# Sea Lamprey Control: Looking Forward

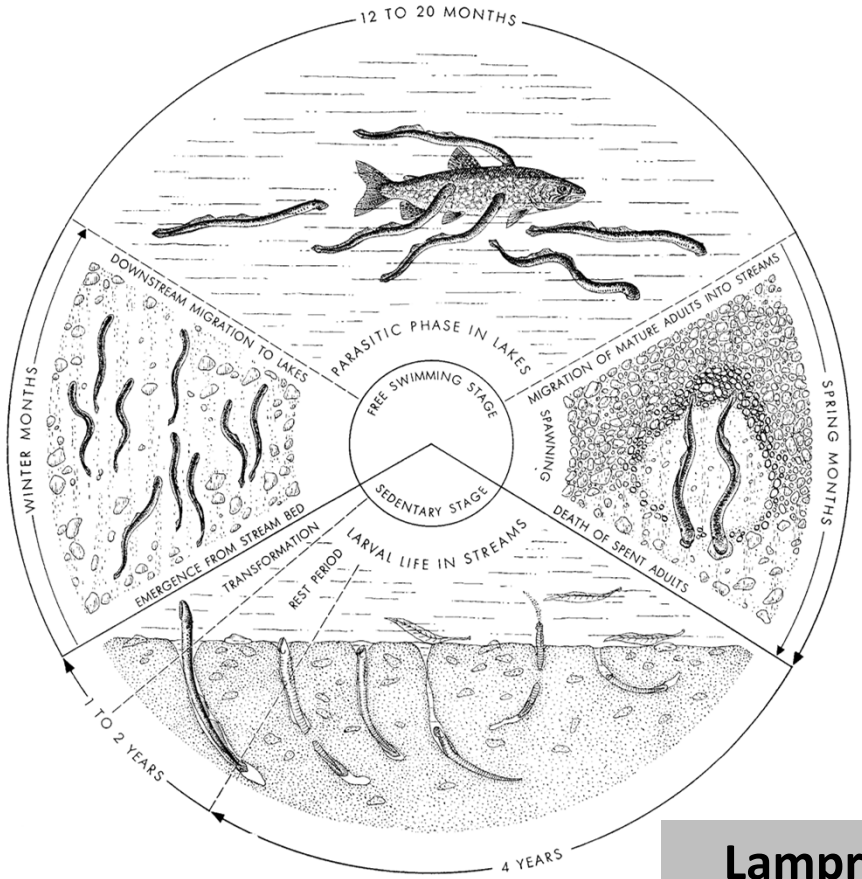
Tyler Buchinger, Mike Siefkes, Jill Wingfield

