Lake Michigan's Nearshore Waters and Type E Botulism

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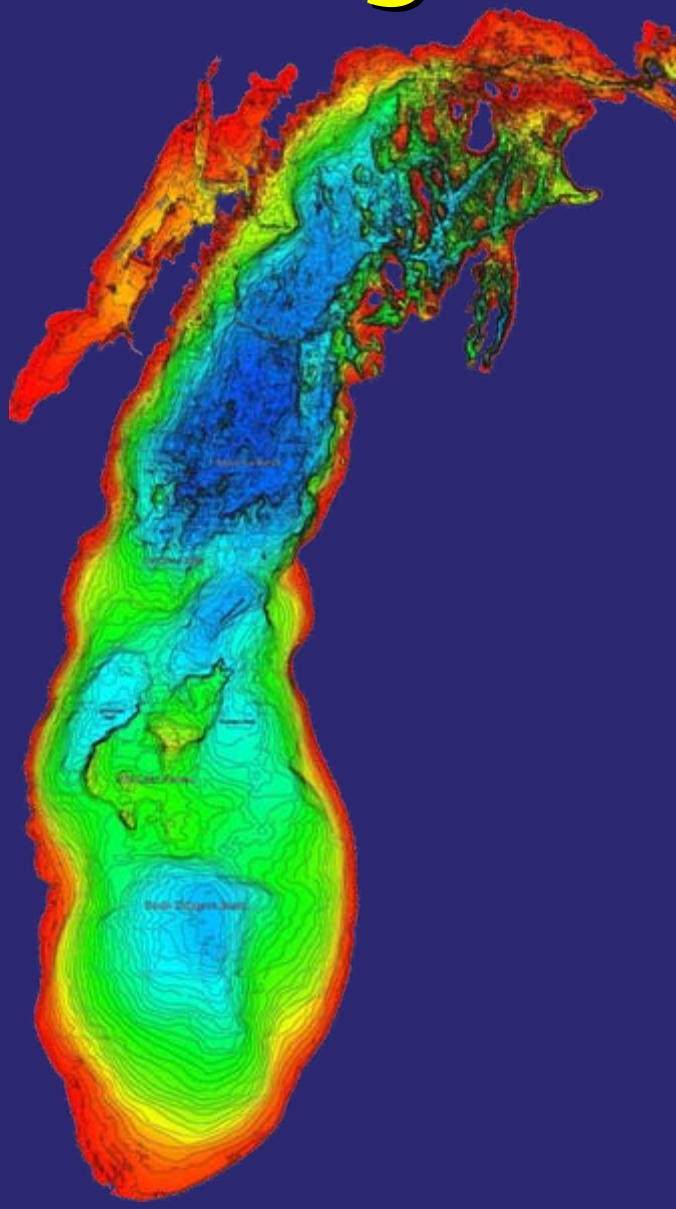
National Park Service

Lake Michigan

Average Depth	279 feet 85 meters
Maximum Depth	925 feet 282 meters
Volume	1,180 cu. mi. 4,920 cu. km.
Water Area	22,300 sq. mi. 57,800 sq. km.
Land Drainage Area	45,600 sq. mi. 118,000 sq. km.
Shoreline Length	1,638 miles 2,633 km
Population (U.S. 2000)	15,351,202
Retention Time	99 years



Source: State of the Great Lakes 2005; NOAA, GLERL

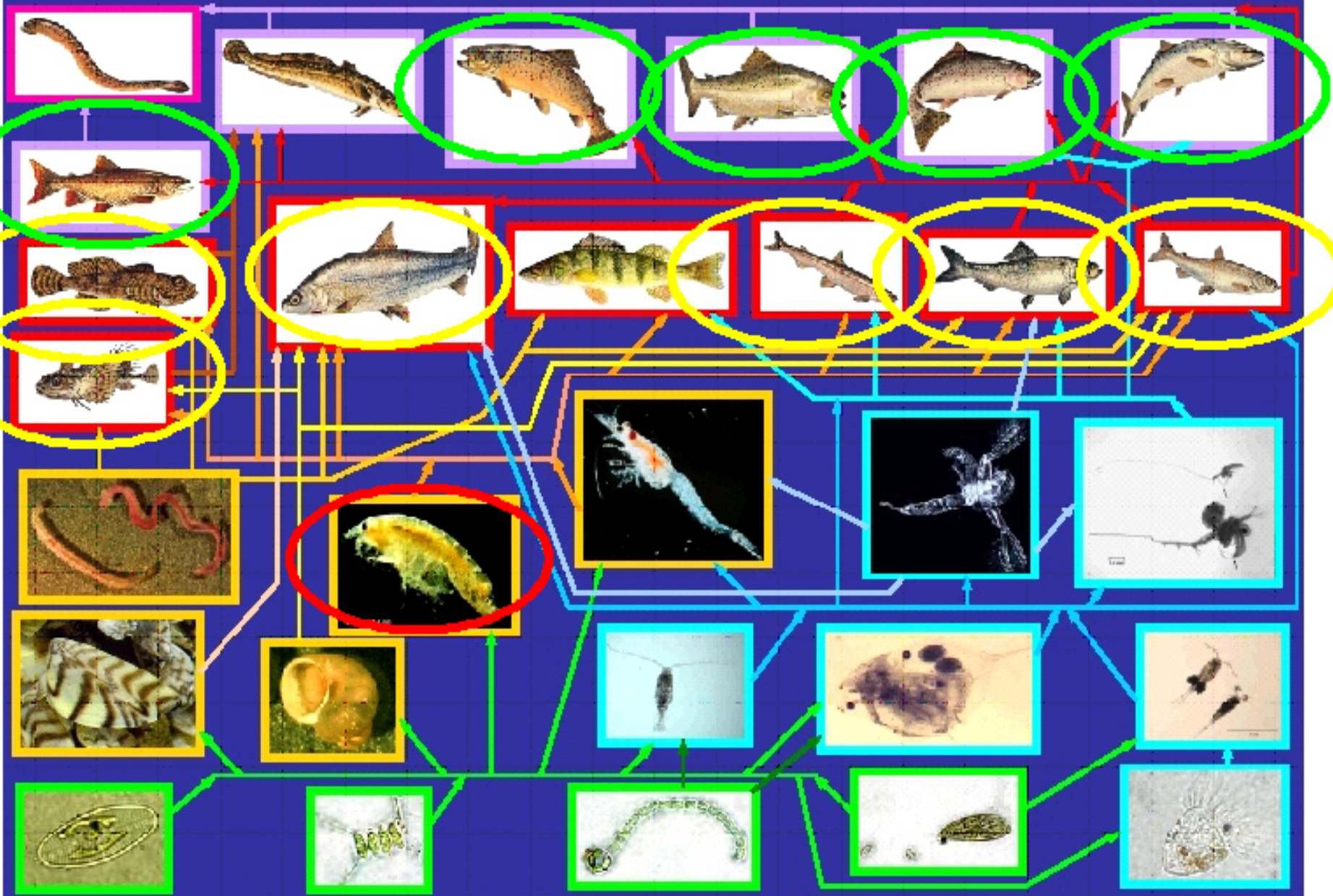
1996 SOLEC
Status of Lake Michigan's Nearshore Areas

