



Coeur d'Alene, Idaho
31 March – 4 April, 2003

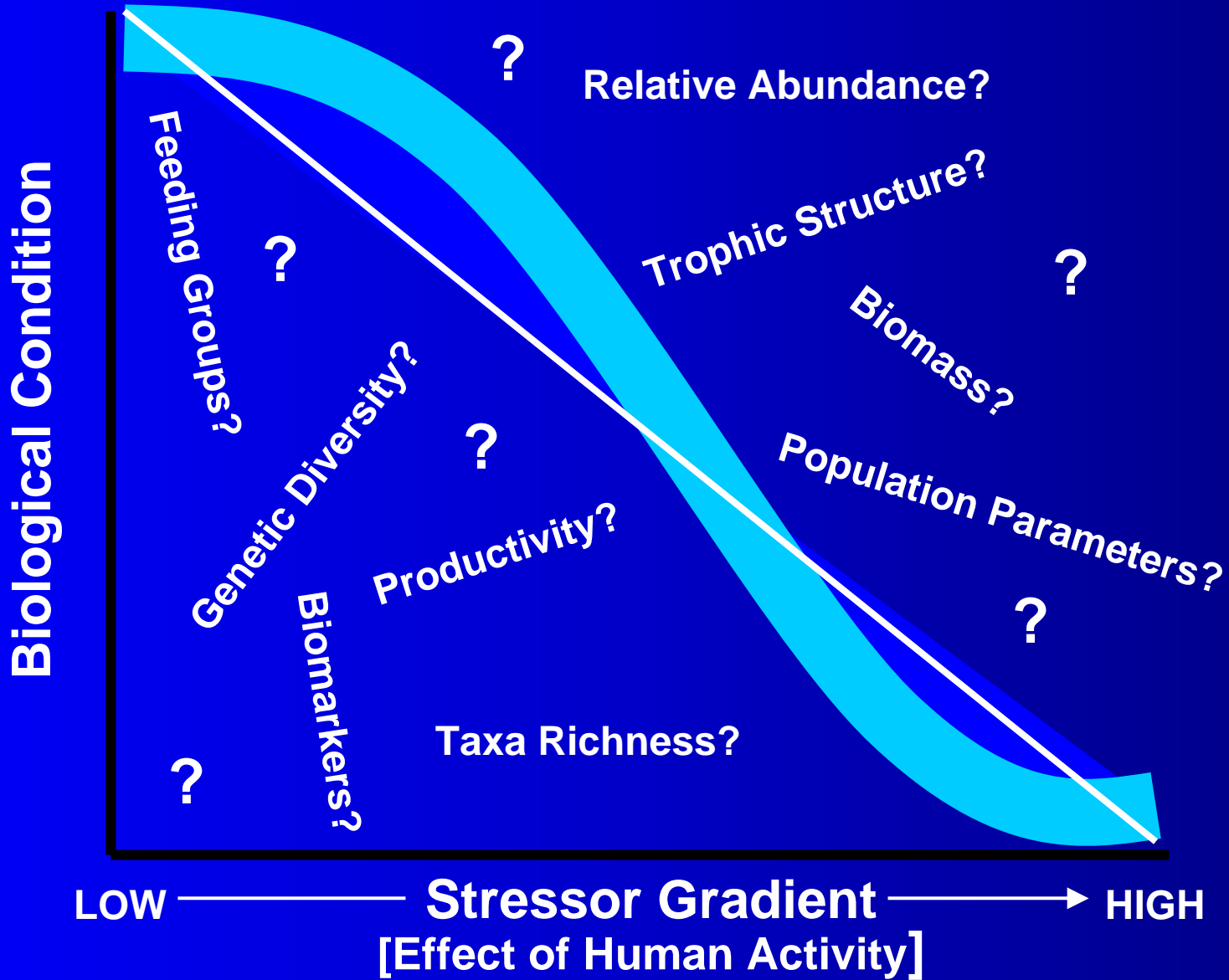
*Section 4a:
Introduction to
Environmental
Indicators of Riverine
Ecosystem Quality*

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Center for Applied Bioassessment and Biocriteria

What to Measure?

