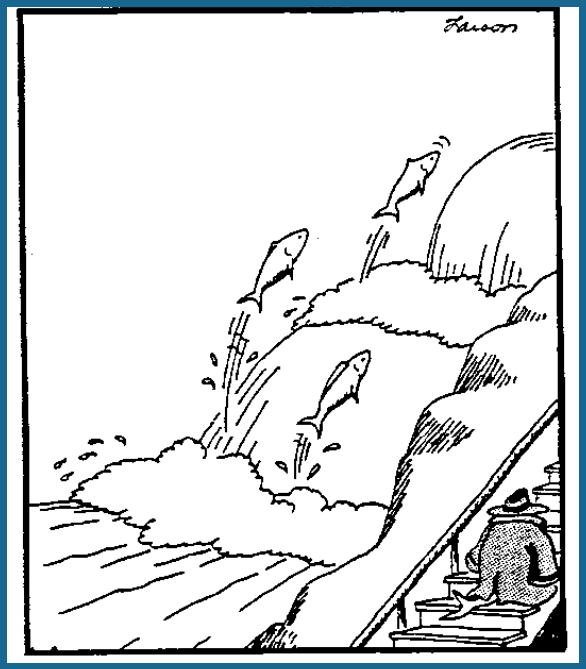
# Where are my fish going? Only GLATOS knows

Gary Whelan
Fisheries Division
Christopher Vandergoot
Michigan State University/Great Lakes Fishery Commission
NRC Meeting
October 2022

# Presentation Outline

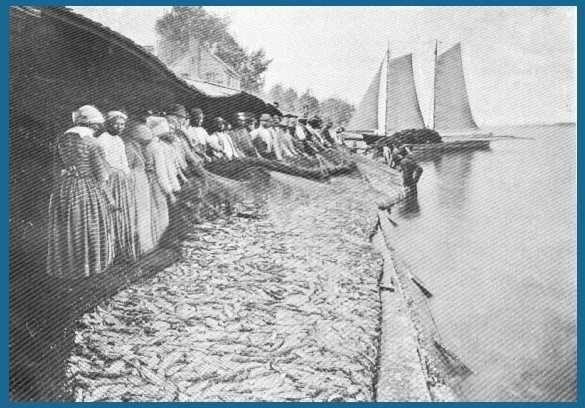
- Why care about movement
- Who and what is GLATOS
- DNR GLATOS projects



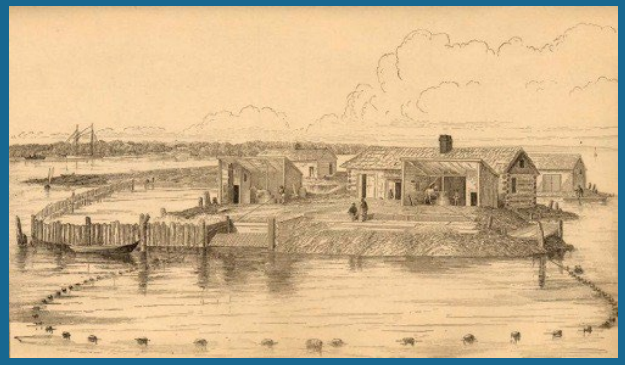
# Historically, our waterways were superhighways at rush hour for fish

**"Our rivers were seas of silver, black, green and brown" – Running Silver – Waldman (2013)**

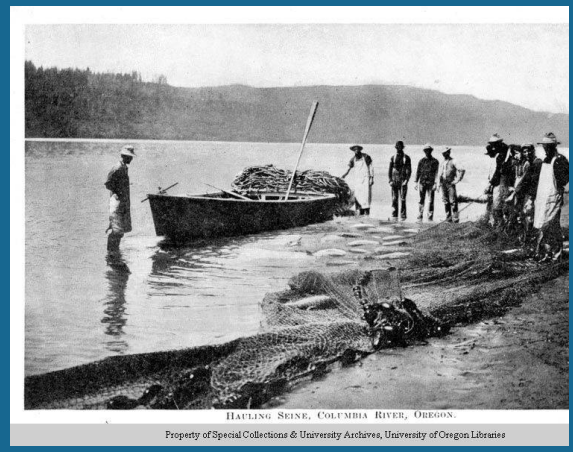
**EAST**




**MIDWEST**



**WEST**

# Historic Paradigm to the 1990s



## THE RESTRICTED MOVEMENT OF FISH POPULATIONS

By SHELBY D. GERKING

*Department of Zoology, Indiana University, Bloomington, Indiana, U.S.A.*

(*Received* 11 *April* 1958)

CONTENTS



### I. INTRODUCTION

This article* brings together a body of information which attempts to explain why individual fish of many species tend to stay in a specific area for a considerable period of time. It grew out of some extensive observations on two stream populations in Indiana from which it was concluded that several species spend a great part of their lifetime in a restricted area (Gerking 1950, 1953). A quarter-mile stretch of a bedrock stream was divided into four sections, and the fish in each section were given a distinctive mark by clipping off one or more fins. The marking procedure was carried out for four years. Movement of the marked individuals was traced by the location of recaptures taken in summer surveys of the area. On the average about 80% of the fish stayed in the same pool from one year to the next, and some were found in the same place for four consecutive years. Some species ranged more widely than others, but their movements were well within the experimental area. Similar work on a sand and gravel stream for one summer produced essentially the same results.

The concepts of home range and territory were used to describe the behaviour, since neither of the populations travelled freely up and down the stream. Both ideas were supported by earlier observations on other fish populations and by laboratory studies. Recent work strengthens this interpretation as well. The evidence for restricted movement by stream, lake, and ocean fishes is reviewed in the first part of the article. The question naturally arises as to why the fish have this habit, and the remainder of the discussion presents certain features of behaviour from this point of view.

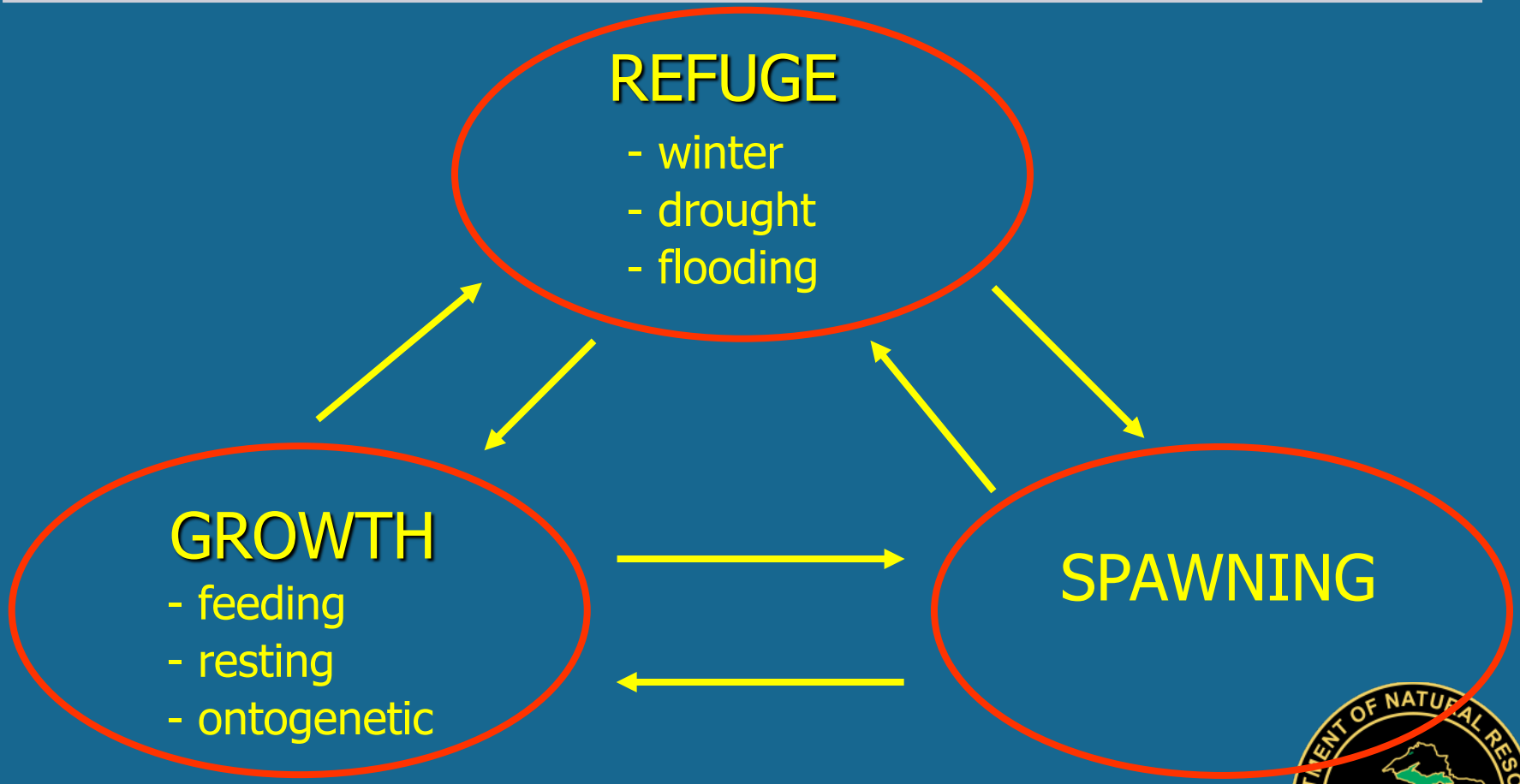
Restricted movement cannot be interpreted on the basis of reproductive behaviour, since many species occupy limited areas throughout the year. There is

* Contribution no. 650 from the Department of Zoology, Indiana University, Bloomington, Indiana, based on a paper given at a 'Symposium on evaluation of fish populations in warm-water streams', held on 25 March 1957 at Iowa State College, Ames, Iowa.

