Great Lakes RESTORATION

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

Exploring Stakeholder and Community Perspectives on Genetic Biocontrol for Invasive Species

Great Lakes Panel on Aquatic Nuisance Species Meeting| NOAA Great Lakes Environmental Research Laboratory, Ann Arbor, MI | December 10-11, 2024

Jason Delborne

Professor of Science, Policy, and Society
Department of Forestry and Environmental Resources
Genetic Engineering and Society Center
North Carolina State University

Beginning January 2025
Assoc. Professor of Science & Technology Policy
La Follette School of Public Affairs
University of Wisconsin-Madison


PRO GMO
MIDDLE GROUND
NO GMO

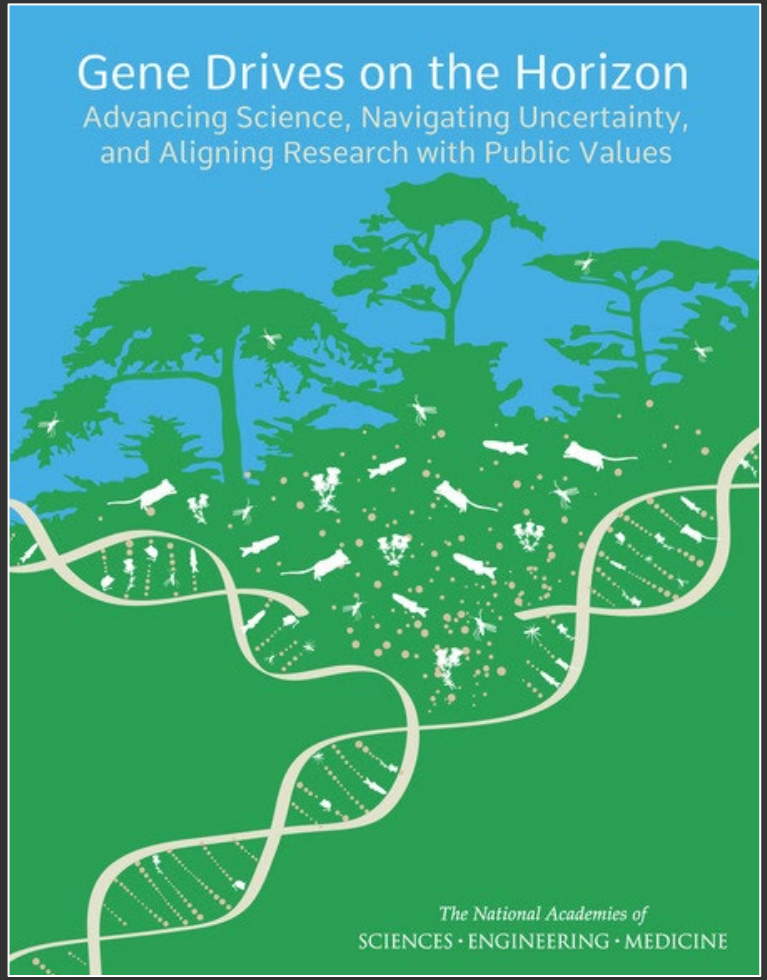

I FEED MY KID GMOs


THE WORLD DOESN'T WANT YOUR GMOs

The National Academies of SCIENCES ENGINEERING MEDICINE

"Public engagement cannot be an afterthought."