How to Decide?



What is an

“Environmental Indicator”

“...A measurable feature which singly or in combination provides managerially and scientifically useful evidence of ecosystem quality, or reliable evidence of trends in quality.”

Ecological Indicators

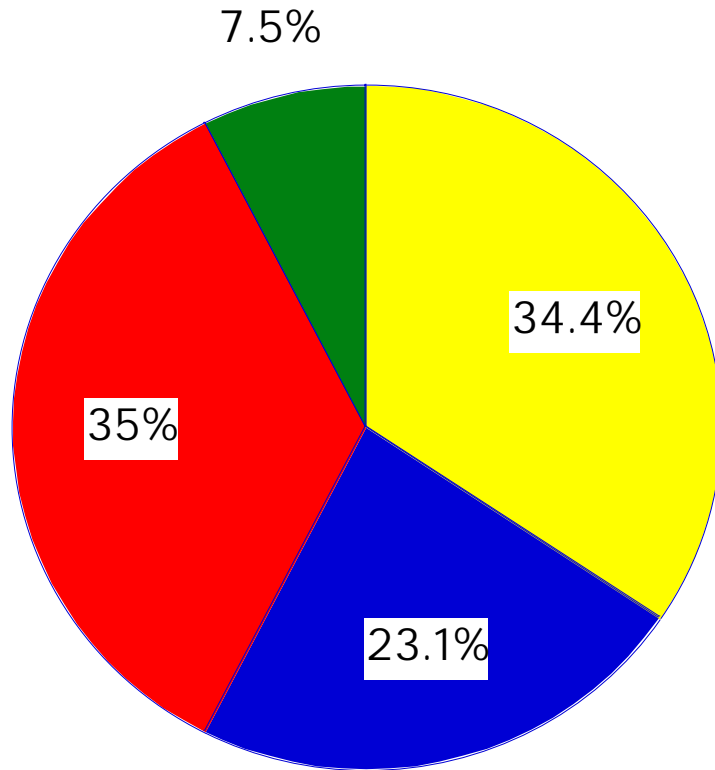
Indicators linking organisms & environment



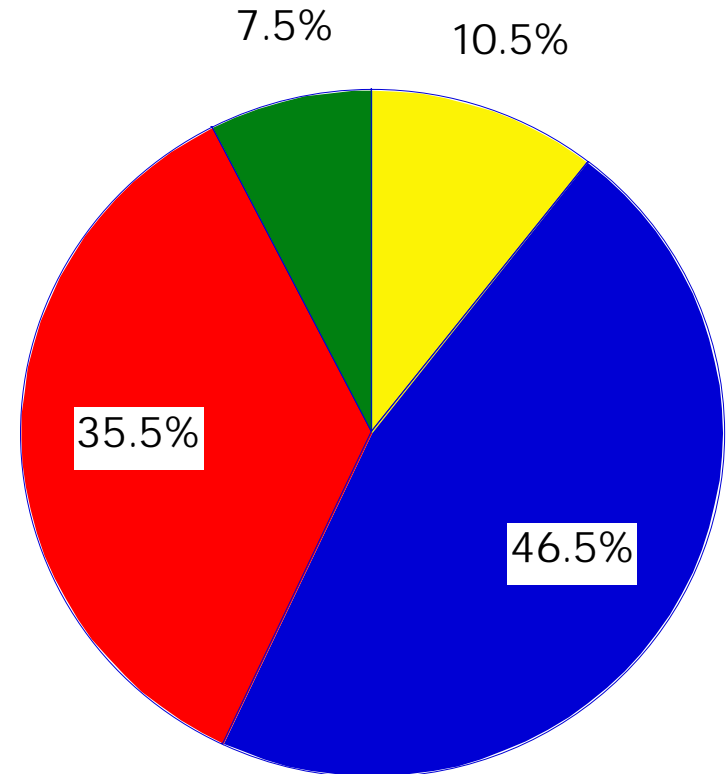
Problem Statement:

“The problem nationally has been with the inappropriate use of stressor and exposure indicators as response indicators”

COMPARATIVE ANALYSIS OF CHEMICAL & BIOLOGICAL ASSESSMENT FOR ALUS: OHIO RIVERS & STREAMS



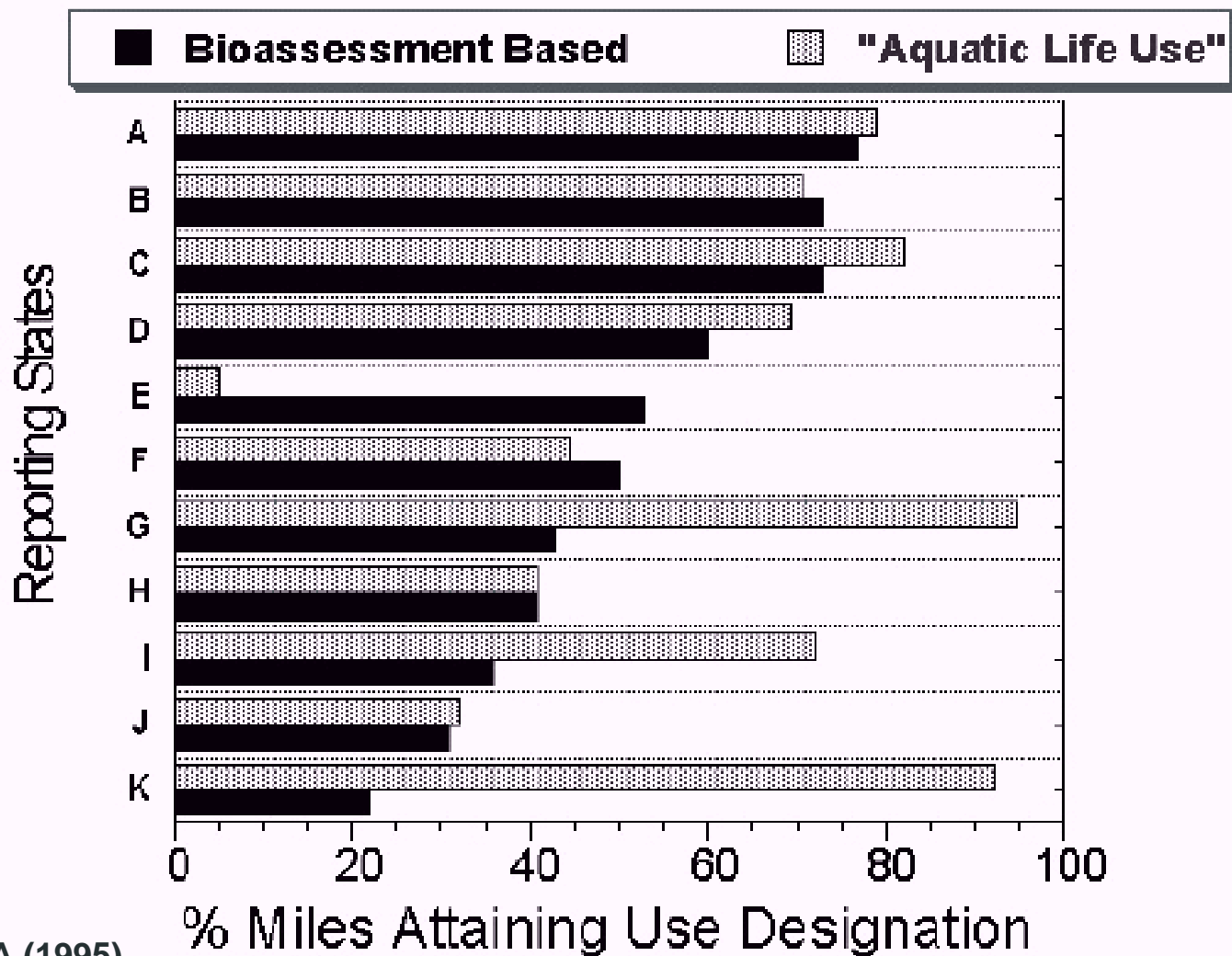
1981-1987



1994-2000

- Agree about impairment } About STATUS Only
- Agree about attainment } About STATUS Only
- Disagree about attainment (chemical impairment)
- Disagree about impairment (biological impairment)