# Movement Scales

- Individual Fish
- Populations and Communities
- Watersheds and Ecosystems

# Individual Fish Scale – Movement is Essential to Complete Life Histories and to Maximize Production




From Schlosser 1991

# Fish Population Scale - Move to avoid catastrophes

- Range of potential issues
  - Physical
    - Landslides
    - Volcanic eruptions
    - Floods and droughts
    - Climate change
    - Human activity
  - Ecosystem changes
    - Food web changes from invasive species
- Refugia
  - Thermal
  - Hydrodynamic (Extreme currents)
  - Life stages
    - Spawning and early rearing
- Nearly every fish species has multiple life history strategies
  - 53 species from the Great Lakes (McIntyre)

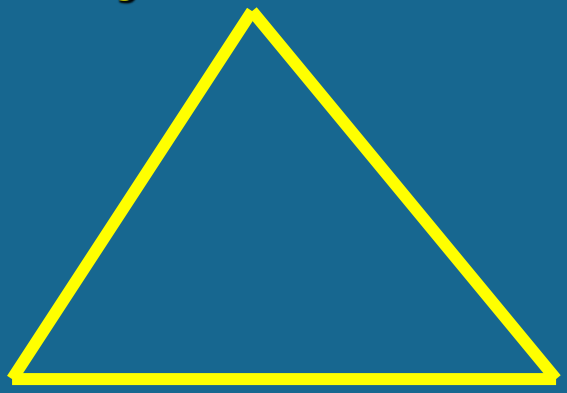
# Fish Population Scale – Movement is Essential to "Recruitment Refugia Strategy" – Bet Hedging

- Many species that live in large systems reproduce in multiple habitats
  - For example – Great Lakes Lake Whitefish and Smallmouth Bass spawn in the Great Lakes and in tributaries
- Many species that use large systems for growth leave precocious (early maturing – non-migratory) individuals in stream systems
  - Examples – Rainbow trout and steelhead, Great Lakes Burbot
  - Multiple life histories expressed

# Fish Community Scale - Movement is Essential to Maintaining Life History and Guild Strategies

Periodic - late maturing

Long Distance Movers



Opportunistic – colonizing

Either

Equilibrium – "nesting"

Short Distance Movers

Continuum Axes of fecundity, juvenile survivorship and age of first maturity

From Winemiller and Rose (1992)

# Ecosystems rely on movement for energy and nutrient transfer by fish from large to smaller subsystems

- West Coast
  - All parts of ocean assessable watersheds are reliant on oceanic subsidies from Pacific salmon (Cederholm et al. 1999, Gende et al. 2002, Naiman et al. 2002, Schlinder et al. 2003, Twining et al. 2017)
- East Coast
  - Large marine subsidies seen from Atlantic Salmon in Norway (Jonssen and Jonssen 2003)
  - Alewife subsidies in Northeast streams (Durbin 1979)
- Great Lakes and Midwest
  - Longnose and White Suckers providing Great Lakes subsidies in inland streams (Jones and Mackereth 2016, Childress and McIntyre 2015,2016)
  - Gizzard Shad move energy from benthos to pelagic zones in Acton Lake, OH (Nobre et al. 2019)
- Coral Reefs
  - Movement of fish between pelagic zones and coral reefs moves key nutrients to coral reefs (Francis and Cote 2018)

# GLATOS

## Great Lakes Acoustic Telemetry Observation System

Christopher S. Vandergoot
Michigan State University/ Great Lakes Fishery Commission
October 2022

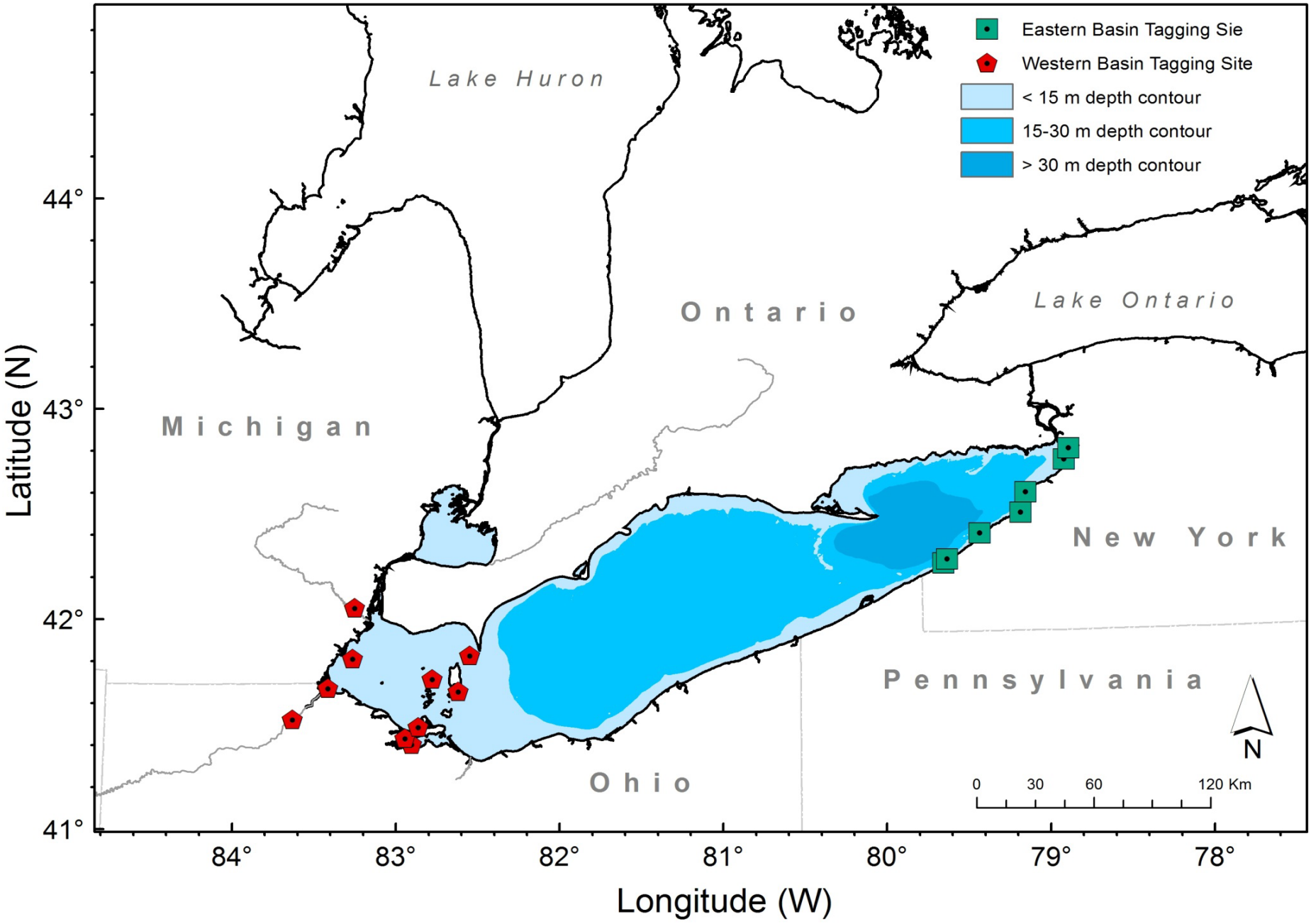
Lake Erie Walleye

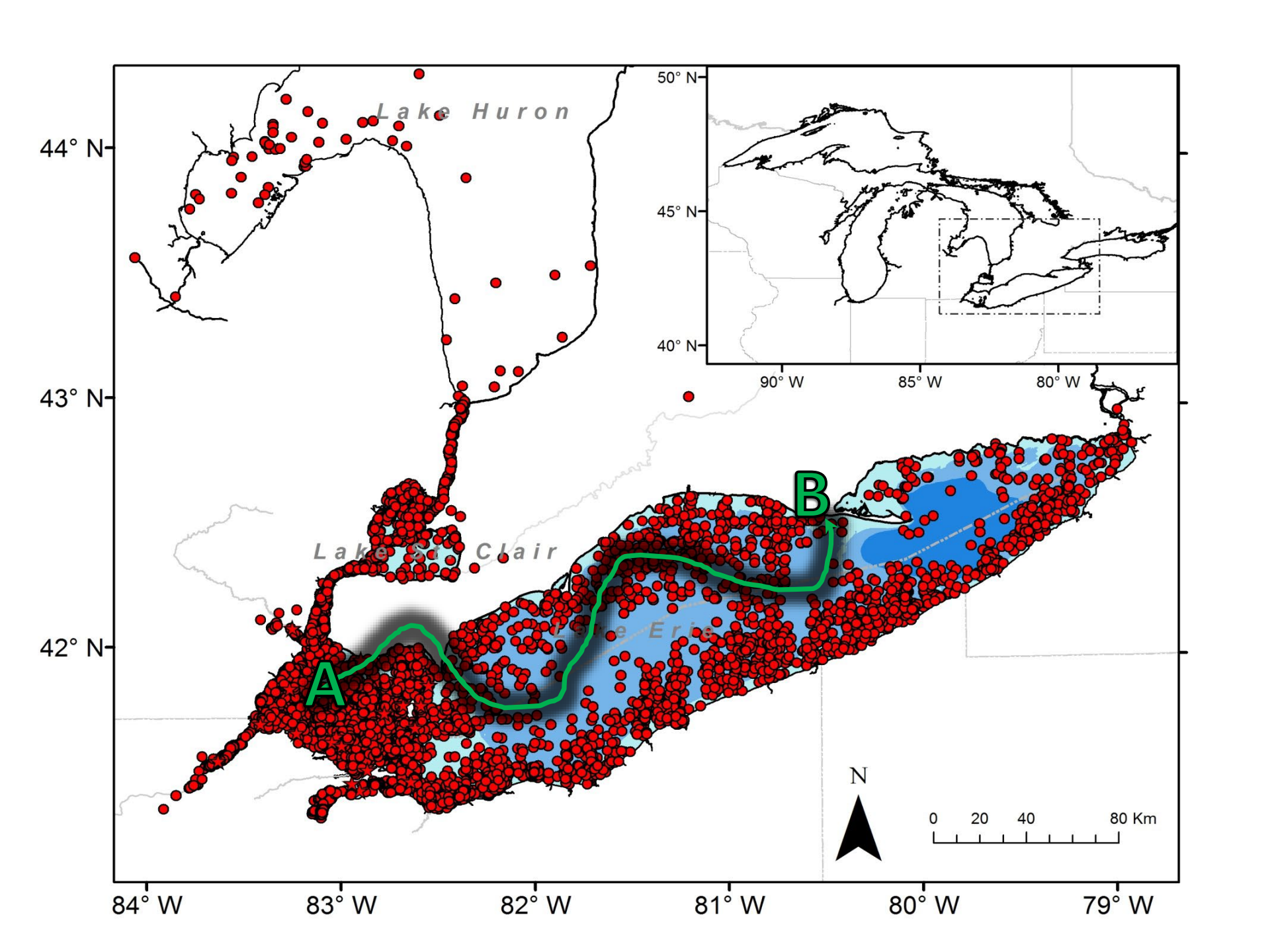
# Traditional Tagging

- Many fish can be tagged
- Only point to point information


Jaw-Tagged Walleye from Lake Erie

Sean Landsman


Eastern Basin Tagging Sie
Western Basin Tagging Site
< 15 m depth contour
15-30 m depth contour
> 30 m depth contour
Lake Huron
Ontario
Lake Ontario
Michigan
New York
Pennsylvania
Ohio
N
0 30 60 120 Km
44°
43°
42°
41°
84°
83°
82°
81°
80°
79°
78°
Latitude (N)
Longitude (W)


