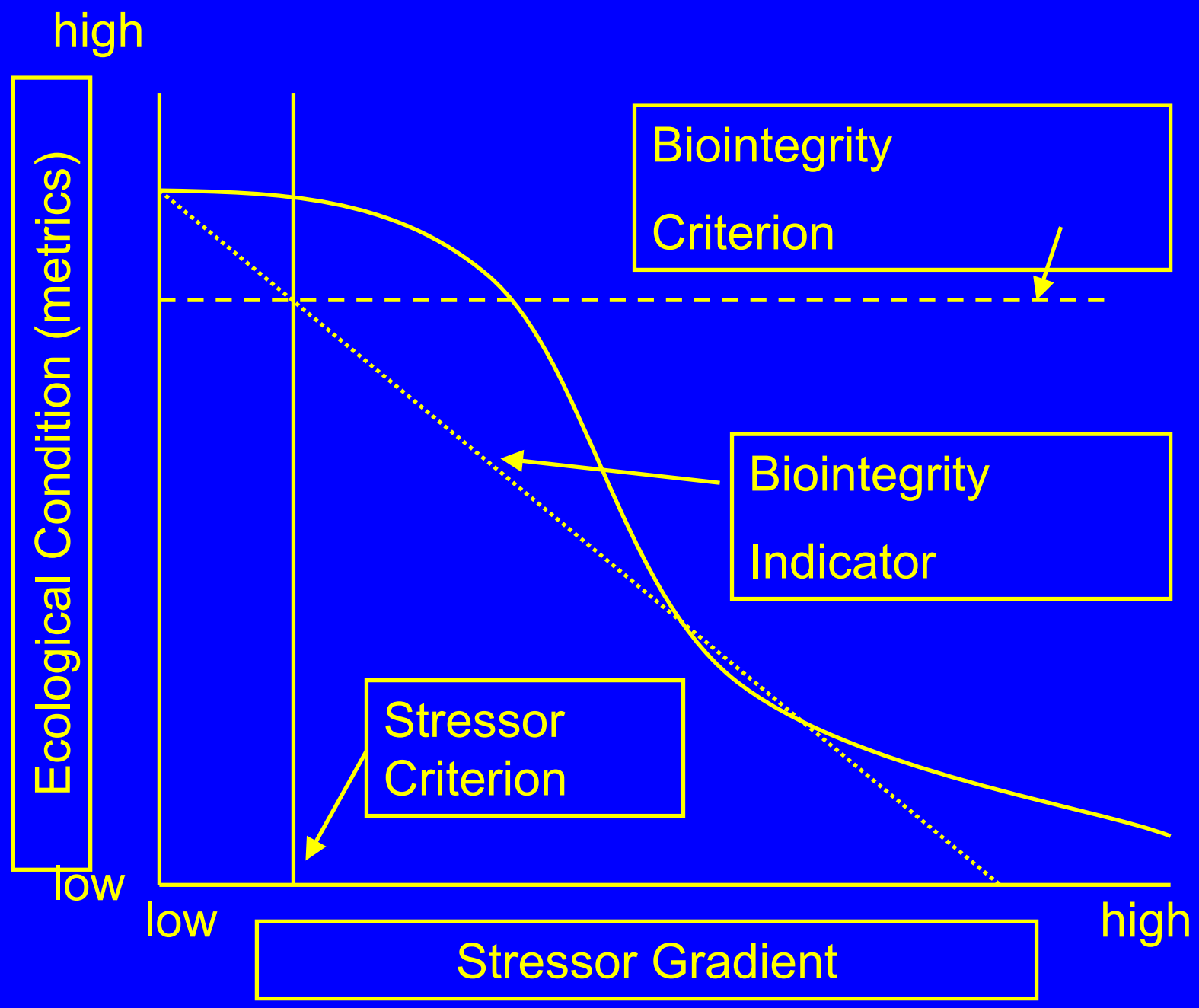
Seeking Common National Assessment of the Human Disturbance Gradient

