Contaminants, Biotic Communities, and Invasive Species

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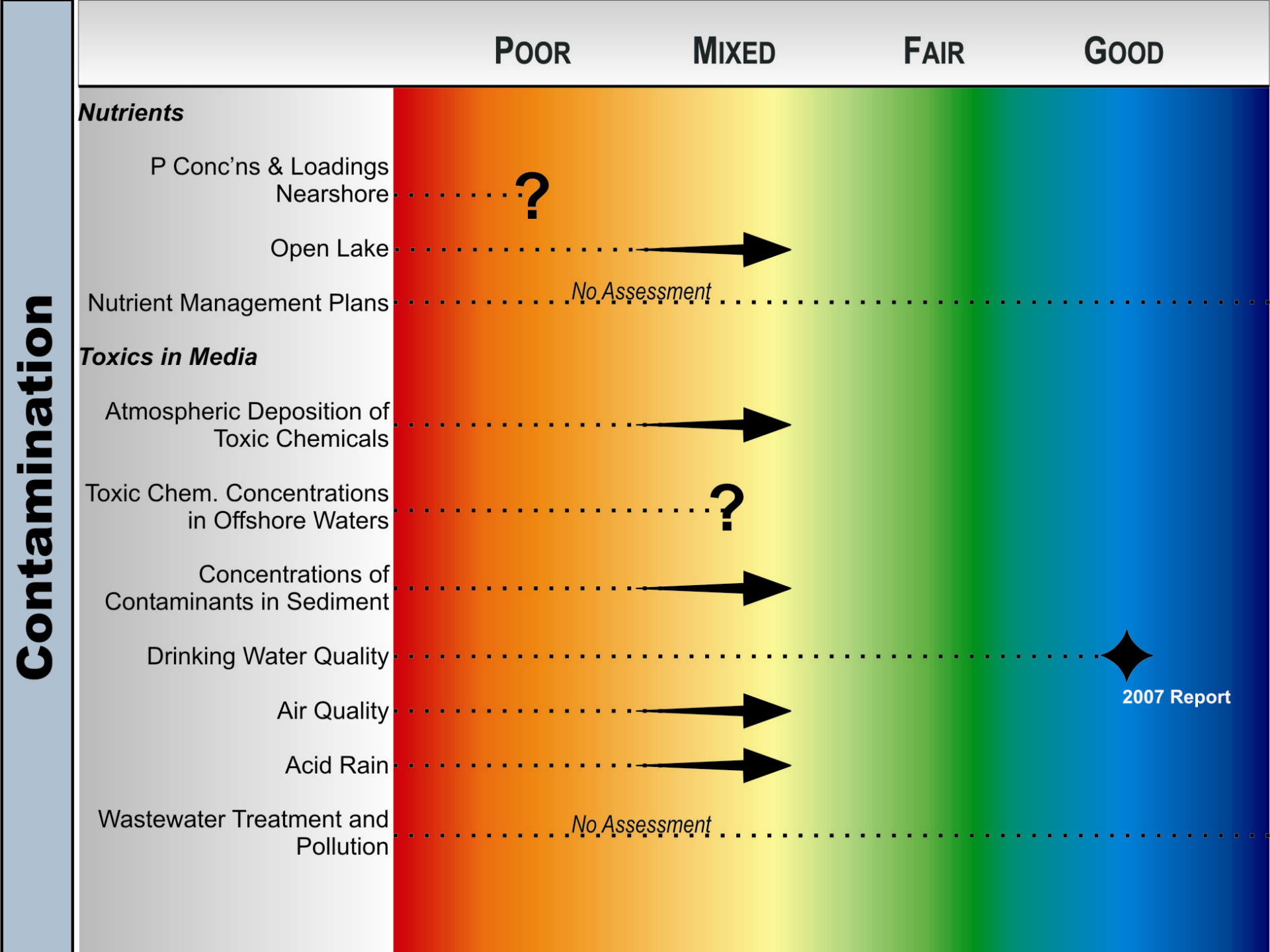
U.S. Fish & Wildlife Service

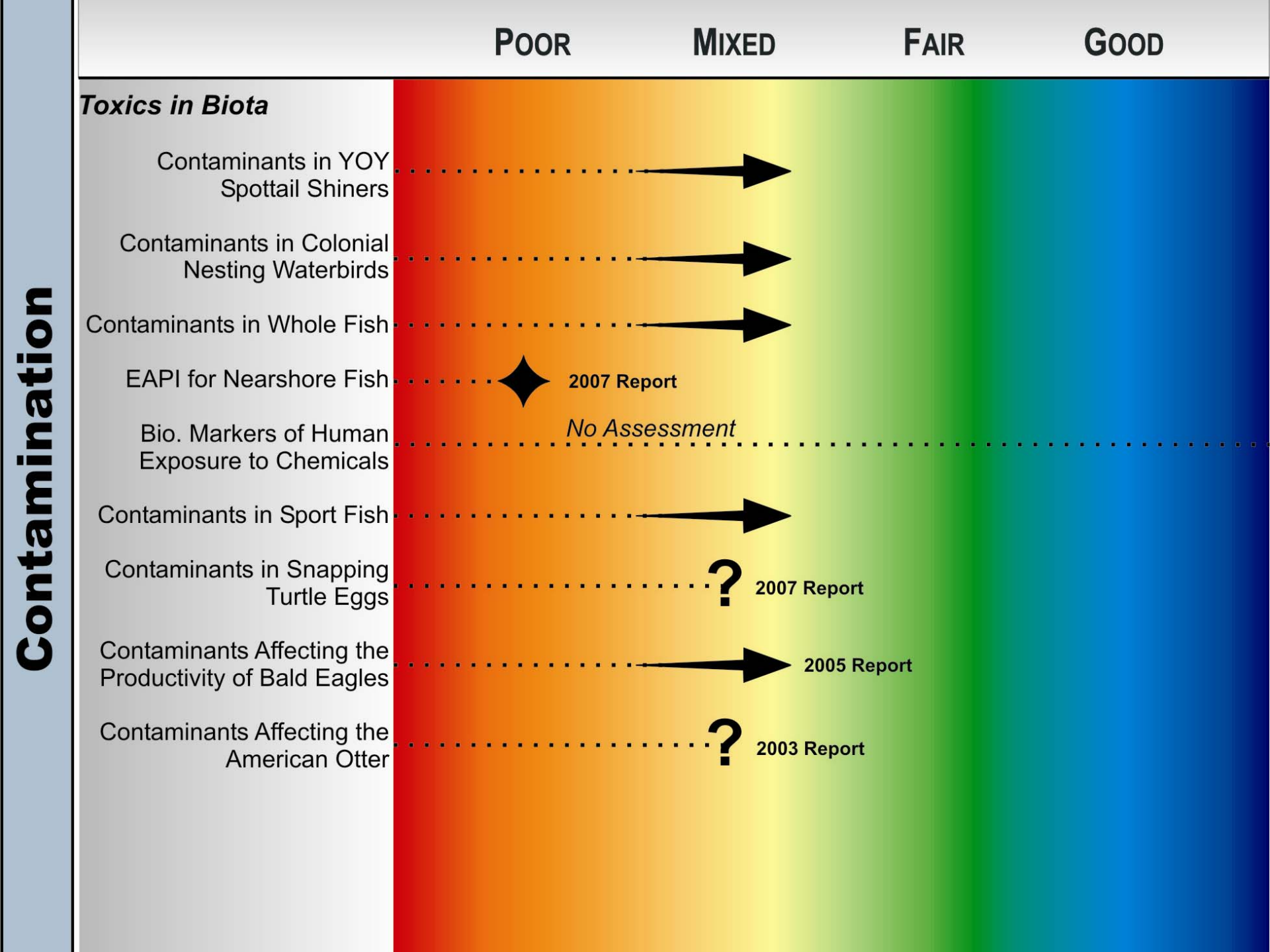
Contaminants

The Great Lakes should be free from materials entering the water as a result of human activity that will produce conditions that are toxic or harmful to human, animal, or aquatic life

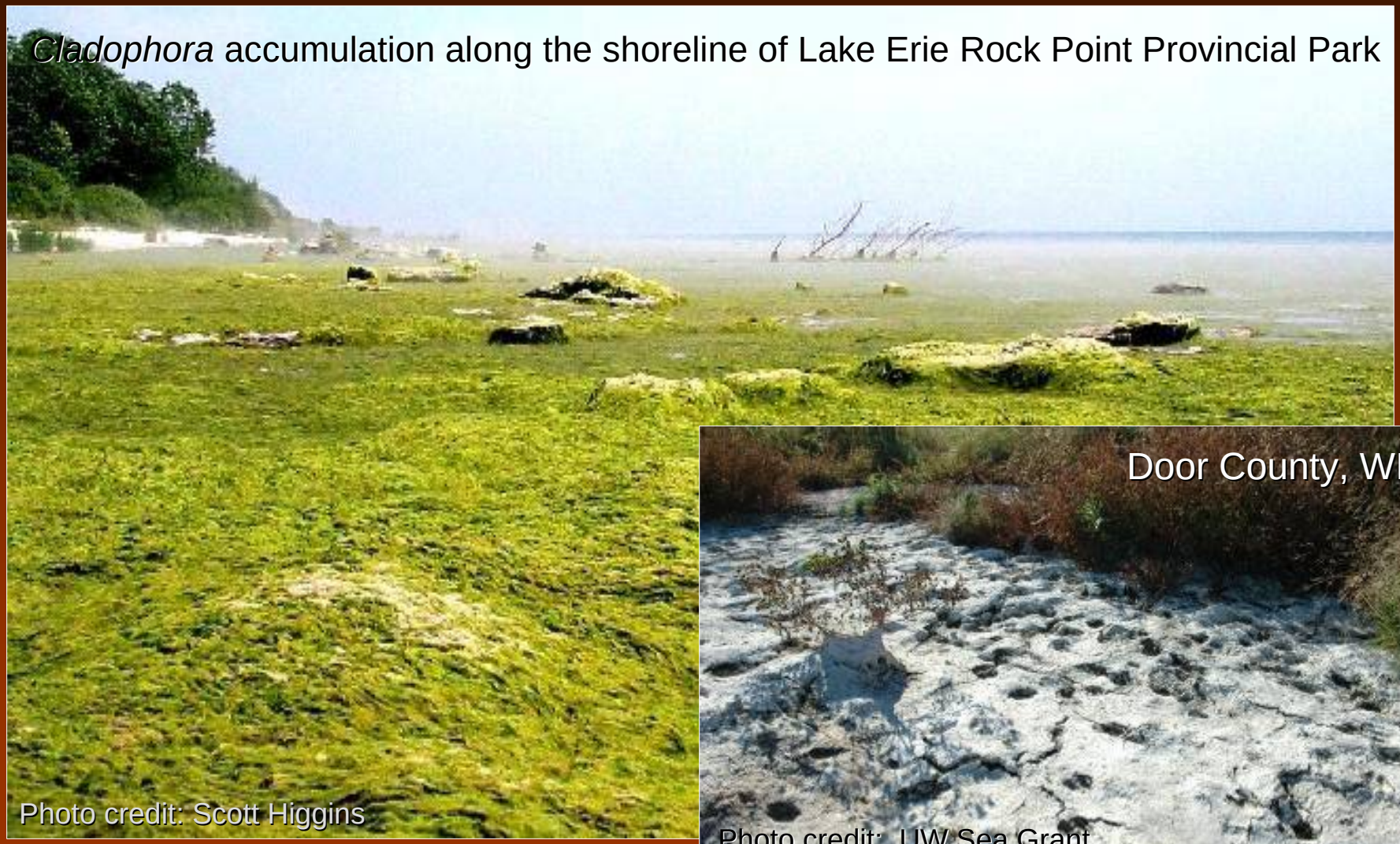
-Great Lakes Water Quality Agreement, Article III9d), 1987

Photo Credit: M. Weimer


Contamination
Poor
Mixed
Fair
Good
Nutrients
P Conc'ns & Loadings Nearshore
?
Open Lake
Nutrient Management Plans
No Assessment
Toxics in Media
Atmospheric Deposition of Toxic Chemicals
Toxic Chem. Concentrations in Offshore Waters
?
Concentrations of Contaminants in Sediment
Drinking Water Quality
2007 Report
Air Quality
Acid Rain
Wastewater Treatment and Pollution
No Assessment

