



Invasive Crayfish Collaborative Great Lakes

Five-Year Strategic Plan to Advance the
Management of Invasive Crayfish

2025–2029

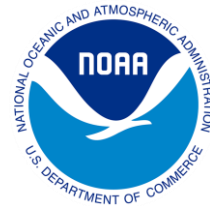


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Preface

The Invasive Crayfish Collaborative (ICC) was established in 2017 by the Great Lakes National Program Office of the U.S. Environmental Protection Agency to bring together industry, science, and land management stakeholders to improve the management of invasive crayfish in the Great Lakes region. The ICC is convened and facilitated by Illinois-Indiana Sea Grant and the Illinois Natural History Survey with funding from the Great Lakes Restoration Initiative.

As of June 2024, the ICC has a broad membership base that includes over 140 representatives of Great Lakes local, state, and federal natural resource agencies, universities, non-governmental organizations, and private businesses. The ICC brings these experts and stakeholders together to improve the management of invasive crayfish in the Great Lakes region by disseminating novel crayfish research, encouraging collaboration among members, and conducting research and outreach projects with collaborators. Its organizational structure includes a 14-member Advisory Committee (ICCAC) that provides high-level guidance and vision to coordinate, sustain, and expand collaborative efforts.

Vision Statement

The ICC envisions a robust network of scientists, outreach practitioners, and industry partners working collaboratively to produce well-informed strategies for managing invasive crayfish species in the Great Lakes region, with a focus on protecting native species and preserving the delicate balance of aquatic ecosystems.

Mission Statement

Uniquely positioned at the intersection of research, management, and outreach, the ICC is dedicated to fostering collaboration, building a diverse network, and engaging in science-driven research, management, and outreach to prevent the spread of invasive crayfish in the Great Lakes region. The ICC provides value to its members and partners through network building, project development, outreach and education, program sustainability, responsive collaboration, and continuous information exchange.

Introduction

[The invasive crayfish crisis in the Great Lakes](#)

Invasive crayfish pose a substantial threat to aquatic habitats in the Great Lakes region because of their ability to reduce habitat quality, dramatically alter food webs, and outcompete native species. The red swamp crayfish (*Procambarus clarkii*) and rusty crayfish (*Faxonius rusticus*) are currently established in multiple states in the Great Lakes basin with documented impacts. Two other potentially invasive crayfish species, the marbled crayfish (*Procambarus virginalis*) and signal crayfish (*Pacifastacus leniusculus*), have been reported in a Great Lakes state or province, but the latter is not yet known in the basin (Figure 1).

The invasive crayfish species found in the Great Lakes region have been shown to contribute to the decline of multiple native species by outcompeting them for food and habitat. *P. clarkii* is among the most popularly traded crayfish species in the world, as it is commonly encountered in the bait, aquaculture, and pet trade industries. *P. virginalis* is considered one of the most widely distributed species of crayfish in the pet trade, and its potential invasiveness is extremely high due to its parthenogenic reproductive strategy. Other crayfish species that have the potential of causing great



damage if introduced into the Great Lakes region include the Australian red claw (*Cherax quadricarinatus*) and the common yabby (*Cherax destructor*). *C. quadricarinatus* has been recorded in the western U.S. and may be introduced in the Great Lakes region via aquaculture escapes and/or aquarium trade releases. *C. destructor* is not currently found in the United States or in any waters connecting to the Great Lakes; however, it has been increasingly transported globally for aquaculture, food markets, and, more recently, in the aquarium trade.