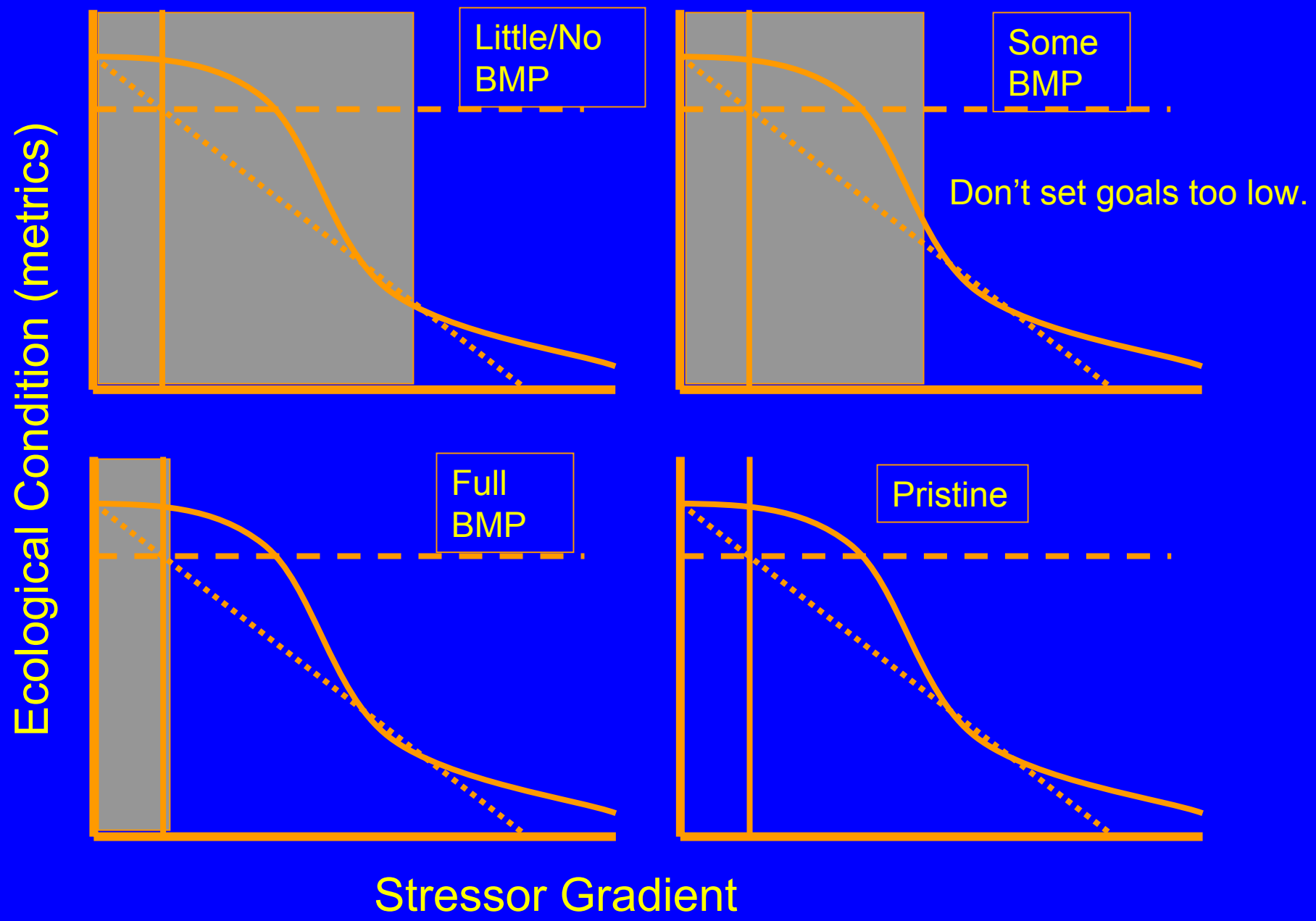
Robert M. Hughes
(Dynamac Corporation)
&
The Aquatic Life Uses
Steering Group