Lake Huron
Lake St. Clair
Lake Erie
A
B
44° N
43° N
42° N
84° W
83° W
82° W
81° W
80° W
79° W
50° N
45° N
40° N
90° W
85° W
80° W
N
0 20 40 80 Km

# GLATOS

- *initiated in 2010 w/ GLRI funding, 4 "demonstration" projects*
- *binational consortium of scientists who use telemetry to understand fish behavior & provide information to managers*
- *connects acoustic telemetry researchers & their projects*
  - *database & annual coordination meeting*
- *infrastructure, study design and data analysis assistance*


Great Lakes Fishery Commission
PROTECTING OUR FISHERY

USGS
science for a changing world

MICHIGAN STATE UNIVERSITY

Great Lakes RESTORATION

OCEAN TRACKING NETWORK

great lakes observing system

REAL-TIME · AQUATIC · ECOSYSTEM · OBSERVATION · NETWORK
RAEON

# Vision and Mission

GLATOS
Great Lakes Acoustic Telemetry Observation System

*Vision*: To unravel the mysteries of Great Lakes fish.

*Mission*: To facilitate and conduct acoustic telemetry research in support of fishery science and management in the Great Lakes Basin.

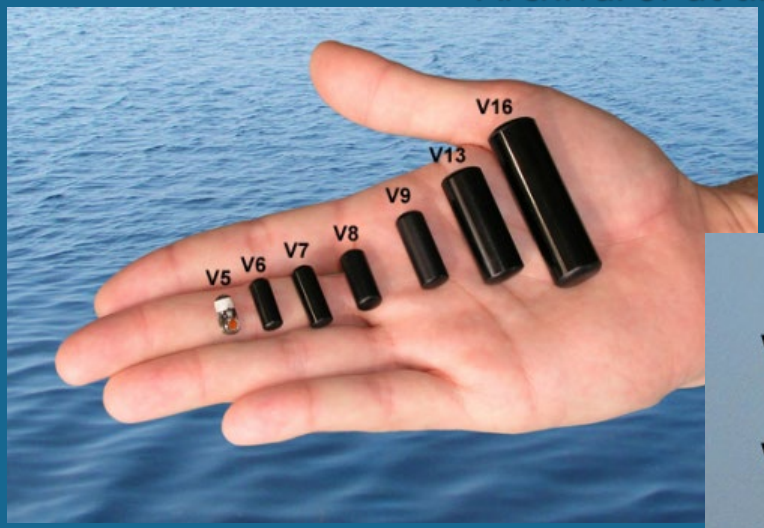
*Provide managers w/ information traditional fishery assessment gears were unable to provide (e.g., broad & fine-scale habitat use)*

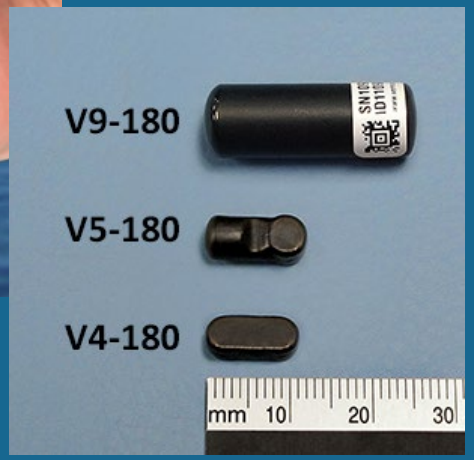
DEPARTMENT OF NATURAL RESOURCES
DNR
MICHIGAN
TM

A. Muir, GLFC

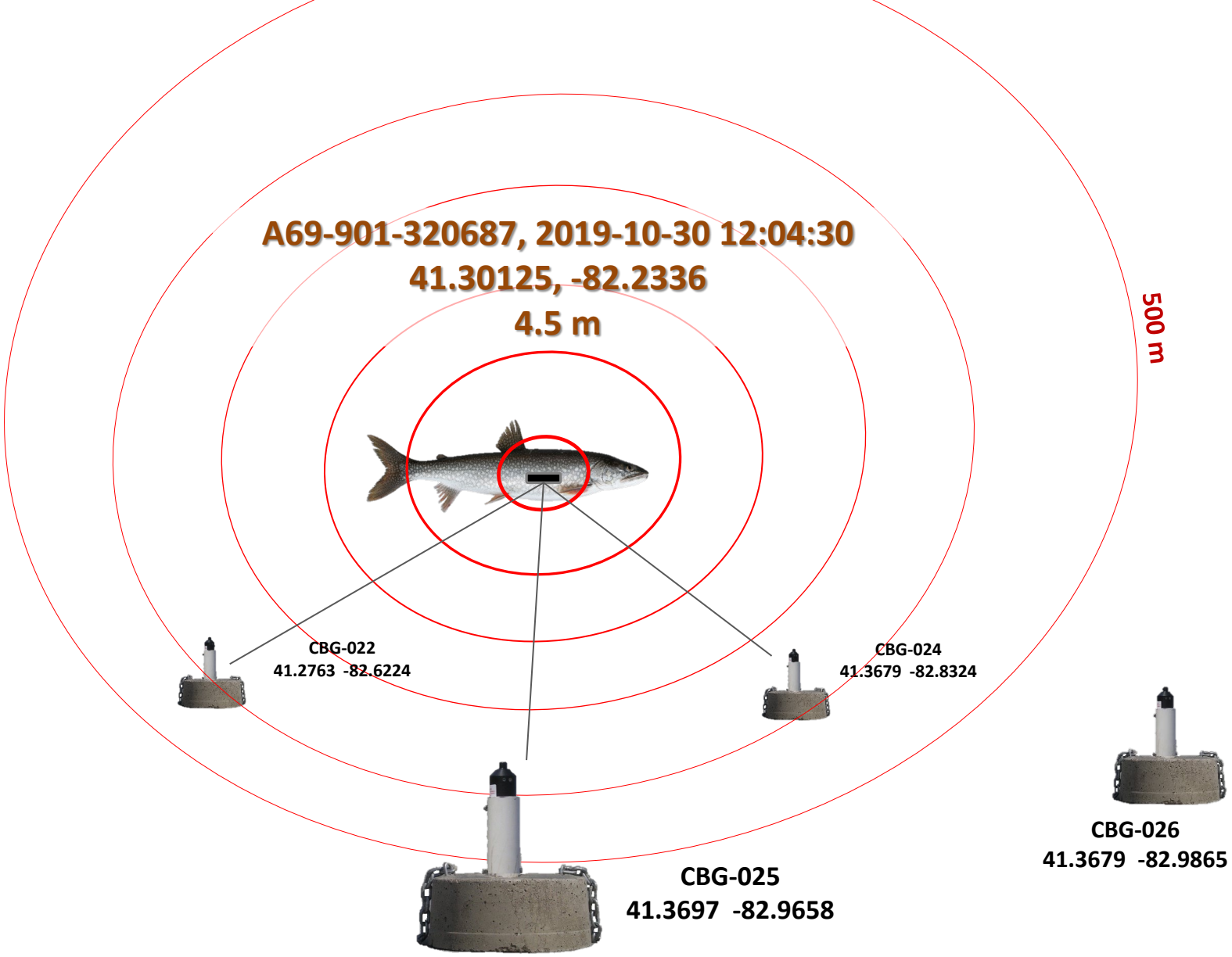
# How Does GLATOS Work?

- **Transmitters**
  - Location
  - Temperature
  - Depth (pressure)
  - Accelerometer
  - Predation
  - Archival or at time of transmission

