

Making a Great Lake Superior, October 29, 2007



# The Lake Superior GIS Project

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University of Michigan & Michigan DNR





# Topics

**Objectives and Project Description**

**Uses of the Great Lakes GIS**

*cartography, science inquiry, and decision support*

**Distribution, education, and outreach**

*Internet distribution and workshops*

**Future direction**

*distribution and long-term management*



# Objectives

- 1) Develop a seamless, standardized, habitat-based GIS database for Lake Superior; and
- 2) Facilitate sharing of data and holistic management of Great Lakes basin resources in accordance with the *Joint Strategic Plan for Management of Great Lakes Fisheries* (1981, revised in 1997)





# Structure

 Data

 Project Files

 Mini-Projects

 Support Documents

 User Guide.html



# Great Lakes GIS

Institute For Fisheries Research  
University of Michigan  
Michigan DNR

A Geographic Information System for Great Lakes Aquatic Habitat

- GLGIS Home
- LEGIS
- LMGIS
- LHGIS
- LOGIS
- LSGIS
- Classifications
- GIS Help
- Links
- Contacts



[What's New](#) - [Project Background](#) - [Using the GLGIS](#) - [GLGIS Project Structure](#) - [Partners](#)

How do I get data?

For information on GLINDA-disseminated Internet distribution, click [here](#).

- LEGIS
- LMGIS
- LHGIS
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# Lake Superior GIS



[Data](#) - [Project Files](#) - [Mini-Projects](#) - [Environmental Objectives](#)

How do I get data?

## Lake Superior Data


- [Lake Superior Data Inventory](#) [xls](#) (updated 01/2007)

## Lake Superior Project Files

- [base\\_political](#)  
Expected completion: 12/07



## Structure / Data

 **Data:** contains all data, spatial and tabular

 Base/political

 Biological


 Classifications

 Environmental

 Physical



# Structure / Data

 **Data:** contains all data, spatial and tabular

 **Base/political**

 Biological

 Classifications

 Environmental


 Physical



Statistical districts (IFR)



# Structure / Data

 **Data:** contains all data, spatial and tabular

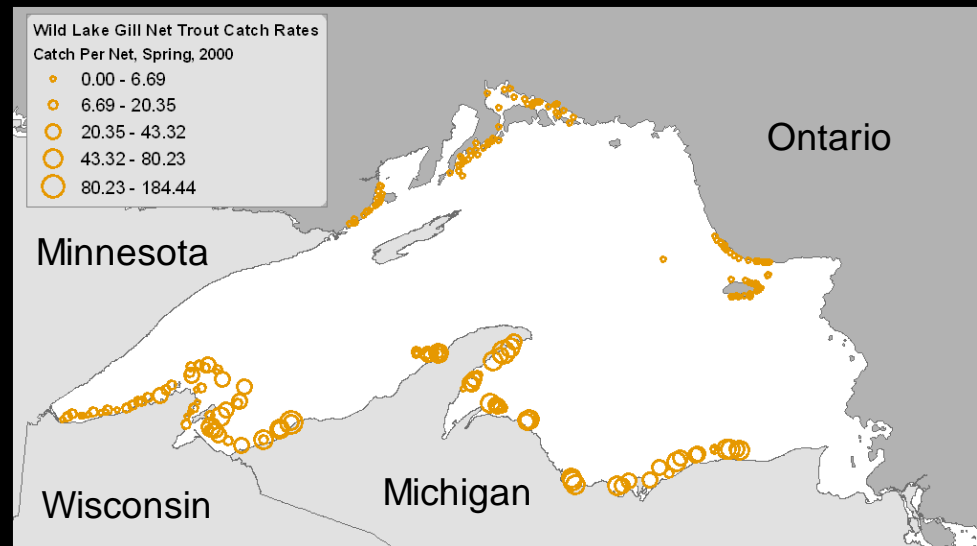
 Base/political

 **Biological**

 Classifications

 Environmental


 Physical



Lake trout gill net catch rates (multi-agency)



# Structure / Data

 **Data:** contains all data, spatial and tabular

 Base/political

 Biological

 **Classifications**

 Environmental


 Physical



Fish habitat classification (IFR)



# Structure / Data

 **Data:** contains all data, spatial and tabular

 Base/political

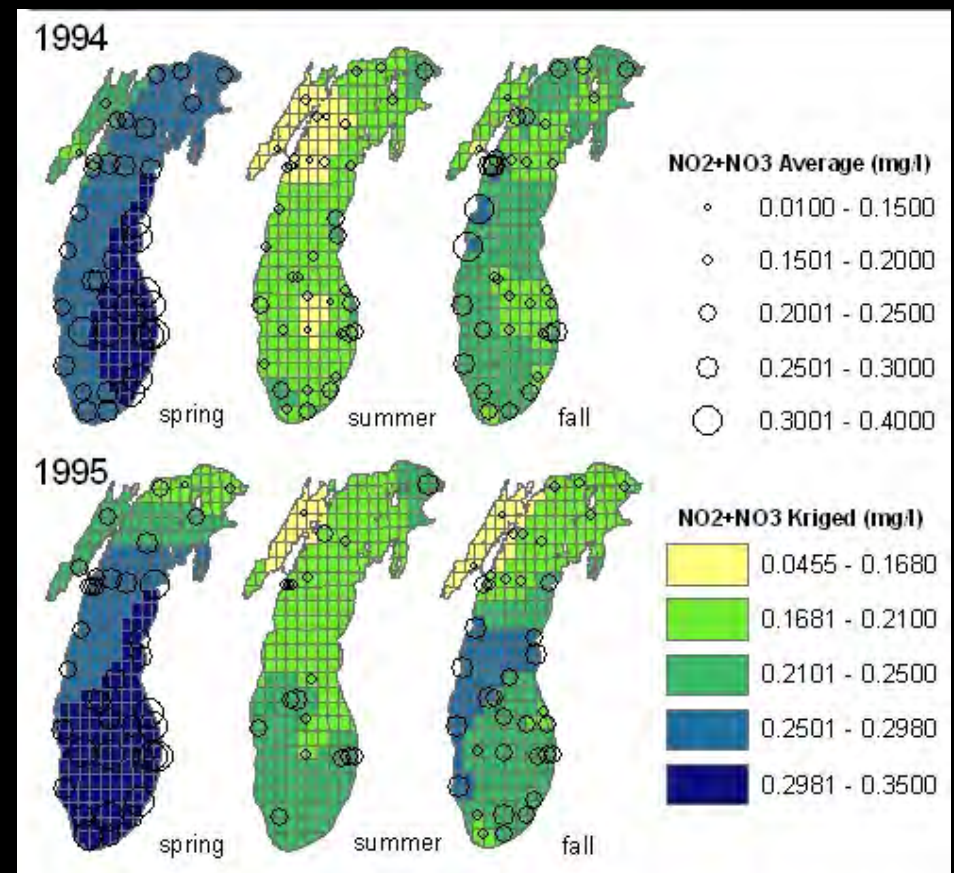
 Biological

 Classifications

 **Environmental**


 Physical

Lake Michigan Nitrogen concentrations,  
1994 & 1995 (EPA)





