

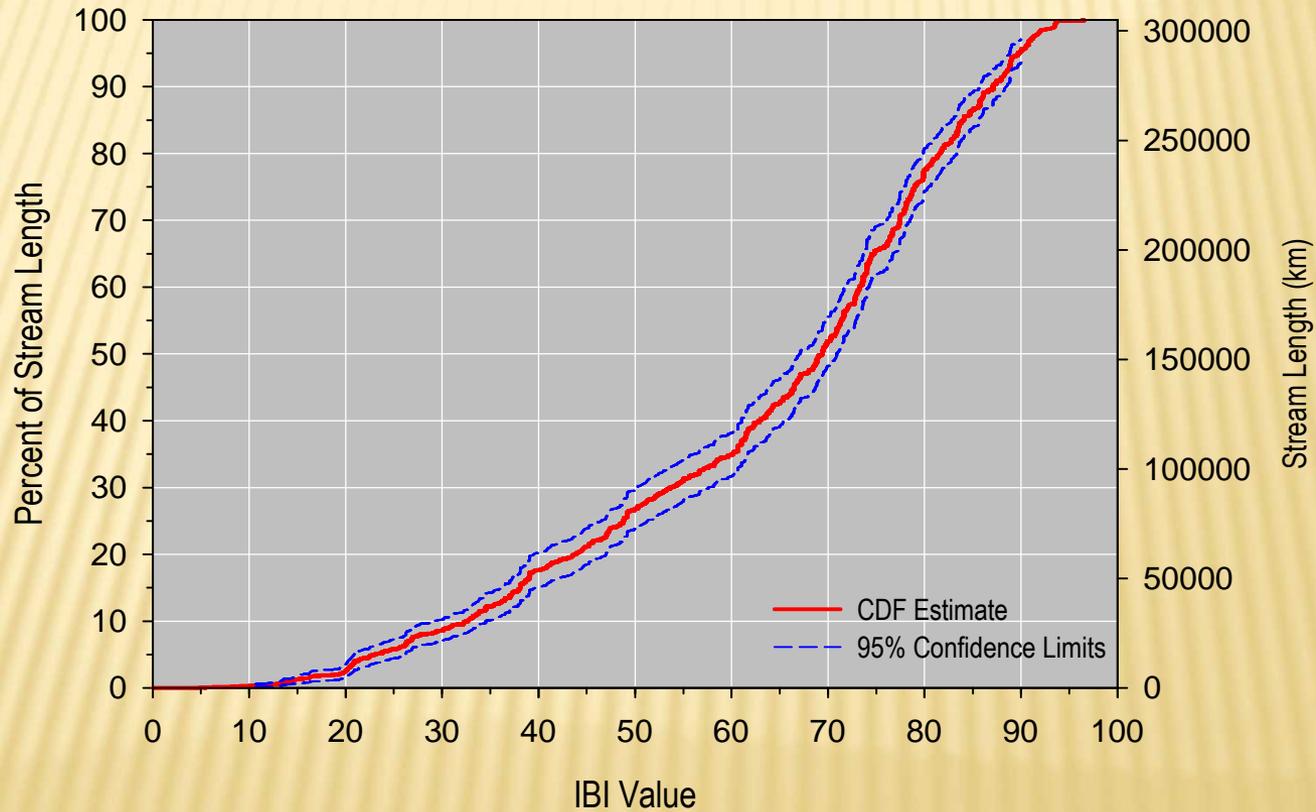
# ESTIMATING REFERENCE CONDITION FOR LARGE-SCALE SURVEYS—WHERE ARE WE, AND HOW DID WE GET HERE?



