

# Great Lakes Panel Member Updates

## Fall 2021

Meeting of the Great Lakes Panel on Aquatic Nuisance Species  
October 26-28, 2021 | Virtual Meeting

### U.S. Federal

#### U.S. Fish and Wildlife Service

No update provided.

Contact: Amy McGovern, U.S. Fish and Wildlife Service, 612-713-5109, amy\_mcgovern@fws.gov

#### National Oceanic and Atmospheric Administration

[POC: Steve Pothoven]

- Continued its long term research sampling at Muskegon this year along a nearshore to offshore gradient. This research includes collections of quagga mussels and plankton.
- Conducted high frequency sampling of mussel veligers in order to evaluate their importance to the plankton community, their production, and to begin to understand mussel recruitment dynamics.
- Sampled young of year alewife to understand their recruitment dynamics and the importance of drowned river mouth areas to their early life success.

[POC: Ashley Elgin]

- Assessed quagga mussel body condition and reproductive status at three sites in SE Lake Michigan (April, July and October), which adds to our long-term, seasonal record of mussel metrics in this location.
- Conducted our annual southern Lake Michigan benthic survey and assessed quagga mussel body condition lakewide in coordination with the Lake Michigan Cooperative Science and Monitoring Initiative.
- Collaborated with USGS on a project to use new multibeam echosounder and AUV video survey technologies to sample dreissenid mussels. Processing of ground truthing Ponar samples is in progress.
- Authored or coauthored three dreissenid mussel/benthos articles for a Journal of Great Lakes Research Special Issue on Lake Ontario
  - o Elgin et al. 2021- <https://doi.org/10.1016/j.jglr.2021.08.006>;
  - o Karatayev et al. 2021- <https://doi.org/10.1016/j.jglr.2020.11.010>;
  - o Burlakova et al. 2021- <https://doi.org/10.1016/j.jglr.2021.03.006>
- Coauthored a Journal of Molluscan Studies article about morphometrics and genetics of quagga mussel morphs in Russia and the U.S.
  - o Pavlova et al. 2021- <https://doi.org/10.1093/mollus/eyab024>
- Coauthored a Biological Invasions article about Dreissena invasion dynamics
  - o Karatayev et al. 2021- <https://doi.org/10.1007/s10530-021-02518-3>

Contact: Felix Martinez, National Oceanic and Atmospheric Administration, 734-741-2254, felix.martinez@noaa.gov

#### National Park Service

##### *AIS prevention*

NPS purchased multiple boat-washing stations for deployment at Voyageurs National Park (two stations operated in cooperation with local counties), Isle Royale launch points (Houghton, MI area, operated in coordination with Keweenaw Invasive Species Management Area), near Pictured Rocks National Lakeshore (Kingston Lake, in cooperation with MDNR and USFS), and near Apostle Islands, in cooperation with local marinas. At the Isle Royale launch point, over 198 people were contacted at 13 events boat wash events. No zebra mussels were found.

At 10 national parks, NPS employed AIS prevention educators to prevent spread and introduction.

Invasive species early detection and monitoring

NPS and academic partners conducted snorkel-based surveys for invasive mussels in marina settings at Voyageurs National Park and scuba-based surveys of reef, dock, and nearshore habitats at Apostle Islands and Isle Royale. Invasive mussels were detected in multiple new dock and reef settings but densities remain low.

NPS deployed passive samplers and conduct veliger sampling for invasive mussels at Isle Royale, Pictured Rocks, and Voyageurs. At Apostle Islands, three types of passive samplers were deployed; rock bags and artificial substrate samplers were deployed by NPS at docks, and mesh banners were deployed by EPA-Duluth at nearshore sites.

NPS facilitated volunteer based AIS early detection efforts on nine inland lakes at Sleeping Bear Dunes, targeting 17 invasive species from the State of Michigan aquatic invasive species watch list. NPS staff also conducted aquatic vegetation surveys in two additional lakes, four total.

#### *Invasive mussel removal*

NPS, state, and academic partners continued follow-up monitoring at invasive mussel removal sites at Sleeping Bear Dunes' Good Harbor Reef, including sites of the 2016 manual removal experiment and the 2019 Invasive Mussel Collaborative-sponsored Zequanox experiment.

These efforts were featured in a front-page Chicago Tribune piece this summer: Lake Michigan's invasive mussels targeted - Chicago Tribune

#### *Round goby research*

NPS and UWM partners conducted a larger scale goby exclusion experiment at Sleeping Bear Dunes' Good Harbor Reef.

#### *Invasive mussel rapid response*

Voyageurs National Park purchased barriers for deployment in marina settings in the event of an invasive mussel detection, and prepared a draft invasive mussel rapid response strategy.

Invasive mussel veligers were detected outside park waters in Rainy Lake: Zebra mussel larvae confirmed in Rainy Lake in St. Louis County : Sep 1, 2021 | News Release | Minnesota DNR (state.mn.us). Voyageurs National Park is engaging in meetings with partners to adjust our management and operations due to this finding.

#### *Invasive species impacts*

Voyageurs continues to collaborate with the University of Minnesota, the Minnesota Department of Natural Resources, and Natural Resources Research Institute on a study addressing AIS impacts on walleye populations, resulting in two presentations at the International Rain-Lake of the Woods Watershed Forum, International Falls, MN.

#### *Invasive mussel outreach*

A wealth of targeted outreach products were developed via a Great Lakes Research and Education Center internship, including flyers to post in park facilities, marinas, local bait shops, dive shops, and elsewhere as well as invasive mussel ID/reporting cards for distribution to the public in these same locations and through public programming. Four articles for websites were developed, featuring invasive mussel information from Apostles and Isle Royale as well as a cautionary tale from Lake Michigan, and a feature on the moss ball issue. Five graphics were developed for use with the web articles and social media posts. Three videos (one related to Apostles, one related to Isle Royale, and a more general version for use in other parks) were developed.

Ongoing invasive species control efforts at multiple parks with GLRI funding:

Additional high priority areas at 7 national park sites are targeted for aquatic and terrestrial invasive species treatments.

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#### **U.S. Army Corps of Engineers**

No update provided.

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## **U.S. Coast Guard**

### **Ballast Water Regulation**

The Coast Guard published its ballast water discharge standard regulation in the Spring of 2012. The standard aligns with the IMO D-2 standard and require the installation of type-approved ballast water management systems (BWMS) on "salties". The use of type approved ballast water management methods are required on those new ships constructed after 1 DEC 2013 and will be implemented on existing ships during the vessel's first scheduled drydock after 2014 or 2016 depending on the vessel's BW tank capacity and availability of type approved systems.

