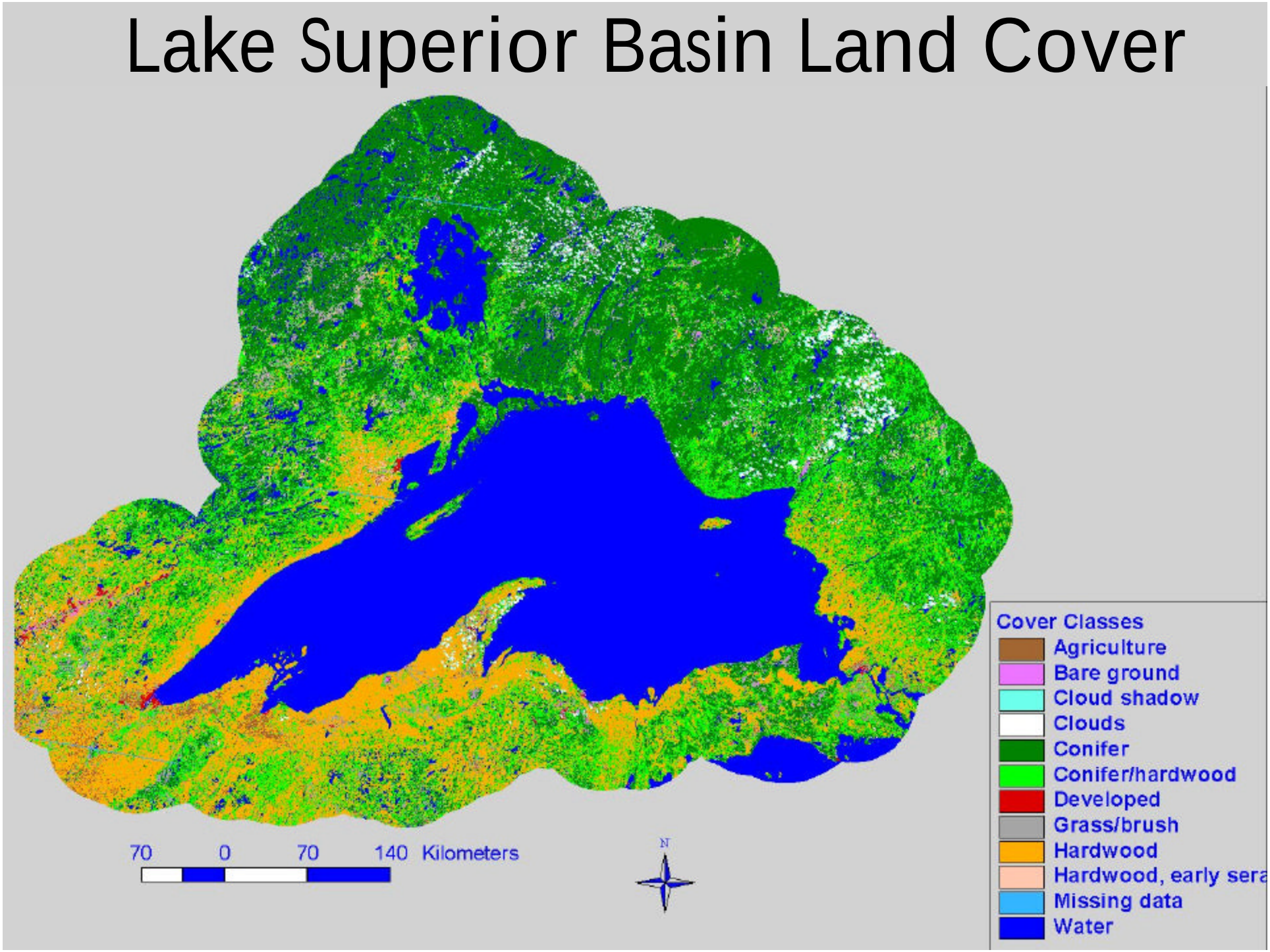
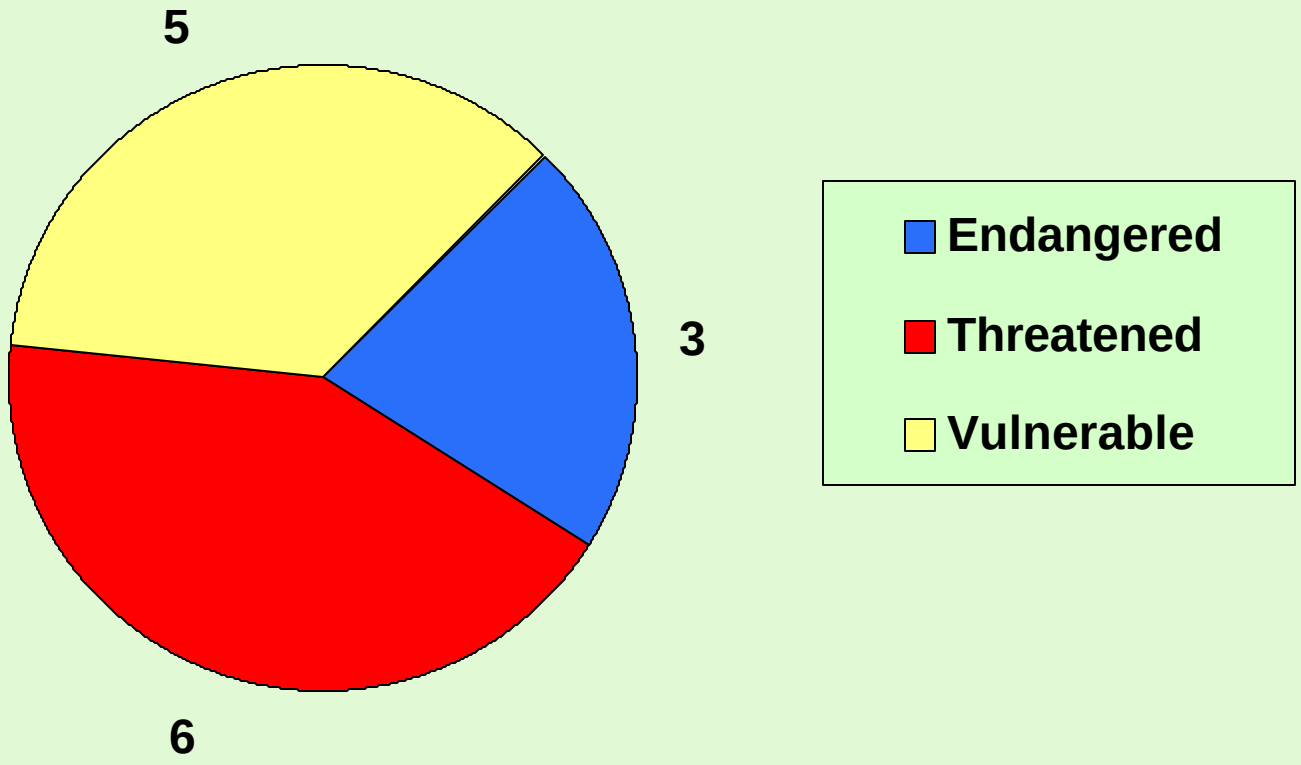

