Evaluating Control of Priority Established Species: Species- and site-based analysis of control efforts in the Great Lakes region

Research Coordination Committee Meeting

June 17, 2024

Evaluating Control of Priority Established Species: Species- and site-based analysis of control efforts in the Great Lakes region: background

Project Team: GLC/TNC/MAISRC (Phelps)

Objectives:

1. Identify priority established invasive animals and status of associated species control tools

2. Assess GLRI site-based control efforts
    - what is being controlled where
    - what are gaps (e.g. habitats, species) (and why?)

3. Integrate species and site-based assessments to identify species-specific management needs
    - Develop decision support tools to identify suppression methods that have the highest probability of success (hence priority for investment)

Governance: Advisory committee building off research committee but ensure greater agency and tribal representation and participation

Identify priority established invasive animals and status of associated species control tools: literature reviews

Included priority species

1. Faucet snail
2. Spiny waterflea
3. Fishhook waterflea
4. Golden clam
5. Round goby
6. Red swamp crayfish
7. Waterflea (*Daphnia galeata galeata*)
8. Chinese mystery snail
9. Banded mystery snail
10. Freshwater tubenose goby
11. Redbreast sunfish
12. Tench
13. Ruffe
14. Western mosquitofish
15. New Zealand mudsnail
16. Rudd
17. Rusty crayfish
18. Common carp
19. Flathead catfish
20. Bloody red shrimp
21. Goldfish

Literature review: overview

- Literature reviews complete
- Large range in available control tools (from 2 pages for *D. galeata galeata* to 42 pages for common carp)
- Significant interest in goldfish control and common carp
- Most literature reviews identified gaps/challenges to control that can drive future research and on-the-ground management
- Thank you to reviewers!

Fish: goldfish and common carp

- Almost excluded but received the most interest from managers
- Little published literature but a lot of case studies
- Initial evidence that as common carp populations are controlled, goldfish numbers increase (Boston et al. 2023)
- As expected, historical focus on mechanical removal
- Integrated control methods and understanding source/sink dynamics are promising for common carp control
- Common carp eradication not impossible! (Eradicated from several lakes with connected wetlands in Tasmania)
- Similar species, but some differences with control implications
- Thank you to everyone who provided data!

Gastropods

- Faucet snail: desiccation and copper-based molluscicides largely ineffective
- Chinese and banded mystery snails: significant hand harvest efforts in Ontario (930,000 snails to date) and MN (has observed declines); anecdotal success of copper sulfate crystals in Oregon ponds
- New Zealand Mudsnail: copper sulfate and niclosamide are effective; drawdowns for annual maintenance

Bivalves

- Golden clam (*Corbicula fluminea*):
  - Heat treatments, benthic barriers, dredging but non-target impacts and low long-term success but may be appropriate for rapid response
  - Drawdown promising in Montana reservoir Lake Elmo (eradication TBD)

Fish

- Western mosquitofish: several eradications with rotenone and drawdown; suppression with restoring variable flow regimes
- Ruffe: local reductions with bottom trawling (Czypinski and Ofgle 2011); surveillance/early detection (Tucker et al. 2016) could allow measures to increase community resilience (e.g., augment predator populations) and limit further spread
- Round goby: chemical options include rotenone and antimycin; few eradication attempts though it may be possible; need for more empirical case studies of control efforts in the filed
- Western/freshwater tubenose goby: see round goby

Fish (cont.)

- Redbreast sunfish: several populations in New York with no control efforts attempted
- Rudd: has been eradicated with rotenone and suppressed with gillnetting in New Zealand
- Flathead catfish: electrofishing removal with >25% exploitation effective in suppression to maintain native fish
- Tench: recent introduction; pilot harvesting project in QC