- Nearshore = "the land and water interaction zone" out to 30 m depth.
- 25% of Lake Michigan's surface area
- Affected by:
  - Water Levels
  - Ice
  - Temperature
  - Currents
  - Wind

1996 SOLEC
Status of Lake Michigan's Nearshore Areas

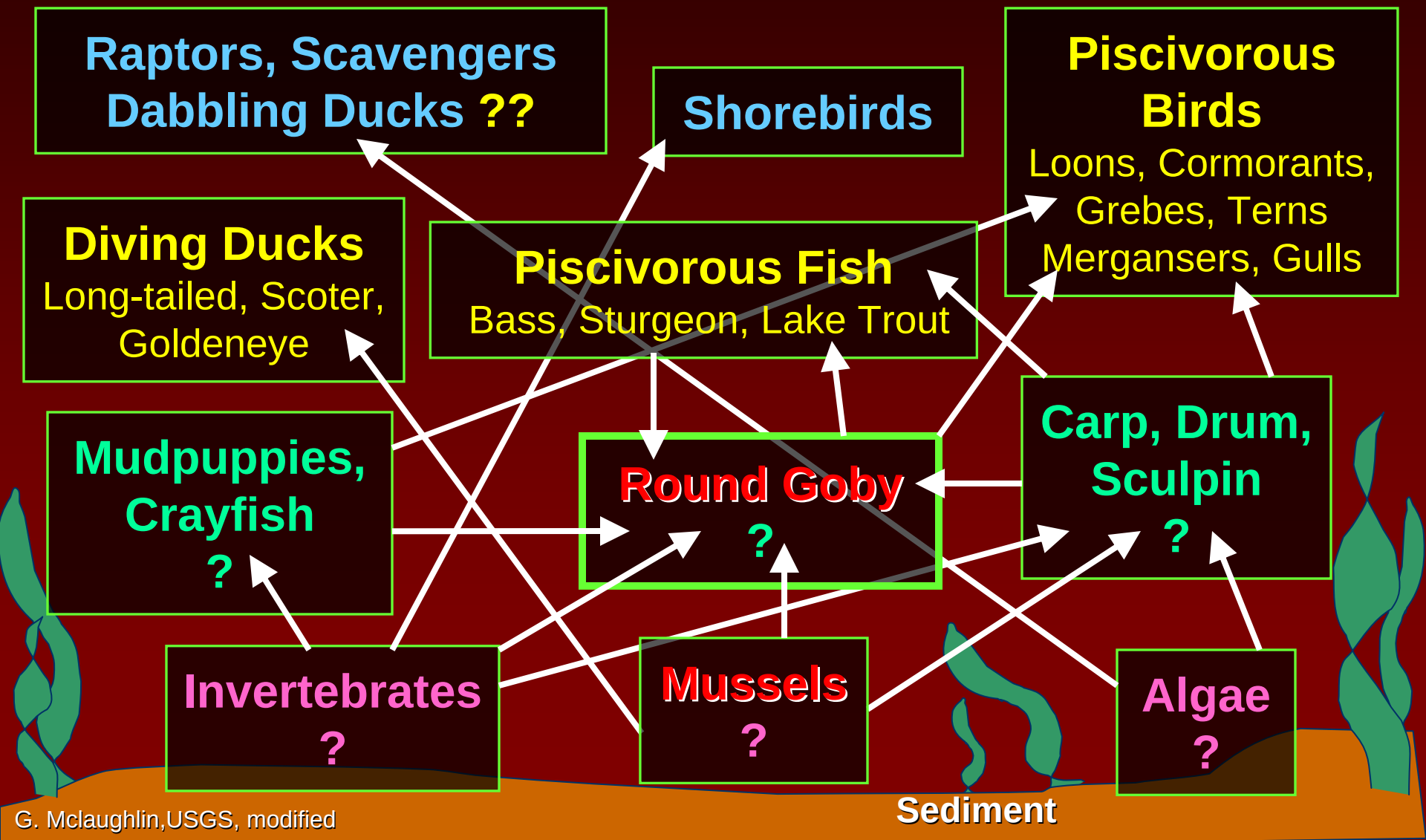
- Fish habitat in danger
- Warning of Global Climate Change effects
- Cautiously 'optimistic' about nutrient controls
- More development = ↑ run-off related problems
- Lake temperatures ↑, Lake levels ↓, Lake ice ↓