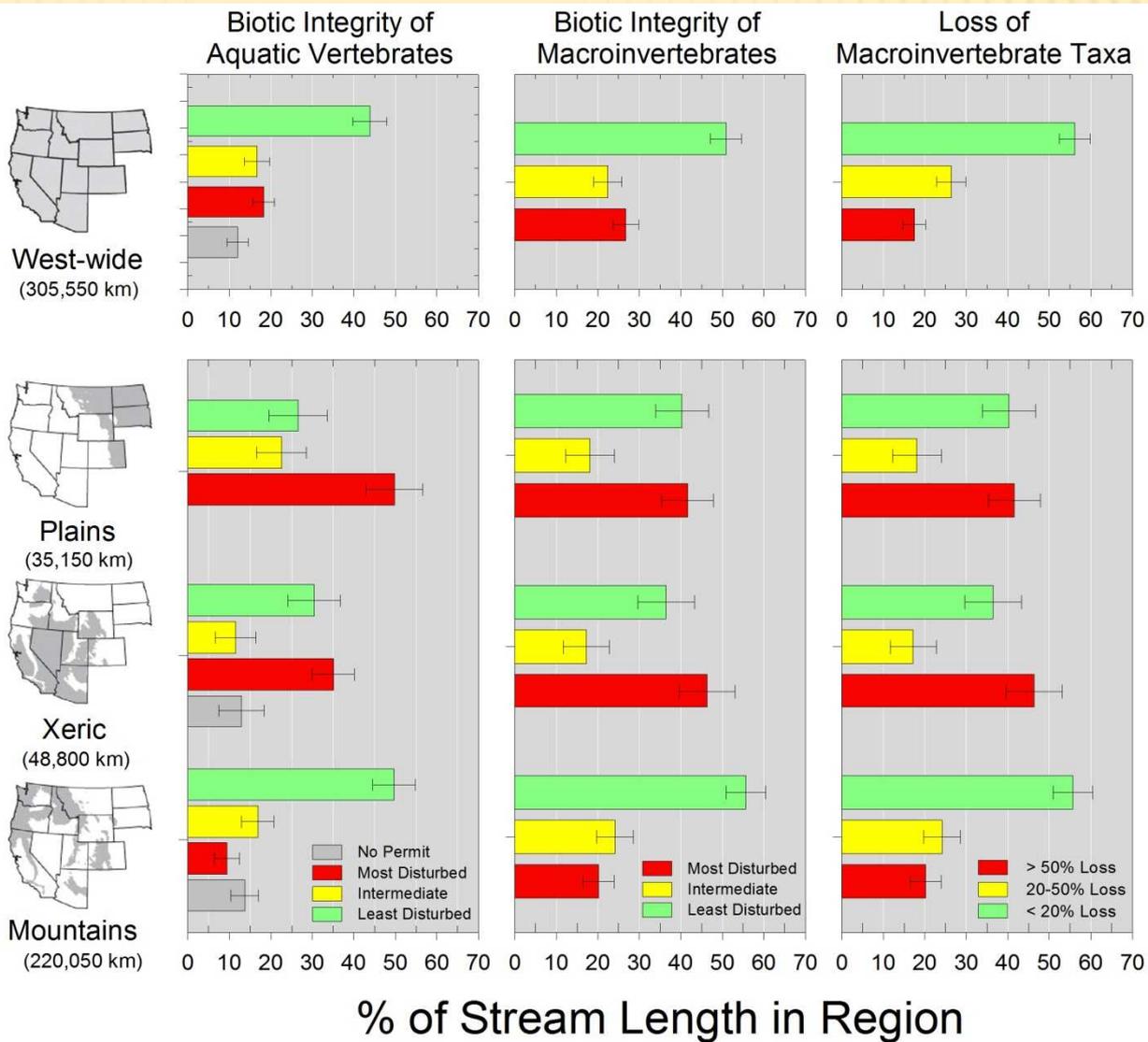
John L. Stoddard, U.S. EPA Western Ecology Division  
Corvallis, Oregon