# Sea lamprey life cycle

## Current control efforts focus on larvae and adults

Parasites

Transformers




Adults

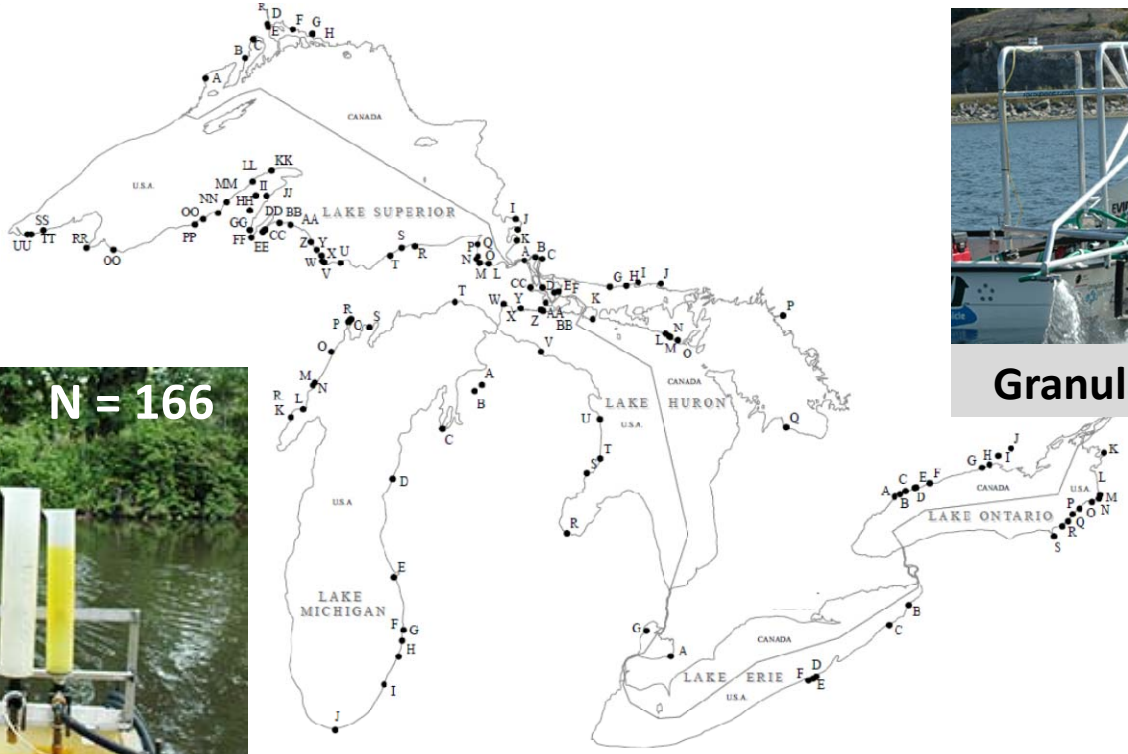
**Barriers**

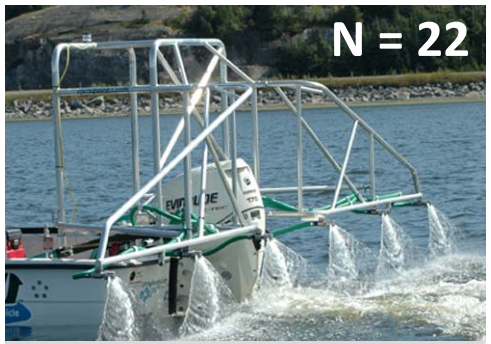
**Lampricides**

Larvae

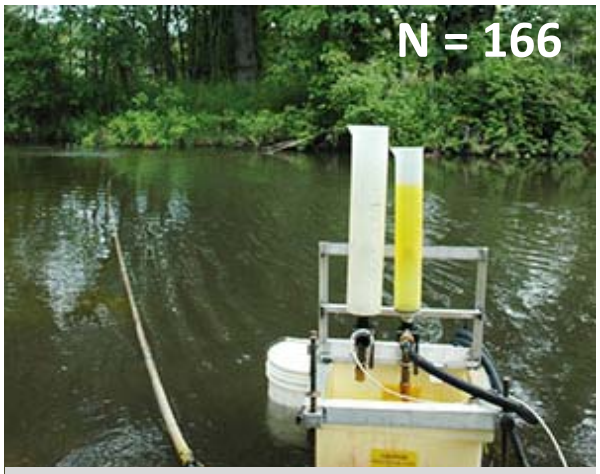