# Structure / Data

 **Data:** contains all data, spatial and tabular

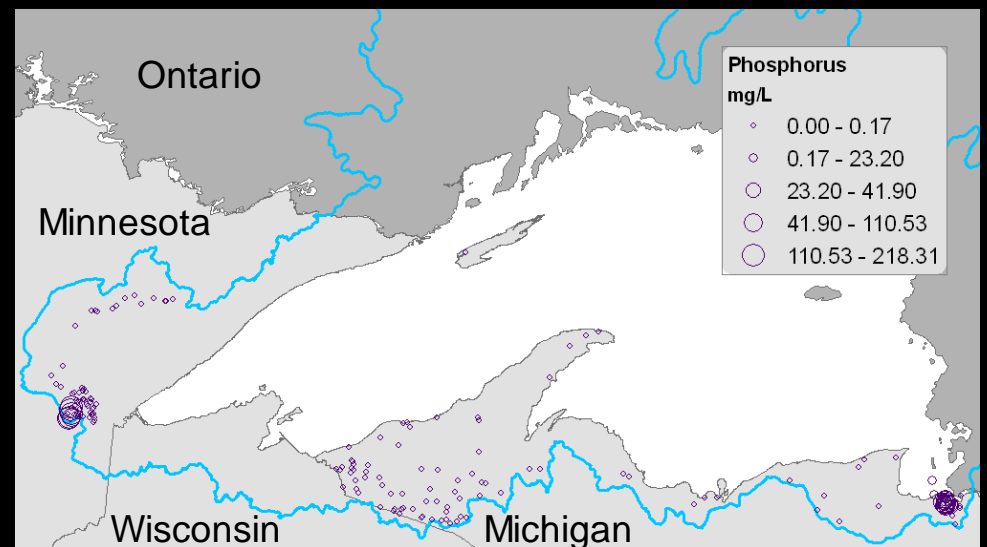
 Base/political

 Biological

 Classifications

 **Environmental**

 Physical



Mean phosphorus concentrations (EPA)



# Structure / Data

📁 **Data:** contains all data, spatial and tabular

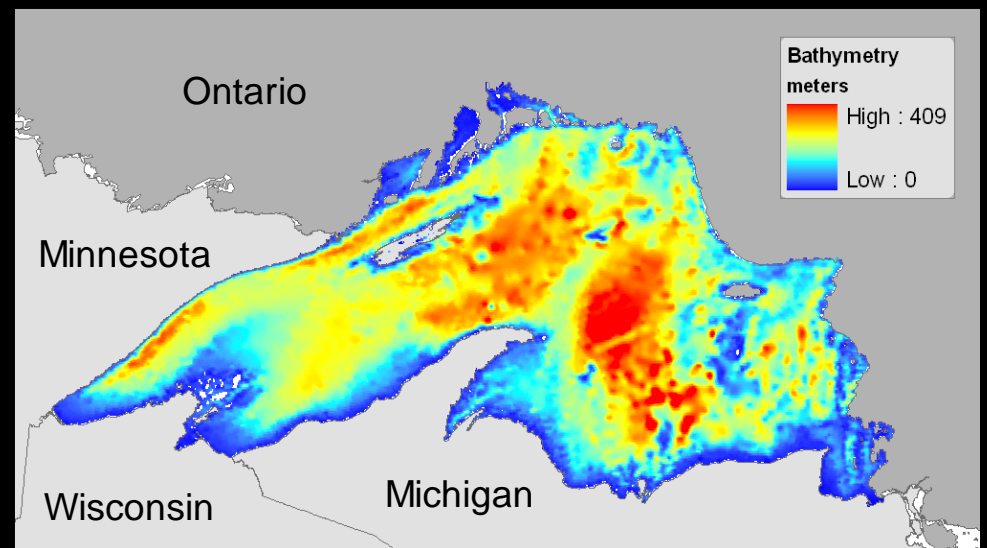
📁 Base/political

📁 Biological

📁 Classifications

📁 Environmental

📁 **Physical**



Bathymetry (NOAA)



## Structure / Data

### Data

Acquire data

Make data spatial?

Make spatially  
consistent

Merge files

Clip to basin boundary



National Land Cover Dataset (USGS)



## Structure / Data

### Data

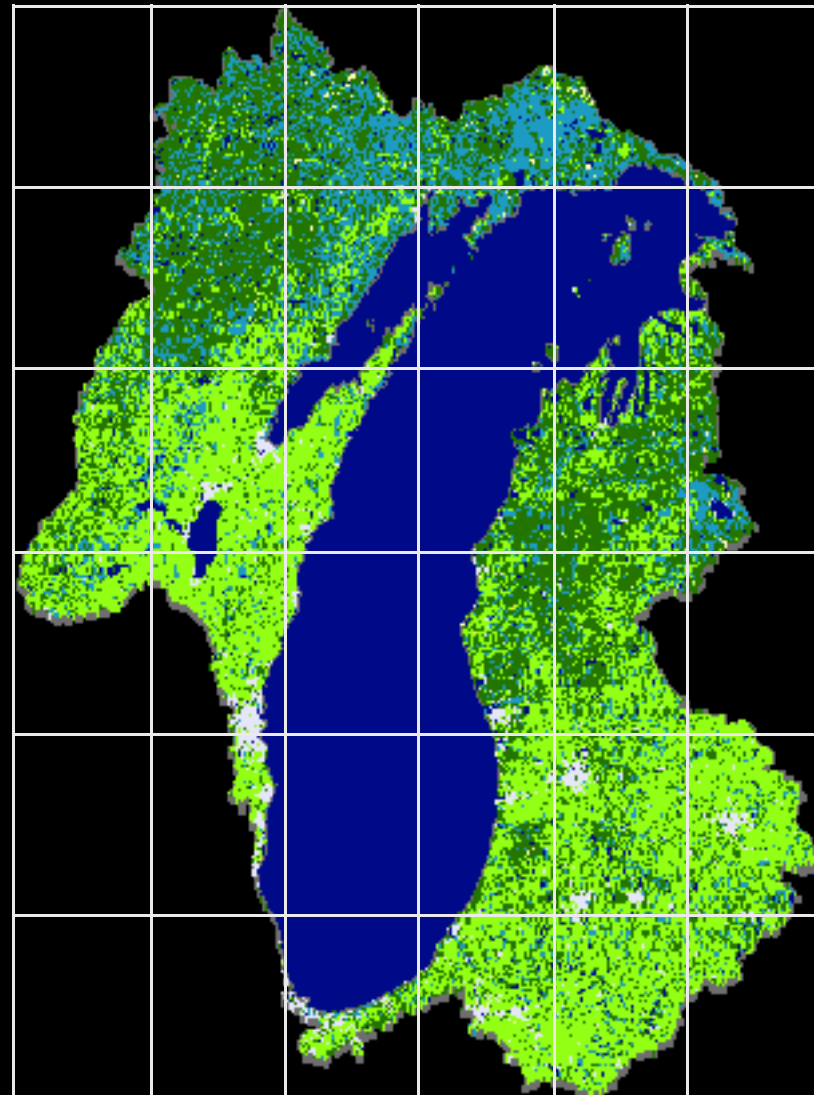
Acquire data

Make data spatial?