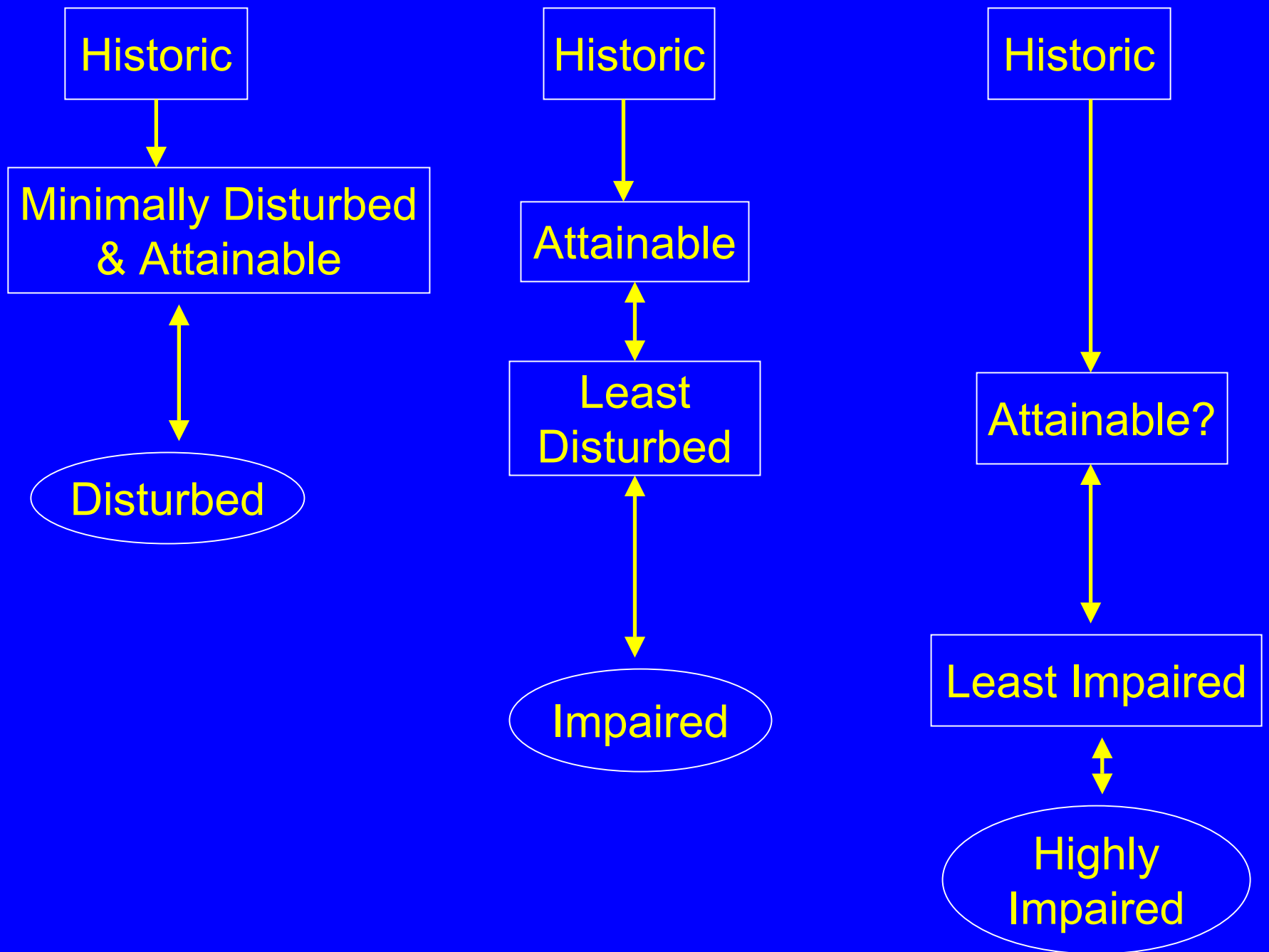
Objectives

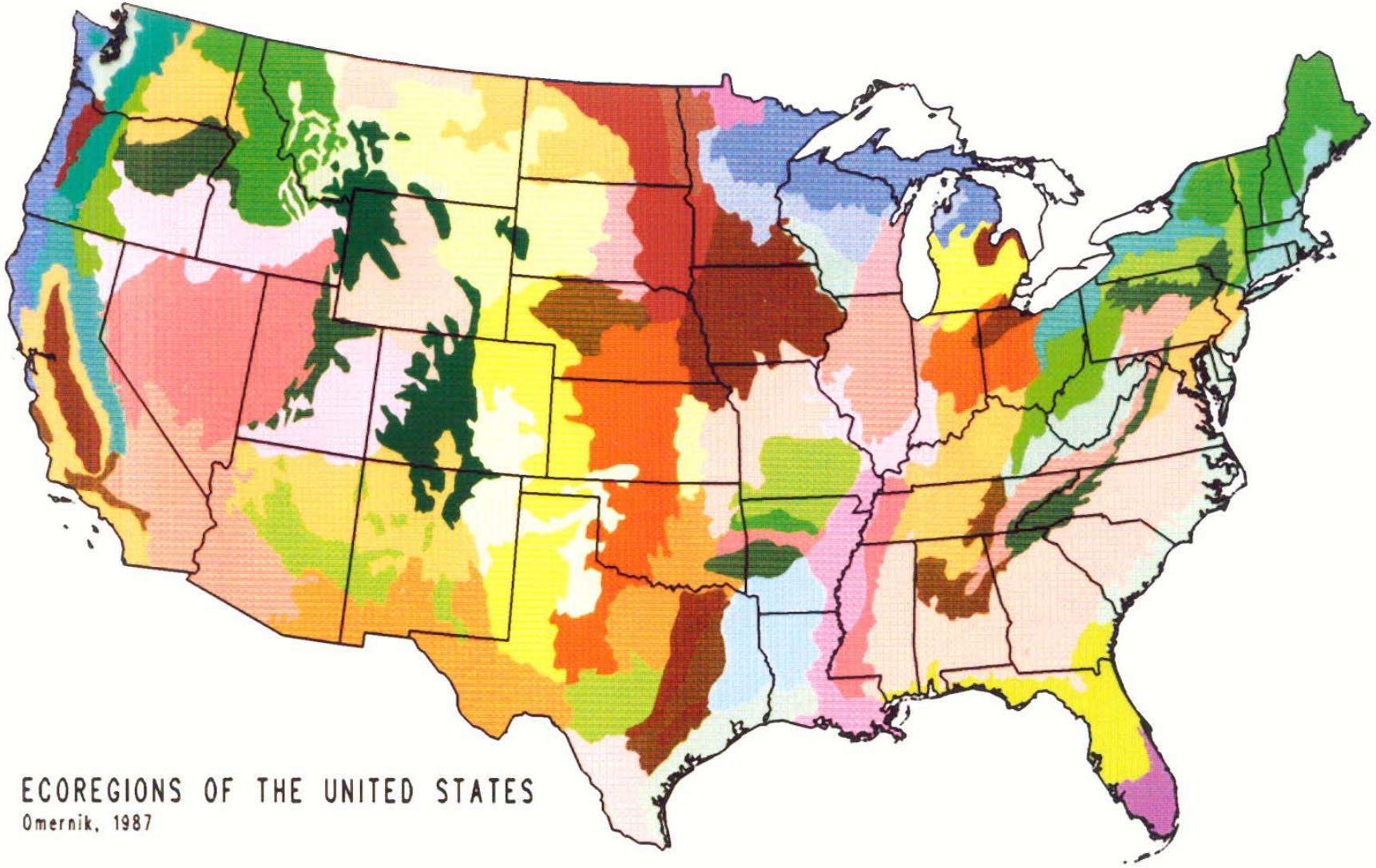
- Provide rationale for human disturbance gradient (HDG)
- Summarize recent studies concerning biological responses to land use
- Outline key components of HDG
- Summarize interstate workshop results