The Coast Guard anticipates that more than 3,000 United States domestic vessels in various classes will be required to install an approved ballast water management system (BWMS). In addition, about 9,000 foreign vessels that enter U.S. waters each year will be subject to the rule. The IMO estimates that more than 60,000 vessels worldwide will need to comply with the Ballast Water Management Convention when it enters into force.

### **CG Type Approval**

The multi-faceted type approval process consists of land-based and shipboard-based testing (by independent labs) focused on the biological efficacy of the BWMS. For those systems whose performance could be affected by the cold and pure fresh water of the Great Lakes, additional testing may be necessary. Assessment of the BWMS' ability to properly operate in the harsh marine environment is also undertaken and all of the system's components are examined to ensure compliance with marine engineering, electrical, and mechanical standards. This testing and certification is usually conducted by vessel classification societies. The Coast Guard has certified five Independent Labs (IL) that are involved in the type approval process. Duluth-Superior's Great Ship Initiative is part of a certified IL.

Since 2013, the Coast Guard Marine Safety Center has received 59 of Letters of Intent from BW treatment system manufacturers stating they intend to pursue type approval for their ballast water treatment system. The Coast Guard's Marine Safety Center has type approved 44 BW treatment systems. Eight systems are under review as of September 28th, 2021.

### **Ballast Water Working Group (BWWG)**

The Ballast Water Working Group has completed the 2020 annual report and it is posted on this website; 2020 Summary of Great Lakes Ballast Water Management ([greatlakes-seaway.com](http://greatlakes-seaway.com))

In 2020, 100% of vessels bound for the Great Lakes Seaway from outside the Exclusive Economic Zone (EEZ) received ballast management exams on each Seaway transit. In total, all 10628 ballast tanks were assessed during the 536 vessel transits. Vessels that did not exchange their ballast water or flush their ballast tanks were required to either retain the ballast water and residuals on board, treat the ballast water in an environmentally sound and approved manner, or return to sea to conduct a ballast water exchange. Vessels that were unable to exchange their ballast water/residuals and that were required to retain them onboard received a verification exam during their outbound transit prior to exiting the Seaway.

### **Vessel Incidental Discharge Act (VIDA)**

On December 4th, 2018, the Vessel Incidental Discharge Act was signed into law as part of the Coast Guard Authorization Act. The title provides for a uniform, national standard to govern discharges that are incidental to vessel operations, such as ballast water discharges. It makes the Environmental Protection Agency the lead for establishing these standards, and it makes the Coast Guard the lead for monitoring and enforcing the standards. The Coast Guard and the EPA are working on their respective regulatory mandates. On Monday, October 26th, 2020 the EPA published its "Vessel Incidental Discharge National Standards of Performance" proposed rule in the Federal Register. This proposed rule would establish national standards of performance for discharges incidental to the normal operation of a vessel that will apply primarily to commercial vessels 79 feet in length and above that discharge into waters of the United States or waters of the contiguous zone. The proposed rule also includes procedures for states to petition EPA for additional requirements as provided for under the VIDA. Public comments on the proposed rule were accepted for 30 days and the EPA is currently reviewing the comments from the docket.

VIDA requires the USCG to promulgate implementation, compliance, and enforcement requirements for EPA's national performance standards:

- o The USCG program will be no less stringent than the EPA's current VGP, to ensure, monitor, and enforce compliance with the EPA's national performance standards.
- o Implementing regulations will include vessel management practices, design and construction, testing, approval, installation, and use of marine pollution control devices.
- o VIDA includes additional requirements such as developing an intergovernmental workgroup with Federal and State agency cooperation, submitting annual invasive species reports to congress, and developing an invasive species contingency plan.

The Coast Guard established a working group in December 2019 to help implement several of state coordination requirements. The Ballast Water Reporting and Enforcement Data Working Group with interested State partners, the CG's Navigation Center, EPA, and members of the Smithsonian's National Ballast Water Information Clearinghouse (NBIC) continues their work virtually. This

workgroup's current focus has been on ensuring States have access to the Marine Traffic Automatic Identification System, as well as information on how to receive commercial vessel BW reporting information from NBIC. The participating states now have direct access to the NBIC data.

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#### **U.S. Forest Service**

No update provided.

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#### **U.S. Department of Agriculture-APHIS**

No update provided.

Contact: Vacant

#### **U.S. Department of State**

No update provided.

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#### **U.S. Environmental Protection Agency**

No update provided.

Contact: Kevin O'Donnell, U.S. EPA- Great Lakes National Program Office, 312-353-0813, ODonnell.Thomas@epa.gov

#### **U.S. Geological Survey**

### **Phragmites Research**

The GLC and USGS are jointly leading a regional partnership – the Great Lakes *Phragmites* Collaborative (GLPC) – to improve communication and collaboration leading to more coordinated, efficient and strategic approaches to managing non-native *Phragmites* across the Great Lakes basin. The GLPC provides educational resources tailored to diverse interest groups, connects invasive species managers with the latest research and technology, encourages the use of adaptive management, and facilitates alignment of partner efforts across jurisdictional barriers.

- Continued to provide information via the high-traffic website [www.greatlakesphragmites.net](http://www.greatlakesphragmites.net)
- Hosted several webinars in 2021, including 6 as part of a “Students of Phrag” Webinar Series
- Continued to draft audience-specific outreach materials across various multi-media formats
- Maintained a database and dynamic map of regional organizations (including CISMAs, CWMAAs and PRISMAs) working on invasive species in the Great Lakes
- Created 32 case studies of *Phragmites* management in both Canada and the U.S.
- Shared the work of the GLPC at many national and international conferences

#### *Phragmites Adaptive Management Framework (PAMF)*

The GLC and USGS are working to promote effective *Phragmites* management and track the effectiveness and resource efficiency of management activities through the PAMF program (<http://www.greatlakesphragmites.net/pamf/>). PAMF engages a variety of land managers across the basin, from state and federal employees to private citizens, in a strategic attempt to help and learn from people actively managing *Phragmites*. The program needs your participation to develop data-driven best management practices as quickly as possible.