# Lampricide control

## Lampricides remain the most important control tool



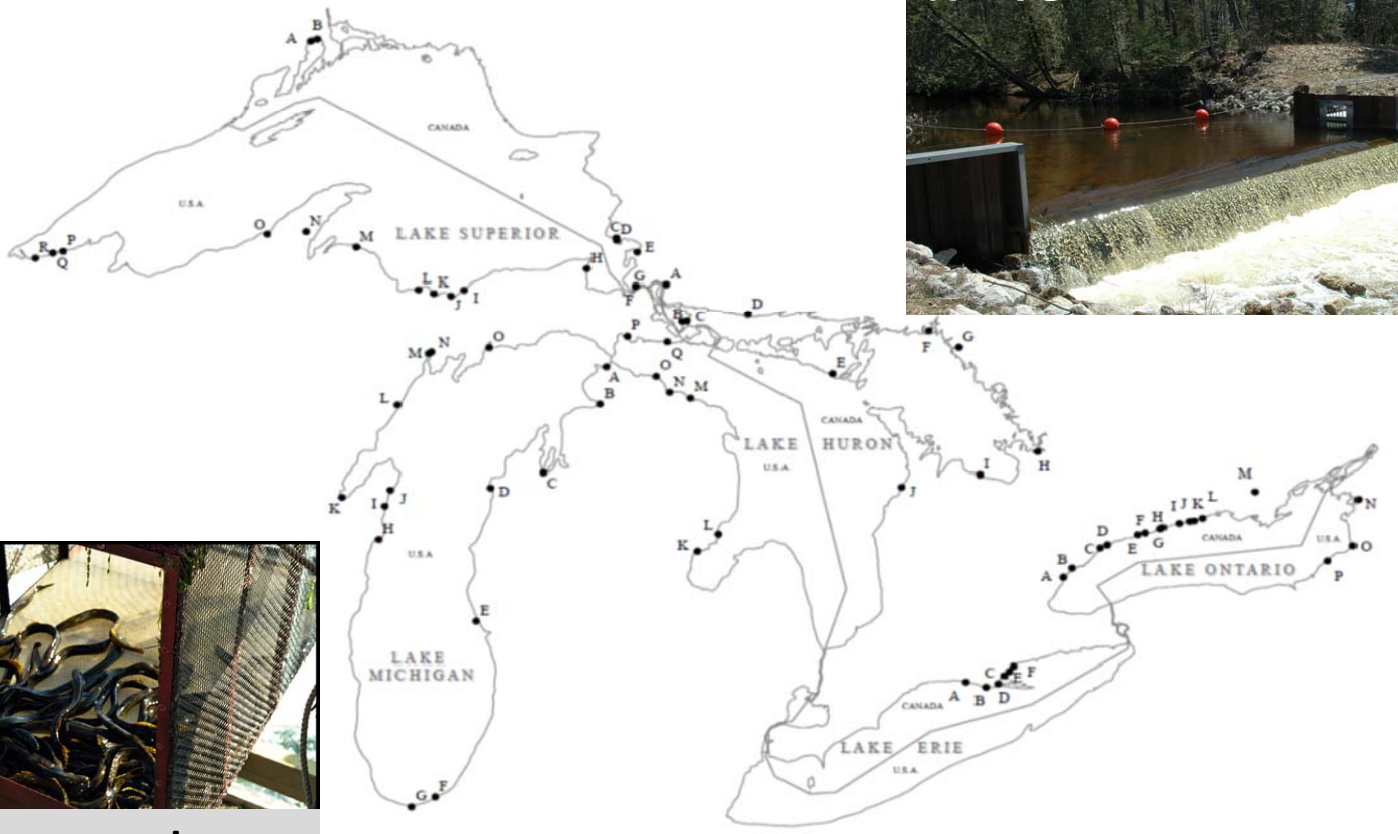

**Granular Bayluscide**




**TFM**

# Alternative control- Barriers

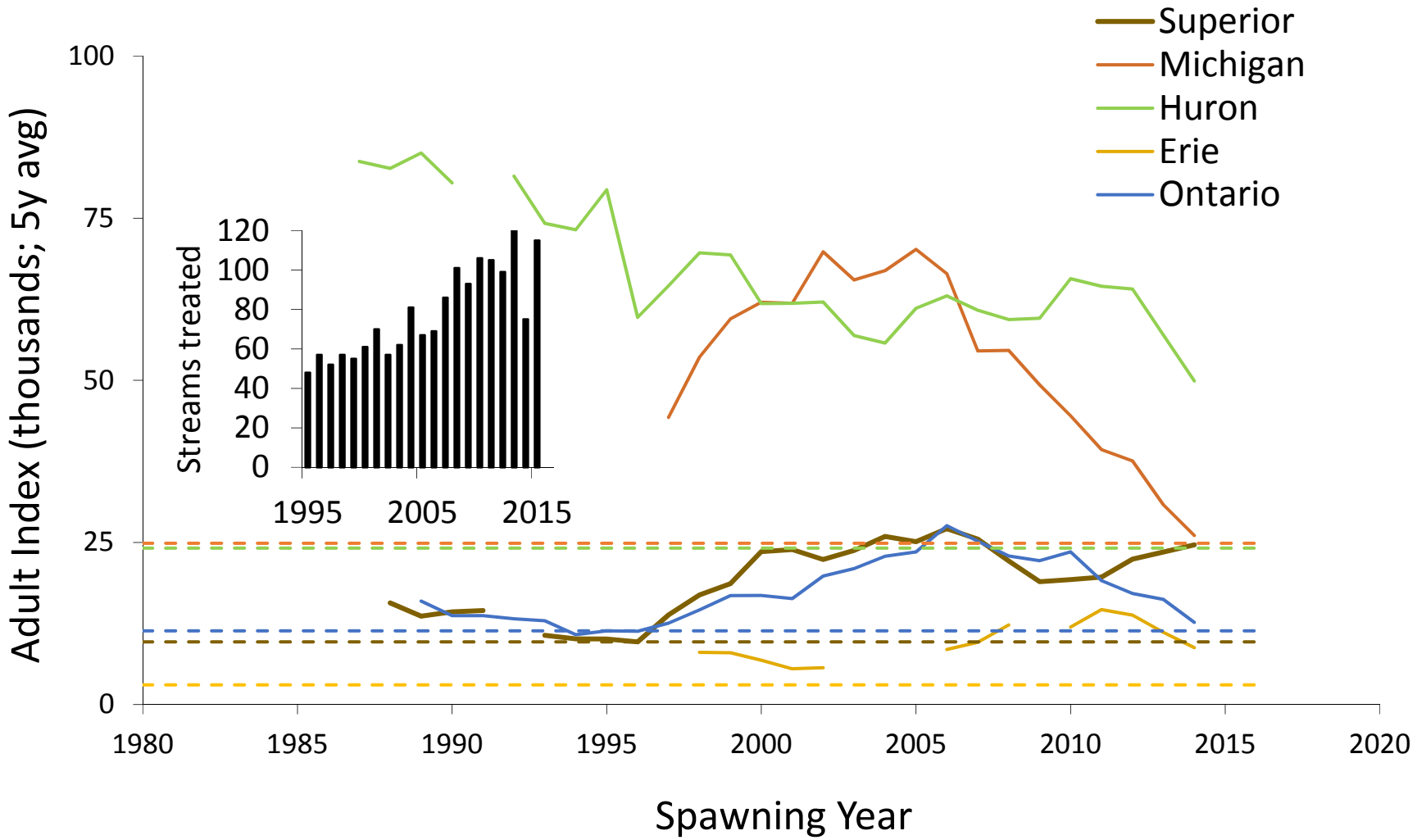
Barriers remain only alternative to lampricides