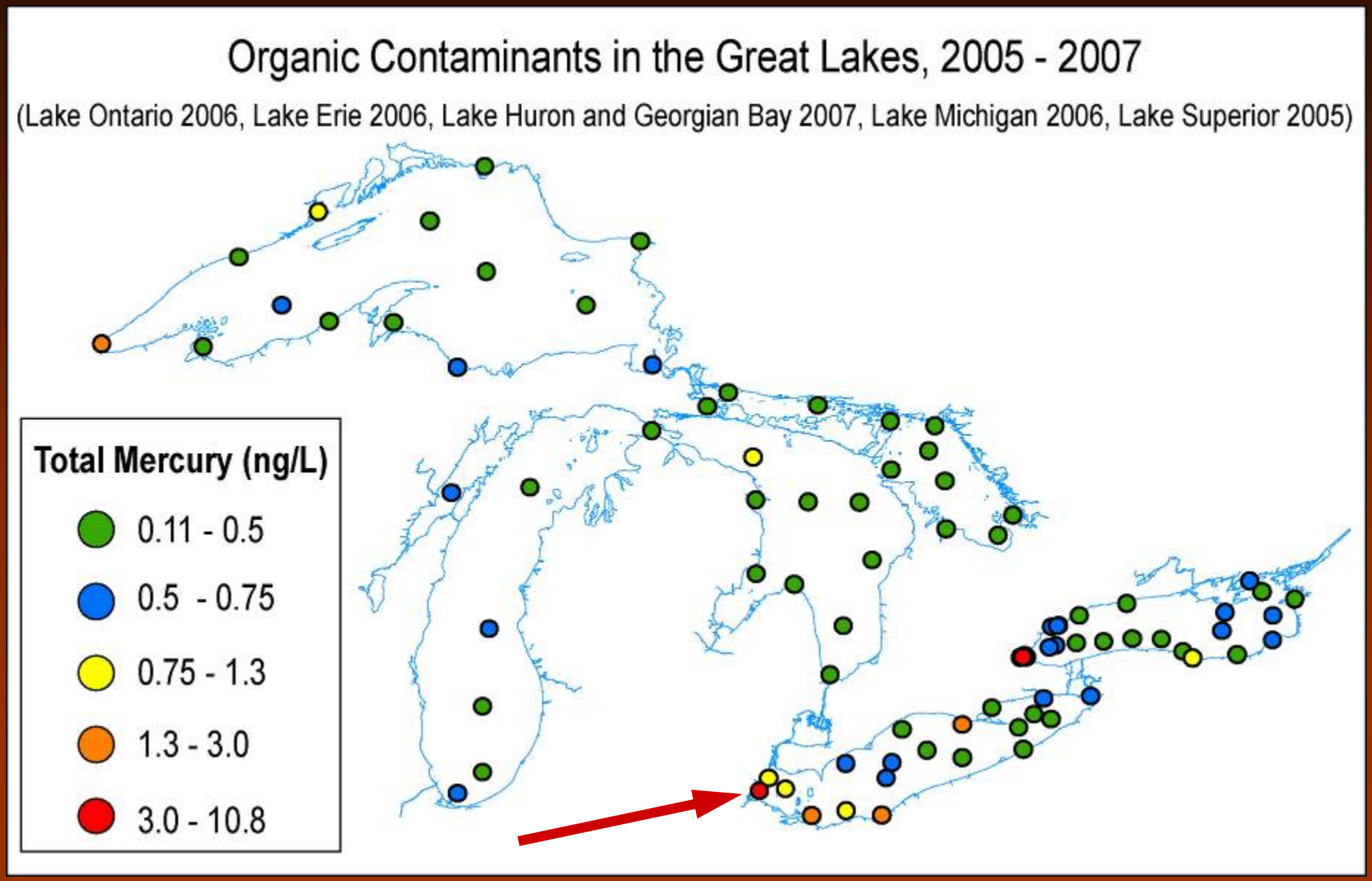

Contamination
Poor
Mixed
Fair
Good
Toxics in Biota
Contaminants in YOY Spottail Shiners
Contaminants in Colonial Nesting Waterbirds
Contaminants in Whole Fish
EAPI for Nearshore Fish
2007 Report
Bio. Markers of Human Exposure to Chemicals
No Assessment
Contaminants in Sport Fish
Contaminants in Snapping Turtle Eggs
2007 Report
Contaminants Affecting the Productivity of Bald Eagles
2005 Report
Contaminants Affecting the American Otter
2003 Report