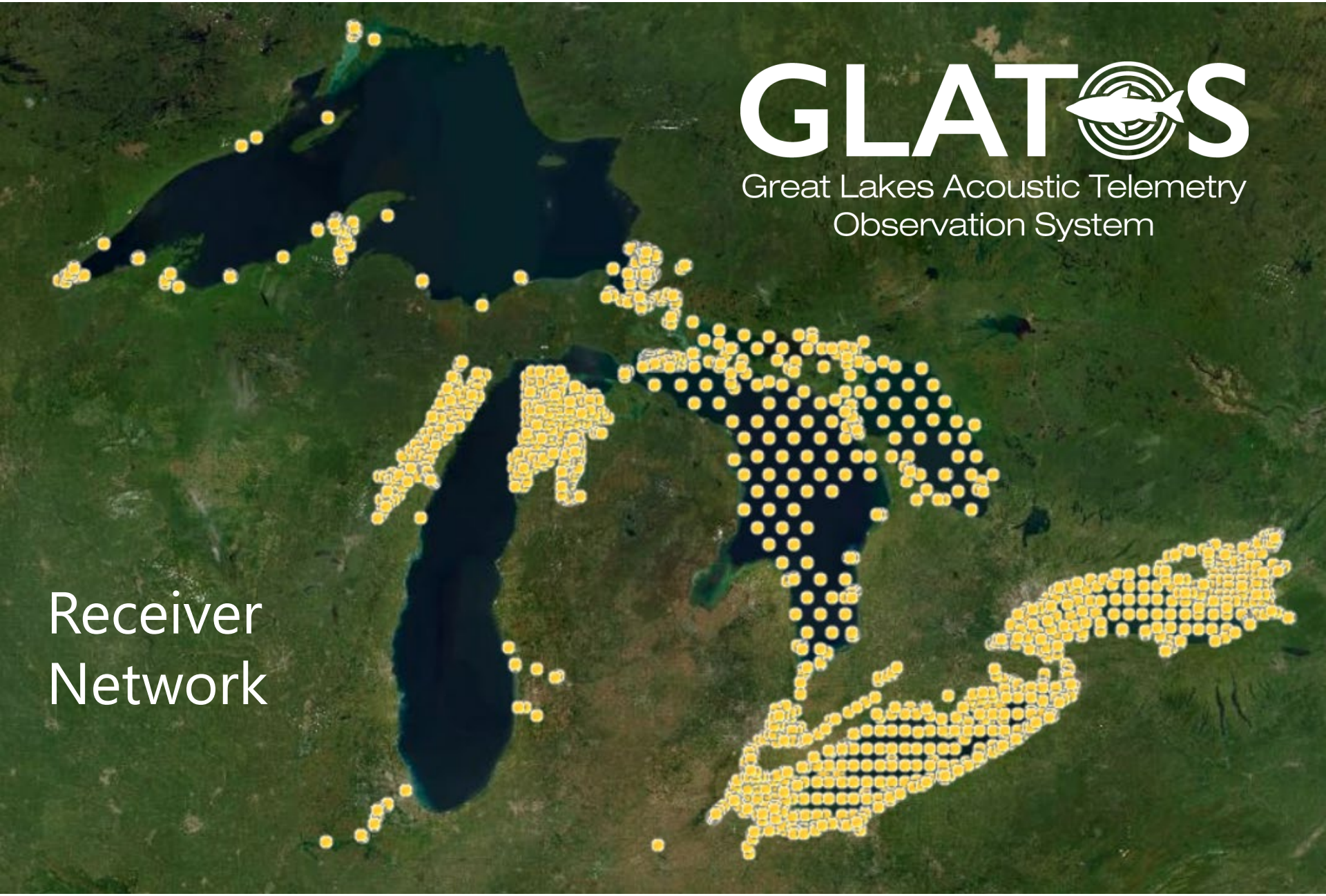


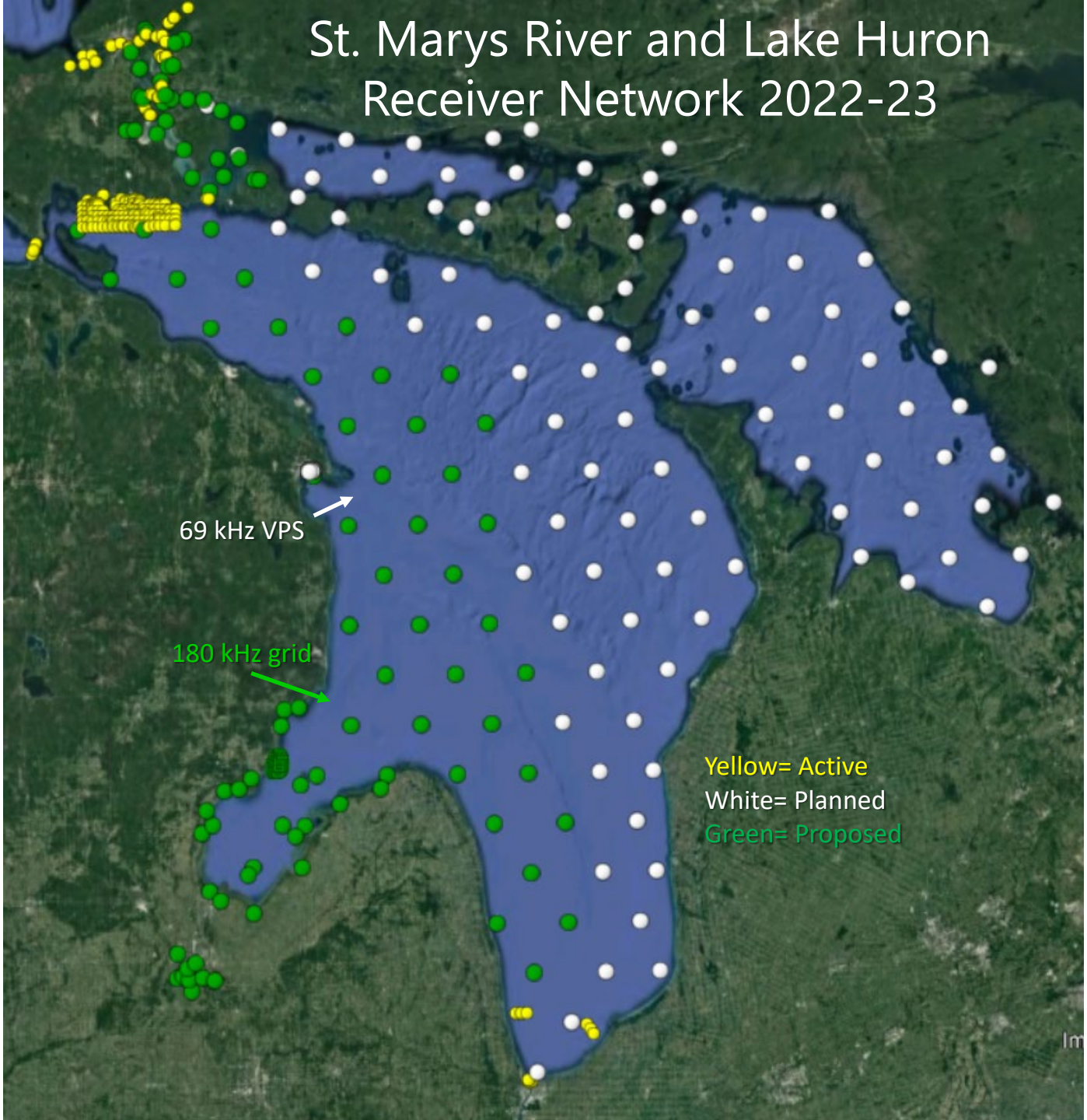



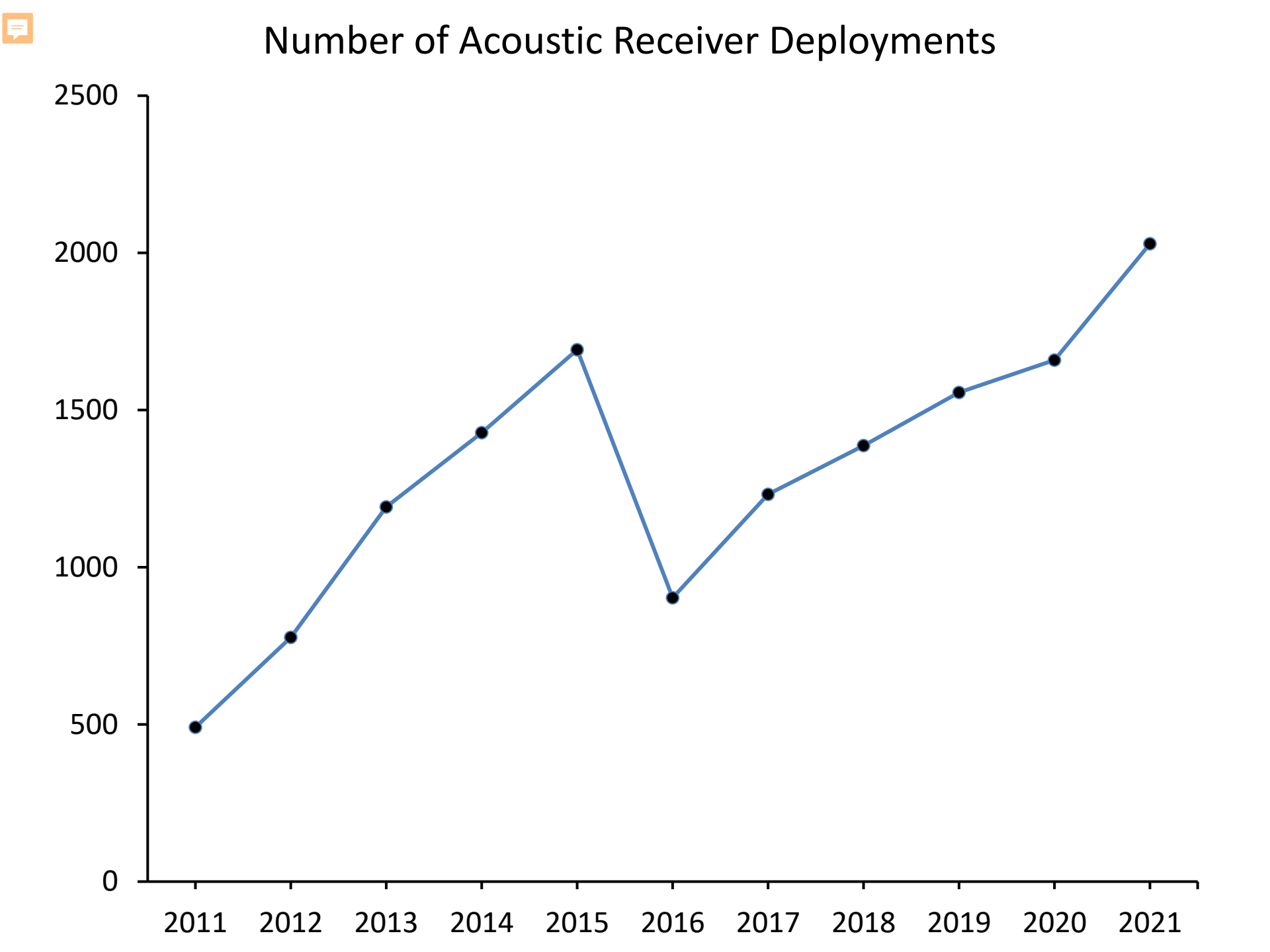

**Receivers**




# Fine-scale Positioning Tagged Fish

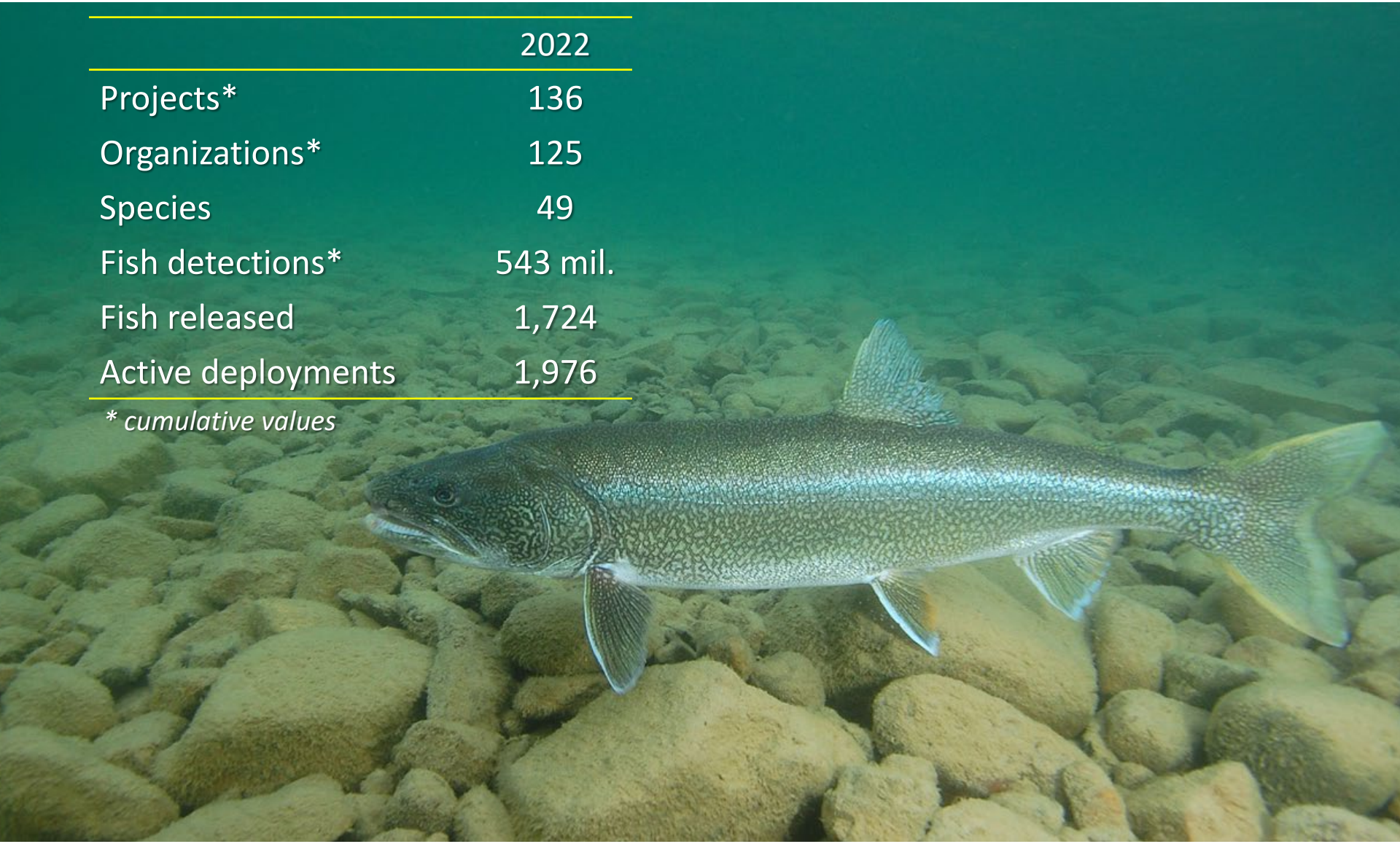

GLATOS
Great Lakes Acoustic Telemetry
Observation System
Receiver
Network


St. Marys River and Lake Huron
Receiver Network 2022-23
69 kHz VPS
180 kHz grid
Yellow= Active
White= Planned
Green= Proposed


Number of Acoustic Receiver Deployments
2500
2000
1500
1000
500
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

| | 2022 |
|---|---|
| Projects* | 136 |
| Organizations* | 125 |
| Species | 49 |
| Fish detections* | 543 mil. |
| Fish released | 1,724 |
| Active deployments | 1,976 |

** cumulative values*



# Individual Lake Erie Walleye Movements
# April 2016 to March 2017

# How are the Data Used?

- Population dynamics
  - Stock contribution
  - Survival estimation and predation
  - Testing assumptions of assessment models
  - Spawning site fidelity
- Behavior
  - Migratory patterns
  - Dam/barrier passage
  - Habitat use
  - Spawning behavior
  - Phenology
- Ecology
  - Species interactions
  - Environmental interactions