- In 2021, leadership of PAMF transitioned to the GLC, which works daily with PAMF participants (representing over 50 different organizations) to coordinate efforts effectively
- Since 2017, PAMF conducted 33 total training sessions (hosted 1 live virtual training session in 2021) reaching over 300 people across the Great Lakes basin to educate *Phragmites* managers about PAMF and encourage their participation. In response to the COVID-19 pandemic, PAMF transitioned to live virtual trainings in summer 2020, and in 2021 introduced a self-paced online training course through the Moodle platform
- Increased total enrolled management units to 251 across all eight Great Lake states and Ontario; provided management guidance to 110 enrolled management units for the 2021/22 cycle

- During 2020-2021, PAMF staff assisted with monitoring 35 management units that managers were unable to monitor due to COVID-19 travel or budget restrictions
- Since 2018, PAMF staff promoted PAMF or presented at >20 scientific meetings or conferences
- The animation “[Phragmites Adaptive Management Framework: Participation Cycle](#)” won a USGS Shoemaker Award for Communications Product Excellence in 2019
- Developed the PAMF Strategic Plan to guide successful implementation of PAMF by setting program-specific goals, objectives, and measures for five years (2020-2026)
- Currently enrolling new management units for the 2021/2022 PAMF cycle year – contact the PAMF Coordinator at [pamf@glc.org](mailto:pamf@glc.org)

### Control measures

The USGS Great Lakes Science Center is conducting research into innovative control measures for non-native *Phragmites australis* (common reed), a highly invasive species with wide-ranging social, economic, and ecological impacts, based on the bacteria, fungi, and other microbes that it supports. A USGS-led group developed a science agenda (Kowalski et al 2015, <https://pubs.er.usgs.gov/publication/70147339>) that is guiding a nation-wide effort to develop new management approaches that promote the microbes that are harmful to this invasive plant and inhibit those that help it outcompete native plants. There have been many publications on this topic since 2015, all of which are highlighted in the Published *Phragmites* Research section of the GLPC web site (<https://www.greatlakesphragmites.net/research/>).

Close partnerships with the University of Michigan, Rutgers University, Tulane University, Louisiana State University, and other organizations are identifying the key microbes and microbial processes to target for manipulation as a form of plant control. Field and greenhouse studies over the past few years have tested the virulence of harmful microbes on *Phragmites* plants, cataloged the microbes associated with this invasive plant, and evaluated how the application of non-toxic antimicrobial treatments affect plant growth. These and other studies are helping identify the mechanisms associated with plant-microbe mutualisms and leading to the development of new management tools for managers of *Phragmites* and other non-native plant species. Field studies are underway in Michigan and New Jersey to test potential treatments.

USGS continues to work closely with colleagues at the U.S. Army Corps of Engineers Engineer Research and Development Center to develop genetic biocontrol treatments for non-native *Phragmites australis*. Based on the natural plant process of RNA interference, the research team is developing species-specific treatments that limit the expression of plant traits (e.g., high growth) and offer managers additional treatment options. This work is being informed by genomic and transcriptomic analyses by USGS, Louisiana State University, and Tulane University, including the first published full genome description of non-native *Phragmites*. Additionally, we are working to describe the genome of the North American native *Phragmites* to be able to take a comparative genomics approach to understand the genetic underpinnings of *Phragmites* invasiveness and identify more specific and effective targets for genetic control.

The USGS Great Lakes Science Center is partnering with the U.S. Fish and Wildlife Service to explore the impacts of Great Lakes water levels on the growth, spread, and management of *Phragmites*. After several years of prolonged high water, many existing *Phragmites* populations in the coastal zone of the Great Lakes are being stressed or drowned. Additionally, land managers are taking advantage of the high water and cutting *Phragmites* below water to drown the plant as a control strategy. However, very little data have been collected on the viability of rhizomes following natural drowning or the efficacy of cut-to-drown management. We are combining field and greenhouse studies as well as cataloging geographic zones where retreat or expansion may occur under future water-level patterns. This work is funded by the USGS-FWS Science Support Partnership Program.

### **Grass Carp**

#### *Identifying spawning locations in the Sandusky and Maumee Rivers*

The FluEgg drift model was successfully used to identify a primary grass carp spawning area in the Lower Sandusky River prior to the removal of Ballville Dam at Fremont, OH. However, the dam removal in September 2018 and subsequent capture of well-developed grass carp eggs at the previously known spawning site in 2019 necessitated the need to identify any new grass carp spawning sites upstream of Fremont. The underlying hydraulic model of the Sandusky River was extended about 37 km upstream to Tiffin, OH, and inverse drift modeling using FluEgg was completed to determine the most probable spawning sites of approximately 960 staged grass carp eggs captured during four spawning events in 2019. Results will be shared with management agencies in the first quarter of FY22 and will be formally published in a journal article later in the fiscal year.

Probable grass carp spawning areas in the Maumee River were identified in early FY21 using the FluEgg drift model and 2017-2019 grass carp egg and larvae samples. A total of twelve probable grass carp spawning areas were identified over a 77-km reach of the Maumee River between Independence Dam near Defiance, OH, and the Ohio Turnpike bridge near Perryburg, OH. Nine of the spawning areas are located downstream of the Grand Rapids and Providence Dams. Additional FluEgg modeling has been completed to determine the river conditions (e.g. discharge, mean velocity, and water temperature) and spawning sites that have the highest

risk of recruitment based on in-river egg hatching probability. This large FluEgg drift modeling effort included simulations of other invasive carp species (bighead and silver) as well as several native species (White Bass and Walleye) to support individual-based bioenergetics modeling by NOAA. FluEgg modeling is nearly complete (only native species remain) and analysis and publication of the results is expected in FY22.

#### *Early Life History*

We sampled six tributaries for Grass Carp eggs and larvae during the 2021 field season. Two were in Michigan (Tittabawassee and St. Joseph Rivers) and were sampled following the capture of diploid adults in the recent past. We sampled at 52 sites among these six tributaries (163 net tows). No Grass Carp eggs were found. We also expanded the coverage of USGS gage data by installing new water temperature sensors within one known (Maumee) and three potential (Cuyahoga, Portage, and Tittabawassee Rivers) Grass Carp spawning tributaries.

#### *Acoustic Telemetry*

In 2021, we deployed 80 acoustic telemetry receivers in the nearshore habitat of Lake Erie and two dense receiver arrays for fine-scale locations in the Sandusky River. These arrays and existing arrays from other projects in Lake Erie recorded over 2 million detections of tagged Grass Carp in Lake Erie and tributaries and over half of these detections were from the nearshore and Sandusky River arrays. These data have been used to provide fine-scale location hotspots of Grass Carp in the Sandusky River to aid in removal efforts. Data from these detections have also shown the individual carp will enter multiple spawning tributaries sometimes more than one spawning tributary per season.