Lake Michigan Food Web



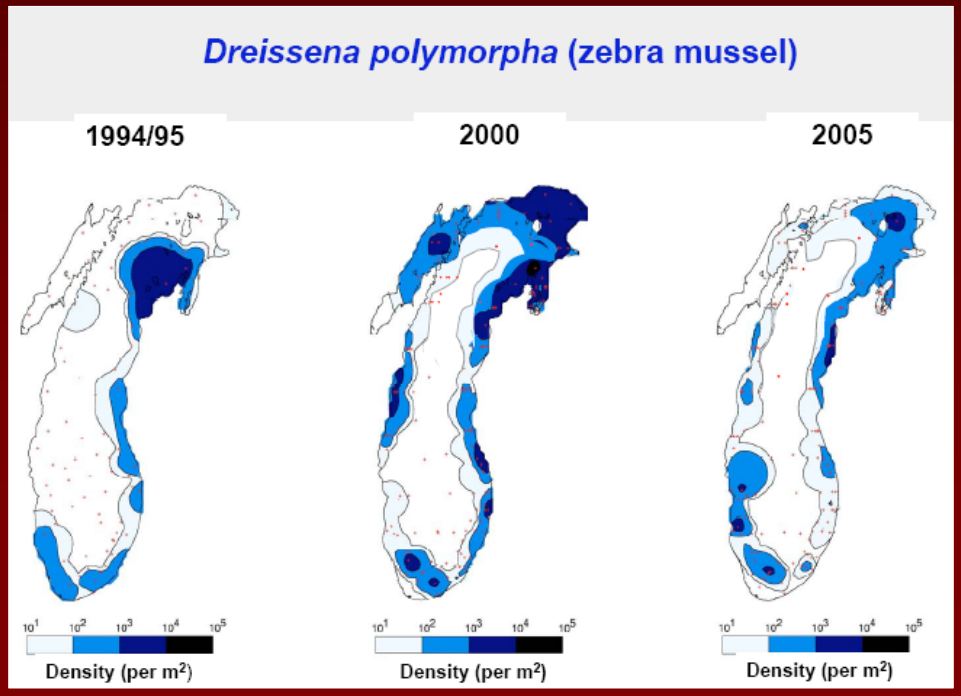
Food Web based on model constructed for "Impact of Exotic Invertebrate Invaders on Food Web Structure and Function in the Great Lakes a Network Analysis Approach" by Mason, Krause and Ulanowicz—2002