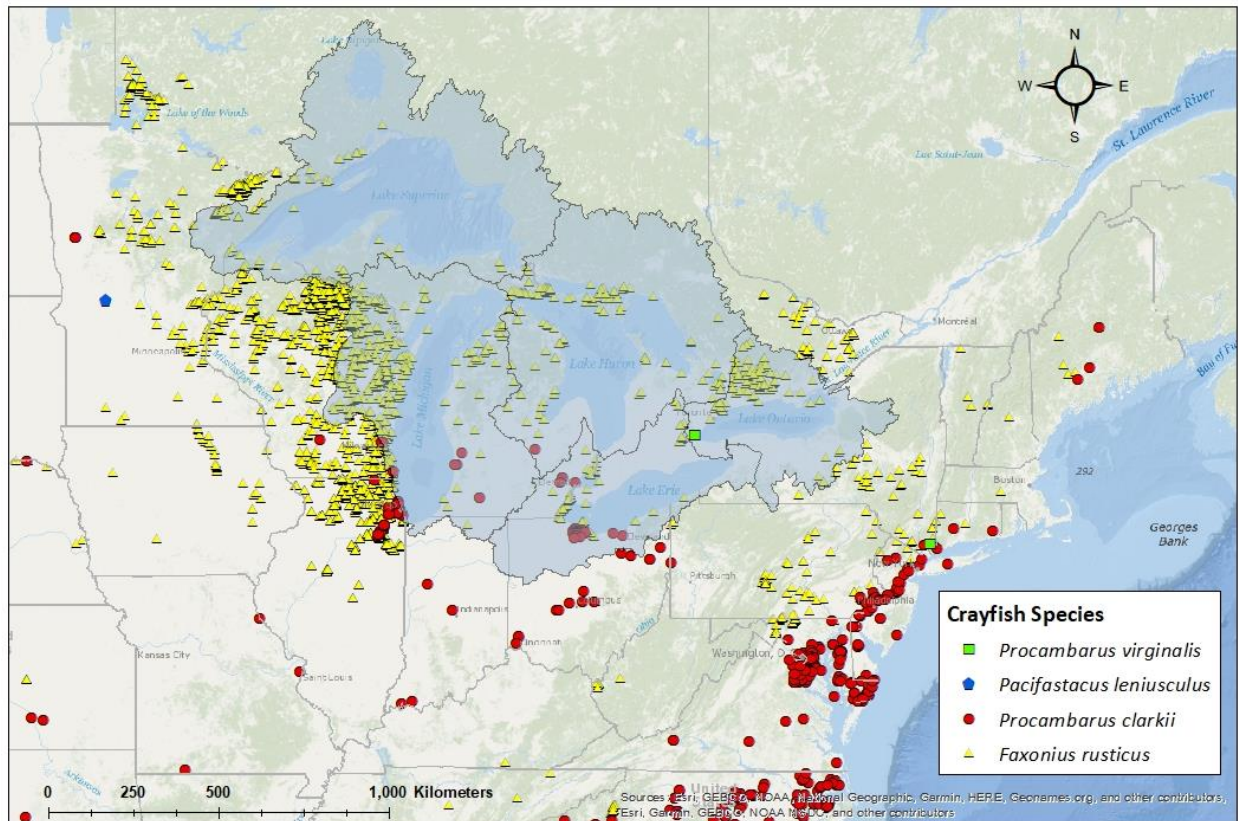


Figure 1. Non-native occurrences of four crayfish species in the Great Lakes basin and region. Data taken from USGS NAS Database, February 2024.

[Efforts to control invasive crayfish in the Great Lakes](#)

Efforts to prevent the introduction and spread of invasive crayfish in the Great Lakes consist largely of surveillance, controlling existing populations, as well as promoting prevention through education and outreach. Current control measures for invasive crayfish include chemical control (i.e., pesticides), biocontrol (i.e., predation largemouth bass *Micropterus salmoides*), monitoring (i.e., environmental DNA, trapping, public reports, telemetry), and education (i.e., outreach programs). Additionally, regulations exist throughout the Great Lakes to prevent the introduction of invasive crayfish. As summarized in a report by the National Sea Grant Law Center (invasivecrayfish.org/products), these regulations vary widely, which can create confusion among industry, managers, and the public.

[A Five-Year Strategic Plan](#)

Recognizing that the management of invasive crayfish crosses jurisdictional boundaries, it is important to have effective coordination, communication, and collaboration among stakeholders. The ICC acknowledges its role in fostering such discussions to ensure information is accessible and collaborative



solutions can be cultivated. The strategic plan presented here was developed to systematically guide the direction of the ICC for the next five years (2025–2029) and facilitate the coordination of research, collaboration, and outreach activities, thereby ensuring effective and successful efforts to combat invasive crayfish.

Given the transboundary nature of crayfish introduction pathways, the projects outlined in this five-year strategic plan are designed to benefit all states and provinces in the Great Lakes region. This strategic plan was developed collaboratively by crayfish stakeholders, comprising various government, (state, local, federal), industry, academic, and nonprofit partners directly involved in invasive crayfish management. The focus areas, goals, and objectives outlined in this plan were created from data gathered through a survey distributed to ICC members in November 2023 (Appendix A), supplemented by insights gathered at a virtual workshop in January 2024 (Appendix B), as well as through external and individual feedback.

The following plan contains a list of priority projects and resources intended to equip Great Lakes crayfish stakeholders and partners with the tools, knowledge, and strategies necessary to effectively work collaboratively to address the challenges posed by invasive crayfish. This includes offering resources such as best practices, educational materials, collaborative frameworks, and research findings aimed at preventing the spread of invasive crayfish species and mitigating their impacts on local ecosystems.

Guiding Principles

- The Great Lakes represent a shared ecological and economic asset among the United States, Canada, Tribal Nations, and First Nations, encompassing multiple management jurisdictions and stakeholders who contribute to societal expectations that form an integral part of the context for management actions.
- The ecological value of crayfish and their role in aquatic ecosystems is unequivocal as they serve as keystone species that maintain ecological balance, contribute to nutrient cycling, and provide food and habitat for a diverse range of organisms.
- The single greatest threat to crayfish biodiversity is invasive crayfish.
- Invasive crayfish cause deleterious effects on the environment, the economy, and human health through their ability to outcompete native crayfish, disrupt food webs, cause bank destabilization, and introduce disease.
- Prevention is the most cost-effective strategy for mitigating the impacts of invasive crayfish, and continuous investments in prevention efforts are imperative to minimize future ecological and economic damage.
- Management tools that are designed to be species-specific help minimize non-target impacts of management actions.
- Strong enforcement of regulations is necessary to ensure compliance and effective management of invasive crayfish found in trade.
- Enhancing public knowledge of invasive crayfish and aquatic invasive species more broadly is crucial to foster awareness and understanding across diverse audiences.
- The identification and reporting of invasive crayfish by the public must be accurate to ensure effective detection and monitoring.