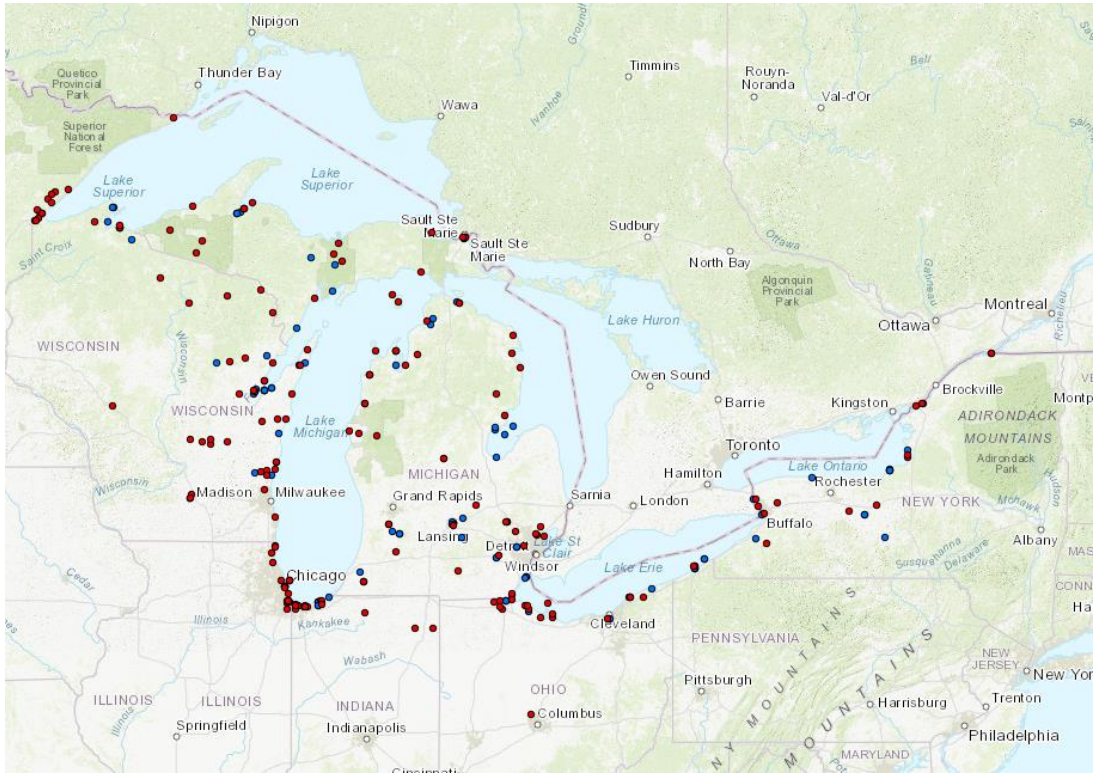
Crayfish

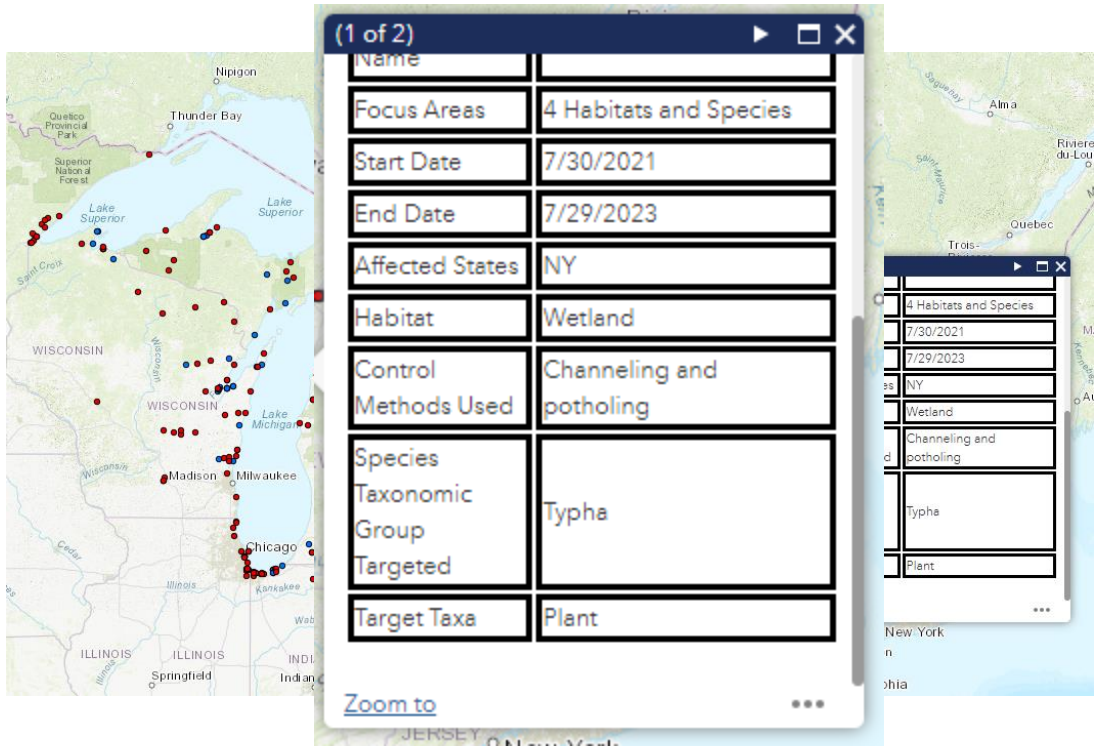
- Rusty crayfish: most successful control effort for rusty crayfish occurred in Sparkling Lake, WI, using a combination of intense trapping and augmented fish predation to achieve low levels of rusty crayfish (functional eradication). Despite cessation of trapping >10 years, low abundance of rusty crayfish has continued until date of last monitoring (2019).
- Red swamp crayfish: several eradication successes; trapping, habitat destruction, and pyrethrum can drastically reduce numbers. Burrowing make control difficult.
- Both: Pyrethroids (yet to be registered for use with crayfish) show the most promise for chemical control.