  - Invasive Species Ecology and Effects

# Fisheries Division GLATOS Studies

Transmitter Deployment

# Fisheries Division GLATOS Studies

- Total Number = 23 with FD leading on 9
  - A range of funding sources
  - Most are cooperative projects
- Total Species = 12
- Species

| | | |
|---|---|---|
| Brook Trout | Lake Whitefish | Smallmouth Bass |
| Cisco | Mooneye | Steelhead |
| Lake Sturgeon | Muskellunge | Walleye |
| Lake Trout | Round Goby | Yellow Perch |

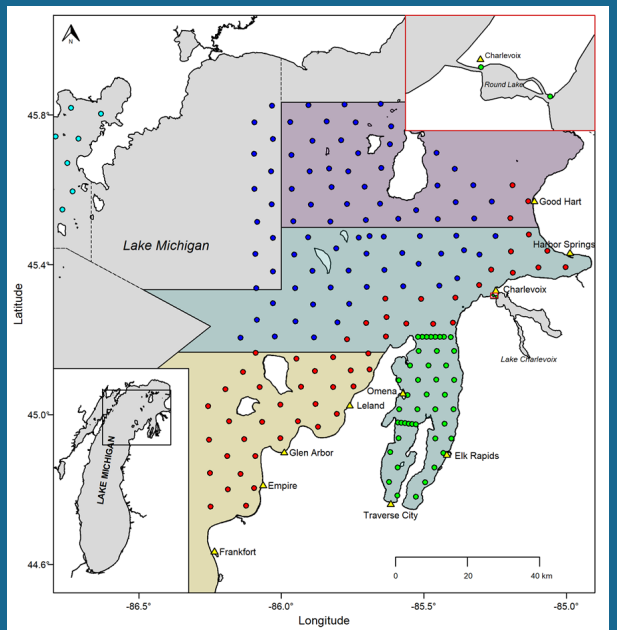
# Lake Trout at Isle Royale (MFRS)

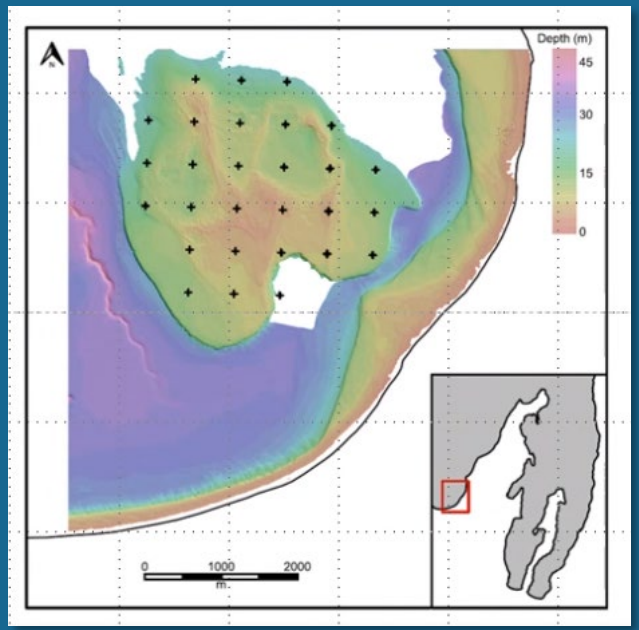
- Tagged siscowet Lake Trout around Isle Royale and placed receivers on suspected deep-water spawning habitat
- Documented use of and spawning on deep-water (300 +ft) spawning habitat
- Spawning took place in both spring and fall

# Stock structure and interactions of Lake Whitefish in Grand Traverse Bay and adjacent areas of Lake Michigan (CFRS)

## Objectives

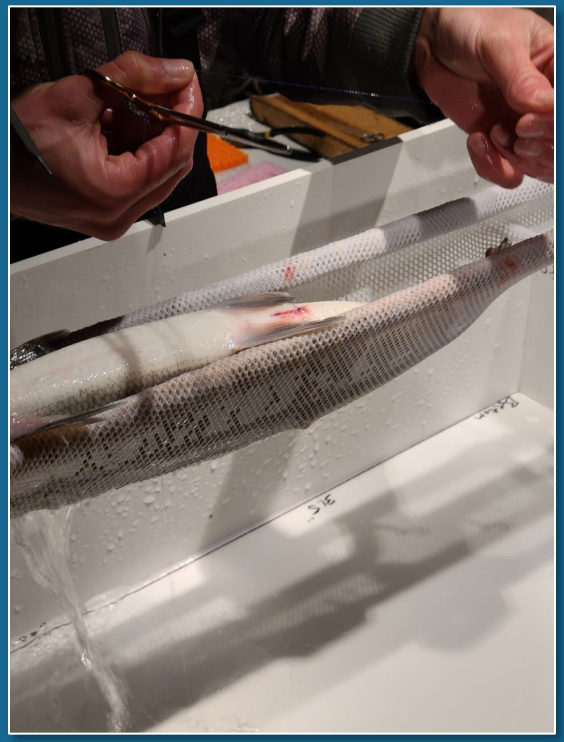
- Geographic boundaries and spatial overlap of Lake Whitefish stocks in WFMs -04, -05, & -06
- Depth-habitat use, spawning site fidelity varies among stocks
- Genetic signatures among stocks