Guiding Focus Areas

1. **Detection, Response, Control, Containment, and Eradication:** Implementing swift and effective measures in response to invasive crayfish threats is crucial. This involves developing strategies for control, containment, and, where appropriate, eradication. The ICC will support research and management efforts that strive to mitigate the impacts of invasive crayfish and conserve aquatic ecosystems and native crayfish populations. This may include but will not be limited to: (1) the use of monitoring tools (e.g., trapping, sampling, eDNA) to support detection efforts, (2) continued work on rapid response efforts, (3) chemical/biological/physical removal (e.g., pesticides, electrofishing, autocidal control, species-specific methods), and (4) analysis of non-target impacts of various techniques.
2. **Organisms-In-Trade Pathways:** Because one of the most important pathways for the introduction of invasive crayfish is through the sale of live organisms, this focus area addresses invasive crayfish spread by increasing the understanding and management of organisms-in-trade (OIT). The ICC will collaborate with stakeholders involved in trade and commerce of crayfish to implement measures that minimize introductions into new environments. A strong focus on OIT pathways across research, policy, outreach, and education is essential for informing enforcement efforts and preventing future invasions.
3. **Interjurisdictional Collaboration:** Recognizing the interconnected and often regional nature of invasive crayfish challenges, this focus area aims to foster collaboration across jurisdictions with the goal of creating a unified response to invasive crayfish challenges. This involves establishing strong partnerships with regional, national, and international entities and facilitating bi-directional information exchange among ICC members and partners.
4. **Education, Outreach, and Participation from Diverse Partnerships:** Engagement of diverse partners in educational and outreach activities is central to achieving the ICC's vision. This involves engagement with consumers, hobbyists, retailers, suppliers, and producers. The ICC will support educational and outreach programming that enhances public awareness and engagement regarding invasive crayfish issues. This focus area seeks to create a network of informed and responsible individuals. Additionally, the ICC will strive to recruit and highlight participants with diverse perspectives and affiliations, promoting diverse engagement in our programming.
5. **Program Sustainability:** This focus area involves developing and implementing strategies to ensure the ongoing success and impact of ICC programs. This includes exploring funding diversification, establishing multiple partnerships for long-term support, and creating a long-term funding model to help with the identification and evaluation of funding opportunities (i.e., a way to identify funding sources for our partners).



Implementation and Tracking Progress

Portions of the five-year strategic plan will be implemented by ICC members and other Great Lakes partners (i.e., government, non-government, academia, industry, the public). ICC members and partners will assess the strategic plan's objectives to determine their role in implementation. Partners involved in combating invasive crayfish issues in the Great Lakes are encouraged to collaborate to bolster support for the strategic plan's execution. To facilitate the implementation process, the ICC will convene in fall of 2024 to develop an implementation plan, identify interested partners, and assign leads to specific action items and tasks.

To ensure effective progress toward tracking and community engagement, ICC facilitators will regularly review and refine the five-year strategic plan based on evolving scientific knowledge and stakeholder needs. The ICC will convene the ICCAC and other stakeholders each year to assess the progress made, identify emerging challenges, and adjust priorities accordingly. Additionally, the ICC will solicit feedback from diverse communities involved in crayfish management to ensure that the plan remains responsive to their needs and concerns. The ICC will also serve as a platform for sharing results and information from related projects. Progress will be documented regularly, and updates will be made available on the ICC website (InvasiveCrayfish.org).



Focus Area I: Detection, Response, Control, Containment, and Eradication

Goal

Work with and support members to develop best strategies for managing invasive crayfish in the Great Lakes region. Achieve a significant reduction in the spread and impact of invasive species through early detection, rapid response, effective control, containment, and targeted eradication efforts.

Objectives and Strategies

Objective 1.1 By 2029, invasive crayfish management and research priorities will be clearly understood across 80% of academics, land managers, and governmental agency representatives who work on crayfish management in the Great Lakes region.

- 1.1.1 Share identified research and management priorities across jurisdictions and stakeholder groups by facilitating discussions.
- 1.1.2 Highlight recent or upcoming crayfish research, programs, and other work via monthly ICC webinars and newsletters.
- 1.1.3 Host two topical meetings each year that target specific ICC subgroups (i.e., research, management, early detection and rapid response, and communication) to provide members with opportunities to present their work, brainstorm, and communicate their needs.
- 1.1.4 Expand and refine decision-making tools (e.g., [AIS Explorer](#), STAIR, risk, cost-benefit, or multi-criteria analyses) for crayfish managers and incorporate updated research findings. Evaluate existing resources and share these resources with the ICC membership.

Objective 1.2 By 2029, standardized crayfish monitoring will be integrated into existing broad-spectrum monitoring programs in high-risk waterbodies across the Great Lakes region to enhance early detection and management of invasive crayfish.

- 1.2.1 Assess existing field sampling guides/methodologies and identification procedures and broaden their applicability for use across the Great Lakes region.
- 1.2.2 Perform risk assessments (using STAIR or similar tools) for invasive crayfish species and develop a framework for species surveillance.
- 1.2.3 Organize a training workshop for broad-spectrum monitoring programs to teach and promote standard crayfish sampling techniques and reporting.
- 1.2.4 Map current sampling efforts taking place in the Great Lakes region and share monitoring program information (e.g., program name, monitoring dates, species found, trends) with partners.