Other invertebrates

- Spiny and fishook water flea, bloody red shrimp
  - Some weak effects of predation (cisco, alewife, lake whitefish, rainbow smelt, yellow perch, pumpkinseed sunfish) – more on spiny than fishhook
- *Daphnia galeata galeata*

Site-based control mapper





Next steps

- Literature reviews available upon request
- Continue building the site-based control map with additional GLRI records
- Develop decision-tree that uses published criteria that are associated with successful management of AIS along with trait-based data to identify the management approaches with the highest probability of enabling control at both local sites and regional scales
  - Led by TNC and MAISRC

Background/supporting slides

Faucet snail (*Bithynia tentaculata*)

- GLANSIS impact: high/3 (env); moderate/2 (soc/cult)
- ERSS: high risk

Lit review results:

- No reviewer found

Spiny waterflea (*Bythotrephes longimanus*)

- GLANSIS impact: high/3 (env); low/1 (soc/cult)
- ERSS: high risk

Fishhook waterflea (*Cercopagis pengoi*)

- GLANSIS impact: high/3 (env); moderate/2 (soc/cult)
- ERSS: high

Golden clam (*Corbicula fluminea*)

- GLANSIS impact: moderate/2 (env); moderate/2 (soc/cult)
- ERSS: high risk

Round goby (*Neogobius melanostomus*)

- GLANSIS impact: high/3 (env); high/3 (soc/cult)
- ERSS: high

Red swamp crayfish (*Procambarus clarkii*)

- GLANSIS impact: moderate/2 (env); moderate/2 (soc/cult)
- ERSS: high

Waterflea (*Daphnia galeata galeata*)

- GLANSIS impact: high/3 (env); low/0 (soc/cult)
- ERSS: none

Flathead catfish (*Pylodictis olivaris*)

- GLANSIS impact: high/3 (env); low/1 (soc/cult)
- ERSS: high
- RCC vote: 7 include, 3 exclude:
  - Annick Drouin: habitat requirement too far away from the habitat characteristic in Quebec
  - Sarah LeSage: I believe there's a recreational fishery in some of Michigan's larger rivers
  - Tim Campbell: I don't have strong feelings, I feel that the desirable recreational aspects of flathead catfish combined with limited resources doesn't make this a high priority for me.
- Decision: include

Common carp (*Cyprinus carpio*)

- GLANSIS impact: high/3 (env); low/1 (soc/cult)
- ERSS: high
- RCC vote: 10 include, 1 exclude (MI – not a priority)
- Decision: include
- Caveat: extensive literature on common carp control; I was not able to include everything but welcome suggestions

Chinese mystery snail

- *Cipangopaludina chinensis* (Chinese mystery snail)
- Getting data from Brook, brook_schryer@ofah.org (originally proposed adding at 5/4/22 meeting)
- QC has a database of the presence of the mystery snails. They will have a summer student investigating Chinese mystery snail and its relationship to swimmers itch (following up)
- Mystery snails are of concern in MN especially by tribal entities
- ERSS for Chinese mystery snail is high
- GLANSIS: Chinese: uncertain/uncertain
- Decision: include

Banded mystery snail

- *Viviparus georgianus* (banded mystery snail)
- Getting data from Brook, brook_schryer@ofah.org (originally proposed adding at 5/4/22 meeting)
- Mystery snails are of concern in MN especially by tribal entities
- ERSS in process for banded mystery snail (draft has “uncertain”)
- GLANSIS: Banded: moderate/moderate impacts (latter was 0 when made spreadsheet)
- Decision: include

Proterorhinus semilunaris (Western/freshwater tubenose goby)

- Jesica Goldsmit, jesica.goldsmit@dfo-mpo.gc.ca originally proposed adding at 5/4/22 meeting
- Jesica asked about the western tubenose goby. It is expanding its range rapidly and has been found in QC and they will be trying to address the species this year (following up)
- Tubenose goby is also expanding its range in the Duluth-Superior harbor
- Brook noted Western Tubenose Goby has been reported from the Georgian Bay (Lake Huron) in Ontario as well. Definitely seeing a range expansion but may not be reported as often as it should since Round Gobies are lookalikes and people may not know the difference
- GLANSIS: low env and soc/cult
- ERSS: high
- Decision: include

Carassius auratus, goldfish

- Uncertain environmental, low soc/cult
- RCC feedback: 7 include, 3 exclude
- Decision: include