Phosphorus Loading



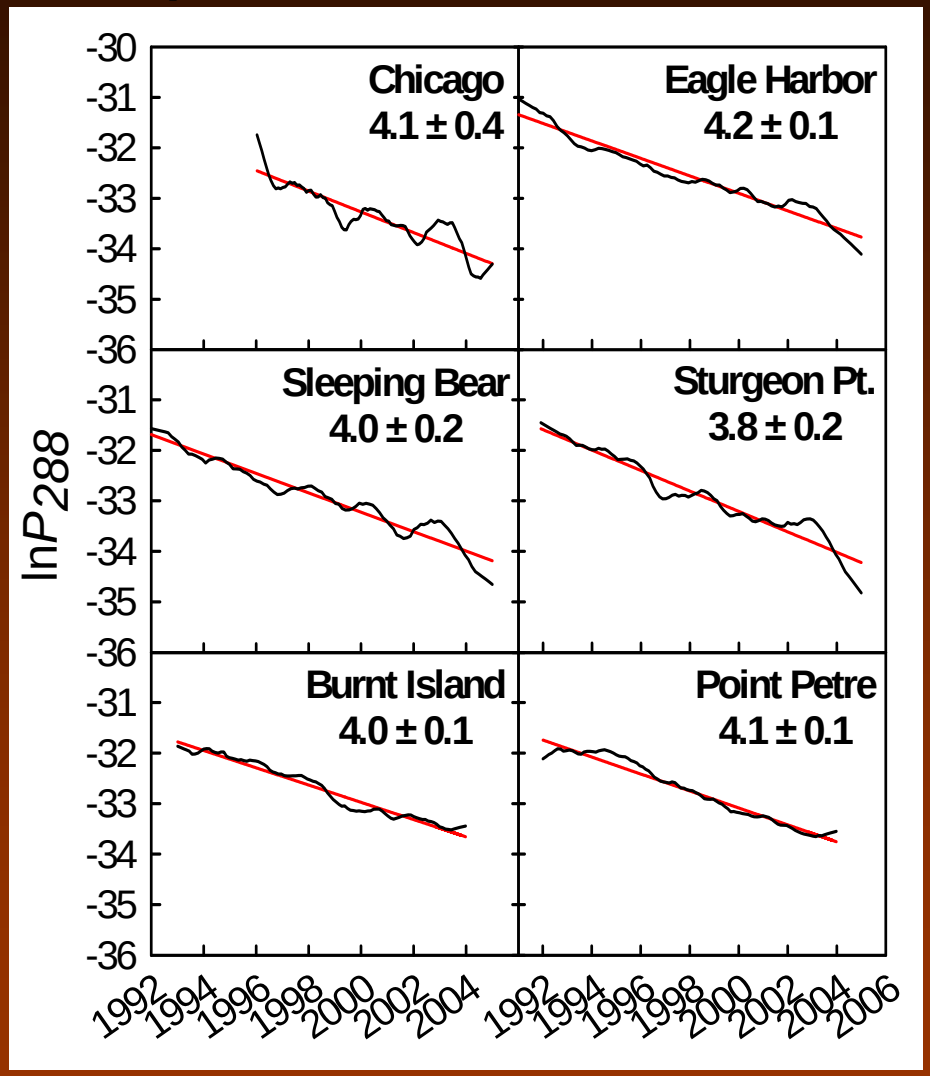
Acid Rain

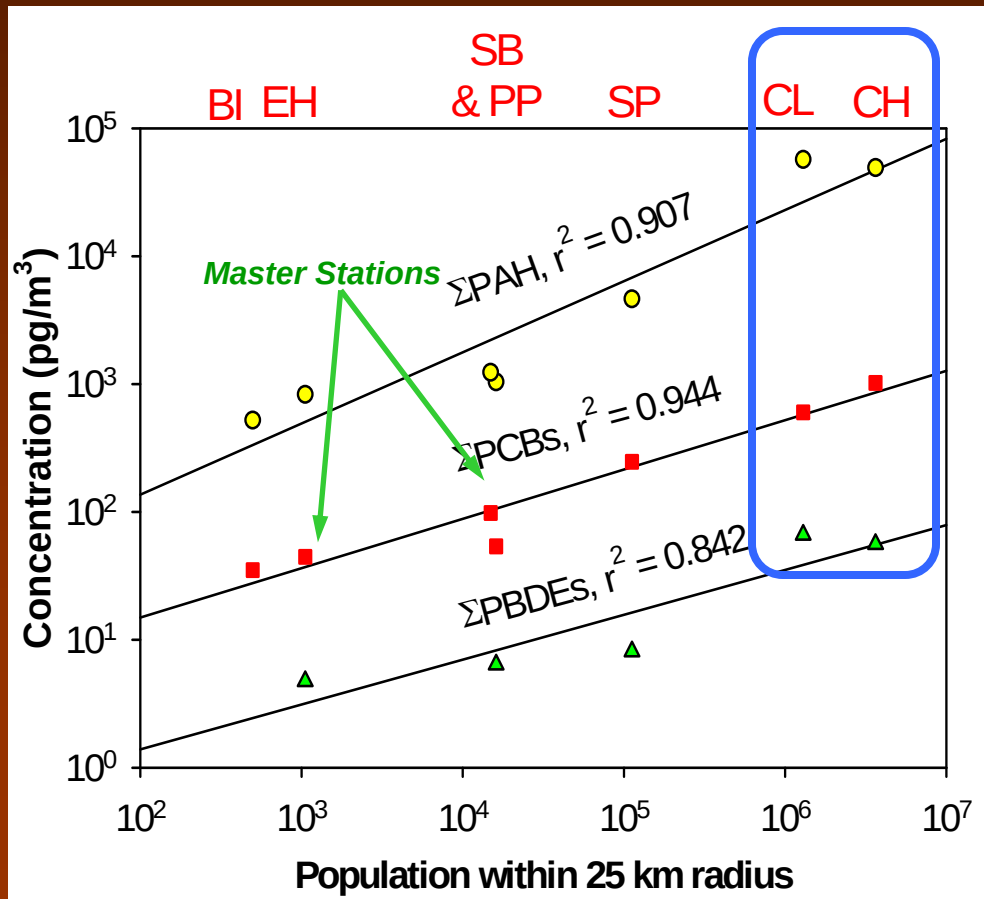
Toxic Contaminants in Offshore Waters



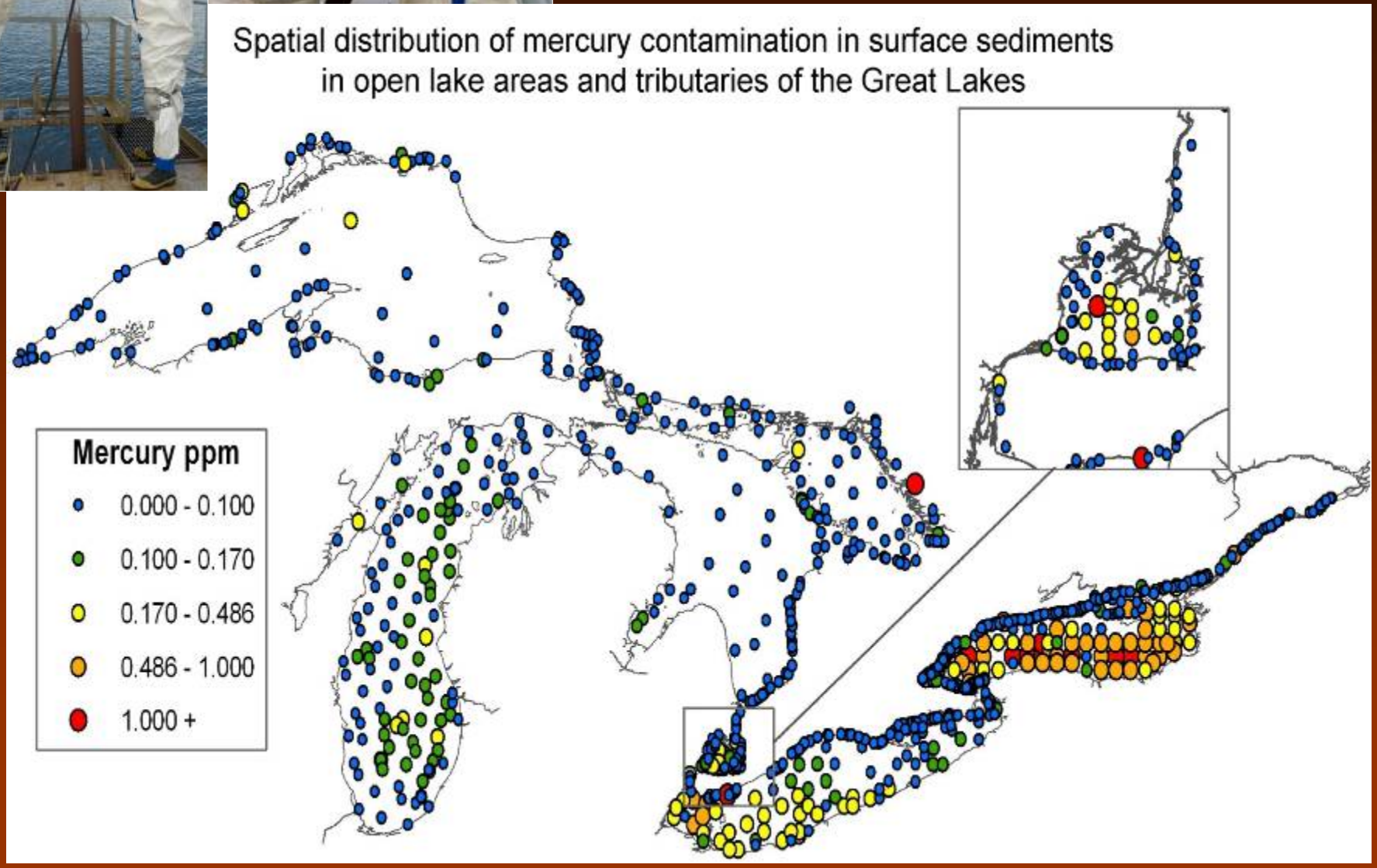
Atmospheric Deposition

Gas phase α-HCH

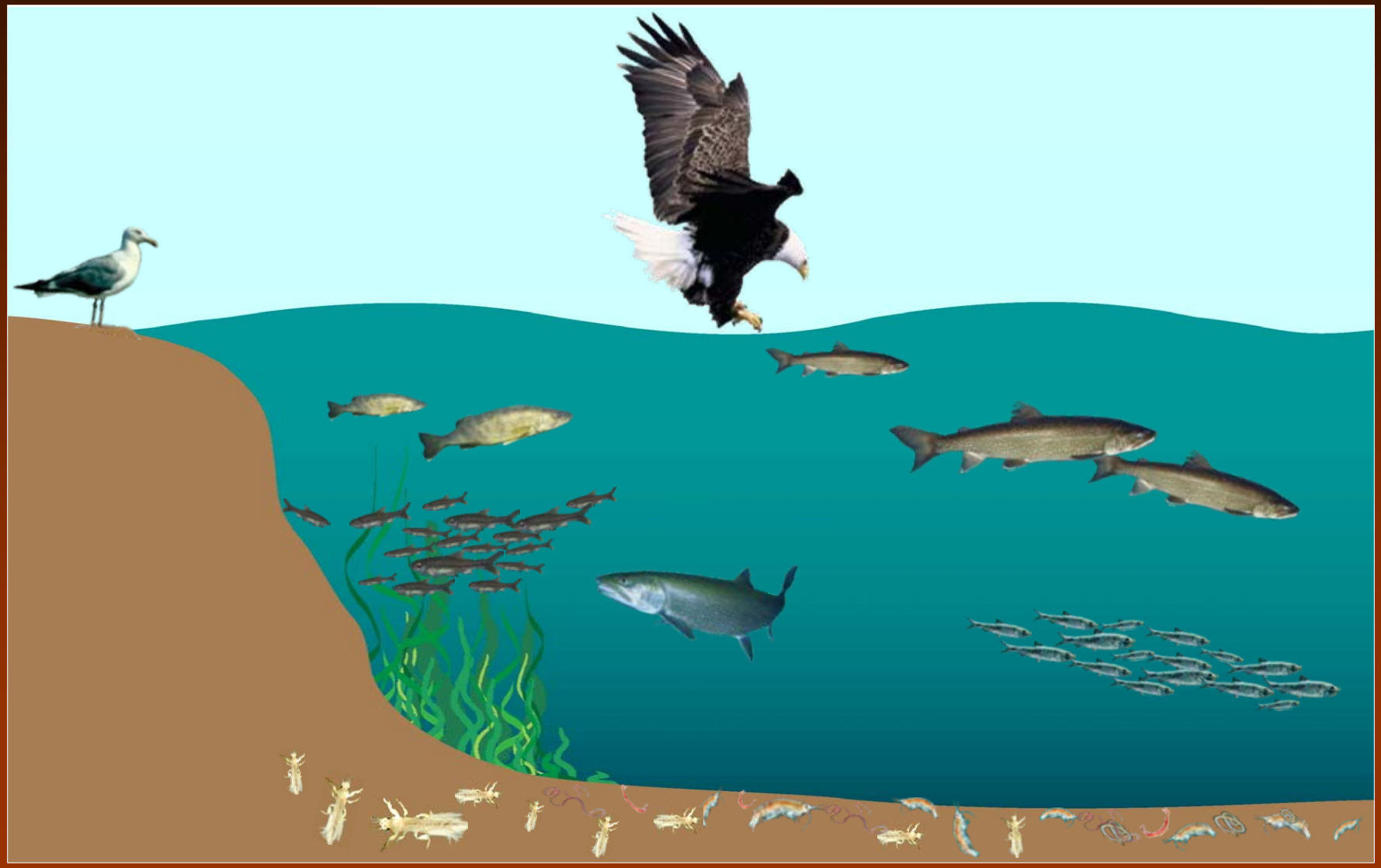




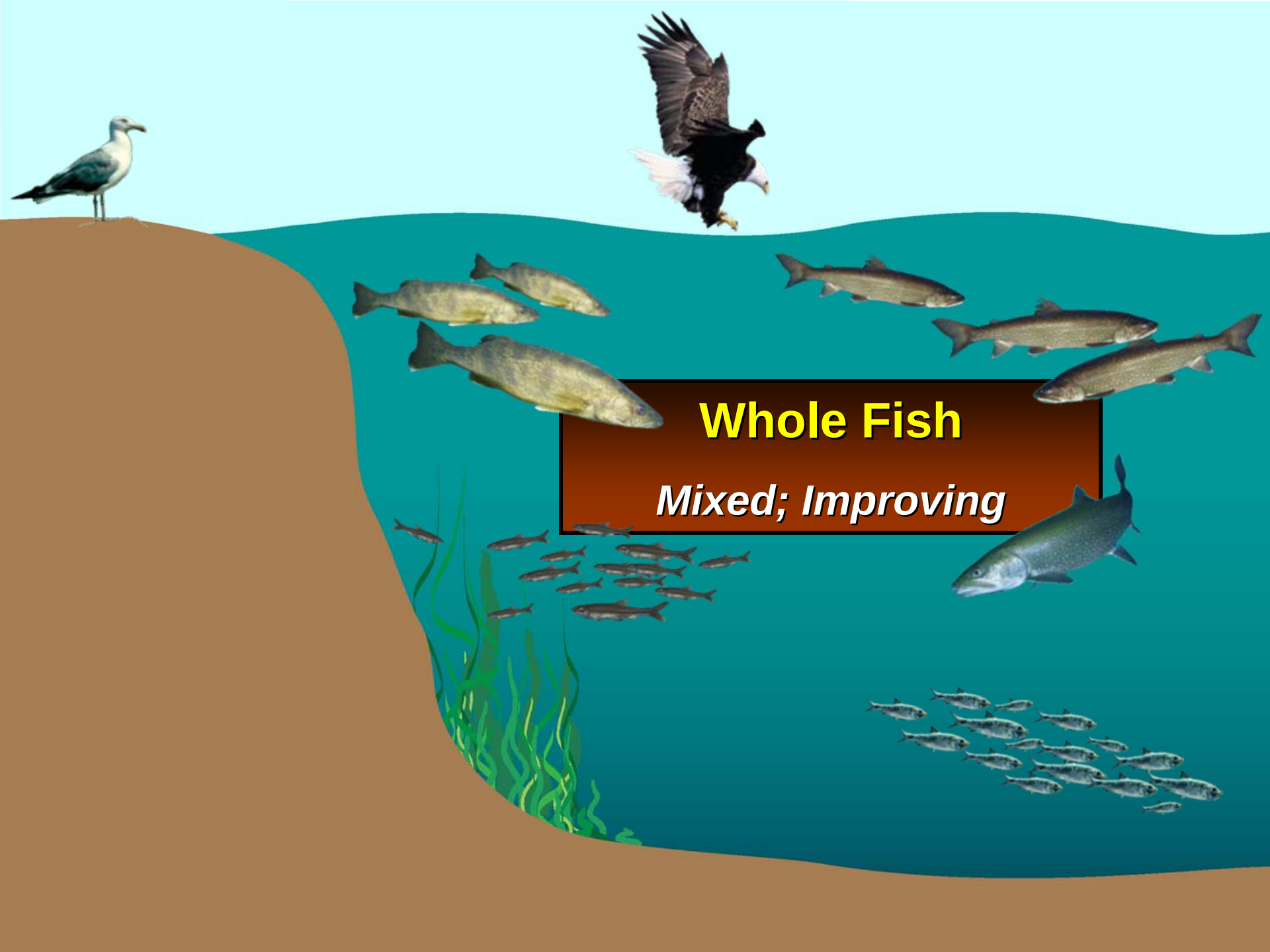
Sediments

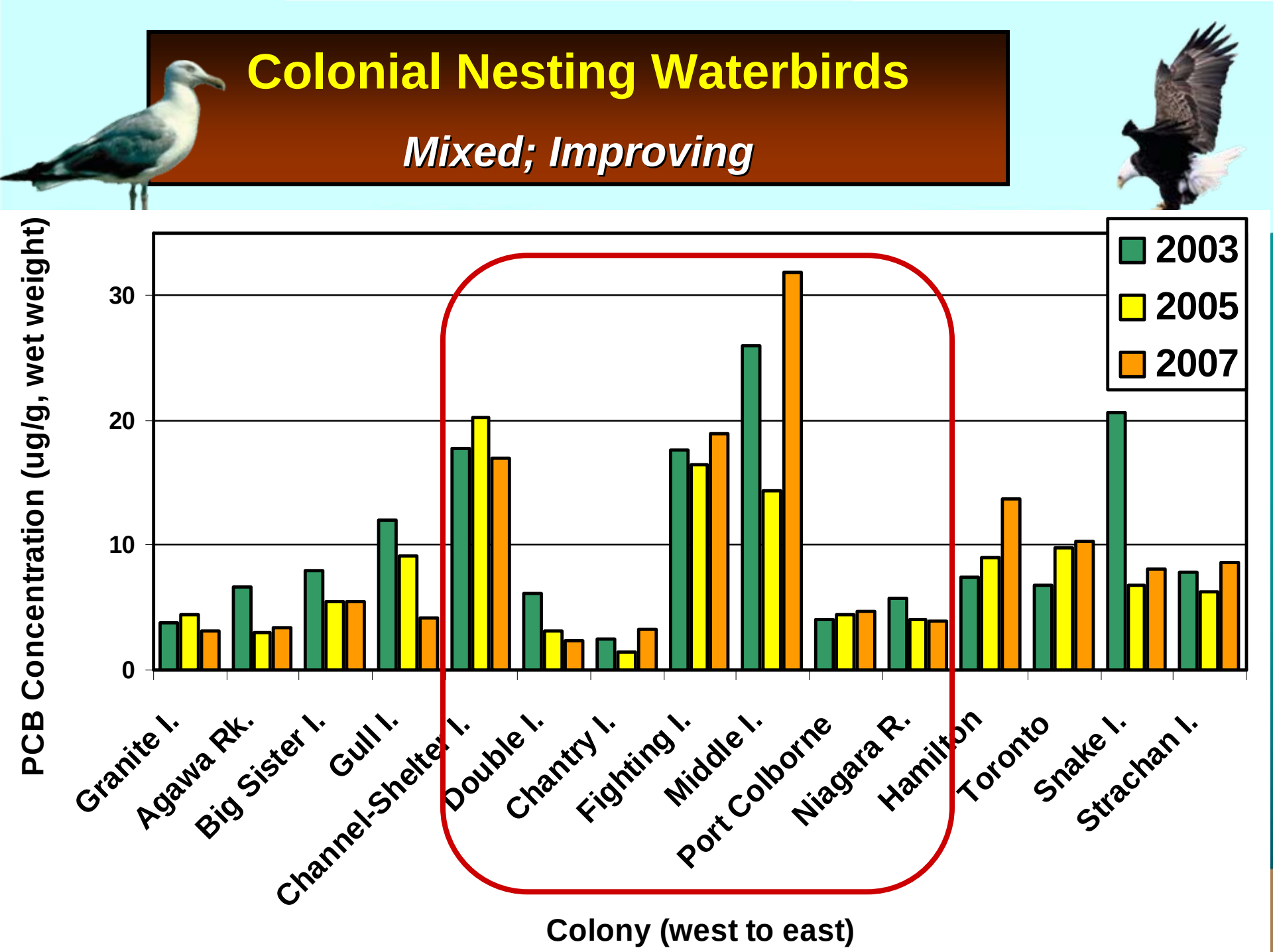

Spatial distribution of mercury contamination in surface sediments
in open lake areas and tributaries of the Great Lakes
Mercury ppm
0.000 - 0.100
0.100 - 0.170
0.170 - 0.486
0.486 - 1.000
1.000 +