Objective 1.3 By 2029, a standardized protocol for the response, control, and containment of invasive crayfish will be implemented in the Great Lakes region to enhance response efforts and advance the eradication of invasive crayfish.

- 1.3.1 Assess and enhance existing crayfish rapid response/control methods and develop a manager's toolbox that lists available prevention and control methods.
- 1.3.2 Train managers on standard crayfish sampling techniques and reporting.
- 1.3.3 Integrate tools that streamline connections between novel crayfish reports and Great Lakes managers. Existing communications will be reinforced.



Focus Area II: Organisms-In-Trade Pathways

Goal

Enhance awareness and management of invasive crayfish species relevant to the organisms-in-trade (OIT) pathways (i.e., live food markets, bait shops, pet trade, online sale, biological supply, and aquaculture) and reduce the introduction and spread of invasive crayfish species through these pathways.

Objectives and Strategies

Objective 2.1 By 2029, 10 representatives of crayfish commerce and trade will engage and build relationships with ICC members and partners.

- 2.1.1 Work with specialty groups relevant to OIT pathways to target and identify primary pathways responsible for the introduction of invasive crayfish (e.g., “bait trade specialty group,” “biological supply specialty group,” “pet trade specialty group,” “online sale,” “live food markets”).
- 2.1.2 Develop online platforms to support open communication between OIT audiences and crayfish experts.
- 2.1.3 Work with enforcement and legislative agencies to strengthen regulatory measures and improve monitoring capabilities along OIT pathways.
- 2.1.4 Expand Minnesota’s [HACCP Training Curriculum](#) and promote to crayfish wholesalers.
- 2.1.5 Inform harvesters about responsible crayfish production practices and the sale of approved crayfish in accordance with state regulations.
- 2.1.6 Maintain a list of crayfish retailers and wholesalers across the Great Lakes region.

Objective 2.2 By 2029, 60% of crayfish wholesalers and retailers in the Great Lakes region will be able to correctly name and describe the invasive crayfish species found in their state or province.

- 2.2.1 Organize crayfish identification workshops and trainings for crayfish retailers.
- 2.2.2 Offer in-person seminars to supply chain partners to increase knowledge on invasive crayfish impacts, native crayfish importance, and general invasive species information.
- 2.2.3 Distribute educational materials to retailers, including brochures, pamphlets, and online resources that include scientific names of common crayfish, key features, responsible disposal directions, and crayfish rehoming options.
- 2.2.4 Identify and survey major crayfish wholesalers in the Great Lakes region to tailor future outreach efforts to their needs.
- 2.2.5 Promote responsible product delivery by distributing crayfish identification resources and regulations to wholesalers.
- 2.2.6 Ensure effective dissemination of information from wholesalers to retailers and customers by providing wholesalers with educational resources to include in product shipments.
- 2.2.7 Distribute annual updates to wholesalers and retailers, featuring reminders on best management practices, updates on any new regulations concerning crayfish in their respective states, and a designated avenue for feedback.



Focus Area III: Interjurisdictional Collaboration

Goal

Create a unified approach to invasive crayfish management across the Great Lakes region by fostering collaborations across jurisdictions and establishing strong partnerships with regional, national, and international entities.

Objectives and Strategies

Objective 3.1 By 2029, crayfish professionals will possess tools to identify potential collaborators and share project summaries across jurisdictional boundaries.

- 3.1.1 Develop consistent standards for data sharing among crayfish partners resulting in a framework for shared data (e.g., agency guidelines for sharing, how much will be shared online, frequency of updates, contact information).
- 3.1.2 Establish a directory of crayfish research groups and professionals categorized by their respective specialties. The directory will serve as a resource for those seeking specialized expertise and will help support collaboration.
- 3.1.3 Publish and maintain a list of ICC members (or their agency logos) on the ICC website.

Objective 3.2 By 2029, the ICC, in collaboration with existing collaborative entities, will facilitate regular meetings and discussions of invasive crayfish management projects across jurisdictional boundaries.

- 3.2.1 Host in-person meetings every other year to update members on ongoing projects and provide opportunities for collaboration.
- 3.2.2 Host quarterly virtual meetings with facilitated discussions and member updates.
- 3.2.3 Maintain the ICC Google Group as a resource for open communication with members.
- 3.2.4 Send monthly newsletters with crayfish literature and news and share relevant research articles on the ICC website.

Objective 3.3 By 2029, the ICC will engage with interjurisdictional initiatives aimed at advancing Early Detection and Rapid Response (EDRR) frameworks, outreach strategies, and regulatory measures.

- 3.3.1 Disseminate outreach products made by interjurisdictional management groups throughout the Great Lakes region via ICC support.
- 3.3.2 Identify aquatic invasive species programs across jurisdictions to create a basin-wide surveillance network and support the U.S. Geological Survey Nonindigenous Aquatic Species Program.
- 3.3.3 Convene experts to identify and promote best EDRR frameworks in the Great Lakes region (e.g., [Department of the Interior](#), USGS [SIREN](#)).
- 3.3.4 Update and distribute the [National Sea Grant Law Center Crayfish Regulation Report](#) to Great Lakes crayfish stakeholders.