Lake Superior Basin Ecosystem
Darrell Piekarz
Environment Canada

Lake Superior Watershed

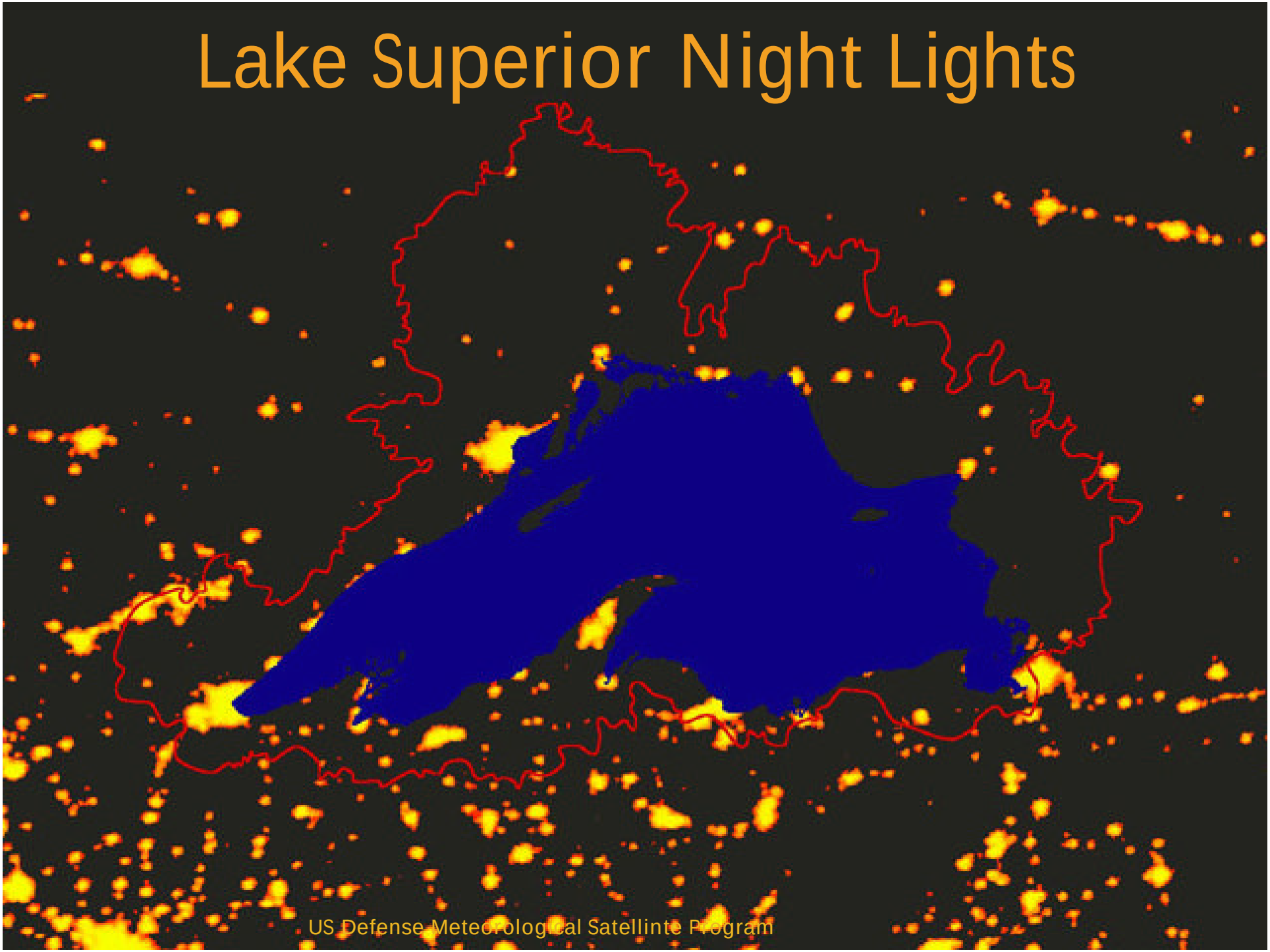
Lake Superior Basin Land Cover



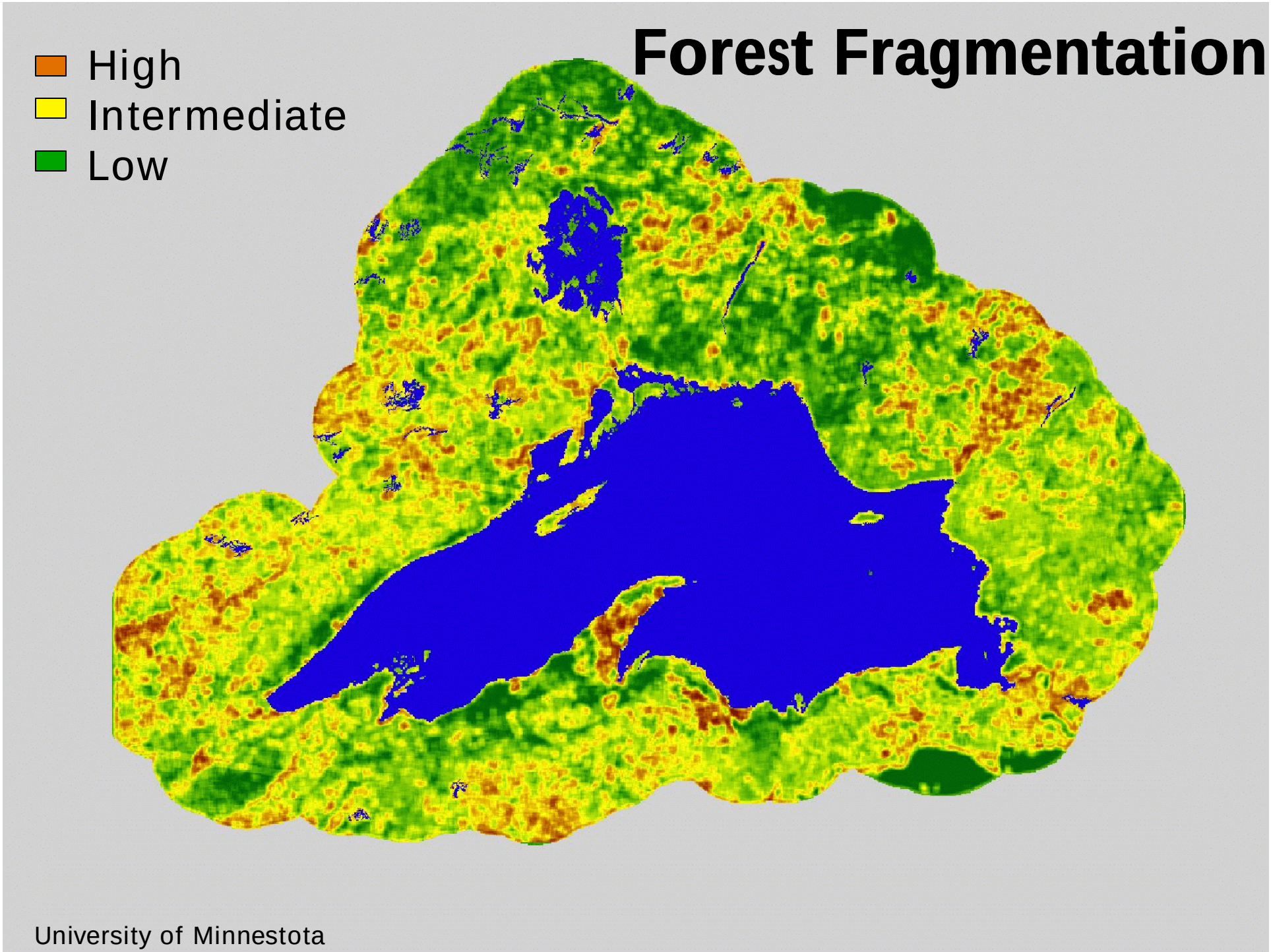
Lake Superior Endangered Species



Lake Superior Night Lights



Forest Fragmentation

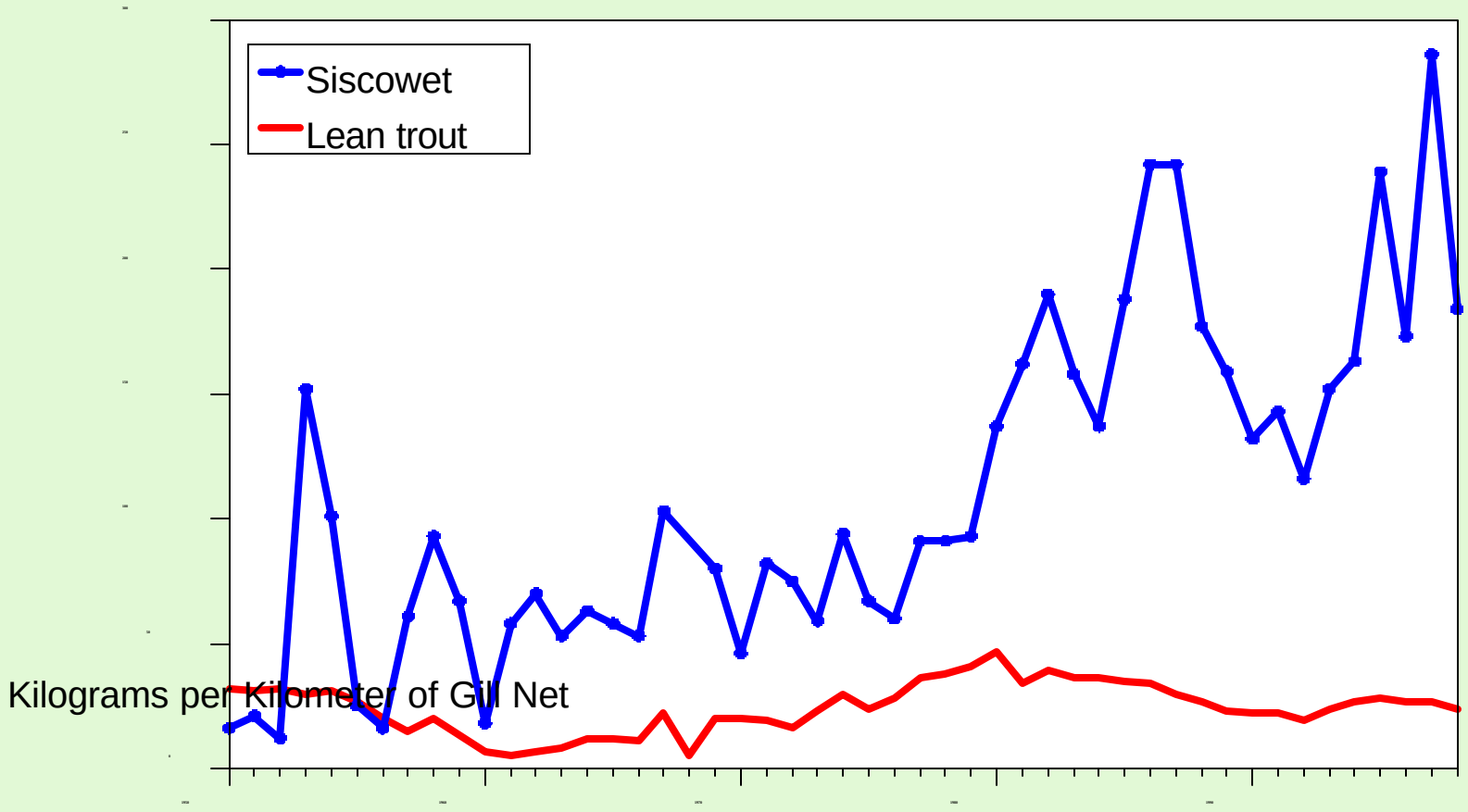


University of Minnestota

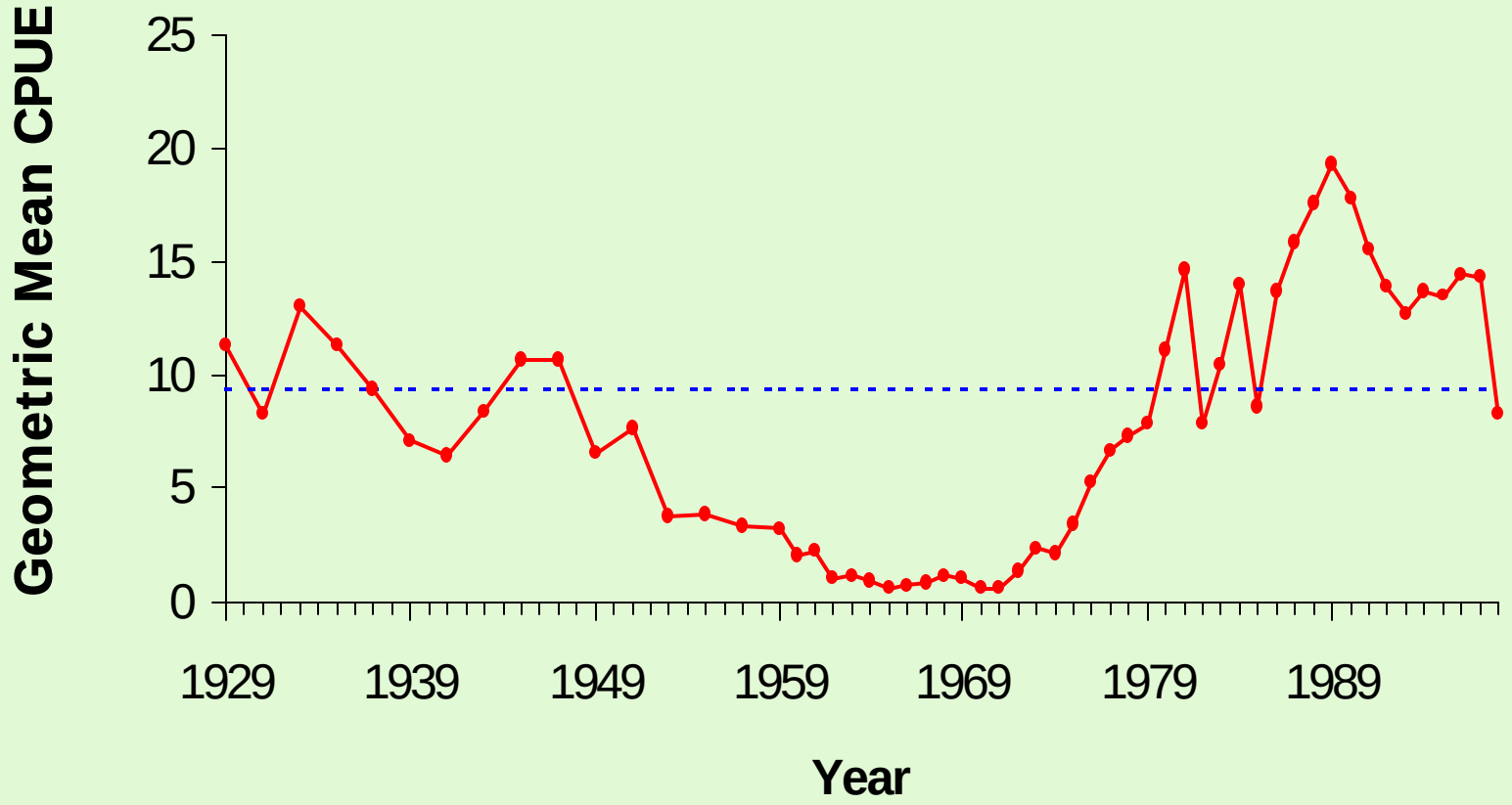
Aquatic Communities