Make spatially  
consistent

Merge files

Clip to basin  
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## Structure / Support Documents



**Support Documents:** a directory containing all support documentation related to the Great Lakes GIS project



**Project Files:** pre-manufactured map documents that focus on a particular region or theme



**Mini-Projects:** directories that are comprehensive with respect to a particular research question or problem



# Structure / Support Documents

 **Support Documents:** a directory containing all support documentation related to the Great Lakes GIS project

 Fact sheets


 Feedback

 Inventory

 Standards



## Structure / Project Files

 **Project Files:** pre-manufactured map documents that focus on a particular region or theme

Base/political

e.g., lake units, protected areas

Biological

e.g., spawning locations, commercial harvest

Classifications

e.g., fish habitat, shoreline classification

Environmental


e.g., Areas of Concern (AOCs), contaminants

Physical

e.g., surface temperature, terrain variables



## Structure / Mini-Projects

 **Mini-Projects:** directories that are comprehensive with respect to a particular research question or problem



data



images



report



map document(s)



# Topics

Objectives and Project Description

**Uses of the Great Lakes GIS**

*cartography, science inquiry, and decision support*

Distribution, education, and outreach

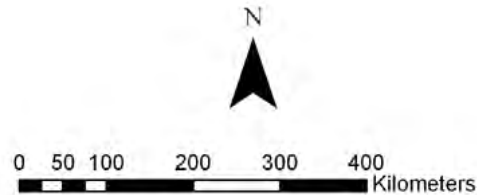
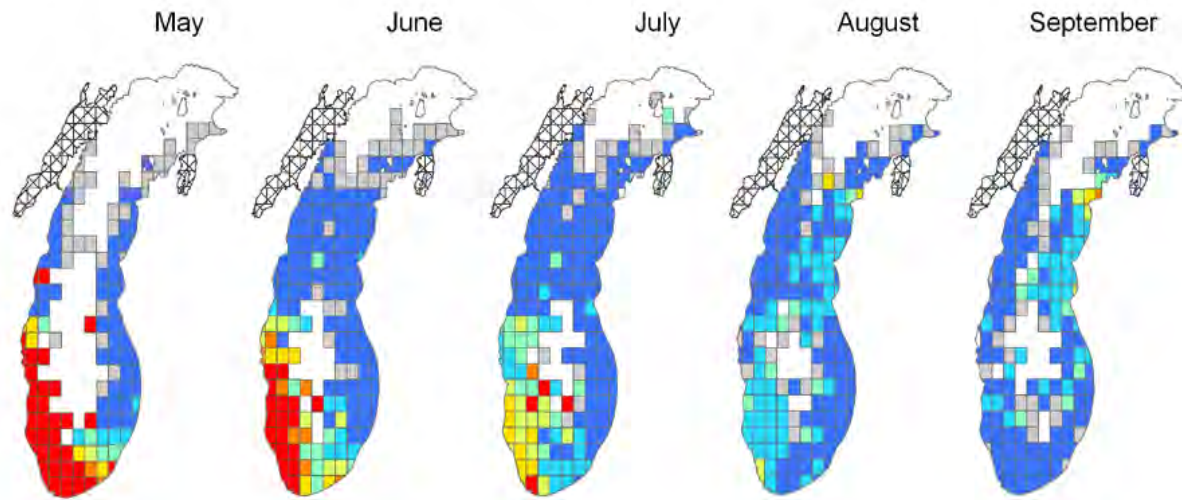
*Internet distribution and workshops*

Future direction

*distribution and long-term management*

# Coho Salmon Movement in Lake Michigan

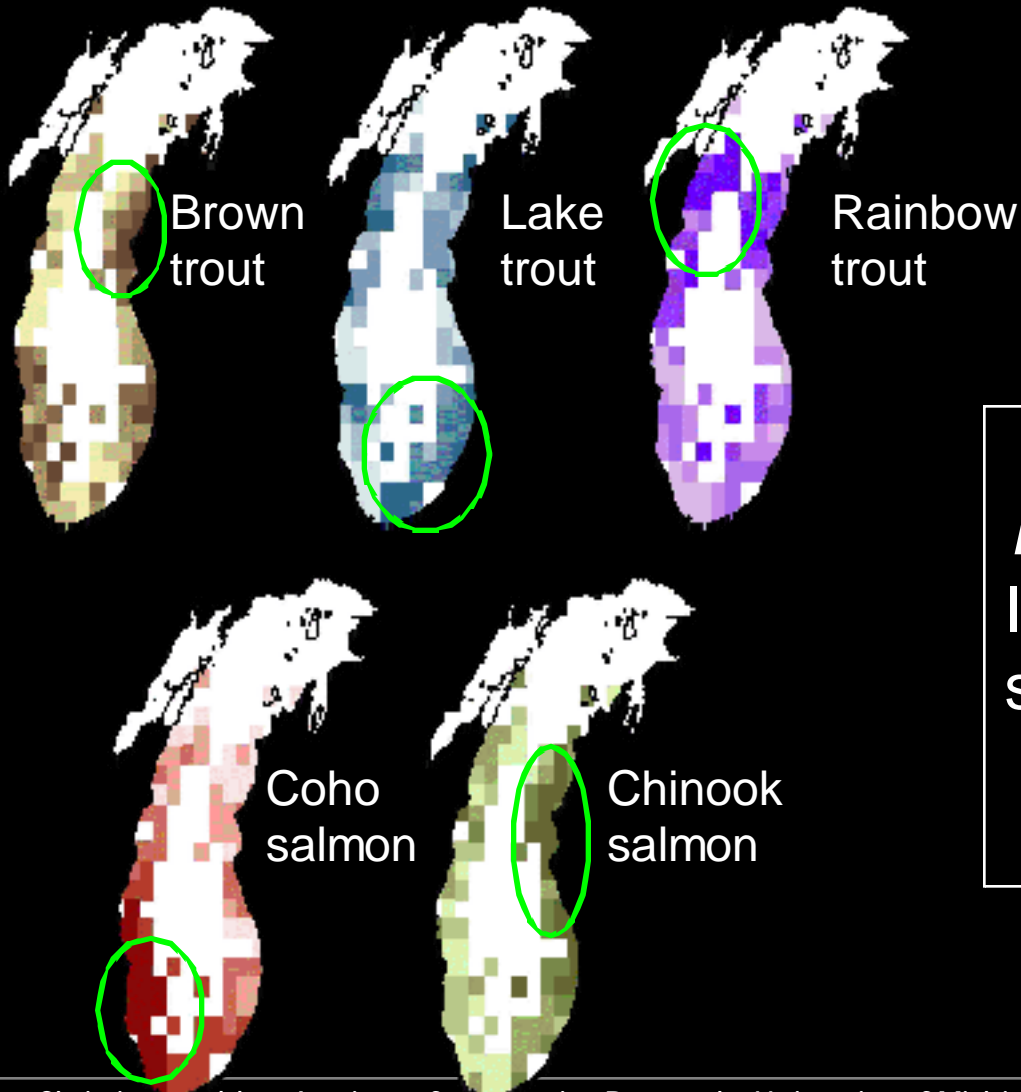
Coho Salmon Catch Per Unit Effort By Month, 1992-2001



Data sources: Wisconsin, Illinois, Indiana, and Michigan Departments of Natural Resources  
 Funding sources: U.S. Fish and Wildlife Service, Great Lakes Fishery Commission,  
 U.S. Environmental Protection Agency, and Michigan Department of Natural Resources  
 Cartographer: Christine Geddes, Institute for Fisheries Research



# Competition with Other Salmonines?



June, 1994

***Competitive Displacement Theory:***  
If alewife are abundant, species may spread out and have overlapping distributions.



