scale patterns of distribution which could be exploited, and identify areas that are considered high risk of invasion. The project is on track to be completed in 2025 by Rob Hunter with support from Chris Mayer and Matthew Acre.

Individual-Based Bioenergetics Model

Individual-based model (IBM) is continuing to be developed by Brian Brenton, Doran Mason, and Joseph Langan for grass carp and key native species. Ed Rutherford was involved with this work until his retirement in 2024 and Ryan Jackson and Jess LeRoy (USGS-CMWSC) contributed FluEgg model output to inform ichthyoplankton drift estimates for the IBM model. The model is expected to predict the magnitude and timing of grass carp population growth, potential impacts on native species, and evaluate factors affecting grass carp recruitment success. It is also expected that this model could be used to evaluate spawning barriers and target removals. Data have been gathered from several sources, including the Telemetry, Early Life History, and Modeling task groups. Significant progress has been made on this project and the PIs on this project are preparing a manuscript based on the initial model results but are also looking to add new data sources. Additional basins will be included in subsequent modeling efforts pending funding status.

Grass Carp Catchability

This study demonstrated that current invasive grass carp removal efforts in the Sandusky River may be poorly aligned with fish behavior, reducing their effectiveness. Using telemetry data and capture records, the authors found that grass carp are more active and abundant at night and during early spring and late fall—times when most removal efforts are not conducted.

Catchability estimates were extremely low across all methods (<0.0007), suggesting that grass carp are difficult to capture with existing techniques. However, capture rates nearly doubled when telemetered fish were present, indicating that leveraging real-time telemetry (the “traitor” approach) could improve efficiency. From a management perspective, aligning removal efforts with diel and seasonal behavioral patterns, incorporating telemetry into field strategies, and refining gear use based on these insights could substantially increase capture success. These findings provide the first empirical catchability estimates for the species and underscore the need for adaptive, behavior-informed removal strategies to effectively control this high-risk invader in the Great Lakes.

Acre, M.R., Hessler, T.M., Bonjour, S.M., Roberts, J.J., Colborne, S.F., Brenden, T.O., Nathan, L.R., Broaddus, D.W., Vandergoot, C.S., Mayer, C.M., Qian, S.S., Hunter, R.D., Brown, R.E., Calfee, R.D., 2024. Capturing potential: Leveraging grass carp behavior Ctenopharyngodon idella for enhanced removal. Journal of Great Lakes Research 50, 102373. https://doi.org/10.1016/j.jglr.2024.102373

Removal method efficiency

This study quantifies per vessel hour and per effort removal efficiency between non-spawning electrofishing only and combined (electrofishing around a trammel net) removal efforts using a single vessel in the lower 24km of the Sandusky River during 2020–2023. Results showed on average electrofishing only was at least 2.4x more efficient per vessel hour with no significant difference in per efforts catch rates. Results highlight potential tradeoffs between optimizing for detection vs. efficiency for relatively rare fishes when target species distributions are unknown. This manuscript provides an analytical framework to optimizing invasive grass carp capture methods in the Great Lakes.

Hunter, R. D., Qian, S. S., Fischer, J. L., Brown, R., Nathan, L., Dettmers, J. M., ... & Mayer, C. M. (2025). Optimizing per vessel hour capture efficiency for rare, heterogeneously distributed fishes: Invasive grass carp Ctenopharyngodon idella in the Sandusky River. Fisheries Research, 285, 107344. https://doi.org/10.1016/j.fishres.2025.107344

Reproductive Biology

This study reveals that invasive grass carp in Lake Erie exhibit high reproductive plasticity—characterized by batch spawning, asynchronous ovarian development, and indeterminate fecundity—allowing them to spawn multiple times across a protracted season (April to November). These traits, combined with earlier-than-expected age-at-maturity (as young as age-3), higher body condition, and greater fecundity compared to Missouri populations, suggest a heightened risk of population expansion in the Great Lakes. From a management perspective, this underscores the urgency of early detection and removal efforts targeting juveniles before they reach reproductive maturity. Additionally, the establishment of gonadosomatic index (GSI) thresholds for assessing maturity in the field provides managers with a practical tool to rapidly evaluate reproductive potential, improving both risk assessments and the effectiveness of removal programs.