- Superior is the Great Lake closest to ancestral aquatic communities
- Lake Superior aquatic foodweb
- Indicator: fish abundance
  - lake trout, chubs, lake herring and whitefish
- Indicator: sea lamprey abundance

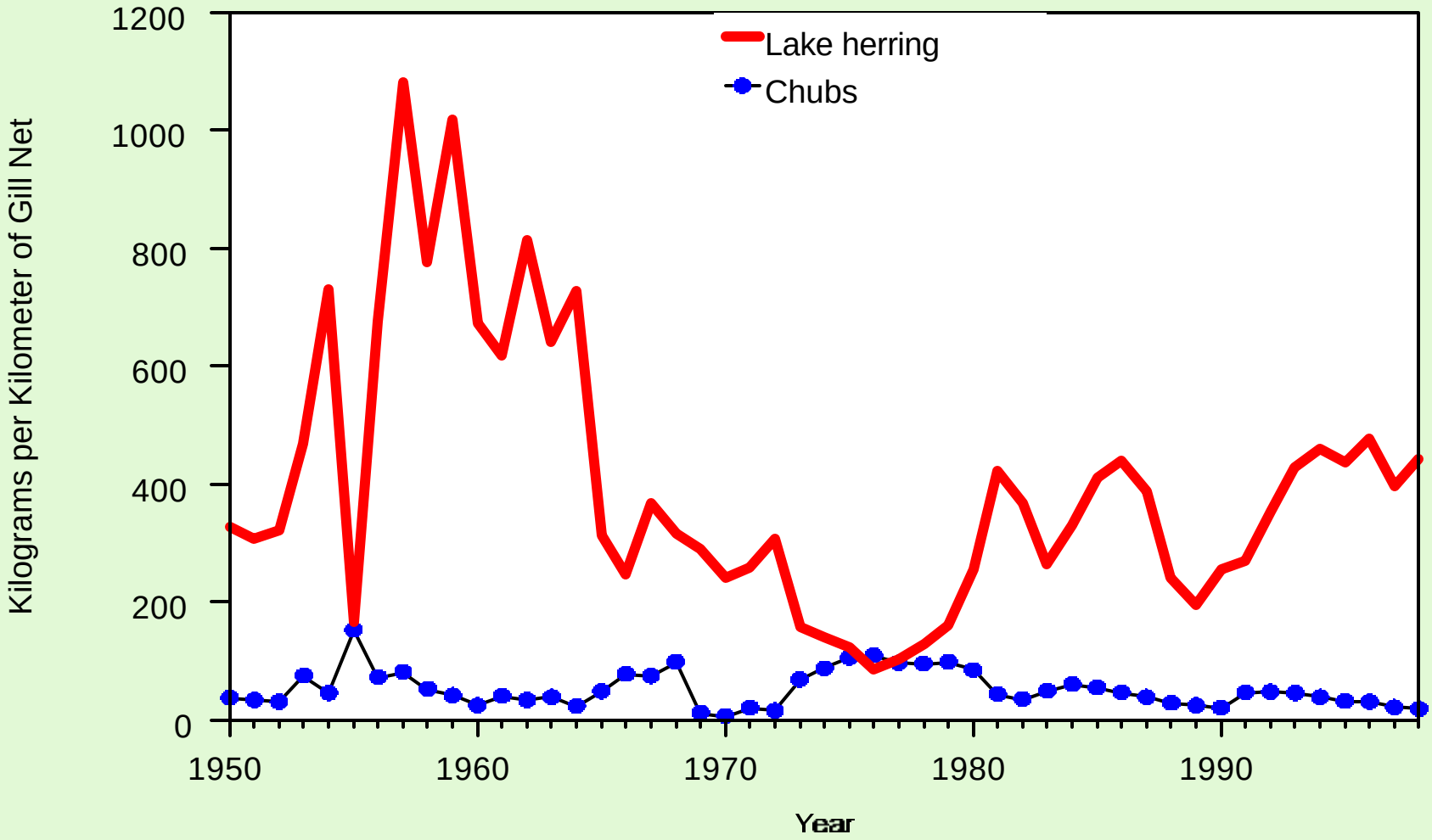
Catch per Unit Effort of Lean and Siscowet Lake Trout in Commercial Fisheries, 1950-1998



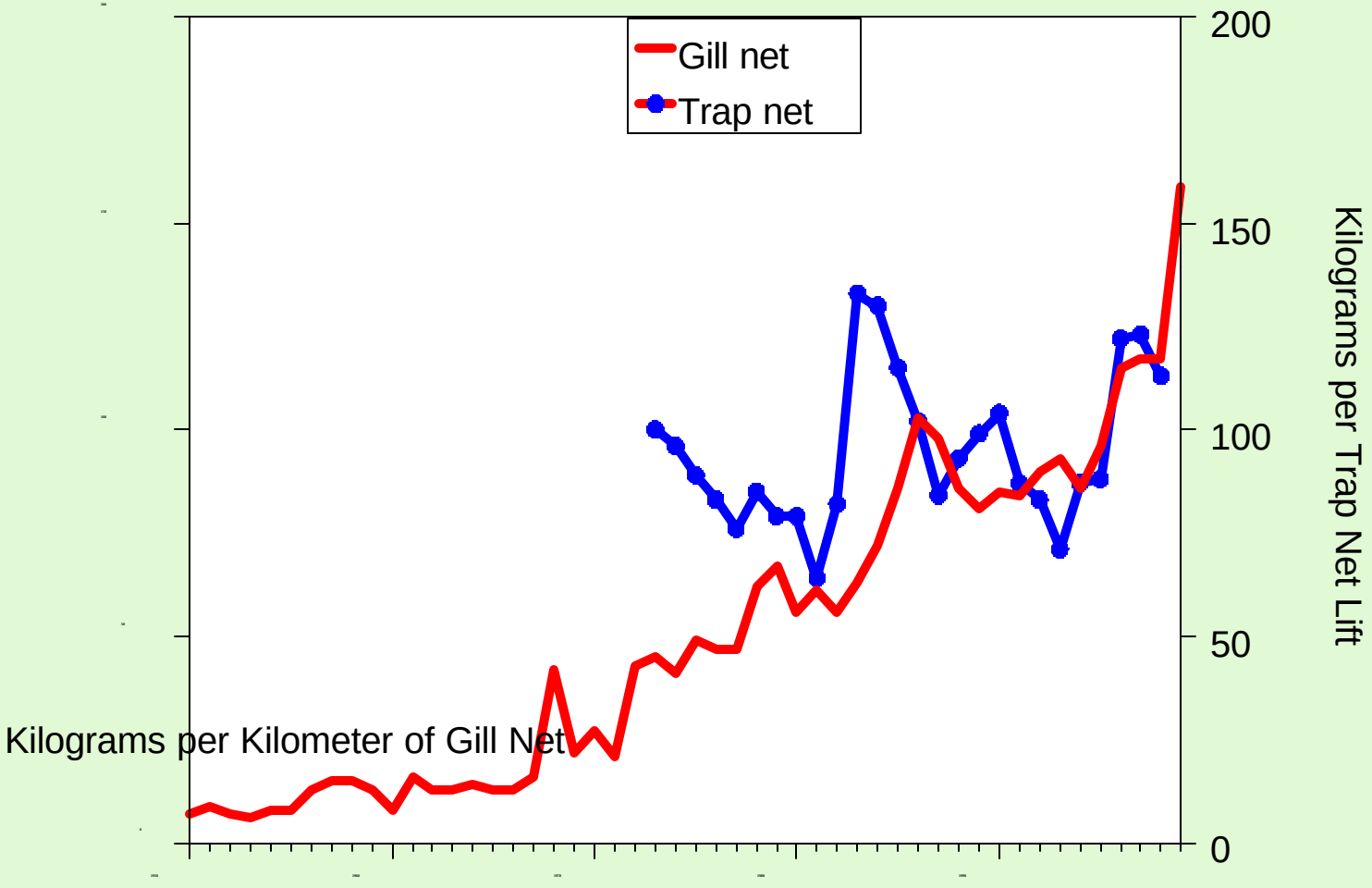
Lean Lake Trout Catch per Unit Effort in Michigan Waters of Lake Superior, 1929-1998