Contaminants in Fish and Wildlife



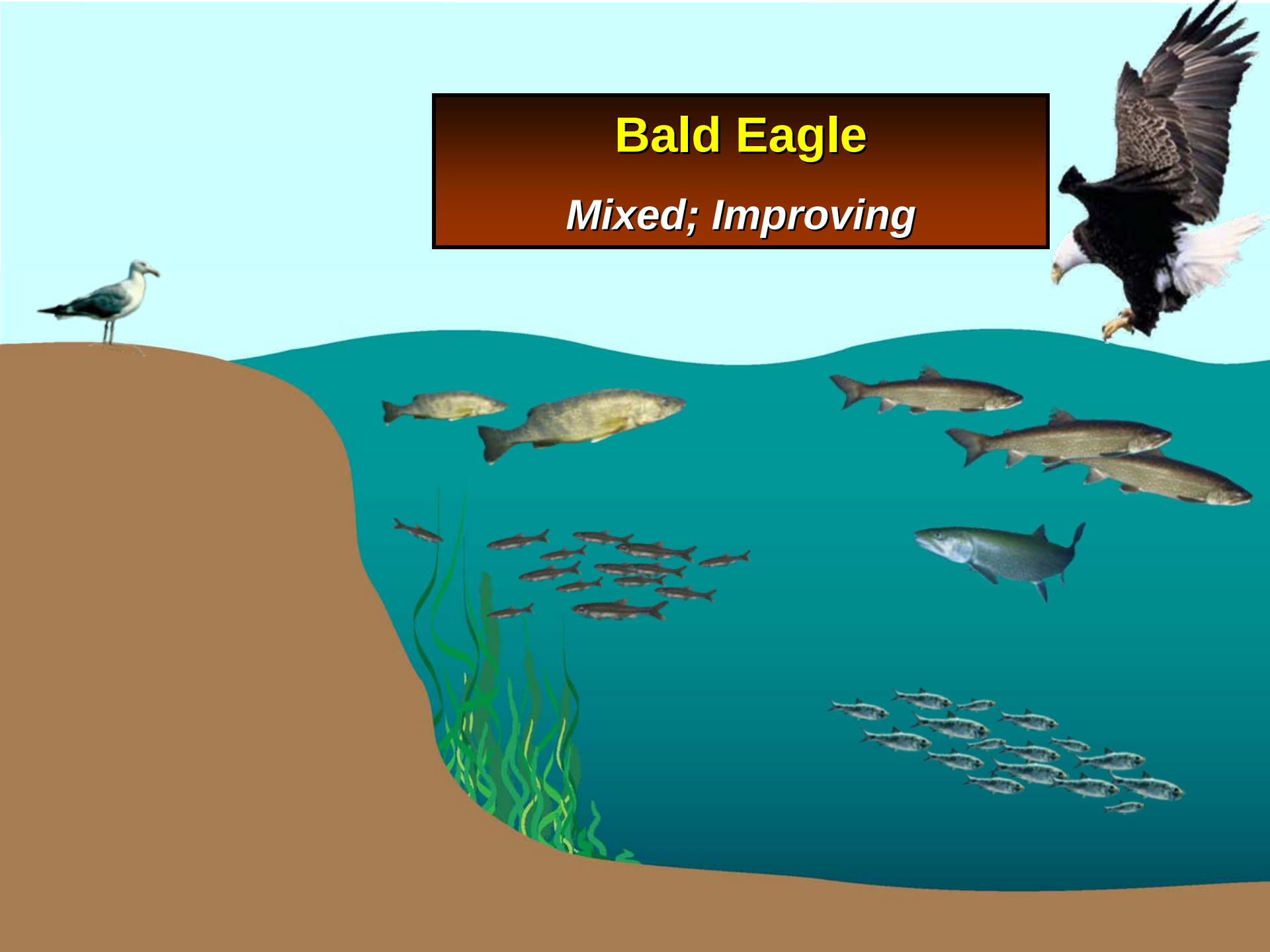
Spottail Shiners
Mixed; Improving


Whole Fish
Mixed; Improving

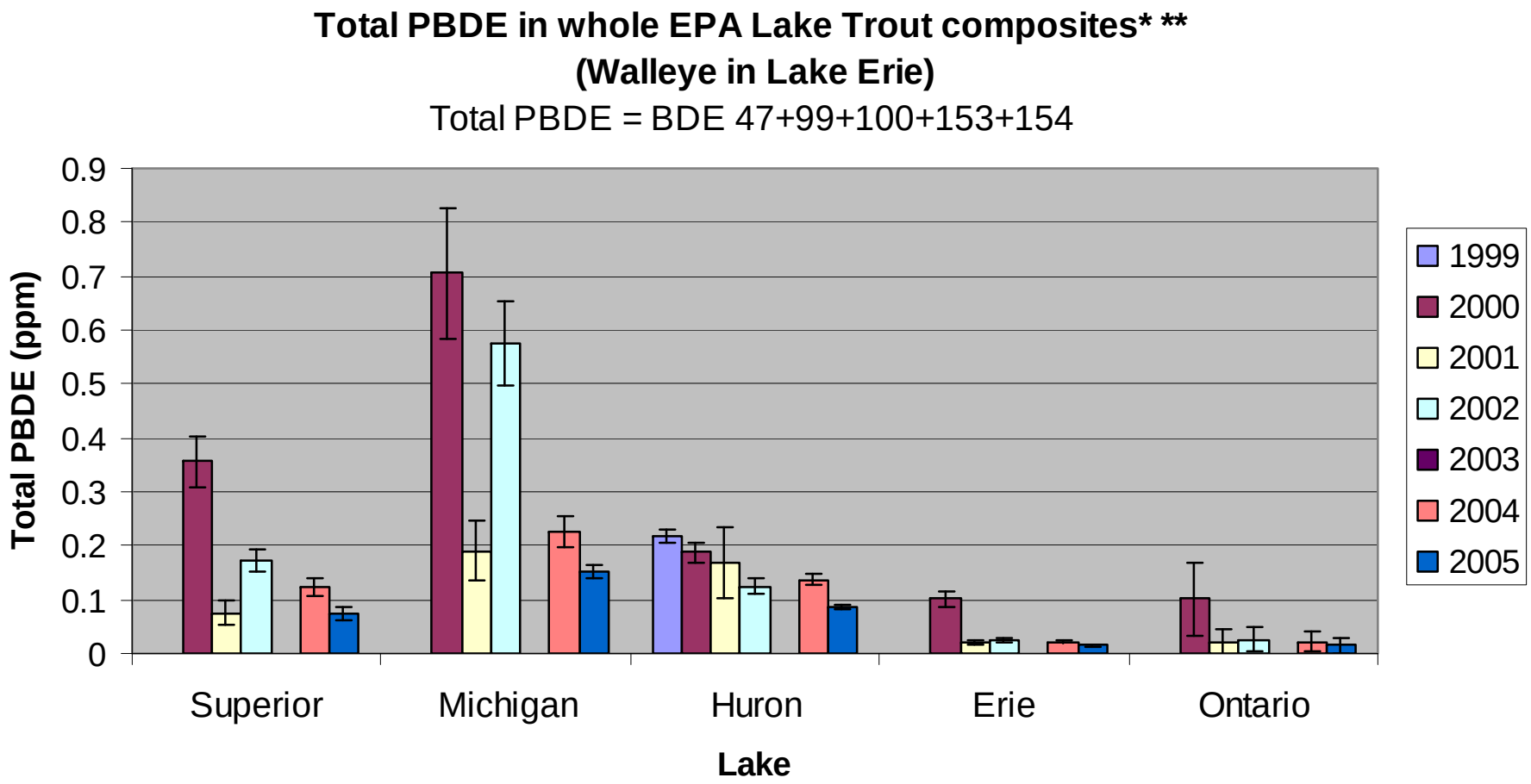

Colonial Nesting Waterbirds
Mixed; Improving
2003
2005
2007
PCB Concentration (ug/g, wet weight)
0
10
20
30
Granite I.
Agawa Rk.
Big Sister I.
Gull I.
Channel-Shelter I.
Double I.
Chantry I.
Fighting I.
Middle I.
Port Colborne
Niagara R.
Hamilton
Toronto
Snake I.
Strachan I.
Colony (west to east)

Bald Eagle

Mixed; Improving



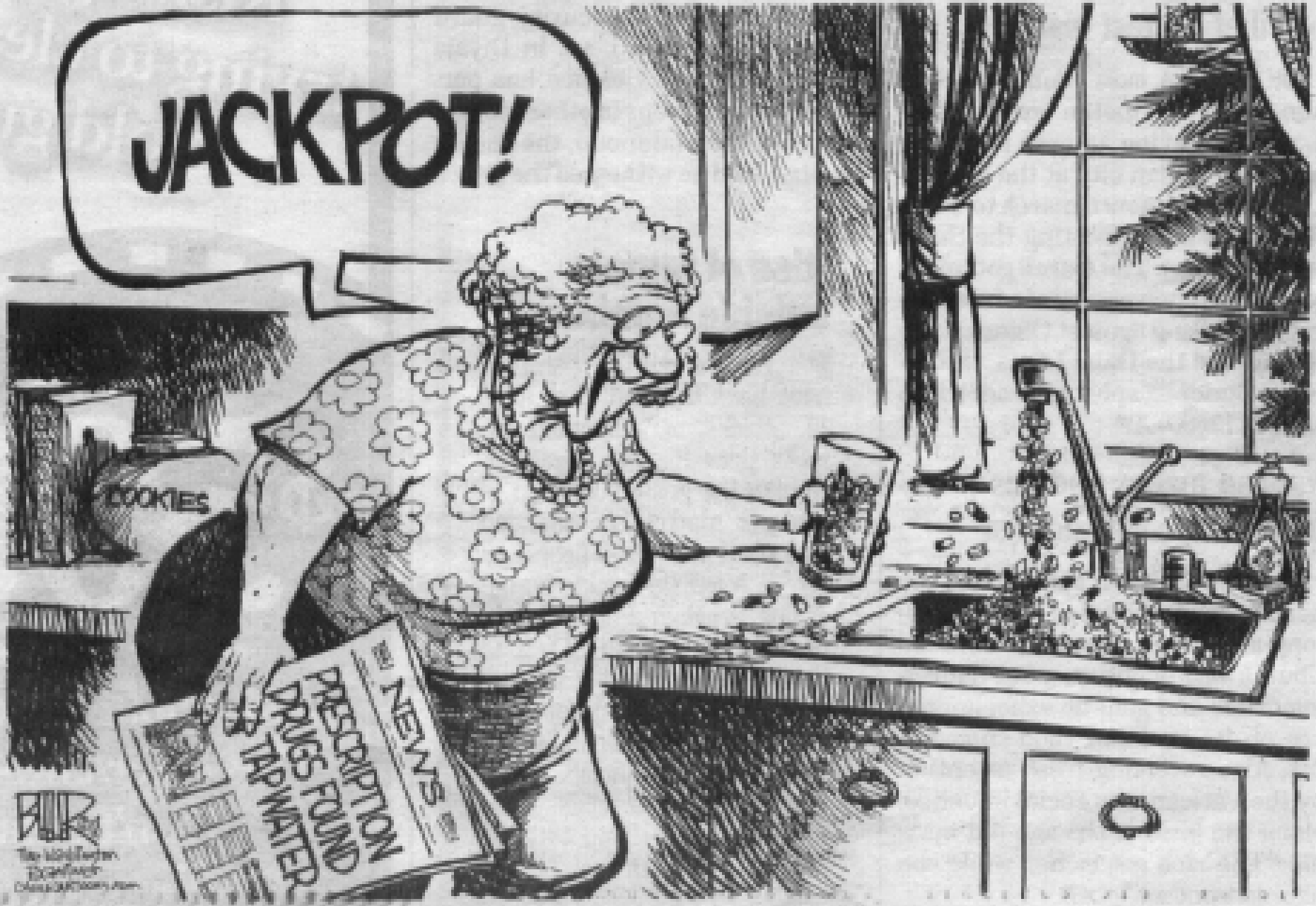
Emerged Contaminants



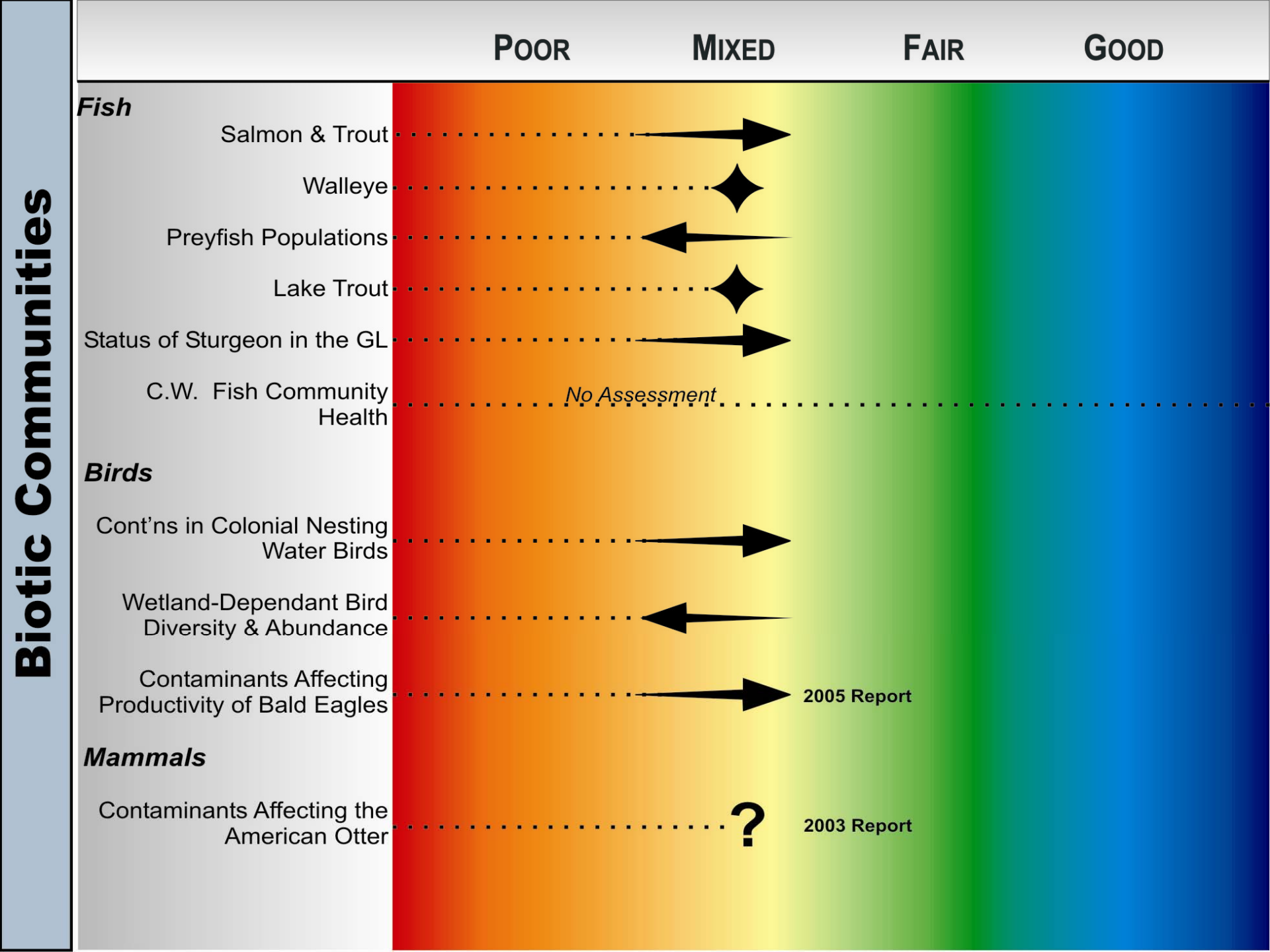
* Even year samples collected: Apsotle Islands - LS, Saugatuck - LM, Rockport - LH, Middle Bass Island - LE, Oswego - LO

** Odd year samples collected: Keewenaw Pen. - LS, Sturgeon Bay - LM, Port Austin - LH, Dunkirk - LE, North Hamlin - LO

EDITORIAL CARTOON *By Nate Beeler/Examiner*



Biotic Communities


Biotic Communities
POOR
MIXED
FAIR
GOOD
Fish
Salmon & Trout
Walleye
Preyfish Populations
Lake Trout
Status of Sturgeon in the GL
C.W. Fish Community Health
No Assessment
Birds
Cont'ns in Colonial Nesting Water Birds
Wetland-Dependant Bird Diversity & Abundance
Contaminants Affecting Productivity of Bald Eagles
2005 Report
Mammals
Contaminants Affecting the American Otter
?
2003 Report

