National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

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

TALU 201

USING BIOLOGICAL ASSESSMENTS TO REFINE DESIGNATED AQUATIC LIFE USES: THE HUMAN DISTURBANCE GRADIENT

Presenters and Contributors

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Seeking Common National Assessment of the Human Disturbance Gradient

Presented by

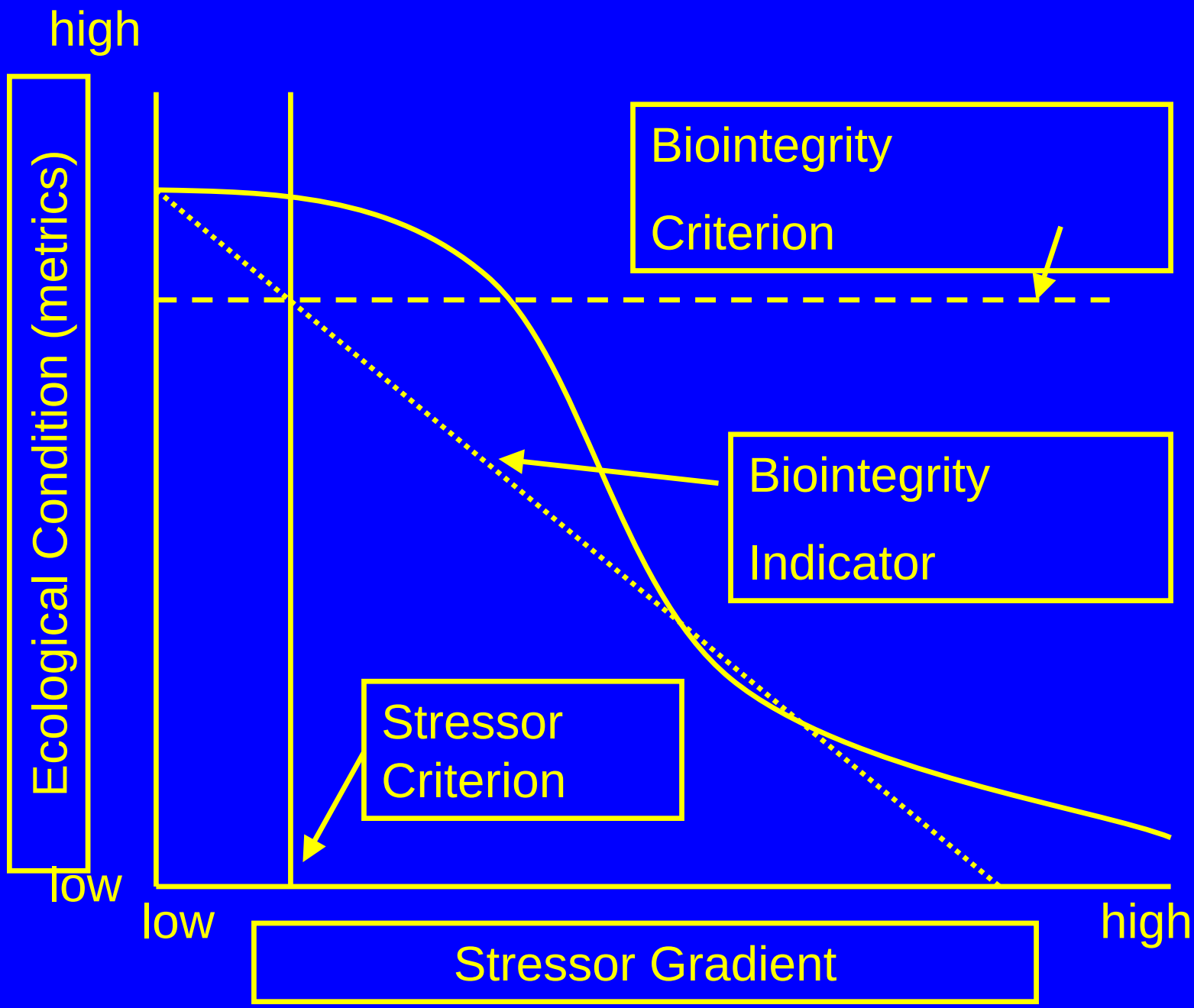