## Lake Sturgeon Spawning Habitat Suitability Index

1. Classify variables into lake sturgeon spawning suitability groups

Variables: Discharge, Gradient, Temperature

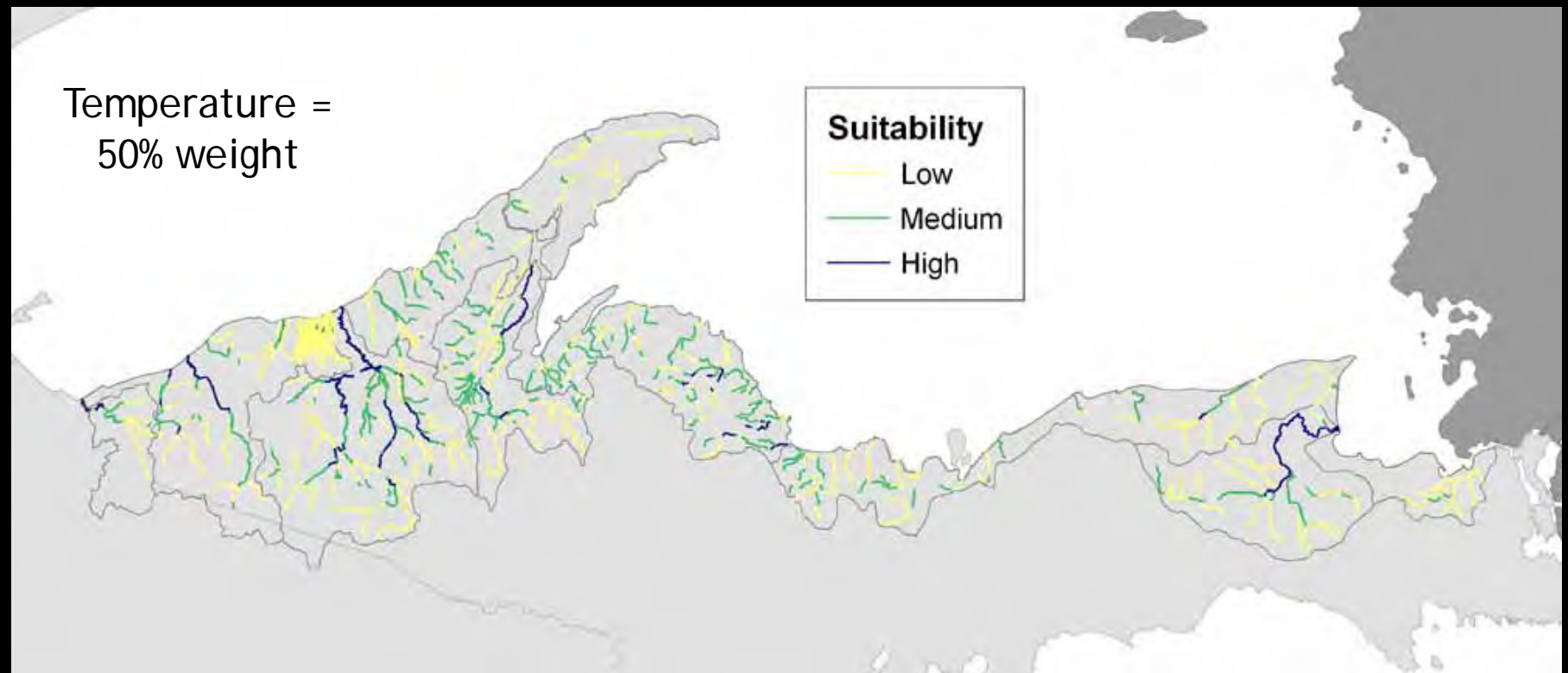
Low=1, Medium=2, High=3

2. Spawning Suitability Index=  
(discharge score + gradient score +  
temperature score)

3. Perform hypothetical dam removal calculations

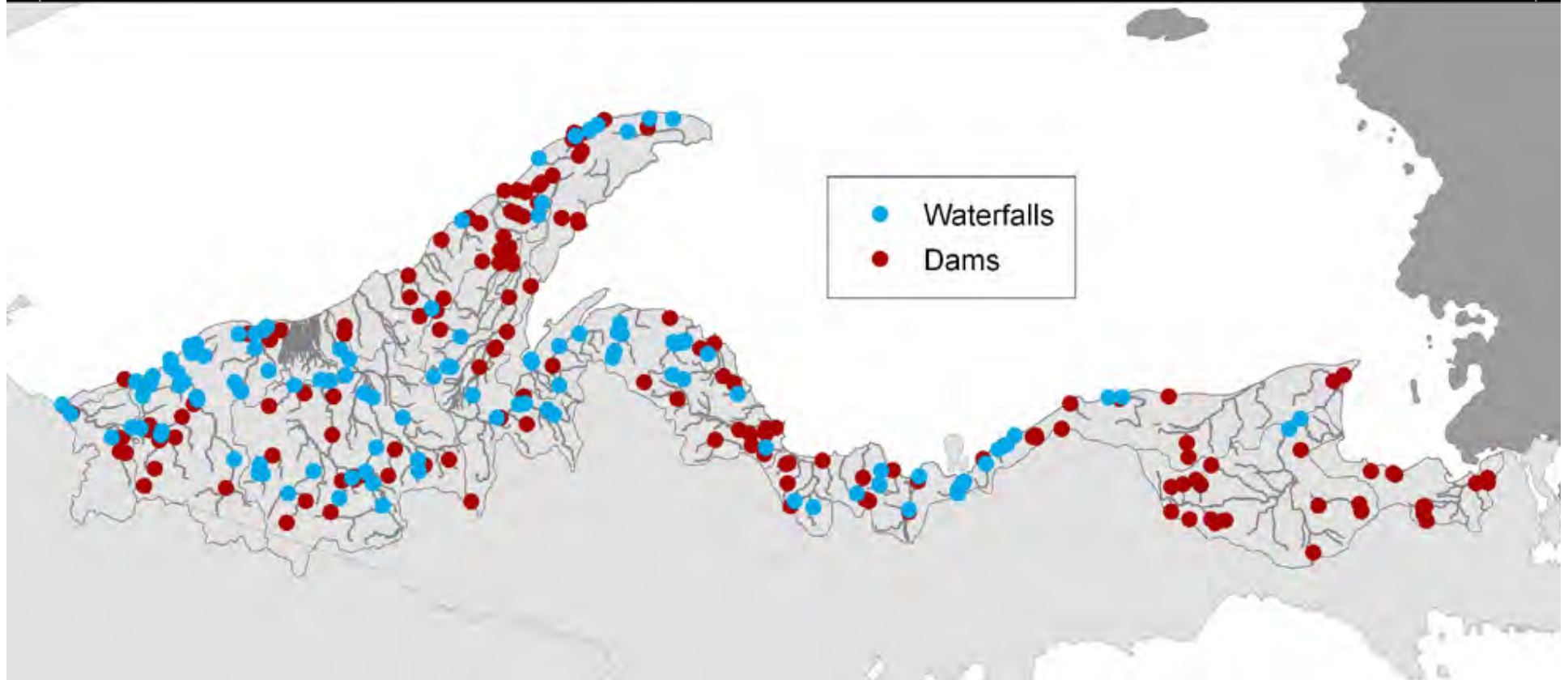


