State of Michigan's Environment 2008:
First Triennial Report
December 2008
Part I: Environmental Measures

Michigan Department of Environmental Quality
Michigan Department of Natural Resources

Constitution Hall 1st Floor North
P.O. Box 30473
Lansing, Michigan 48909-7973

Prepared by KGH Environmental PLC

State of Michigan's Environment

Legislative Charge (1999 Public Act 195):

- Prepare a report that assesses the status of and trends related to the overall state of the natural environment in Michigan.
- The report shall be based upon environmental indicators identified by the departments of environmental quality and natural resources (DEQ and DNR) and upon data obtained through sound scientific methodologies and processes.

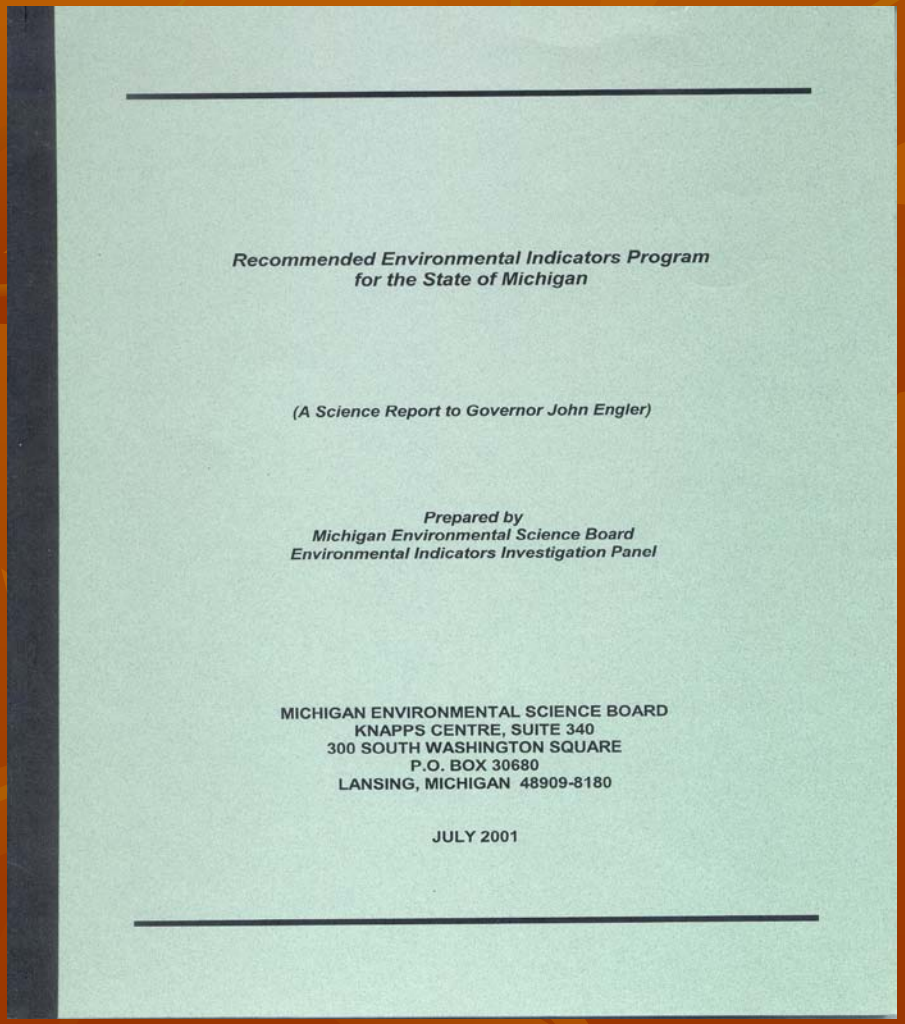
State of Michigan's Environment

Governor's January 28, 2000 Charge to the Michigan Environmental Science Board (MESB):

Review the list of DEQ and DNR proposed environmental indicators and evaluate each of the proposed indicators based on the following criteria:

- **Scientific basis for the use of the indicator as a measure of the quality of the environment** (i.e., does the proposed indicator describe a measure of the natural environment); and
- **Utility of the indicator** (i.e., what would it mean in terms of the quality of the environment if there is a change in the value of the indicator from one reporting period to the next).

MESB July 2001 Report Recommendations



Recommended Environmental Indicators Program for the State of Michigan

(A Science Report to Governor John Engler)

Prepared by
Michigan Environmental Science Board
Environmental Indicators Investigation Panel

MICHIGAN ENVIRONMENTAL SCIENCE BOARD
KNAPPS CENTRE, SUITE 340
300 SOUTH WASHINGTON SQUARE
P.O. BOX 30680
LANSING, MICHIGAN 48909-8180

JULY 2001

Of the indicators proposed by the DNR and DEQ, the MESB recommended that 21 be included in the biennial report on the state's environment.

The MESB also recommended that the state begin to develop a monitoring protocol referred to as Master Stations in order to begin to systematically and consistently collect information on the state's environment.

Working Definitions

- **Environmental Indicators** are scientific, broadly based measures designed to detect and track changes in the quality of the state's ambient environment from one reporting period to the next.
- **Programmatic Measurements** are measures that, while in and of themselves may ultimately detect a change in the overall quality of the environment, are designed more to assess how well a given regulatory program is functioning to correct or control more short-term or localized environmental problems.
- **Emerging Contaminants of Concern** are newly recognized environmental chemicals and/or materials that are characterized by a perceived, potential, or real threat to human health or the environment or a lack of published health standards.
- .

Biennial Report Measurements

- **Environmental Measures** [22]*
  - Ecological Indicators (11)
  - Physical/Chemical Indicators (11)
- **Programmatic Measures** [20]
  - Air Measures (4)
  - Water Measures (7)
  - Land Measures (9)
- **Emerging Contaminants** [14]**

---

* Fulfills the requirements of 1999 Public Act 195 and 2005 Public Act 313

** Fourteen contaminants of concern are identified

State of Michigan's Environment 2008: First Triennial Report

Submitted to the Governor and Legislature December 2008

In addition to being widely distributed, the report was made available to every high school science teacher in the state to be used as teaching resource.

State of Michigan's Environment 2008: First Triennial Report

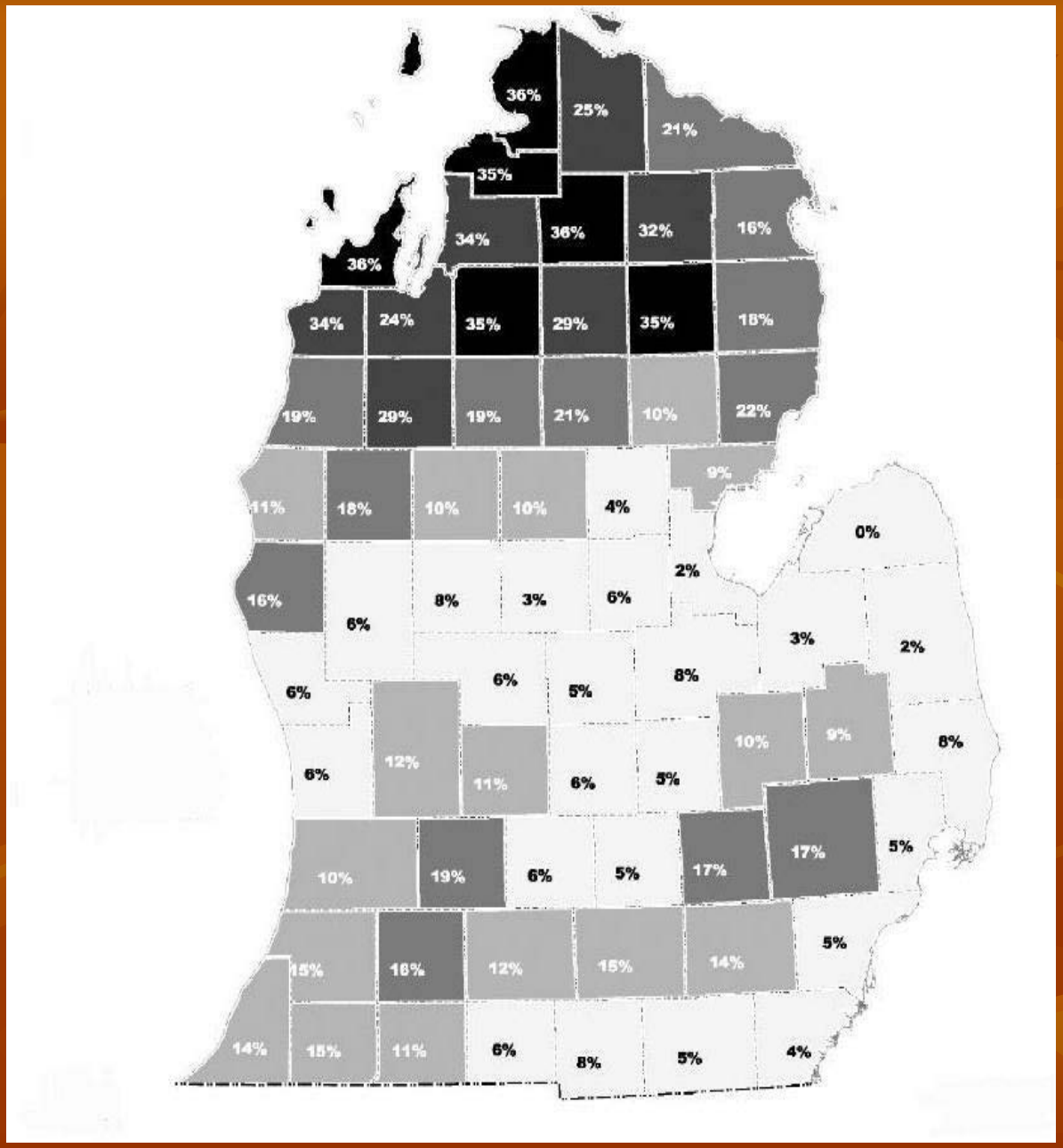
PART I: Environmental Measures

Trends in Land Use/Cover

Changes in land cover can provide a useful indirect measure of trends in ecosystem health.

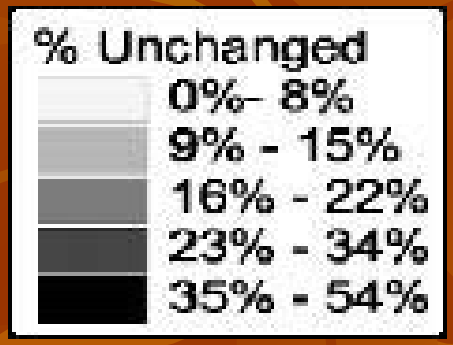
Noticeable trends since the 1980s Include:

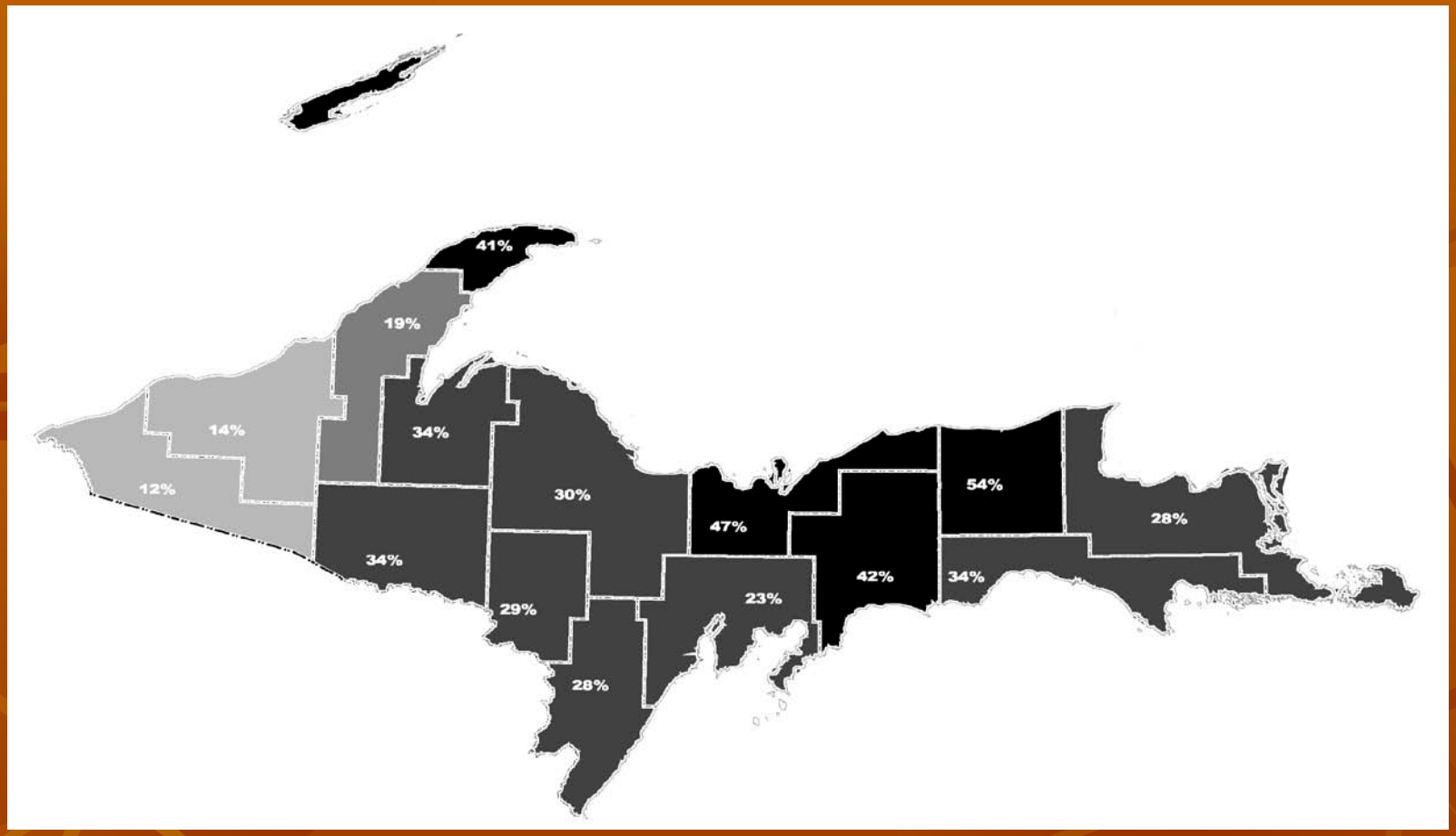
- Increase in developed land
- Increase in forests
- Increase in suburban and urban areas
- Decrease in agricultural areas
- Continued decrease in wetlands



Percent Change in Native Vegetation between the 1880s and 1990s:

Lower Peninsula





Percent Change in Native Vegetation between the 1880s and 1990s: Upper Peninsula

Environmental Measures – Ecological Indicators

Exhibit 5. Classes of Land Use in 1980 and Projections to 2040

Land Use Classes	1980 (Millions of Acres)	2040 (Millions of acres)	Change	Percent
Agriculture	11.0	9.1	-1.9	-17%
Developed Land	2.3	6.4	+4.1	+178%
Private Forestland	18.2	16.9	-1.3	-8%
Other Vegetated Lands	2.9	2.2	-0.7	-24%
Wetlands	1.8	1.7	-0.2	-10%

Source: Public Sector Consultants, *Michigan Land Resource Project*, November 2001.

Environmental Measures – Ecological Indicators

In February 2003, the Governor of Michigan created the Michigan Land Use Leadership Council (Council).

The Council was charged with studying and identifying trends, causes, and consequences of urban sprawl and providing recommendations to the Governor and the state legislature designed to minimize the negative effects of current and projected land use patterns on Michigan's environment and economy.

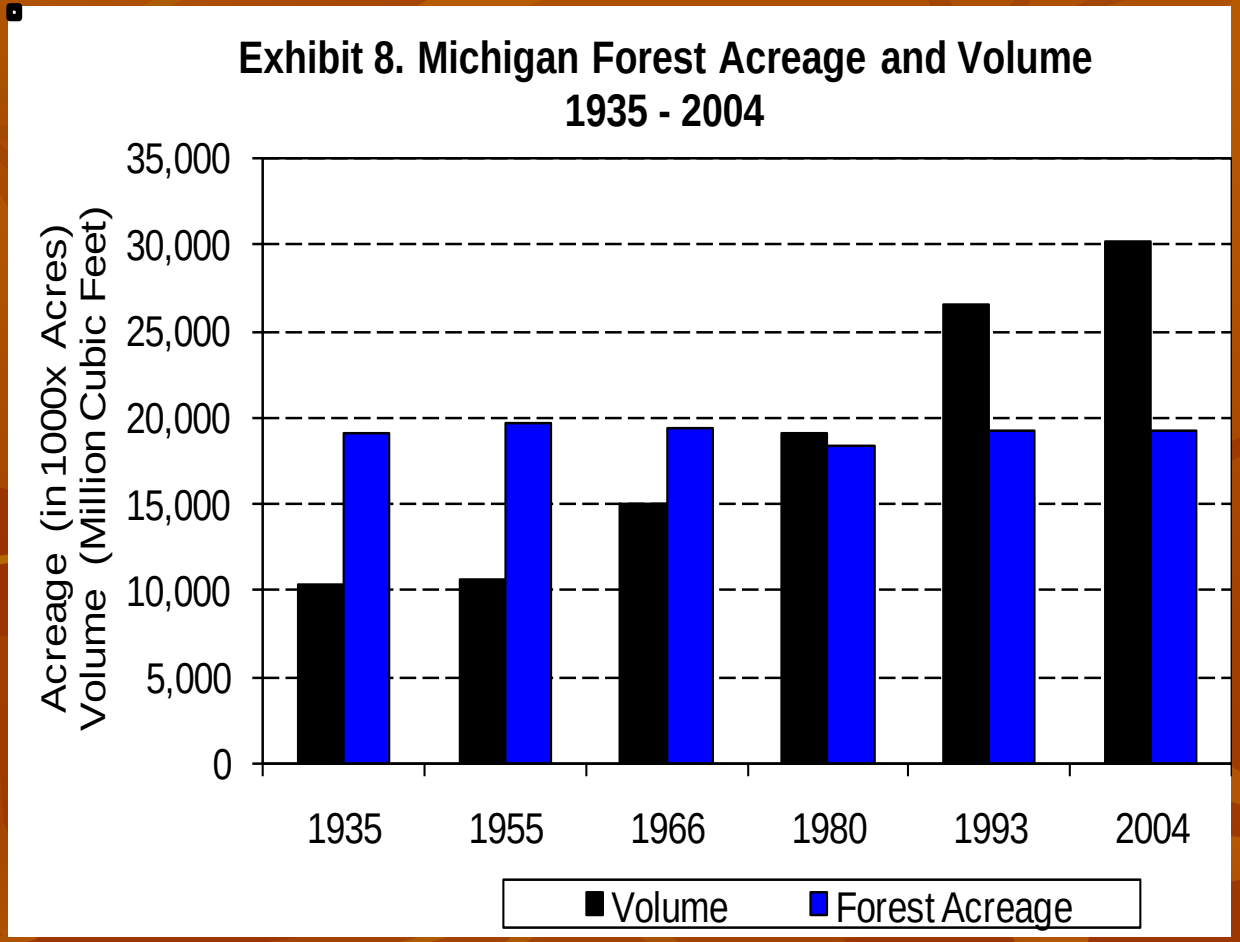
The Council's report entitled, Michigan's Land, Michigan's Future: Final Report of the Michigan Land Use Leadership Council (Land Use Report), was released in August 2003.

Environmental Measures – Ecological Indicators

The Land Use Report, the Council called for the state to complete its natural features inventory and to update its 1978 Michigan Resource Information System Current Inventory by completing a new round of aerial photography and land use/cover classifications.

The Land Use Report also called for the development of a report every five years that would evaluate the amount of farmland and forested lands that were in active production, the change in land cover by county, and the number of Michigan citizens housed each year in new construction.

Trends Forest Acreage, Mortality, Growth and Removals

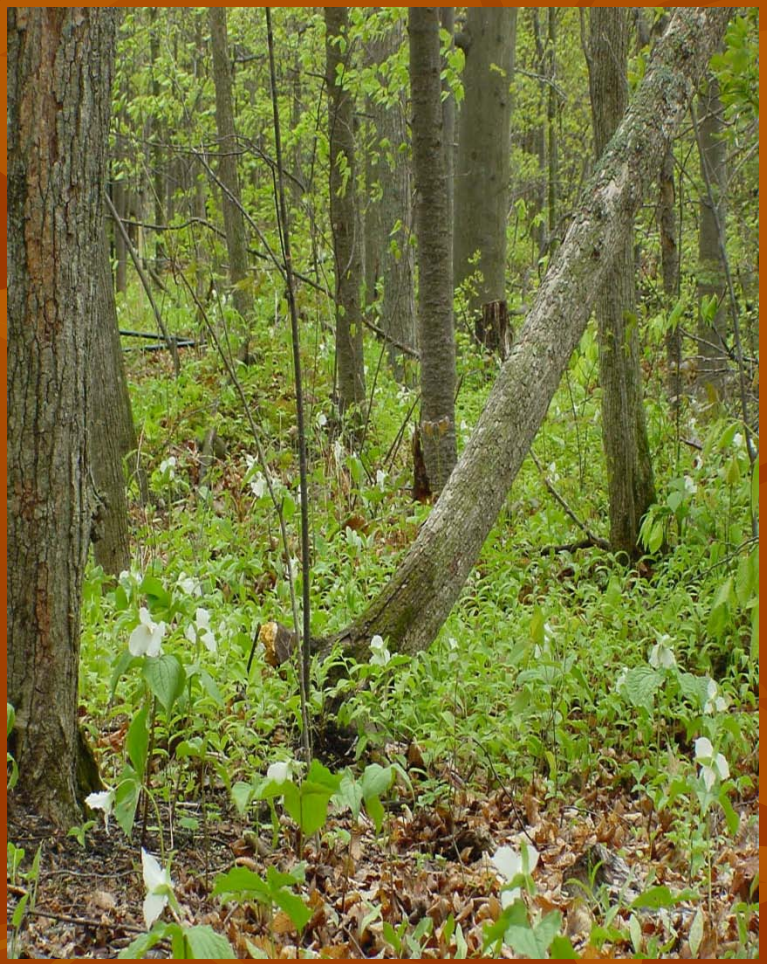


Forest Acreage, Mortality, Growth and Removals

- Michigan's forests are maturing and are transitioning toward more shade-tolerant, later successional tree species.
- Michigan's Climax Forest: Beech-Maple-birch forest community increased by almost 1 million acres since 1980.

Trends in Vegetation Diversity and Structure

- This indicator measures forest under story diversity, richness, and vegetation structure.
- The DNR systematically began collecting these data in 2001.
- Overtime, this indicator will provide additional indices to wildlife habitat, plant diversity, soil conservation, and carbon cycling.



Trends in Lichen Communities

- Lichens rely totally on the atmosphere for nutrition.
- Lichen community composition is a good indirect indicator of air pollution (e.g. for levels of sulfur dioxide and nitrogen).
- The US Forest Service developed the lichen community indicator. To date, 29 lichen species have been identified in 240 plots in Michigan.

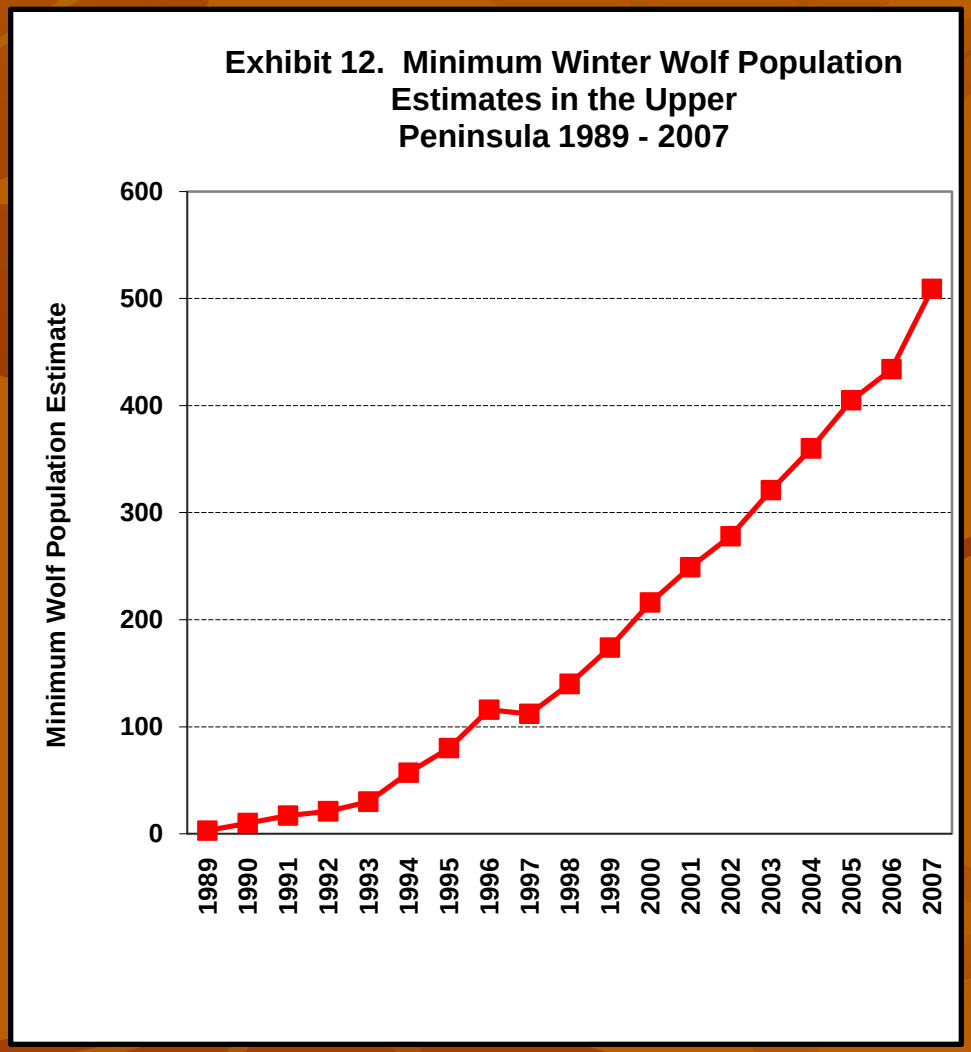
Environmental Measures – Ecological Indicators

Trends in Mammal Populations

Environmental Measures – Ecological Indicators

The DNR conducts an annual Winter Track Survey for gray wolves. The Winter Track Survey is completed after new snow events to identify individuals and packs.