**Barrier-integrated traps**

# Population status

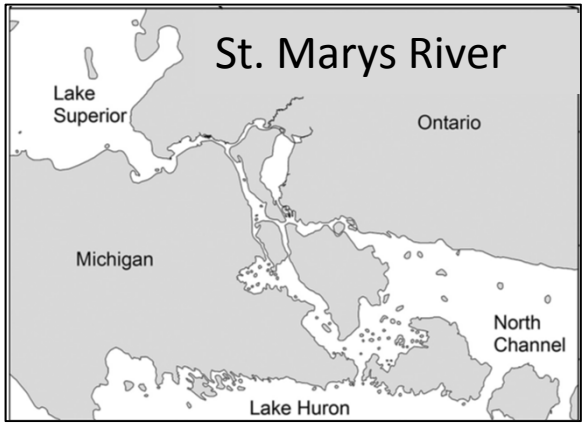
Populations are declining but above target in Huron, Superior, and Erie

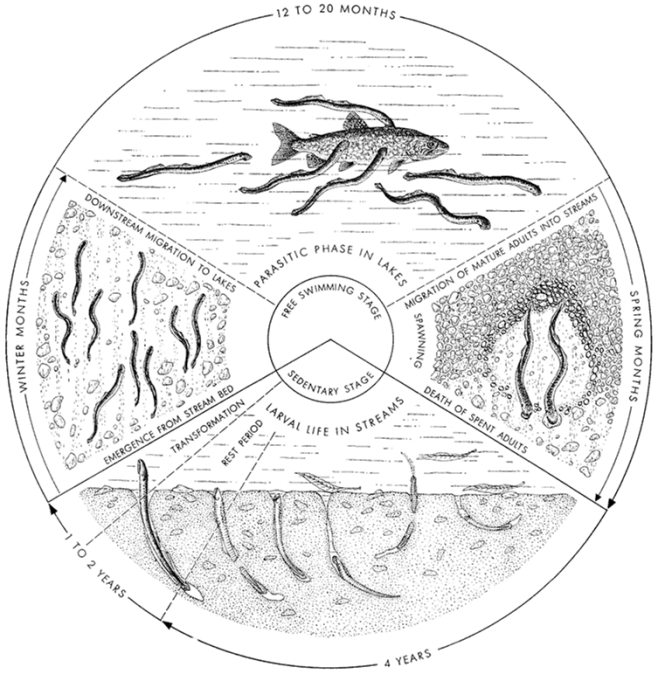


# Goal: improve and integrate

## Search for cost-effective environmental benign control tools

Problem systems




Resistance

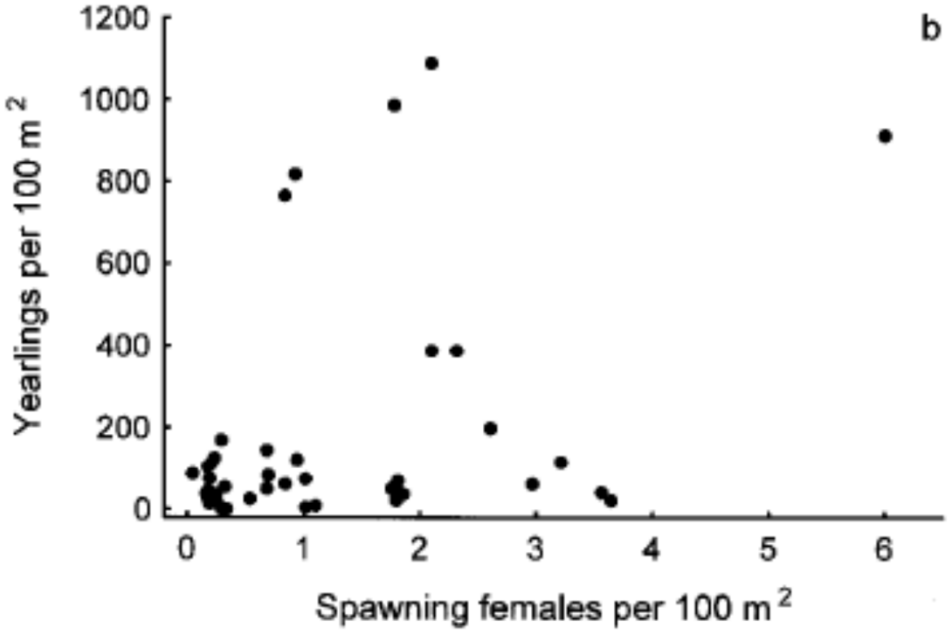

Non-target species

# Alternative techniques

Develop new tools and exploit all life stages