# THE PROBLEM

Cumulative Distribution Function  
for Macroinvertebrate IBI  
West-wide



# THE PROBLEM

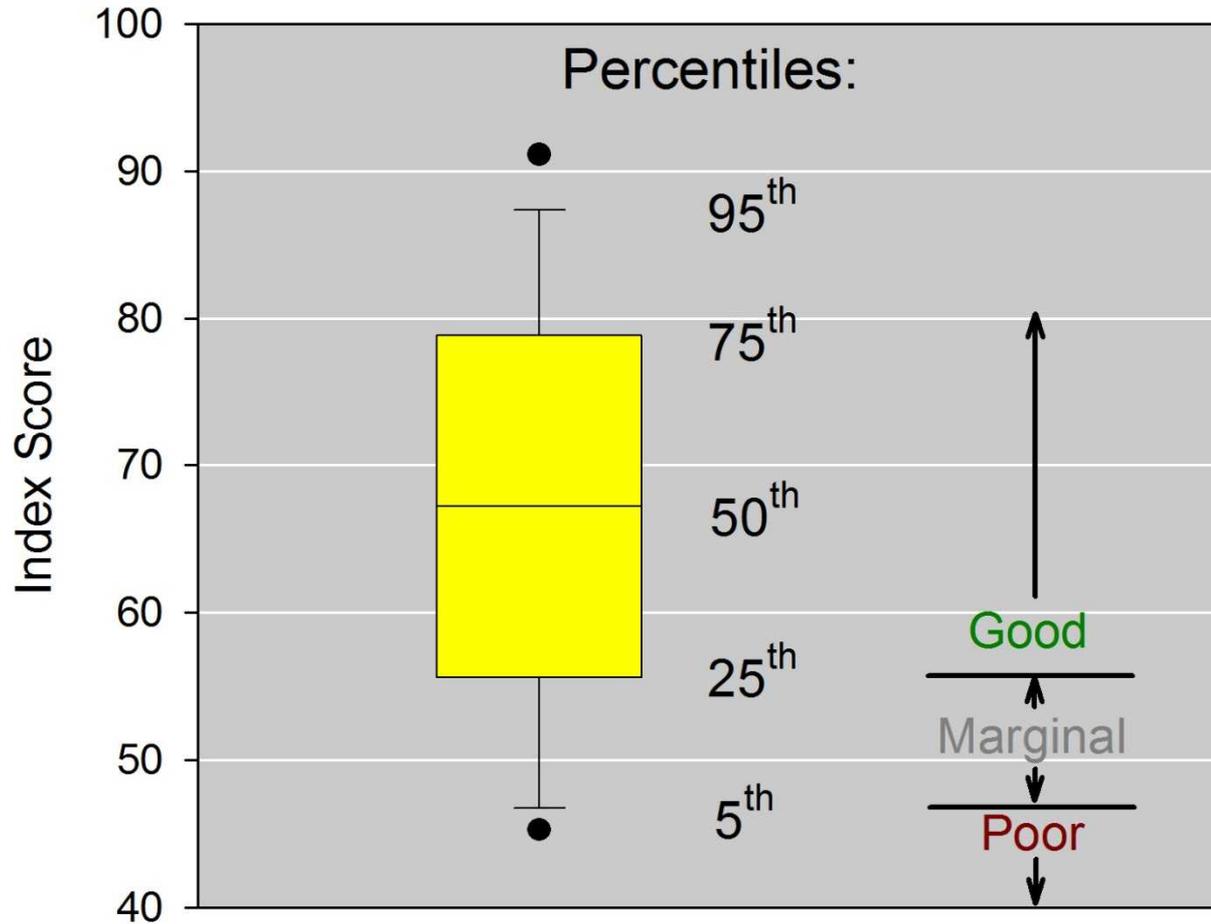


# ESTIMATING REFERENCE CONDITION

- ↳ Reference site approach
  - ↳ Measuring condition at “least disturbed” sites
    - ↳ hand-picked reference sites
    - ↳ “filtered” probability sites
    - ↳ using hand-picked sites to fill out distributions
- ↳ Infer from data distributions
  - ↳ Maximum Species Richness lines
- ↳ Infer from ambient frequency distribution (CDF)
- ↳ Modeling

# THE PROBLEM

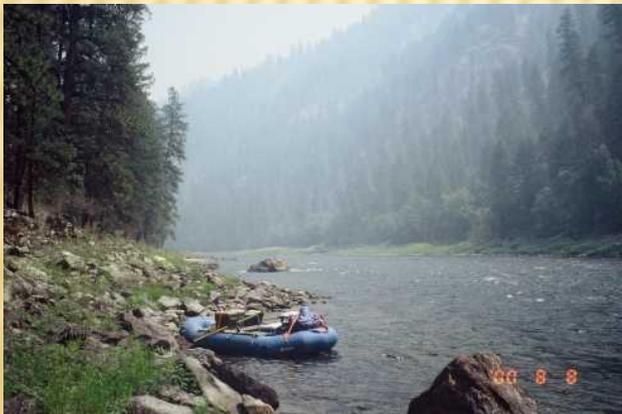
## Reference Distribution



# REFERENCE SITE FILTERS

Criteria	NAP	SAP	CPL	UMW	TPL	SPL
Total P (ug/L)	>20	>20	>30	>30	>150	>150
Total N (ug/L)	>750	>750	>1000	>1000	>4500	>4500
Chloride (ueq/L)	>250 <sup>a</sup>	>200	—	>300	>2000	>1000
Sulfate (ueq/L)	>250	>400	>600	>400	—	—
ANC (ueq/L)+DOC (mg/L)	<50+<5	<50+<5	<50+<5	<50+<5	<50+<5	<50+<5
Turbidity (NTU)	>5	>5	>10	>5	>50	>50
Mean RBP Habitat Score	<15	<15	<12.5	<15	<12.5	<12.5
Riparian Disturbance Index	>2	>2	>2	>2	>2	>2
% Fine Substrate	>25	>25	>50	25	>80	>90

Any site which passes all of the criteria becomes a reference site



# UNINTENDED CONSEQUENCES

## OF REFERENCE SITE APPROACH

- Variable reference site quality within regions (Xeric example)