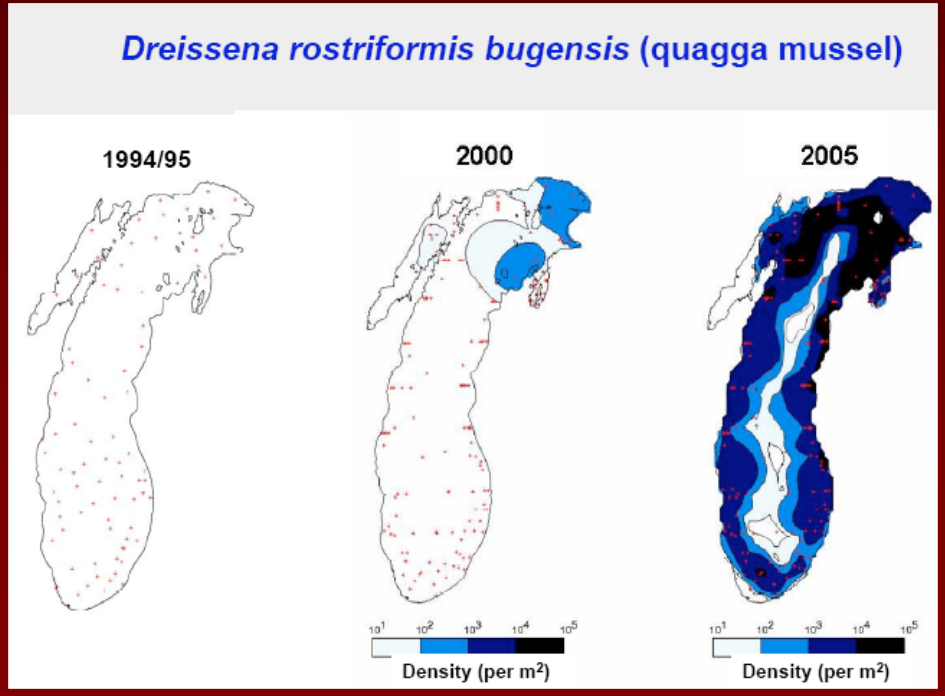
“Rerouting” the Food Pathway…



G. Mclaughlin,USGS, modified

Recent changes: The Quagga Invasion

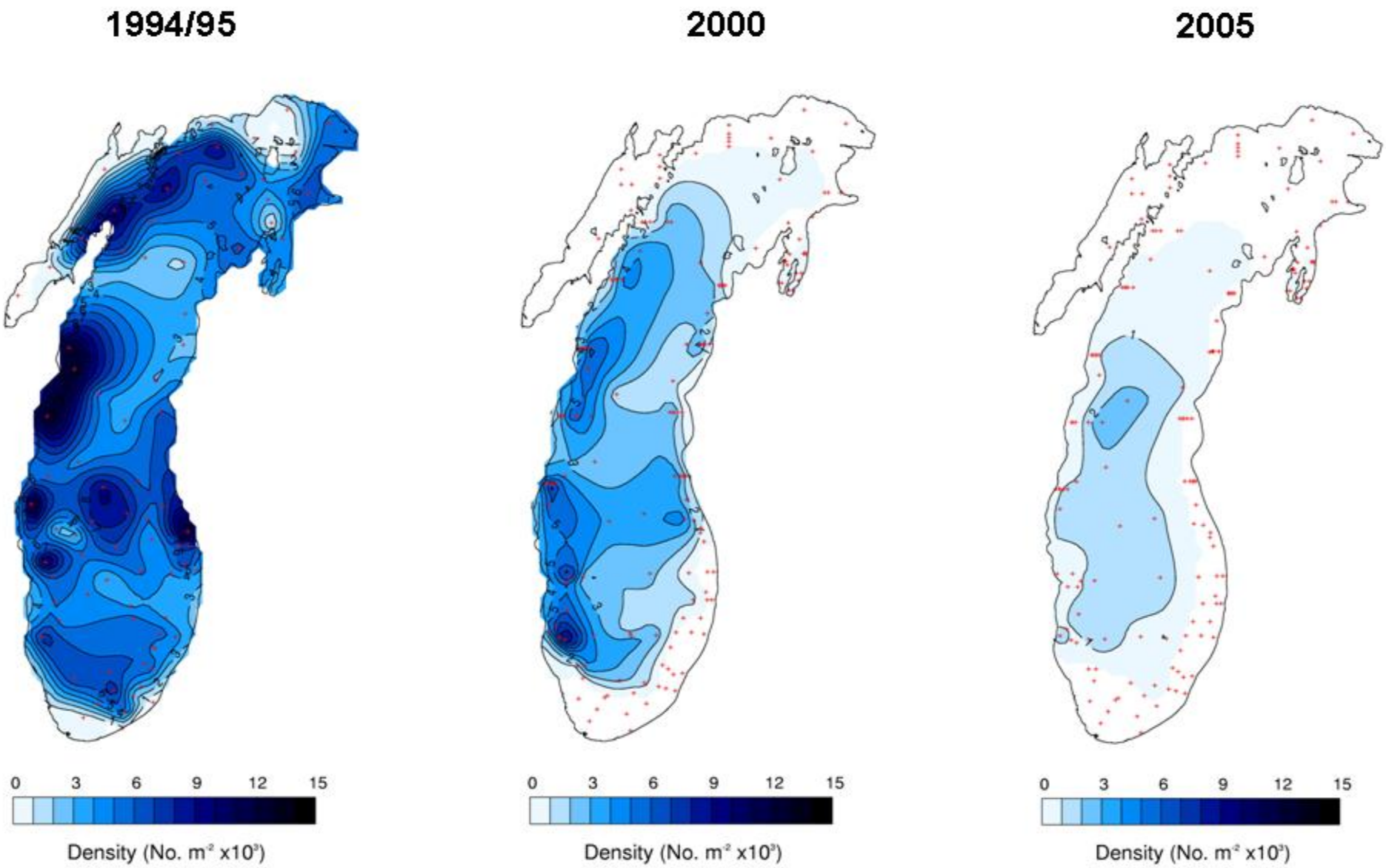




Source: Thomas F. Nalepa; Great Lakes Environmental Research Laboratory, NOAA

Diporeia Abundance in Lake Michigan

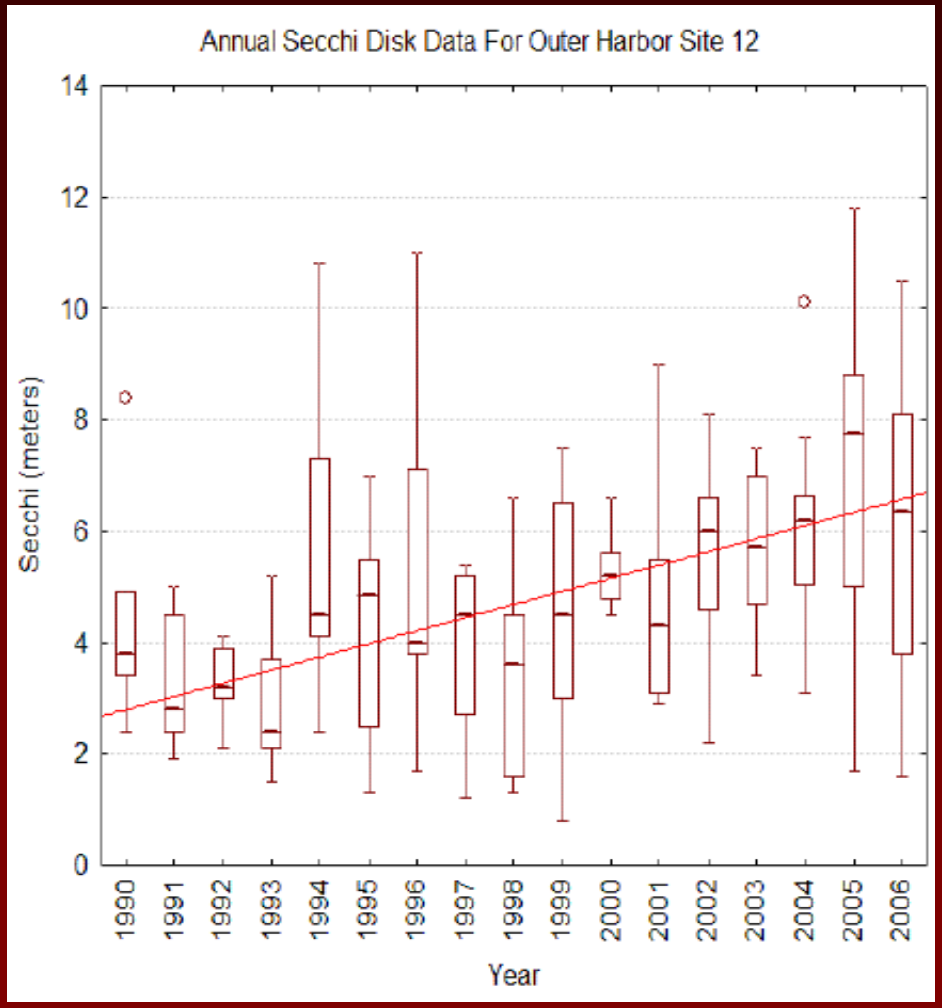
94% Decrease in 10 Years



Source: Thomas F. Nalepa, Great Lakes Environmental Research Laboratory, NOAA

Rapid Change in Nearshore Areas

Water clarity ↑



Dreissinid acceleration of nearshore phosphorus cycle

Study Site: **Milwaukee River Mouth**	**Phosphorus**	