Wilson, T.M., Acre, M.R., Williams III, F., Calfee, R.D., Mayer, C.M., Mapes, R.L., Kemp, C.M., Young, R.T., Byrne, M.E., 2025. Reproductive biology of invasive grass carp (Ctenopharyngodon idella) in two North American systems. Journal of Fish Biology. https://doi.org/10.1111/jfb.70003

Stock Assessment

The goal of this research is to assess the current stock status of Grass Carp and evaluate the effectiveness of ongoing management efforts in reducing biomass. Using data from the shared capture database, the project applies three modeling approaches: Length-Based Indicators (LBI), Length-Based Spawning Potential Ratio (LBSPR), and the Length-Based Bayesian Biomass Estimator (LBB). LBI results indicate that over 95% of captured individuals are classified as mega spawners, large, highly fecund fish. While the LBSPR and LBB produced divergent estimates, this discrepancy is likely due to the sensitivity of the LBB model. Notably, LBSPR results highlight a key management gap: the limited capture of young adults and immature fish. This research is ongoing and led by Tammy Wilson, with support from Matthew Acre and Michael Byrne.

Sandusky River VPS Projects

The acoustic telemetry positional VPS array in the Lower Sandusky River has been in operation seasonally since 2020. There are now multiple projects working with these data to describe the movements and habitat selection of grass carp in the lower Sandusky River. The VPS arrays in the Sandusky River give increased spatial resolution to fish movements not possible from the standard acoustic receivers deployed in other areas of Lake Erie. Below we have outlined three projects making use of these VPS data over the last year.

(1) Hidden Markov Models to uncover fine-scale behavioral patterns of invasive grass carp in the Sandusky River, revealing key mismatches between current removal efforts and fish behavior. The analysis shows that grass carp frequently occupy shallow, vegetated backwater habitats during the day, times and locations where removal crews using electrofishing are least effective. At night, fish exhibit more directed movements in the main channel, suggesting increased vulnerability to passive gears such as gill nets. These findings highlight the need for adaptive management strategies that exploit diel and habitat-driven patterns, such as shifting removal efforts to nighttime or targeting fish when they exit backwaters. The study provides a framework for refining removal tactics based on behavior, which could enhance control effectiveness and reduce the risk of selection for evasive behaviors in this ecologically damaging invader. This work involves multiple members the modeling task group, but has been under the leadership of Sophia Bonjour and Matt Acre at USGS CERC.

Bonjour, S. M., Hunter, R. D., Roberts, J. J., Brenden, T. O., Colborne, S. F., Faust, M. D., Mayer, C. M., Mapes, R., Kraus, R. T., Calfee, R. D., Acre, M. R. Grass carp (Ctenopharyngodon idella) movement states and backwater use can inform removal efforts. In-review at the Journal of Great Lakes Research.

(2) Identification of behavioral states of Grass Carp using Hidden Markov Models (HMMs). The central research objective of this study is to identify environmental conditions corresponding with latent behavioral states in which grass carp are vulnerable to control efforts. Current efforts are focused on understanding what level of error sensitivity (horizontal positioning error; HPE) is acceptable for use with HMMs as well as how to address gaps in observations. HPE and data gaps impact one another; at a high level of HPE filtering, there will be more frequent and longer data gaps, but the remaining data have a higher level of confidence. Conversely, at a low level of HPE filtering, gaps are shorter and less frequent, but the remaining data may be less suitable for inference. To evaluate an appropriate approach to addressing both of these issues, a sensitivity analysis is being used by generating datasets across a range of plausible HPE filtering thresholds then either voiding data gaps or simulating paths between detections. We will then fit null models (i.e. models without covariates) to the resulting datasets and compare parameter estimates, pseudo-residuals, and paths simulated from these null models to evaluate the impacts of these data processing steps. This work is being led by Nick Boucher and Travis Brenden at Michigan State University.

(3) The lower Sandusky River VPS data are also being used to examine patterns of habitat selection through use of a resource selection function (RSF) approach. Recent work on this project has focused on the validation of VPS position data, the organization of predictor data, and code writing for a RSF model. Grass carp positions in the Sandusky River from 2020 – 2024 will be used in this analysis. The positions were inspected to ensure that each fish included in the final data set contained sufficient numbers of detections, i.e., considering fish that resided in the lower Sandusky River rather than those that transitioned through the area quickly. Predictor data, including substrate types, depth, distance to shore, and discharge, has been obtained and organized for analysis to proceed. Code has been prepared to run the RSF models using the ctmm package in R. This work is being led by Alex Maguffee, Scott Colborne, and Travis Brenden.