Focus Area IV: Education, Outreach, and Participation from Diverse Partnerships

Goal

Support education and outreach programming that enhances stakeholder and public awareness of invasive crayfish issues. Create a network of informed, responsible individuals and promote engagement of diverse audiences in crayfish programming.

Objectives and Strategies

Objective 4.1 By the end of each year, at least one in-person training will be organized and conducted for crayfish consumers, hobbyists, educators, lakefront homeowners, or specialists from management groups and agencies.

- 4.1.1 Develop a crayfish monitoring curriculum for grade 5–12 educators and train educators to implement the curriculum in their classrooms.
- 4.1.2 Establish standard crayfish sampling and host training workshops for invasive species management groups and enforcement agencies.
- 4.1.3 Work with conservation stewardship programs to train consumers, hobbyists, and recreational water users (i.e., kayakers, canoers, boaters, and anglers) on crayfish identification and reporting.
- 4.1.4 Work with external educational programs (e.g., aquariums, zoos, museums) to offer events and exhibits (e.g., “touch a crayfish”) to increase participant knowledge on native and invasive crayfish. This will also promote controlled and safe outreach with low biohazards.
- 4.1.5 Identify waterfront landowners and provide training to monitor, report, and remove invasive crayfish populations.

Objective 4.2 By 2029, digital crayfish education products and services will be used to engage the public, thus increasing their knowledge of native and invasive crayfish species and topics.

- 4.2.1 Conduct an “Ask Me Anything” event on Reddit (e.g., on the subreddits r/crayfish or r/science) to encourage interaction between Reddit users and crayfish experts.
- 4.2.2 Enhance public understanding of crayfish regulations by distributing an infographic of the Sea Grant Law Center Crayfish Regulation Report with social media users.
- 4.2.3 Share humane disposal steps and rehoming options with the public.
- 4.2.4 Promote accessible webinars and seminars to involve the public in crayfish-related discussions.

Objective 4.3 By 2029, invasive crayfish awareness will increase with the public and at least 30% of the ICC membership will include hobbyists, consumers, retailers, and producers to engage a broader range of audiences.

- 4.3.1 Produce an online gallery to showcase visually compelling images and videos of crayfish species, their habitats, and invasive species impacts.
- 4.3.2 Work with regulatory agencies to offer “green certifications” to producers that follow best management practices and work with the ICC.
- 4.3.3 Follow the International Association for Public Participation model to increase public participation in invasive crayfish-related outreach and research.



Focus Area V: Program Sustainability

Goal

Develop and implement strategies that ensure the ongoing success and impact of invasive crayfish research, management, and outreach programs in the Great Lakes region and beyond.

Objectives and Strategies

Objective 5.1 The ICC program will adapt and progress over time based on performance assessments and member feedback.

- 5.1.1 Evaluate ICC effectiveness on invasive crayfish programming and efforts through a [needs assessment](#).
- 5.1.2 Create a [logic model](#) and [evaluate](#) the impact of programs on a regional scale each year.

Objective 5.2 By 2029, 10 Great Lakes partners invest in invasive crayfish management by incorporating aspects of crayfish management into future projects.

- 5.2.1 Offer guidance and resources for drafting and submitting grant proposals.
- 5.2.2 Support Request for Proposals for partners applying for grants related to invasive crayfish management or native crayfish conservation.
- 5.2.3 Send diverse and relevant funding opportunities to partners via the ICC Google Group. Add a repository to the ICC website for recurring opportunities.
- 5.2.4 Promote basin-wide crayfish research groups and their work through various means (see 3.1.2).

Objective 5.3 Broaden crayfish conservation and management projects to a basin-wide approach, ensuring that future investments have basin-wide implications and align with the broad goal of preventing the spread of invasive crayfish species to the Great Lakes basin.

- 5.3.1 Forge partnerships with state and provincial agencies, as well as tribal nations across the Great Lakes basin to leverage expertise, resources, and collective efforts in crayfish conservation and invasive crayfish management.
- 5.3.2 Encourage the formation of interdisciplinary teams and offer guidance on partnership building to foster effective collaboration and teamwork.



Appendix A

Invasive Crayfish Collaborative (ICC) Five-Year Strategic Plan Survey Results, 2024

Member Assessment: Of the 25 ICC members who completed the survey, 52% work on crayfish 1–25% of the time, while 16%, 12%, and 20% of participants work on crayfish 26–50%, 51–75%, and 76–100% of the time, respectively. A majority (60%) of participants work in Government (G), followed by Academia (A, 36%), and Land Management (LM, 28%). Aquaculture/Production (AP), Retailers (R), and Consumers/Hobbyists (CH) combined represent <10% of participants. The “Other” category (12%) includes volunteers, NGO workers, and retired biologists. The predominant involvement of respondents working on crayfish topics part-time indicates a diverse range of commitments among members. However, the concentration of participants in G, A, and LM sectors suggests a gap in representation from AP, R, and CH and a significant opportunity for expanding the ICC’s reach and impact.