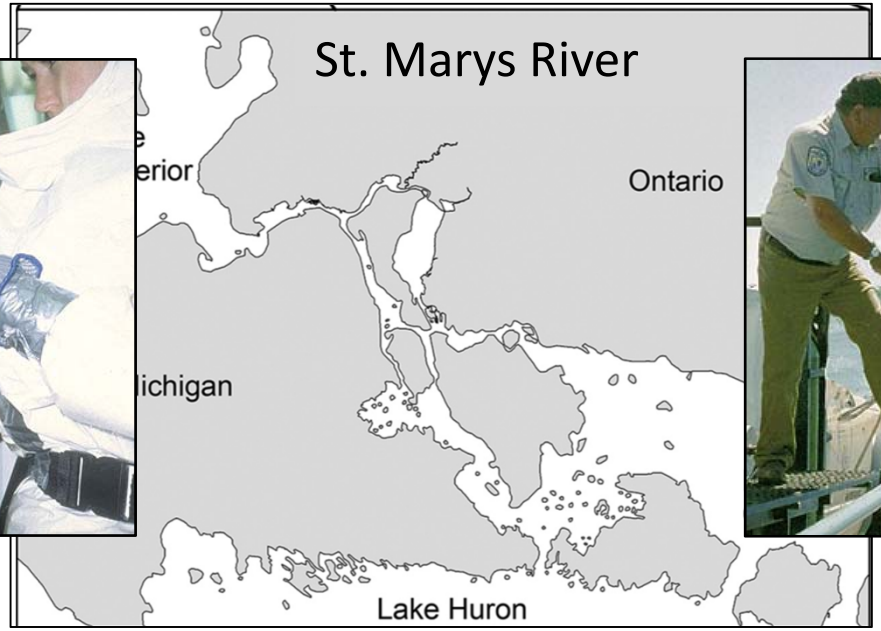
- Sterile male release
- Pheromones
- Electrical guidance
- Trapping
- Emerging genetic tools

Compensatory responses



# Sterile male release

Compete with fertile males to waste female reproductive potential

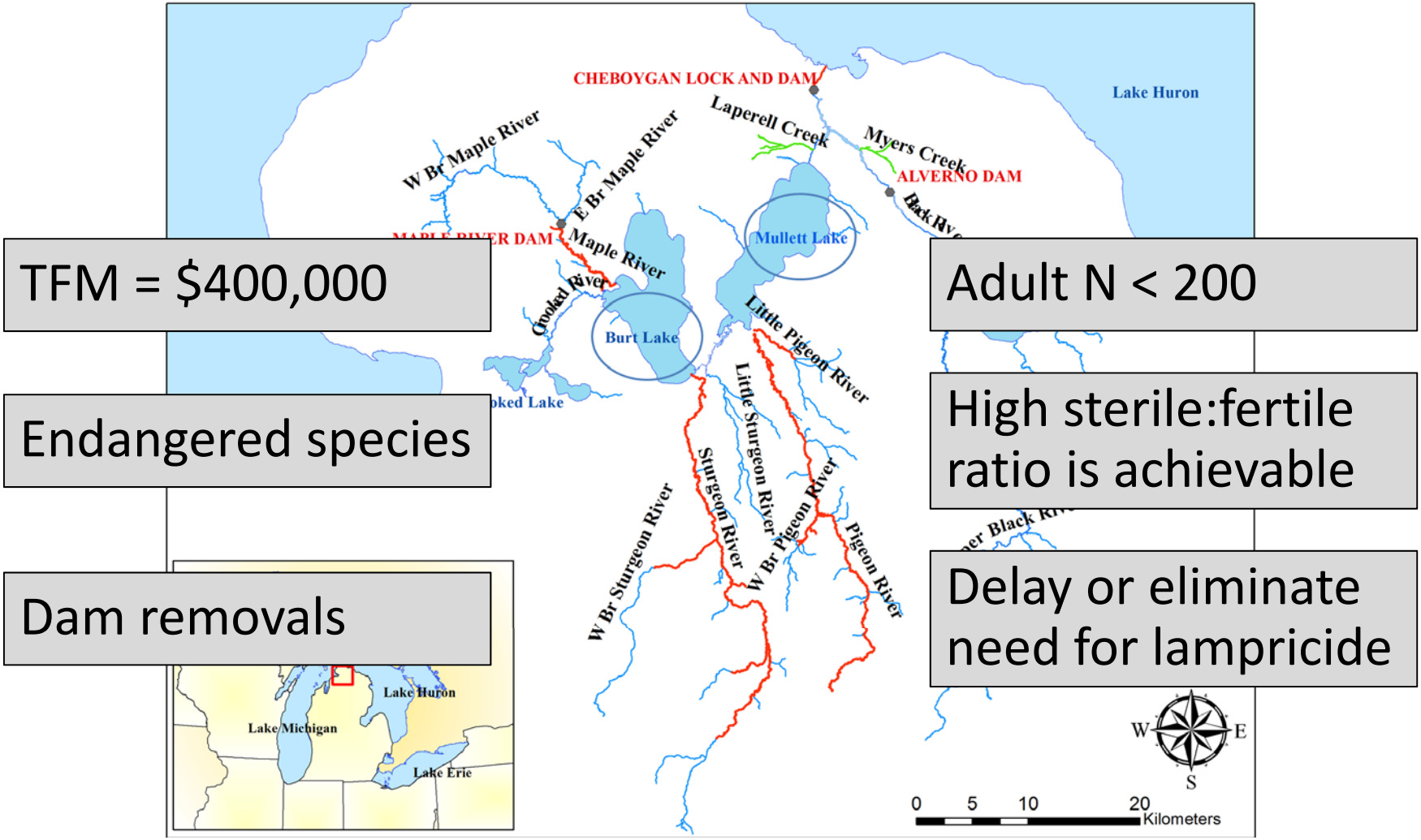



**1997-2011: ↓ effective female spawners**

**Difficult to assess; no decrease in recruitment at achievable trapping rates, sterilization ratios, and Bayluscide application**