	Mg/m²	**Probable Source**
River Water	**120**	Waste water/Ag chemicals
Quagga Excretion	**506**	River particulate Phosphorus/ Offshore plankton

Cladophora production ↑

Source: Dr. Harvey Bootsma, Great Lakes WATER Institute, Univ. of Wisconsin-Milwaukee

Cladophora

A Native Algae with Major Impacts

Wilderness State Park

Sleeping Bear Dunes

Image © 2008 TerraMetrics
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Image NASA
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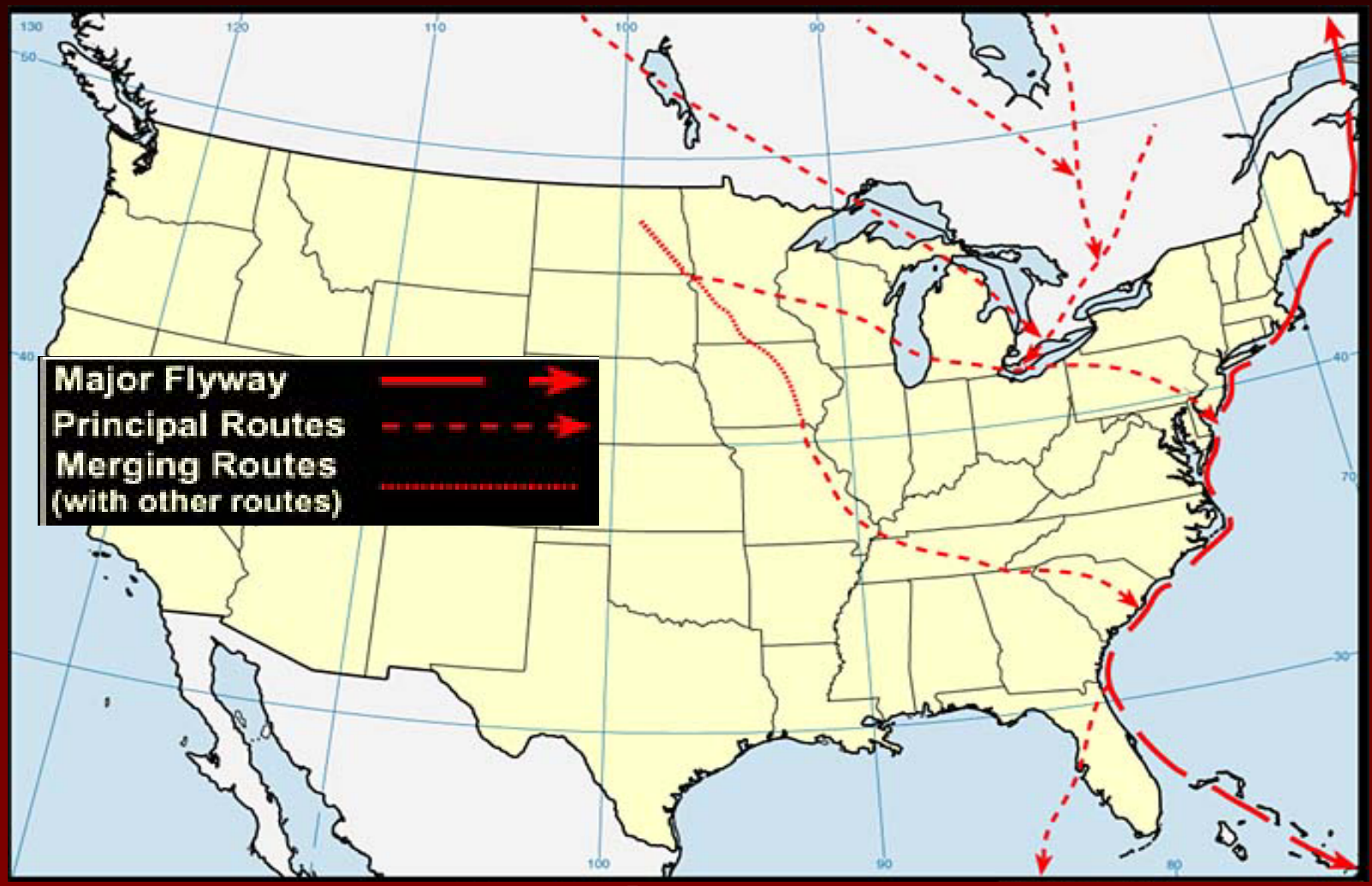
Pointer 45°31'16.65" N 85°33'58.90" W elev 578 ft