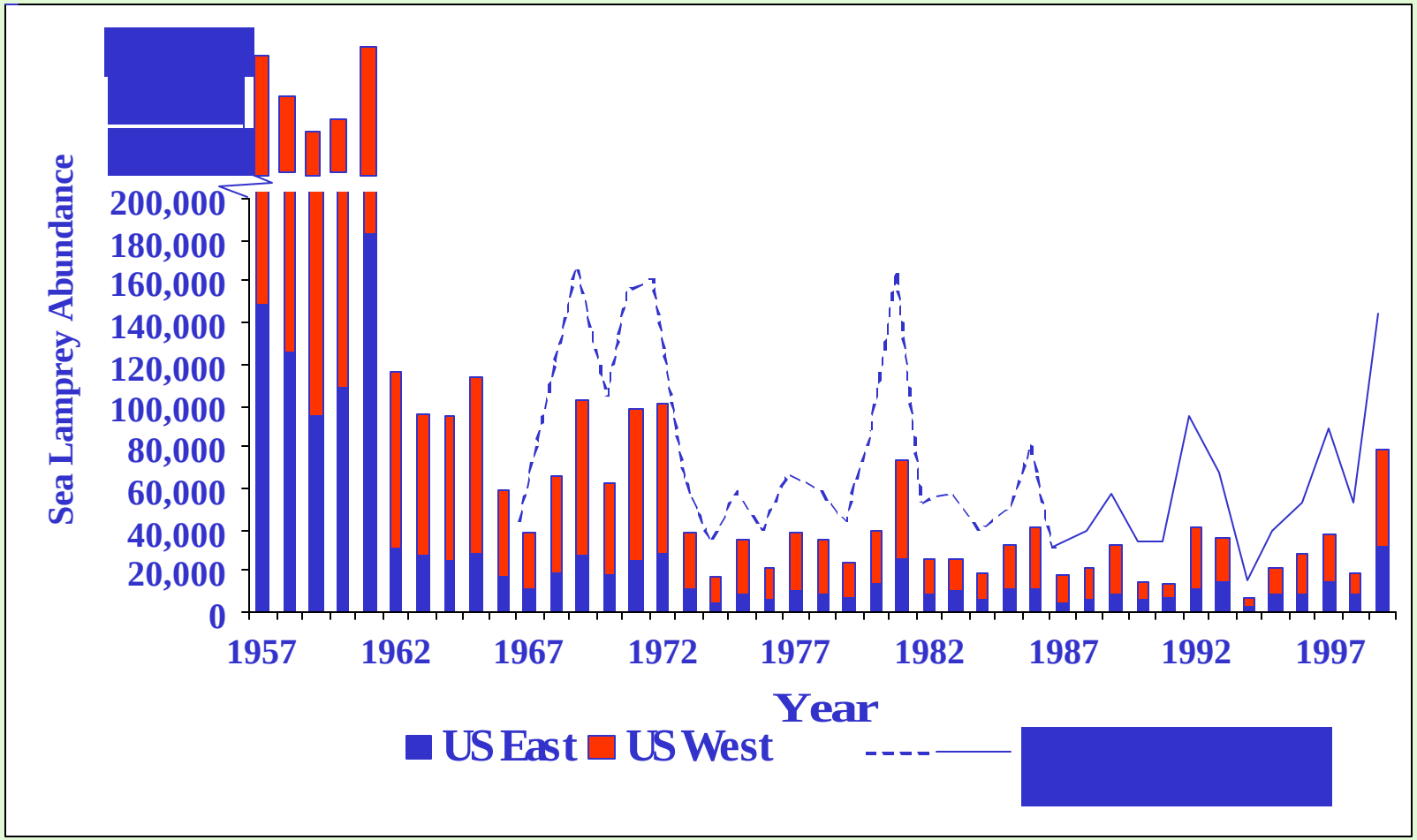
Catch per Unit Effort of Lake Herring and Chubs in Lake Superior Commercial Fisheries, 1950-1998



Catch per Unit Effort of Lake Whitefish in Lake Superior Commercial Fisheries, 1950-1998

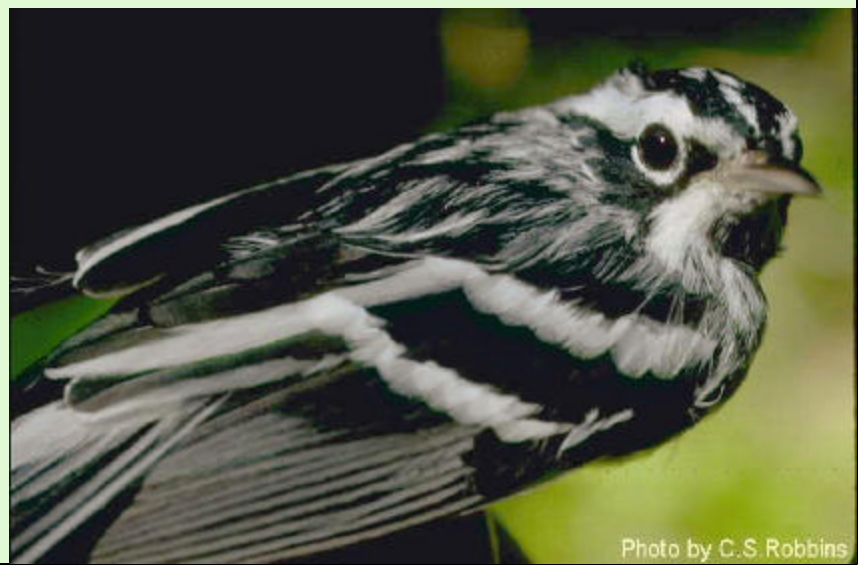


Abundance of Sea Lamprey in Lake Superior, 1957-1999



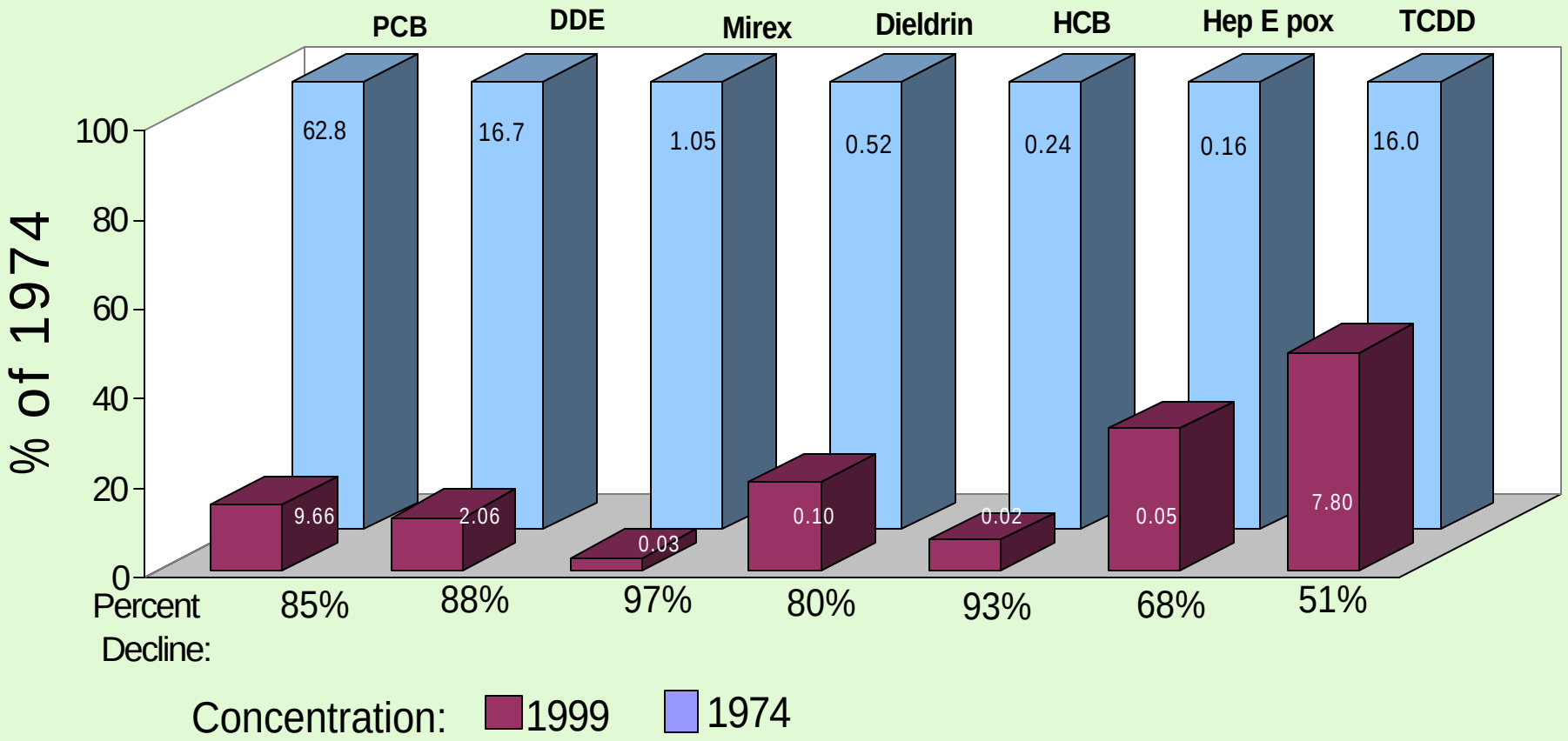
Wildlife Communities

- **Indicator:** forest breeding birds
  - trend data are unique to the local level
- **Indicator:** colonial waterbirds
  - herring gulls are indicators of regional contaminant levels