Comparison of 305b Reporting Between States: Aquatic Life Use Attainment (1992 305b Report)



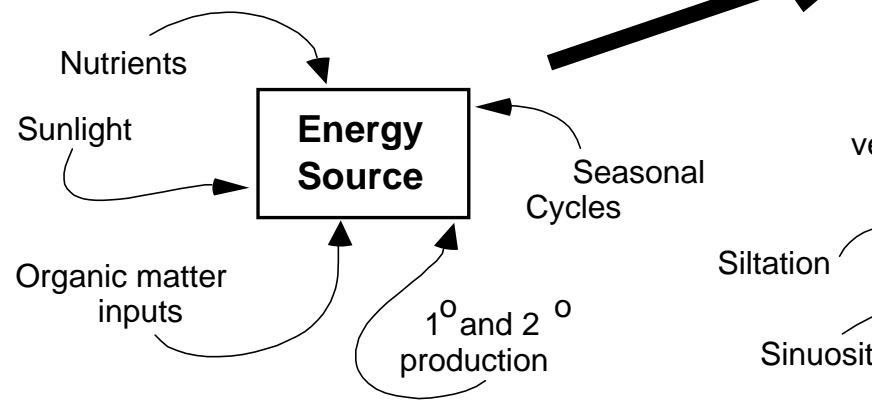
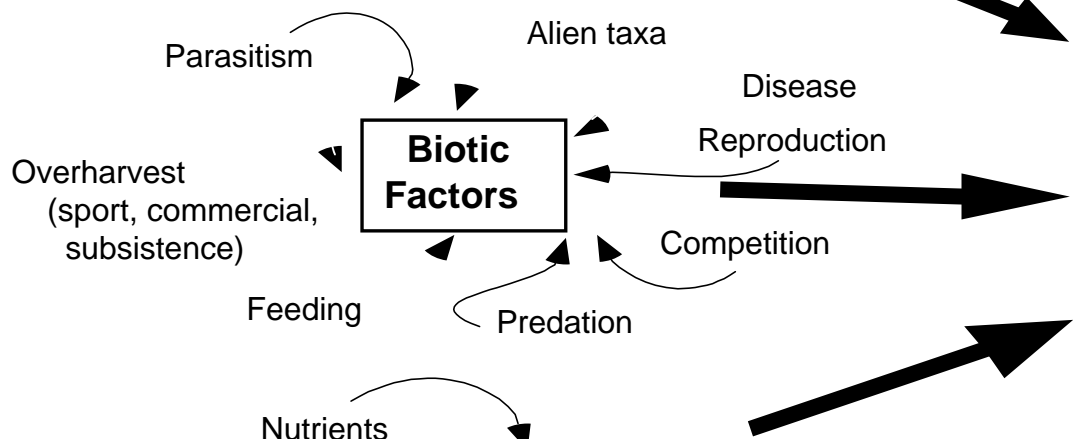
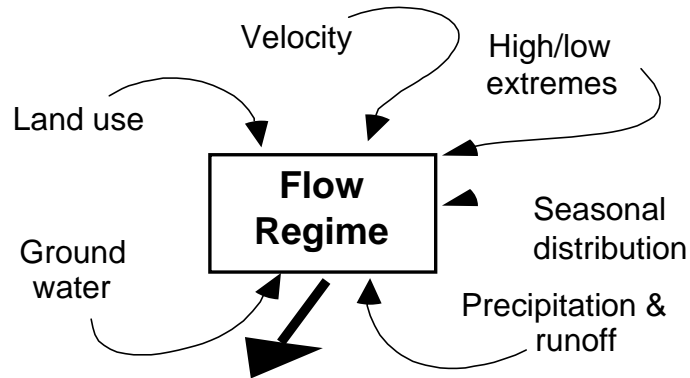
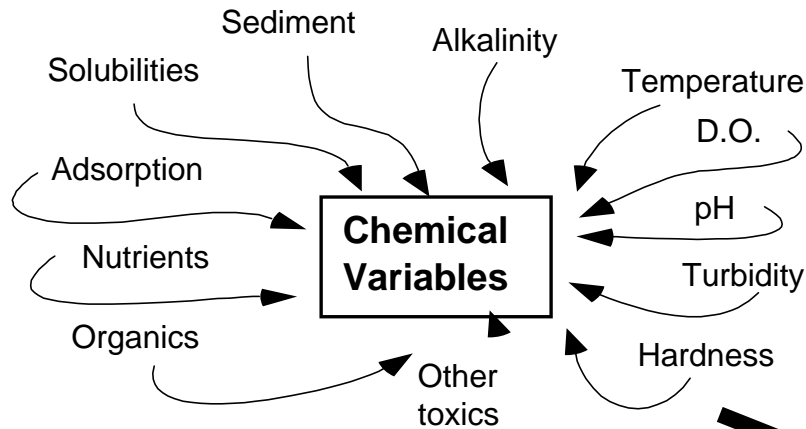
Source: U.S. EPA (1995)