Streaming 100%

Eye alt 152.16 mi

The Great Lakes –
The 'Hub' of the Atlantic Migratory Flyway

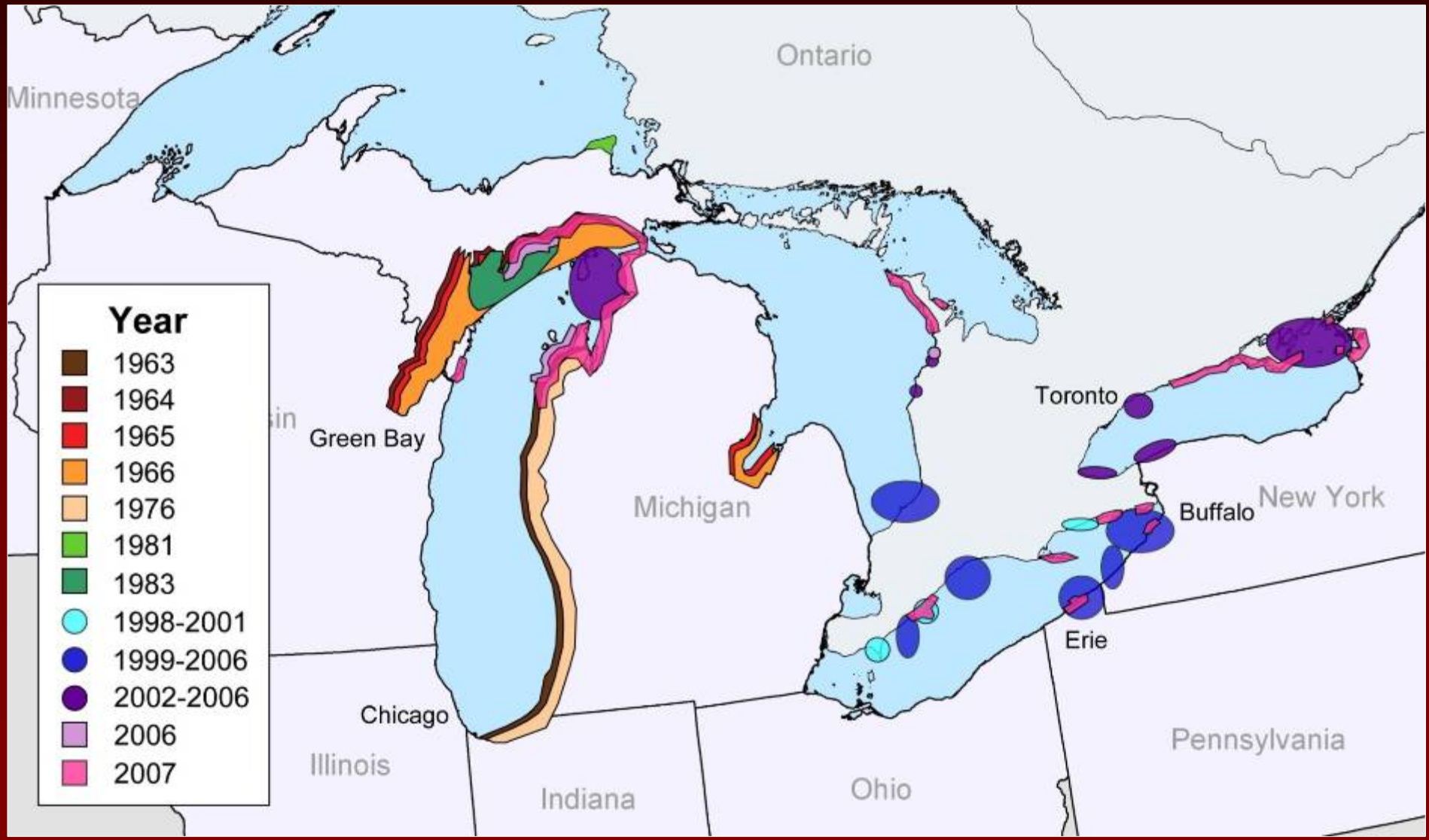


Atlantic Flyway
(with Principal Routes)

Source: www.birdnature.com/atlantic.html

Avian Type E Botulism Outbreaks

Historical Distribution



Clostridium botulinum Type E

- Endemic bacterium
- Dormant spores await appropriate growth conditions
- Vegetative state needs low-oxygen environments
- Potent neurotoxin
- Affects motor function

Victims

Numerous bird species affected

At least 25 species

- Waterbirds
  - Grebes to Loons
- Diving Ducks
  - Scoters to LT Ducks
- Shorebirds
  - Sanderlings, Killdeer, and Piping Plover
- Great Blue Herons
- Bald Eagles

Possible Food Chain Routes

Bird	Diet
Diving ducks	Mussels, crayfish, aquatic insects
Piscivorous waterbirds	Sick round gobies, native fish, mudpuppies
Ring-billed gulls	Sick fish, carrion, crayfish, mussel pieces
Shorebirds	Macroinvertebrates in algae, dead mussels, carrion, maggots/insects in carcasses
Bald Eagles	Fish or bird carrion