Wyoming 515  
Bug IBI = 91

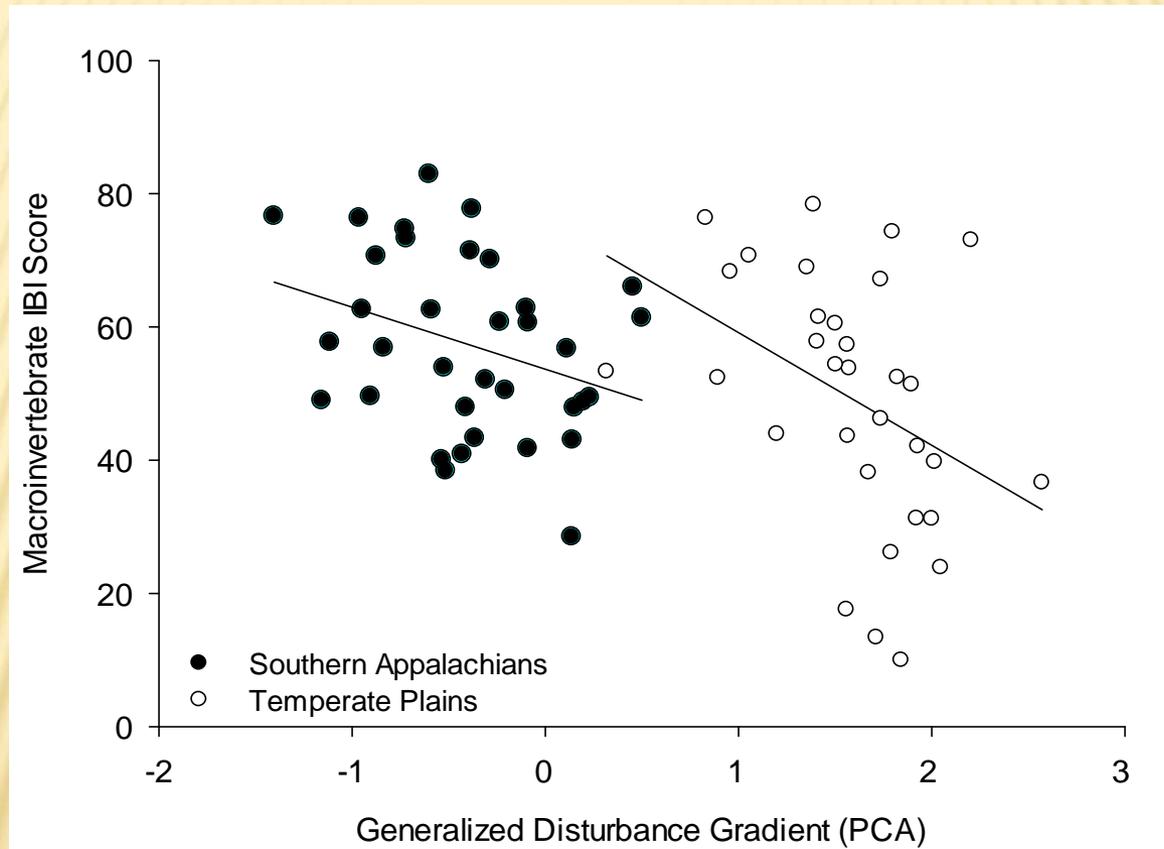


Nevada 561  
Bug IBI = 84



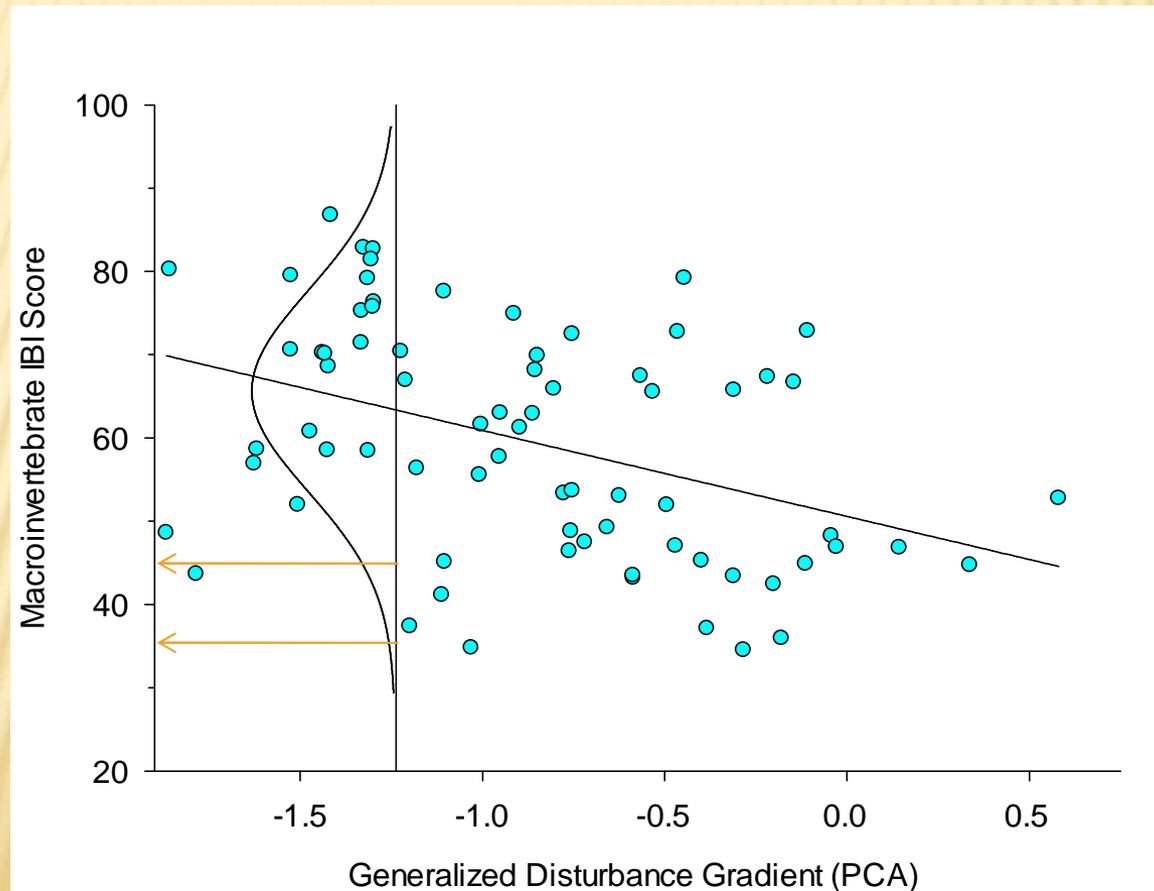
Wyoming 708  
Bug IBI = 55