Environmental Indicators

“Each is best used within their most appropriate role” (Yoder and Rankin 1998)

Roles/Categories:

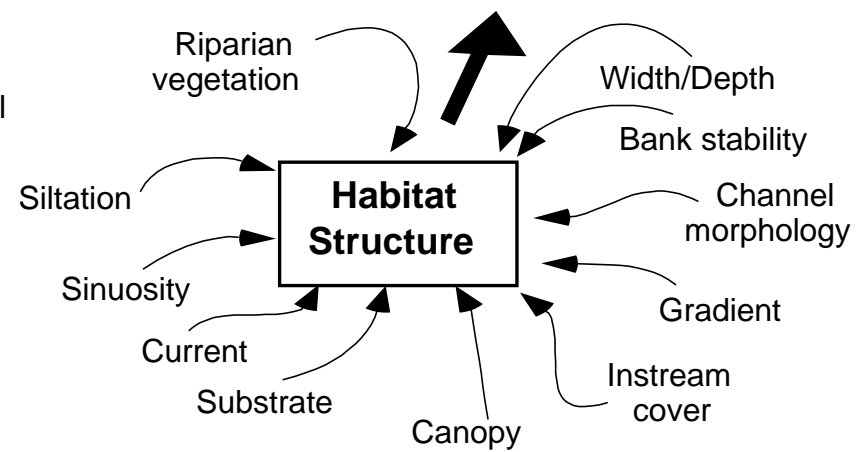
- **Stressor Indicators**
(e.g., loadings, land use, habitat)
- **Exposure Indicators**
(e.g., chemical-specific, biomarkers, toxicity)
- **Response Indicators**
(e.g., biological community condition, target species)



INTEGRITY OF THE WATER RESOURCE



"Principal Goal of the Clean Water Act"



Stressor Indicators

- Loadings
- Land use
- Channel & flow modifications
- Physical habitat structure (can also function as a exposure)