Conclusions from Recent Research

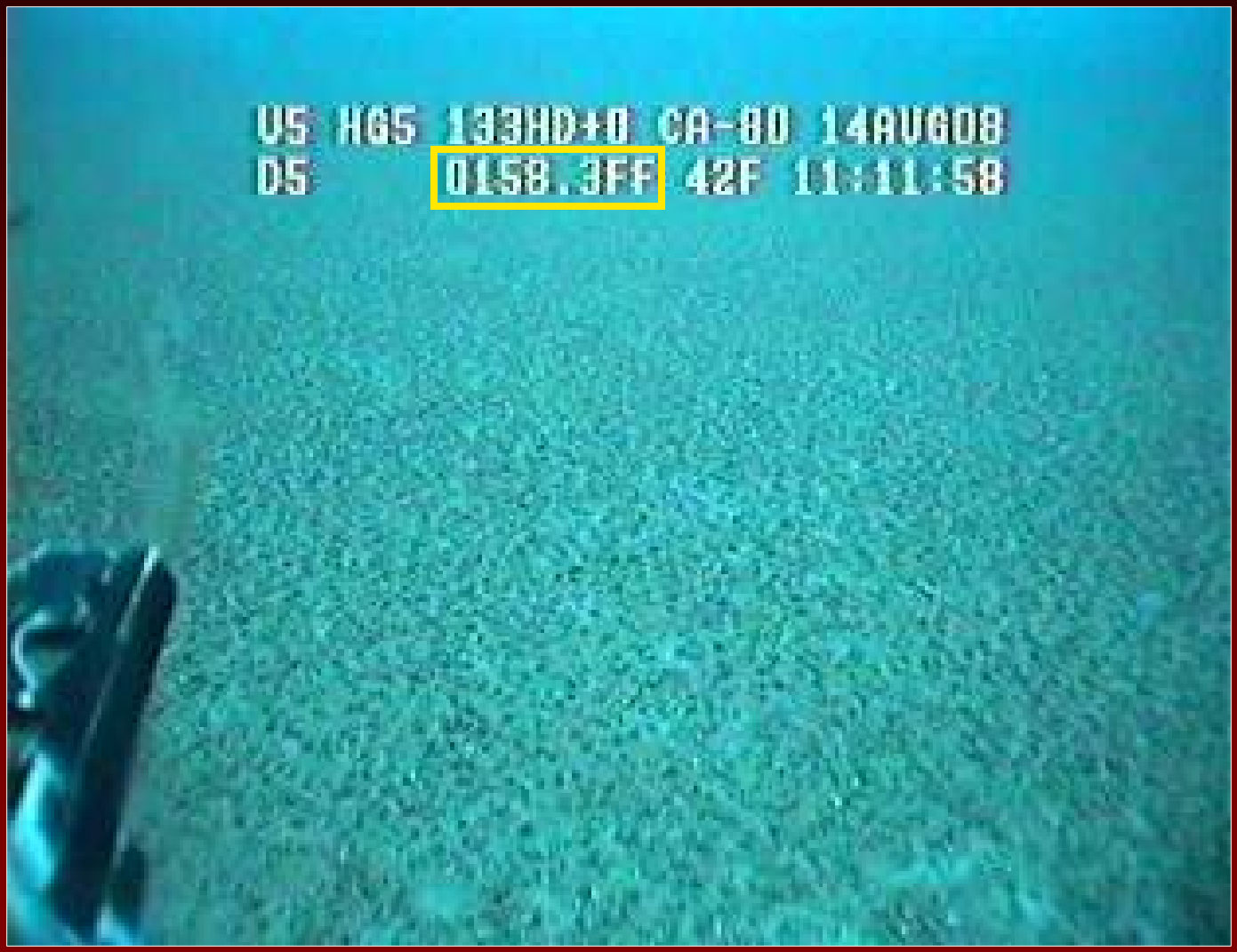
- Behavior of sick fish **may** make them a feeding "magnet"
- Mussels and decaying algae **may** serve as medium for toxin production

- Annual outbreaks **appear to be** linked to presence of plentiful Algae, Quagga Mussels, and Round Gobies
- The toxin pathway involves many species which all **appear to be** toxin carriers

MANY RESEARCH QUESTIONS REMAIN!