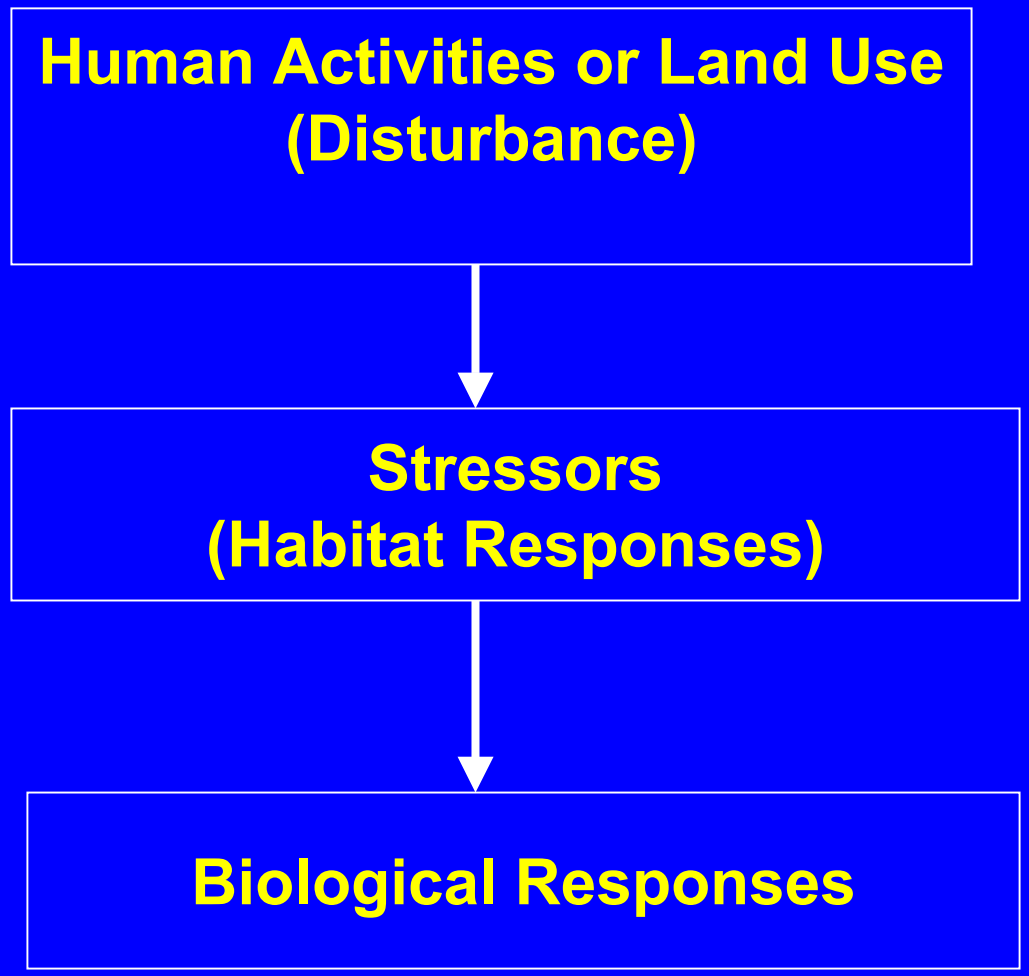

high
Ecological Condition (metrics)
low
Biointegrity
Criterion
Biointegrity
Indicator
Stressor
Criterion
low
high
Stressor Gradient