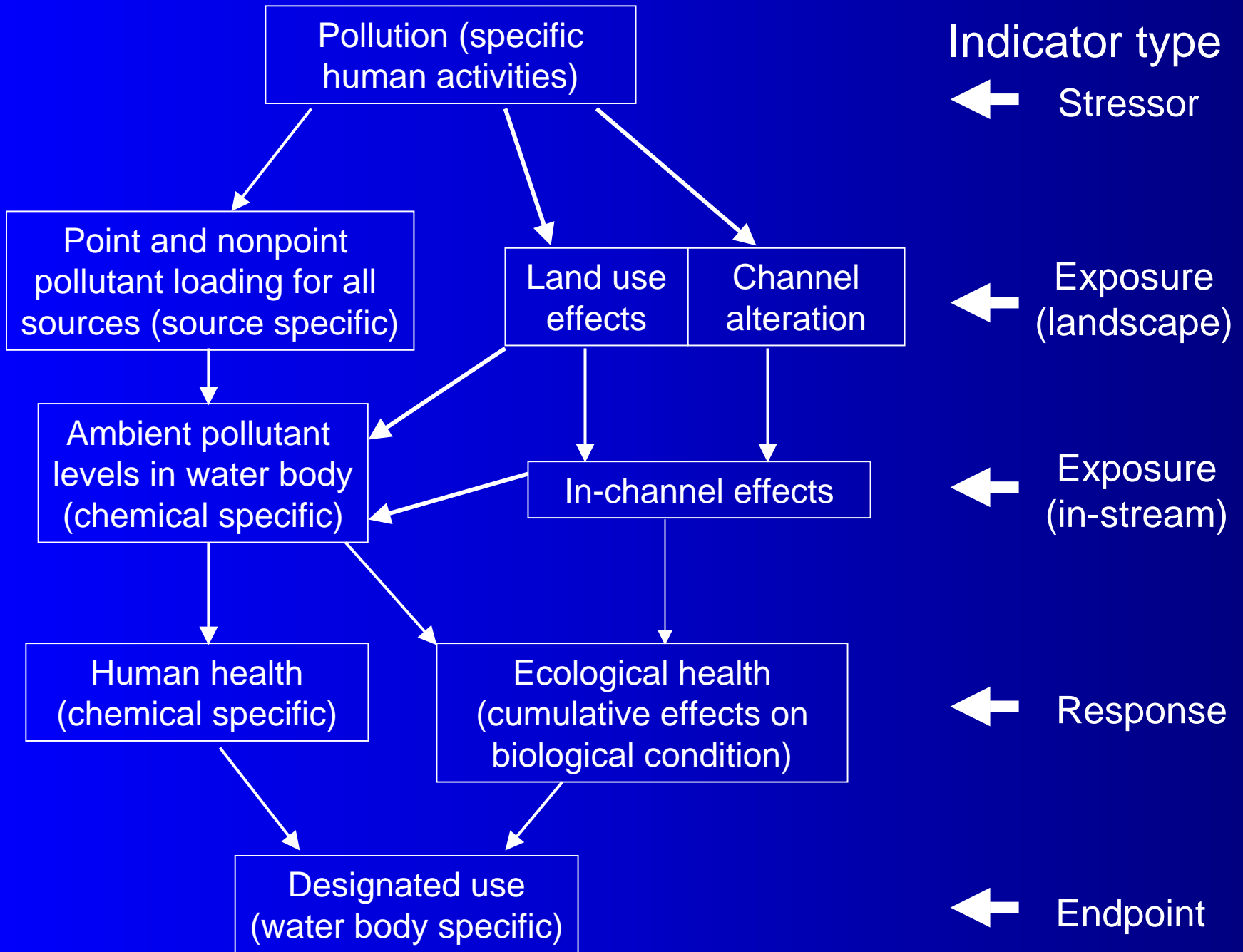
Exposure Indicators

- Chemical-specific
- Biomarkers
- Toxicity

Response Indicators

- **Biological community condition**
 - **Core indicator assemblages:**
 - algae, benthic macroinvertebrates, fish
 - **Other assemblages:**
 - zooplankton, macrophytes, bivalves, etc.

These are explored in more detail in next section



1. Management actions

2. Response to management

3. Stressor abatement

4. Ambient conditions

5. Direct exposure to effects
of pollution

6. Biological response

Administrative indicators
[permits, plans, grants, enforcement]

[technologies used, BMPs installed]