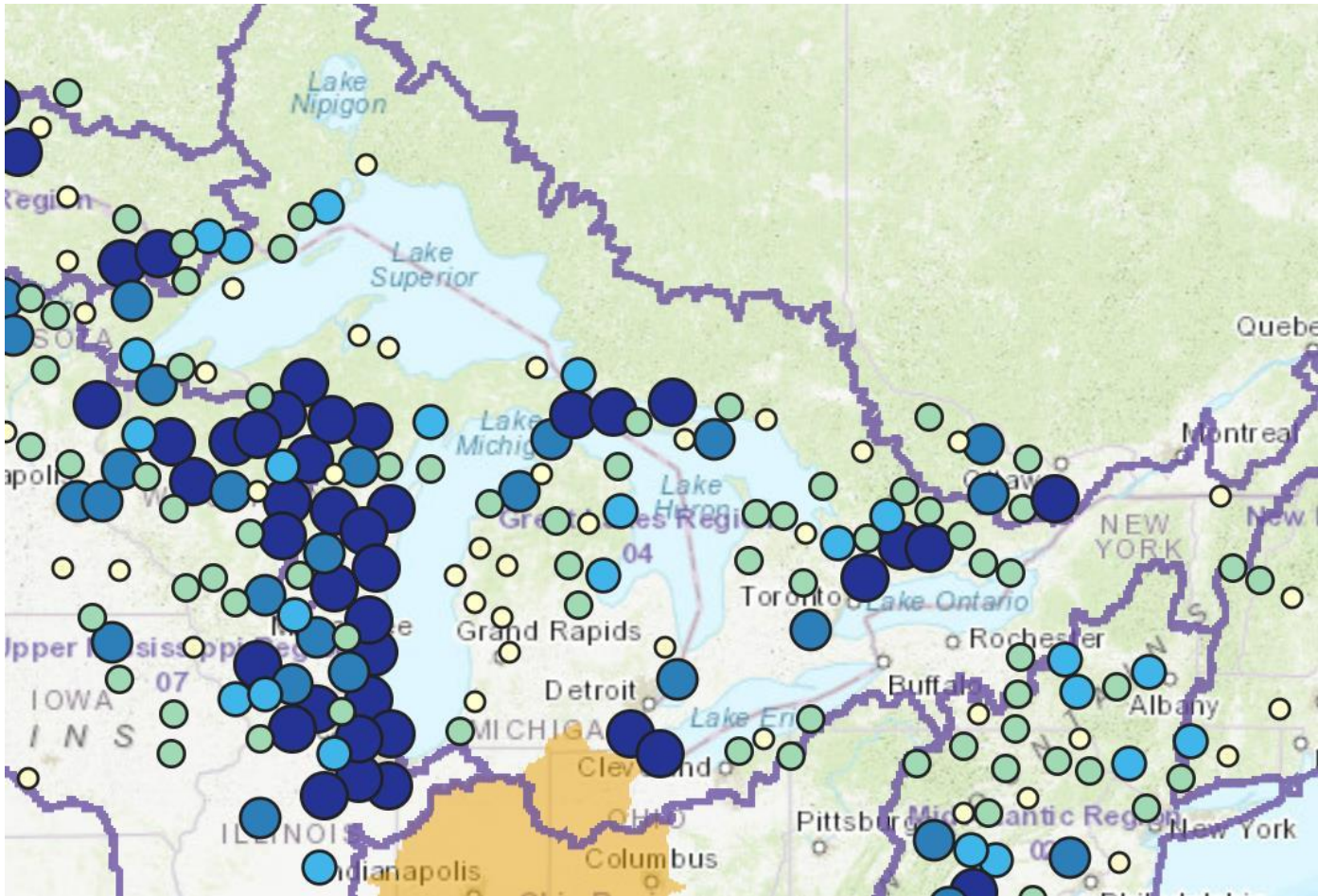
Range expander species: include

These species meet impact criteria. They have part of their range in the Great Lakes basin (pink in Excel sheet).

- The following are native to a small part of the basin would likely rely on human spread (therefore include in our list):
  - Rusty crayfish

RE: Rusty crayfish

- Native to small part of basin
- GLANSIS impact:
  moderate/2 (env),
  moderate/2 (soc/cult)
- ERSS: high