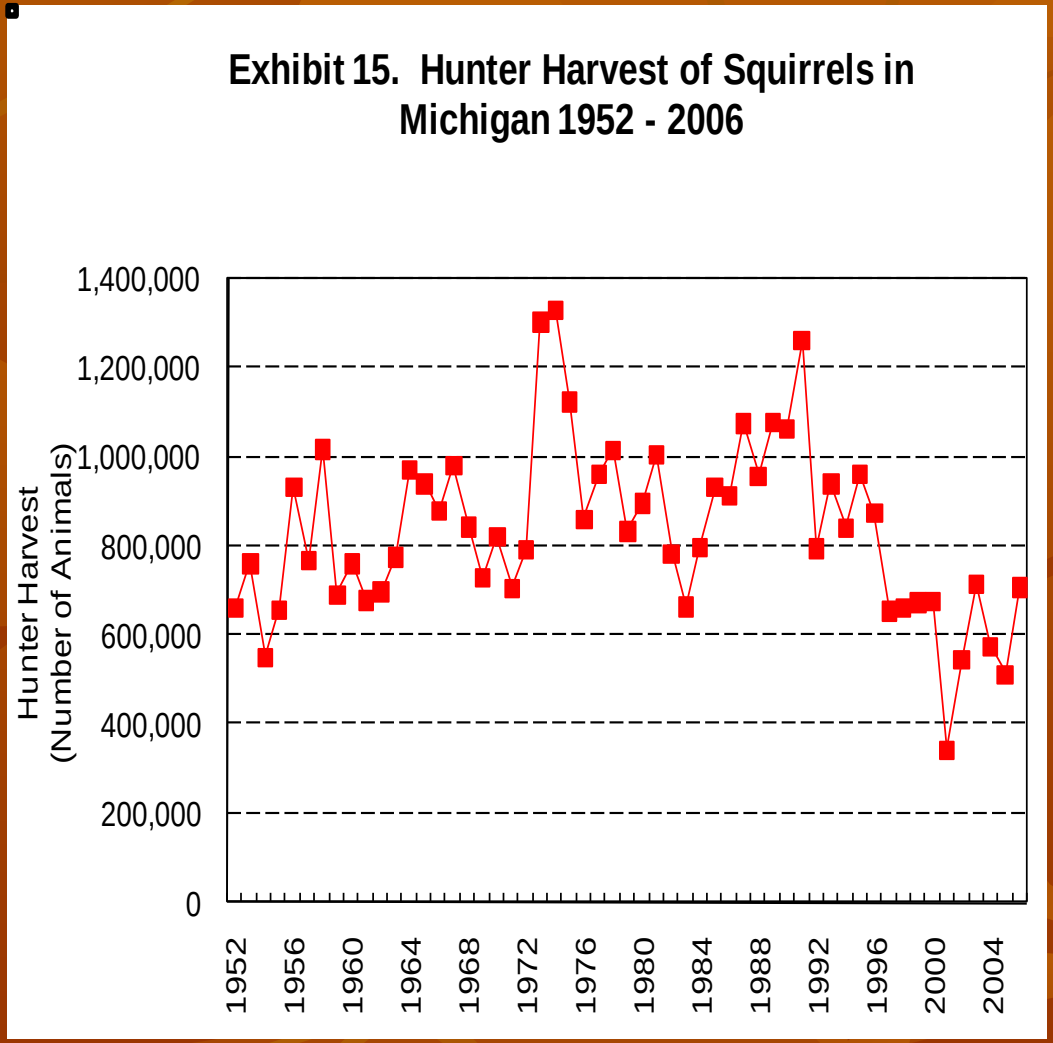
The data collected since 1989 indicate a steadily increasing population of wolves in the state's Upper Peninsula.



Environmental Measures – Ecological Indicators

The Hunter Harvest Survey provides an indirect measure for tracking long-term population trends in small mammals.

The decline seen in this small mammal and others discussed in the Triennial Report is related, in part, to declines in hunter participation in the Hunter Harvest Surveys and in sales of small game licenses.

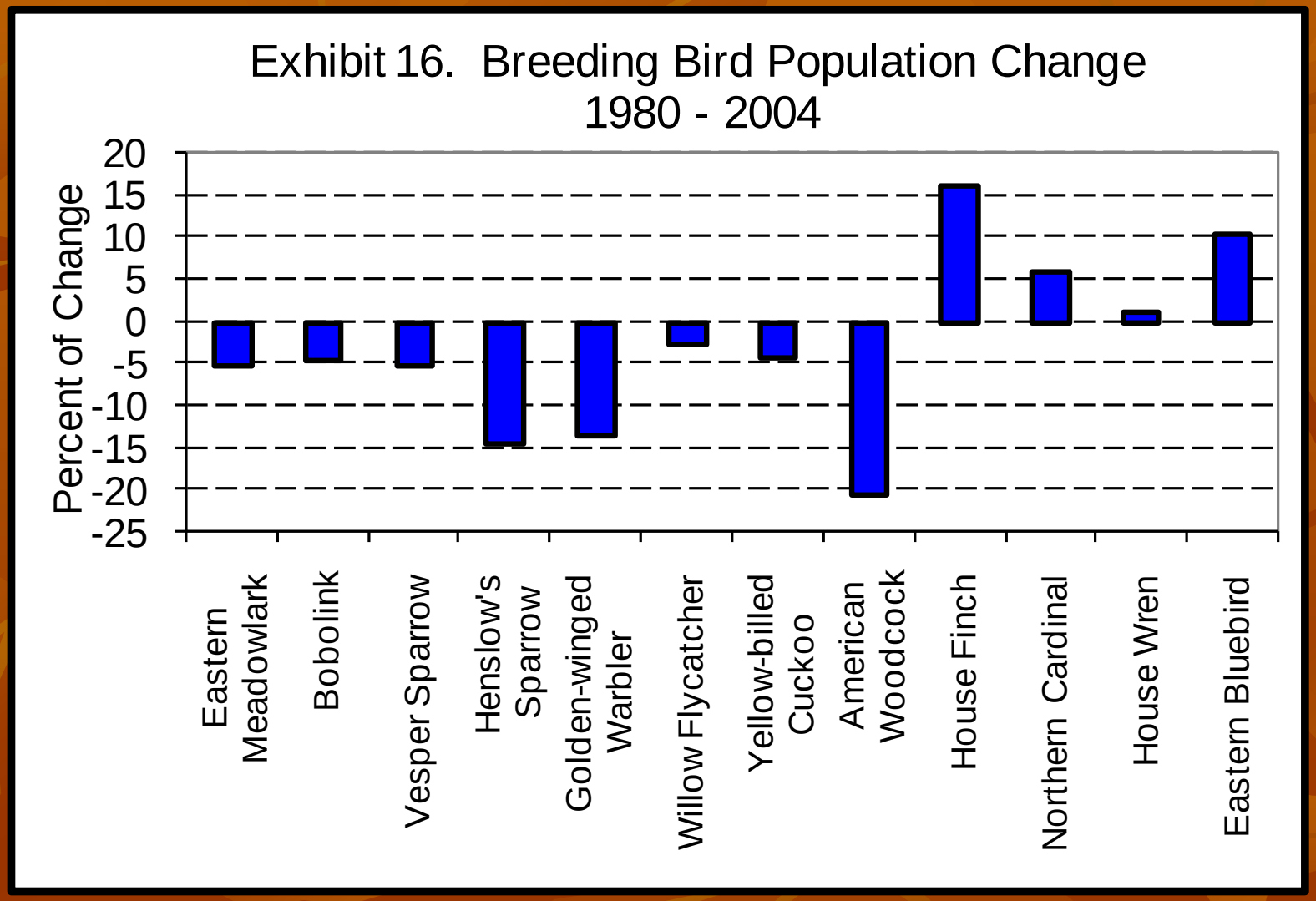


Environmental Measures – Ecological Indicators

Trends in Breeding Bird Populations

- Grassland species and transitional species are declining in numbers.
- Generalist species are increasing in numbers.
- Declines in some species can be attributed to habitat fragmentation, loss of shrub and forest systems and development.

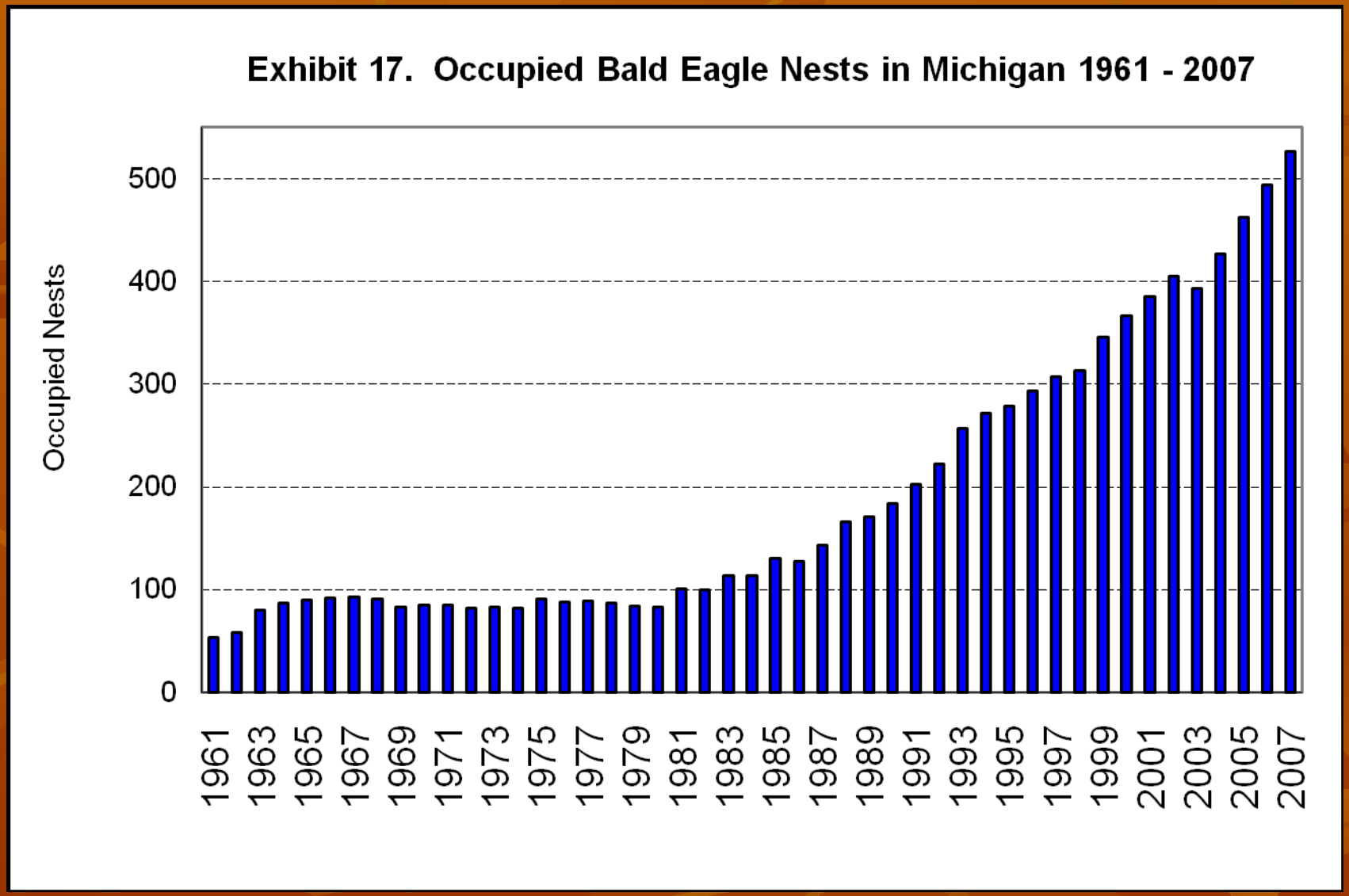
Environmental Measures – Ecological Indicators