# Sturgeon Spawning Suitability





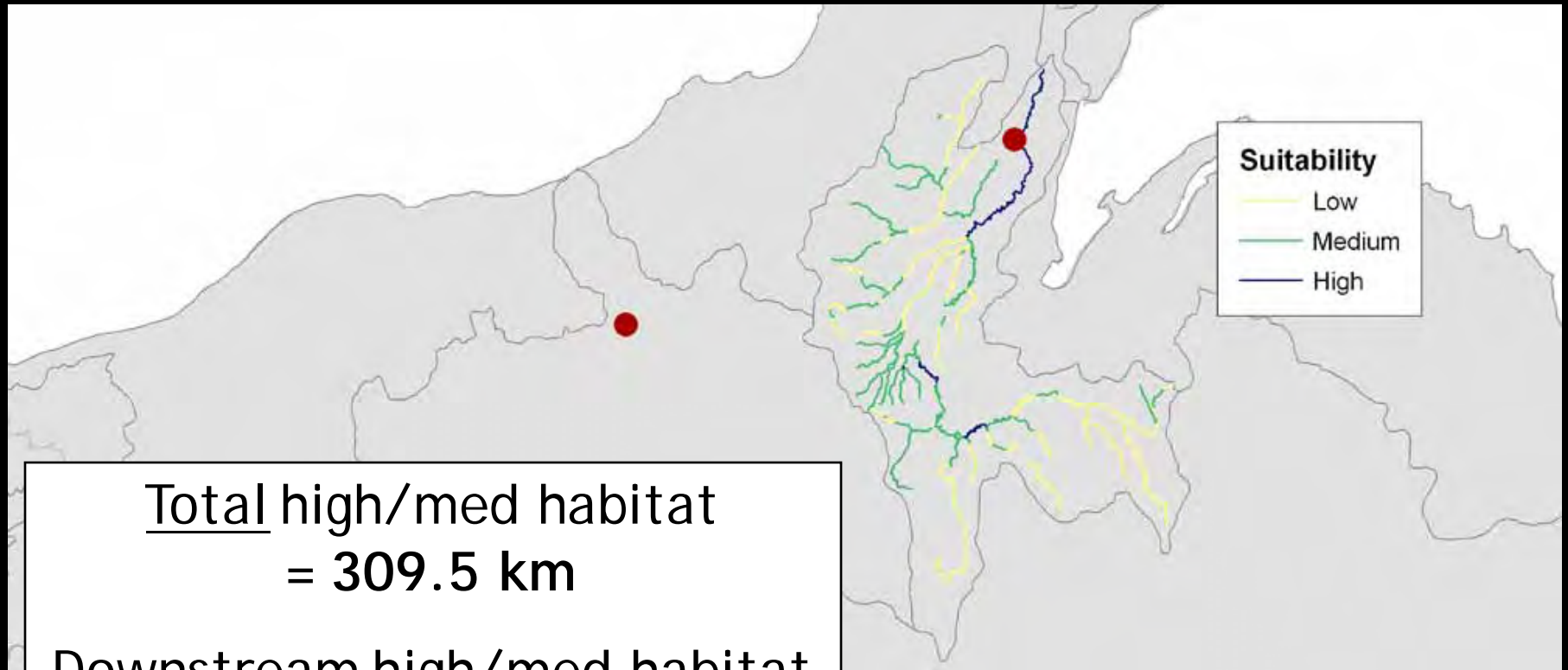
# Barriers



Source: Digital Water Atlas, Dam Database



# Habitat Calculations



Total high/med habitat  
= 309.5 km

Downstream high/med habitat  
= 15.9 km

# Decision Support

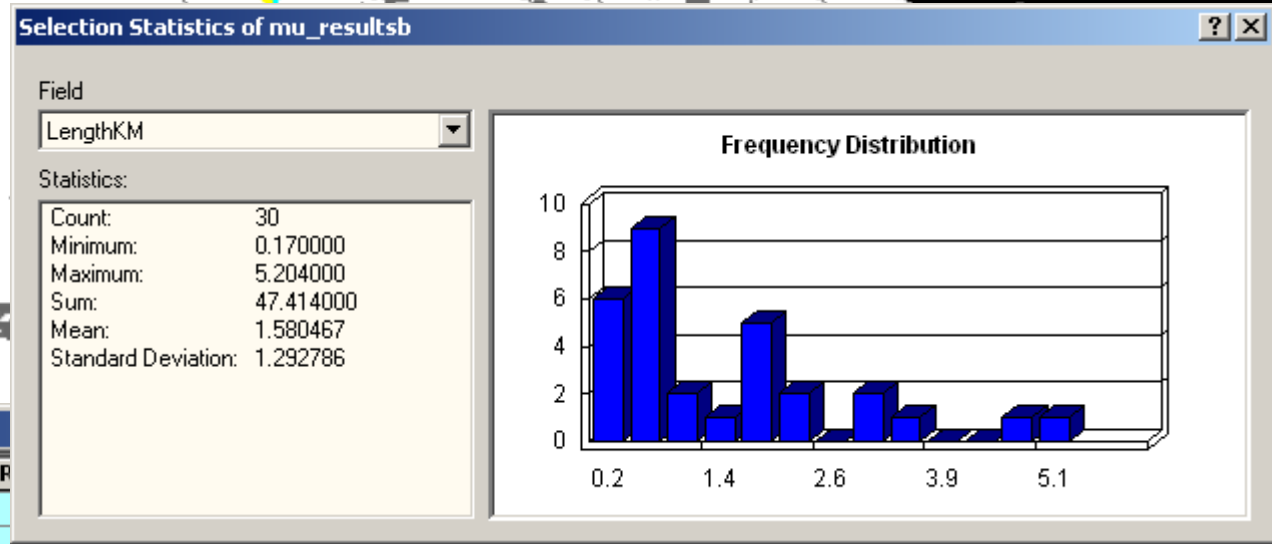
**Q:** How much lake sturgeon habitat would be gained upon removing Croton and Hardy Dams from the main stem of the Muskegon River?