# UNINTENDED CONSEQUENCES OF REFERENCE SITE APPROACH



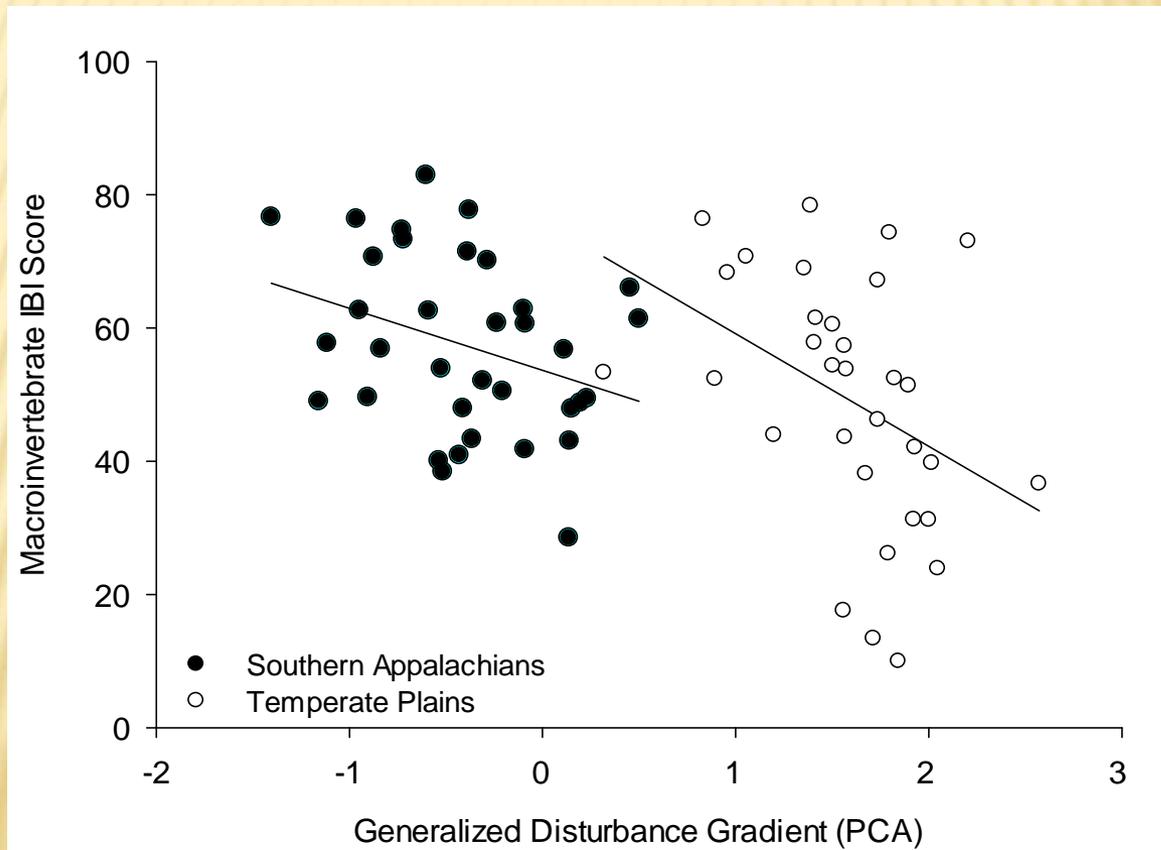
Long-term solution: More reference sites (and discarding sites at disturbed end of gradient)