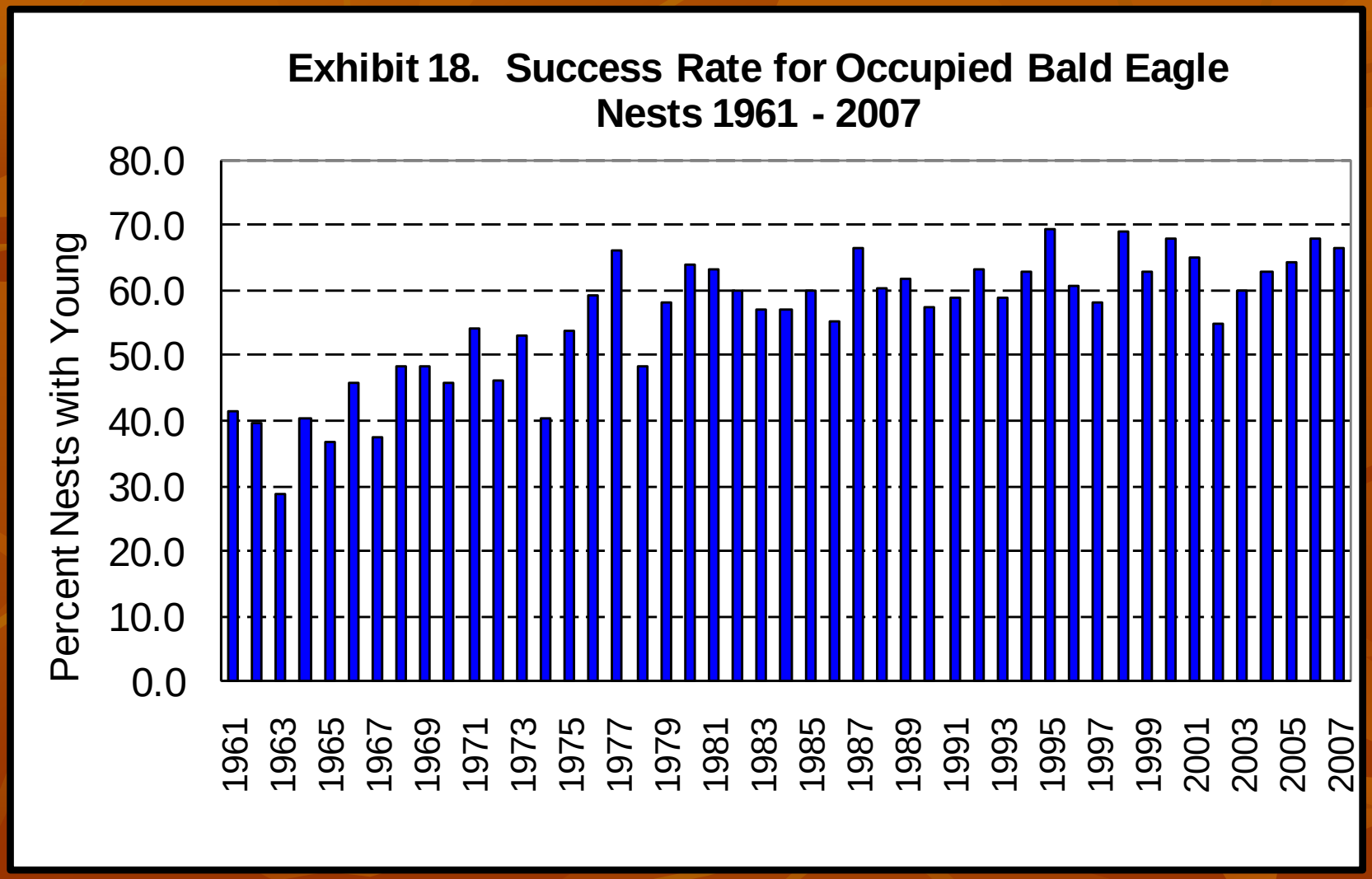
Trends in Bald Eagle Populations and Contaminant Levels

- This indicator set was included in the USEPA's *Report on the Environment*
- Annual census conducted since 1961.
- Data show that numbers are increasing and eagles are successfully raising more young per pair.

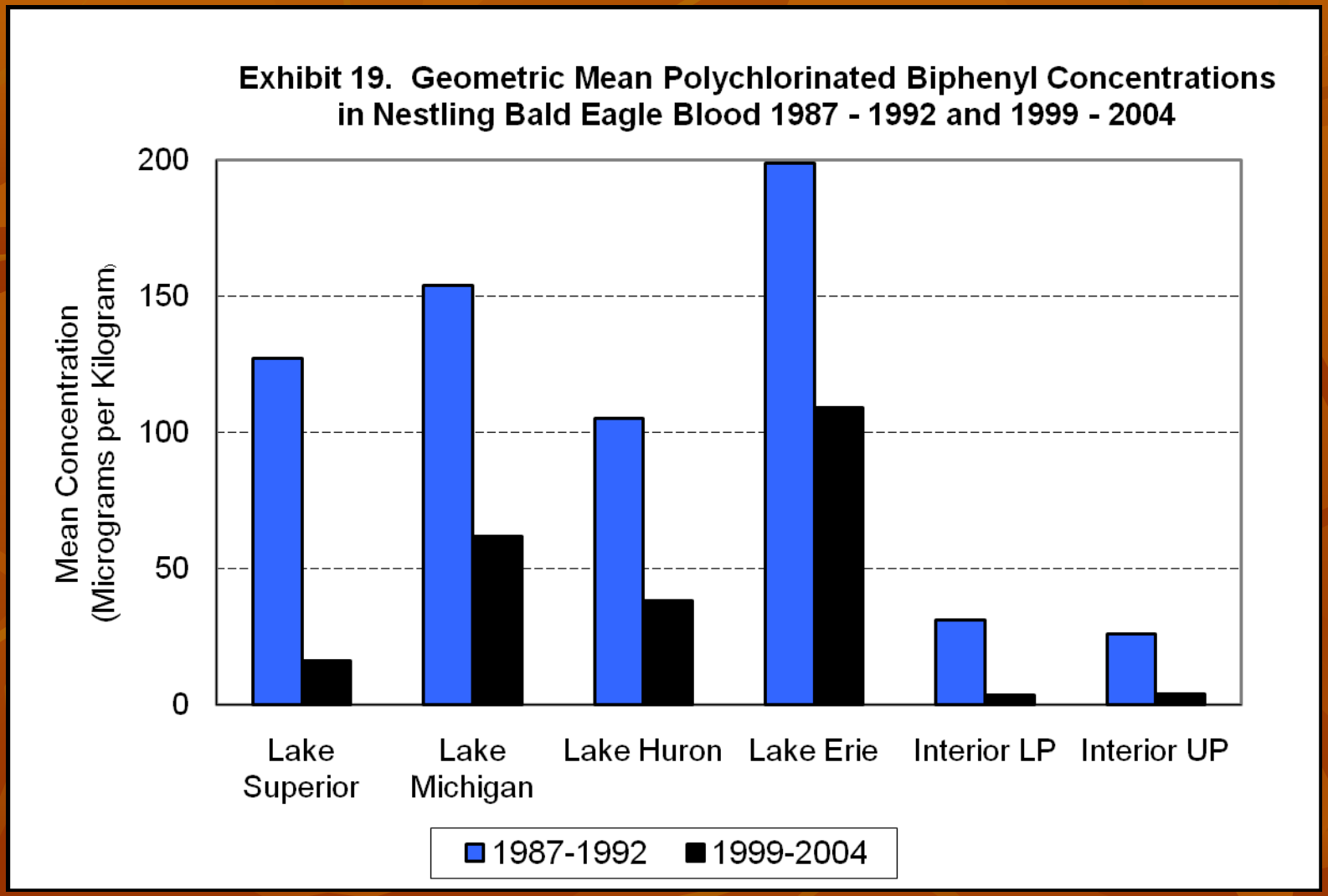
Environmental Measures – Ecological Indicators



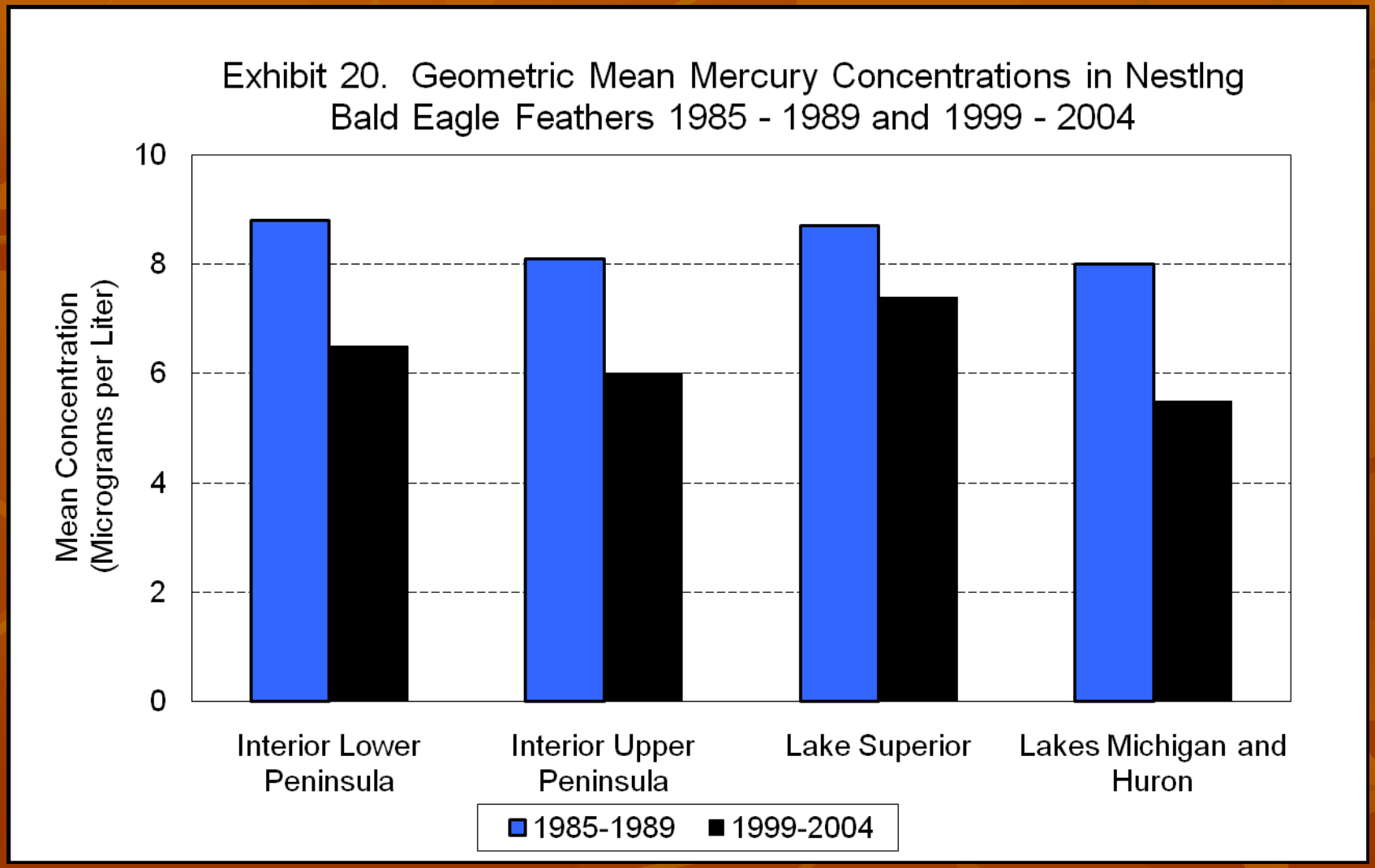
Environmental Measures – Ecological Indicators