# Decision Support

Select optimal lake sturgeon habitat and summarize results.



Selected Attributes of Query Results

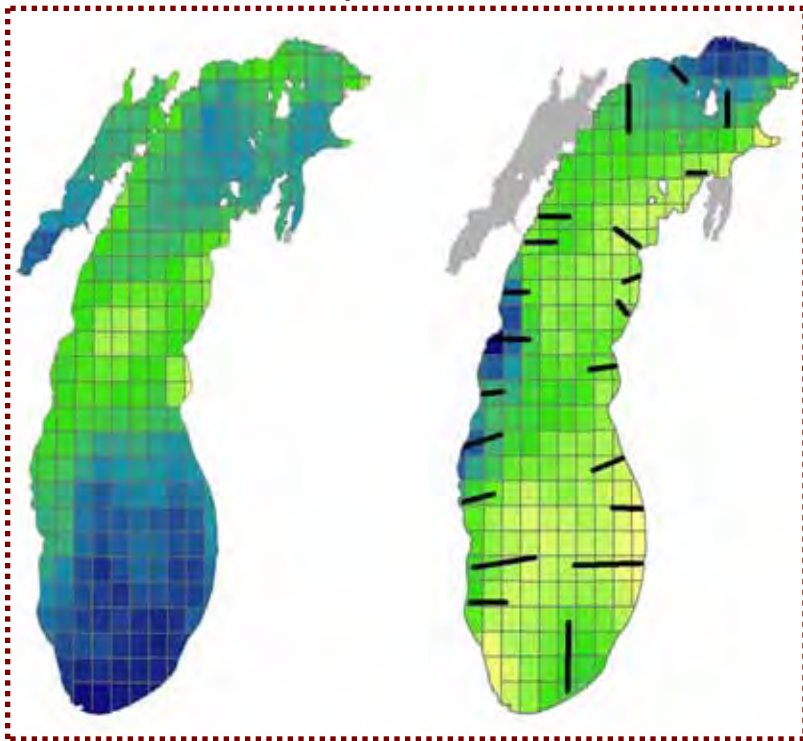
OUTWASH	COAP
0.304057	
0.316993	
0.307522	0.332372
0.305442	0.335928
0.305442	0.335928
0.305442	0.335928
0.303515	0.338683
0.318728	0.319512
0.30897	0.331705
0.30807	0.330949
0.307381	0.332246

Record: 1 Show: All Selected Records (30 out of 203 Selected.) Options



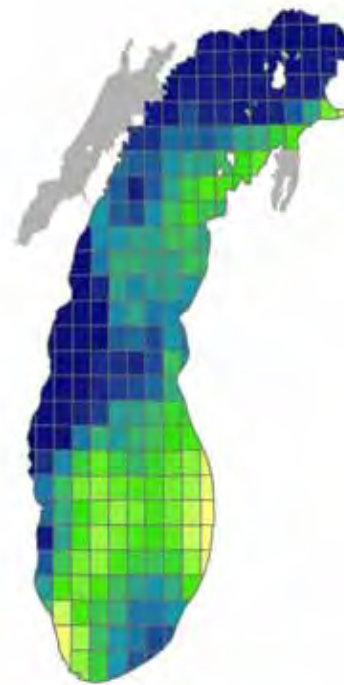
# Steelhead Bioenergetic Growth Potential