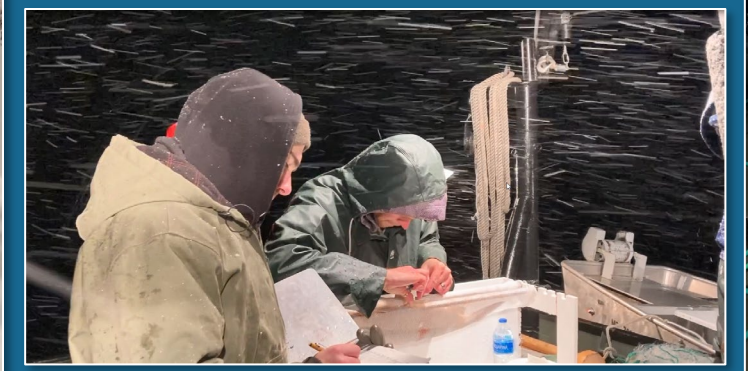


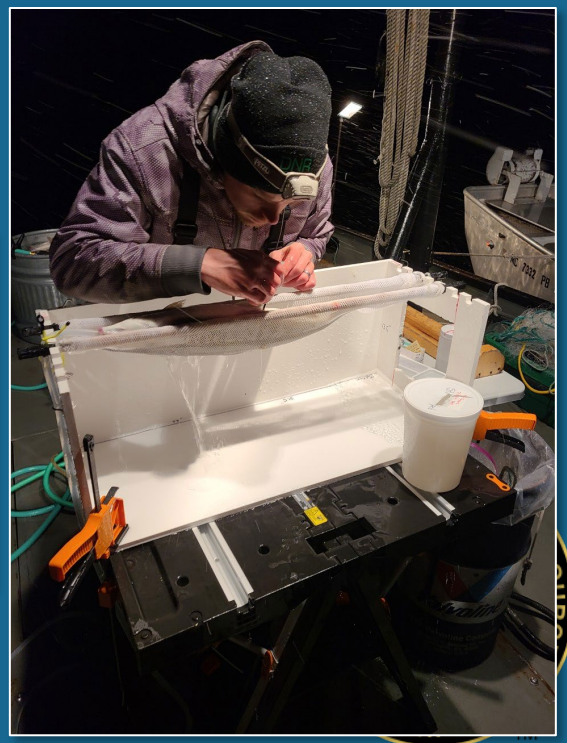



# Lake Whitefish Tagging
# December 2021

| Sex | Mean Length (mm) | # Tagged |
|---|---|---|
| M | 572.2 | 29 |
| F | 590.7 | 3 |
| U | 590.3 | 6 |



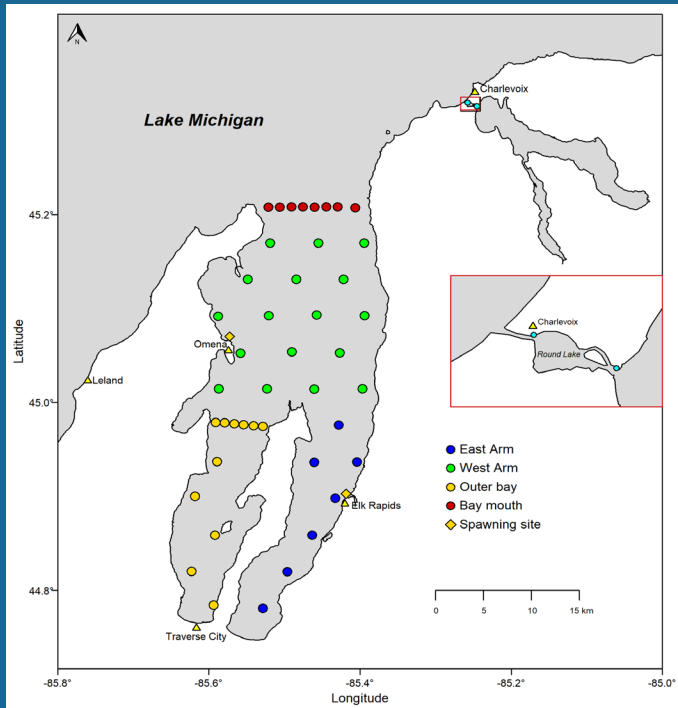




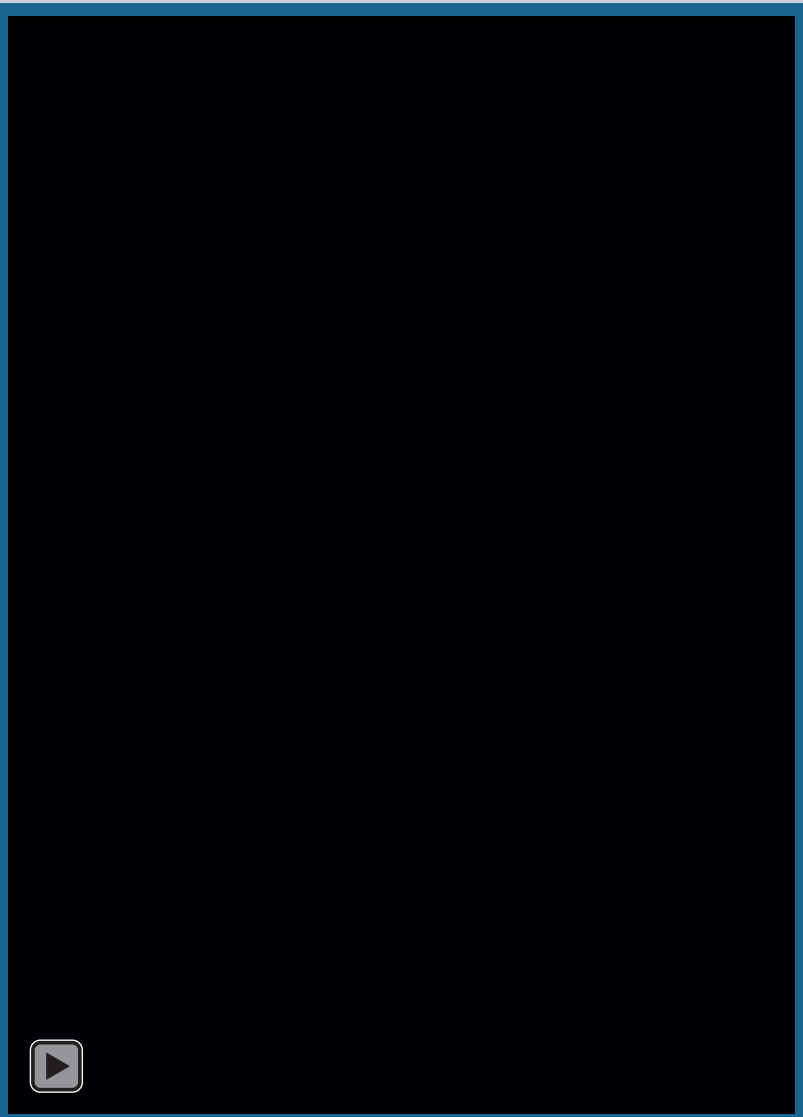
# Cisco movement ecology in Grand Traverse Bay, Lake Michigan (CFRS)

- **Objectives**
  - Determine if within-bay movements vary seasonally and/or capture site (east bay vs. west bay)
  - Determine whether bathythermal (depth-temperature) habitat use varies by season
- Ongoing (2019 –2022)

*112 Cisco tagged since 2019



# Example Movement Data from Grand Traverse Bay



# Lake Trout Use of Artificial Reefs, Thunder Bay, Lake Huron (AFRS)


- J. Ellen Marsden,  University of Vermont
- Tom Binder, USGS-HBBS and MSU
- Ji He, MDNR, Fisheries


40 lbs.+ Lake Trout – Thunder Bay MI


Funded by the
GREAT LAKES FISHERY COMMISSION
2021-2023

# Project Objectives

1. Is the proportion of tagged fish that visit the artificial reefs in Thunder Bay each year increasing since 2014.

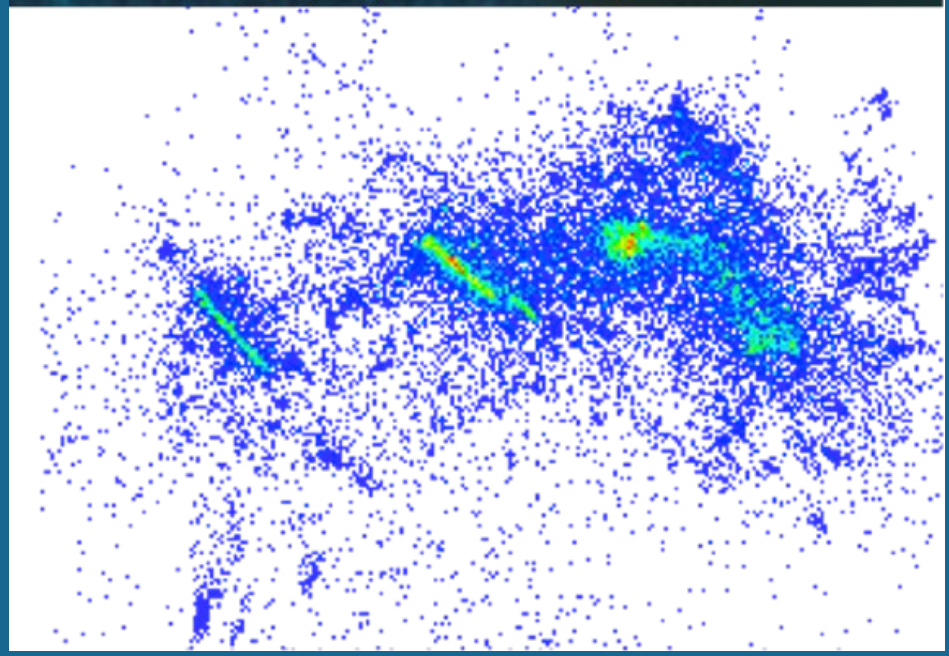
2. Has the distribution of spawning habitat use between Thunder Bay artificial reefs and East Reef changed after 2014 when compared to 2012-14
   a) Has the relative use of the artificial reefs has increased.

1. Are younger (i.e., smaller) fish are more likely than older (i.e., larger) fish to be using the Thunder Bay artificial reefs than East Reef for spawning.