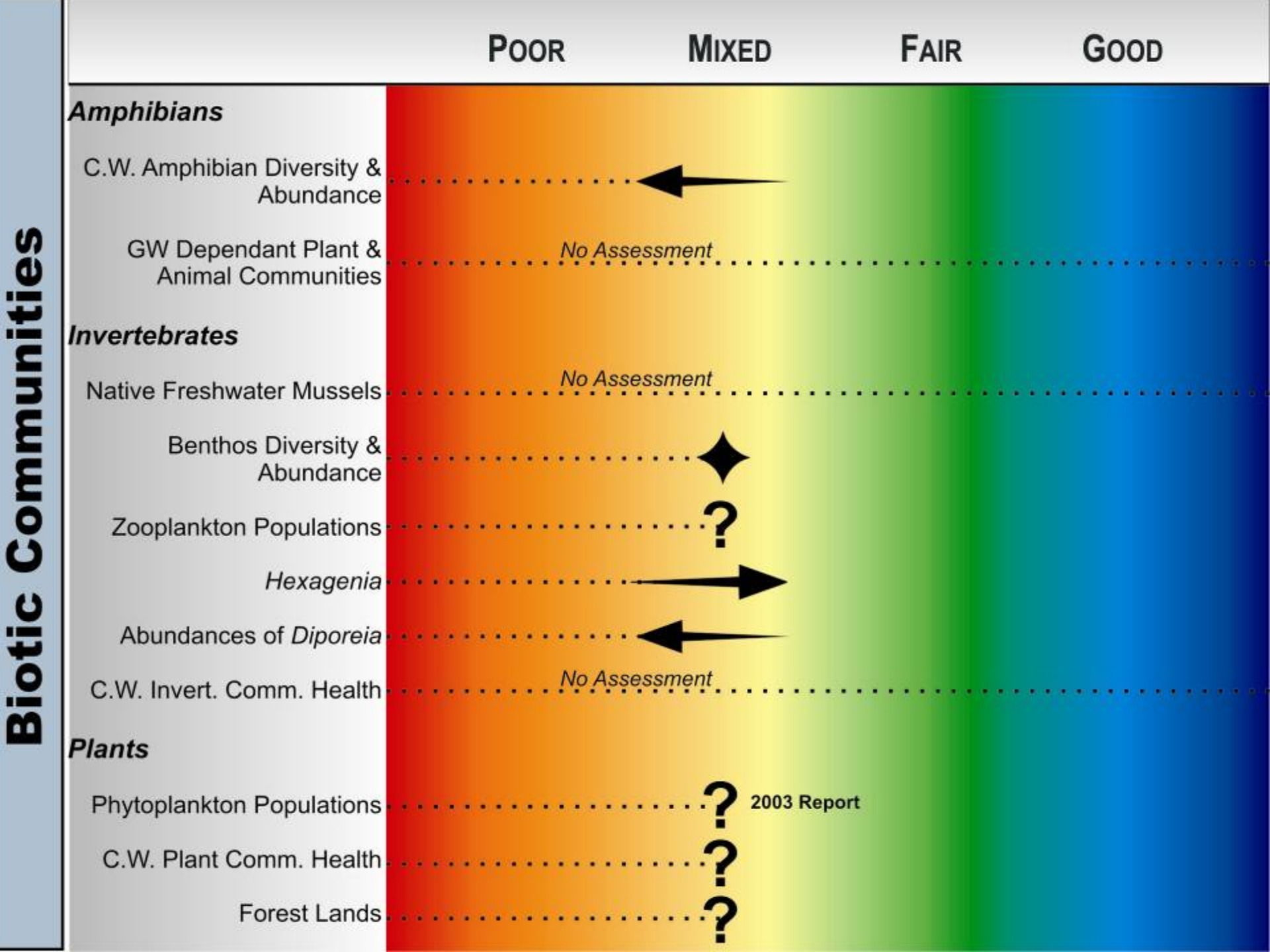
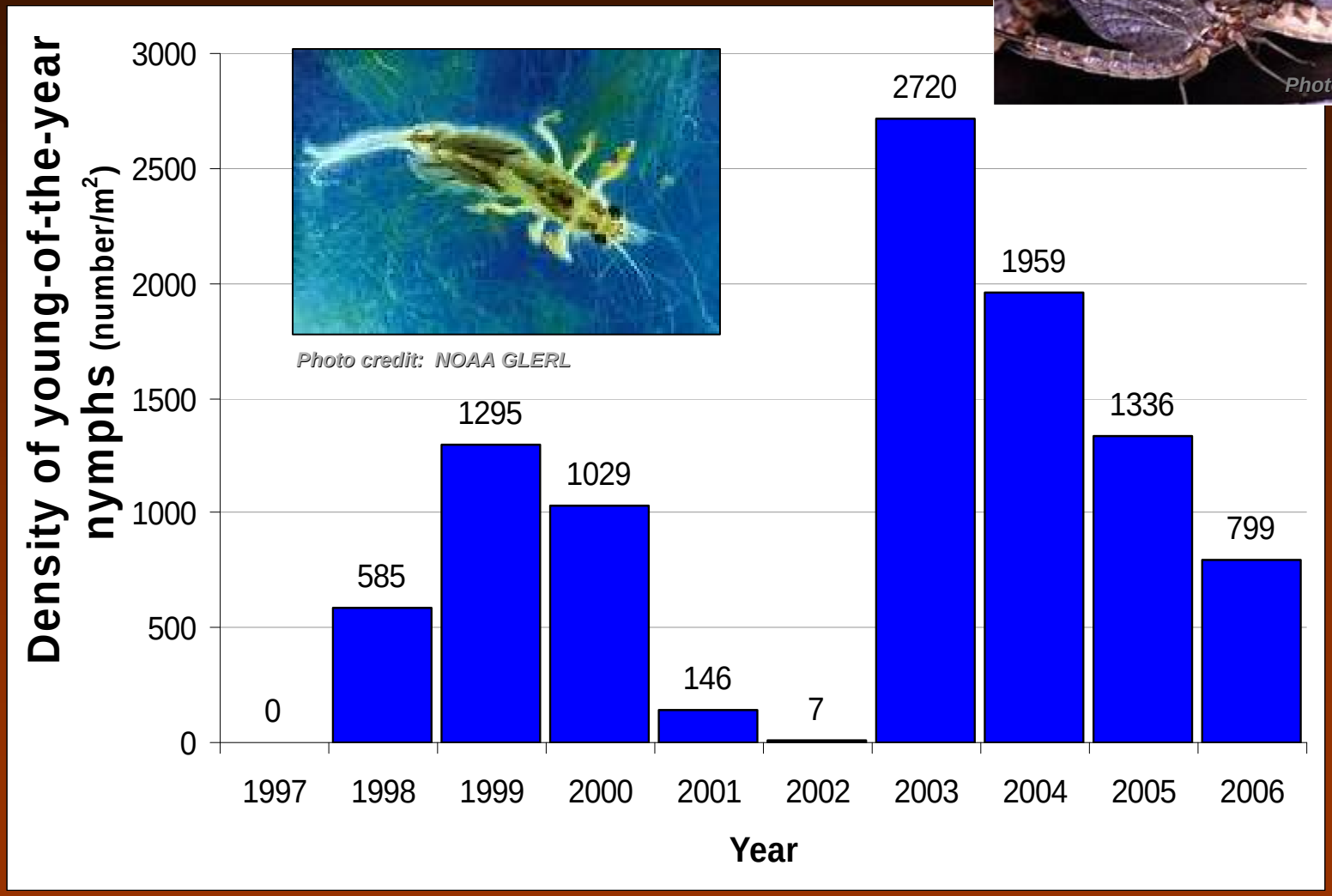

Biotic Communities
POOR
MIXED
FAIR
GOOD
Amphibians
C.W. Amphibian Diversity & Abundance
GW Dependant Plant & Animal Communities
No Assessment
Invertebrates
Native Freshwater Mussels
No Assessment
Benthos Diversity & Abundance
Zooplankton Populations
Hexagenia
Abundances of Diporeia
C.W. Invert. Comm. Health
No Assessment
Plants
Phytoplankton Populations
2003 Report
C.W. Plant Comm. Health
Forest Lands

Photo credit: NOAA, GLERL – G. Carter

Benthos Diversity

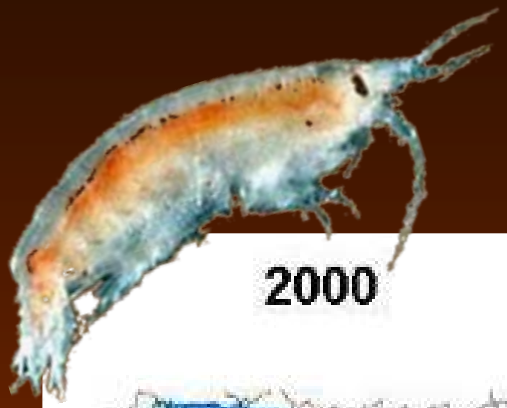
Mixed; Unchanging/Deteriorating

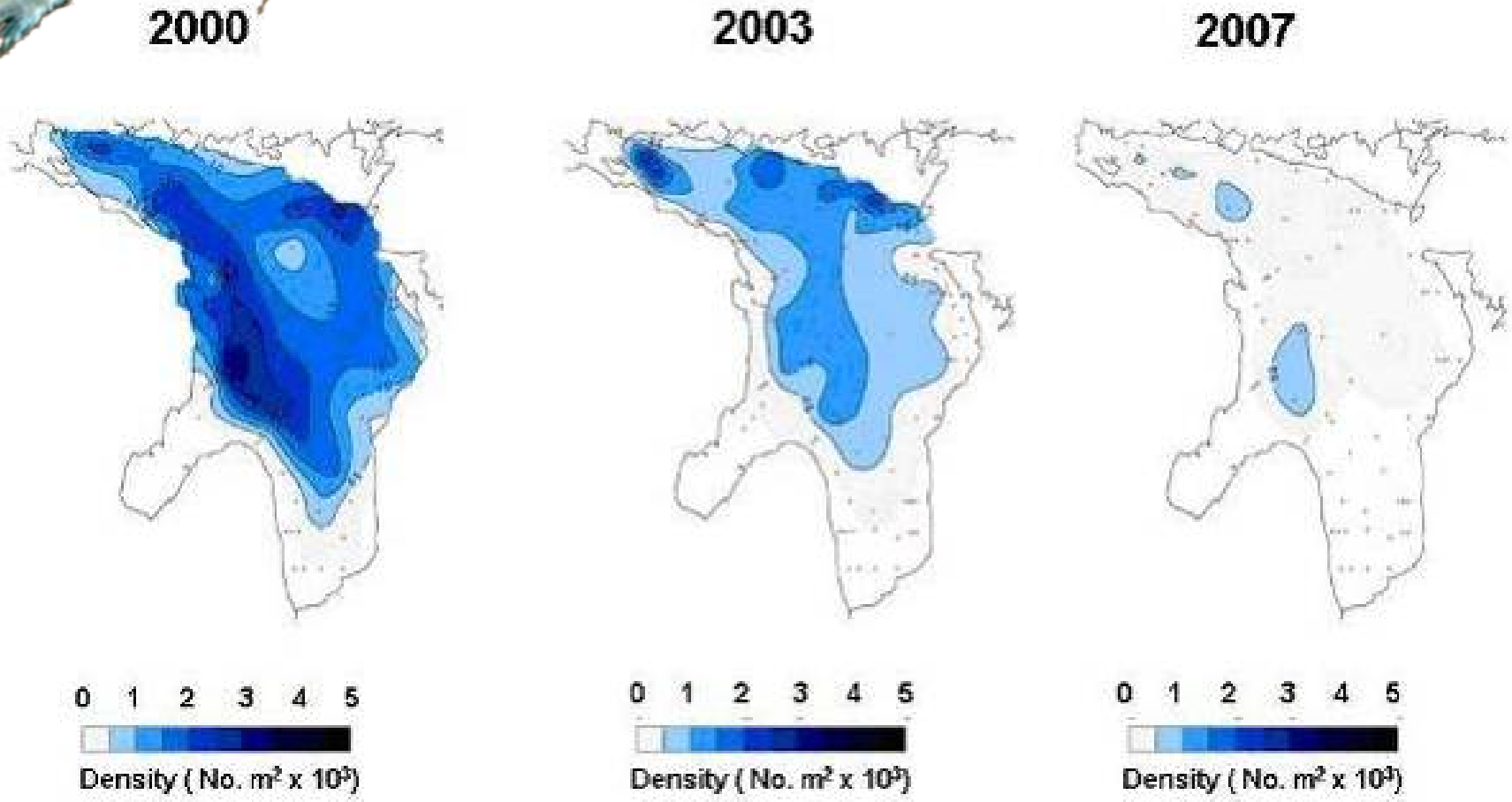
Hexagenia



Lake Erie

Diporeia




2000
2003
2007
0 1 2 3 4 5
Density (No. m² x 10³)
0 1 2 3 4 5
Density (No. m² x 10³)
0 1 2 3 4 5
Density (No. m² x 10³)

