



Indicators of Persistent Toxic Substances in the Great Lakes Basin

Jon Dettling
Great Lakes Commission
PBT Reduction Team – Great Lakes Regional
Collaboration
Maumee Bay, Ohio
22 February 2005



Why Use Indicators?

- *Assess trends*
- *Evaluate progress toward goals*
- *Evaluate existing programs, policies and regulations*
- *Develop new programs, policies and regulations*
- *Understand existing problems*
- *Understand relationship of actions to impacts*
- *Prioritize research, data collection, monitoring and remediation*

Indicators must be . . .

- 1) Quantifiable
- 2) Able to be measured consistently across time and geography
- 3) Adequately reflect the state of the environment with regard to the impacts in question

Resolution:

Indicators must have adequate resolution in:

- Space
- Time
- Chemicals assessed

Indicator Categories

- Concentrations in environmental compartments, biota and humans
- Emissions, loadings and out-of-basin transport
- Human and wildlife health impacts and biological markers
- Institutional or societal response actions

Concentrations in Environmental Compartments, Biota and Humans

Concentrations in:

- Great Lakes water
- Inland waters
- Sediments
- Soils
- Air
- Phytoplankton, algae and microorganisms
- Invertebrates
- Forage fish
- Piscivorous fish, birds, and mammals
- Terrestrial plants and animals
- Humans

Emissions, Loadings and Out-of-Basin Transport

- Allow assessment of near-term and long-term future trends
- Allow determination of mass balances and recovery trajectories
- Allow evaluation of future loading scenarios
- Support management decisions

Emissions, Loadings and Out-of-Basin Transport

- Emissions to water
- Emissions to air
- Emissions to soil
- Atmospheric deposition (dry, wet and gaseous)
- Tributary inputs
- Recovery trajectory
- Contribution of long-range transport

Human and Wildlife Health Impacts and Biological Markers

Indicators of impacts can be:

- Predicted; or
- Observed

Impact indicators allow comparisons across chemicals and over time.

Biological markers can track organismal or physiological responses to “the total environment”

Human and Wildlife Health Impacts and Biological Markers

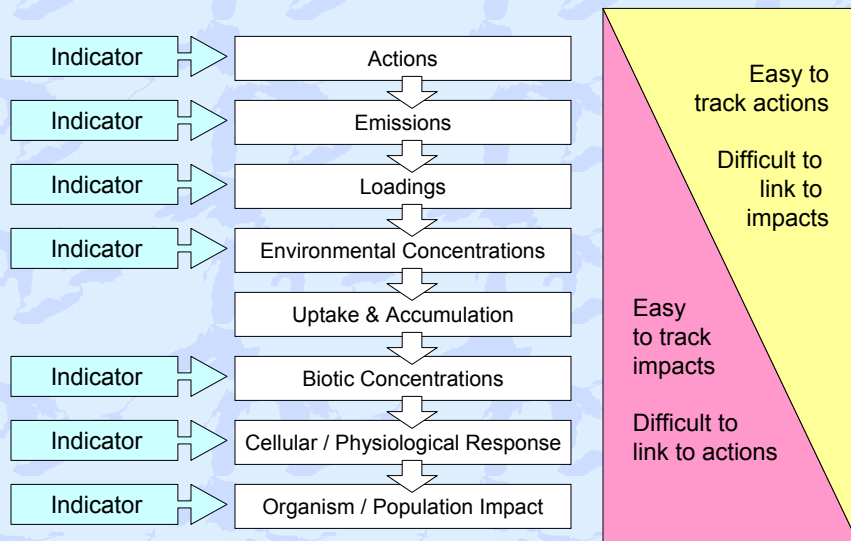
- Predicted impacts on:
 - Microorganisms
 - Invertebrates
 - Forage fish
 - Piscivorous fish, birds, mammals
 - Humans
- Sediment toxicity by laboratory test
- Estrogenic / androgenic activity of sediments
- Additional biological markers

Institutional or Societal Response Actions

Track what we are doing to respond to the problem:

- Energy use
- Transportation use
- Industrial "eco-efficiency"
- Pesticide use
- Regulatory implementation
- Cleanup programs
- . . .

Relationship of Indicators



SOLEC Indicators

- State of the Lakes Ecosystem Conference held biennially, with reports in intervening years
- Nearly 100 indicators are included on the current list
- Many relate to PTS

SOLEC PTS Indicators

ID	Title	2003 Status
114	Contaminants in Young-of-the-Year Spottail Shiners	Mixed - improving
115	Contaminants in Colonial Nesting Waterbirds	Mixed - improving
117	Atmospheric Deposition of Toxic Chemicals	Mixed
118	Toxic Chemical Concentrations in Offshore Waters	Mixed - improving
119	Concentrations of Contaminants in Sediment Cores	Mixed - improving
121	Contaminants in Whole Fish	New Indicator

SOLEC PTS Indicators

ID	Title	2003 Status
4177	Chemical Contaminants in Human Tissue	Not Reported
4201	Contaminants in Sport and Commercial Fish	Mixed – Improving
4506	Contaminants in Snapping Turtle Eggs	Mixed
TBD	Contaminant Accumulation in Coastal Wetlands	New Indicator
8135	Contaminants Affecting the Productivity of Bald Eagles	Mixed – Improving
8147	Contaminant Affecting the American Otter	Mixed

SOLEC PTS Indicators

ID	Title	2003 Status
3515	Cosmetic Pesticide Controls	New Indicator
3514	Commercial / Industrial Eco-Efficiency	New Indicator
7057	Energy Consumption	Mixed – Deteriorating
7064	Vehicle Use (Mass Transportation)	Mixed
8142	Sediment Available for Coastal Nourishment	Not Reported

Great Lakes Environmental Indicators (GLEI)

- Large project, coordinated by NRRI and involving many partner organizations
- Currently developing 2 PTS indicators:
 - Photo-induced PAH toxicity in larval fish
 - Estrogen induction in male fish

Monitoring, Modeling and Information Management

- New indicators will often require additional monitoring and data collection
- Modeling could be used in many cases to fill some gaps
- Information management

Data Quality

Our indicators will only be as accurate as our monitoring, modeling and data collection

Table I. Adequacy of Data on Temporal Trends in Levels and Effects of Persistent Toxic Contaminants in the Great Lakes

Ecosystem Compartment	Adequacy of Data on Trends	
	Contaminant Levels	Contaminant Effects
Sediments	8	NA
Water	4	NA
Air	2	NA
Fish	6	1
Birds	8	6
Reptiles/Amphibians	1	0
Mammals	2	0
Biomarkers	NA	2

From: Nisbet, I. C. T. *Environmental Monitoring and Assessment*. **1998**, 53, 3-15.