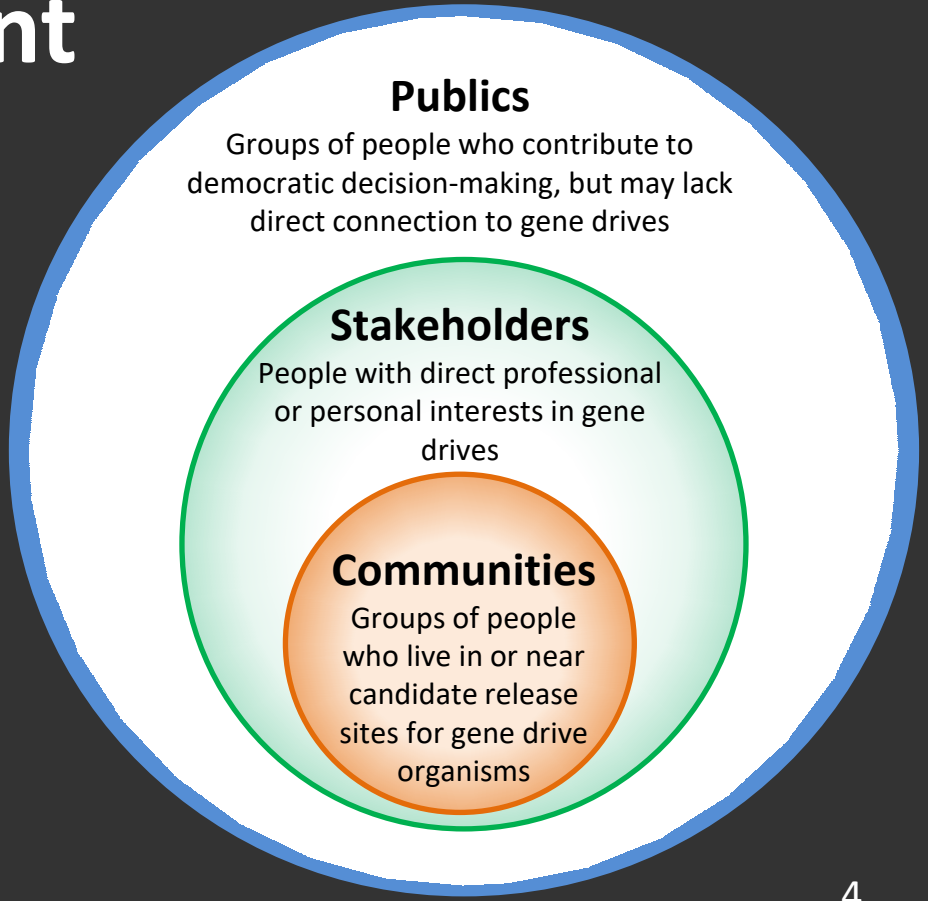
"The outcomes of engagement may be **as crucial as the scientific outcomes** to decisions about whether to release a gene-drive modified organism into the environment" (NASEM, 2016)



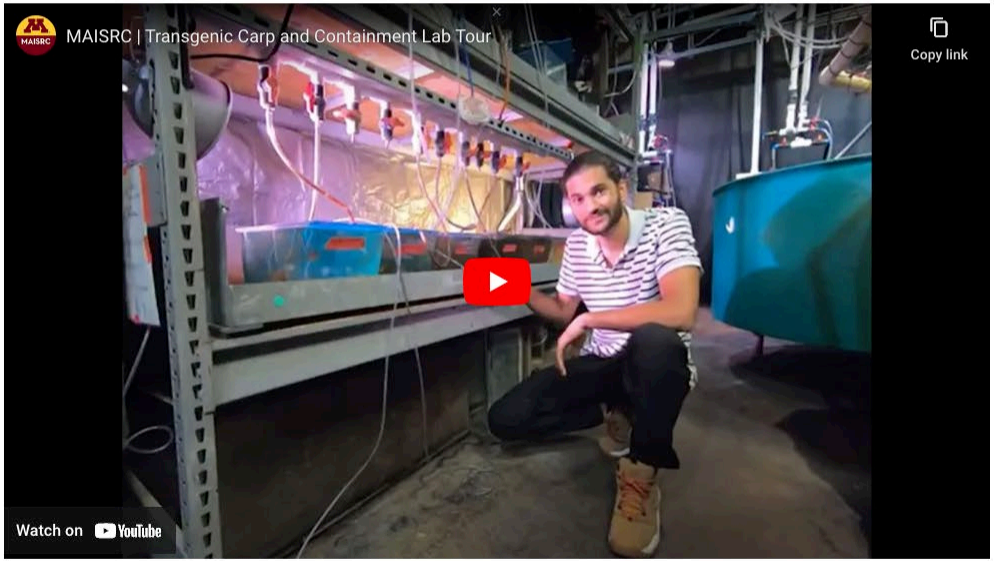
nas-sites.org/ gene-drives

Defining Engagement

"Seeking and facilitating the sharing and exchange of knowledge, perspectives, and preferences between or among groups who often have differences in expertise, power, and values" (NASEM, 2016)



Genetic Control of Invasive Fish Species



This project focuses on a novel method of biocontrol for common carp which will complement existing technologies by introducing a synthetic species-like barrier to reproduction. Researchers will use programmable transcription activators to drive lethal embryonic overexpression of endogenous genes in hybrid embryos.