Native Freshwater Mussels

Mussel larvae (*glochidia*) on host fish
Photo: USFWS

USFWS divers conducting mussel survey

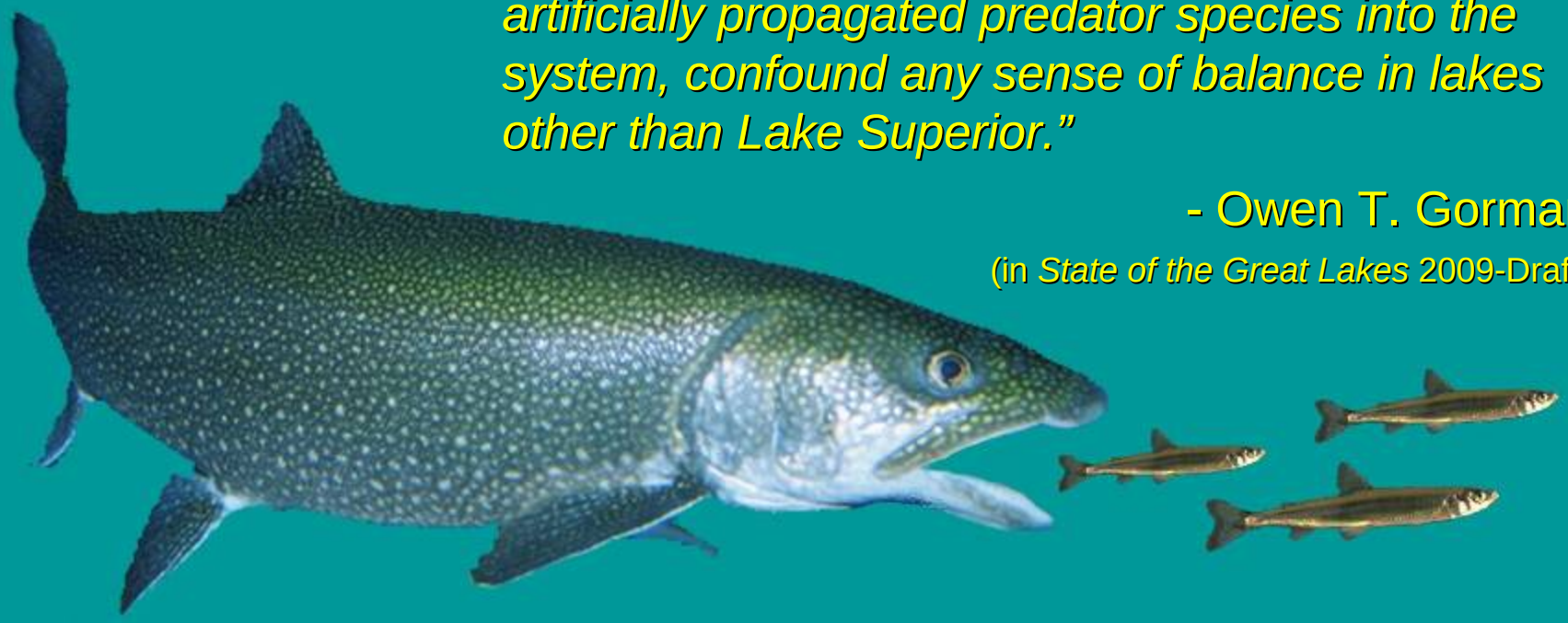
***Unionidae* mussel**

Prey Fish

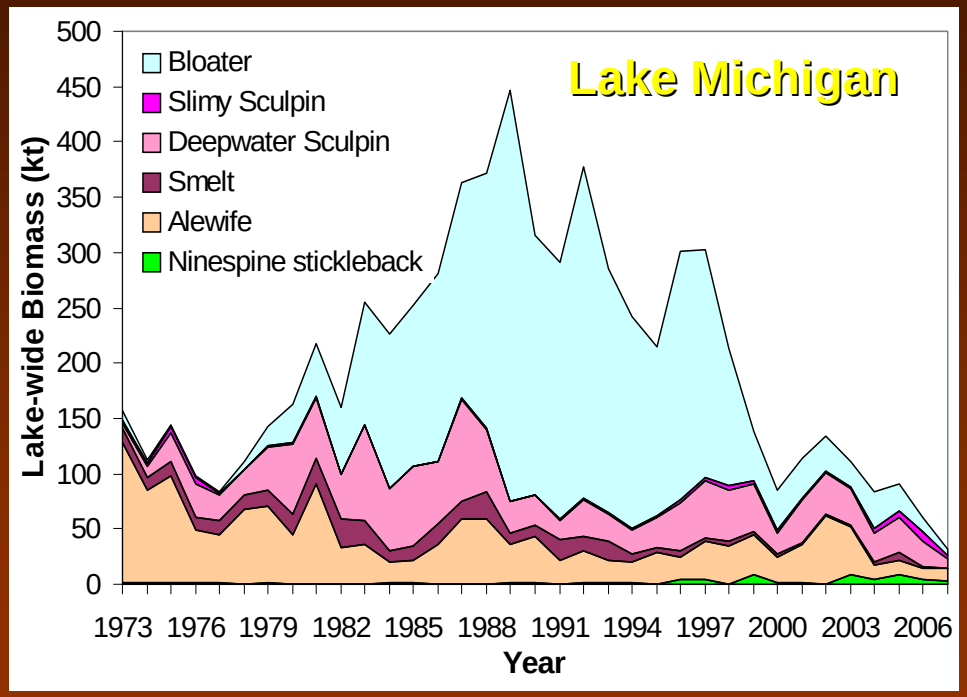
"…the current mix of native and naturalized prey and predator species, and the contributions of artificially propagated predator species into the system, confound any sense of balance in lakes other than Lake Superior."

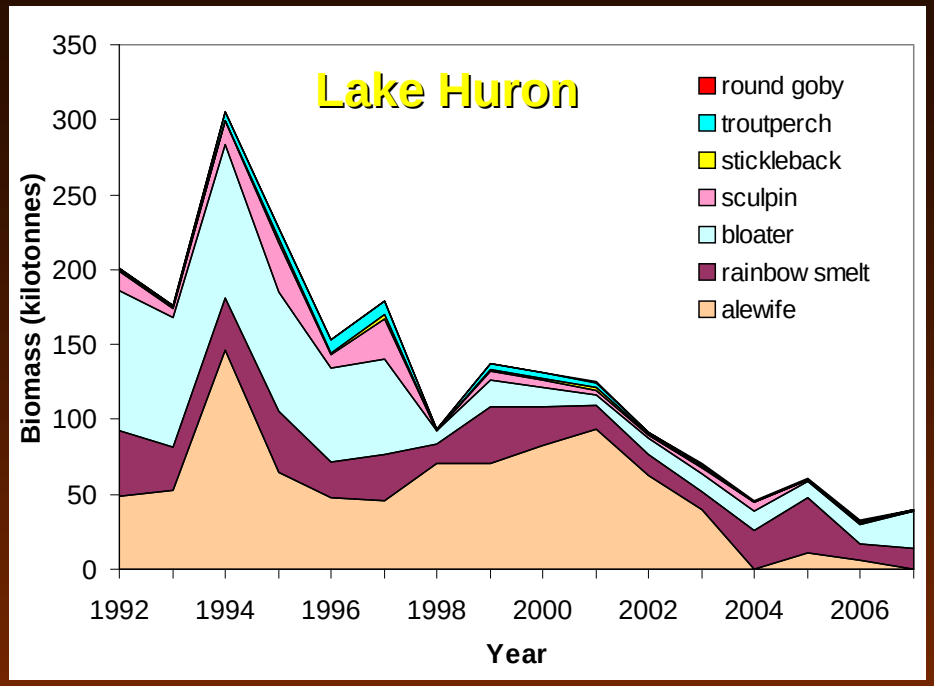
- Owen T. Gorman

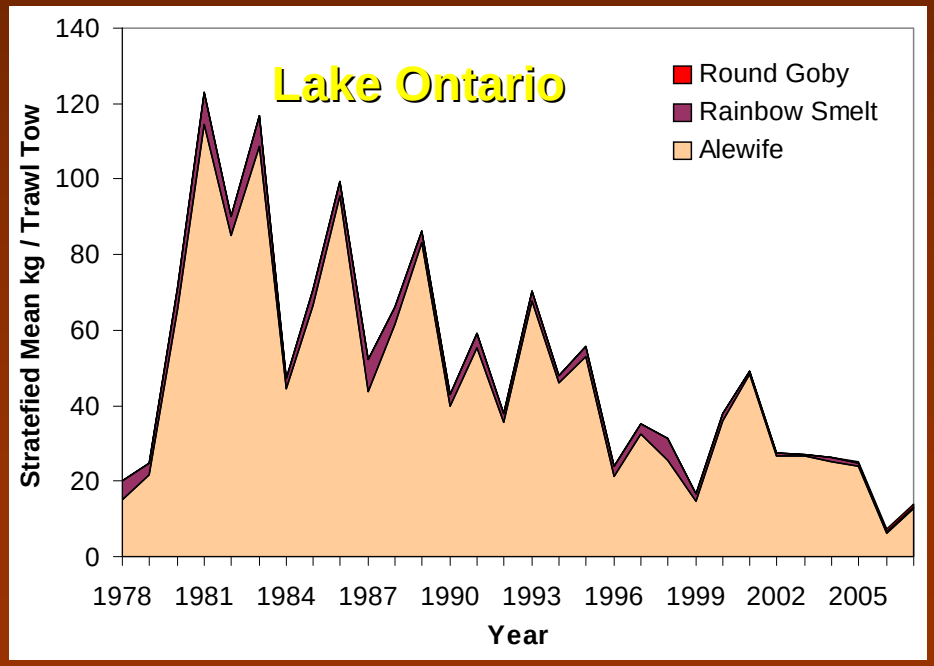
(in *State of the Great Lakes* 2009-Draft)



Prey Fish


Lake Michigan
Bloater
Slimy Sculpin
Deepwater Sculpin
Smelt
Alewife
Ninespine stickleback
Lake-wide Biomass (kt)
500
450
400
350
300
250
200
150
100
50
0
1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006
Year


Lake Huron
round goby
troutperch
stickleback
sculpin
bloater
rainbow smelt
alewife
Biomass (kilotonnes)
350
300
250
200
150
100
50
0
1992 1994 1996 1998 2000 2002 2004 2006
Year


Lake Ontario
Round Goby
Rainbow Smelt
Alewife
Stratefied Mean kg / Trawl Tow
140
120
100
80
60
40
20
0
1978 1981 1984 1987 1990 1993 1996 1999 2002 2005
Year

Salmon and Trout

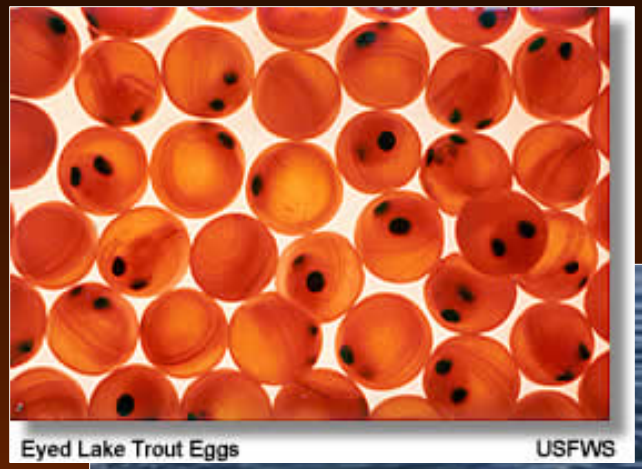
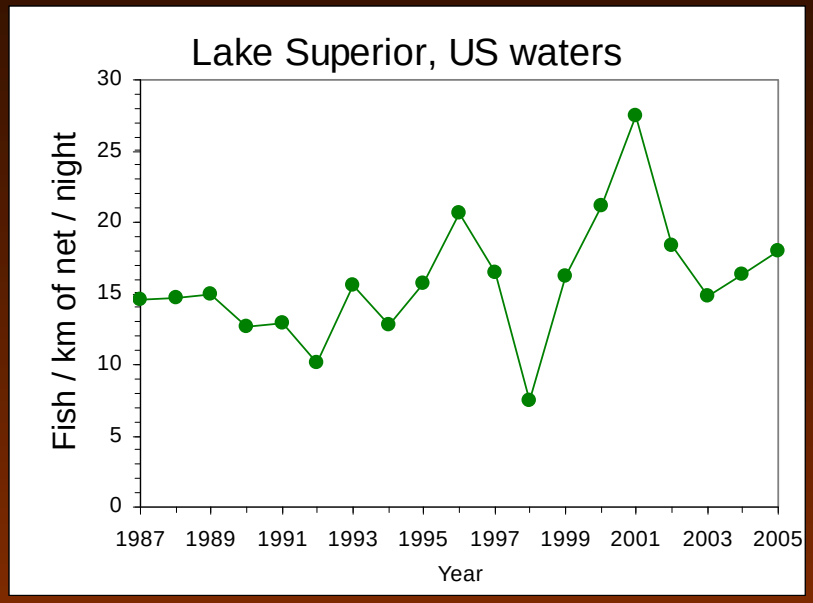
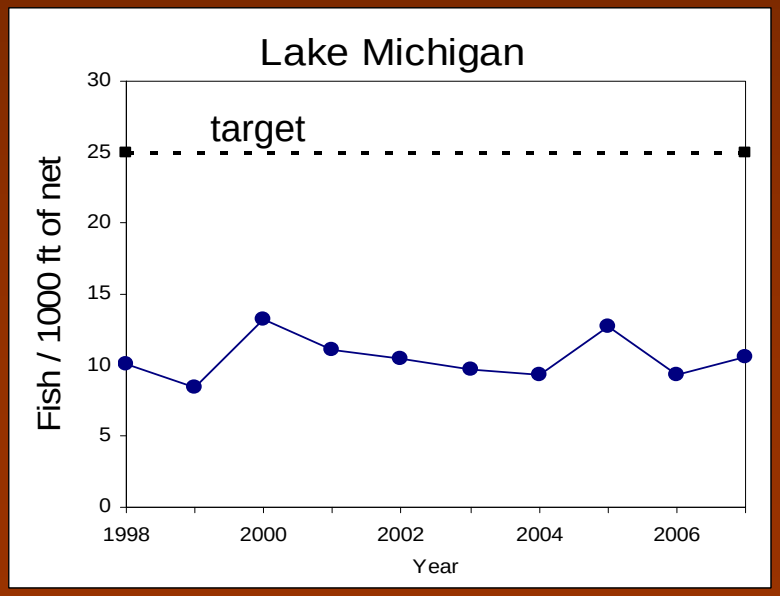