Herring Gull
JIM FLYNN

Herring Gull Contaminants



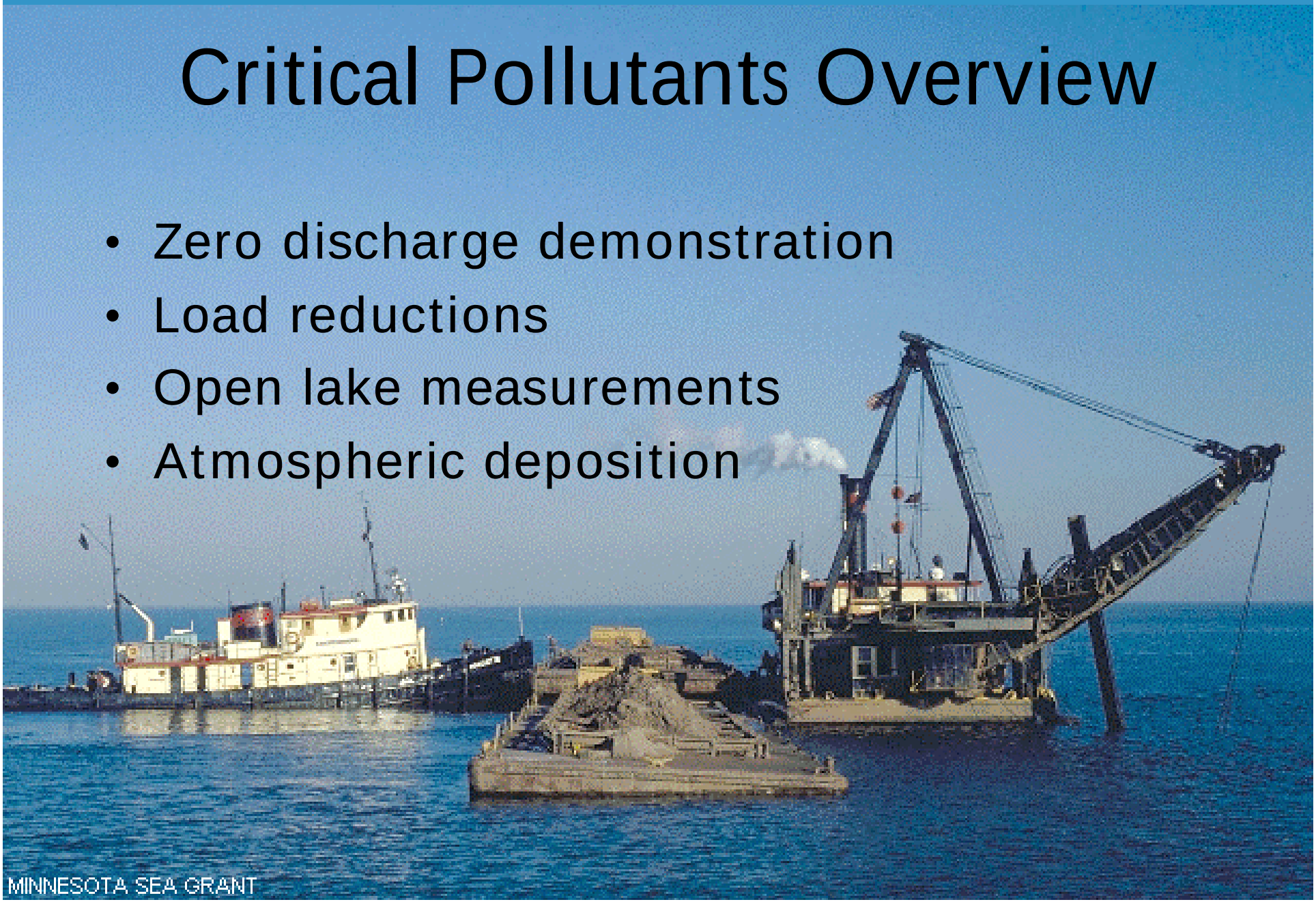
Lake Superior Herring Gull Abundance

	1976-77		1989-90		1999	
	pairs	colonies	pairs	colonies	pairs	colonies
Canada	6,410	149	12,181	299	11,115	301
% change from previous survey			90.0%	100.7%	-8.7%	<1.0 %
U.S.	7,106	90	13,263	187	7,715	134
% change from previous survey			86.6%	107.8%	-41.8%	-28.3%

Canadian data - D.V. Weseloh, personal communication.
U.S. data - J. McKearnan, personal communication,
Cuthbert and McKearnan (1999).

Critical Pollutants Overview

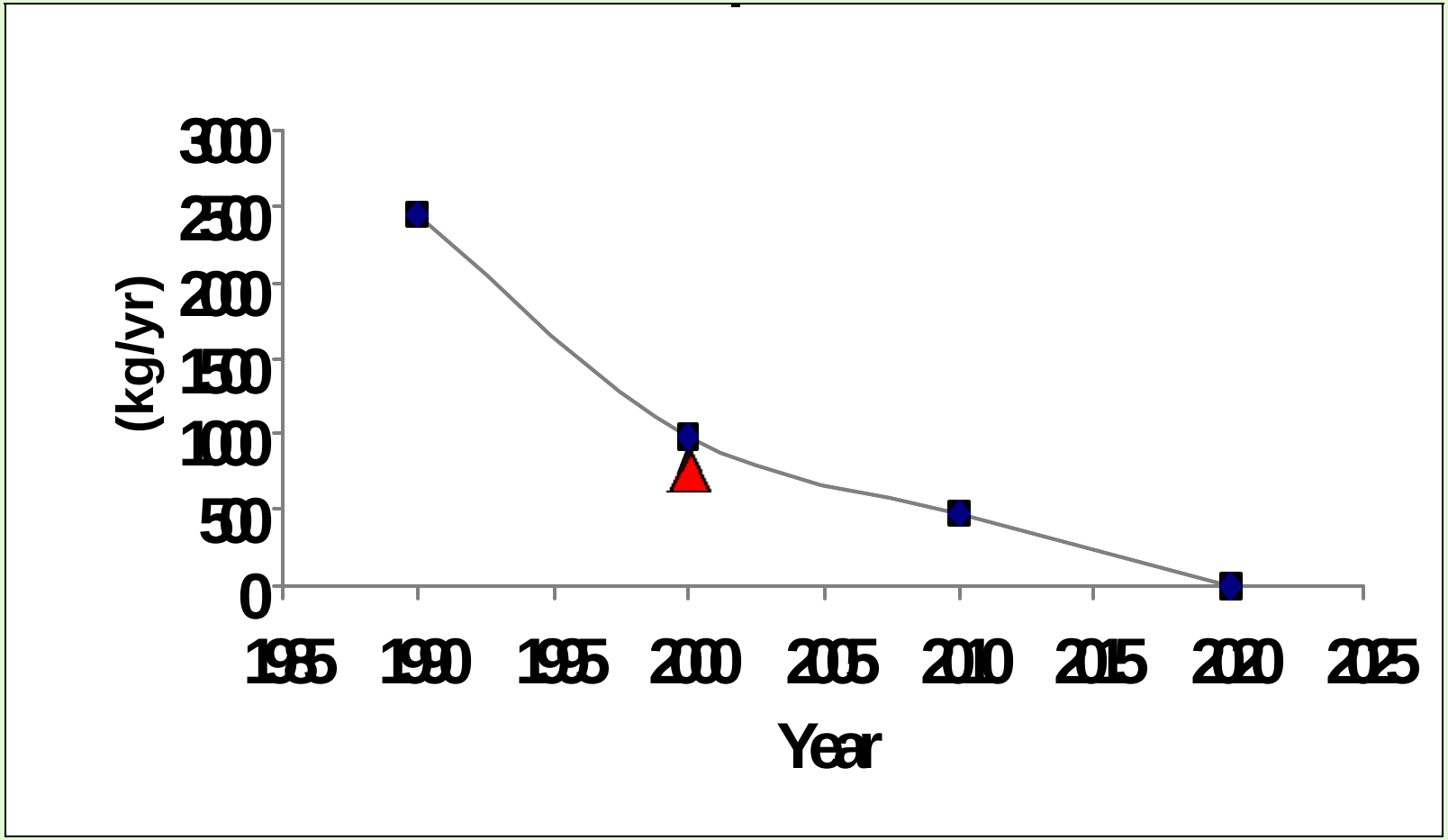
- Zero discharge demonstration
- Load reductions
- Open lake measurements
- Atmospheric deposition



Progress Towards Zero Discharge

- **Management goal:** zero discharge/ emissions of nine critical pollutants
- 2000 mercury goal has been met
- Meeting 2010 milestones requires strategies for fuel combustion and mining