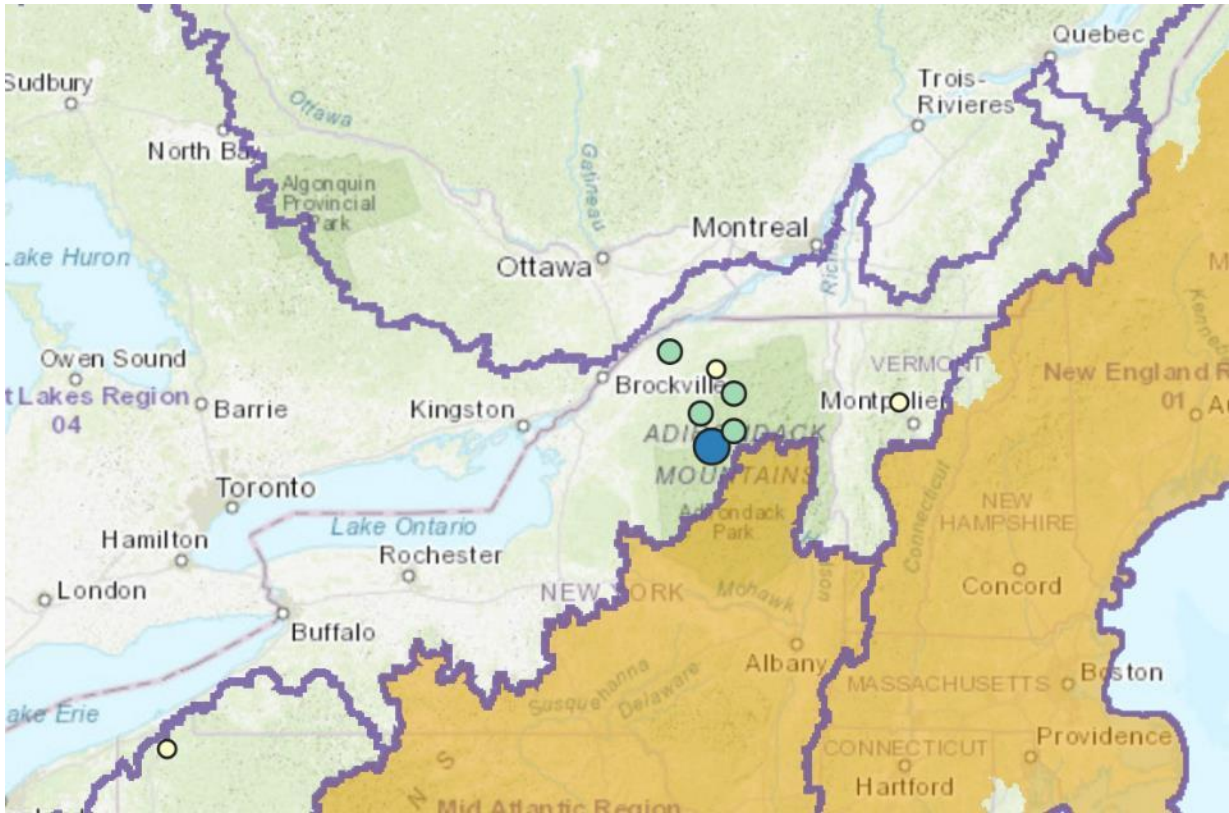
Watchlist species: include

- Includes species only established in inland waters (i.e., not established in the Great Lakes themselves – hence not considered by GLANSIS to be established)
- Most GLANSIS watchlist species are not established inland or Great Lakes, however some have reported populations in the basin – these were considered and included due to established (yellow in Excel sheet):
  - Redbreast sunfish
  - Tench

Watchlist: Redbreast sunfish (*Lepomis auritus*)

- Many GL records, 2007-2010, ‘established’ status
- ERSS: none
- Current recommendation: include

  due to established



Watchlist: Tench (*Tinca tinca*)

- Many recent GL records, “established” status
- ERSS: high
- Current recommendation: include

due to established

Low GLANSIS impact: include

- These are below the impact threshold (threshold is total of 4, 5, 6, or 3 in either category) but were included based on committee feedback (orange in Excel sheet)
  - Ruffe
  - Western mosquitofish
  - New Zealand mudsnail
  - Bloody red shrimp
  - Rudd

Impact: Ruffe (*Gymnocephalus cernuu*)

- Original GLANSIS impact: moderate/2 (env), low/0 (soc/cult)
- Updated GLANSRA impact: high/3 (env), high/3 (soc/cult)
- ERSS: high
- Propose to include
- Support from QBC
- Some management data in Cuthbert et al. 2021

Impact: Western mosquitofish (*Gambusia affinis*)

- GLANSIS impact: high/3 (env); low/1 (soc/cult)
- ERSS: high
- Propose to include

Impact: New Zealand mudsnail (*Potamopyrus antipodarum*)

- GLANSIS impact: moderate/2 (env); low/1 (soc/cult)
- ERSS: high risk
- MI asked to include, and do our own assessment

Impact: bloody red shrimp (*Hemimysis anomala*)

- GLANSIS impact: moderate/2 (env); low/1 (soc/cult)
- ERSS: high (Kate: ERSS high level and doesn't get into GL impacts)
- Review impacts – mostly based on European impacts
- What year introduced to GL? 2006
- Only impact data in GL recently: https://www.sciencedirect.com/science/article/abs/pii/S0380133021002513
- RCC feedback: 7 include, 3 exclude

Impact: Rudd (*Scardinius erythrophthalmus*)

- GLANSIS impact: moderate/2 (env); low/0 (soc/cult)
- ERSS: high risk
- Include (Chadderton, abundant in upper Richelieu and Lake Champlain)
- Include

Included in list but no literature review

- These species represent established AIS with high impact, but will not have a literature review of available control methods completed due to existing effort and understanding. However, they will be included in the site-based analysis and priority-setting assessment to prioritize future management actions (dark green in Excel sheet):
  - Grass Carp (diploid)
  - Grass carp (triploid)
  - Zebra mussel
  - Quagga mussel
  - Bighead carp
  - Sea Lamprey

Range expander species: exclude

These species meet criteria and were originally considered. They have part of their range in the Great Lakes basin (pink in Excel sheet).

- The following are native to a small part of the basin would likely rely on human spread (therefore include in our list). However, RCC discussion recommended to exclude due to lack of priority and recreational importance:
  - Gizzard shad
  - Rainbow smelt
- The following are native to much of the basin, would likely spread north naturally due to climate change (therefore exclude from our list):
  - Freshwater drum
  - Calico crayfish
  - Northern clearwater crayfish
  - American bullfrog

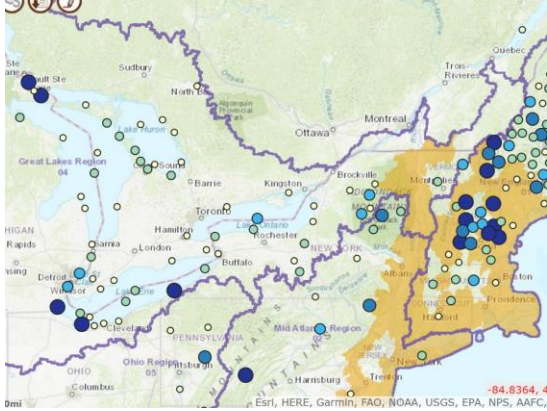
RE: Gizzard shad (*Dorosoma cepedianum*)