# UNINTENDED CONSEQUENCES OF REFERENCE SITE APPROACH



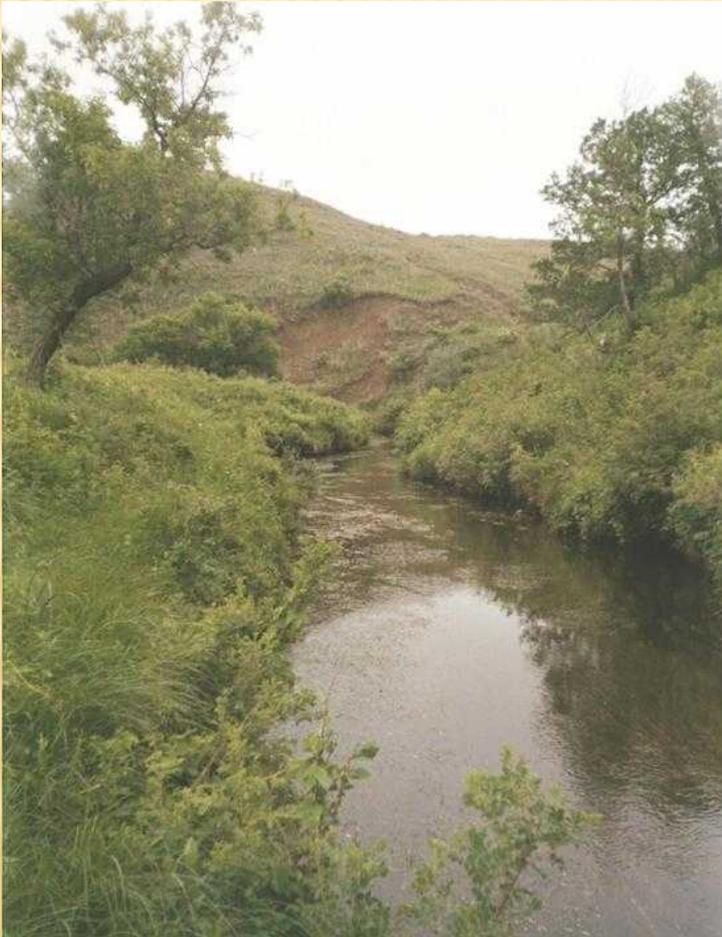
# UNINTENDED CONSEQUENCES OF REFERENCE SITE APPROACH

- Variable reference site quality within regions
- Universally degraded reference site quality in some regions