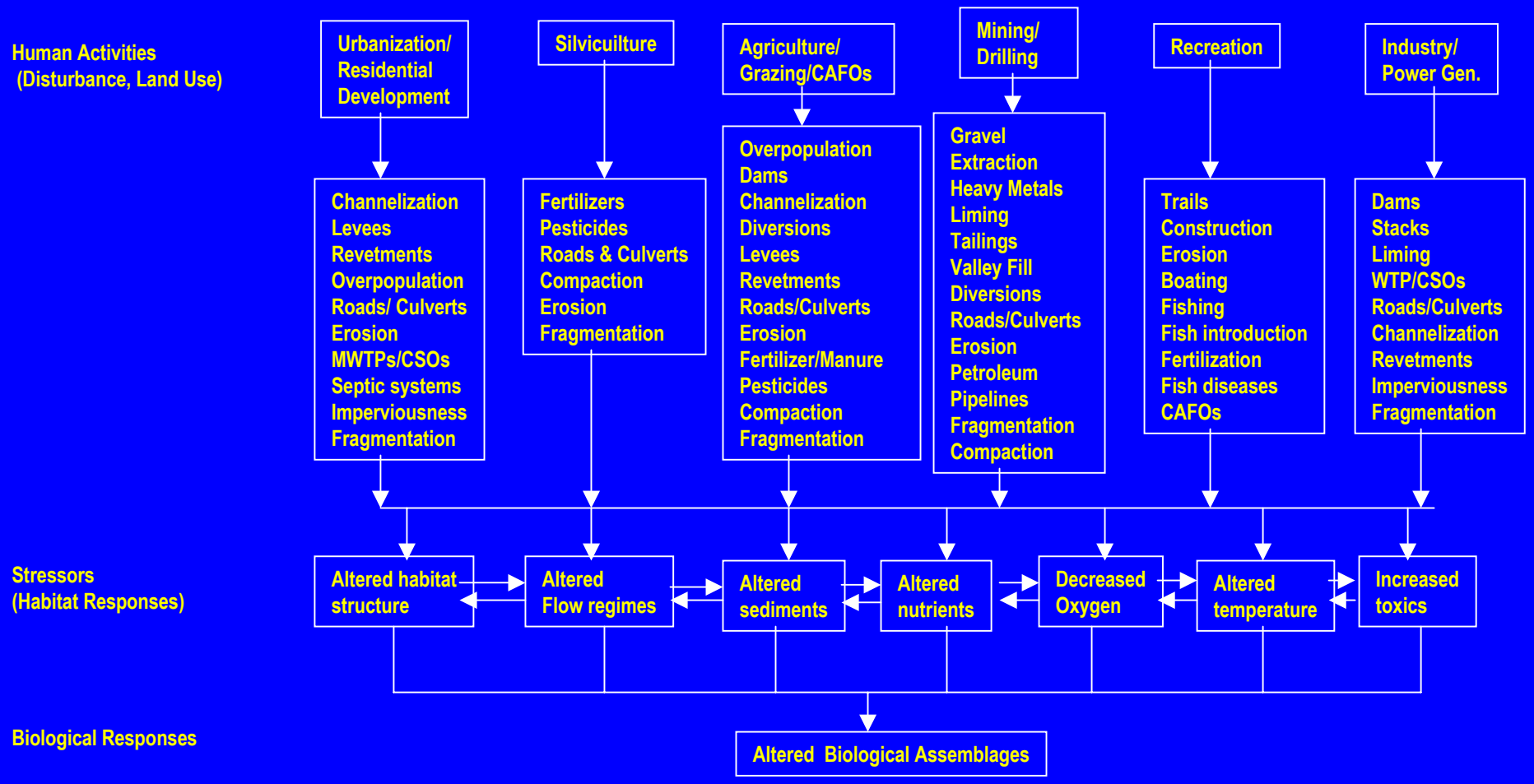
What we may learn as “attainable” improves with BMP implementation!




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



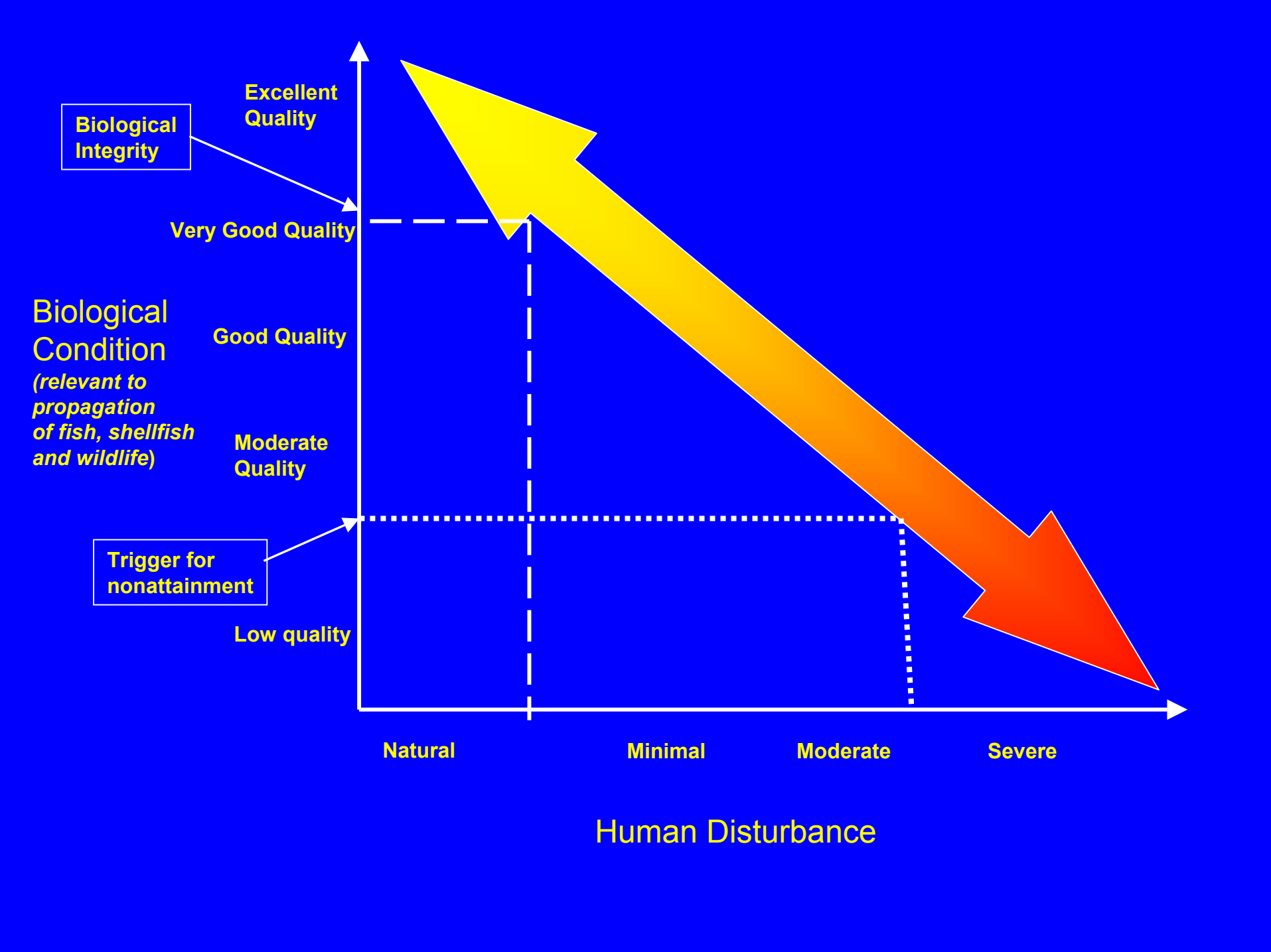
(from Bryce et al. 1999. J. Am. Wat. Resour. Assoc. 35:23-36)