Diet Projects

This study uses metabarcoding of grass carp stomach contents from Lake Erie and Lake Michigan tributaries to explore unexpected dietary patterns with potential management implications. While previous assumptions suggested grass carp primarily consume submerged aquatic vegetation (SAV), individuals in the western and central basins of Lake Erie were found to consume mostly terrestrial and terrestrial-wetland plants. In contrast, those in the eastern basin and Lake Michigan appeared to rely more on SAV. These findings suggest that grass carp may be highly flexible in their foraging behavior and could be taking advantage of food sources associated with urbanization and riparian vegetation. As a result, current removal strategies that focus on aquatic vegetation zones may benefit from reconsideration. Management efforts could be expanded to include areas with high terrestrial input, particularly in disturbed or urban-influenced habitats. The study highlights the importance of incorporating field-based diet data into risk assessments and suggests that understanding invasive species' behavior in novel environments can help inform adaptive and effective management strategies. A manuscript is in preparation and expected to be submitted to a peer-reviewed journal in 2025. The project is being co-led by Matthew Acre, Ryan Brown, and Sophia Bonjour.

DFO Early Detection and Surveillance Site Prioritization

A project is currently underway by Eric Smyth and Andrew Drake to prioritize key locations within the Canadian waters of the Great Lakes for DFO surveillance monitoring. The work is based on the probability of Grass Carp dispersing to Canadian locations from known sources (e.g., Western basin of Erie) and the suitability of the locations for spawning and feeding/growth. Potential spawning suitability builds on existing spawning suitability assessments of Canadian tributaries and is based on the duration and frequency of suitable spawning conditions in each tributary. Potential feeding and growth locations have been identified using a Great Lakes coastal wetland inventory and will be assessed based on the estimated total biomass of submerged aquatic vegetation in the wetland. The analysis is currently underway. Results will be presented at a CSAS meeting in June and later published in a DFO Research Document.

DFO Grass Carp Catchability Simulations

A simulation model was completed by Eric Smyth and Andrew Drake to estimate the probability of capture for Grass Carp by DFO response crews. Draft results were presented to the GCAC in August 2024. Simulation models determined the probability of capture that most closely matched with the mark-recapture results from a mock field-based response using Common Carp in Rondeau Bay, Ontario in 2017 and 2018. Various carp dispersal and habitat preference scenarios were explored and estimated probability of capture was highly variable across scenarios and years. A draft manuscript is currently in progress and submission to a journal is anticipated for 2025.

Other On-going Projects

E-fishing vs. combined fishing efficiency (Rob Hunter and Christine Mayer)

Fine-scale grass carp distribution mapping (Rob Hunter and Christine Mayer)

Basin-wide species distribution model (Hunter, Mayer, and Acre)

Upcoming Projects

Management program evaluation - abundance modeling

Gear optimization

<u>Telemetry Task Group</u>

Using detections from 2024 there were confirmed to be 54 tagged Grass carp alive at large whose transmitters have remaining battery life for 2025. During 2024 four at-large fish from 2023 had their batteries expire and 1 of these expired tags was harvested. In addition, these active tags include 25 new grass carp tagged during 2024, 10 in the Sandusky River, and 10 in the Maumee River, two in the Grand River (OH), two in the Black River, and one in the Huron River (OH). Twelve of these newly tagged fish were also given external satellite tags that provide real-time locations via satellite communication when these fish swim close to the water surface allowing the tethered tags to break the surface. There were also 20 native fish tagged (all White Bass) in the Sandusky River close to Brady's Island to continue providing spatial ecology

information as it relates to the proposed seasonal barrier/deterrent planning process. The nearshore array which included 72 receivers in Lake Erie habitat less 5m depth and less than 1km offshore was maintained in 2024 including the 6 near-real-time receiver stations outside of important river mouth habitats. We also maintained the 5 real-time receivers placed on seasonal buoys in nearshore habitats of the south shore from the Maumee River to Cuyahoga River. The fine-scale positioning arrays in the Sandusky River were maintained in 2024 which included 24 receivers surrounding Brady's Island and 100 receivers in the lower river. We also maintained 54 receivers in priority Grass Carp rivers, this array provides point detections in contrast to the previously mentioned dense array which provides 2-demensional positioning estimates of tagged fish. As part of this river array new receivers were deployed in the middle (n=2) and upper (n=3) sections of the Maumee River.

Detections from these receiver arrays and tagged Grass Carp in 2024 have added to a database which includes millions of detections and provides novel insights of Grass Carp movement and behavior. During 2024 Grass Carp were detected in one new tributary, the Black River. Locations from Satellite tagged fish help identify an area within Sandusky Bay which is not conducive to acoustic telemetry where Grass Carp maybe aggregate during early spring. Fine-scale positions of Grass Carp in the lower Sandusky River provided insight into habitat use in deep pools and bend habitats of these reaches. Further analysis of position data revealed heavy use of backwater habitat during daylight hours, rendering Grass Carp unavailable for capture with traditional capture techniques. This information in combination with past telemetry work led to the use of a new gear, gill nets. The results of leveraging telemetry information during the planning for placement of gill nets, were in increases in Grass Carp captures for 2024.