Environmental Measures – Ecological Indicators



Environmental Measures – Ecological Indicators

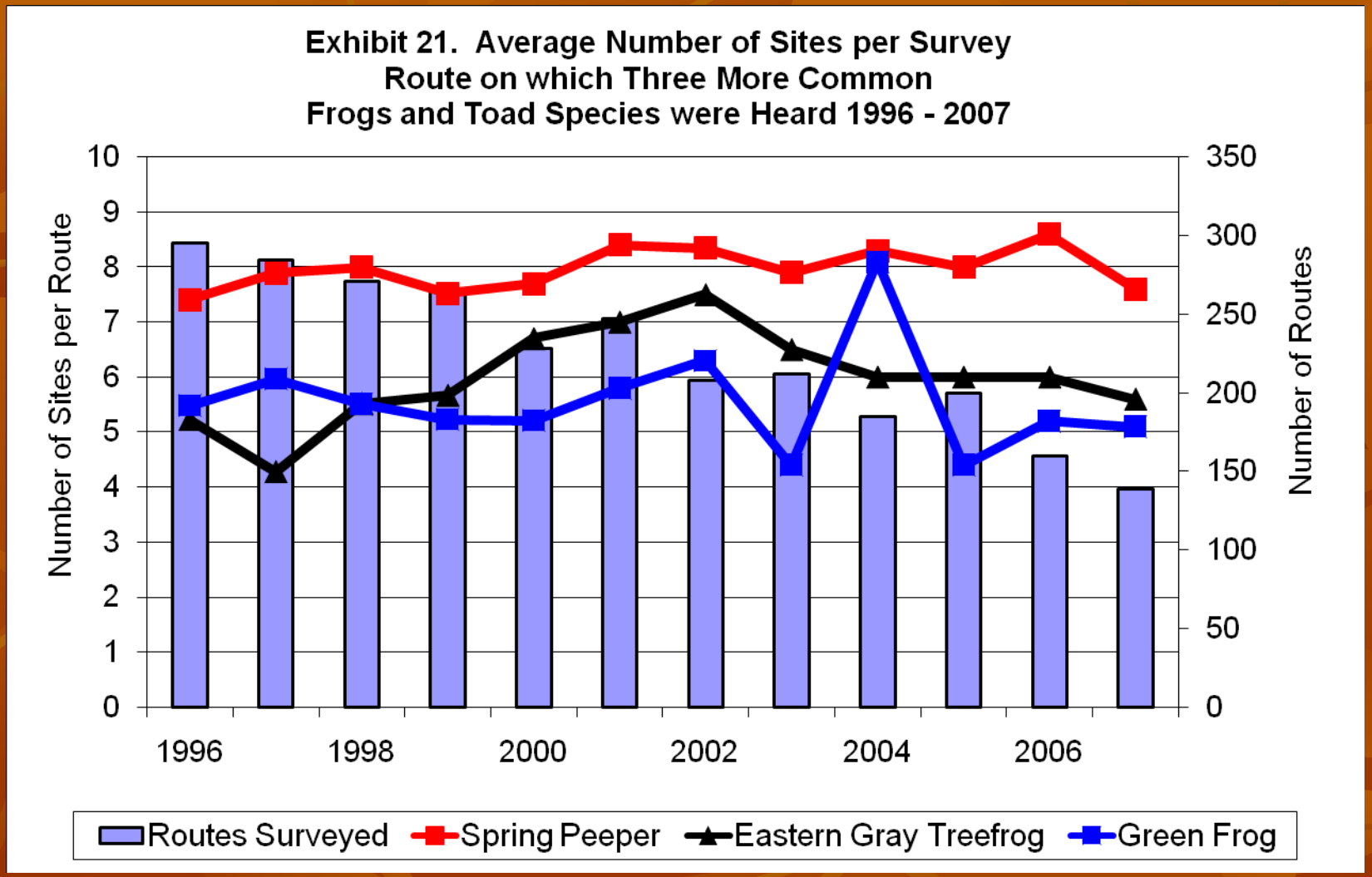


Environmental Measures – Ecological Indicators

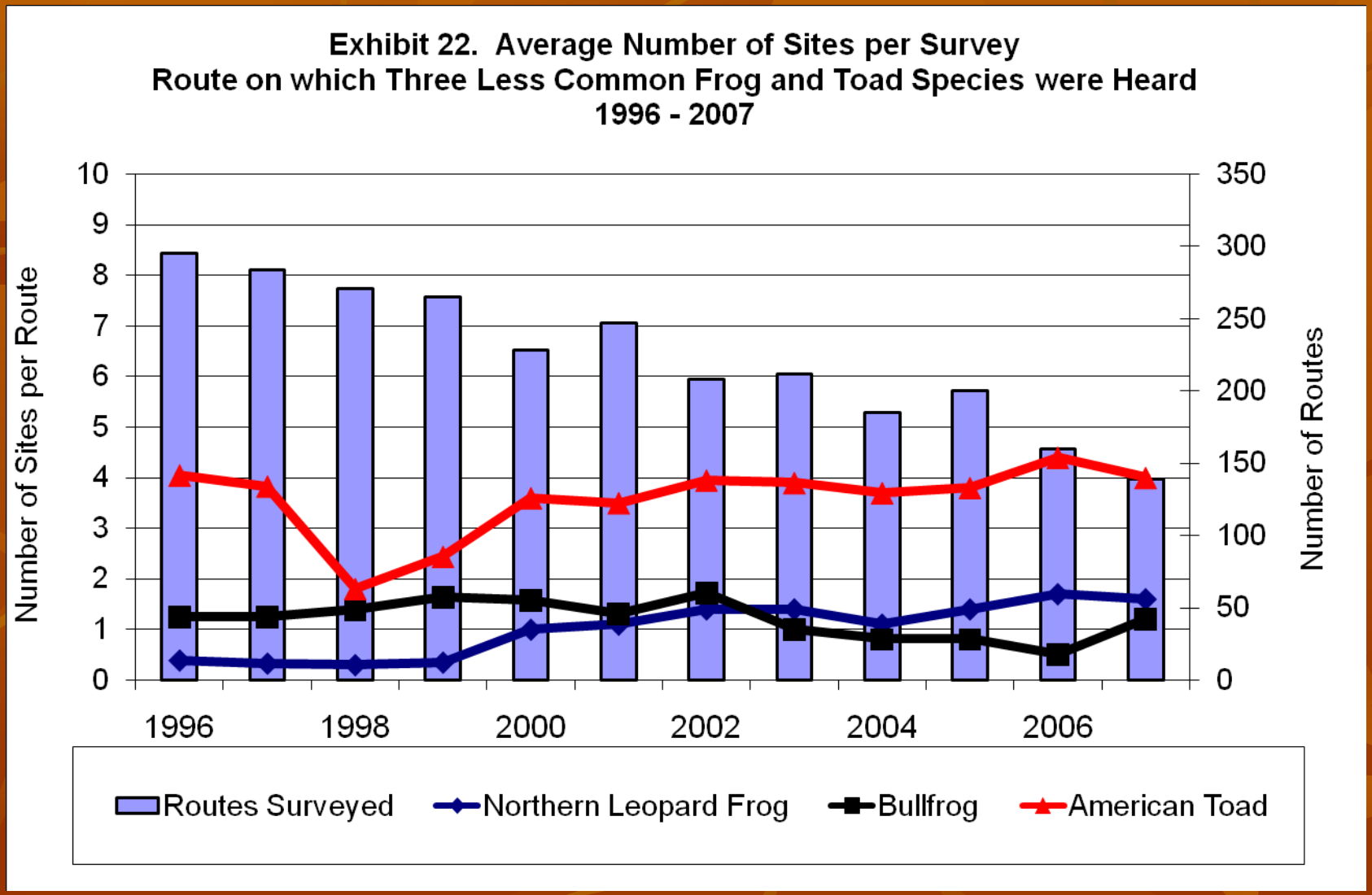
Trends in Frog and Toad Populations

- Thirteen native species of frogs and toads in Michigan.
- Amphibians can serve as an index to environmental quality because they are sensitive to changes in water quality and land use practices.
- Populations data have been collected by volunteers since 1996.
- More years of data needed to discern long-term trends.

Environmental Measures – Ecological Indicators



Environmental Measures – Ecological Indicators



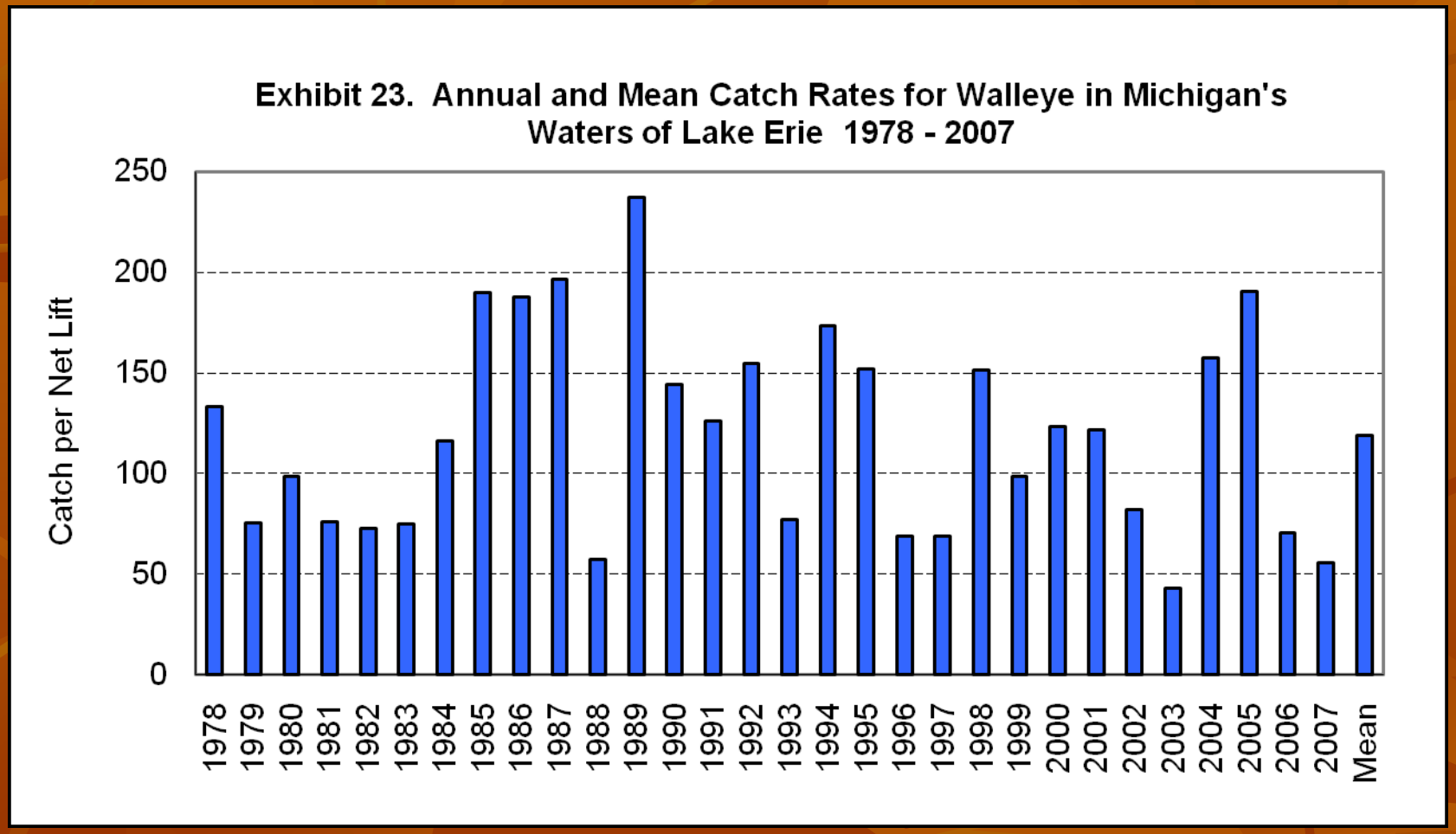
Environmental Measures – Ecological Indicators

Trends in Fish Populations and Contaminant Levels

Measurements:

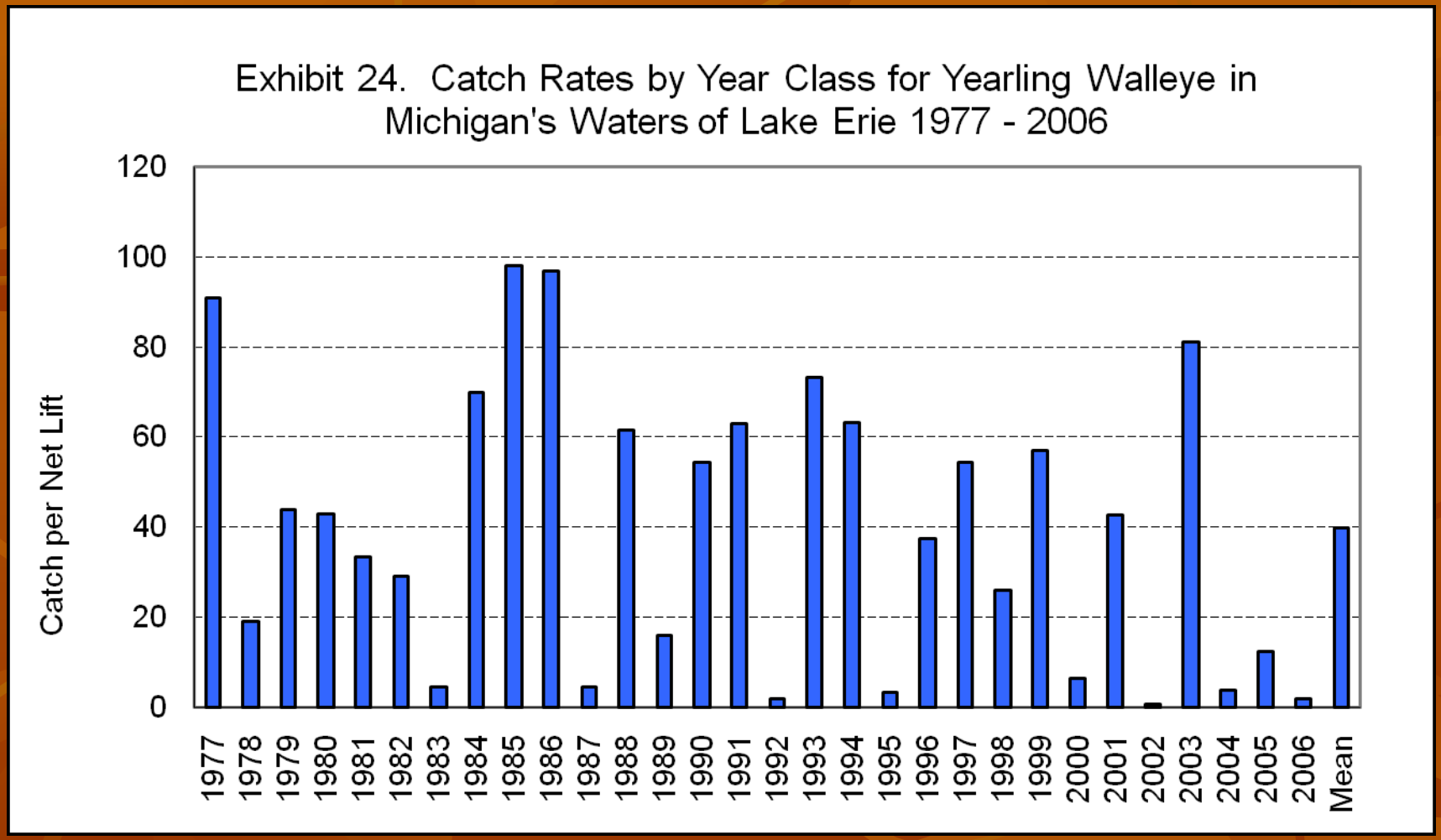
- Walleye in Lake Erie
- Lake Trout in Lake Superior
- Brook Trout in the Au Sable River System

Environmental Measures – Ecological Indicators



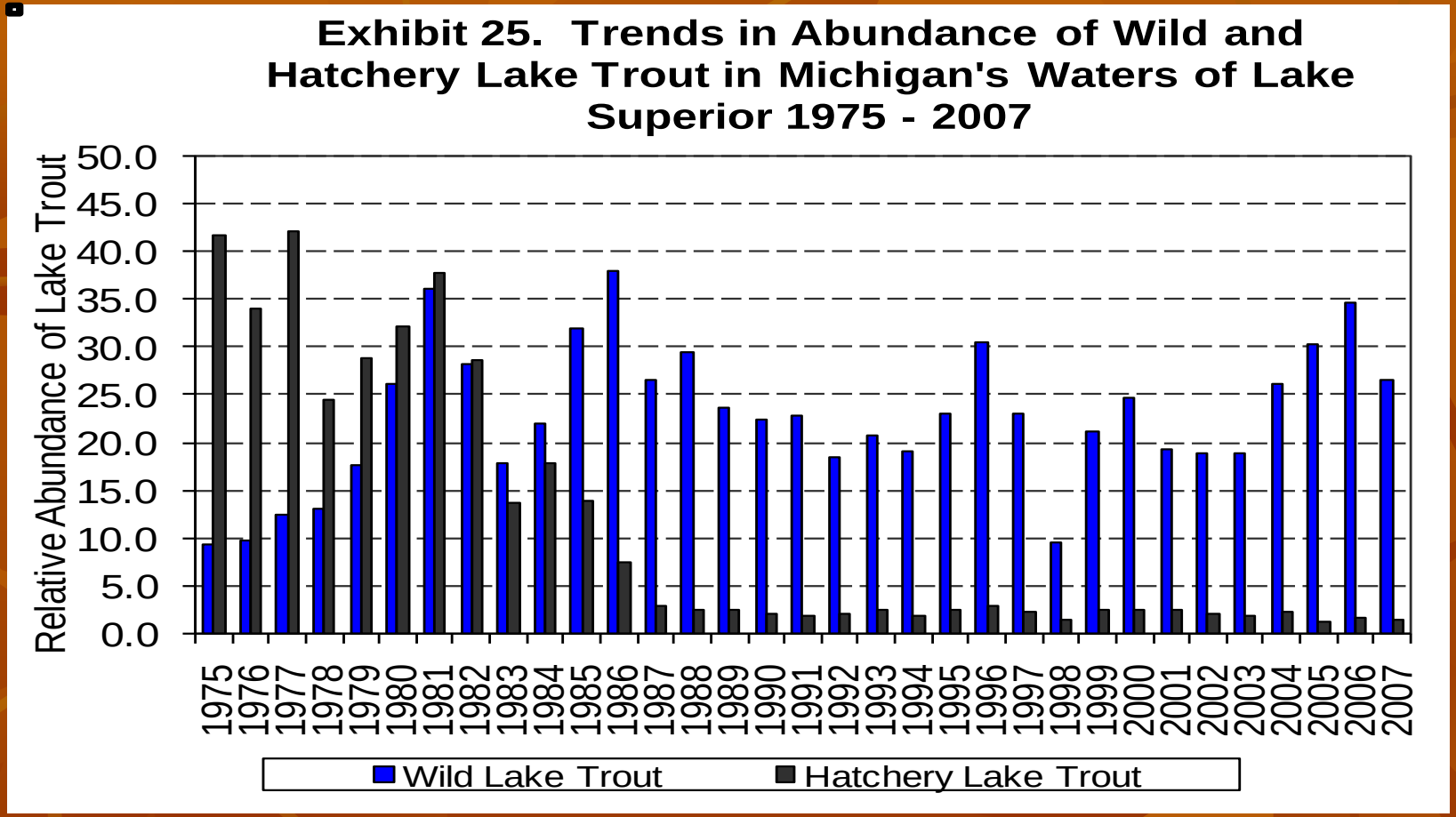
Walleye abundance has been cyclic since the late 1970s

Environmental Measures – Ecological Indicators



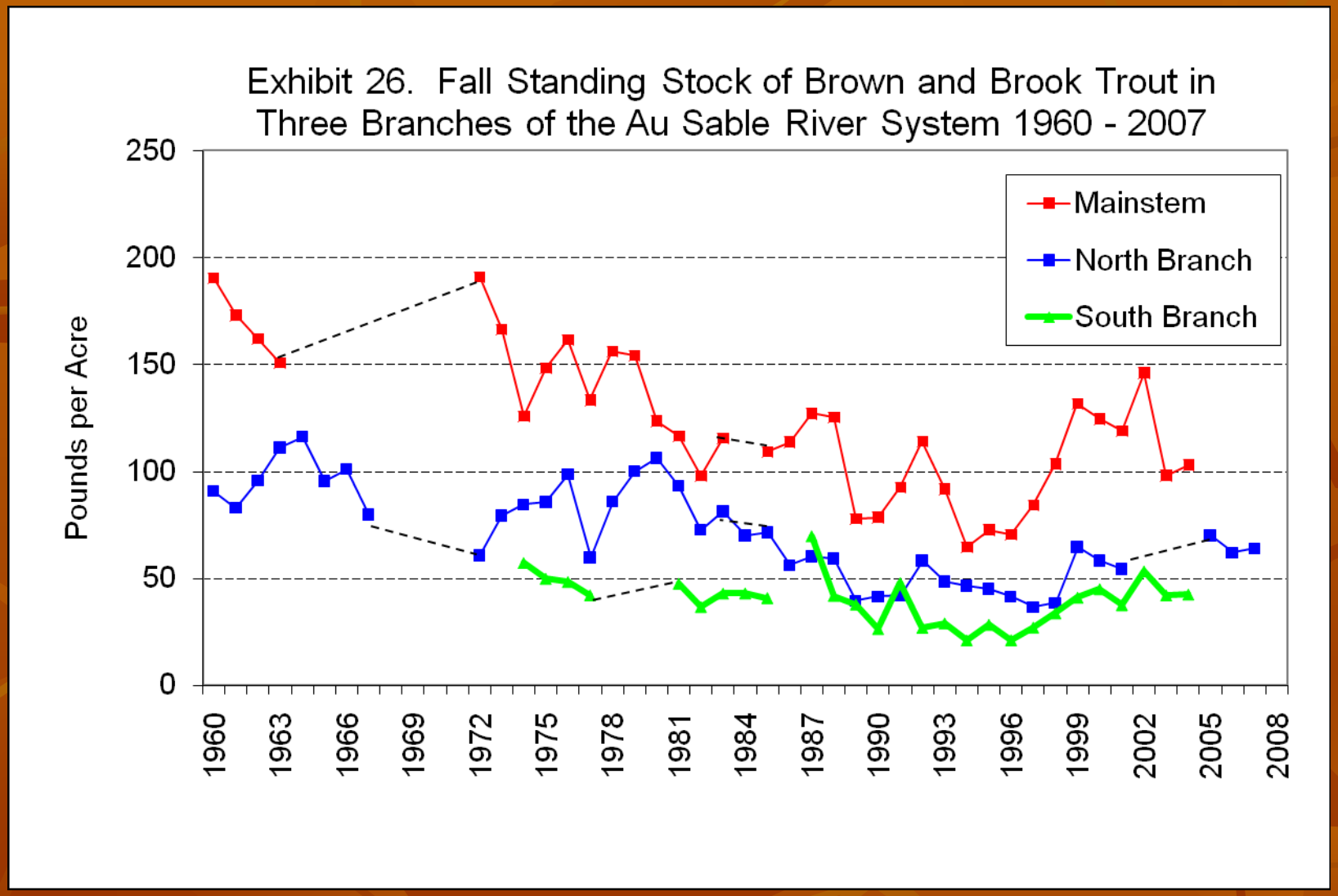
Walleye abundance is strongly related to annual variation in reproductive success

Environmental Measures – Ecological Indicators



Due to sea lamprey control, commercial fisheries restrictions and stocking of hatchery-raised fish, wild Lake Trout in Lake Superior have increased in abundance.