Rationale for Human Disturbance Gradient (HDG)

- Landscape condition affects in-stream condition
- Human disturbance is root source of most-manageable stressors
- Landscape perspective is critical for stream protection and restoration
- Drainage perspective is necessary for understanding & conserving biota

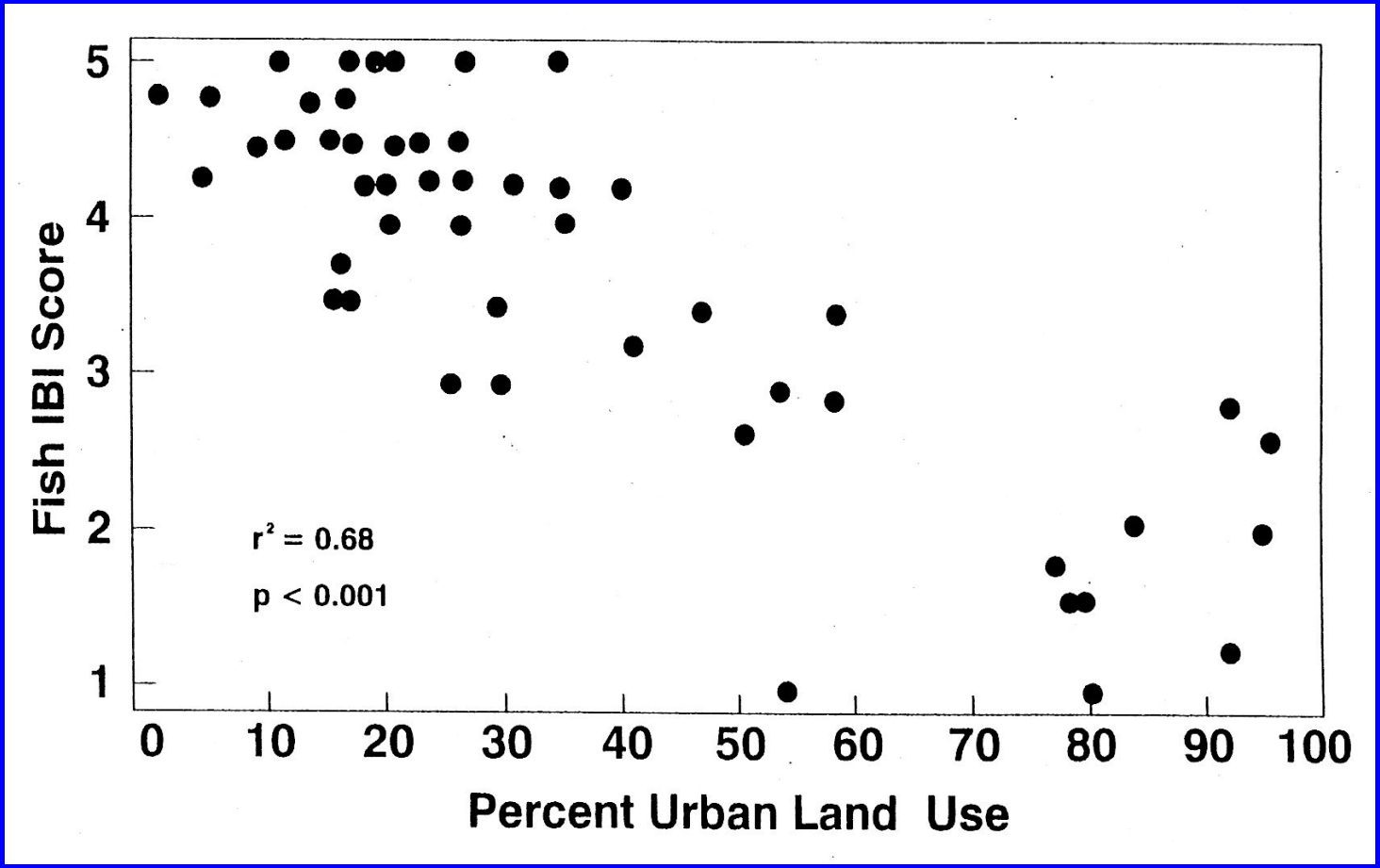
Rationale for Human Disturbance Gradient (HDG) (continued)