Bob Hughes, Dynamac Corporation

Contributors

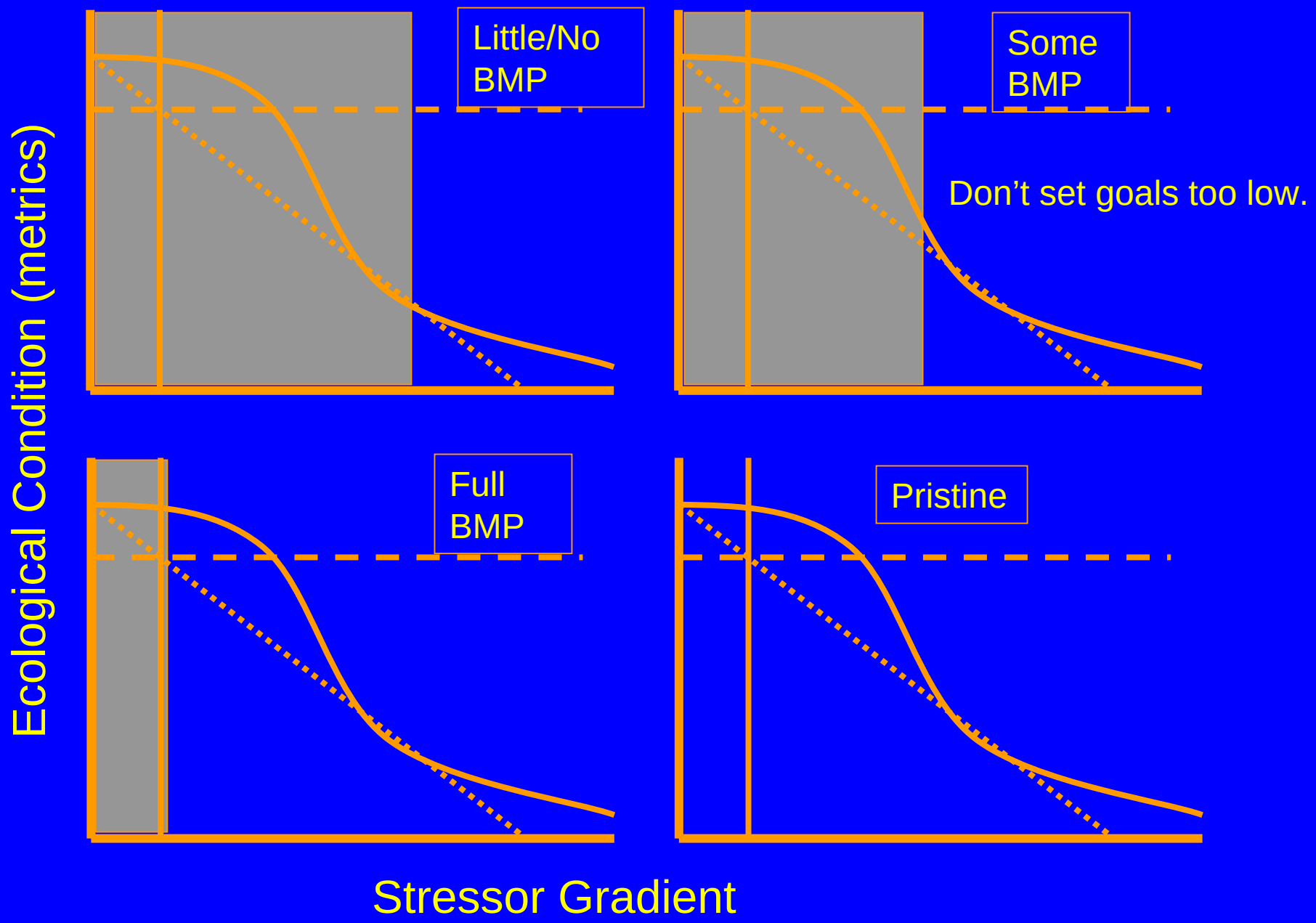
The Aquatic Life Uses Steering Group

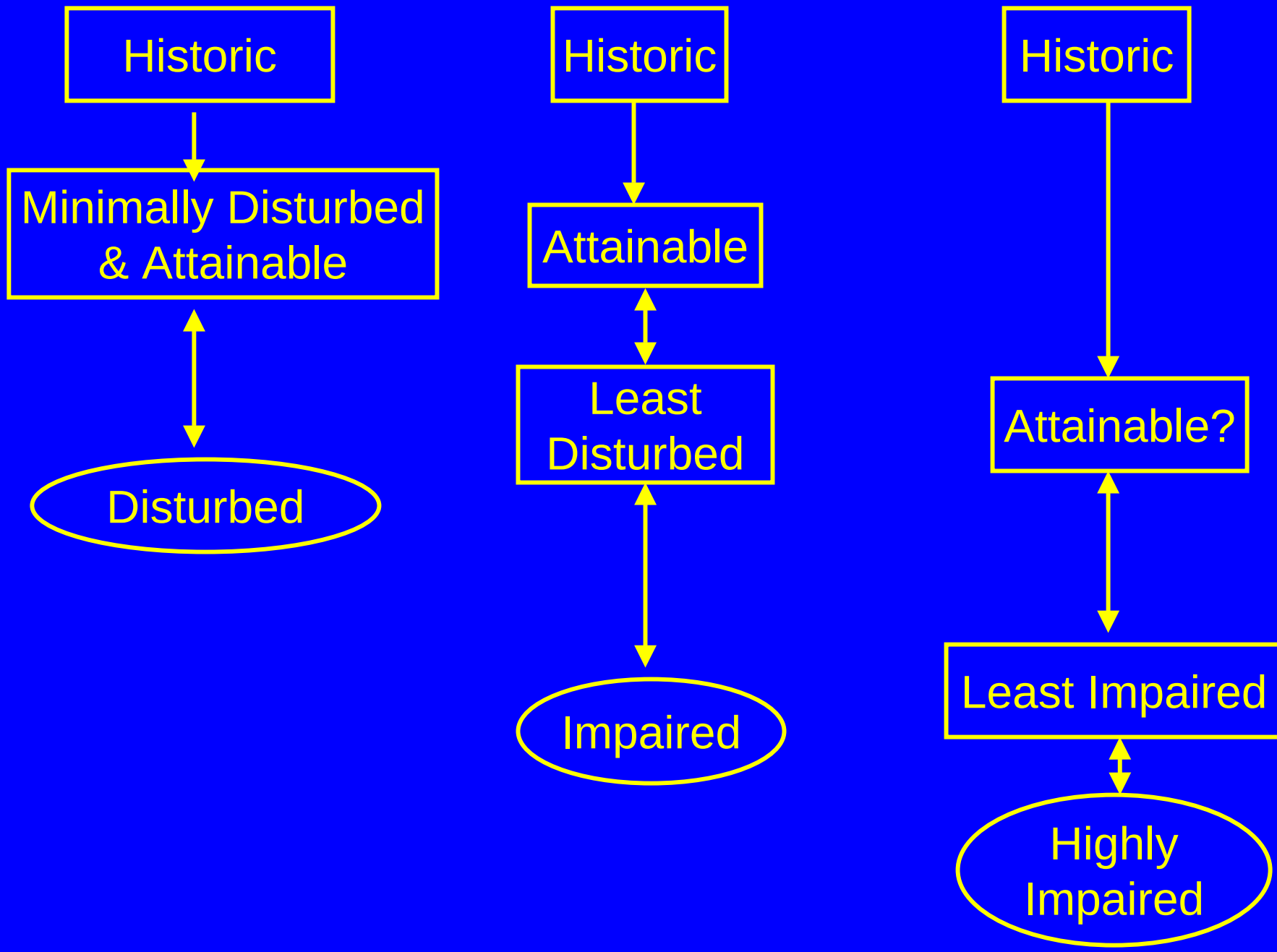
Objectives

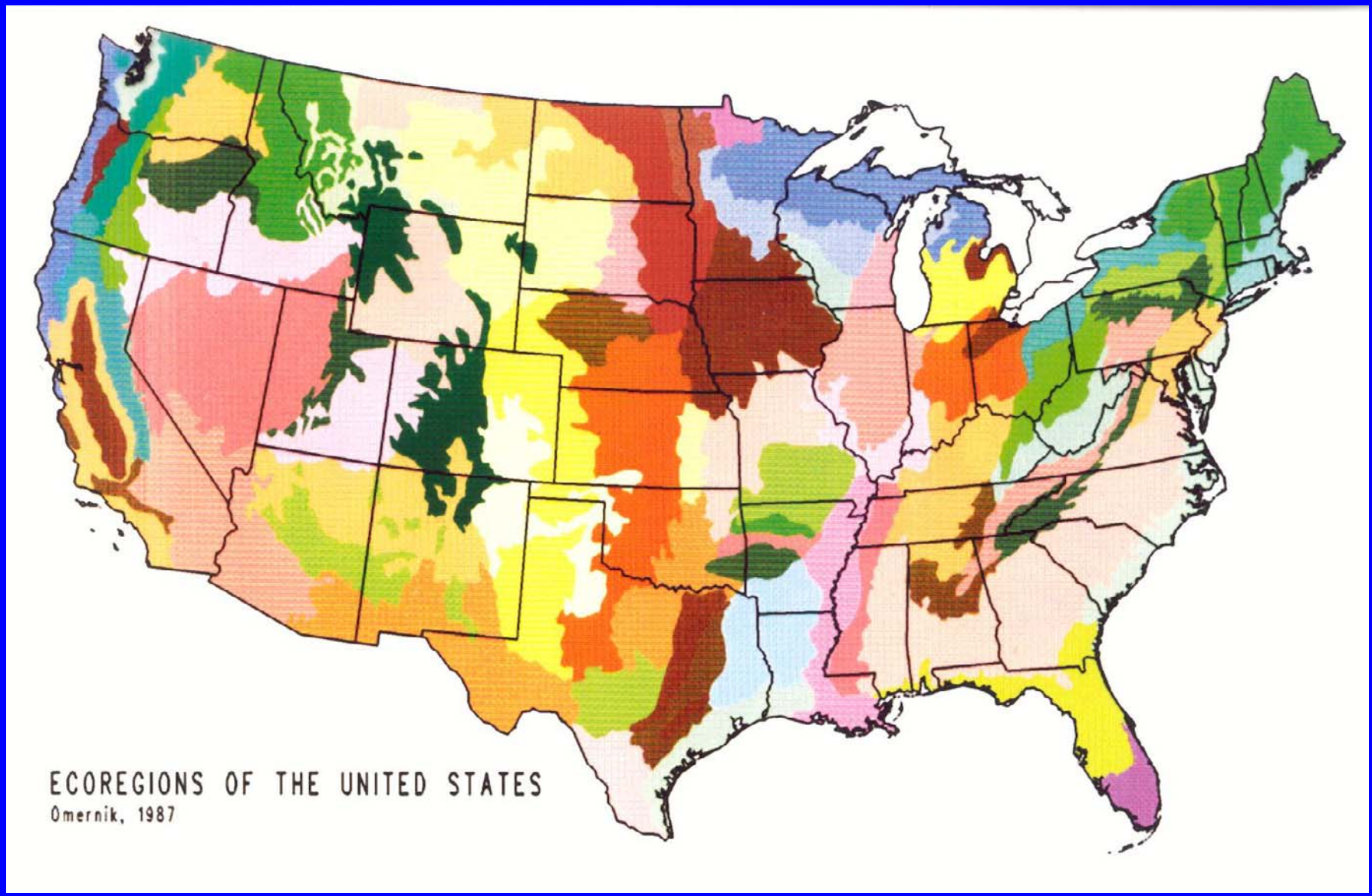
- Provide rationale for human disturbance gradient (HDG)
- Summarize recent studies concerning biological responses to land use
- Outline key components of HDG
- Summarize interstate workshop results