Phase II

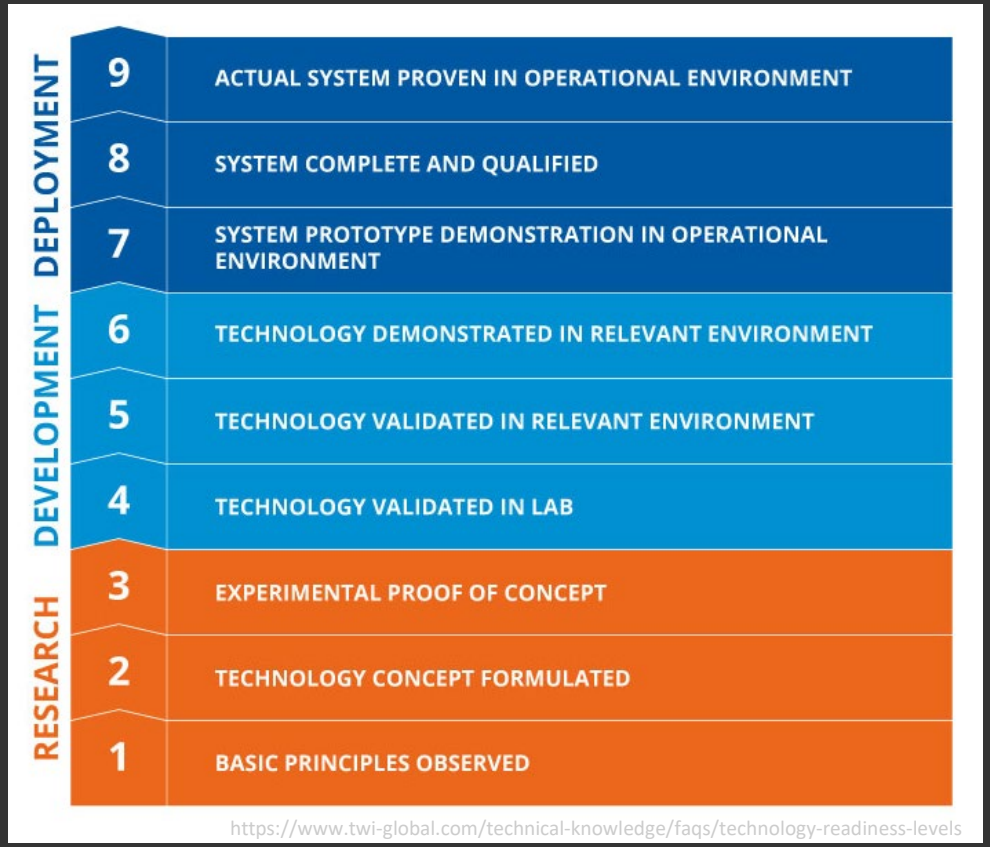
Project manager: Michael Smanski

Funded by: Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources

Start date: 2018

Estimated end date: 2020

Technology Readiness Levels (TRLs) for Genetic Biocontrol of Invasive Carp



https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels

Testing the waters for genetic biocontrol technologies:

Engaging resource managers and key stakeholders to understand decision landscapes, information needs, and diverse perspectives

Great Lakes Restoration Initiative
Interjurisdictional Aquatic Invasive Species Project
U.S. Fish & Wildlife Service
(F23AP00046, 2023-2026)

- ❑ Landscape Analysis (resource managers)
- ❑ Interviews (experts, interested parties)
- ❑ Workshops (partnering with state agencies)
- ❑ Tribal Cooperative Projects

Landscape Analysis

Draft in Shared Folder

Genetic Biocontrol and Aquatic Invasive Species Management in the Great Lakes Region: Perspectives of Resource Managers

Rex Alirigia[1,2], Jill Furgurson[1,2], Katie Barnhill[2], and Jason Delborne[1,2,3]

October 2024

Project funded by the U.S. Fish and Wildlife Service, Great Lakes Restoration Initiative (Grant #F22AS00183)

1.0 Introduction

Genetic biocontrol refers to the intentional release of genetically engineered organisms to control a population of those same organisms (Kapuscinski & Sharpe, 2014; Teem et al., 2020). This approach shows promise for managing and eradicating invasive species by precisely

Table 1.0: Targeted invasive species for genetic biocontrol technologies

Invasive Species	Impacts	Management method(s)	Genetic Biocontrol Technique	Developing Institution	Project Stage
Invasive carp: Common carp (*Cyprinus carpio)*	Outcompete other fish for food. Impacts ecosystem bed diversity.	Mechanically removal Electric barriers to block upstream adult carp migration.	Synthetic incompatibility	University of Minnesota	Laboratory testing
Sea lamprey *(Petromyzon marinus)*	Predates on native fish species. Caused the collapse of native species such as lake trout	Lampricide to target larval stage. Physical and Electric barriers to block upstream migration of adult lampreys.	RNA interference	University of Michigan	Laboratory testing
			Sterile insect technique	US Geological Service	Testing in rivers Maple, Pigeon, and Sturgeon
Zebra mussels *(Dreissena polymorpha)*	Clog water intake pipes filter algae that native plants need for food Impact water quality.	Mechanical removal Chemical treatment	RNA interference	University of Minnesota	Laboratory testing
Common weed (*Phragmites australis)*	Reduces plant biodiversity nutrient cycle Impacts ecosystem quality.	Herbicide treatment Physical removal	RNA interference	USGS - GLSC US Army Corps of Engineers Louisiana State University Wayne State University	Laboratory testing