# Sterile male release

Systems where higher sterile:fertile ratio is achievable




TFM = $400,000

Endangered species

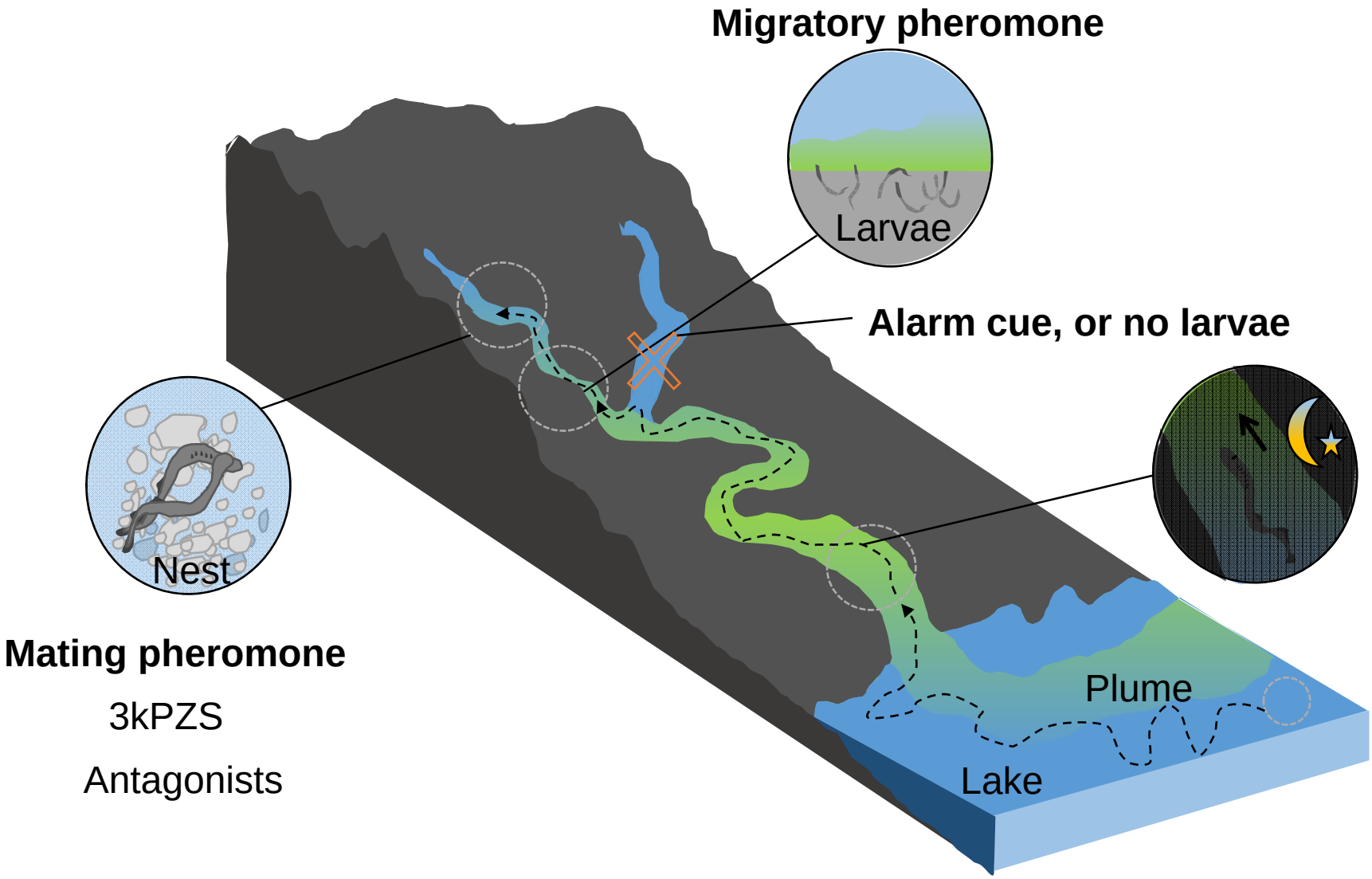
Dam removals

Adult N < 200

High sterile:fertile ratio is achievable

Delay or eliminate need for lampricide

# Sea lamprey pheromones

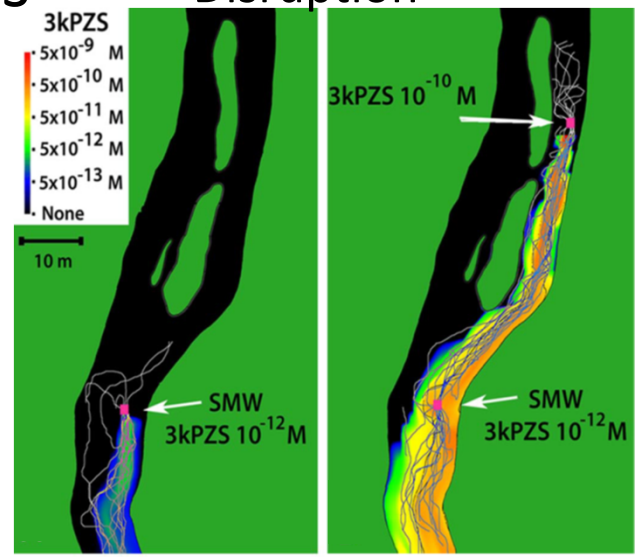


# Pheromone control tools

- **Trapping**
  - Up to 75% catch rate