- Native to southeastern GL
- Established throughout
- GLANSIS impact:

  high/3 (env),

  low/0 (soc/cult)
- ERSS: none
- ON and MI confirm no interest in managing shad
- Native to much of GL (Holm et al.)
- Propose to exclude

RE: Rainbow smelt (*Osmerus mordax*)



- Native at eastern edge of GL (range expander)
- Established throughout GL
- GLANSIS impact: high/3 (env), low/0 (soc/cult)
- ERSS: none
- Rainbow smelt is highly valued in MN as a fishery, MI does not include in AIS program, IL manages as a sport fishery, ON noted they do not see it being managed, recreational fishery in QBC (and native)
- Propose to exclude; RCC feedback:
- Sarah LeSage: (exclude) recreational fishery in MI that is regulated
- Debra DiCianna: (exclude) RCC feedback [to exclude].
- Kelsey Taylor: (exclude) Food source, anecdotal noted decline in populations
- Grace Loppnow: (include with conditions) smelt are commonly regarded as naturalized and are fished for food, populations are declining. A lot of my perspective on this species is informed by having grown up in Wisconsin, and having worked on Lake Michigan with USFWS-Green Bay. Rainbow smelt are an invasive species, but are not usually managed as such. There is a long tradition of fishing for smelt, to eat at "smelt fries" in northern Wisconsin and Minnesota. People used to catch them by the garbage can-full. Now, a good catch is a few dozen. Predation by lake trout (and maybe overfishing) have contributed to their decline. Currently, with their low numbers, I think it is unlikely that they could be having much impact on the ecosystem. They could even be having a positive impact on salmonids. They are also still valued as a food fish, mostly for the tradition. Local organizations or fire stations will hold smelt fries to raise funds. Some restaurants serve them when they are in season. I think the bigger risk is to inland lakes where if predators were not present to keep them in check, they could become very abundant. Most management has been to try to educate folks to not move them from the Great Lakes to other locations. I would be fine with that as long as its inclusion [specified as a concern for inland waters only] doesn't take away from work on higher-priority species.
- Eric Fischer: this species is not a high priority and will not be a priority in the near future. If this list is meant to be long term (decades) then it may be worth including, but if the plan is to revise on a regular schedule (every 510 years) then it may not be worth including
- Jim Grazio: (exclude) My opinion is NO. For better or worse, this species is long naturalized in the Great Lakes. Short of gene drive, I don't see any plausible control options. And it wouldn't be my first pick for that
- Sean Hartzell: (exclude) I agree with Jim for the reasons he cited below. The same situation is true of inland waters- Rainbow Smelt have been long-established where they occur in inland waters of PA (largely due to historic stocking in the 20th century) and I don't see this species as any priority for control in PA- in many cases, we really don't have the effective capacity for control of more "recent" invaders, let alone the long-established ones.
- Cathy McGlynn: (include) Rainbow smelt is not currently on our Part 575 List of Prohibited and Regulated Species. It is under consideration for the revised list.
- John Navarro: (exclude) No. They are well established and other species should be a priority.
- Jeff Brinsmead: Rainbow Smelt are particularly complicated in Ontario. We actually have a very small number of lakes in eastern Ontario where they are thought to be native. And of course the one user group most interested in smelt control is from one of these native lakes! Personally, I'm not sure how we would make a meaningful difference with smelt. They have been introduced widely in Ontario. They are in hundreds of lakes and are very well established in many of these. They are also a valued sport fish for many people. It would be hard to believe that we can make a meaningful dent in smelt in Ontario
- Mindy Barnett, IL; Rainbow smelt is a huge sport fishing "resource", so adding it to a control priority would most likely not go over very well. While I understand the concern, I feel this would get a lot of pushback that can be avoided.

RE: Freshwater drum (*Aplodinotus grunniens*)