Mercury Reduction from Sources in the Lake Superior Basin

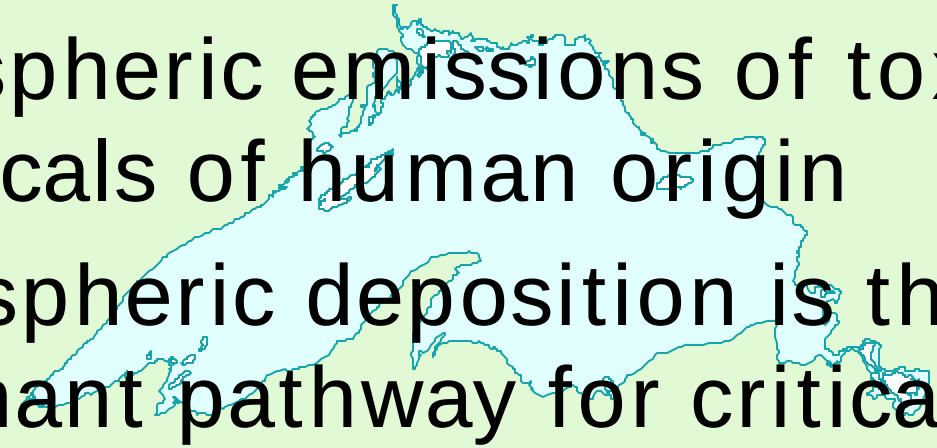


Open Lake Water Concentrations

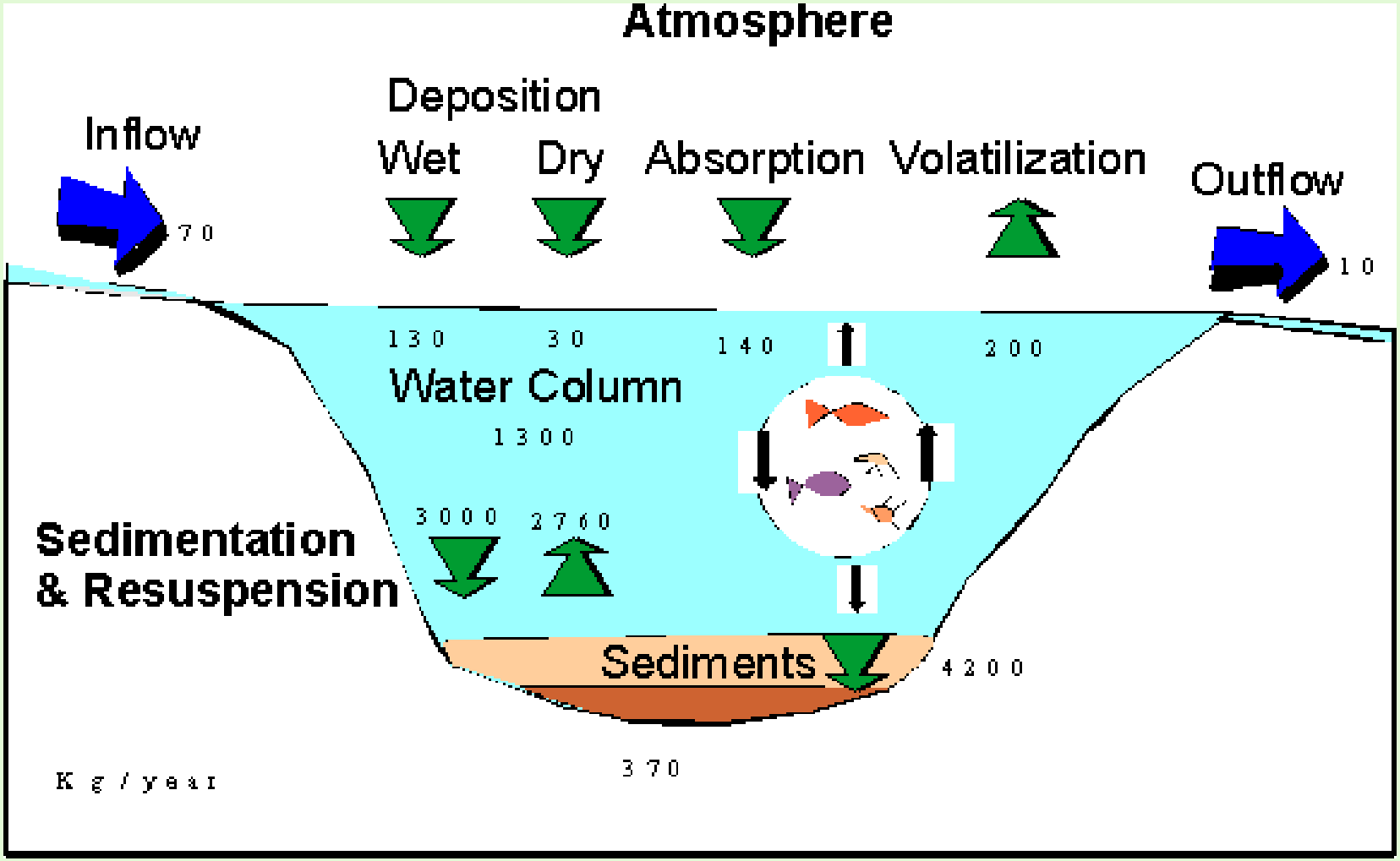
Chemical	Open Lake concentrations (ng/L)	Most sensitive guideline
Chlordane	<0.03; 0.0099	**0.012 (WI)**
DDT	<0.023	**0.011 (WI, MI)**
Dieldrin	**0.114**	**0.0012 (MN)**
2,3,7,8-TCDD	data not available	**0.0000014 (MN)**
Hexachlorobenzene	0.012	**0.074(MN)**
Mercury	0.21 - 1.00	**1.3 (MN, MI, WI)**
Octachlorostyrene	<0.020	**--**
PCBs	**0.0705**	**0.003 (WI)**
Toxaphene	**0.9; 0.7**	**0.011 (MN)**
PAHs, total	0.168	**2.8 (EPA)**
a-BHC	2.768	**3.7 (WI)**
Cadmium	data not available	**100 (MOE)**
Heptachlor + heptachlor epoxide	**<**0.019+0.052; n/a+0.044	**0.1 (MOE)**

Atmospheric Deposition

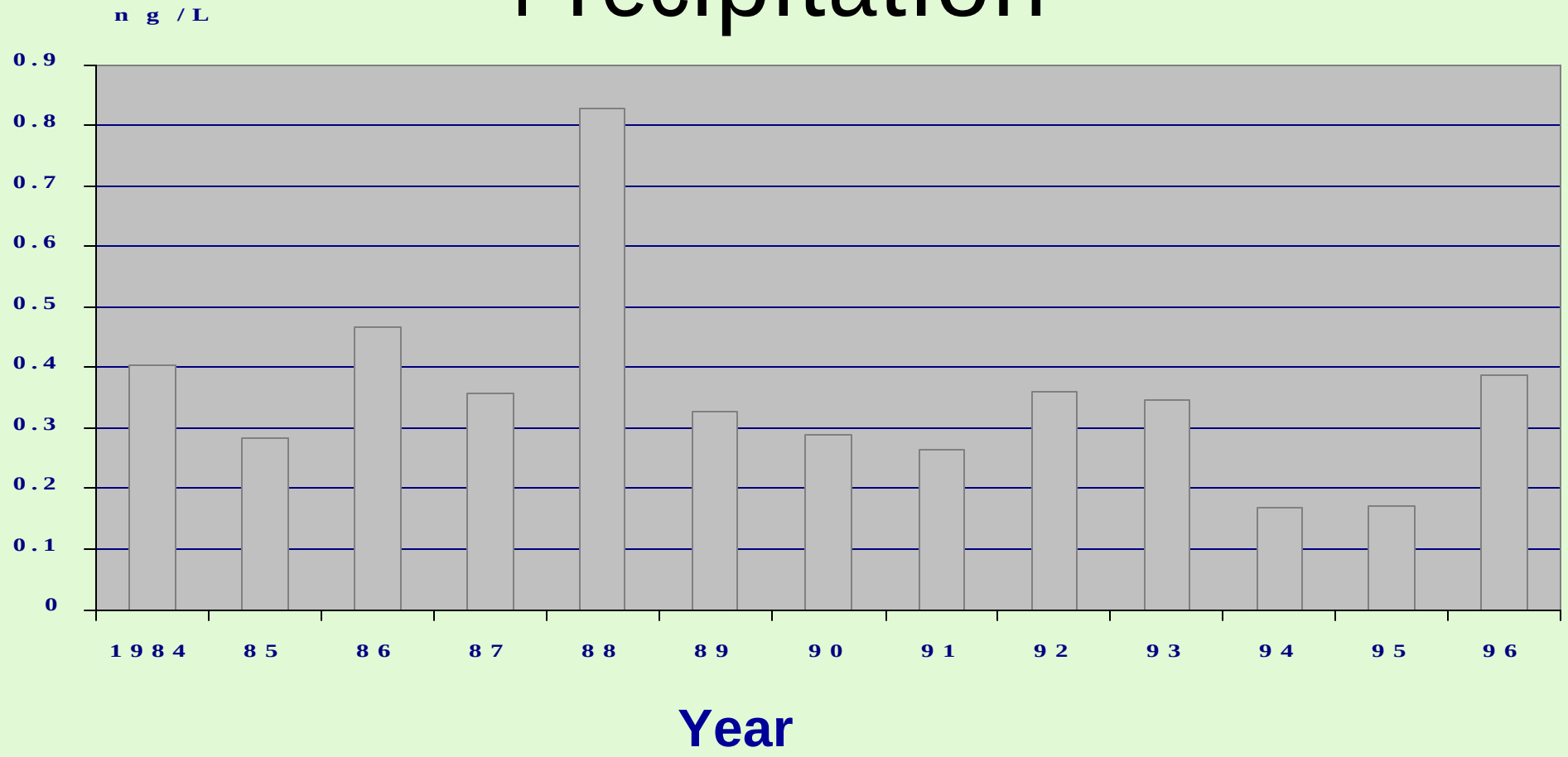
- **Objective:** virtual elimination of atmospheric emissions of toxic chemicals of human origin
- Atmospheric deposition is the dominant pathway for critical pollutants
- Atmospheric loadings will continue for an unknown time