  - 3kPZS registered with EPA
- **Redistribution**
  - Migratory/mating pheromones
  - Alarm cue
- **Disruption**
  - Enshroud with pheromone
  - Antagonists

Traps

Disruption



# Pheromone-baited traps

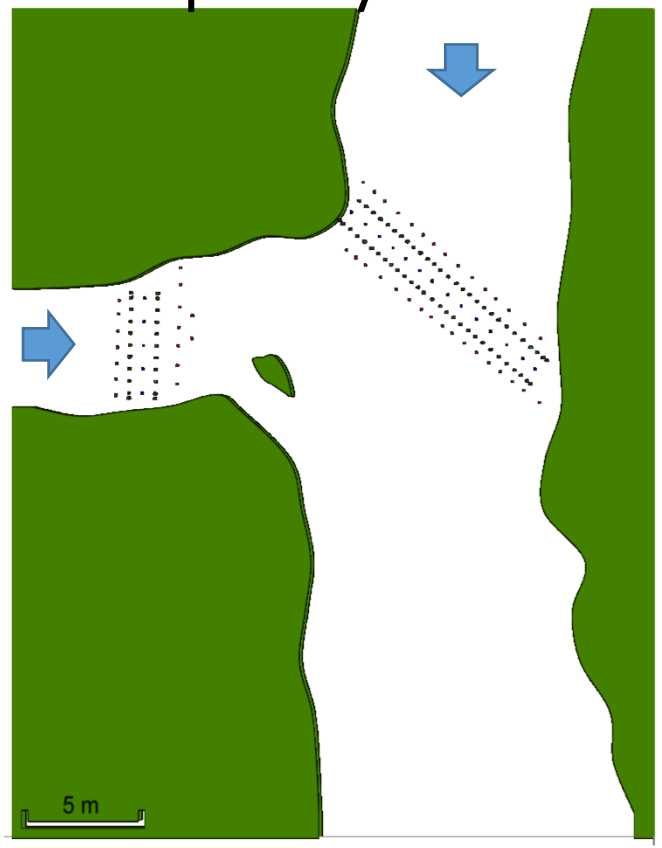
## Management-scale test of 3kPZS-baited traps


- $\bar{x}$= 10%, max = 40%
- Improved by full pheromone mix
- Modelling indicates could be cost-effective control tool