Member Work Application to Other Groups: Participants have stronger confidence that their work is useful to LM, A, and G groups, while there is generally low belief in the application of crayfish work (or knowledge of application) to AP, R, and CH groups. To address this disparity, the ICC should work to facilitate stronger connections between LM, A, and G with AP, R, and CH. Connecting these groups would help bridge the critical gaps in information dissemination and ensure that the expertise and insights of each group could be used and applied by others. The result would be a more robust and unified effort towards addressing crayfish-related challenges and enhancing overall management outcomes.

Best Practices: The ICC helps members access research and news via newsletters and seminars. Participants want increased collaboration with organizations outside of their own to share resources, tools, techniques, and strategies for managing invasive crayfish. Prior to pandemic pauses, in-person meetings were helpful for connecting individuals who were interested in invasive crayfish but would normally not interact. Participants indicate that they would like the ICC to facilitate bi-directional information exchange among members and have a less top-down flow of information. Some participants suggested that the ICC follow a more formal framework for collaboration (e.g., IAP2 Spectrum).

Program Outcomes: ICC members want program outcomes to include creating a hub for information gathering, facilitating bi-directional exchange of information, promoting greater sharing of resources, organizing a regional strategy, hosting in-person meetings, engaging with partners outside of the Great Lakes, increasing focus on Organism-In-Trade (OIT) pathways and Early Detection and Rapid Response (EDRR) efforts, promoting better data management, supporting enforcement, promoting communication between members and those within OIT pathways, and helping secure permits for managers and harvesters.

Program Niche: The ICC is uniquely positioned at the intersection of research and outreach, and is dedicated to fostering collaboration, building a diverse network, and engaging in science-driven research and outreach to prevent the spread of invasive crayfish in the Great Lakes region. The ICC provides value to its members and partners through network building, project development, outreach and education, program sustainability, responsive collaboration, and continuous information exchange.



Group	Goals (In your opinion, what are the goals of this group as related to invasive crayfish?)	Needs (What might this group need to address future changes)	Help (How could your work help this group achieve changing needs?)	Changes (What changes as related to invasive crayfish do you want to see in this group in the future?)
Land Manager	<ul style="list-style-type: none"> -better understand the changes in native/non-native ranges -research the impacts of invasives -EDRR efforts -avoid damage caused by invasives -how/when/where to monitor for crayfish invasions -slowing the spread of invasives -mitigate impacts on human infrastructure 	<ul style="list-style-type: none"> -good baseline data -public involvement and buy-in, collaboration across borders -consistent funding and trainings -better tech for eradication -publications of past research and impacts on non-targets 	<ul style="list-style-type: none"> -address questions related to status -information transfer/collaboration -help coordinate trainings -continue advocating for more regulation in the OIT pathway -provide GLRI support -help train managers 	<ul style="list-style-type: none"> -use species-specific tools -reduce trade in live crayfish by focusing on regulation and enforcement -understand how to report crayfish -more attention given to invasive crayfish issue by agencies -successful management stories -implement techniques on their own
Government	<ul style="list-style-type: none"> -limit impacts to ecosystems and human health, law enforcement -prevent spread of invasive crayfish -provide guidance on management, funds for research, and policy/enforcement -protect native ecosystems -make prevention, control, management, enforcement, and public outreach as priority 	<ul style="list-style-type: none"> -funding, information, prioritization -reduce trade of live crayfish -education -adequate information to demonstrate the need to take action -continued stream of new and relevant research 	<ul style="list-style-type: none"> -provide information and demonstrate why invasive crayfish need to be controlled -secure GLRI funding and advocate for regulations that prevent their spread -update agencies with information on distribution and risks -provide and conduct relevant research 	<ul style="list-style-type: none"> -simpler funding -more attention given to invasive crayfish -better regulation and enforcement -cohesive strategy for addressing invasive crayfish across the country -create consistent regulations in GL region -more bans on live bait -acknowledgment of climate crisis and impacts -better tools for enforcement
Academic	<ul style="list-style-type: none"> -support land managers and policy makers, work collaboratively -conduct novel, statistically sound research and publish articles -learn and research new techniques for management and control -correctly ID and locate crayfish species -train next generation of scientists -get grants 	<ul style="list-style-type: none"> -funding, apply for grants -advertise for graduate/post-grad student work -outreach to administrators -communication of research findings -collaboration -more time/resources 	<ul style="list-style-type: none"> -boost partnerships for specific projects -help academics communicate their findings through connections and communicate back needs -long-term monitoring of crayfish -promote invasive crayfish as a priority -knowledge of habitat and species distributions 	<ul style="list-style-type: none"> -more collaboration, networking, and funding between academics -more research on novel control techniques -more focus on documenting spread and negative impacts -focus on emerging pathways and genetic adaptation -more research on all aspects -a shift from documenting the spread to controlling from invaded waters
Aquaculture/ Production	<ul style="list-style-type: none"> -increase awareness of invasive crayfish problem by fish producers -minimize 'contaminated shipments' -comply -minimize harm, sell safe products -be a benefit to society -be profitable 	<ul style="list-style-type: none"> -training, new best practices -outreach/education -enforcement -create a business plan 	<ul style="list-style-type: none"> -continue developing new tools to control invasive crayfish -support law enforcement 	<ul style="list-style-type: none"> -close pathways through innovative hatchery designs and HACCP plans -no sales of regulated crayfish -support harvesters in securing permits
Retailer	<ul style="list-style-type: none"> -follow regulations related to invasive species -sell crayfish in compliance with regulations -not get fined -care for environment and gain consumers by selling most attractive crayfish (whether native or not) -promote consumer awareness in-store or online 	<ul style="list-style-type: none"> -updated knowledge and understanding of regulations -more training/outreach -better resources for ID, understand who to reach out to and how to report an unknown species -effective outreach tools for themselves AND consumers -ID training 	<ul style="list-style-type: none"> -supply info on crayfish regulations and IDs -provide trainings/outreach 	<ul style="list-style-type: none"> -crayfish are correctly labeled in stores -regulations followed -clear communication with customers about disposal or surrender of unwanted organisms
Consumer/ Hobbyist	<ul style="list-style-type: none"> -have live crayfish for food or as a pet -accurately ID species and understand their regulations -do not want to euthanize pet crayfish; want a better, more humane way of disposal -keep crayfish as a hobby and value their role in ecosystem -raise awareness and prevent releases, or provide alternatives to releases 	<ul style="list-style-type: none"> -knowledge and informational materials -education/outreach -rehoming options -understand the alternative species/allowed species 	<ul style="list-style-type: none"> -help educate retailers who then educate their own customers (cascade of information) -conduct outreach -support rehoming events -provide information regarding best practices 	<ul style="list-style-type: none"> -want the average consumer to know how to safely dispose of their unwanted crayfish -no sale/trade of regulated crayfish -greater interest in natives, lower rates of release of crayfish into wild -having retailers that can actively relay information
Other (e.g., private landowners, business owners, general community)	<ul style="list-style-type: none"> -to avoid damage caused by invasive crayfish -to keep their membership informed 	<ul style="list-style-type: none"> -funding, knowledge of invasives, efficacy of pesticides, willing to help 	<ul style="list-style-type: none"> -monitor populations on their property with trapping (with approval) -habitat alteration projects and increased control efforts 	<ul style="list-style-type: none"> -more awareness about harm of invasives -understanding that removal is key -increased reporting of potential invasives to government agencies -open to innovative techniques for management/eradication of invasive crayfish



