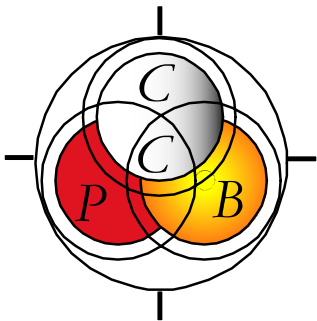


Examining biological integrity and stressor gradients in wadeable streams in the Central Plains.

Debbie Baker, Andy Dzialowski, and Donald Huggins

*Central Plains Center for BioAssessment,
Kansas Biological Survey*



Abstract

- In order to assess the impacts of human mediated disturbances, scientists often identify sites that experience relatively minimal levels of impairment and therefore represent “healthy or acceptable” conditions. These reference conditions can then be used as benchmarks for ecosystem health in the development of bioindicators and biocriteria. However, the question arises as to the meaning of reference condition and the extent of disturbance, or lack of disturbance, it represents. The *minimally disturbed* condition, or the absence of significant human disturbance, if this can be determined, may serve as a benchmark in comparing other definitions of reference condition such as *least disturbed*, which may change over time as climate, land use, and management practices change. Most states in the Central Plains region refer to the *least disturbed* reference condition due to the extent and nature of modern land use in the plains region. The Central Plains Center for BioAssessment is attempting to refine our understanding of the gradient of disturbance in wadeable streams by fitting landscape conditions and measures of biological integrity (e.g. fish and macroinvertebrates) to Tiered Aquatic Life (TAL) models for several Central Plains ecoregions. The TAL model was conceptualized by USEPA as a means of recognizing the continuum of aquatic communities that are structurally and functionally different as a result of anthropogenic disturbances (www.epa.gov/ost/biocriteria/alus). The model integrates the results of biological, habitat, chemical, and toxicological assessments in making a determination of aquatic life use support.

Thanks

- USEPA Region 7
- Biological Criteria Workgroup
- Data contributors:
 - NDEQ, UNL
 - KDHE, KDWP
 - IDNR, ISU
 - MDNR, MDOC



Reference condition

Minimally Disturbed Condition

- Condition of streams in the absence of significant, or with minimal, human disturbance (e.g., “natural,” “undisturbed”)
- A benchmark condition.
- Does it exist? How do we measure it?

Least Disturbed Condition

- The best available physical, chemical & biological habitat conditions given the contemporary landscape
 - defined by a set of explicit criteria to which all reference sites must adhere.

Reference conditions

- 1. Point sources**
- 2. Animal feeding / grazing operations**
- 3. Instream habitat**
- 4. Riparian habitat**
- 5. Land use / land cover (broad scale)**
- 6. Land use / land cover (site-specific)**
- 7. Physical and chemical parameters**
- 8. Altered hydrologic regime**
- 9. Biological metrics (verification only)**
- 10. Biotic assemblages (current & historic)**
- 11. Representativeness**

Tiered Aquatic Life Uses: Conceptual Framework

Jackson et al., EPA

natural

Biological condition

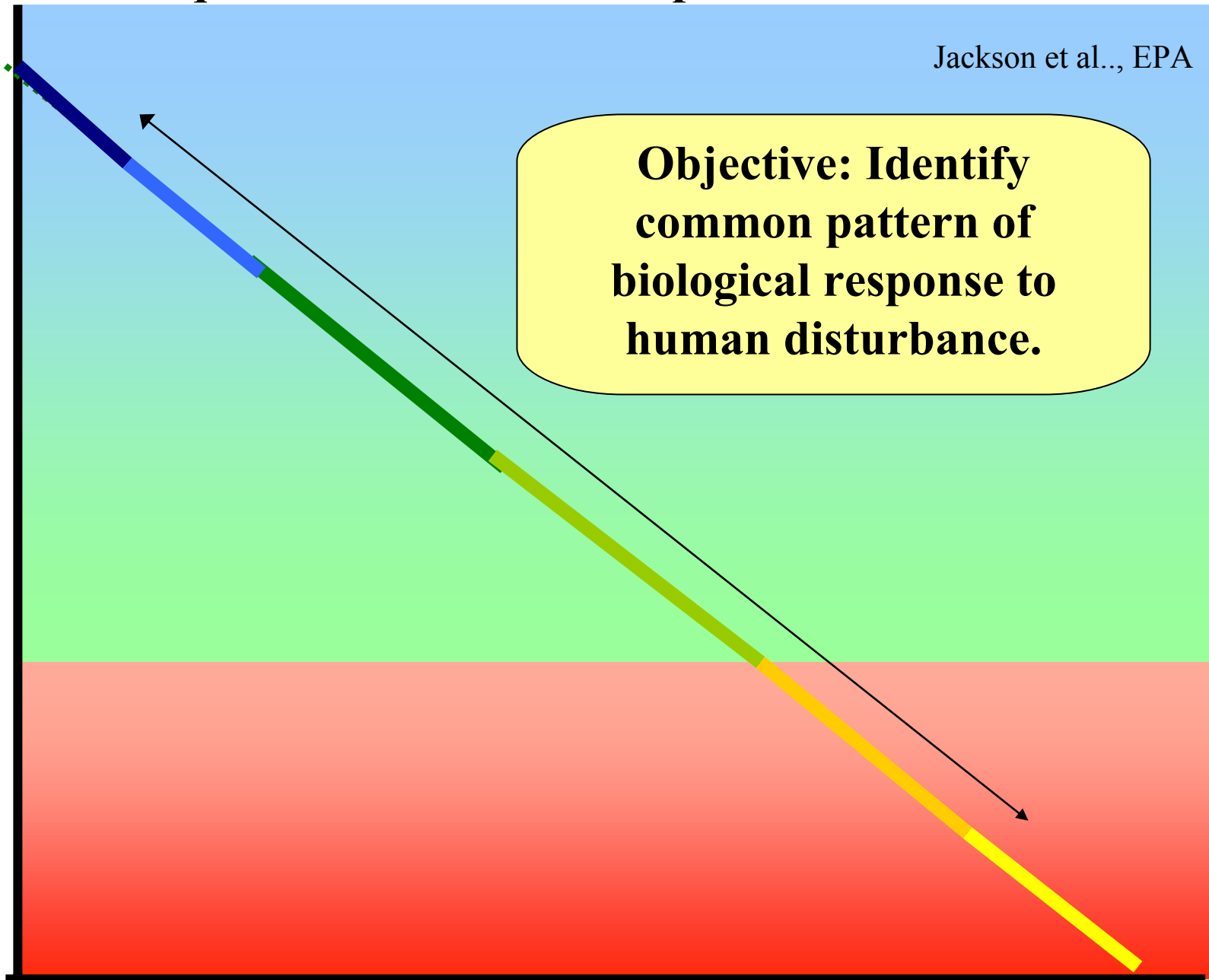
**Objective: Identify
common pattern of
biological response to
human disturbance.**