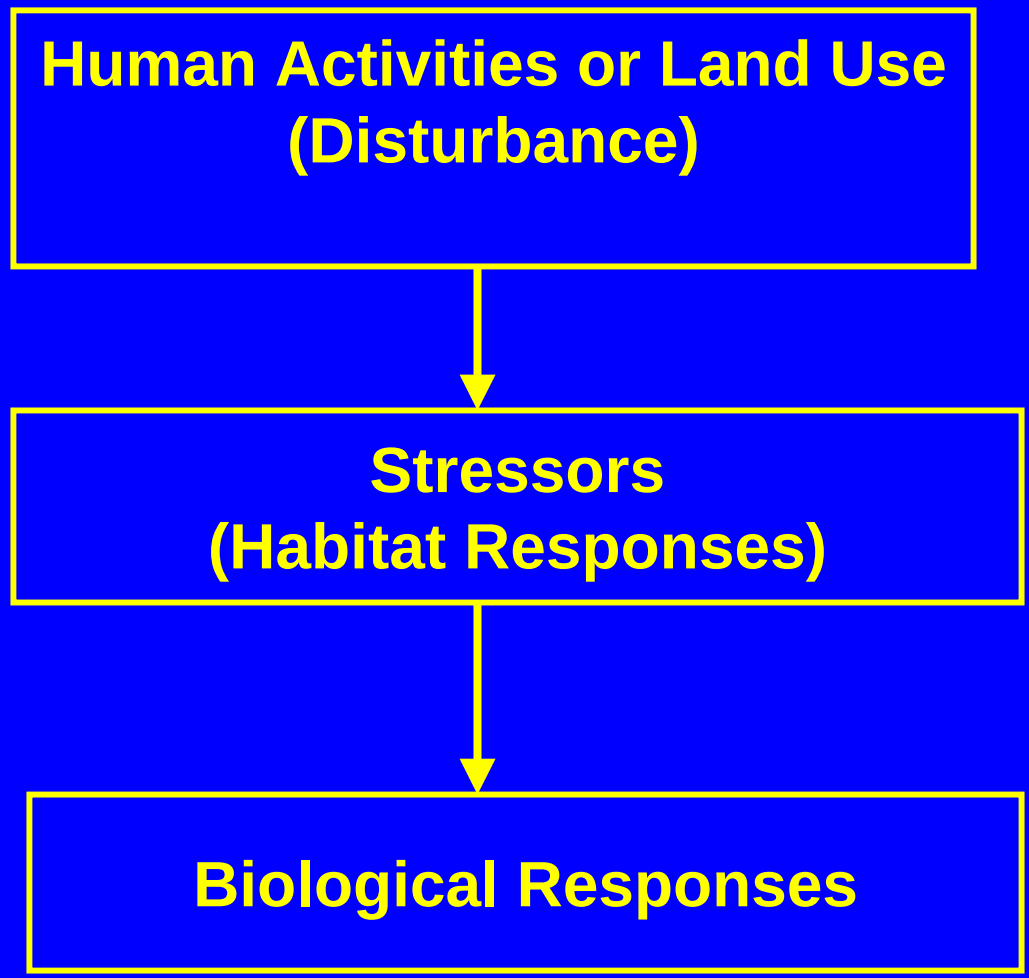

high
Ecological Condition (metrics)
low
Biointegrity
Criterion
Biointegrity
Indicator
Stressor
Criterion
low
high
Stressor Gradient

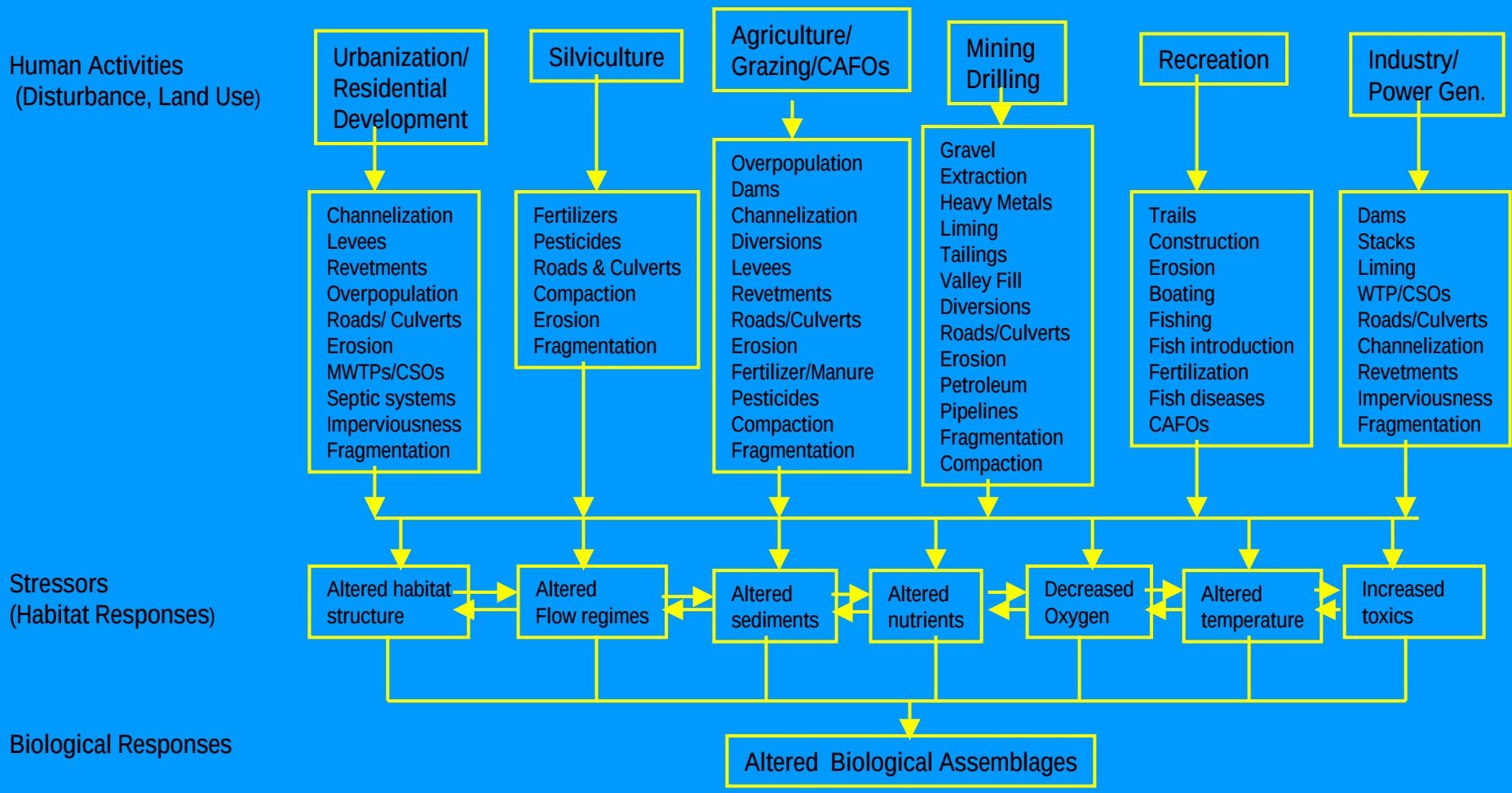
What we consider as “attainable” improves with BMP implementation!




Historic
Minimally Disturbed & Attainable
Disturbed
Historic
Attainable
Least Disturbed
Impaired
Historic
Attainable?
Least Impaired
Highly Impaired


ECOREGIONS OF THE UNITED STATES
Omernik, 1987


Human Activities or Land Use
(Disturbance)
Stressors
(Habitat Responses)
Biological Responses



(from Bryce et al. 1999. J. Am. Wat. Resour. Assoc. 35:23-36)

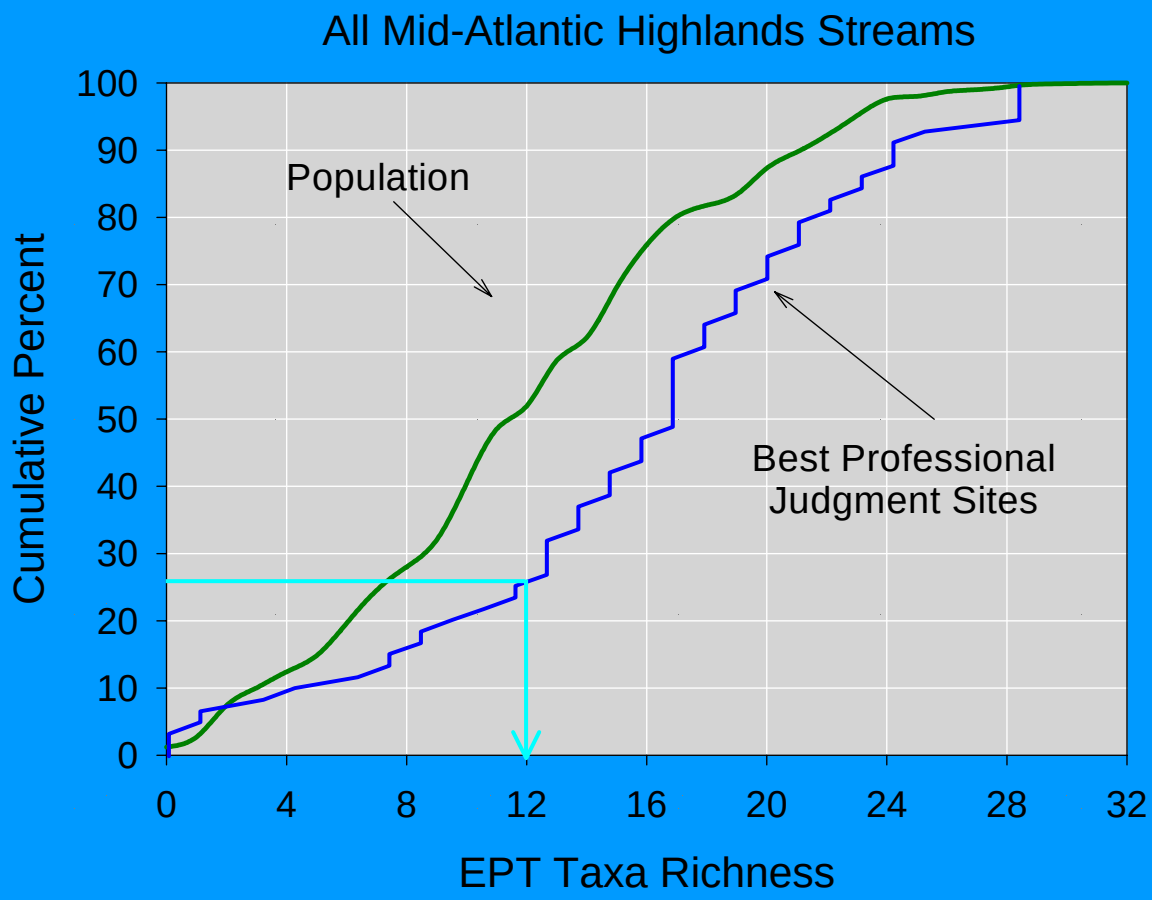
Rationale for Human Disturbance Gradient (HDG)