Appendix B

Invasive Crayfish Collaborative Five-Year Strategic Plan Meeting – Summary Notes

January 30, 2024
11:00 am – 12:35 pm CT
Virtual Zoom Meeting

Facilitated by Natalia Szklaruk, Katie O'Reilly, and Greg Hitzroth, Illinois-Indiana Sea Grant

11:00-11:20, Welcome and Introduction

Szklaruk welcomed all members, introduced herself and her team (O'Reilly and Hitzroth), and gave a brief introduction to the ICC. O'Reilly summarized the five-year strategic planning process, NOAA's strategic planning framework, and the five-year strategic plan survey that was sent out in November 2023. Szklaruk then summarized key results from the survey and introduced five focus goals that would be the basis of the meeting's discussion.

11:20-12:20, Facilitated Break-out Rooms

The group was divided into three break-out rooms, each facilitated by O'Reilly, Hitzroth, or Szklaruk. In each break-out room, groups discussed their needs and desired outcomes for the ICC. Groups developed concrete outcomes and objectives for each of the five focus goals. The five focus goals and related questions for the discussions are listed below:

1. Detection, Response, Control, Containment, and Eradication
 - a. What are the current methods used for each? What are key research topics that we should prioritize? How do we coordinate efforts across stakeholder groups?
2. Organism-In-Trade Pathways
 - a. How can we better address OIT pathways? How should we support enforcement and regulations within OIT pathways?
3. Interjurisdictional Collaboration
 - a. How can we share and manage data better? What does bi-directional flow of information look like?
4. Education, Outreach, and Participation from Diverse Partnerships
 - a. How do we recruit and engage with diverse partners and those not well represented in the ICC community? How can we get the community interested? How do we keep them interested?
5. Program Sustainability
 - a. How do we diversify funding to ensure ongoing success? How do we measure program effectiveness? Are there any measurable indicators or metrics we can use to highlight our effectiveness?

12:20-12:30, Reporting Back

After the discussion, groups were brought back into one meeting room, and O'Reilly, Hitzroth, and Szklaruk briefly reported out a summary of specific items that were discussed in their respective break-out rooms. The following topics were discussed:



Focus Goal 1: Detection, Response, Control, Containment, and Eradication

- Need to clearly identify management needs so that researchers can prioritize work – the ICC can help facilitate those conversations
- Continue hosting webinars on current and upcoming research to engage others
- Generate a discussion with other state agencies (multiple groups and presentations in one call)
- Continue using and promoting early detection efforts with iNaturalist
- Engage with non-expert audiences (public) in finding/monitoring new invasive populations (e.g., iNaturalist)
 - Challenges ICC members face in doing engagement – time, money/resources, matching up with other goals, getting funding, crayfish keys aren't super accessible to non-experts, connecting with education (e.g., curriculum); agency folks involved in ICC may not have direct interactions with public; ICC coordinating efforts/having better tools to communicate within orgs (so on-the-grounds folks can do outreach)
- There is value in the consistent monitoring of waterbodies likely to become invaded (locations near populations, angler activity, etc.) – risk based on previous data/modeling/etc.
- Local/regional governments may not care about /prioritize crayfish – ICC could help provide guidance on policy changes
- Facilitate information sharing/connections about new invasions – who can folks contact to learn more?