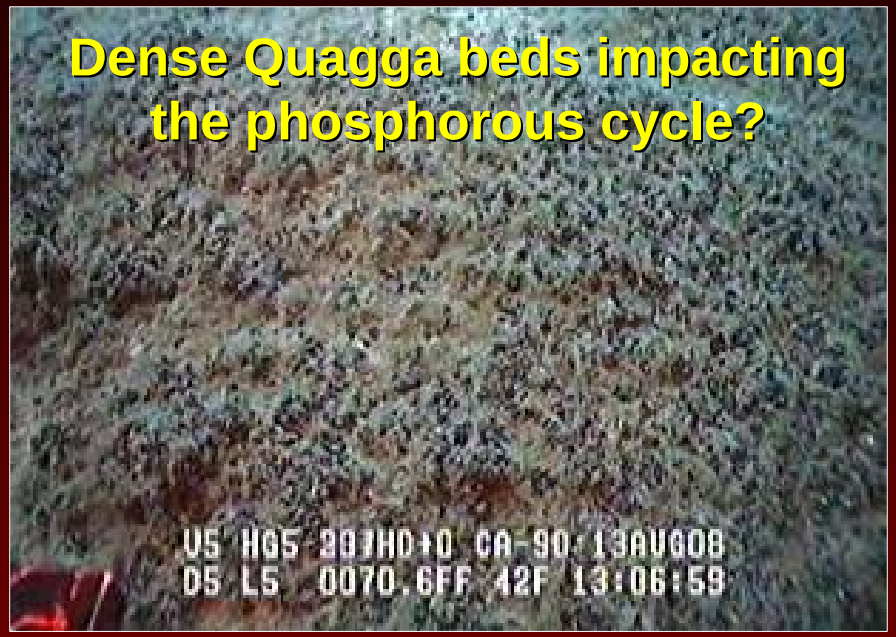
Sleeping Bear Dunes

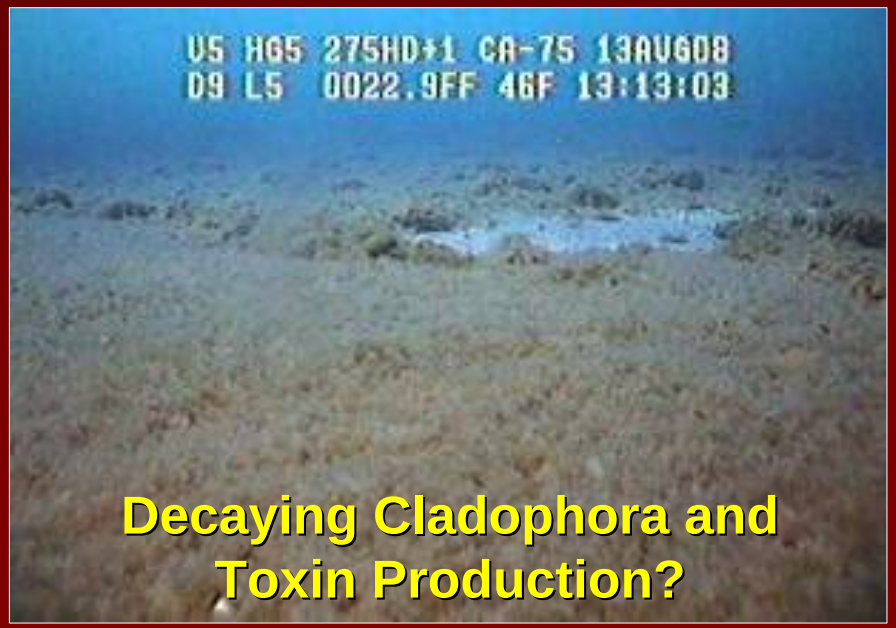
August 2008 ROV Underwater Video



Light penetration easily exceeds 50 meters

More Underwater Video – More Questions

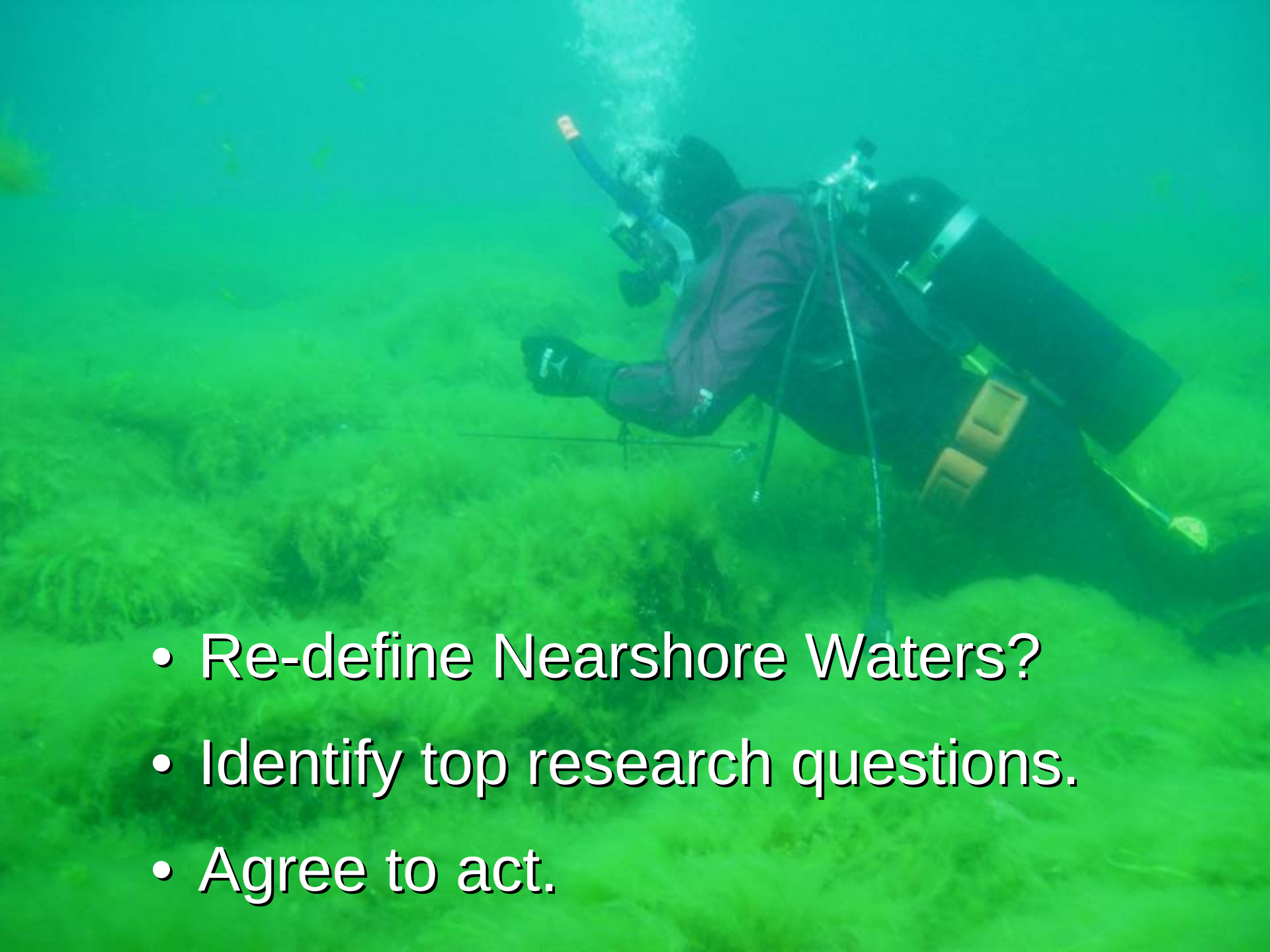




The Beaches of Today Indicate the Health of the Lake Michigan Nearshore Waters

Which is of the most concern?

Human Food Impacts … Visitor Experience & Safety … Ecological Impacts



- Re-define Nearshore Waters?
- Identify top research questions.
- Agree to act.

Acknowledgments

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- NPS Midwest Regional Specialists Brenda Moraska Lafrancois and Jay Glase
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