#### *Efficacy of an Oblique Bubble Screen System as a Two-Way Dispersal Barrier for Invasive Carp*

The goal of this project is to develop a two-way oblique bubble screen (OBS) system to both entrain and inhibit downstream dispersal of invasive carp eggs and larvae and deter the upstream movement of adult carp attempting to reach spawning areas. While bubble screens/curtains have proven to substantially inhibit passage of adult invasive carp with 80% or greater efficacy (Zielinski and Sorensen 2016, Dennis et al. 2019), work to date has exclusively been one-directional, designed to stop either upstream or downstream movement. Oblique bubble screens, deployed across a channel at an angle to the flow, are an emerging technology in the fight against plastic pollution. Recent pilot studies have demonstrated a mean efficacy of 86% in trapping and collecting plastic particles > 1mm from flowing rivers and canals.

The first series of laboratory experiments began at the University of Illinois at Urbana-Champaign's Ecohydraulics and Ecomorphodynamics Laboratory (EEL) in Rantoul, Illinois, in late FY2021. These experiments are quantifying the response of synthetic grass carp 'eggs and larvae' to turbulent features of the flow across various configurations of an OBS system (e.g., type, number, length, and orientation (angle) of the bubble diffusers; distance between diffusers; temporality and intensity of air injection; water velocity and flow depth). Preliminary results from these ongoing experiments show that the orientation and configuration of the OBS and the intensity of the supplied air flow are the fundamental parameters to determine efficacy of OBS systems at high water velocities. A proper design will determine whether drifting particles are trapped upstream of the bubble screen, redirected to the downstream-most end of the OBS for passive or active capture, or just slowed down and partially redirected by the OBS. Encouraging early results indicate we are on-track to exceed the minimum efficacy goal of 50% for redirection and capture of synthetic grass carp eggs by an OBS system for flow velocities up to 1.5 m/s. Funding permitting, data from this first series of experiments will inform a second series of experiments in FY2022 with downstream-drifting live grass carp eggs and larvae, intended to define optimal OBS configurations for capture efficiency across developmental stages and flow conditions. A third experimental series (also in FY2022) will assess the efficacy of the OBS configuration(s) (optimized for capture of downstream drifting eggs/larvae) on deterring upstream passage of sub-adult/adult grass carp.

#### *USGS SpawnCast beta test in FY2021*

In FY2021, the USGS consulted agency response coordinators regarding the need for a decision support tool to facilitate the planning, coordination, and mobilization of resources for rapid response to grass carp (*Ctenopharyngodon idella*) spawning events in tributaries to Lake Erie. There was broad support for a web- and mobile-accessible decision support tool capable of forecasting grass carp spawning events up to 5-days in advance to enable resource management agencies time to mobilize and deploy grass carp strike teams and sampling crews effectively and efficiently. It was emphasized that such a tool should utilize real-time USGS gaging station data (water level, temperature, velocity, discharge), National Weather Service (NWS) river and weather forecasts, necessary river physiographic characteristics (drainage area, undammed river length, bedslope, substrate, etc.), and known grass carp spawning times, areas, and habitat requirements. To meet this need, USGS scientists, in collaboration with the National Weather Service Ohio River Forecast Center, developed USGS SpawnCast, a prototype grass carp spawning event prediction tool for the Sandusky River. In its most general form, USGS SpawnCast is a first-generation spawning forecast dashboard for rivers that is, in theory, broadly applicable to rivers and aquatic species throughout the United States. USGS SpawnCast uses observed and forecast discharge and water-quality data combined with species-specific spawning requirements to forecast spawning probability for species of interest in select rivers and tributaries to the Great Lakes. Beta testing by agency response coordinators occurred throughout the 2021 grass carp spawning season. Feedback from users and managers has been largely positive and constructive and will be used to refine this tool to meet the current and future needs of the Great Lakes Grass Carp Advisory Committee (GLGCAC) and the broader

community battling invasive carp. While this tool was developed to help scientists and natural resource managers eradicate invasive species through targeted removal and control efforts, we envision this tool may eventually also help forecast spawning of native, threatened, and endangered species to help promote successful reproduction of beneficial species.

In response to requests from agency response coordinators, grass carp spawning forecast dashboards for the Maumee and Cuyahoga Rivers will be added to USGS SpawnCast prior to the 2022 spawning season (funding permitting).

#### *Baits and Attractants for Increasing Removal*

The objective of this study is to congregate Grass Carp at feeding platforms to demonstrate a possible tool which could aid in mass removal of this invasive species. We have completed three of four 10-day feeding trials where we deployed a rapeseed bait developed at the Upper Midwest Environmental Science Center and a pelleted algae attractant. There are a total of three sites each comprising of five treatments, 1) combined algae and rapeseed, 2) rapeseed, 3) algae, 4) platform control, and 5) true control. One site is in Plum Creek, MI near the confluence with Lake Erie and the other two sites are in the Sandusky River, OH near the confluence with Sandusky Bay. Attractants (rapeseed and algae) are released twice a day at dawn and dusk. Each treatment in the Sandusky River is monitored daily with two hoop nets starting one day prior and throughout the feeding trial, but no hoop nets are set in Plum Creek.

We have completed three 10-day trials at all three sites and have a fourth trial ending on October 18, 2021. The first trial had minor complications getting liquid algae consistently delivered as well as issues with fat content of the canola-based bait (rapeseed) which was remedied by the bait manufacturer. Algae was originally delivered as liquid which had significant field challenges; therefore, algae was pelleted for easier delivery. To monitor Grass Carp use at each treatment, we have completed nine mobile acoustic surveys using an ARIS Explorer 3000 to collect high resolution sonar data at three time periods (pre-, mid-, and post-trial).

Additionally, we have completed six electrofishing events at all treatments at two periods (pre- and post-trial). We have captured five Grass Carp in the Sandusky River during feeding trials, most of which were caught in hoop nets (n = 4; Figure 1). In total, we have captured 10,116 in hoop nets representing 34 unique species (Table 1). Lastly, between USGS and the Sandusky River Watershed Coalition we have collected 840 water samples to be processed for Grass Carp eDNA.