- **Essential for determining reference sites & minimal disturbance**
- Necessary for metric & index development & evaluation
- Often represents half the variability in biological response scores
- Easier to assess than large suite of stressors

Rationale for Human Disturbance Gradient (HDG) (continued)

- Assists in diagnosing stressors
- Source of most-manageable stressors
- Critical for stream protection, BMPs & restoration

Measuring Condition at Reference Sites

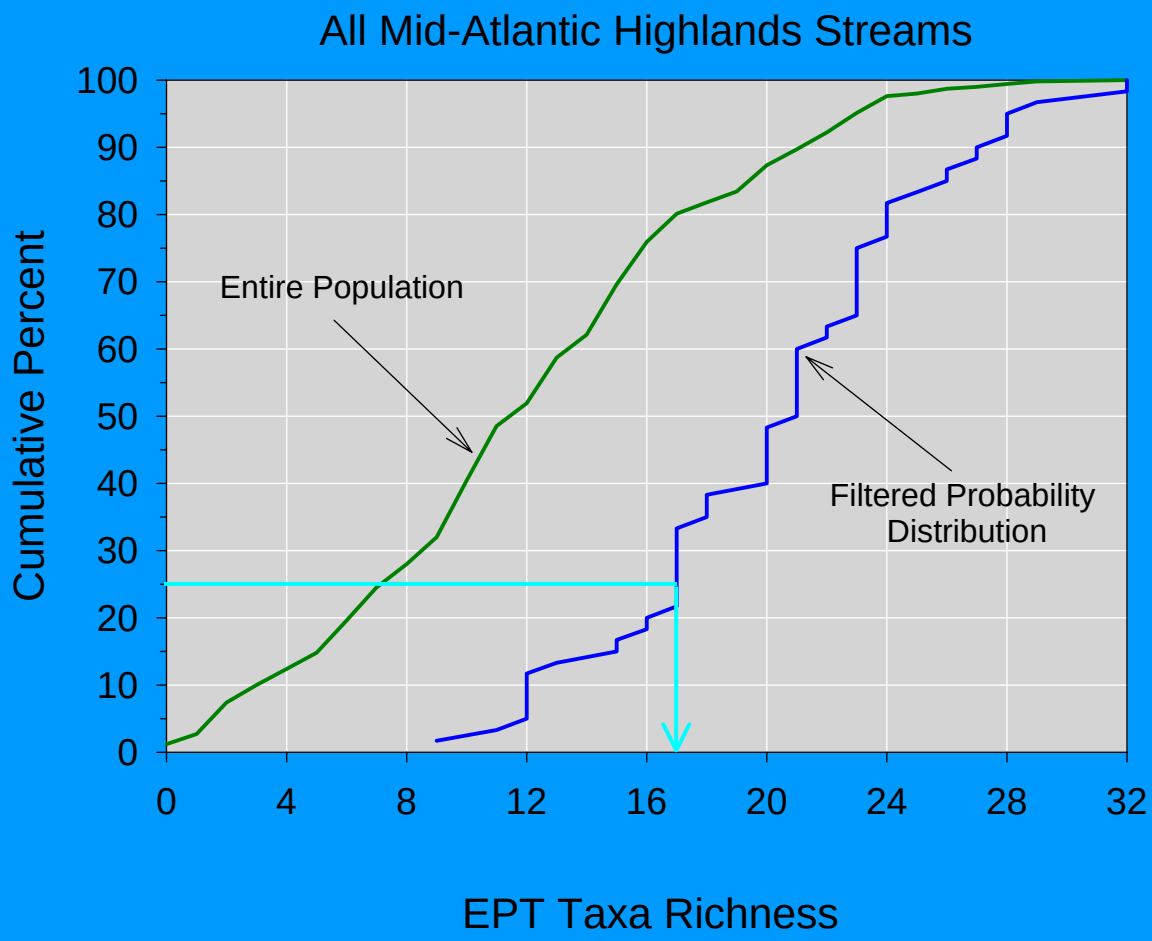


Filtering Probability Sites

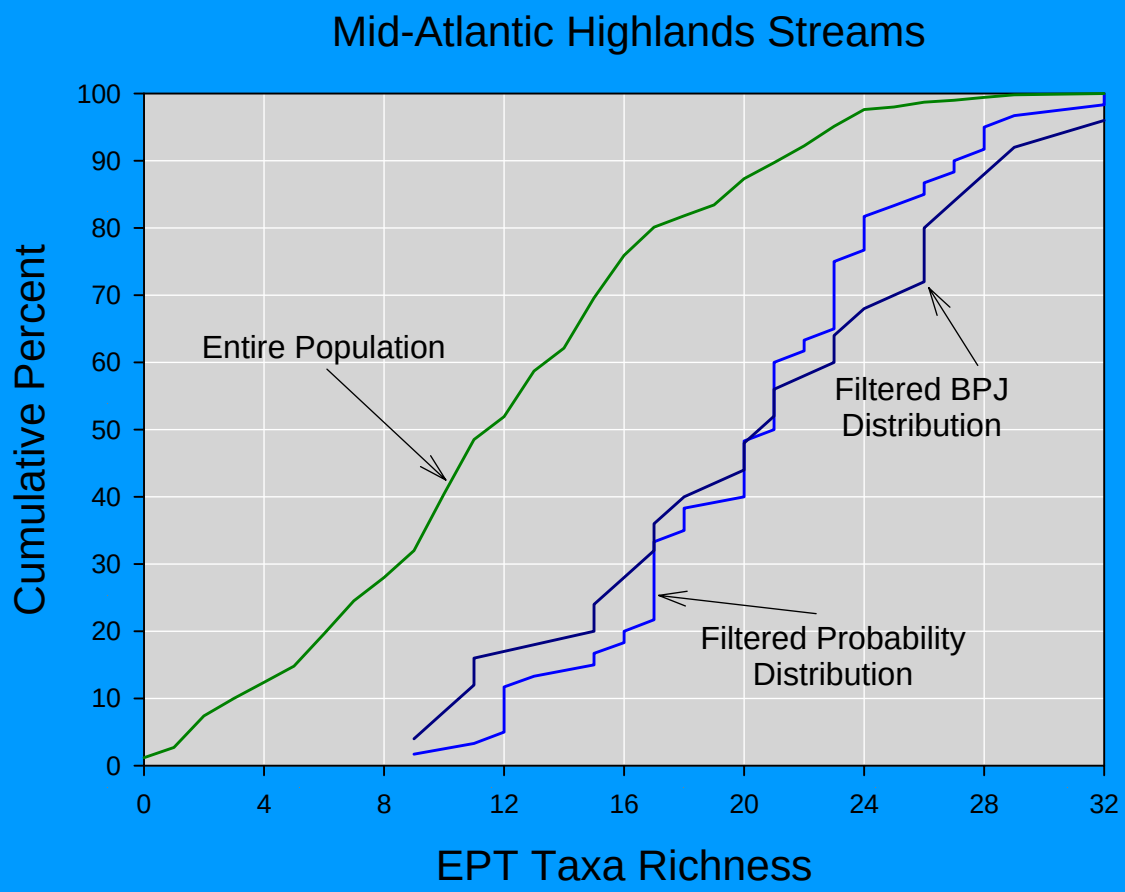
"Filters" on probability data: exclude all sites with:

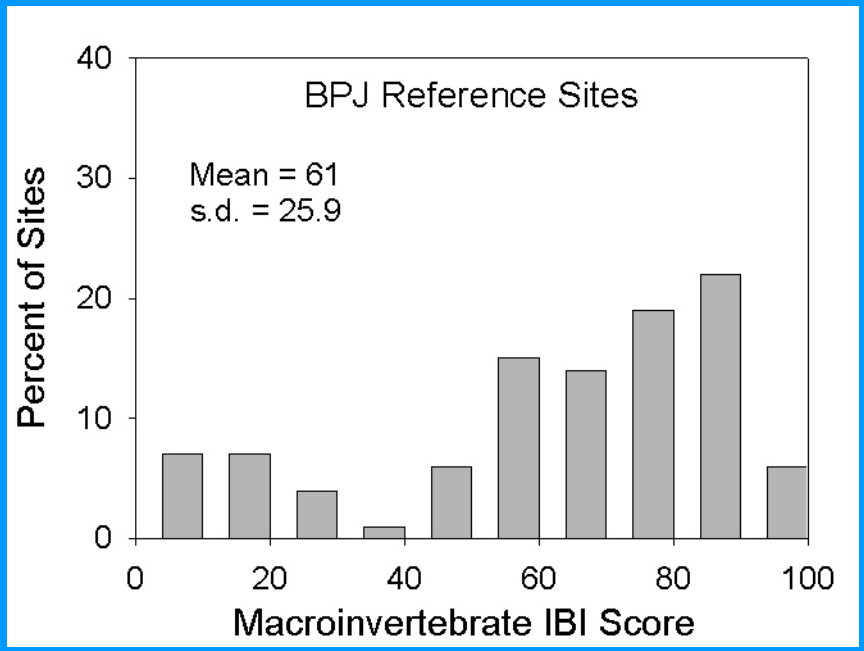
- sulfate over 400 µeq/L (mine drainage)
- acid neutralizing capacity less than 50 µeq/L (acid rain)
- average RBP habitat score less than 16 (habitat)
- total phosphorus over 20 µg/L (nutrient enrichment)
- total nitrogen over 750 µg/L (nutrient enrichment)
- chloride over 100 µeq/L (general watershed disturbance)
- insufficient sample (< 100 macroinvertebrate individuals; watersheds < 2 sq. km. for fish)

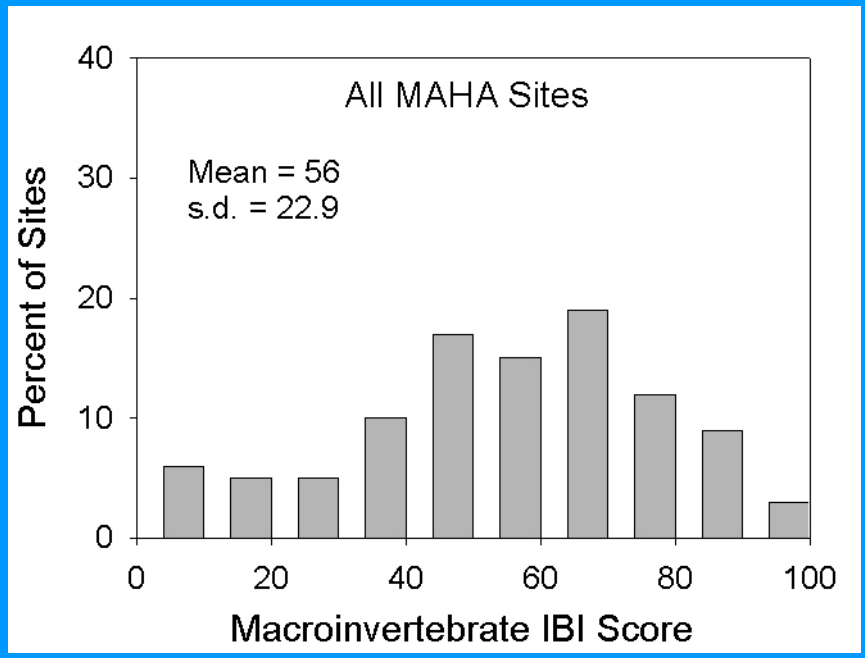
Filtered Probability Reference Sites

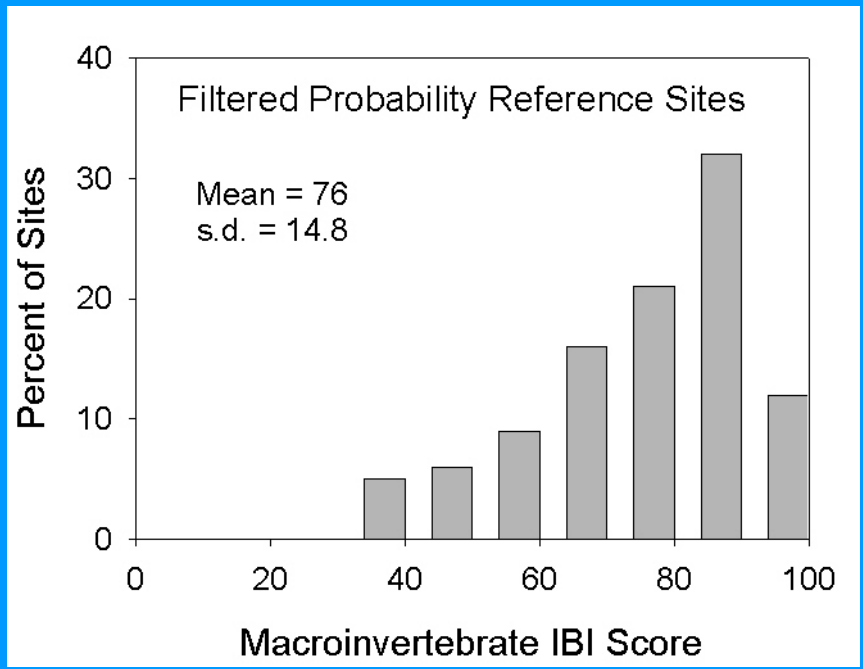


Filtered Probability and BPJ Reference Sites




BPJ Reference Sites
Mean = 61
s.d. = 25.9
Percent of Sites
Macroinvertebrate IBI Score
0
10
20
30
40
0
20
40
60
80
100


All MAHA Sites
Mean = 56
s.d. = 22.9
Percent of Sites
Macroinvertebrate IBI Score
0
10
20
30
40
0
20
40
60
80
100


Filtered Probability Reference Sites
Mean = 76
s.d. = 14.8
Percent of Sites
Macroinvertebrate IBI Score
0
10
20
30
40
0
20
40
60
80
100

Rationale for Human Disturbance Gradient (HDG)