# Electrical guidance

## Vertical electrode pulsed DC fields


Temporary barrier



# Electrical guidance-trapping

Electric-leads increase trap efficiency


# Trapping

## Expanding from assessment into control

### Barrier-independent

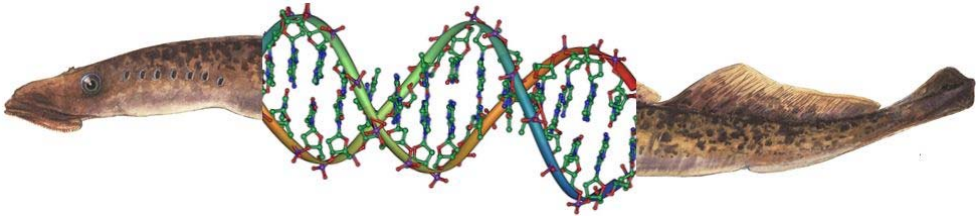
### New designs

### Transformers

Modelling where and when effective

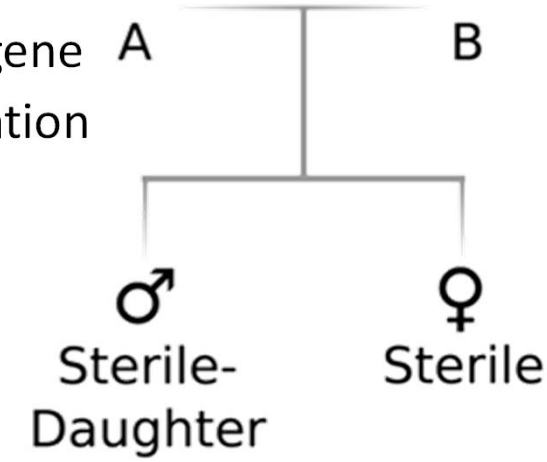
# Genetic manipulations

## Using the genome to develop new control tactics

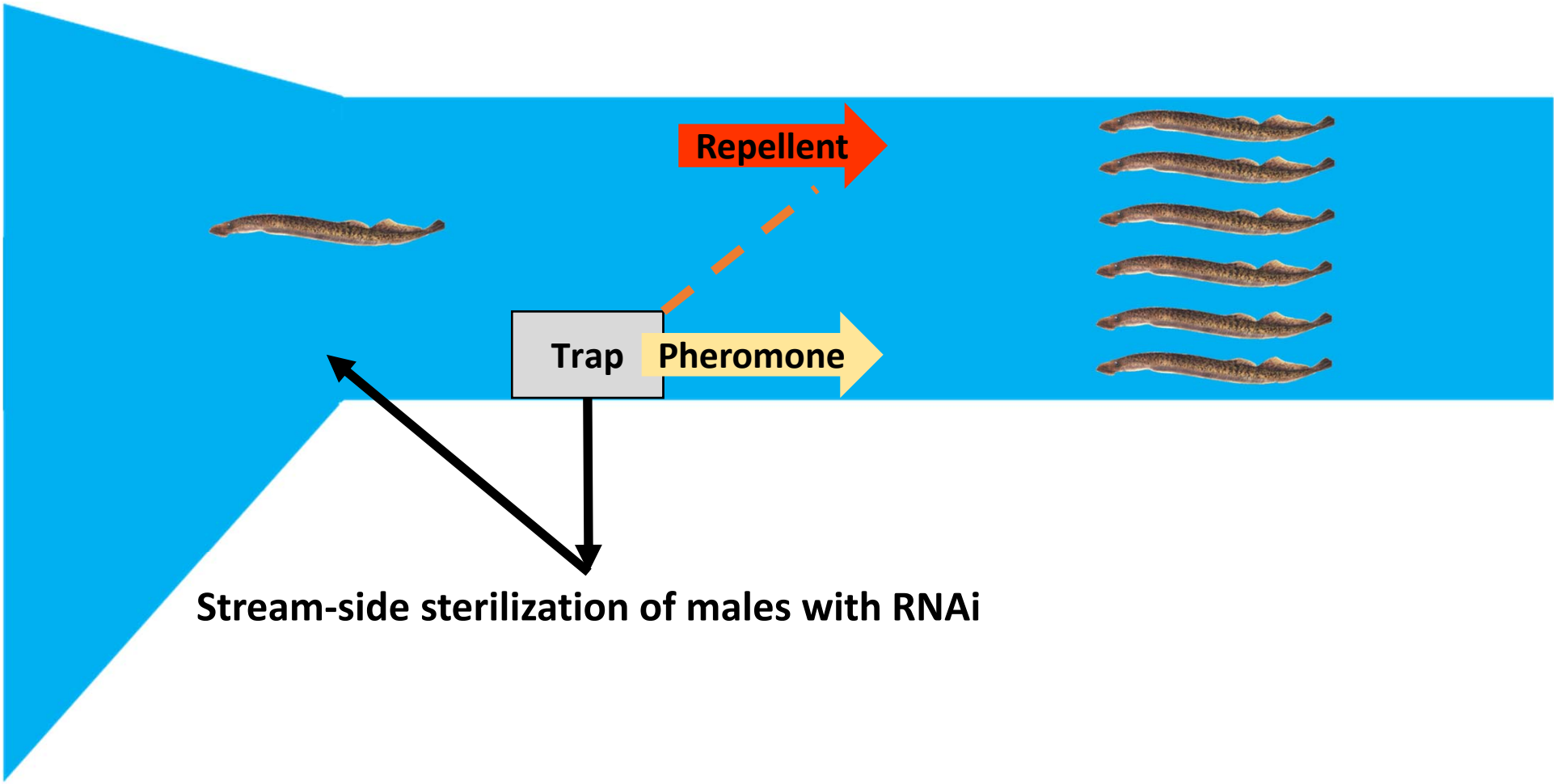


- Status: Discussion and fundamental research
  - Consideration of biological, economical, and social aspects
  - Use genome and transcriptome to identify exploitable genes

- Possible control tools
  - Gene silencing: prevent expression of a targeted gene
    - lampricides, prevent metamorphosis, sterilization
  - Gene drive: Bias inheritance of a particular gene
    - Daughterless populations



# Integrate and optimize



# Conclusion

- Development/discussion phase
- Current alternatives
  - Small populations
  - Reduce reliance on lampricides
- Still need alternatives for large systems

# Acknowledgments


Fisheries and Oceans Canada

University of Manitoba

The University of Oklahoma

USGS

Michigan State University

Eastern Michigan University

Great Lakes Fishery Commission

U.S. Fish & Wildlife Service

University of Michigan-Flint

Wilfrid Laurier University