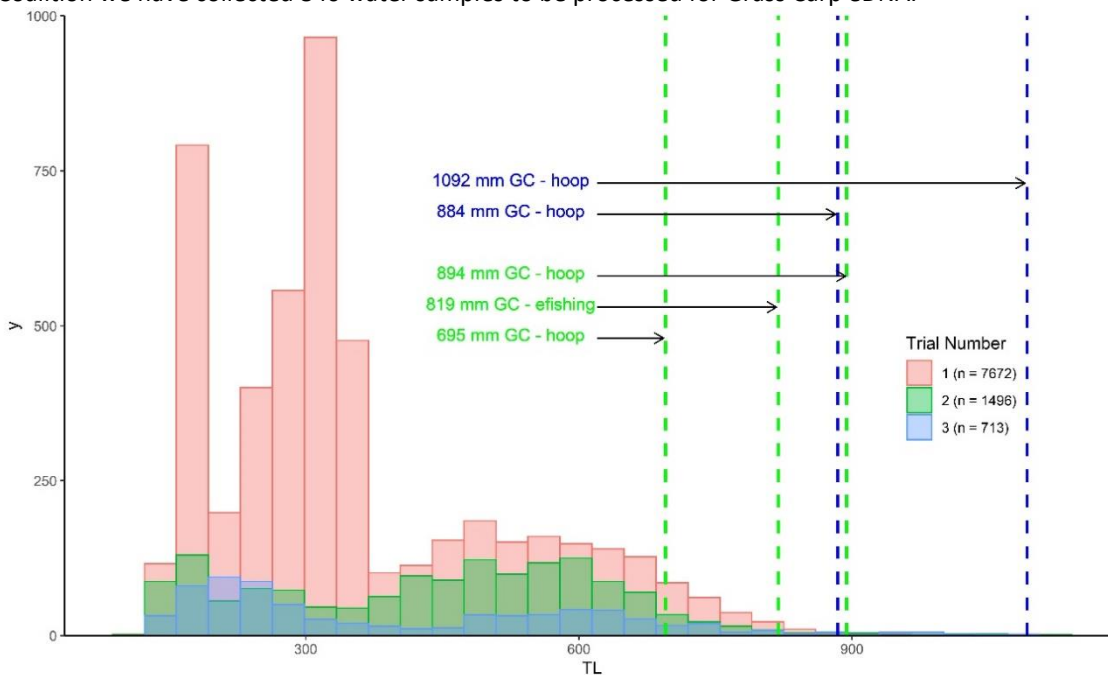


Figure 1. The length frequency histogram represents hoop net captures during the three attractant trials plus the single Grass Carp captured during the electrofishing survey. Capture rates for most species declined from the first trial, except for Grass Carp. The dashed vertical lines indicate the size of the five Grass Carp captured (text and line color corresponds to trial number).

#### **Sea Lamprey**

A journal manuscript titled "Gut Microbiota Associated with Different Sea Lamprey (*Petromyzon marinus*) Life Stages" was published in *Frontiers in Microbiology* <https://doi.org/10.3389/fmicb.2021.706683>. The work is a product of collaboration between USGS-GLSC (Murulee Byappanahalli and Nick Johnson) and the University of Minnesota (Prince Mathai and Michael Sadowsky). The main goal of this research was to identify and characterize bacterial communities in sea lamprey during their different physiological stages using high throughput sequencing. Our working hypothesis was that bacterial communities would differ among life stages and become less complex and more specialized in parasitic juvenile sea lamprey because they feed exclusively on blood and bodily fluids. We found significant differences in the gut bacterial communities among the larval, parasitic juvenile, and adult life stages; the transition from larval to the parasitic juvenile stage was marked with a significant shift in bacterial community structure and reduction in alpha

diversity (i.e., species richness). In summary, understanding the role of host-associated microbes (bacteria, fungi) in sea lamprey fitness may provide new insights into the rearing of lamprey and the development of new lamprey control strategies.

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## **State/Provincial**

### **Illinois**

No update provided.

Contact: Kevin Irons, Illinois Department of Natural Resources, 217-557-0719, kevin.irons@illinois.gov

### **Indiana**

The Indiana Department of Natural Resources continues its efforts to prevent the spread of AIS species throughout the state of Indiana but especially across the Watershed divide between the Mississippi River Basin watershed and the Great Lakes watershed. Indiana Department of Natural Resources has continued to utilize state and Great Lakes Restoration Initiative funding to provide for the implementation of the state AIS management plan implementation but also over the last few years we also have continued to fight the spread of Eurasian Watermilfoil and the growth of Starry Stonewort in northeast Indiana. Starry stonewort a macro algae especially, has proven very difficult to control but we continue to try different chemical prescriptions and are coordinating with universities and plant control companies with hopes of finding better tools that are effective at limiting the growth and success of this invasive aquatic plant. The aggressive and large-scale control and eradication efforts on over 270 acres of infestation that we have put in place through Great Lakes Restoration Initiative grant funding has slowed the spread of this aggressive macro alga but has yet to provide the answers to the best path forward.

In 2020 Indiana DNR put a special emphasis on the completion of all revisions of the 2020 Indiana AIS Management Plan revision. The ANS Task Force reviewed and gave us a chance to present our revised plan during the December 8-10th meeting of 2020. On December 10th I presented the revised state management plan to the ANSTF and received unanimous approval of the revised state management plan.

In the past year plus the Indiana DNR has put special emphasis and funding toward a dedicated Asian Carp program to engage with neighboring states and region partnerships and committees to contribute to better understanding and implementation of control strategies across the drainages.

Along with many other representatives of the AIS programs in the Midwest we continue to be engaged and participating in the following groups: Great Lakes Panel, Mississippi River Basin Panel, the Invasive Mussel Collaborative, Interstate ANS planning group, Indiana Invasive Species Council, regional hydrilla coordination and Asian Carp Regional Coordinating Committee.

Contact: Eric Fischer, Indiana DNR, 317-234-3883, efischer@dnr.in.gov

### **Michigan**

No update provided.

Contact: Sarah LeSage, Michigan DEQ, 517-243-4735, lesages@michigan.gov

### **Minnesota**

No update provided.

Contact: Heidi Wolf, Minnesota DNR, 651-259-5152, heidi.wolf@state.mn.us

### **New York**

- EDRR hydrilla control effort in North Tonawanda Marina along the Niagara River (confirmed in late July)
- eDNA and e-fishing effort to detect and confirm presence of Northern snakehead in the Bashakill WMA
- second year of reports of Northern snakehead in the lower Delaware River
- Round goby confirmed in Hudson River
- Continued surveys, monitoring, and treatment at Green and Hickory Lakes (hydrilla), private Erie County Pond (Brazilian elodea); Tioga County - Spencer Pond (hydrilla) and Kuhlman Pond (hydrilla and parrot's feather); Westchester County - Croton River and New Croton Reservoir (hydrilla); Lower Hudson River aquatic plant surveys and Mohawk River aquatic plant surveys (no hydrilla detected by either); continued coordination of Cayuga Lake hydrilla monitoring, surveying and treatment (USACE, FL PRISM, Tompkins County SWCD, City of Ithaca, Cayuga Lake Watershed Network).
- Successful pilot treatment of Ludwigia peploides in one acre plot of Peconic River. Research conducted by University of Hartford and SePO will allow us to use same herbicides for European frogbit (2ee permit) next year. We will be expanding the project to the



entire freshwater portion of the Peconic River next year based on results of this year's aquatic plant surveys. Cursory pre- and post-treatment macroinvertebrate surveys have not indicated an impact from herbicides in 2021.