- Understanding landscape condition assists in diagnosing stressors
- Catchment condition often represents half the variability in biological response scores
- Catchment condition is essential for screening & selecting reference sites
- 1:1 dose responses rare; wedges & clouds common

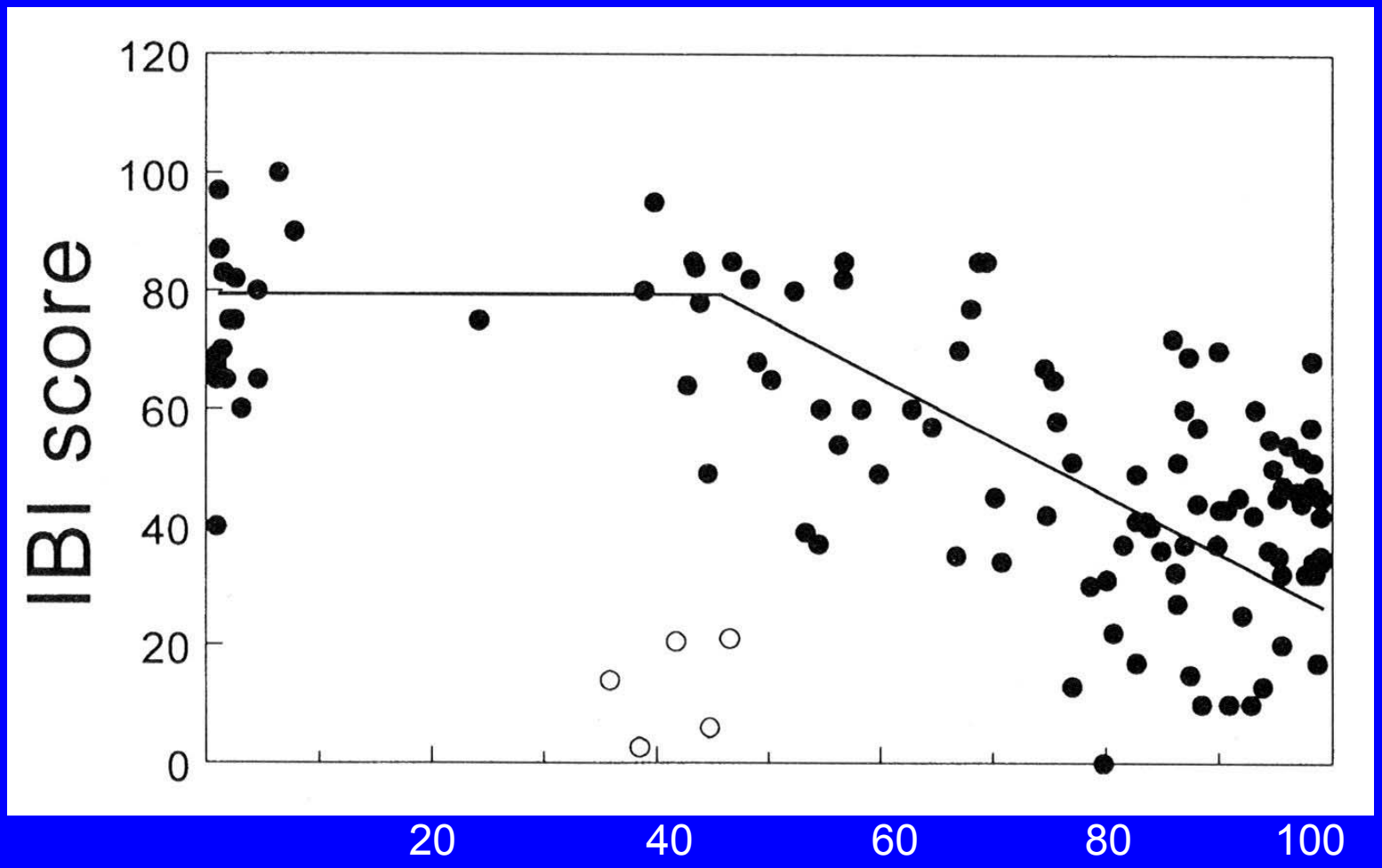

Biological Integrity
Excellent Quality
Very Good Quality
Biological Condition
(relevant to propagation of fish, shellfish and wildlife)
Good Quality
Moderate Quality
Trigger for nonattainment
Low quality
Natural
Minimal
Moderate
Severe
Human Disturbance