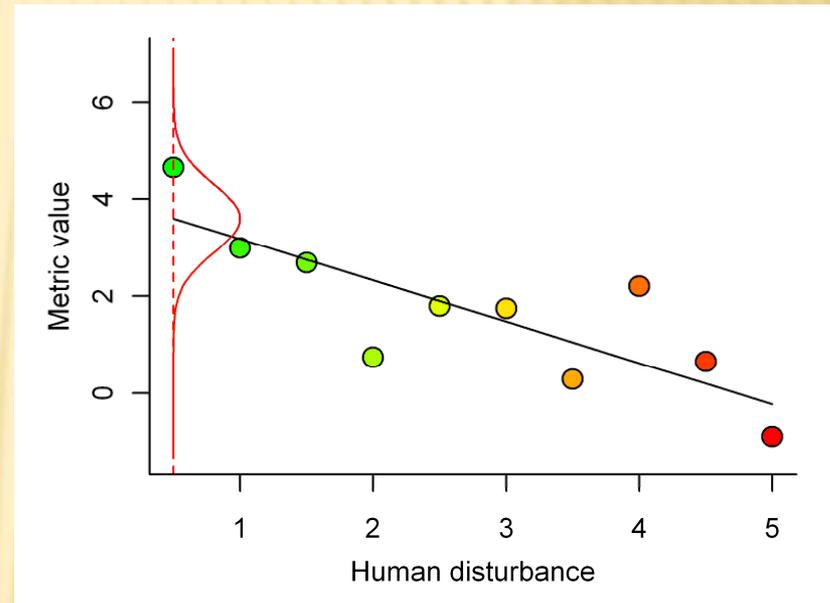
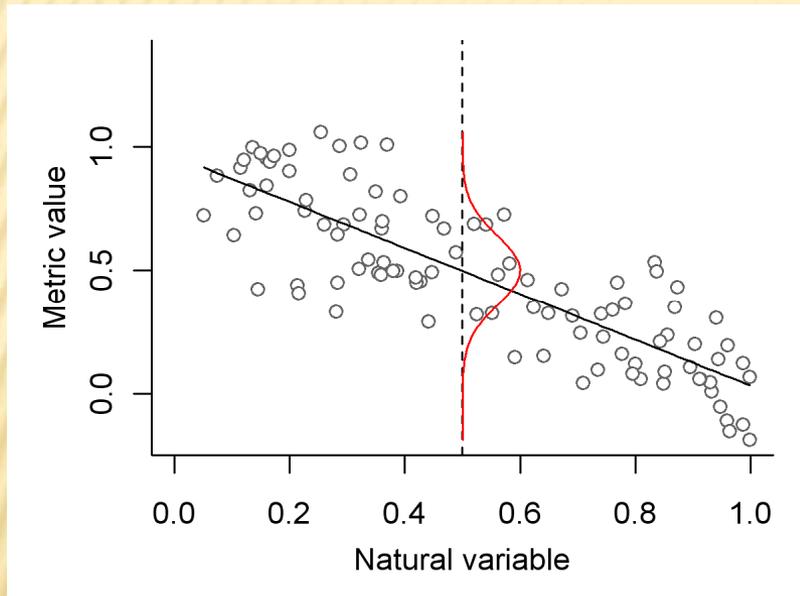


# TEMPERATE PLAINS REFERENCE SITES

- Variable reference site quality within regions
- Degraded reference site quality in some regions