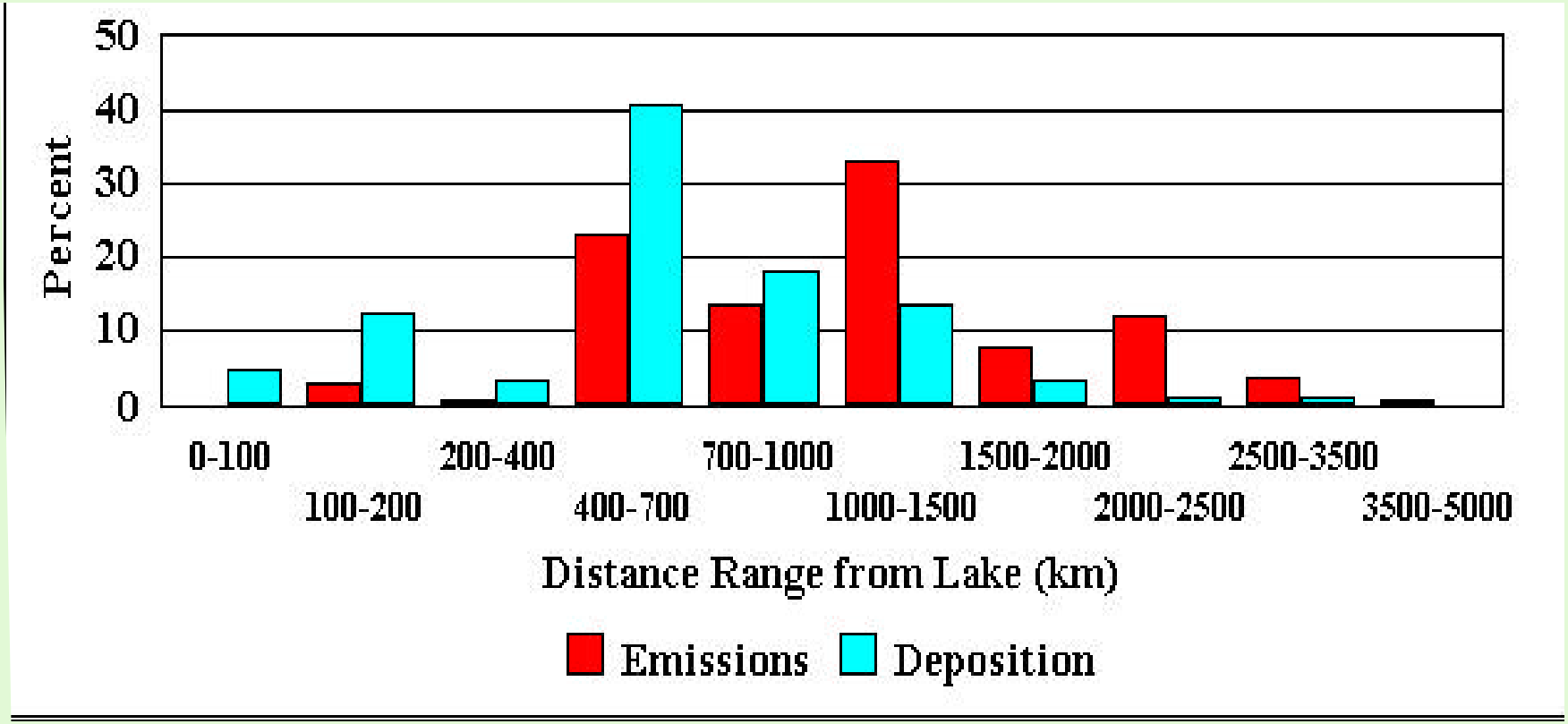
Lake Superior PCB Budget



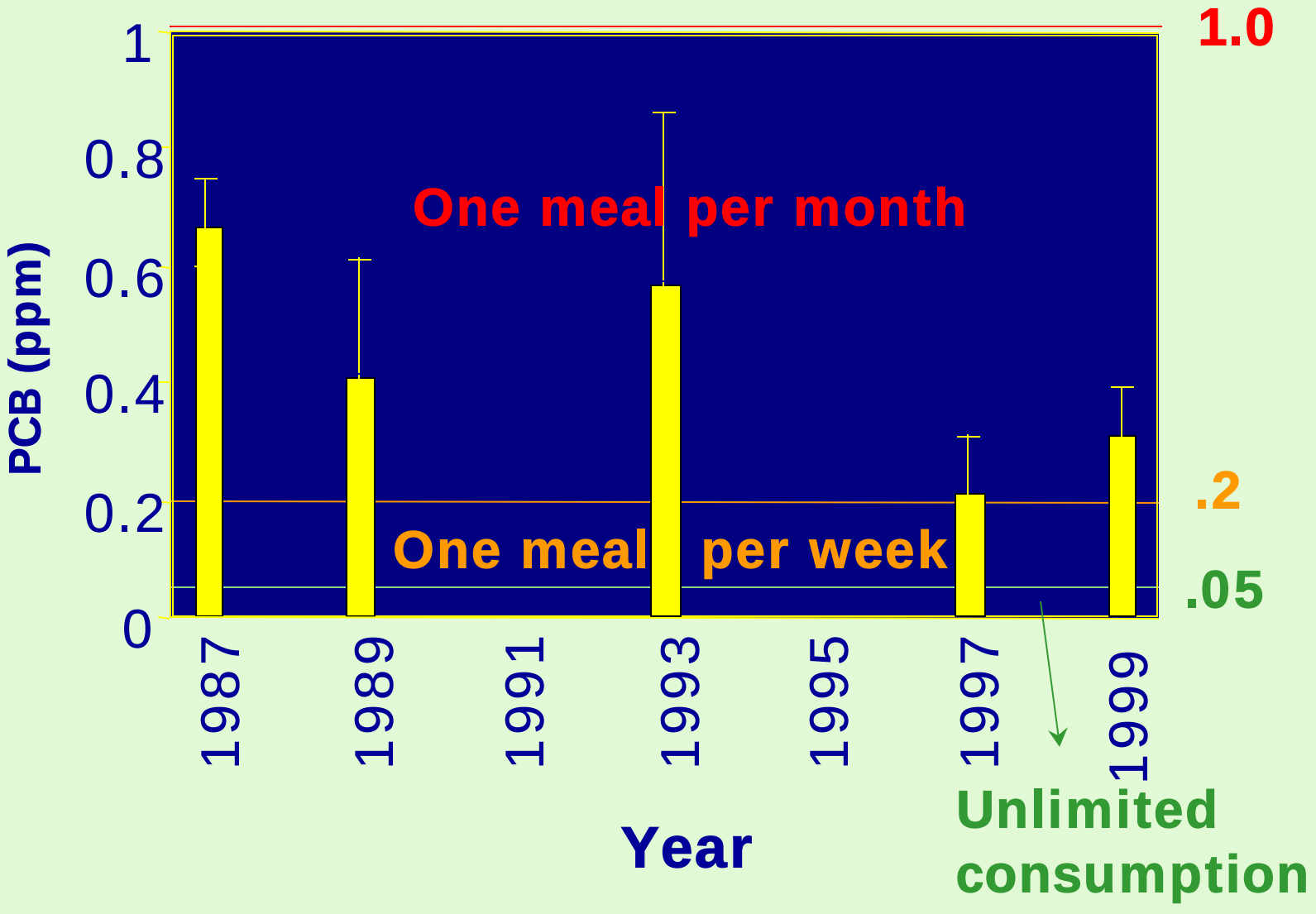
Dieldrin in Lake Superior Precipitation



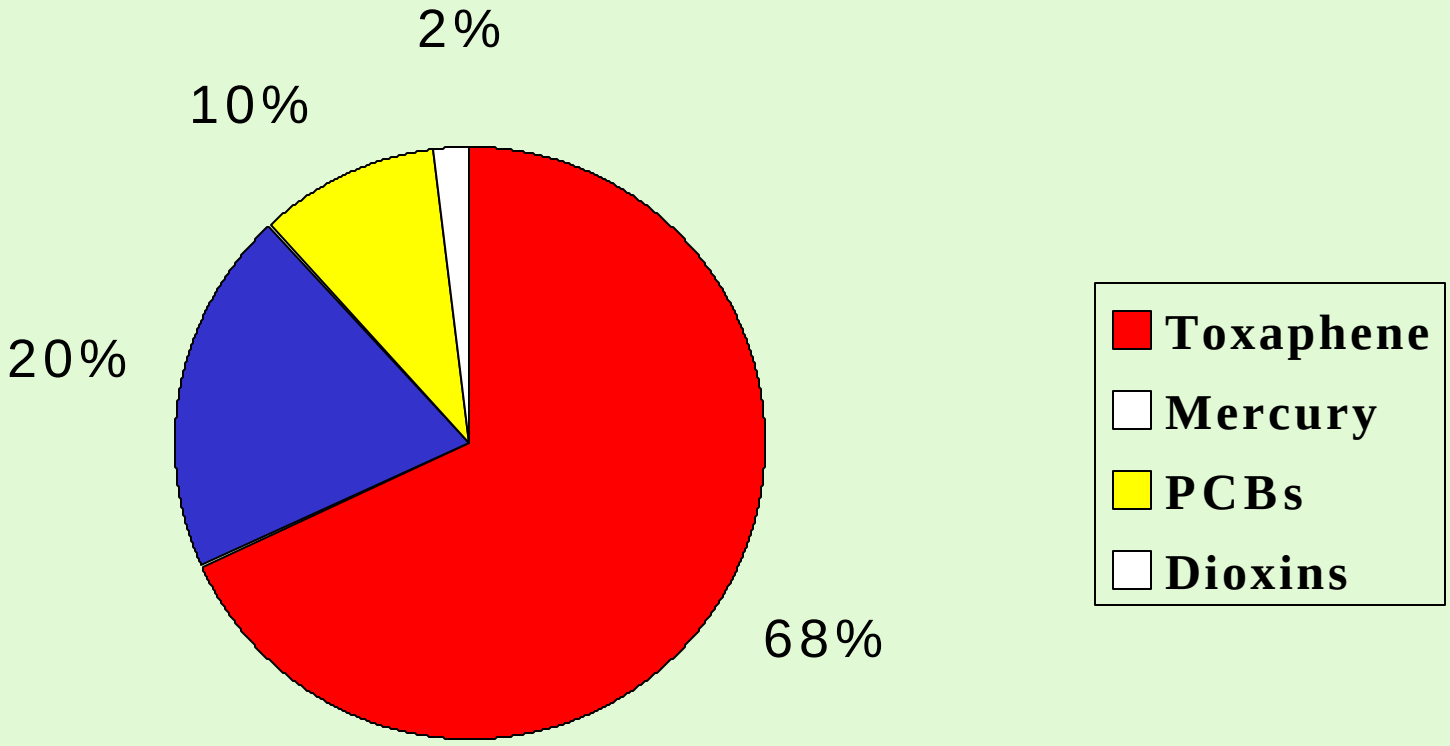
Dioxin Emissions and Deposition within Distance Ranges from Lake Superior, 1996