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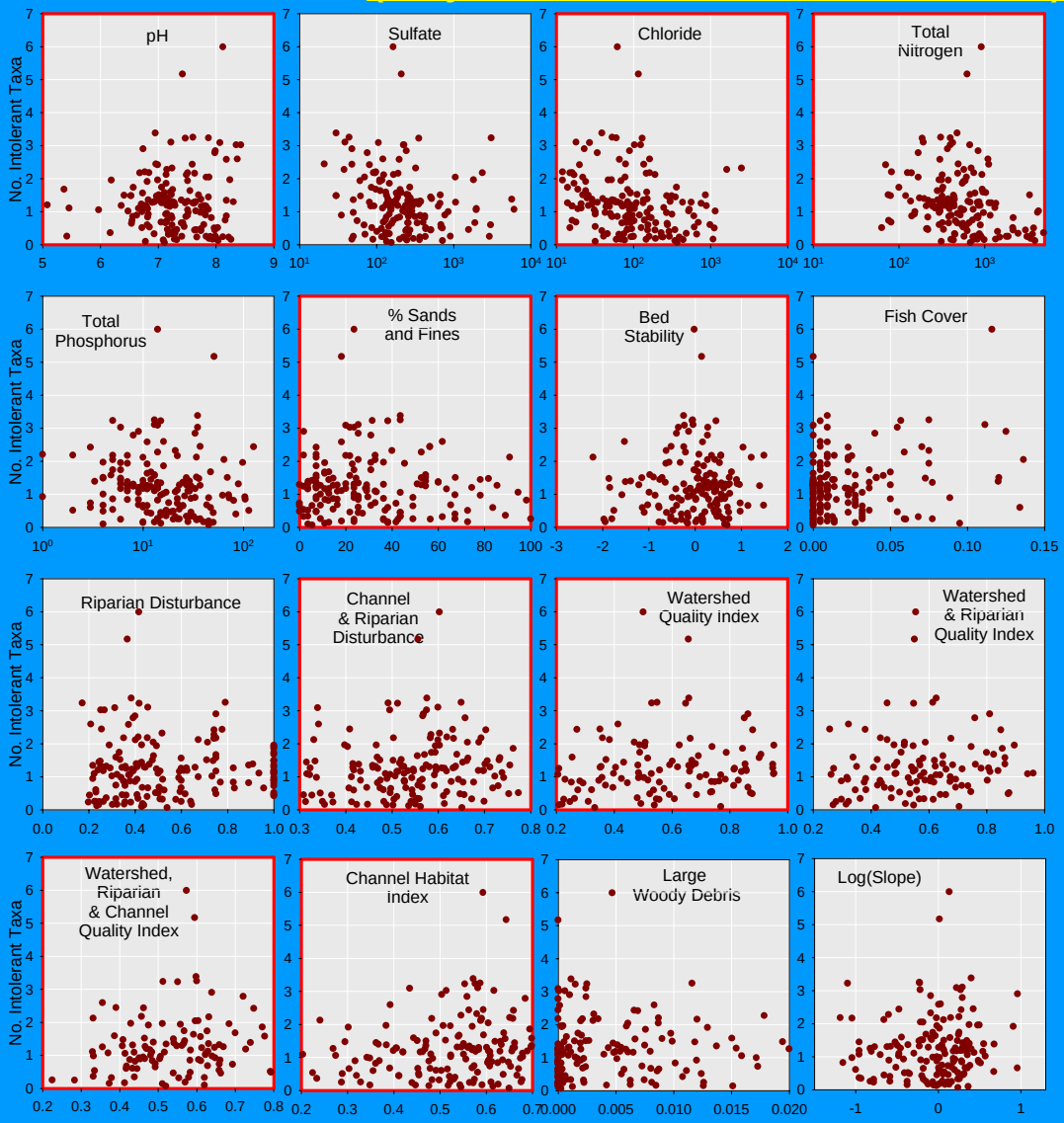
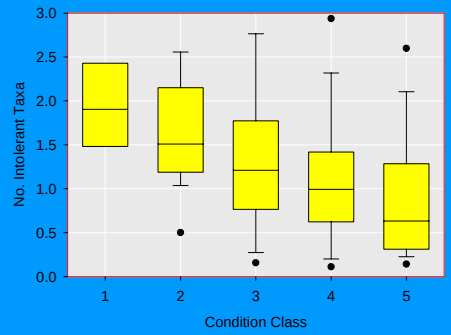
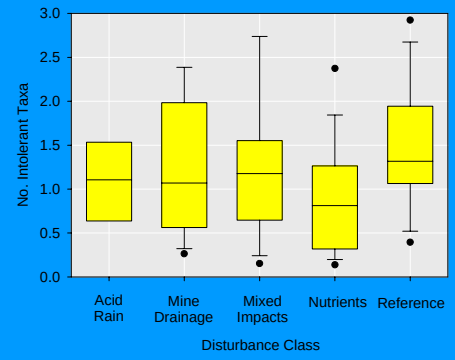
Responsiveness - Example

Number of Intolerant Taxa (Adjusted for Watershed Size)



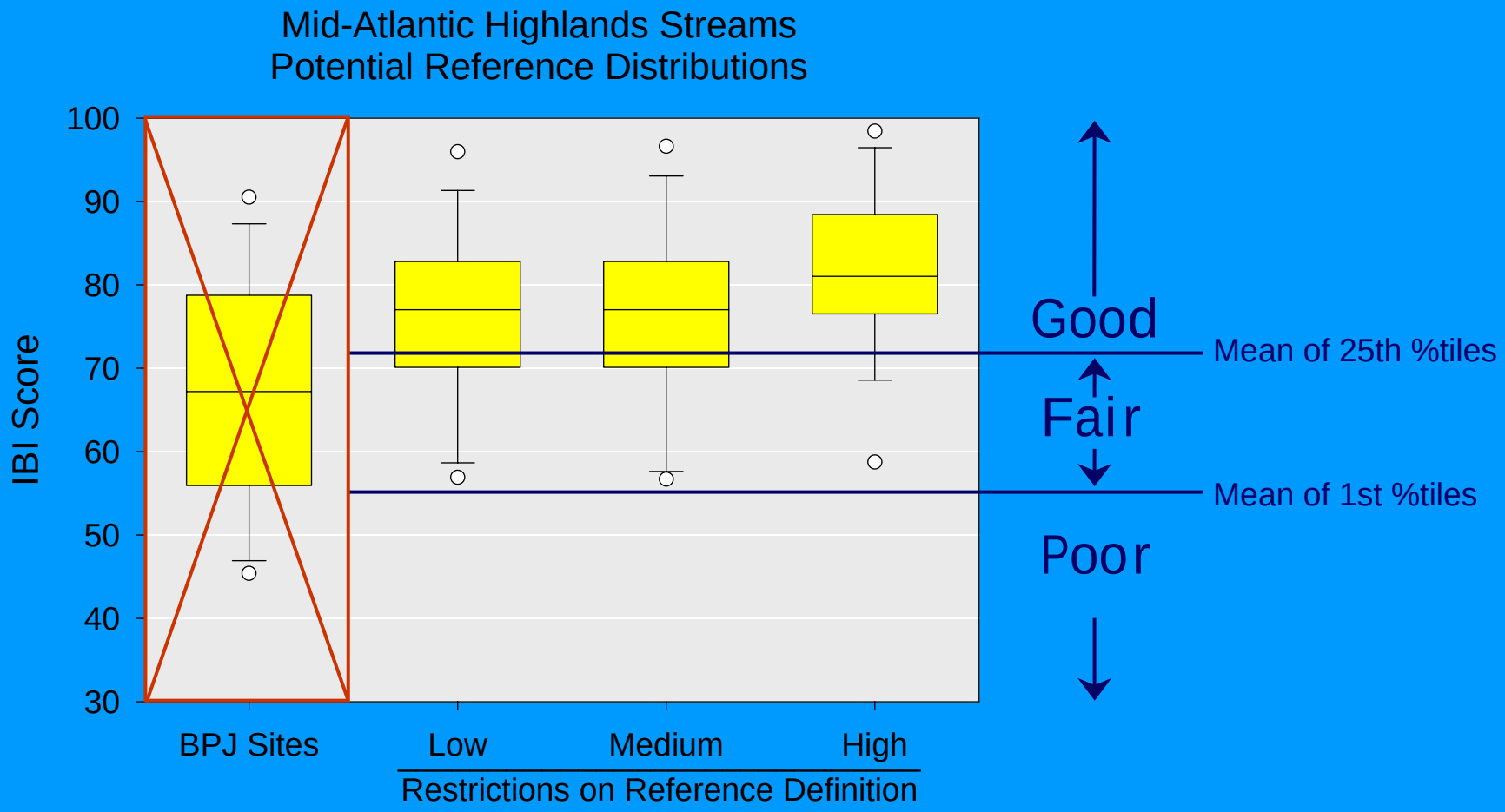




(Plots outlined in red illustrate good metric response)

Reference Condition

Using estimates to set expectations



Rationale for Human Disturbance Gradient (HDG)