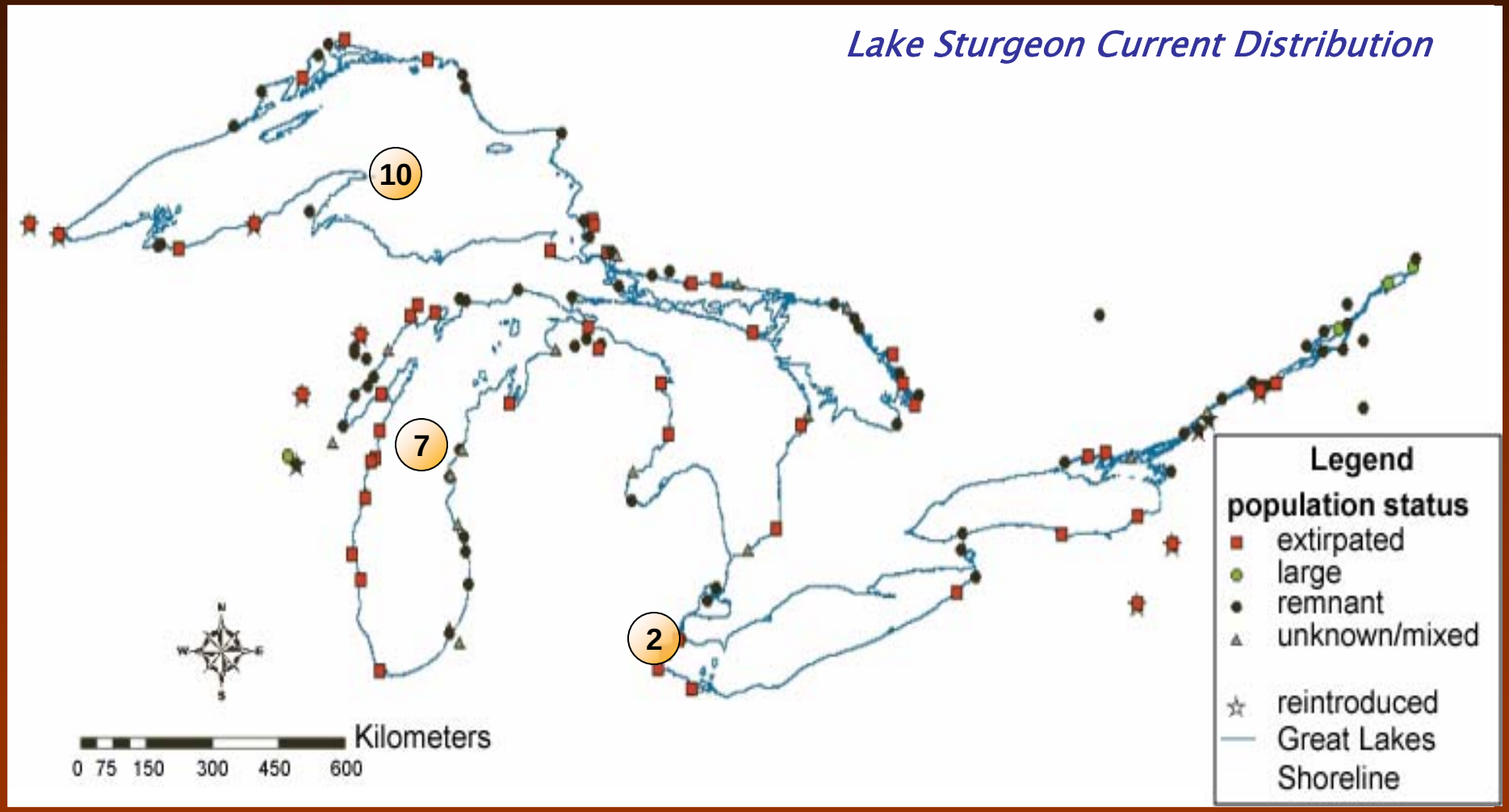
Photo credits: Todd Turner and Karla Bartelt, USFWS and Ontario Ministry of Natural Resources (OMNR)

Lake Trout


Lake Superior, US waters
Fish / km of net / night
30
25
20
15
10
5
0
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Year

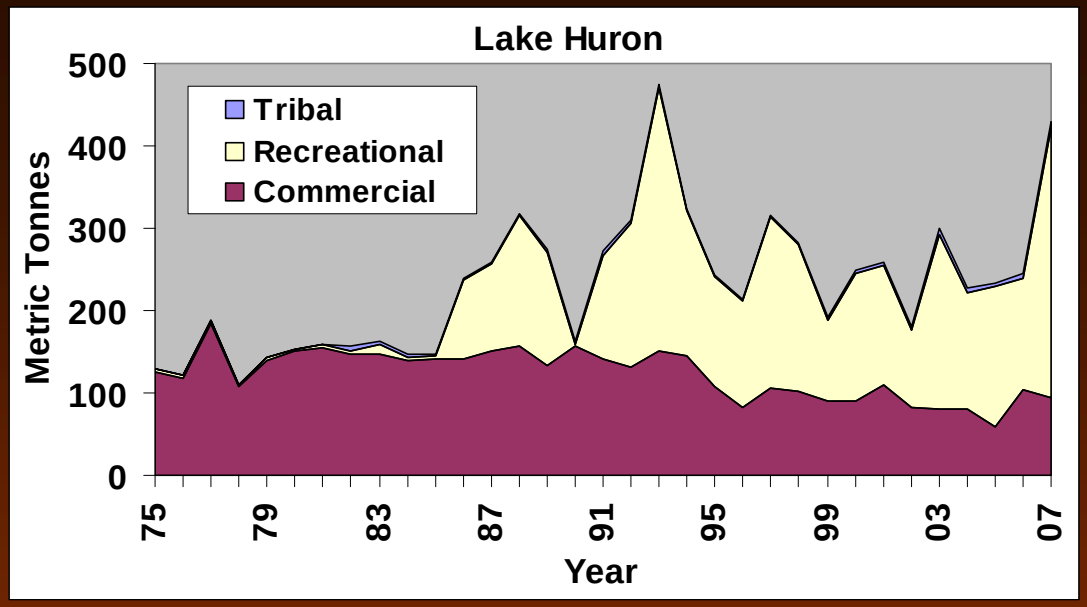

Lake Michigan
target
Fish / 1000 ft of net
30
25
20
15
10
5
0
1998
2000
2002
2004
2006
Year

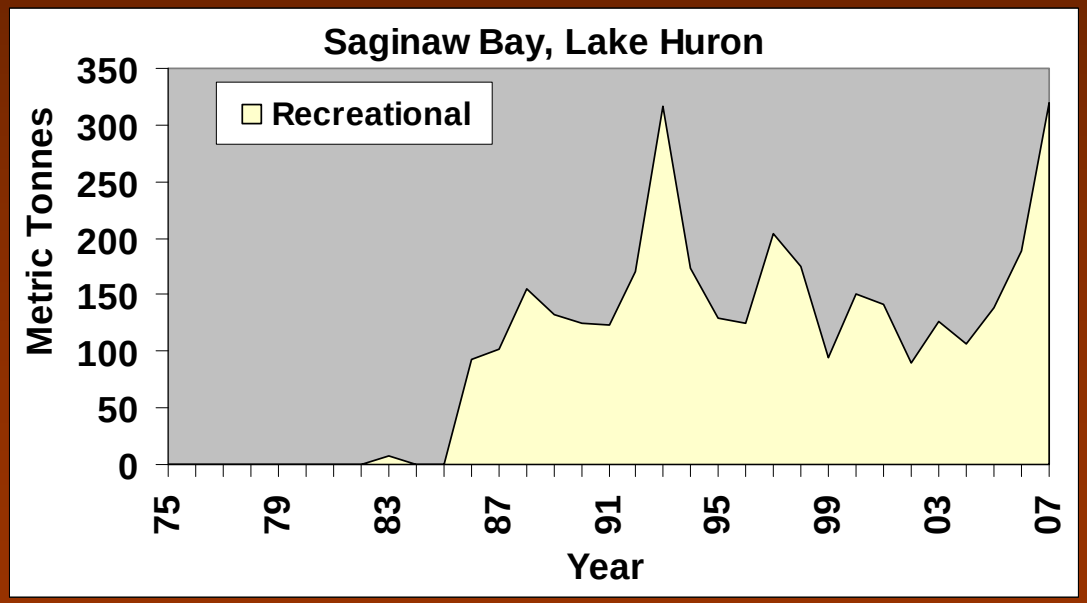
Sturgeon


Lake Sturgeon Current Distribution
10
7
2
Legend
population status
extirpated
large
remnant
unknown/mixed
reintroduced
Great Lakes
Shoreline
Kilometers
0 75 150 300 450 600

Sturgeon

Walleye





Participant in the Detroit River walleye tournament on April 8th, 2006 ***(Photo Credit: John Hartig, USFWS).***

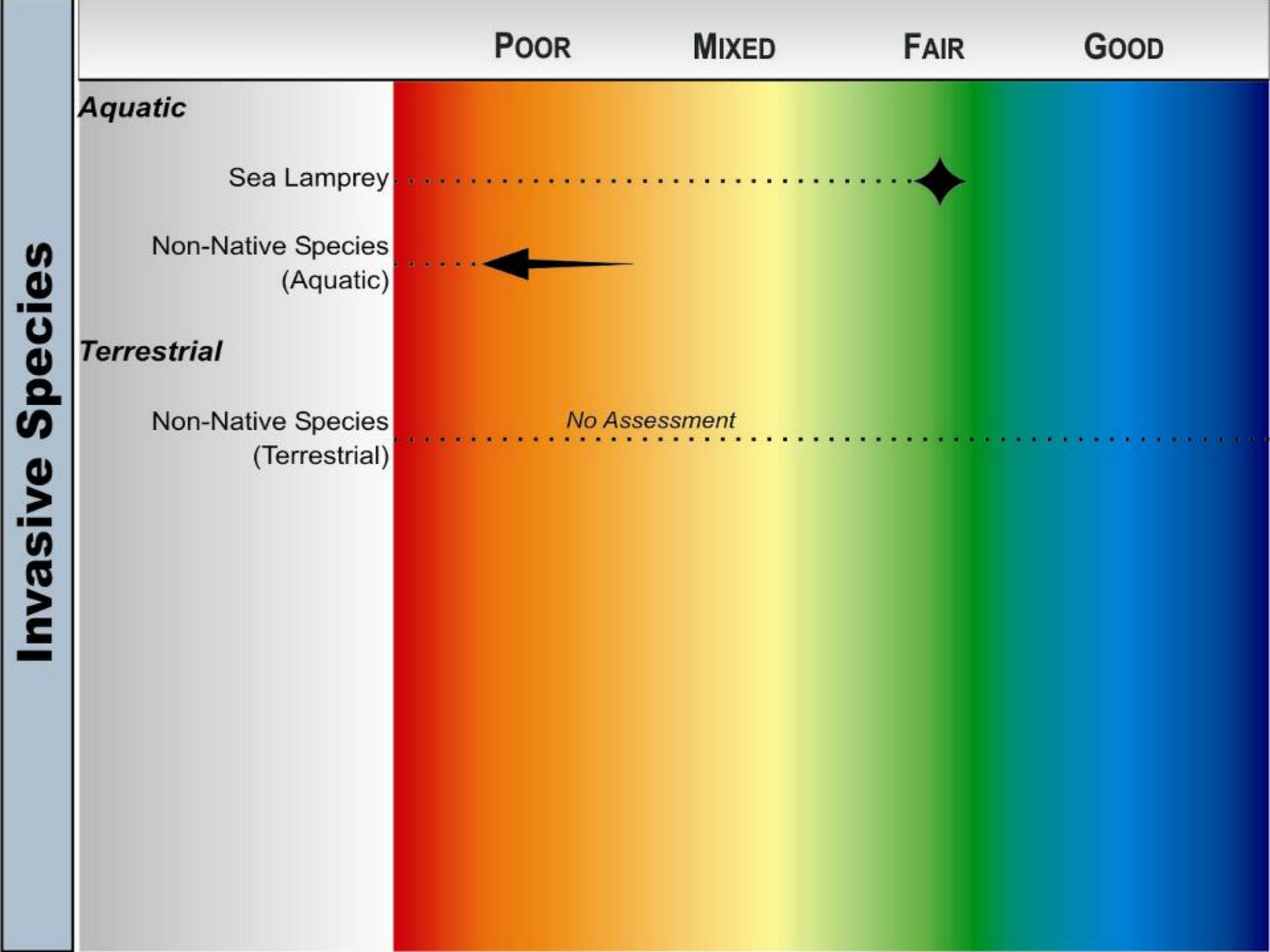
Conserving Lake Ontario and Upper St. Lawrence River Bald Eagle Habitats

Photo credit: P. Nye, NYSDEC

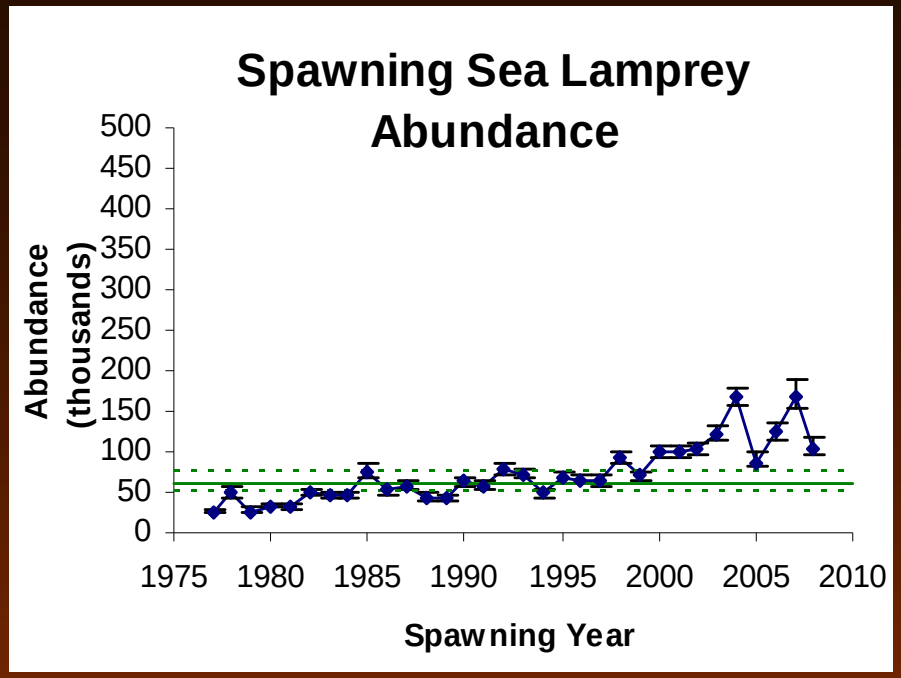
Photograph by: P. Nye

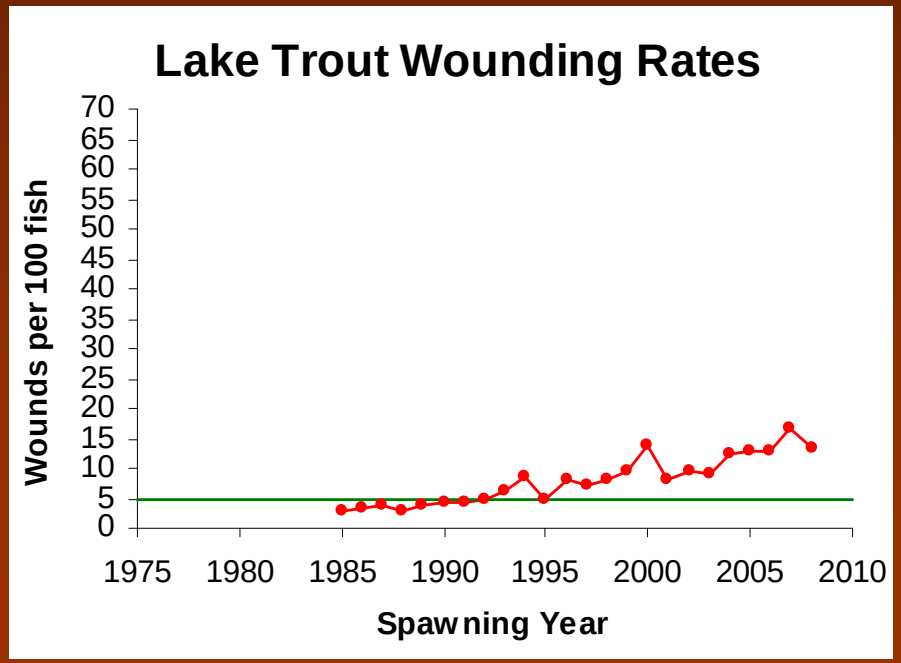
Photo credit: S. Rando, NYSDEC

Invasive Species


Invasive Species
POOR
MIXED
FAIR
GOOD
Aquatic
Sea Lamprey
Non-Native Species (Aquatic)
Terrestrial
Non-Native Species (Terrestrial)
No Assessment