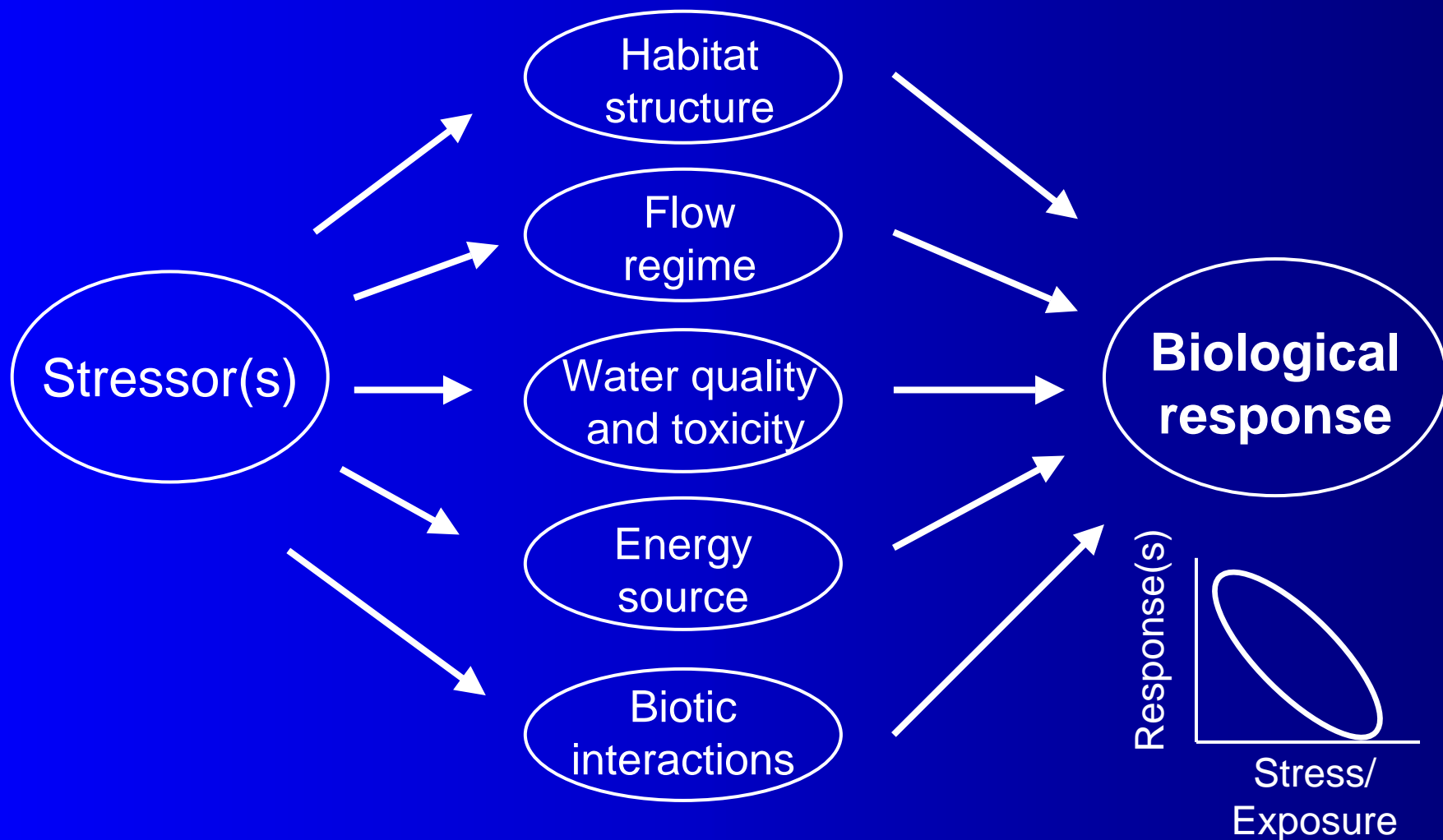
Stressor indicators
[effluent reduction, changes in
land-use practices]

Exposure indicators
[pollutant conc., flow or physical
habitat alteration]
[assimilation and uptake of
pollutants, reduced spawning
success, nutrient dynamics
changed, sedimentation effects]

Response indicators
[biological metrics, multimetric
indexes, target species, other
biological measures]

Endpoint: "ecological health" or biological condition

Linking Stress & Exposure to Response



**Human activities:
(what we manage)**

**Altered water
resource features**

**Biological
"Products"**