# Initial Results

- Top: acoustic receiver array deployed in Thunder Bay, Lake Huron, from Sept 16 to Nov. 16, 2021. Gray polygons denote two natural spawning reefs impacted by cement kiln dust and silt; East Reef is an unimpacted natural reef. The CEM and CKD lines (12 reefs each) and Lafarge Reef were constructed of natural materials in 2010-2011

- Bottom: heat map of the number of tagged lake trout that visited the reefs during a 16- to 18-day period between tagging and receiver retrieval.

# Muskellunge Movement in the Lake St. Clair/Erie Area (LSCFRS)

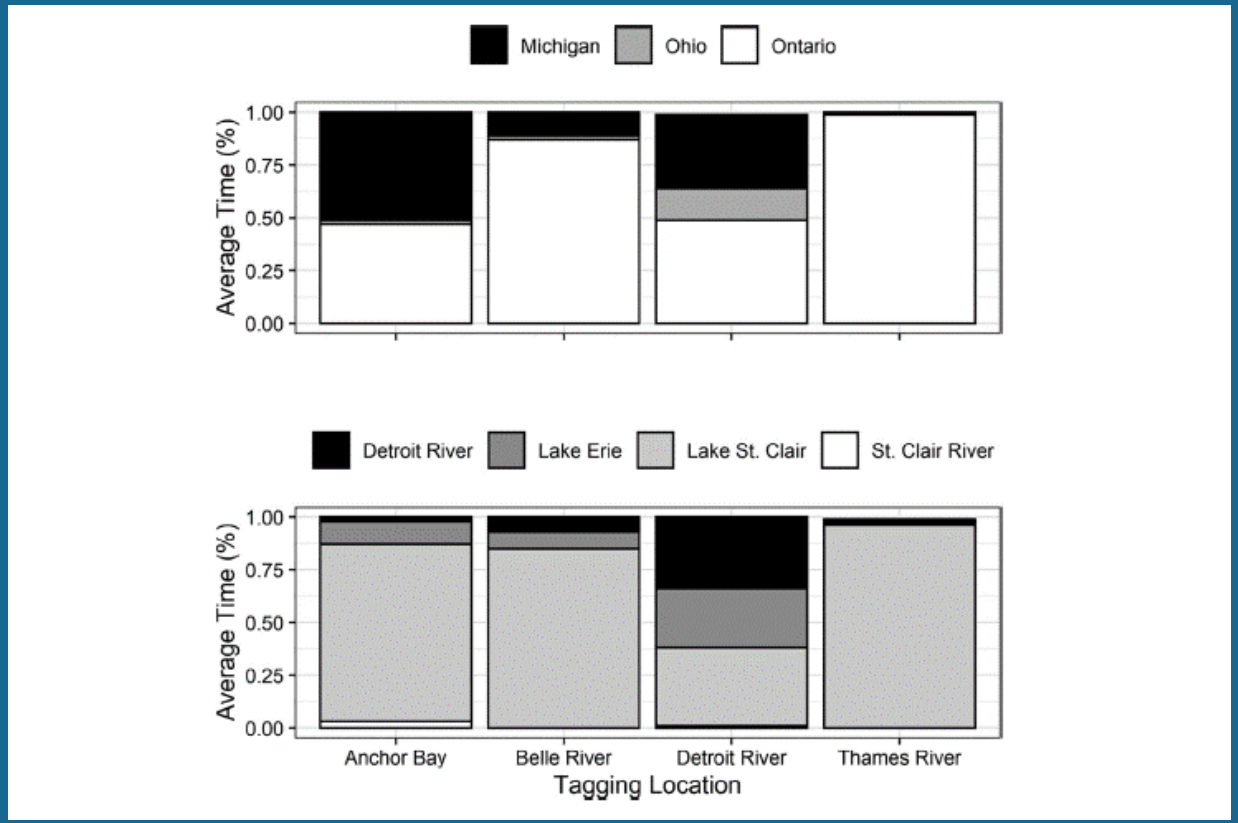
- Collaborative project with USGS, Ontario MNRF, Ohio DNR
- Objectives
  - Document spatial ecology
  - Generate a population estimate
  - Do multiple groups of fish exist in system
- 169 animals tagged to date
- Tagging from 2016-2021
  - No further tagging planned at this time
  - Seven-year battery life
- Approaching 2 million individual data points

# Initial Lake St. Clair Muskellunge Results

## Tagging location shown by color

# Initial Lake St. Clair Muskellunge Study Results

- Patterns emerging about different groups in the system.
- Belle River (ON) and Thames River (ON) have different spatial patterns despite being geographically close.



# Smallmouth Bass Movements in Lake St. Clair/Erie (LSCFRS)

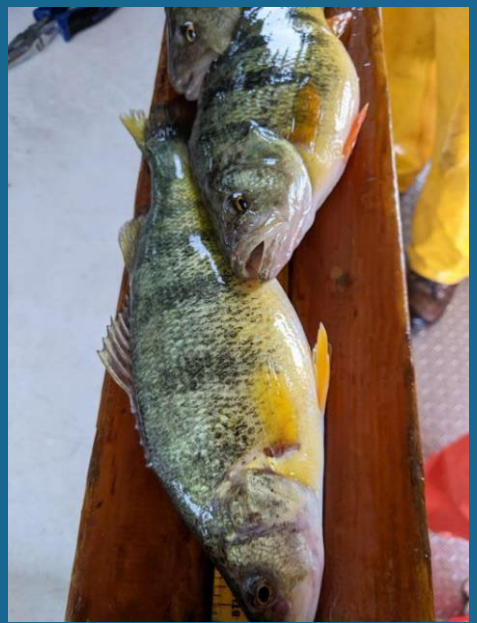
- Pilot Study 46 fish tagged in 2021 (27 in Anchor Bay, and 19 along “Mile Roads”)
- Objectives
  - Compare acoustically tagged fish data with “traditional” jaw tag data
  - Generate population estimates
  - Evaluate behavior before/after capture by anglers
- Working to obtain funds to tag 200 fish

# Initial Smallmouth Bass Study Results

- 1st year worth of movement data processing and analysis underway
- 10 fish captured by anglers and reported to date (22% of tagged fish!)

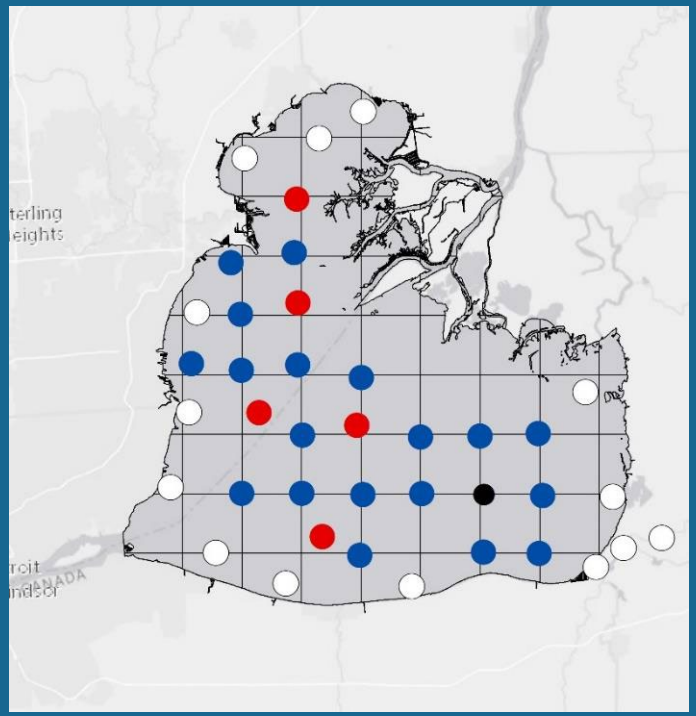
# Yellow Perch Movements in Lake St. Clair/Erie (LSCFRS)

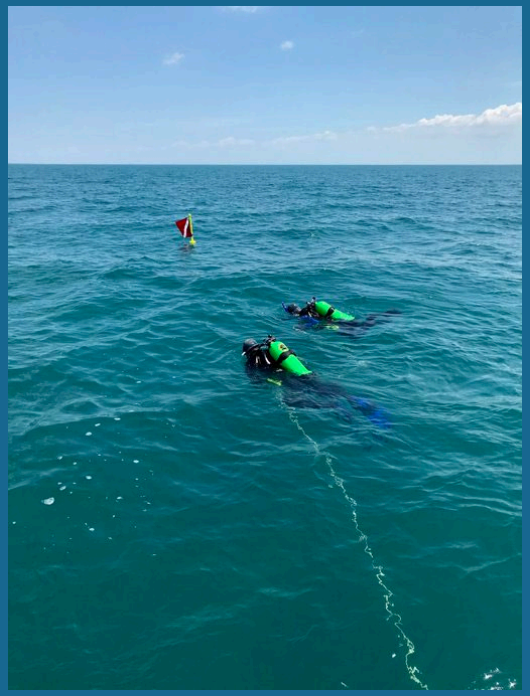
- Pilot study with 53 fish tagged in 2022.
- Objective - understand perch movement through Lake St. Clair




# Acoustic Receiver Grid for New Lake St. Clair studies

- Equipment loan from GLATOS
- Blue Receivers on figure are new improving coverage on LSC