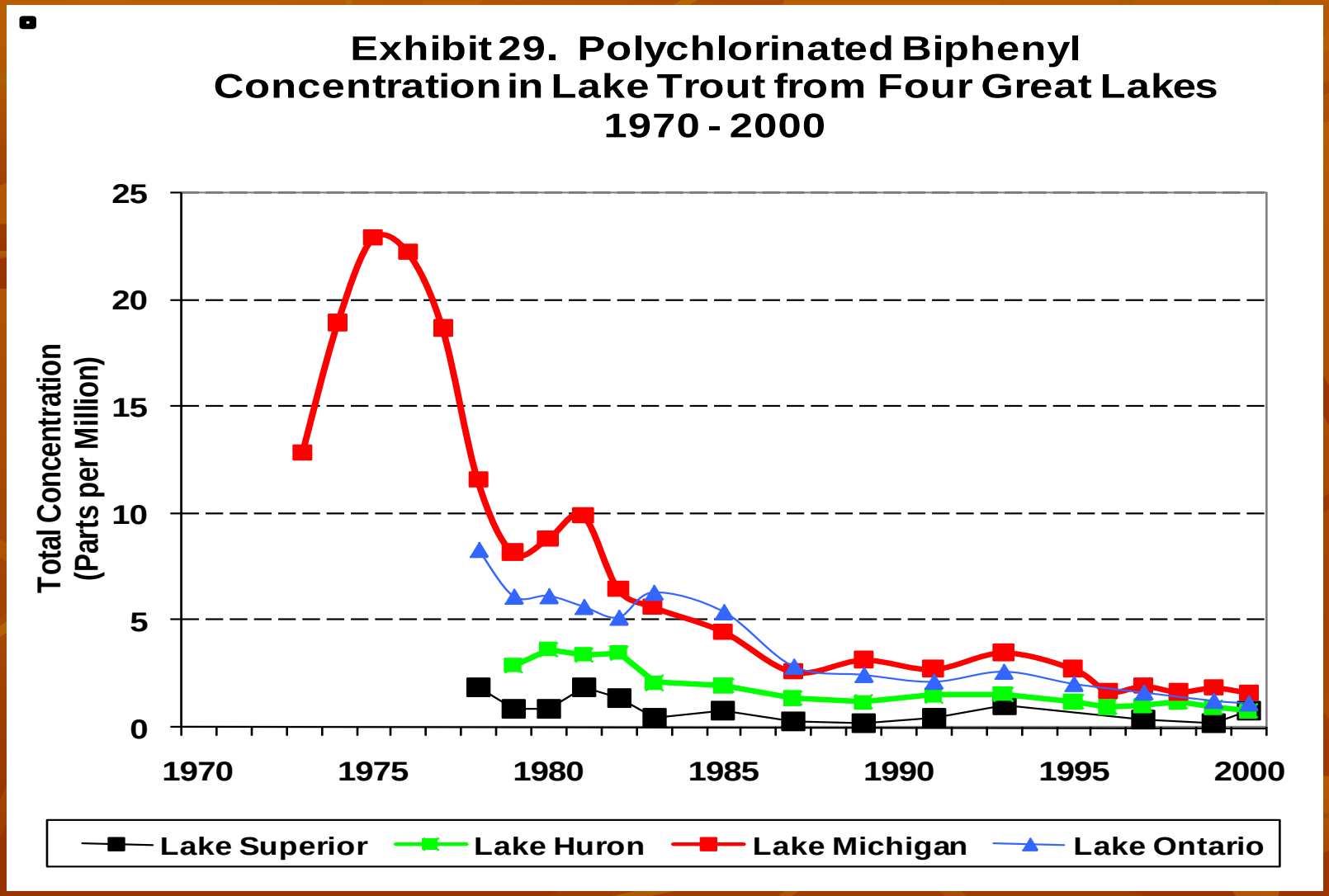
Environmental Measures – Ecological Indicators



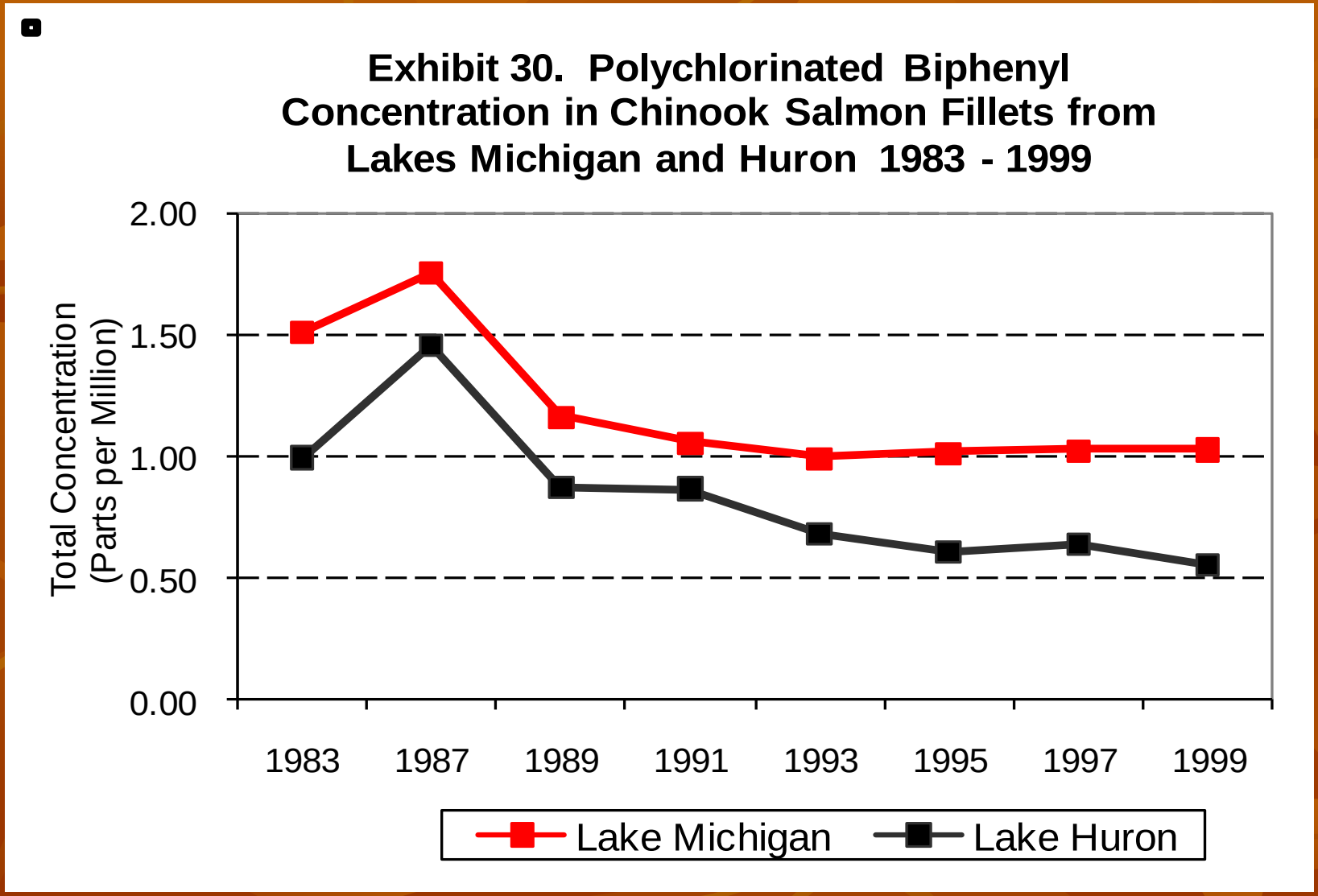
Environmental Measures – Ecological Indicators
Contaminants in Fish

- Michigan collects and analyzes over 700 fish tissue samples from approximately 50 locations.
- Since 1980, Michigan has collected and analyzed over 17,000 fish tissue samples from more than 800 locations.

Environmental Measures – Ecological Indicators



Environmental Measures – Ecological Indicators



Environmental Measures – Ecological Indicators

Trends in Endangered, Threatened, and Special Concern Species

Environmental Measures – Ecological Indicators

- An ***Endangered species*** is one that is in danger of extinction throughout all or a significant part of its range in Michigan.
- A ***Threatened species*** is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range in Michigan.
- A ***Special Concern species*** is one that is declining, but has not reached the level where legal protection would be considered under the Michigan Endangered Species Act.

Environmental Measures – Ecological Indicators

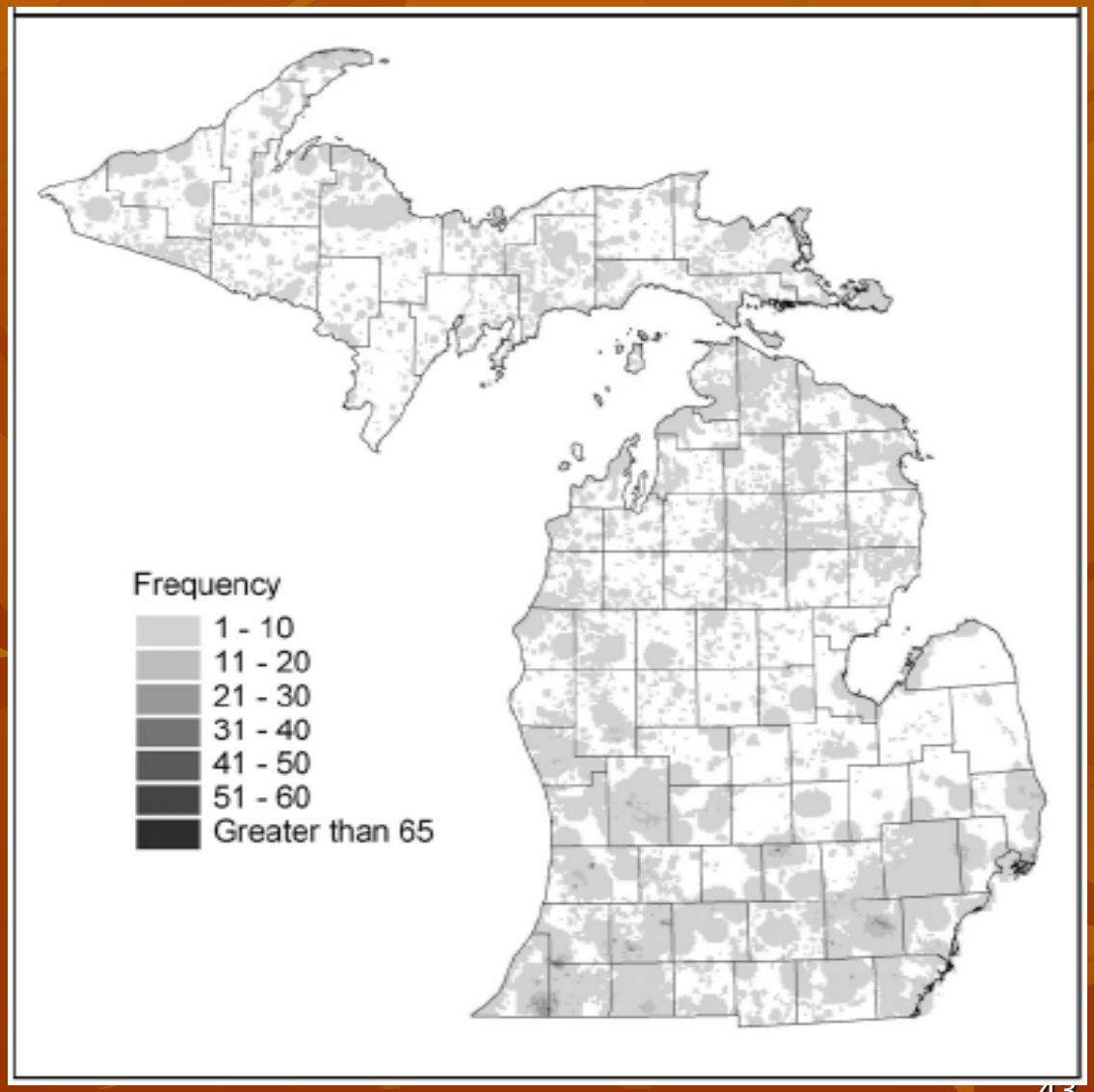
Exhibit 32. Numbers of Plants and Animals Considered Endangered, Threatened, or of Special Concern in Michigan 2007

Category	Endangered Species	Threatened Species	Special Concern Species
Plants	51	210	110
Animals			
Snails	2	2	29
Mussels	8	2	8
Insects	8	11	75
Fish	8	7	11
Amphibians	1	1	2
Reptiles	2	2	6
Birds	8	13	21
Mammals	4	2	4
Total Animals	41	40	156
Total Plant and Animals	92	250	266

Source: Michigan Natural Features Inventory, 2007.