Sea Lamprey

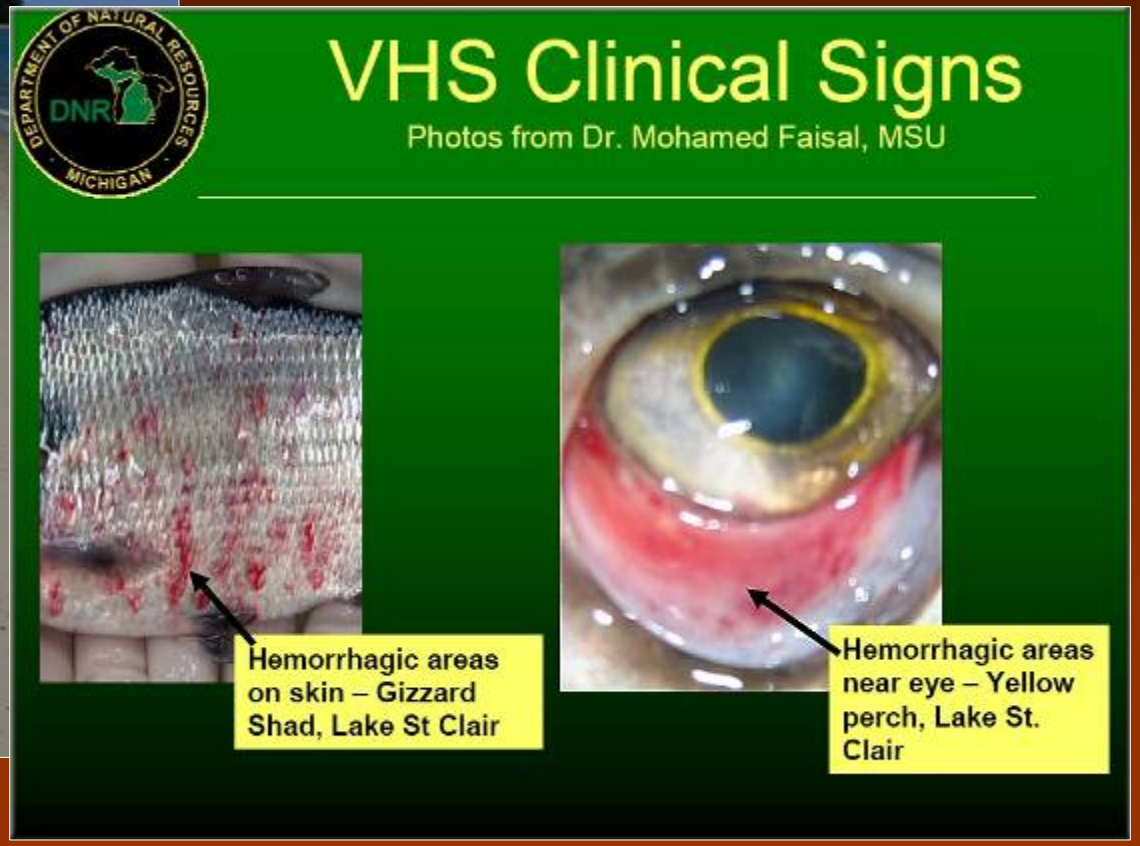




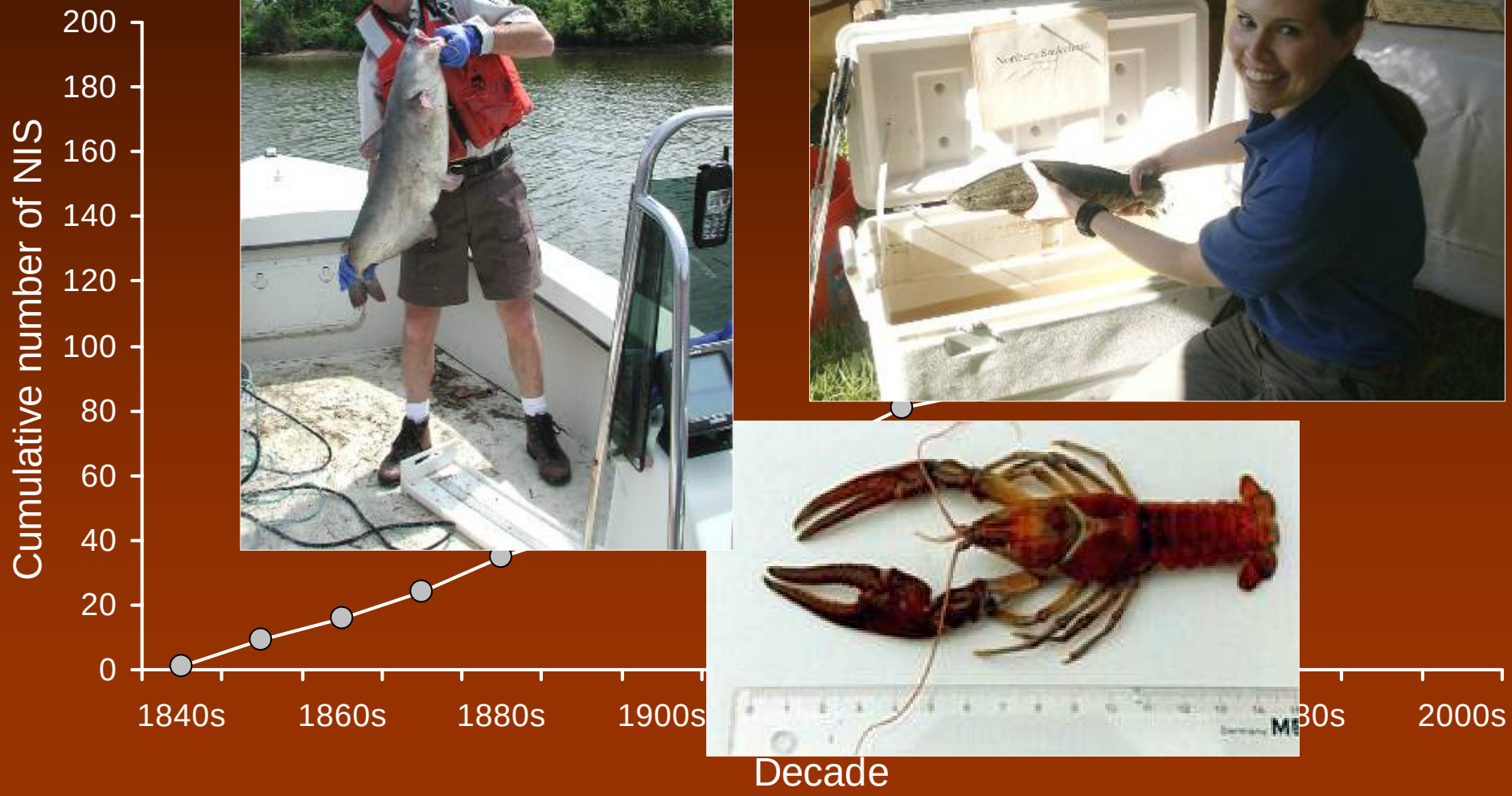
Lake Michigan

Invasive Species and Aquatic Diseases

Photo credit: Alice Van Zoeren, NPS



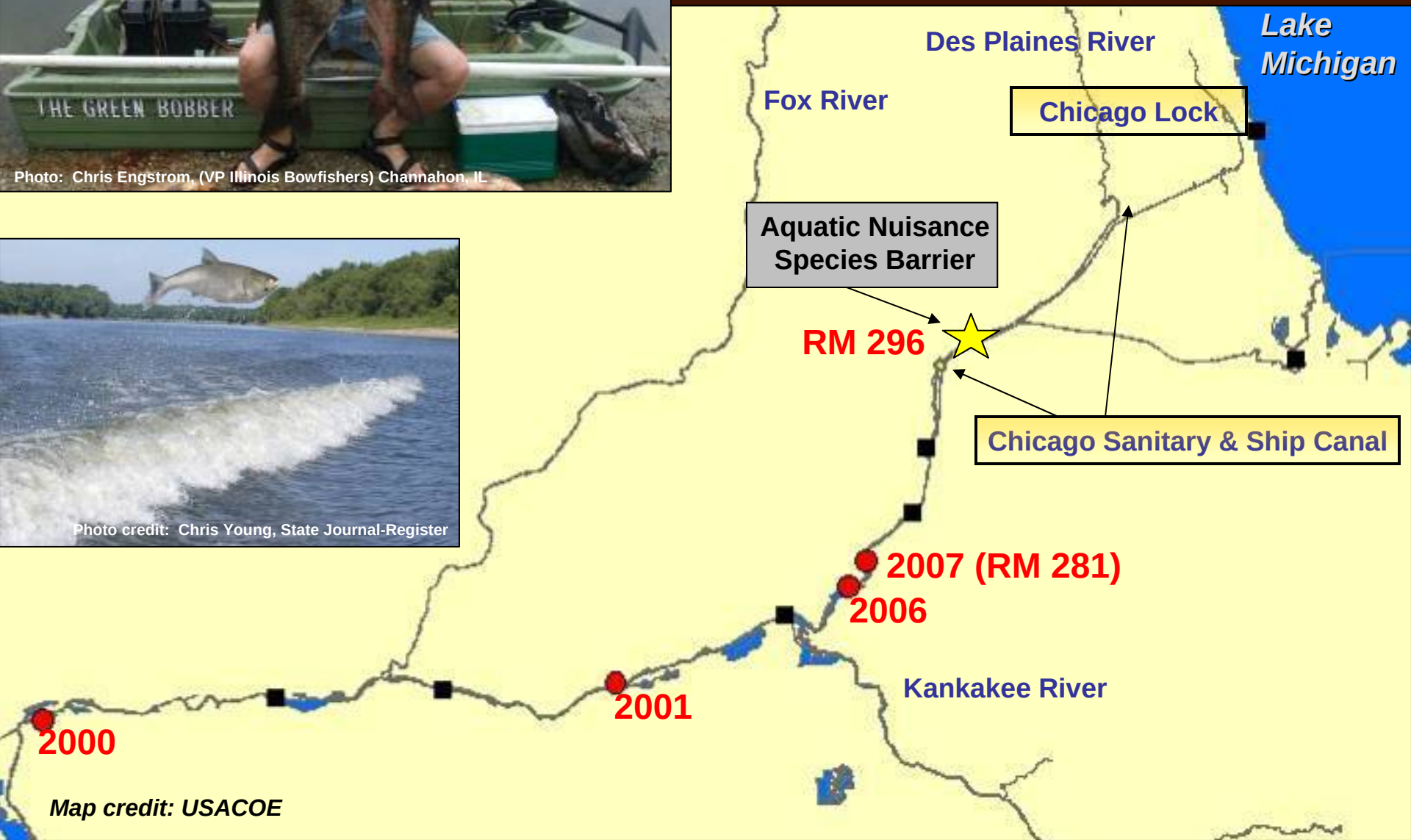
Current and Predicted Introductions



Chronologic Upstream Dispersal of Bighead and Silver Carp

Photo: Chris Engstrom, (VP Illinois Bowfishers) Channahon, IL

Photo credit: Chris Young, State Journal-Register



Map credit: USACOE

Management Implications and Conclusions

- Maintain contaminant monitoring efforts
  - Nutrients
  - Media
  - Biota
- Consider cumulative effects of invasive species, contaminants, and climate change

Management Implications and Conclusions

- Conduct regular assessments of food-web dynamics
  - e.g. *Diporeia* – *Dreissena* interactions
- Continue and enhance sea lamprey control – integrated approach
- Integrate inventories, mapping, and mitigation of invasive species to improve strategies at a basin-wide scale

Acknowledgments

- U.S. EPA
- Environment Canada
- U.S. Fish and Wildlife Service
- U.S. FWS, Digital Library System and NCTC Image Library
- NOAA, Great Lakes Environmental Research Laboratory (GLERL) PhotoGallery
- USGS
- Ontario Ministry of Natural Resources (OMNR)
- Tetra Tech
- Wisconsin Sea Grant