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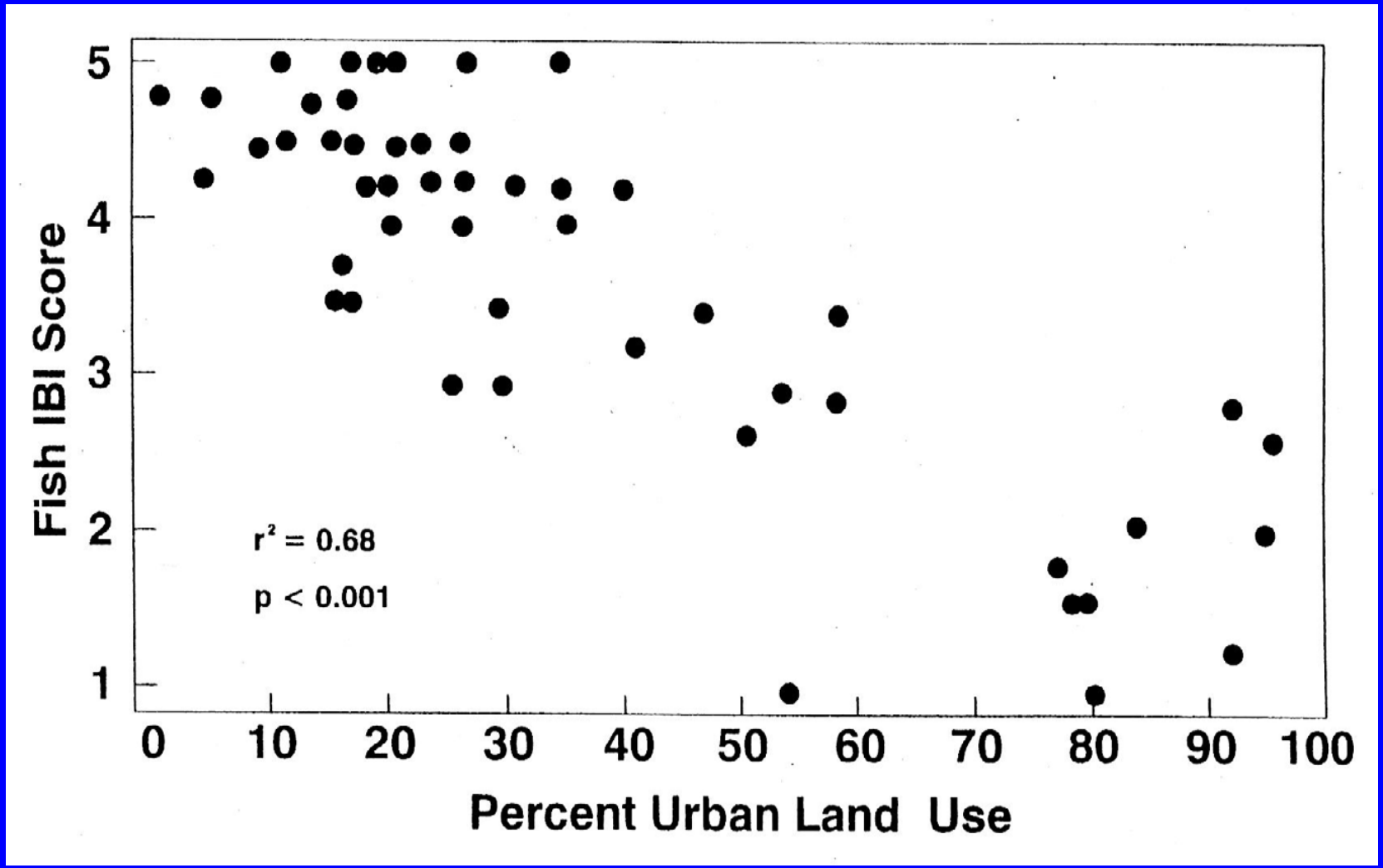
- Easier to assess than large suite of stressors



(from Klauda et al. 1998. Environ. Monitor. Assess. 51:299-316)

Rationale for Human Disturbance Gradient (HDG)

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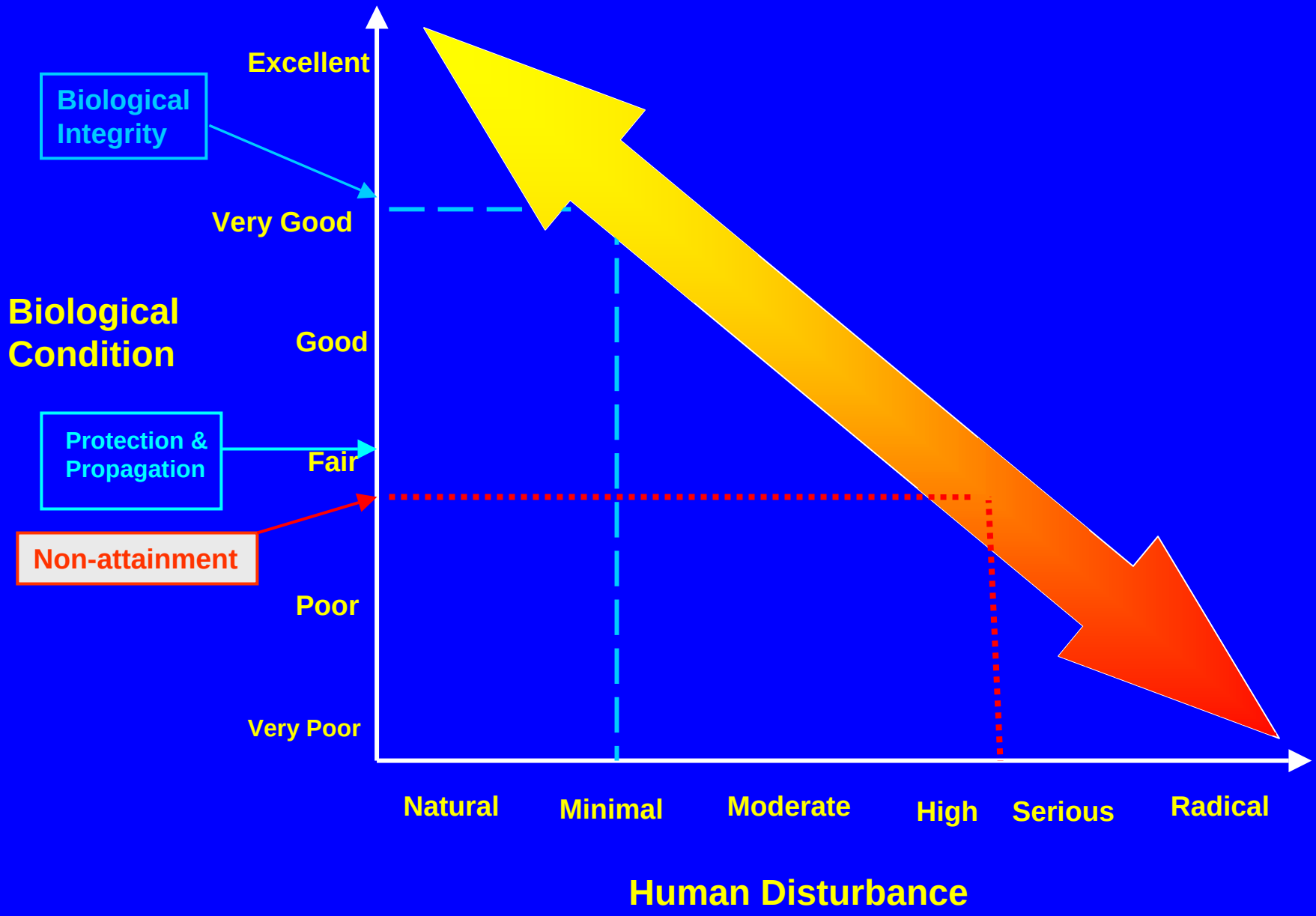
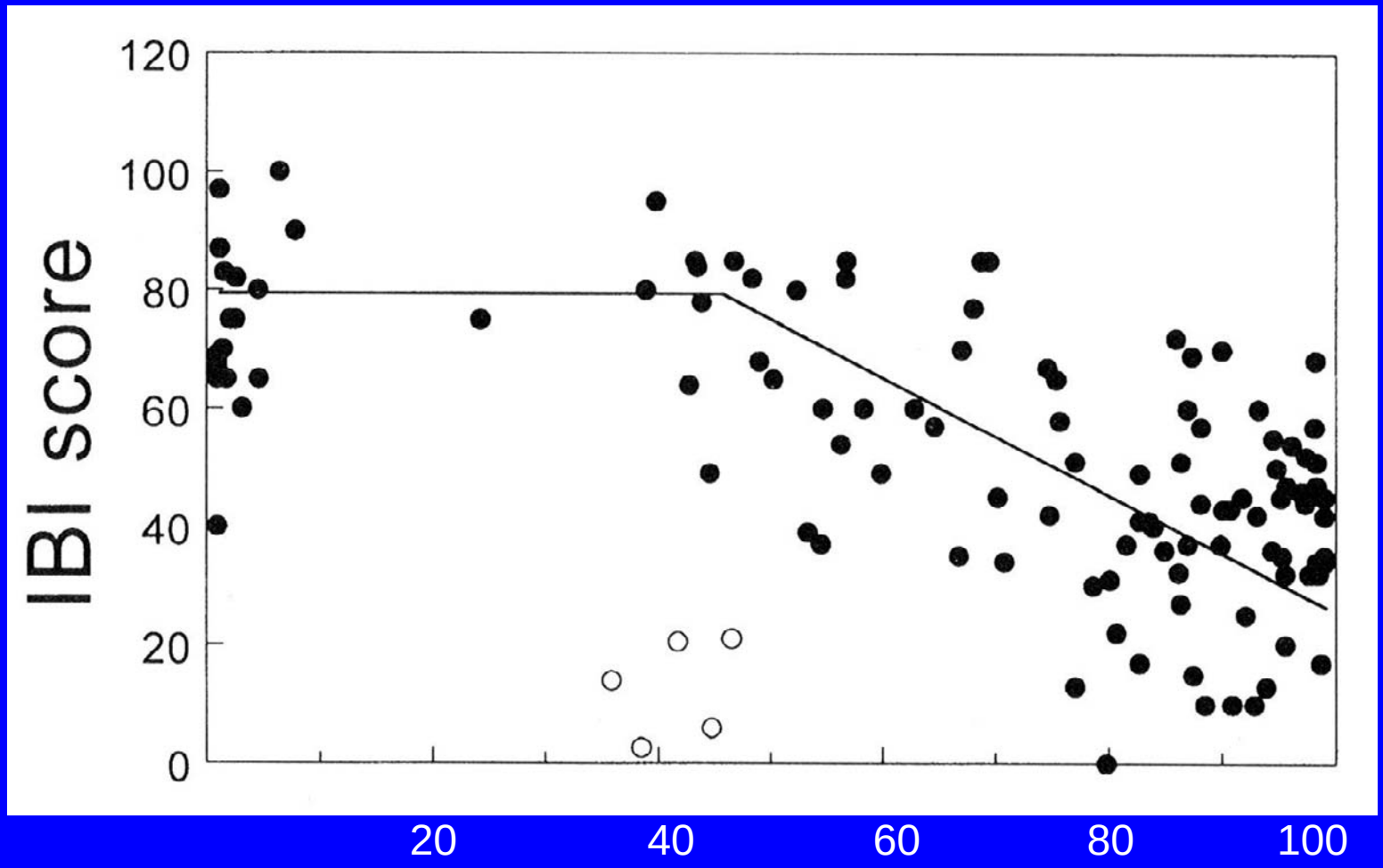