Environmental Measures – Ecological Indicators

Frequency of Occurrence of Endangered, Threatened, and Special Concern Species in Michigan 2008



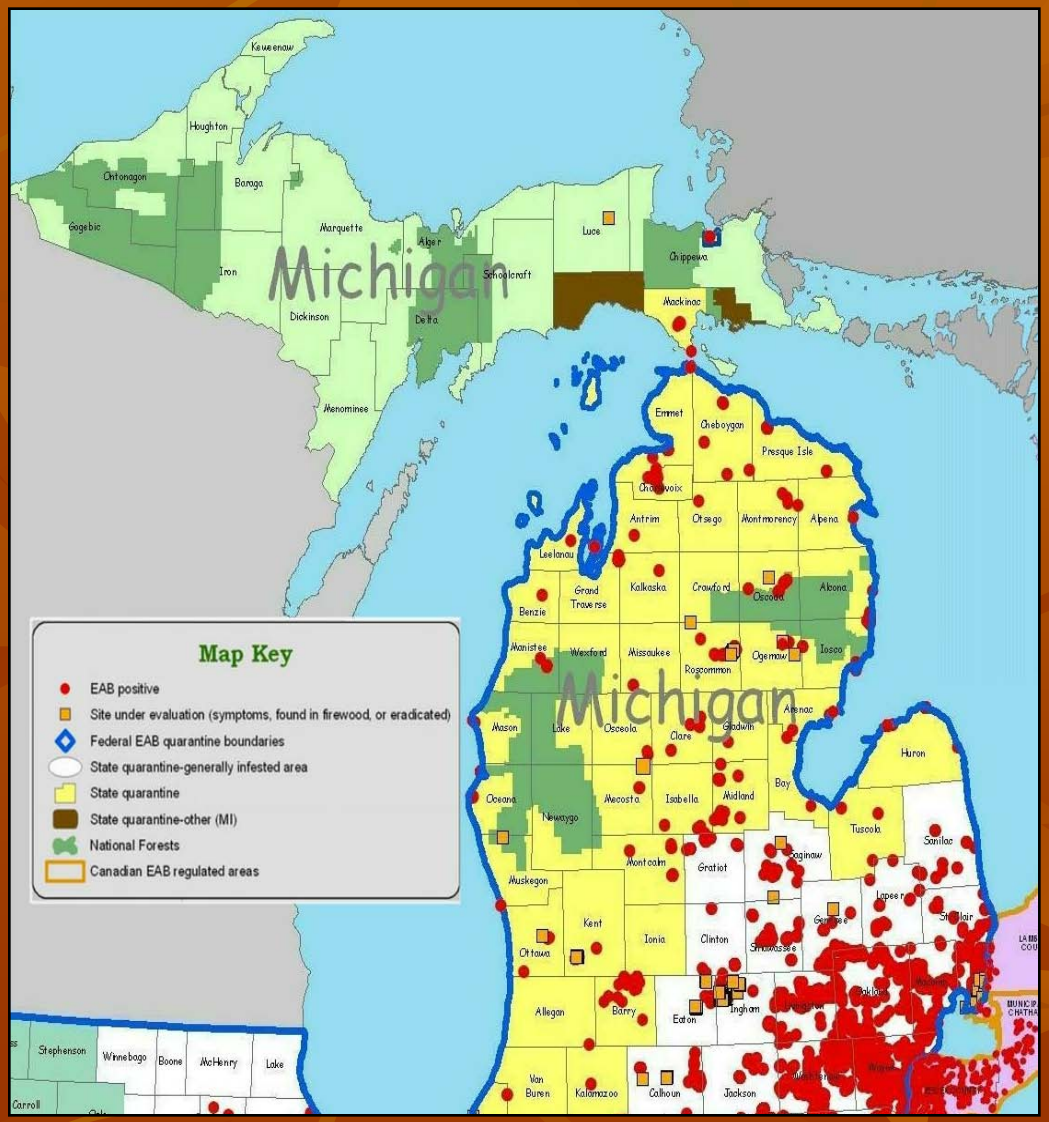
Environmental Measures – Ecological Indicators

Trends in Exotic Species

- Over 200 aquatic and terrestrial exotic species are *known* to have been introduced into Great Lakes Basin since 1800.
- Exotic species negatively impact native species by out competing them for food and habitat and disrupt ecosystem functions

Environmental Measures – Ecological Indicators

Locations of Emerald Ash Borer Michigan Infestations in Michigan



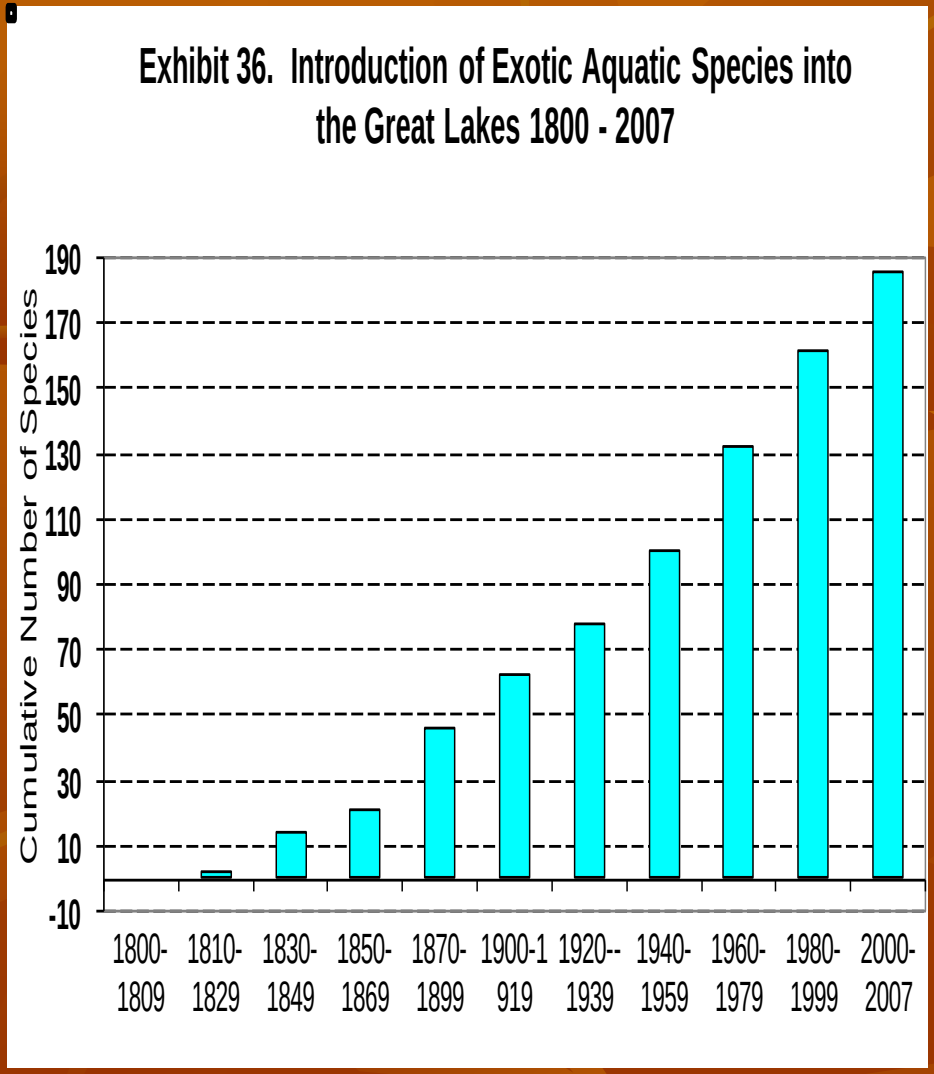
Environmental Measures – Ecological Indicators

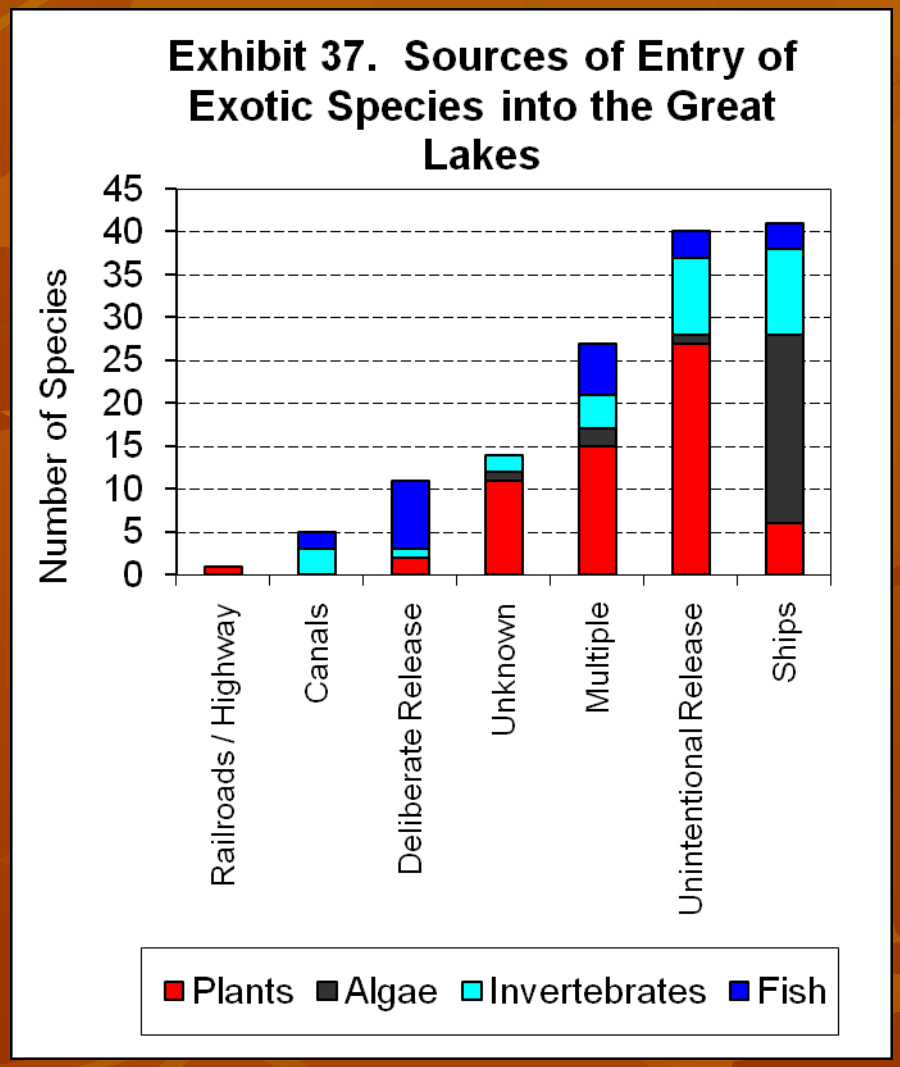
Exhibit 34. Numbers of *Known* Exotic Terrestrial and Aquatic Plant, Animal, and Virus Species Introduced into the Great Lakes Basin 2008

Ecosystem Type	Plant Species		Animals Species				Virus	Total
	Phytoplankton	Vascular	Invertebrates	Insects	Fish	Birds		
Terrestrial	--	37	--	7	--	3	--	47
Aquatic	27	60	68	2	26	--	3	186
Total Species	27	97	68	9	26	3	3	233

Sources: National Oceanic and Atmospheric Administration's National Center for Research on Aquatic Invasive Species, Great Lakes Environmental Research Laboratory: *Great Lakes Aquatic Nonindigenous Species List,* March 2008. Center for Exotic Species, Michigan Technological University, April 2003. National Invasive Species Council, July 2007

Environmental Measures – Ecological Indicators

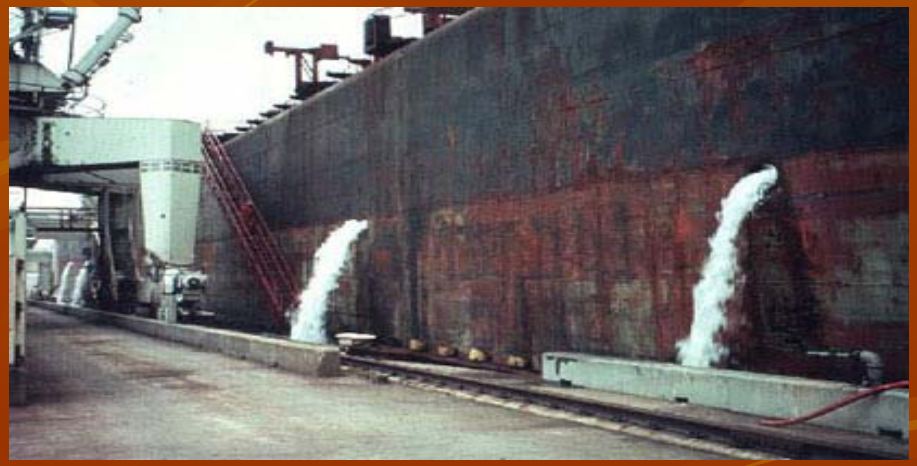




Introductions

Sources of Entry

Environmental Measures – Ecological Indicators
Ballast Water Discharges into the Great Lakes



- Primary source for aquatic exotic species entry into the Great Lakes is ballast water discharge.
- A total of 21 types of control are being investigated to control entry – including the use of biocides.
- Ballast water exchange at sea for ocean-going ships
- Ballast water reporting is now taking place.
- Creation of Aquatic Nuisance Species Council.