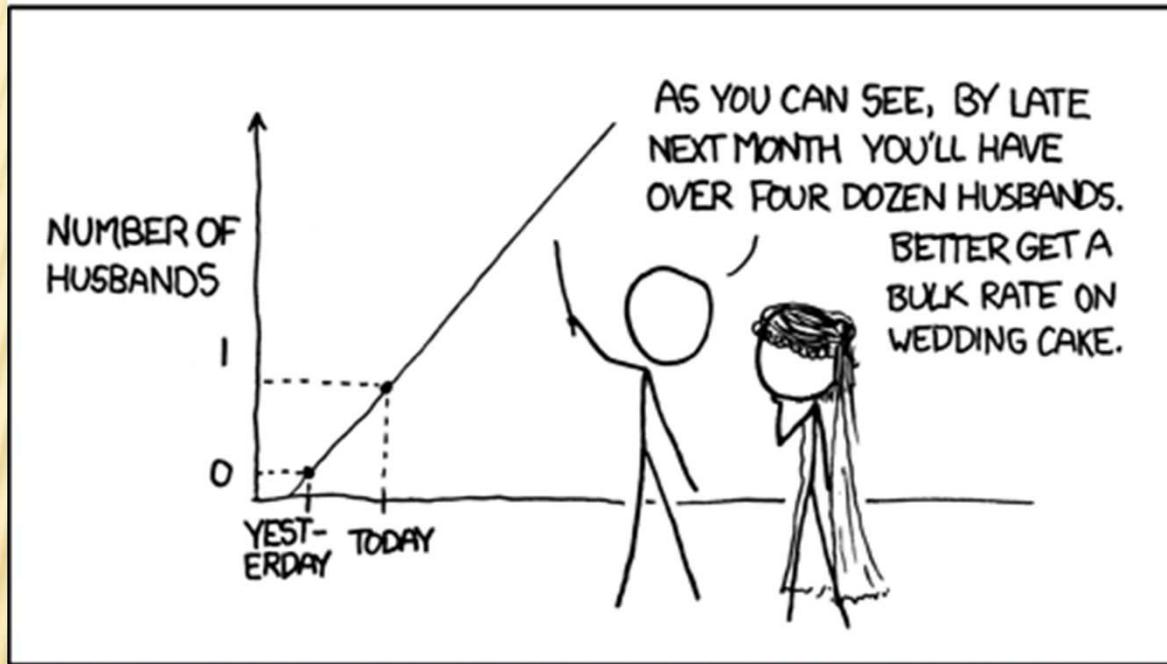
# DIRTY MODELING



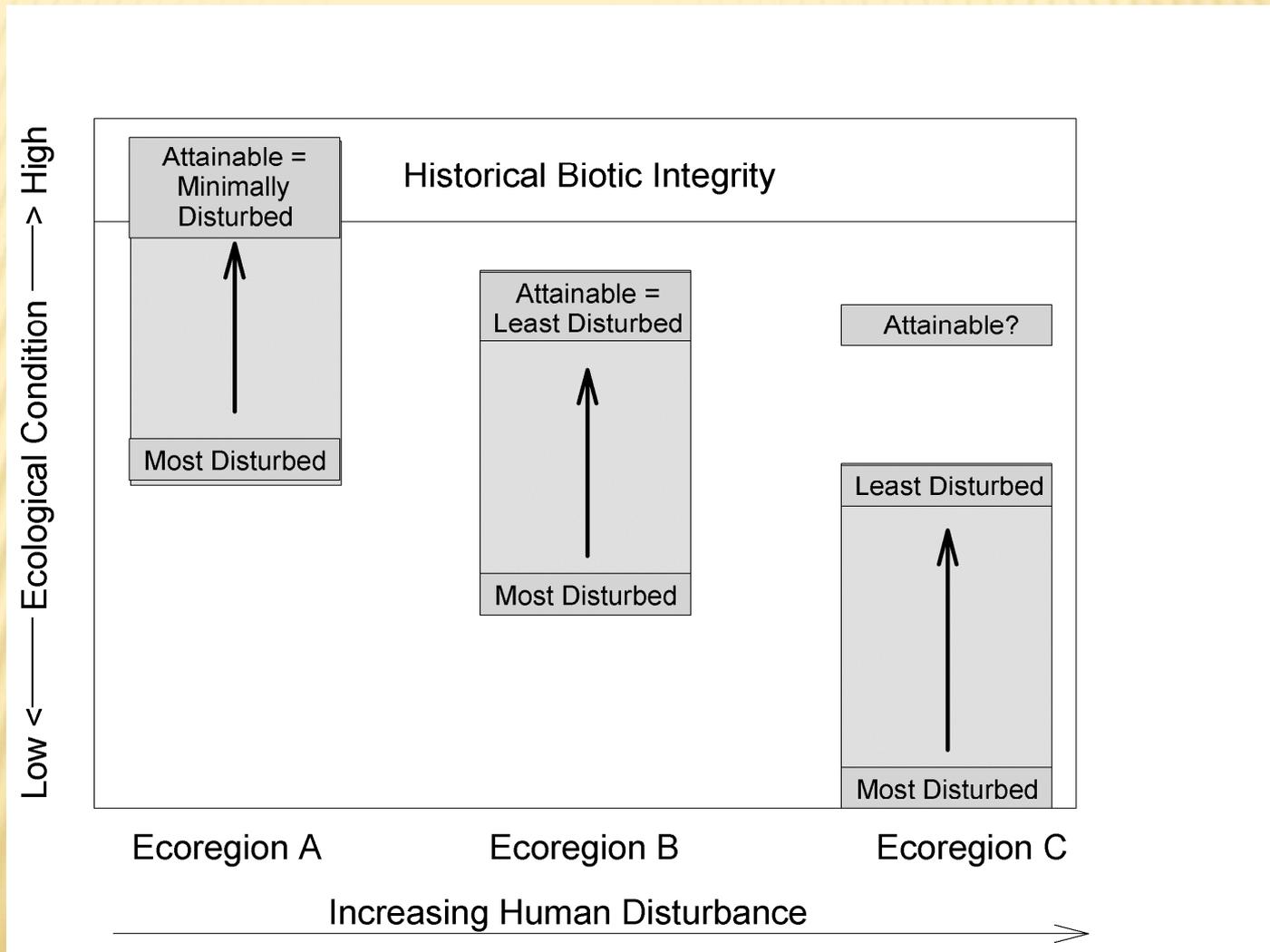
1. Estimate natural variability **in reference sites** to describe shape of distribution for each metric/index
2. Use current relationship of metric/index with disturbance **in all sites** to “hindcast” values of metric/index in the absence of human disturbance.

# DANGERS OF DIRTY MODELING

## MY HOBBY: EXTRAPOLATING



# MODIFYING THE “LEAST DISTURBED” APPROACH



# CONCLUSIONS

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