- Our watercraft inspection steward program inspected more than 220,000 boats and intercepted more than 11,000 AIS; we are working to update our program manual before next season. This year was the first time we had a steward at a marine launch.
- Our interns/grad students completed research on eDNA detection distances for hydrilla and standardized biomass estimation for water chestnut removal efforts. Our current intern will be conducting research into the genetics of variable leaf milfoil.

Contact: Catherine McGlynn, New York State Department of Environmental Conservation, 518-408-0436, catherine.mcglynn@dec.ny.gov

## **Ohio**

- Continue to work on hydrilla control in the Lake Erie watershed
- Continue work on closing GLMRIS connections at Grand Lake St Marys and Little Killbuck Creek
- Grass Carp Strike Teams continue to remove fish from the western basin of Lake Erie
- Determining the feasibility of a behavioral barrier on the Sandusky River to prevent Grass Carp from reaching spawning areas.

Contact: John Navarro, Ohio DNR Division of Wildlife, 614-265-6346, john.navarro@dnr.state.oh.us

## **Ontario**

No update provided.

Contact: Francine MacDonald, Ontario Ministry of Natural Resources, 705-755-5136, Francine.macdonald@ontario.ca

## **Pennsylvania**

No update provided.

Contact: Jim Grazio, Pennsylvania DEP, 814-217-9636, jagrazio@pa.gov

## **Quebec**

No update provided.

Contact: Olivier Morissette, Quebec Ministère des Forêts, de la Faune et des Parcs, 418-627-8694 x7519 olivier.morissette@mffp.gouv.qc.ca

## **Wisconsin**

No update provided.

Contact: Carroll Schaal, Lakes & River Section Chief, Bureau of Water Quality, Carroll.Schaal@Wisconsin.gov

## **Regional/Binational**

### **International Joint Commission**

No update provided.

Contact: Mark Burrows, International Joint Commission, 519-257-6709, burrowsm@windsor.ijc.org

### **Great Lakes Fishery Commission**

No update provided.

Marc Gaden, Great Lakes Fishery Commission, 734-662-3209 x14, marc@glfc.org

### **Great Lakes Commission**

### **Invasive Mussel Collaborative**

Overview: The Invasive Mussel Collaborative (IMC) is working to advance scientifically sound technology for invasive mussel control to produce measurable ecological and economic benefits. The IMC provides a framework for communication and coordination and is identifying the needs and objectives of resource managers; prioritizing the supporting science; implementing communication strategies; and aligning science and management goals into a common agenda for invasive mussel control.

#### Recent and Upcoming Activities:

- Continued to support two work groups surrounding priority issues identified at the September 2019 annual meeting.

- Established a set of research priorities for invasive mussels, which were shared with a U.S. federal working group established under GLRI to better distribute funding related to invasive mussels.
- Developed a manuscript outlining recommendations and best practices for testing new controls in lab settings.
- Finalized development of an interactive geographic site prioritization tool to identify critical coastal habitats that would most benefit from zebra and quagga mussel control efforts.
- Maintained an active communication network, including a comprehensive website, email list with over 400 subscribers, and a biweekly newsletter.

Lead Staff: Samantha Tank, [sam@glc.org](mailto:sam@glc.org)

### **Great Lakes *Phragmites* Collaborative**

Overview: The GLC and U.S. Geological Survey are jointly leading a regional partnership – the Great Lakes *Phragmites* Collaborative (GLPC) – to improve communication and collaboration leading to more coordinated, efficient and strategic approaches to non-native *Phragmites* across the Great Lakes basin. The GLPC provides educational resources tailored to diverse interest groups, connects invasive species managers with the latest research and technology, encourages the use of adaptive management, and facilitates alignment of partner efforts across jurisdictional barriers.

#### Recent and Upcoming Activities:

- Regularly convened an Advisory Committee to guide the work of the GLPC and foster interjurisdictional partnerships.
- Hosted an ongoing webinar series where guest speakers shared successful models for *Phragmites* management, public outreach, and collaborative governance.
- Convened the *Phragmites* Symbiosis Collaborative, a forum for researchers to share and collaborate on their microbial or genetic research.
- Hosted a *Phragmites* symposium at the Upper Midwest Invasive Species Conference with invited speakers from across the Great Lakes.
- Updated the GLPC website ([www.greatlakesphragmites.net](http://www.greatlakesphragmites.net)) to meet the needs to our stakeholders.
- Distributing a biweekly newsletter that shares news, upcoming events, and relevant information to *Phragmites* management.
- Developed audience-specific outreach materials across various multi-media formats.

Lead Staff: Samantha Tank, [sam@glc.org](mailto:sam@glc.org)

### ***Phragmites* Adaptive Management Framework (PAMF)**

Overview: The GLC works with the U.S. Geological Survey (USGS) and University of Georgia to promote effective *Phragmites* management across the Great Lakes basin and track the effectiveness and resource efficiency of those management activities through the PAMF model. PAMF is available to *Phragmites* managers across the basin, from state and federal employees to private citizens, in a strategic attempt to engage, learn from, and assist all levels of *Phragmites* managers.

#### Recent and Upcoming Activities:

- Maintained ongoing communication with program partners from USGS and the University of Georgia to effectively coordinate program efforts.
- Completed the fourth annual model run and delivered *Phragmites* management guidance to 110 active management units.
- Prepared abstracts for presentations at upcoming conferences.
- Distributed PAMF newsletters featuring a blog post and upcoming events.
- Updated the PAMF Web Hub to improve the user experience and ensure the collection of high quality management data.
- Developed a remote training course for PAMF participants with lessons that include recorded presentations, targeted readings, helpful guides, and quizzes designed to be a comprehensive participant learning experience.
- Developed code with USGS partners that automates many data summarization processes that were previously manually quantified, improving resource efficiency.
- Assembling a PAMF program manual to streamline program coordination and document annual outreach activities.
- Enrolling new management units for the 2022/2023 PAMF cycle year.