Gary E. Whelan

Michigan DNR

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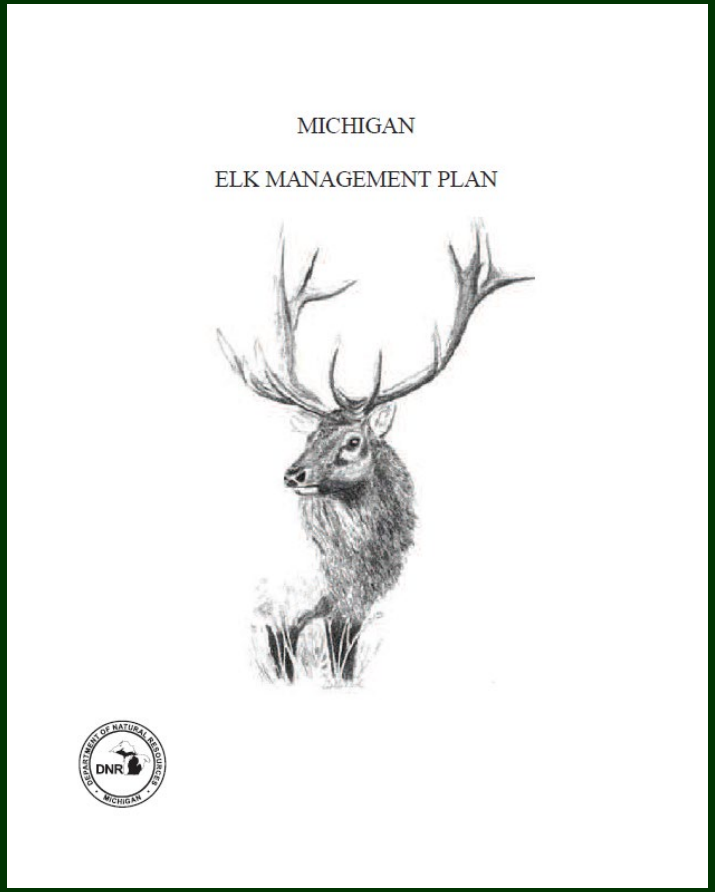
517-242-2764

# 2023 Elk Management Plan Revision

Chad Stewart
Deer, Elk, and Moose Management Specialist
Wildlife Division
Michigan Department of Natural Resources

# Current Elk Management Plan

- Finalized in 2012
- Three main Goals
  - Manage for a sustainable elk population in balance with habitat
  - Use hunting as the primary method to control elk
  - Enhance public understanding of elk management



# Population Goal and Current Estimate

- Goal of 500-900 animals in current range
- 2022 Elk survey estimates:
  - 1,277 estimated animals (95% CI: 870-1,684)

# Evaluating the Past 10 years

- 1,721 elk taken (2012-2021)

# Evaluating the Past 10 years

- Communicating about elk
  - Elk University
  - Elk license plate
  - 100 years of elk celebration

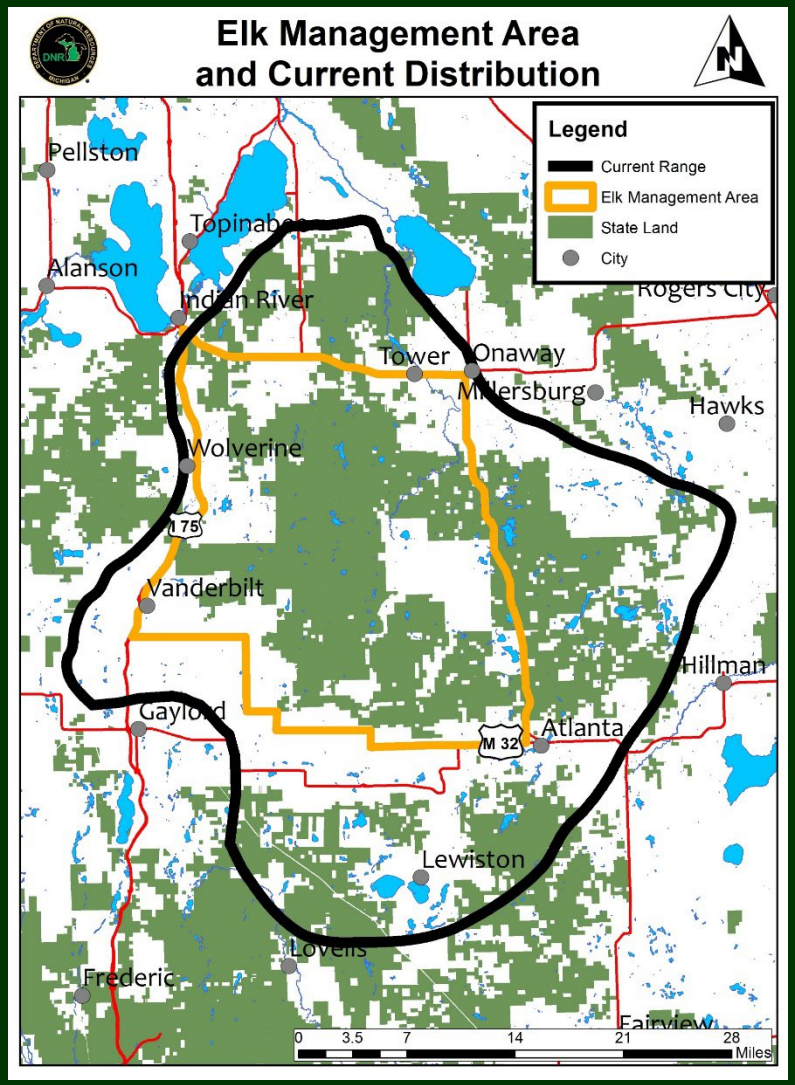

# Elk Management Plan Revision Process

- Separate tribal discussions
- Public scoping session in April
  - Opportunity to submit feedback in-person or electronically
- Development of Elk Management Advisory Team
- Public comment period
  - In-person session in Gaylord; electronic feedback through November 11

# Elk Management Advisory Team (EMAT)

- Bay Mills Indian Community
- Little Traverse Band of Odawa Indians
- Sault Ste. Marie Tribe of Chippewa Indians
- Little River Band of Ottawa Indians
- Grant Traverse Band of Ottawa and Chippewa Indians
- Huron Pines
- Canada Creek Ranch
- Rocky Mountain Elk Foundation
- Michigan United Conservation Clubs
- Michigan Farm Bureau
- Michigan State University
- Montmorency Conservation Club
- Safari Club International
- Backcountry Hunters and Anglers
- Pigeon River Advisory Council
- Jay's Sporting Goods
- Elk Guides
- Farmers
- Michigan Department of Agriculture and Rural Development
- Michigan Department of Natural Resources
  - Wildlife
  - Law Enforcement
  - Forestry
  - Parks

# Important Updates to the 2023 Plan




- Maintain a desired goal of 500-900 animals within the current elk range
  - Majority of EMAT supports
  - Tribes want to see more elk, broader range
- Department doesn't support expansion
  - Can re-evaluate over time

# Important Updates to the 2023 Plan

- Addressing wandering elk on a case-by-case basis
  - Elk in high-risk areas for disease will have attempts made to be lethally removed
- Shift emphasis for openings management to native openings rather than food plots
- Increased engagement with federal tribes and agencies/stakeholders

# Important Updates to the 2023 Plan

- Continue to evaluate research needs to improve management
  - Engage tribal partners
- Continue to monitor elk for the presence of disease
- Enhance public viewing opportunities, including improving accessibility
- Pursue partnerships to improve social and economic benefits locally

# Final Steps

- Continue to collect input from the public
- Evaluate feedback and reengage with EMAT to determine if any changes need made
- Finalized through Director's approval in December

# Questions?

www.Michigan.gov/elk

# Wolf Management Plan 2022 Update

Cody Norton
Wildlife Division
November 10, 2022

# Inform Wolf Management Plan Update

- Conduct public-attitude survey
  - August to December 2021
    - 61,025 individuals
      - Residents (UP, NLP, SLP)
      - Deer hunters
      - Fur harvesters
      - Livestock producers

**Public-attitude survey**

Riley, S. J., M. Cross, and E. F. Pomeranz. 2022. An assessment of public beliefs and attitudes toward wolves and wolf management in Michigan, 2021. Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI, USA.

# Inform Wolf Management Plan Update

- Conduct scientific review
  - August 2021 to April 2022
    - Summarizes best available science
      - Published scientific literature
      - Agency and university reports
        - » MSU public attitude survey
      - Unpublished agency data
      - Personal communication with wolf experts

ESF
State University of New York
College of Environmental Science and Forestry

**Public-attitude survey**
**Scientific review**

Michigan Department of Natural Resources. 2022. Review of Social and Biological Science Relevant to Wolf Management in Michigan. Wildlife Division Report No. 3707. Michigan DNR, Lansing, Michigan, USA. 159 pp.

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# Current Wolf Management Plan

- Gather input on current Plan
  - Public comment period
    - January 2022
      - 5,475 questionnaire responses, 20 emails
      - Goals: acceptable to 44-54% of respondents
      - Strategies and Objectives: acceptable to 39-53% of respondents
        - » Summary located in Appendix

**Public-attitude survey**
**Scientific review**
**Input on current plan**

# Current Wolf Management Plan

- Gather input on current Plan
  - Wolf Management Advisory Council
    - August 2021 to July 2022
      - Met on 16 occasions
      - Produced 35 non-binding recommendations
        - » Recommendations and minority report located in Appendix

**Public-attitude survey**
**Scientific review**
**Input on current plan**

# Current Wolf Management Plan

- Gather input on current Plan
  - Tribal Consultation
    - October to November 2021
      - Meetings and written comments

**Public-attitude survey**
**Scientific review**
**Input on current plan**

# Updated Wolf Management Plan

- Write draft updated Plan
  - May to June 2022
    - Biological and social science
    - Input from public and Tribes

# Updated Wolf Management Plan

- Gather input on draft updated Plan
  - Public comment period
    - July to August 2022
      - 2,883 questionnaire responses, 9 emails
      - Goals: acceptable to 57-76% of respondents
      - Strategies and Objectives: acceptable to 57-81% of respondents
        - » Summary located in Appendix

# Updated Wolf Management Plan

- Gather input on draft updated Plan
  - Tribal Consultation
    - July to August 2022
      - Meetings and written comments

# Updated Wolf Management Plan

- Finalize updated Plan
  - August to October 2022
    - Input from public and Tribes
- Present to Director and NRC
  - For Info: November 2022
  - For Action: December 2022

# 2022 Wolf Plan Update

- Principle Goals
  - Maintain a viable wolf population
  - Facilitate wolf-related benefits
  - Minimize wolf-related conflicts
  - Conduct science based and socially responsible management
- Strategies & Objectives
  - No target abundance
    - Above legal requirements

# Examples of Updates

- Best-available science
  - Attitudes, predation, habitat, dispersal, harvest
- History
  - Legal status, abundance, depredation, protocol
- Action items
  - Partners, monitoring, enforcement, depredation, possession, public harvest
- Plan reviews and updates
  - 10-year interval

# Thank You