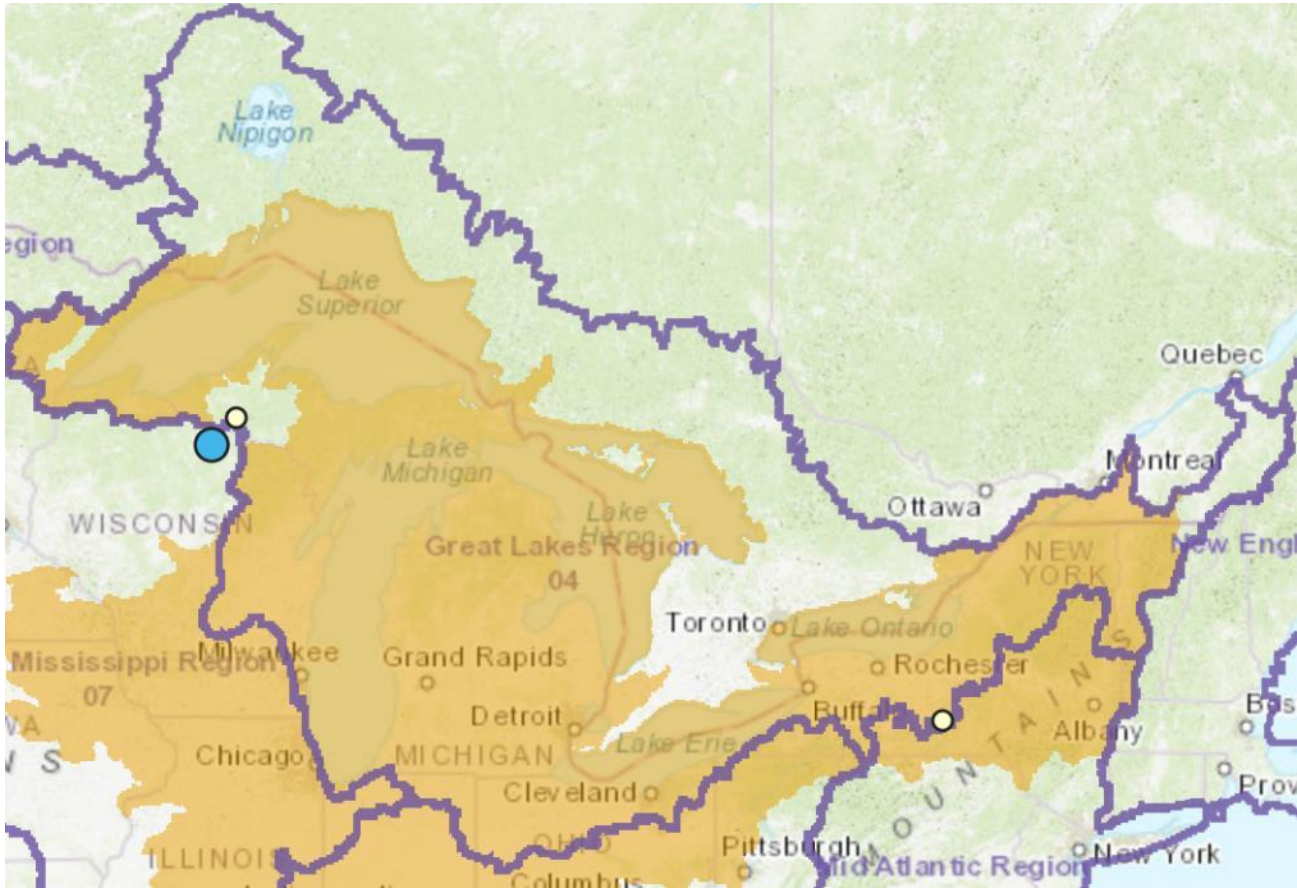
- Several GL records, established status
- Native to much of basin
- Uncertain GLANSIS impact
- ERSS: none
- Propose to exclude
- Support from Olivier (QBC) to exclude

RE: Calico crayfish (*Faxonius immunis*)

- Native to much of basin
- GLANSIS impact: high/3 (env), low/1 (soc/cult)
- ERSS: uncertain
- Propose to exclude

RE: Northern clearwater crayfish (*Faxonius propinquus*)

- Native to much of basin
- GLANSIS impact:
  high/3 (env),
  low/1 (soc/cult)
- ERSS: high
- Propose to exclude



RE: American bullfrog (*Lithobates catesbeianus*)

- Native to much of basin
- GLANSIS impact: high/3 (env), low/1 (soc/cult)
- ERSS: high
- Propose to exclude

Watchlist species: exclude

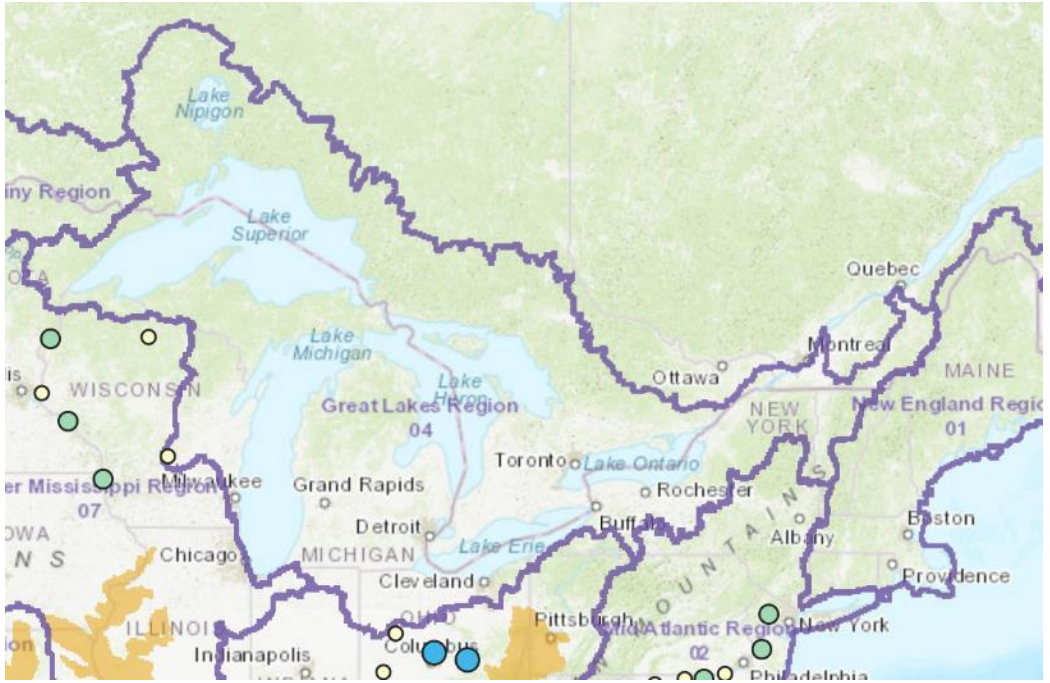
- Includes species only established in inland waters (i.e., not established in the Great Lakes themselves – hence not considered by GLANSIS to be established)
- Most GLANSIS watchlist species are not established inland or Great Lakes, however some have reported populations in the basin – these were considered but excluded due to not established (yellow in Excel sheet):
  - Steelcolor shiner
  - Blue catfish
  - Mississippi map turtle