Lead Staff: Samantha Tank, [sam@glc.org](mailto:sam@glc.org)

### **Interstate Aquatic Invasive Species Prevention, Early Detection, and Response (Phase III)**

Overview: The GLC is supporting the eight Great Lakes states in their efforts to plan and coordinate interstate aquatic invasive species (AIS) prevention, early detection, and response activities. During the third phase of this effort, the GLC will work with the interstate team to review existing communication plans and protocols related to AIS surveillance and response, and use lessons learned from previous response exercises to develop a draft plan for communication of surveillance data and response actions. The GLC will also be coordinating a response exercise with a focus on communications under different scenario conditions (e.g., different taxa, multijurisdictional waters).

#### Recent and Upcoming Activities:

- Finalized the regional communications plan to be used with the existing response framework developed as part of Phase II of this project.

- Integrated the communications plan into the existing surveillance and response plans developed under previous phases of this project.

Lead Staff: Ceci Weibert, [cweibert@glc.org](mailto:cweibert@glc.org)

### **Interstate Aquatic Invasive Species Prevention, Early Detection, and Response (Phase IV)**

Overview: The GLC is supporting the eight Great Lakes states in their efforts to plan and coordinate interstate aquatic invasive species (AIS) prevention, early detection, and response activities. During the fourth phase of this effort, the GLC will work with the interstate team to expand and improve the existing regional surveillance framework and to develop best practice guidance for aquatic plant surveillance. The GLC will also be coordinating the development of an enhanced web interface to support regional prevention, early detection, and response activities.

#### Recent and Upcoming Activities:

- Upcoming work includes assisting The Nature Conservancy in planning and holding a series of workshops to improve and refine the Great Lakes surveillance site prioritization system.
- Additional upcoming activities include the development of a standalone website for this program and its products, with work set to begin in early 2022.

Lead Staff: Ceci Weibert, [cweibert@glc.org](mailto:cweibert@glc.org)

### **Great Lakes Detector of Invasive Aquatics in Trade**

Overview: GLC developed the web-based software tool Great Lakes Detector of Invasive Aquatics in Trade (GLDIATR), which collects, analyzes and allows users to access information about how many and what types of Great Lakes AIS are available for sale on the Internet. This information is being used by invasive species managers to inform and help target a variety of activities, including outreach and education, risk assessment, monitoring and surveillance, and enforcement.

#### Recent and Upcoming Activities:

- Provided sale information at the request of managers and other partners.
- Investigating functionality of novel web tools in the marketplace and potential role in assisting collection, analysis, and dissemination of Great Lakes AIS information.
- Identified third-party web scraping tools that may be used to support GLDIATR and contracted with those companies to support project activities.

Lead Staff: Erika Jensen, [ejensen@glc.org](mailto:ejensen@glc.org).

### **Blue Accounting – Aquatic Invasive Species**

Overview: The GLC is leading work on aquatic invasive species under Blue Accounting. This work focused on providing regional data and information on efforts to: stop species introduction and spread through priority pathways including live trade and recreational boating; Implement a targeted, binational program to detect new species; and control populations of harmful invasive species across the region.

#### Recent and Upcoming Activities:

- Contributed to management of the overall Blue Accounting initiative
- Held webinars with the Blue Accounting AIS work group in May 2021 and August 2021
- Finalized design of a dashboard related to the organisms in trade pathway to track progress on regional consistency in regulatory policies and collated data needed to support that design.
- Participated in refining the prototype web platform for Blue Accounting 2.0
- Upcoming activities include scoping development of data visualizations to track progress on the control of established species.

Lead Staff: Ceci Weibert, [cweibert@glc.org](mailto:cweibert@glc.org)

Contact: Tom Crane, Great Lakes Commission, 734-971-9135, [tcrane@glc.org](mailto:tcrane@glc.org)

### **Canadian Federal**

#### **Fisheries and Oceans Canada**

No update provided.

Contact: Lynn Bouvier, Fisheries and Oceans Canada, 905-336-4981 [Lynn.Bouvier@dfo-mpo.gc.ca](mailto:Lynn.Bouvier@dfo-mpo.gc.ca)

#### **Ballast Water Research**

No update provided.

Contact: Sarah Bailey, Fisheries and Oceans Canada, 905-336-6425 [Sarah.Bailey@dfo-mpo.gc.ca](mailto:Sarah.Bailey@dfo-mpo.gc.ca)

Contact: Becky Cudmore, Fisheries and Oceans Canada, 905-336-4474, [becky.cudmore@dfo-mpo.gc.ca](mailto:becky.cudmore@dfo-mpo.gc.ca)

## **Transport Canada**

No update provided.

Contact: Chris Wiley, Transport Canada, 519-464-5092, [chris.wiley@tc.gc.ca](mailto:chris.wiley@tc.gc.ca)

## **LOCAL COMMUNITIES**

### **United States**

No update provided.

Contact: Vacant

### **Canada**

No update provided.

Contact: Vacant

## **Private Environmental/User Groups**

### **Great Lakes Sport Fishing Council**

No update provided.

Contact: Dan Thomas, Great Lakes Sport Fishing Council, 630-941-1351, [dan@great-lakes.org](mailto:dan@great-lakes.org)

## **Tribal Authorities**

### **Great Lakes Indian Fish & Wildlife Commission**

No update provided.

Contact: Miles Falck, Great Lakes Indian Fish & Wildlife Commission, 715-682-2124, [miles@glifwc.org](mailto:miles@glifwc.org)

### **Chippewa Ottawa Resource Authority**

No update provided.

Contact: Mike Ripley, Chippewa Ottawa Resource Authority, 906-632-0043, [mripley1@chippewaottawa.org](mailto:mripley1@chippewaottawa.org)

## **PRIVATE/COMMERCIAL**

### **Council of Great Lakes Industries**

No update provided.

Contact: Vacant

### **Lake Carriers' Association**

Lake Carriers' began a research and technology grant on funds provided by the Great Waters Research Collaborative to install and operate a ballast water management system (BWMS) on a vessel. The project will examine how a UV-based disinfection BWMS performs in Great Lakes waters. The project is not assessing the viability of installing and operating a BWMS on a U.S.-flag Great Lakes vessel. Testing will begin with the 2022 shipping season.

Contact: Tom Rayburn, Lake Carriers' Association, 440-333-9994, [rayburn@lcaships.com](mailto:rayburn@lcaships.com)

## **University/Research**

### **Great Lakes Sea Grant Network-Research and Extension**

No update provided.