The Telemetry task group has also continued tracking manuscripts related to Grass Carp telemetry data which has improved coordination among the researchers and managers. The task group will continue to provide data and analysis support, including on-demand meetings with removal crews, to help improve the capture and removal of Grass Carp by furthering our understanding of Grass Carp habitat-use, movements, and abiotic drivers of these patterns within Lake Erie and the surrounding waters.

Barriers Task Group

Sandusky River Grass Carp Behavioral Barrier Feasibility Study (Ashley Binion – Zuccaro USACE; John Navarro ODOW)

The Feasibility Study was concluded in 2024, which included a Focused Array of Alternatives and Cost Effectiveness/Incremental Cost Analysis as informed by an expert panel to developing rough order magnitude costs for the barrier alternatives. Project partners were presented with the initial outcomes of the Feasibility Study on August 12, 2024. Following discussion, it was decided to suspend the project based on the high cost of implementation and uncertainty associated with deterrents achieving the desired level of effectiveness (as based on the expert elicitation). This allows partners to revisit the Feasibility Study as certainty is informed through research (i.e. BAFF, UADS; see below) and if additional funding streams become available.

Invasive Carp Behavioral Deterrents (Andrea Fritts - USGS):

The evaluation of the BioAcoustic Fish Fence (BAFF) at Barkley Lock and Dam continued in 2024. This is a multi-modal deterrent comprised of bubble curtains, sound, and lights and is constructed by Fish Guidance Systems from the United Kingdom. Grass carp are among the invasive species that have been surgically implanted with acoustic transmitters to evaluate their response to the BAFF. Statistical analyses are underway to evaluate grass carp behavioral response and crossing rates of the BAFF, plus full upstream passage through the lock chamber. The BAFF switched from experimental operation (i.e., cycling weekly between on and off operation) in Nov 2023 and is now operating continuously.

The evaluation of the Underwater Acoustic Deterrent System (UADS) at Mississippi Lock No. 19 continued in 2024. The UADS is comprised of engineered sound signals developed by the US Army Engineer Research Development Center (ERDC). Grass carp have been surgically implanted with acoustic transmitters to evaluate grass carp behavioral response and crossing rates of the UADS, plus full upstream passage through the lock chamber.

Oblique Bubble Screen (OBS) (Ryan Jackson USGS):

Laboratory-based assessment of the efficacy of bubble screens/curtains for controlling dispersal of grass carp ichthyoplankton continued in 2024 through a collaboration between the USGS and the University of Illinois at Urbana-Champaign. While obliquely oriented bubble screens have been proven effective for redirection and capture of positively buoyant and negatively buoyant particles of similar size to grass carp eggs (Prasad et al., 2024), the same OBS configurations proved ineffective for capture of live grass carp eggs (nearly neutrally buoyant) and larvae in laboratory experiments (Prasad, 2025; Prasad et al., 2025a). In 2024, the prototype bubble screen system was redesigned based on previous experimental data (particle trajectories and hydrodynamics) and tested in a streamwise orientation. The streamwise orientation of bubble screen together with cross-stream-oriented nets on both banks produced substantially higher capture rates compared to an obliquely oriented screen (Prasad, 2025; Prasad et al. 2025b). June 2024 trials with five early-life stages of grass carp were tested: live water-hardened eggs, pre- and post- gas bladder inflation stage larvae, dead larvae, and dead eggs (preserved in formalin solution and later rehydrated—see Doyle (2024) and Doyle et al. [2025]). Relatively high capture efficacies were achieved over a range of mean channel velocities (0.23, 0.45, and 0.75 m/s) for all the drifters (Prasad, 2025; Prasad et al., 2025b). The capture efficacy of the five drifters increased with increasing airflow, allowing up to 98%, 87%, and 68% of drifters captured at low, medium and high-water velocities, respectively. Velocity data were used to estimate helical recirculation timescales, enabling the calculation of optimal bubble diffuser and net array lengths for desired capture efficiencies. This study provides useful guidelines for the design of effective systems to control the dispersal of downstream drifting ichthyoplankton of invasive carp in streams.

Next steps in this research project includes a scaling analysis to facilitate the transition from laboratory to field scale experiments and planning for mesocosm studies in FY2026 (funding permitting). In addition, experimental assessment of the efficacy of obliquely oriented bubble screens for deterring upstream passage of sub-adult grass carp are planned for Fall 2025 in the USGS Columbia Environmental Research Center's (CERC) Eco-flume experimental facility.

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