Focus Goal 2: Organism-In-Trade Pathways

- More outreach on scientific names in pet stores (signs, brochures, pamphlets)
- Add pet shop/bait shop outreach component for all stakeholder groups
- Have trained volunteers visit pet stores to establish relationships with retailers – are they posting signs/understand species?
- Educate suppliers so information can effectively “trickle down” the OIT chain
- Increase law enforcement efforts
 - Get state representatives to address resources
- Engage with consumers through workshops, events, social media campaigns
- Create ICC specialty groups to target all possible pathways and risks
- Facilitate connecting experts with regulators of crayfish. Establish a formal process for this region-wide
- Share user-friendly keys for bait shop owners (MO has a resource); follow-up enforcement after education
- ICC can facilitate larger, interjurisdictional projects

Focus Goal 3: Interjurisdictional Collaboration

- Not a lot of collaboration or communication between various projects being conducted in nearby regions, which causes sampling locations to overlap – communication is lacking
 - ICC can solve this by facilitating communication between local groups
- ICC can help identify the different skill sets in each research lab and provide a “contact list” to know who they can reach out to for help and resources; create a page that directs others to additional databases and repositories (i.e., GLANSIS, NAS, American Crayfish Atlas, etc.)
- ICC can establish a framework for shared data and identify best management practices (e.g., how often the data needs to be updated)
- Have more in-person discussions among government/academic/management groups. Participants want more discussion-based meetings with more focused objectives (i.e., research, management, policy, outreach, etc.). An annual “general” meeting may be beneficial.



- Establish topical sub-groups
- Sharing data can be challenging for a number of reasons – lack of shared framework, some people protective of data, institutional/funding agency guidelines
 - Need to be thoughtful about types of data we share (things like distribution/density are easy to share, but need to develop consistent standards)
 - Alternative idea: Share *descriptions* of data that researchers have (but not actual data themselves to prevent sharing sensitive information)
- Questions for ICC to consider: What types of data of data should be public/private? What other repositories already exist and what do they offer? Which repositories are appropriate for which data?
- Tap into other repositories and resources (e.g., national early detection and rapid response framework being developed by the Department of the Interior)

Focus Goal 4: Education, Outreach, and Activity from Diverse Partnerships

- Engage with crayfish subreddit (hobbyists) and open membership to them – offer our resources
- In-person workshops for those interested in crayfish (i.e., aquarium store workshops, learn more about local crayfish)
- Produce interesting videos, pictures, and other visuals of crayfish to boost engagement and interest in crayfish with the public. Follow Chris Barnhart's *Unio Gallery* that increased awareness of freshwater mussel importance
- Understand how to draw people to the ICC
 - Directly reach out to consumers/retailers and support: regulation, identification resources, unwanted crayfish best practices, EDRR (community science; iNaturalist landing page for crayfish – for people to report things they think are invasive)
 - Measure ICC engagement success by: counting number of people joining the group, send out survey that analyzes *why* they joined the group, keep track of the number of products disseminated, the number of businesses ICC is engaged with
- ICC could host webinars aimed at industry/consumer audiences
- It's really difficult to access/connect with industry partners (even just understanding and identifying who's involved in the supply chain, what are the steps in pathways, etc.)
- ICC could build relationships with industry
- Crayfish aren't always super obvious to people just interacting with waterbodies, and bringing a live invasive crayfish somewhere poses its own risks
 - Aquarium exhibits already have the audience and resources to hold and display crayfish – ICC could partner with aquariums (i.e., Chicago Shedd "touch exhibits" and GL exhibit) and reduce risks of personal transport

Focus Goal 5: Program Sustainability

- Support Request For Proposals for invasive crayfish projects
- Create a directory referring to specific labs and experts to promote their work and increase funding support (or possibly tap into other repositories found online)
- There has been some lag time between applying for a grant and receiving it- how can ICC help with this?
- Create a funding opportunity section on ICC site
- Collaborate with other labs for funding support
- Increase communication to get those connections with funders
- ICC could provide letters of support for grant proposals



- Data sharing: Participants brought up existing resources like Crayfish Atlas, GLANSIS (primarily map data/locations)
- Continuous funding is always an issue
- ICC should play role as facilitator in Great Lakes-wide crayfish issues, facilitating relationships and research activity
- Have ICC participants be able to tie their work back to the bigger picture of regional-wide ICC vision
- ICC could facilitate collaborations between academics and non-academics, connect and share perspectives from industry

12:30-12:35, Next Steps

Szklaruk briefly discussed the next steps, which included continuing to draft the plan throughout February and March 2024 and to address member feedback from past discussions. By the end of March, the ICC will be working with the ICC advisory committee to finalize the draft. By the end of June, the ICC will have a completed final copy of the five-year strategic plan that will be distributed to the ICC membership via email, posted on the ICC website (InvasiveCrayfish.org), and presented at relevant conferences and meetings (i.e., Great Lakes Panel meeting in June). If you have any questions, you can email:

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12:35, Adjourn