GRP input variables

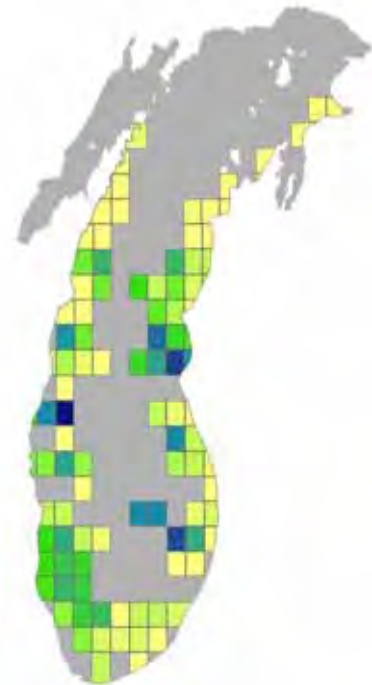


mean surface temperature

interpolated alewife densities



steelhead growth rate potential



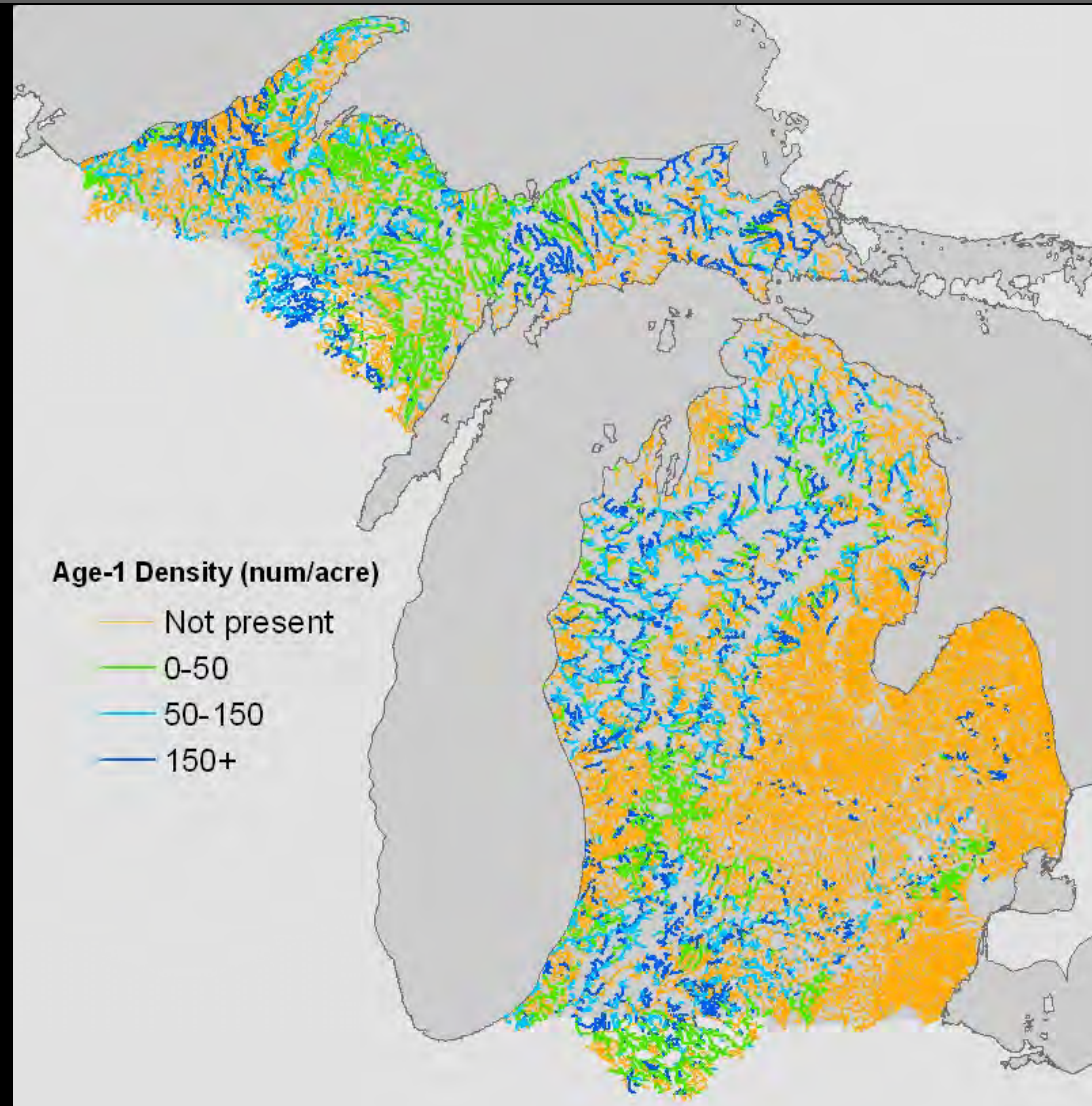
steelhead CPUE

**LOW**

**HIGH**



# Steelhead Parr Density Estimates





# Decision Support: Future Applications





# Topics

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*Internet distribution and workshops*

Future direction

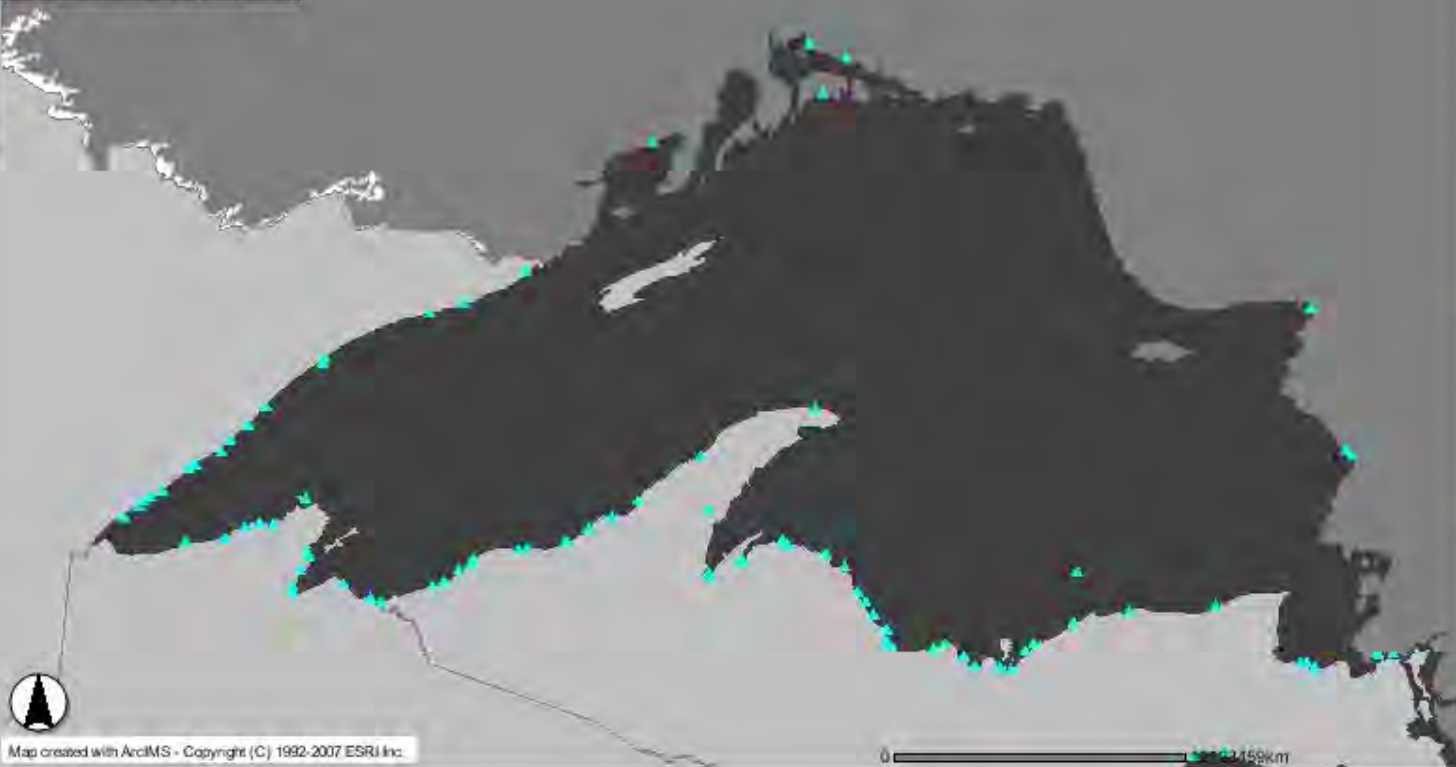
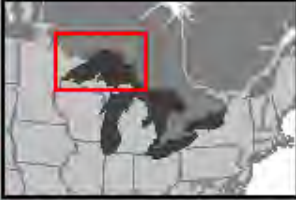
*distribution and long-term management*



# Internet Distribution

- 1) Internet Map Server (IMS)
  - => Deliver dynamic maps via the Web
  - => Pilot: Goodyear Spawning Atlas (USGS)
  - => <http://glein.er.usgs.gov/>
  
- 2) Open-source GIS/web services
  - => Deliver data via the Web
  - => Pilot: Subset of LM GIS data (GLC)
  - => <http://gis.glin.net/>

# Goodyear Spawning Atlas



Map created with ArcIMS - Copyright (C) 1992-2007 ESRI Inc.

0 234.59km

### LAYERS

- All Layers
- Fish Spawning Locations
  - Brown trout spawning
  - Chinook salmon
  - Coho salmon spawning
  - Lake trout spawning
  - Rainbow trout spawning
  - Rainbow smelt spawning
  - Lake whitefish spawning
  - Walleye spawning
  - Yellow perch spawning
  - Bloater spawning
  - Alewife spawning
  - Lake sturgeon spawning
  - Sea lamprey spawning
- Stocking Numbers
  - Brown trout stocking
  - Chinook salmon
  - Coho salmon stocking
  - Lake trout stocking
  - Rainbow trout stocking
  - Walleye stocking
- Catch Rates
  - Brown trout catch
  - Chinook salmon
  - Coho salmon catch
  - Lake trout catch
  - Rainbow trout catch
- Base Map Layers
  - Great Lakes basin
  - Great Lakes
  - Canada
  - USA