Table 1.0 presents examples of invasive species targeted for genetic biocontrol. It is not an exhaustive list of AIS or the genetic biocontrol tools currently being developed in the Great Lakes region.

Slide by R. Alirigia

Potential Effectiveness & Benefits

Potential precision in targeting species

Scalability for widespread implementation

Cost-effectiveness in eradicating AIS

Slide by R. Alirigia

Challenges & Concerns

- **Long development timelines**
- **R&D cost and sustainability of funding (including implementation)**
- **Unintended movement of modified species**
- **Susceptibility of modified species to real-world conditions (vs. lab, models)**
- **Public opposition**

Slide adapted from R. Alirigia

Regulatory Considerations

Inadequacy of current regulation

Lack of clarity on agency jurisdiction

Impact of varying management priorities of states/provinces

Slide adapted from R. Alirigia

Phase 2 Interviews

- Broader diversity of stakeholders (e.g., NGOs, lake associations, additional resource managers, wildlife/fishing associations)
- Scientists involved in genetic biocontrol projects
- State and federal regulators

Workshops (2025)

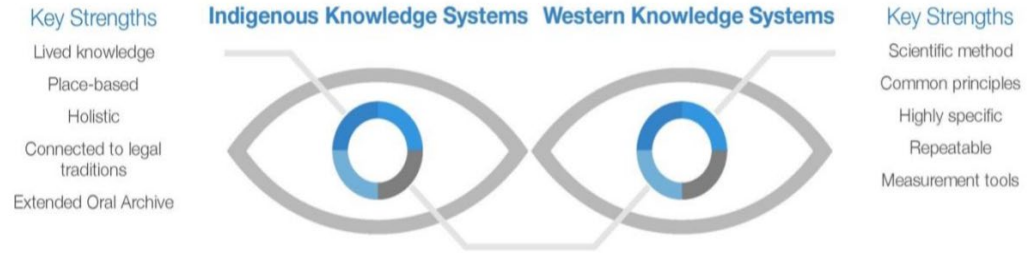
- Select 1-2 species for focus of workshop(s)
- Recruit state agency or other partners
- Select location and date (co-locate with other meeting?)

Tribal Cooperative Projects

- Engaging Indigenous Knowledge (IK) is crucial for collaborative environmental governance, especially in the Great Lakes Region (Berkes, 2017; Johnson et al., 2016; Reo & Ogden, 2018).
- Broad goal: conduct ethical and inclusive engagement with Tribal communities regarding genetic biocontrol for Great Lakes aquatic invasive species.
- Bridging knowledges (Johnson et al., 2016; Muir et al., 2023)

Slide adapted from J. Furgurson

Two-Eyed Seeing



(Bartlett et al., 2012; Reid et al., 2021)

(Ermine, 2007; Nikolakis & Hotte, 2022, Littlefoot and Sutherland, 2021)

Tribal Cooperative Projects

Accomplishments

- Early engagement efforts began in October, 2023
- Temporary partnership with Good Sky Guidance (January - July, 2024)
- Presentation to Voigt Intertribal Task Force (July, 2024)

Current Focus - formation of Tribal steering committee

- Establish shared project goals and outcomes (e.g., interviews, focus groups, workshops, storytelling circles)
- Refine research questions with Indigenous perspectives, priorities, and values
- Strategize on how to allocate project resources in ways that benefit the community

Q’s & Specific Feedback Requested

- Chart of GLR genetic biocontrol projects
- Stakeholders to interview in Phase 2
- Additional Tribal contacts for steering committee
- Advisory Board recommendations
- Species, partners, locations for workshops

Jason Delborne

Professor of Science, Policy, and Society
Department of Forestry and Environmental Resources
Genetic Engineering and Society Center
North Carolina State University
jason_delborne@ncsu.edu

January 2025–
Associate Professor of Science & Technology Policy
La Follette School of Public Affairs
University of Wisconsin – Madison
delborne@wisc.edu