PCBs in Lake Superior Chinook Salmon

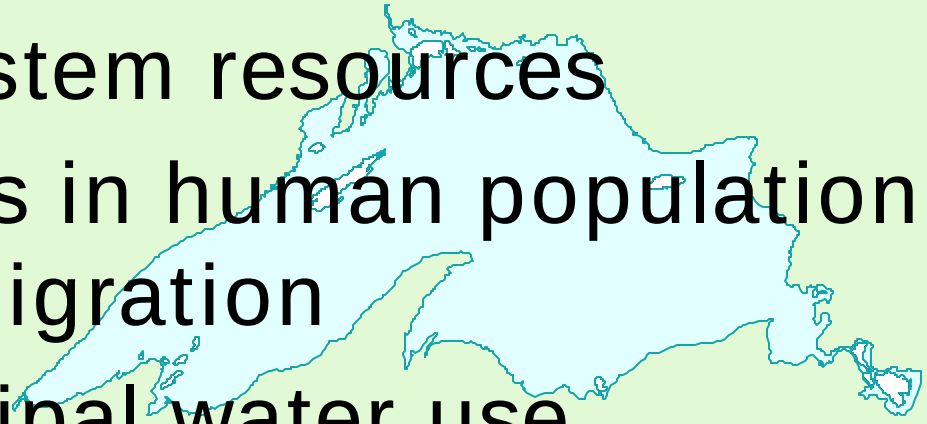


Relative Contribution of Contaminants to Ontario Sportfish Advisories

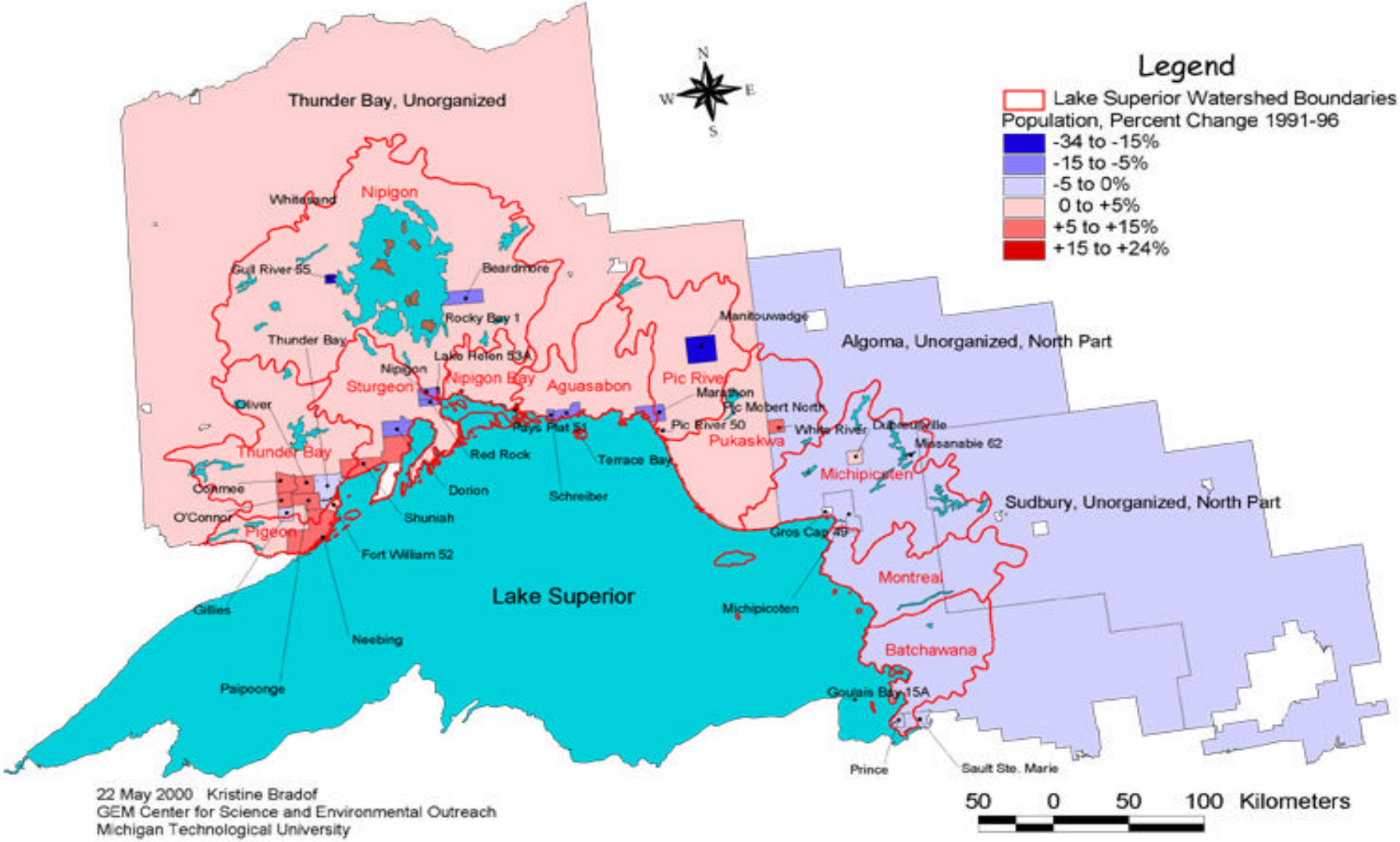


Developing Sustainability

- Indicators relate to use of ecosystem resources
- Trends in human population density and migration
- Municipal water use



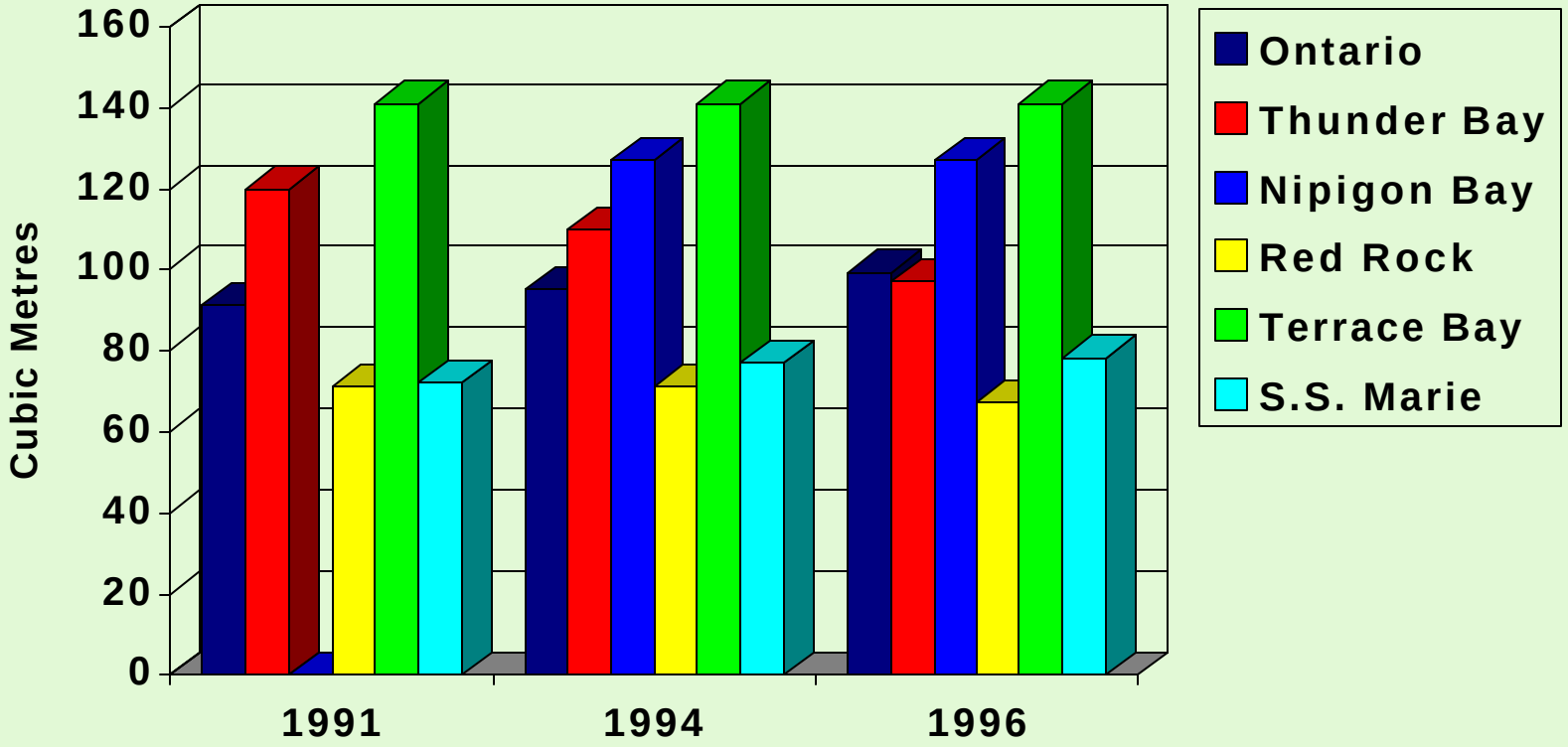
Percent Change in Population, 1991-1996
Ontario Lake Superior Watershed Census Subdivisions



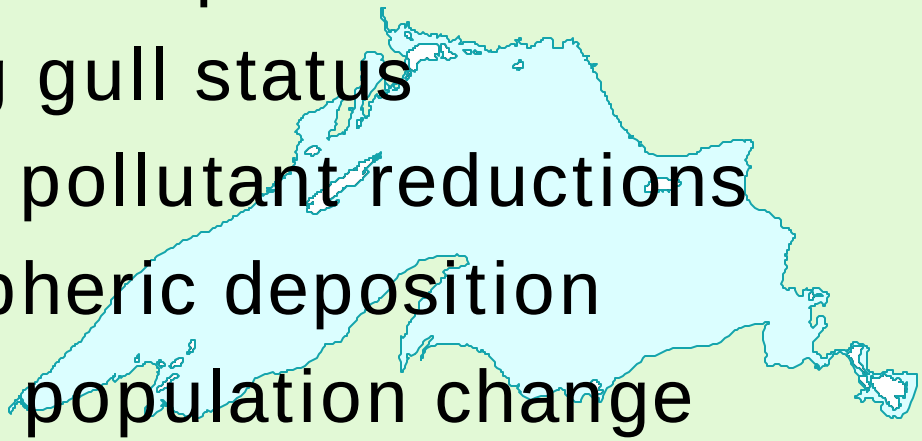
22 May 2000 Kristine Bradof
GEM Center for Science and Environmental Outreach
Michigan Technological University

Data Sources: Statistics Canada 1996 Census Subdivision area profiles for Ontario; Natural Resources Canada watershed boundaries

Annual Per Capita Residential Water Use 1991-1996 (Ontario)



Indicator Summary (1)



- Fish consumption advisories — MIXED
- Herring gull status — MIXED
- Critical pollutant reductions — MIXED
- Atmospheric deposition — MIXED
- Human population change — MIXED
- Water consumption — MIXED

Indicator Summary (2)

- Lake trout offshore habitat — GOOD
- Lake trout nearshore — MIXED/IMP
- Lake whitefish nearshore — GOOD
- Lake herring all habitats — MIXED/IMP
- Chub offshore — POOR
- Sea lamprey abundance — MIXED/IMP

Emerging Issues (1)

- Introduction of non-native species
- Airborne pollutants
- Human migration into the basin
- Habitat fragmentation
- Meeting zero discharge milestones

Emerging Issues (2)

- Exposure and effects of chemical mixtures
- Endocrine disruptor chemicals
- Mercury
- New chemicals
- Domestic use of burn barrels

Lake Superior Binational Program

- Program announced in 1991 to protect and maintain the ecosystem
- Initial focus on Zero Discharge Demonstration Program
- 1997 six ecosystem themes
- Active public participation (Forum)
- 2000-2002 project implementation

Acknowledgements

- Aquatic communities: Mark Ebener Inter Tribal Fisheries and Assessment Program
- Terrestrial wildlife communities: Pam Dryer U.S. Fish and Wildlife Service
- Habitat: Pat Collins Minnesota DNR
- Chemicals: Melanie Neilson Environment Canada Carri Lohse-Hanson Minnesota PCA
- Human Health: Pat McCann Minnesota Department of Public Health
- Sustainability: Jim Cantrill Northern Michigan University, Karl Schaefer Environment Canada