Watchlist: steelcolor shiner (*Cyprinella whipplei*)

- 1 GL record (2005) with unknown status
- ERSS: uncertain
- Current recommendation: exclude due to not established

Watchlist: blue catfish (*Ictalurus furcatus*)

- 1 GL record (2006), unknown status
- ERSS: high
- Current recommendation: exclude due to not established



Watchlist: Mississippi map turtle (*Graptemys pseudogeographica*)

- Not listed on GLANSIS yet
- One recent report in WI
- ERSS: none
- Propose to exclude due to not established

Exclude: other

- Red-eared slider: cryptogenic and low/no impact
- Eastern mosquitofish: Misclassified

Red-eared slider (*Trachemys scripta elegans*)

- GLANSIS impact: uncertain (1) environmental; high (3) social/cultural
- ERSS: none
- Turtle expert Jim Harding indicates no impacts in Great Lakes, and likely native to at least MI and WI (though nonindigenous to Lake Ontario/Canada side of basin)
- Recommendation: exclude
- From Rochelle: After talking this over with NAS, we are going to accept a handful of Michigan locations as 'native relict' populations. This shifts the overall status of Red-eared sliders from nonindigenous to range expansion/cryptogenic for the State of Michigan and for the Great Lakes basin (similar to rusty crayfish, which has a small population in Sandusky Bay designated as native). I believe this is going to be relevant to Lake Michigan and Lake Erie (including Lake St. Clair basins) -- not yet sure about Huron basin. For impact: We discussed whether our assessment is appropriate in not comparing the health impact versus native species (likely all turtles are a salmonella risk) but we aren't willing at this point to change the assessment for a single species - especially when that risk is high enough to have triggered legislation (ban of sales of small RES due to salmonella risk).
- Important to Canadian provinces (Annick Drouin – threat to native herpetofauna; Jeff Brinsmead – on Ontario's radar)
- RCC vote: 7 exclude; 3 include

Impact: Eastern mosquitofish (*Gambusia holbrooki*)

- Not scored in GLANSIS
- GLANSRA: high/3 (env); high/3 (soc/cult)
- ERSS: high
- GLANSIS lists Western (G. affinis); the specimens of Eastern (G. holbrooki) were considered to have been misidentified.
- Therefore not in Great Lakes basin.
- Exclude

Excluded due to criteria:

These species have been considered due to status as established and high impact AIS, but excluded due to high beneficial impacts or status as a virus/bacteria (purple in Excel sheet):

- White Perch
- Alewife
- Salmonid whirling disease
- Viral Hemorrhagic Septicemia Virus (VHSV-IVb)
- Bacterial kidney disease (BKD), Dee disease
- Spring viremia of carp (SVC)
- Rainbow Trout
- Chinook Salmon
- Brown Trout
- Digenean fluke (*Ichthyocotylurus pileatus*)
- Microsporidian parasite (*Heterosporis sutherlandae*)
- Largemouth bass virus (LMBV)

Excluded due to criteria:

These species have been considered due to status as established but excluded due to low impact (white in Excel sheet)

- Muskie pox
- White River Crayfish
- Threespine Stickleback
- Pink Salmon
- Ischnus scud
- Big Water Crayfish
- Muskellunge
- Redear Sunfish
- Coho Salmon
- Atlantic Salmon
- a copepod

Next steps

- Continue literature reviews
- Reach out to RCC members for control case studies (grey lit)
- Reach out to RCC members for review (based on interest/expertise)

Scope

- Geographic: Great Lakes region (by HUC-2)
  - Includes Lake Champlain
  - Consistent with GLANSIS regional border for species records
- Taxonomic: fish, invertebrates (not microscopic), amphibians, reptiles
- Impact: environmental and social/cultural

Criteria for consideration as priorities

- Impact: GLANSIS transformed total impact score of 4, 5, or 6 (possible range is 0-6), unless a 3 (high) in either environmental or social/cultural category.
- Impact: include those with uncertain impact in the GL for <30 years.
- Impact: exclude those with high beneficial impact (e.g., salmonids).
- Distribution:
  - Nonindigenous and range expander (RE) species (only RE with limited native distribution in GL, given those with extensive GL native distribution will have natural expansion due to climate change); or
  - Watchlist species with established populations.
- Include in list as established AIS, but exclude from analysis of control options, those species with regional control efforts (e.g., sea lamprey)
- Exclude virus/bacteria/microscopic species