Contact: Rochelle Sturtevant, NOAA Great Lakes Sea Grant Network, 734-741-2287, [Rochelle.Sturtevant@noaa.gov](mailto:Rochelle.Sturtevant@noaa.gov)

### **Cooperative Research Unit**

No update provided.

Contact: Tom Johengen, Cooperative Institute for Limnology and Ecosystems Research, 734-741-2203, [johengen@umich.edu](mailto:johengen@umich.edu)

## **At-Large**

### **Invasive Species Centre**

Since the last GLP meeting, the ISC has continued working on meeting the deliverables of our 4-year agreement with Fisheries and Oceans Canada for the Asian Carp Canada program. We have run two influencer campaigns with Averie Rose Bonin and Jay Seimens, completed e-mail marketing campaigns through Anglers Atlas, and run advertisements on fishing forums and publications such as Outdoor Canada and Just Fishing Magazine. We have also hosted a public information session focusing on Grass Carp in July, as well as a webinar training workshop targeting Parks staff to train them on identification and reporting methods. Lastly, we are running a survey targeting anglers to get a better understanding of their level of knowledge and learn where they like to get their angling information so we can use this to run more targeted campaigns in the future. We are also continuing our zooplankton diagnostics work where we analyze water samples for presence or absence of invasive mussel veligers and spiny water flea in in-land lakes across Ontario. In addition to this work, we have launched a volunteer-based pilot program, IsampleON, where Lake Associations collect samples that they will then send to our lab to be tested for presence or absence of veligers. This program sampled 25 lakes throughout Ontario that met the high-risk criteria for mussel establishment. The ISC is also working with many partners to develop a Phragmites framework for Ontario through our Green Shovels program. Finally, the ISC is the conference secretariat for the International Conference on Aquatic Invasive Species (ICAIS), and is currently planning for the 22nd ICAIS, which will be a hybrid in-person and virtual conference taking place April 18-22, 2022 in Belgium. Details can be found on [www.icaais.org](http://www.icaais.org).

Contact: Rebecca Schroeder, Invasive Species Centre, [rschroeder@invasivespeciescentre.ca](mailto:rschroeder@invasivespeciescentre.ca)

### **Minnesota Aquatic Invasive Species Research Center**

No update provided.

Contact: Nick Phelps Minnesota Aquatic Invasive Species Research Center, 612-624-7450 [phelp083@umn.edu](mailto:phelp083@umn.edu)

### **Invading Species Awareness Program, Ontario Federation of Anglers and Hunters**

The OFAH/ISAP has been busy delivering programs focused on prevention, monitoring, control, and management. After a two-year hiatus, the ISAP reinstated the Invading Species Hit Squad – a team of youth hired each summer to tackle invasive species projects. Highlights from 2021 include the monitoring and surveillance of water soldier on the Trent-Severn Waterway, filming a Clean, Drain, Dry video for water stewards, filming a video on invasive mysterysnails, conducting invasive species inventories and control on municipal lands and conservation areas, the installation of zebra mussel substrate traps, and moth collection and identification surveys for dog-strangling vine biocontrol.

The recreational boater pathway remains a priority. The ISAP launched its Water Steward Program, which is focused on training volunteers on Clean, Drain, Dry messaging and how to engage boaters at water access points. For the third year, the ISAP participated in the Great Lakes Regional AIS Landing Blitz. Due to COVID-19, the event was delivered as a virtual campaign that included 10 social media posts between June 26-July 4, 2021. The campaign was successful and reached 125,484 people and achieved 13,402 engagements.

With support from MNDMNRF and the acquisition of a License to Collect Fish for Scientific Purposes, the OFAH started working with volunteers to address the increasing concern of mysterysnails in the Haliburton region. Staff delivered multiple virtual training workshops to over 400 volunteers focused on how to monitor for, identify (including native lookalikes), report, and remove these invasive species from local waters. To date, volunteers have monitored 39.3 kilometres of shorelines in Haliburton County, representing 26 lakes, and removed 490,119 banded mysterysnails and 63,455 Chinese mysterysnails.

The ISAP's Management Technician continued the annual monitoring and surveillance for water soldier on the Trent-Severn Waterway to inform the large-scale herbicide treatment in 2021. Program staff also conducted monitoring and surveillance on Red Horse Lake to assess the efficacy of the 2020 treatment and coordinated the treatment required in 2021.

Contact: Sophie Monfette, Ontario Federation of Anglers and Hunters, 705-748-6324 ext. 274, [sophie\\_monfette@ofah.org](mailto:sophie_monfette@ofah.org)

### **The Nature Conservancy**

No update provided.

Contact: Lindsay Chadderton, The Nature Conservancy, 574-217-0262, [lchadderton@tnc.org](mailto:lchadderton@tnc.org)

### **Wildlife Forever**

No update provided.

Contact: Pat Conzemius, Wildlife Forever, 763-253-0222, pconzemius@wildlifeever.org

### **Minnesota Sea Grant**

- BWCAW AIS Signage Project: MNSG is leading a multi-agency initiative to develop a new sign for posting at trailheads and water accesses with a watershed protection message this fall.
- Don't Pack A Pest for Academic Traveler hosted a booth at a UMD Study Abroad Fair in September. 154 students and advisors were educated about the importance of declaring and what they can and cannot bring in their luggage upon return to the U.S.
- Plans are to expand the campaign to seven U of MN and private college campuses.
- Yellow Iris – Concern growing over spread and impacts in the St. Louis River and Duluth area. It is a regulated species under DNR so it can be purchased.
- MISAC – Working with a committee to update the state plan.
- ANSTF Outreach Subcommittee is working to populate the Stop Aquatic Hitchhikers! graphics portal with model outreach materials.
- Congratulations to Tim Campbell as co-chair for the committee!
- UMISC 2022: Beginning to plan conference for October 2022 in Green Bay.
- ICAIS 2022: Doug honored to be the first-ever plenary speaker on AIS and social science at ICAIS, April 18-22, in Belgium. More info: [here](#).

Contact: Doug Jensen, Minnesota Sea Grant, 218-590-7164, djensen1@umn.edu

### **Saint Lawrence Seaway Development Corporation**

No update provided

Contact: David Reid, Consultant, Saint Lawrence Seaway Development Corporation, 734-663-0198, dfrBWR@gmail.com

### **National Wildlife Federation**

No update provided.

Contact: Marc Smith, National Wildlife Federation, 734-887-7116, msmith@nwf.org