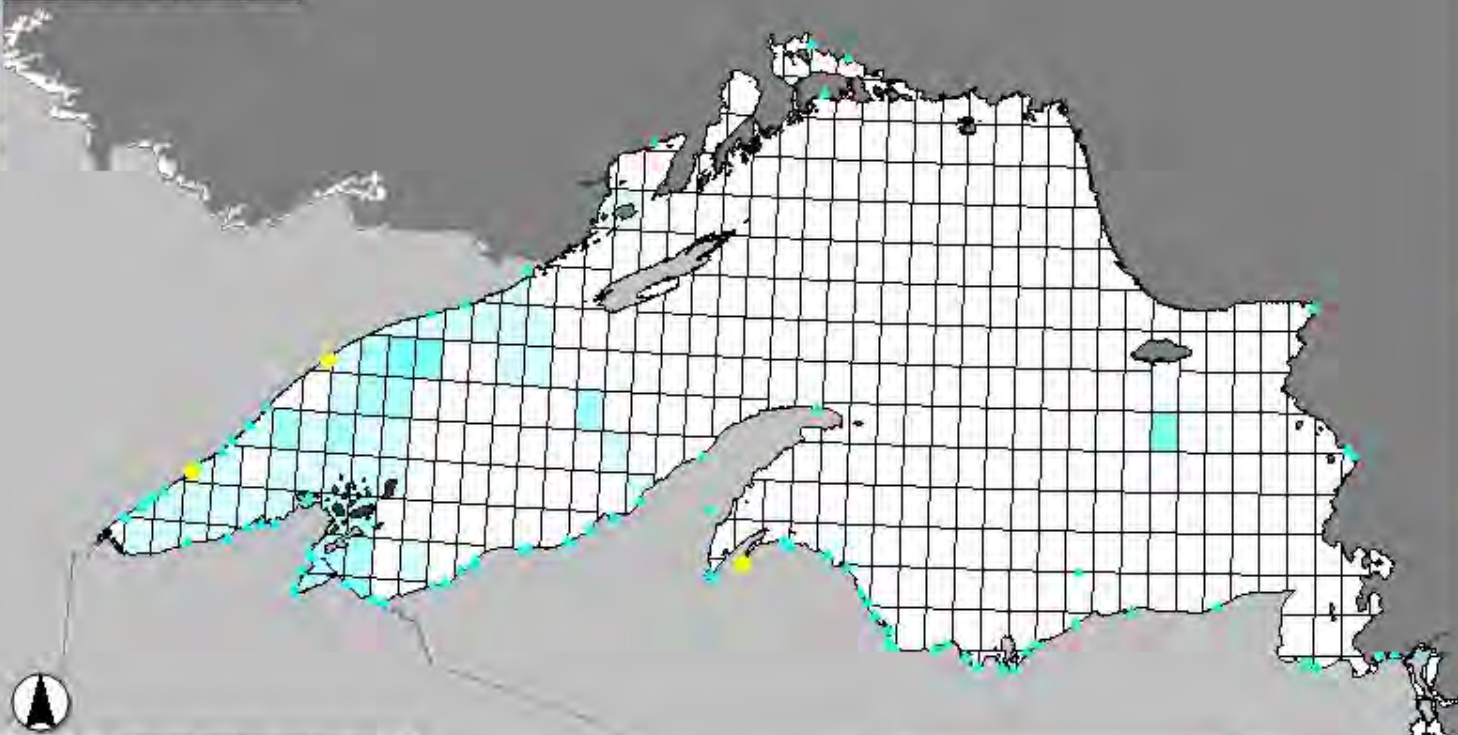
**Refresh Map**

Auto Refresh

Pan

Done

# Goodyear Spawning Atlas



Map created with ArcIMS - Copyright (C) 1992-2007 ESRI Inc.



### Coho salmon spawning site

Rec	FAMILY	LATITUDE	LONGITUDE	LAKE	COUNTRY	CLASS	TEMP	GEOMORPH	NEARSHORE	PROTECTION	#SHAPE#	#ID#
1	Salmonidae	48.77	-87.9	Superior	CA	Open water	Cold	Coarse Beaches	Bedrock	None	[point]	4
2	Salmonidae	46.25	-83.88333	Huron	CA	Open water	Cold	Coarse Beaches	Bedrock	None	[point]	19
3		43.97	-78.01667	Ontario	CA	Open water	Cold	Coarse Beaches	Clay	None	[point]	60
4	Salmonidae	46.42	-84.93333	Michigan	US	Open water	Cold	Coarse Beaches	Bedrock	None	[point]	212

Query

**LAYERS**

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  - Great Lakes basin
  - Great Lakes
  - Canada
  - USA

**Refresh Map**

Auto Refresh



About the photos (©Mahan)

### Maps and GIS Topics

#### Great Lakes GIS Data

- By Topic
- By Geography
- By Organization
- By Upload Date
- >> Publish Spatial Data

#### Map Explorer

- Lake Huron
- Lake Ontario
- Lake Michigan
- Lake Erie
- Lake Superior
- Lake St. Clair
- >> Build Your Own Map

#### Map Gallery

- Images to Download
- Other Images

#### Connect

- GLINDA GIS FAQ
- GLINDA GIS Wiki
- Feedback/Contact
- Links/Resources

### Regional GIS Data by Topic

Welcome, guest [login](#) [register](#)

[Biota](#) | [Boundaries/Political](#) | [Climatology/Meteorology/Atmosphere](#) | [Elevation](#) | [Environment](#) | [Geoscientific Information](#) | [Imagery/Basemaps/Earth Cover](#) | [Inland Waters/Hydrography](#) | [Society](#) | [Structure/Facilities](#) | [Transportation](#)

#### About

These data are sorted by [ISO 19115 Topic Categories](#) and are available in many formats including [OGC WMS](#) and [WFS](#) web services, in addition to [PDF](#), [KML](#) (Google Earth), [SHP](#), and [GML](#) formats. Layers are accompanied by [FGDC-compliant metadata](#) and are ingested into [Geospatial Onestop](#). For more, please see the [GLINDA GIS FAQ](#)

#### Biota

##### [gl\\_zebra\\_mussel\\_distribution](#) (NRCS)

*Zebra mussel (Dreissena polymorpha) locations within the Great Lakes*

[Preview](#) | [Link](#) | [Metadata](#) | [GIF](#) | [PDF](#) | [GML](#) | [Shapefile \(.shp\)](#) | [Google Earth \(.kmz\)](#)

##### [lmb\\_piping\\_plover\\_glc](#) (GLC) (GLGIS)

*Piping plover habitat in the Lake Michigan basin*

[Preview](#) | [Link](#) | [Metadata](#) | [GIF](#) | [PDF](#) | [GML](#) | [Shapefile \(.shp\)](#) | [Google Earth \(.kmz\)](#)

##### [lm\\_brooktrt\\_locs\\_mfa](#) (GLGIS) (MI DNR)

*Locations of collections of brook trout in Lake Michigan*



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# Summary

- Lakes Huron, Michigan, and Erie GISs: done  
Lakes Superior and Ontario GISs: December 31, 2007
- Data acquisition, creation, and standardization; map documents for the Great Lakes basin
- Tool for decision support and research
- Education; including documents, answering Qs, and workshops



## Future Direction

- 1) Address data and research needs
- 2) Technology transfer
- 3) Long-term funding and management



# Thank you for your attention!

Please visit [www.glfc.org/glgis](http://www.glfc.org/glgis).

Questions? Comments?

Contact Christine Geddes at [cgeddes@umich.edu](mailto:cgeddes@umich.edu)