Biological Integrity
Excellent
Very Good
Biological Condition
Good
Protection & Propagation
Fair
Non-attainment
Poor
Very Poor
Natural
Minimal
Moderate
High
Serious
Radical
Human Disturbance

IBI vs. Catchment Land Use

- Steedman (ONT) ↓0-20% urban*
- Roth (MI) ↓25-50% ag.; ↑**0-15% urban**
- Klauda (MD) ↓>30% urban
- Wang(WI) ↓>50% ag.; ↓>10% urban
- Wang (WI) ↑**0-90% ag.;** ↓0-10% urban
- Karr (WA) ↓0-30% urban*
- Snyder (WV) ↑**35-75% ag.;** ↓0-10% urban*
- Fitzpatrick (WI) ↓20-60 % ag
- Mebane (PNW) ↓>15% irr. ag. or ag + urban
- Bryce (MAHA) ↓>50% ag.; ↓0-20% mined*

Rationale for Human Disturbance Gradient (HDG) (continued)

- **Assists in diagnosing stressors**
- Source of most-manageable stressors
- Critical for stream protection, BMPs & restoration



% Catchment Agricultural Land Cover

(from Wang et al. 1997. Fisheries 22(6):6-12)

IBI vs. Riparian Land Use

- Steedman (ONT) ↓70-100% deforested
- Roth (MI) ↓0-100% ag.; ↑**0-10% urban**
- Jones (GA) ↓>2-3 km deforested
- Fitzpatrick (WI) ↓>20% ag.
- Bryce (OR) ↓>50% ag.; ↓>20% urban
- Snyder (WV) **NS effect**

Rationale for Human Disturbance Gradient (HDG) (continued)

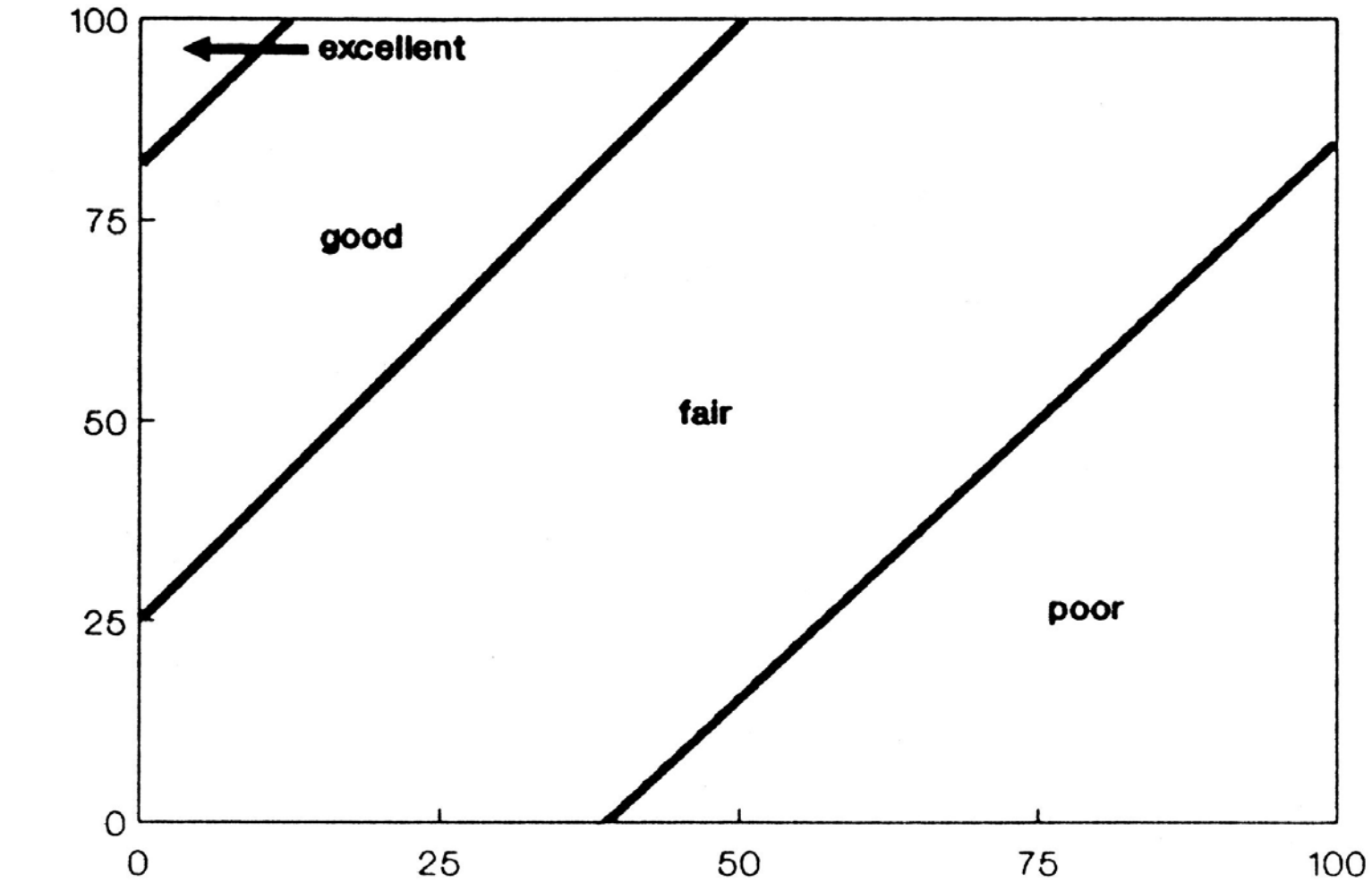
- Assists in diagnosing stressors
- **Source of most-manageable stressors**
- Critical for stream protection, BMPs & restoration

Increasing Disturbance

Agriculture	Urbanization/Mining	Flow	Tier
	Industrial Mines Dominant Urban Dominant	Extreme Flows Only Inter-basin Transfers	F
Irrigated Rowcrops CAFOs; Crop Processors	Suburban Mines Common	Regulated Flows Only Intra-basin Transfers	E
Intense Riparian Grazing Irrigated Forage	Small Cities Industrial Mines Present	Dammed Local Transfers	D
Constant Grazing Dryland Agriculture	Large Lot Residential Small Metal/Aggregate Mines	Slightly Flashier	C
Light/Rotated Grazing	Rural Residential Hand Mines	Natural Flow	B
Natural Vegetation	Transients	Natural Flow	A

Rationale for Human Disturbance Gradient (HDG) (continued)

- Assists in diagnosing stressors
- Source of most-manageable stressors
- **Critical for stream protection, BMPs & restoration**



(from Steedman. 1988. Can. J. Fish. Aquat. Sci. 45:492-501)

HDG Layout

- Six tiers (A-F)
- Six major stressor classes
  - Habitat structure
  - Flow regime
  - Water quality
  - Toxics & bioengineered chemicals
  - Energy sources
  - Biotic interactions

HDG Layout (continued)

- Six major disturbance classes
  - Landscape Character
  - Riparian Condition
  - Barriers
  - Channel Morphology (map scale)
  - Atmospheric Deposition
  - Biotic Interactions

Workshop Summary & Future Needs

- State participants classified site & basin data into HDG tiers
- 80 % agreement on tiers for Northern Forest, Midwest & Southeast work groups
- HDG must be modified for plains, deserts & large rivers
- Linkages between catchment/riparian HDG & instream stressors must be refined

The Human Disturbance-Stressor Gradient

(for usually permanent, unconstrained, desert streams & rivers)

- See handout TALU 201_05