IBI vs. Catchment Land Use

- Steedman (ONT) ↓ 0-80% urban
- Roth (MI) ↓25-80% ag.; ↑ 0-15% urban
- Klauda (MD) ↓ 20-40% urban
- Wang(WI) ↓ >50% ag.; ↓ >10% urban
- Wang (WI) ↑ 0-90% ag.; ↓ >20% urban
- Fitzpatrick (WI) ↓ 20-60 % ag
- Karr (WA) ↓ 0-60% urban
- Snyder (WV) ↑ 35-75% ag.; ↓ 0-30% urban
- Mebane (PNW) ↓ >15% irrigated ag.
- Bryce (MAHA) ↓ >50% ag.; ↓ 10-20% mined



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

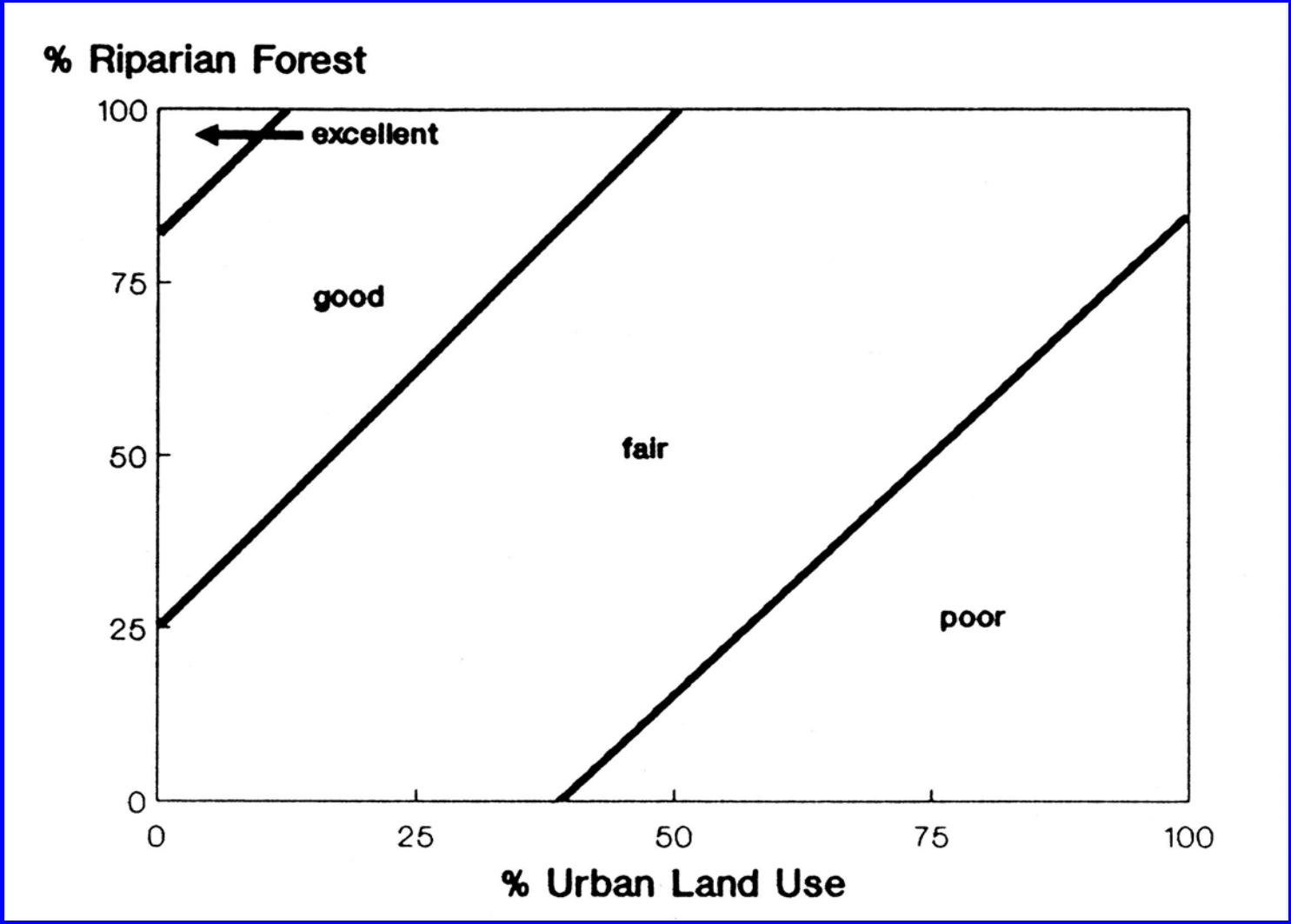


% Catchment Agricultural Land Cover

(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



(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)

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

Increasing
Stressor
Intensity
(Catchment Scale)

Silviculture	Agriculture	Urbanization	Tier
		Industrial	
	CAFO	Urban	F
	Irrigated	Suburban	E
	Conventional		
	Low/no Till		
	Intensive Graze		D
Raw Clearcut	High Swidden	Large Lot Res.	
Scrub/Sapling	Patch Farm		C
Open 2nd Growth	Rotated Graze	Rural Res.	B
Closed 2nd Growth	Patch Swidden	Pioneer	
Select Cut			A
LSOG			

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 & stressors must be refined