extreme
changes

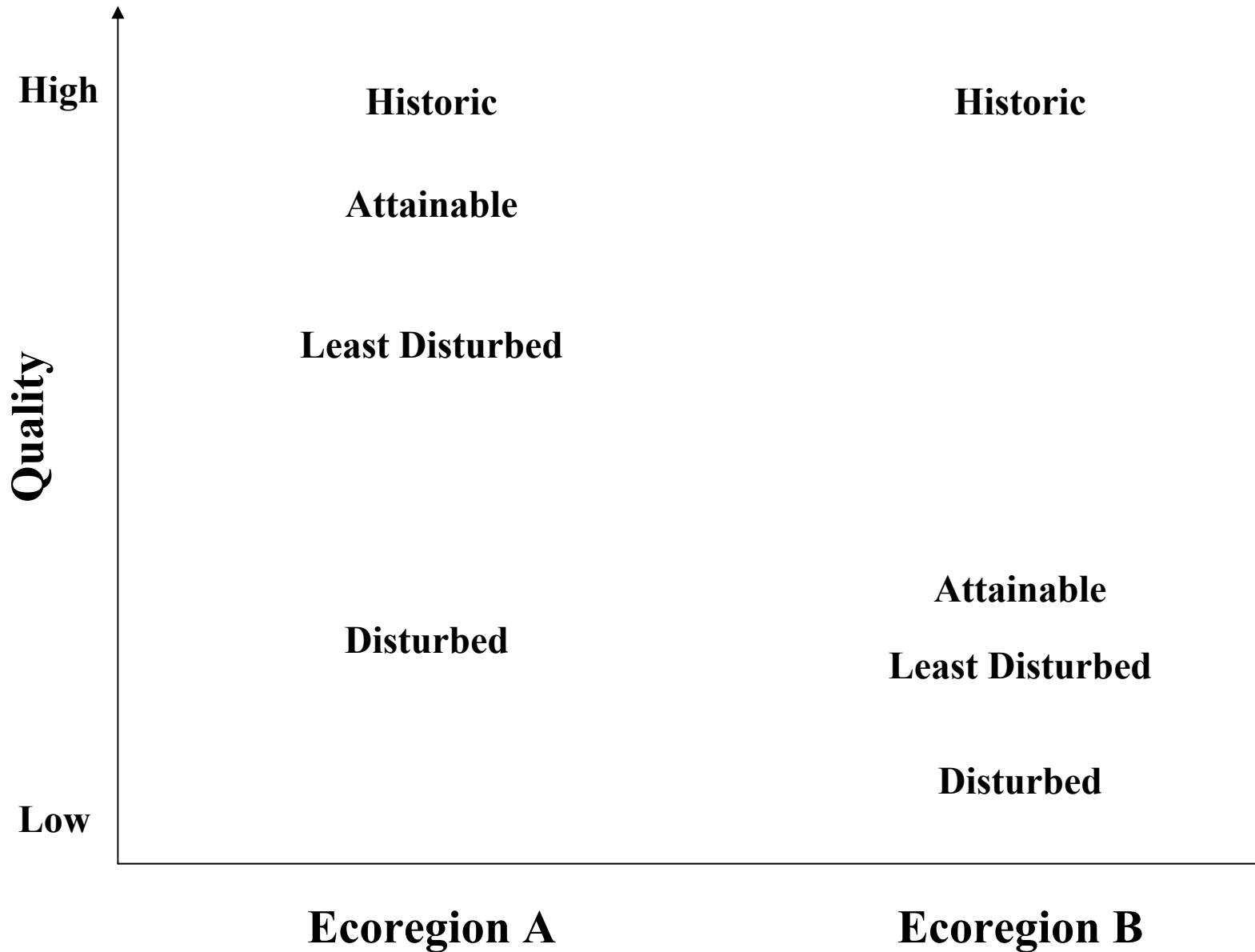
low

Human disturbance or stressor

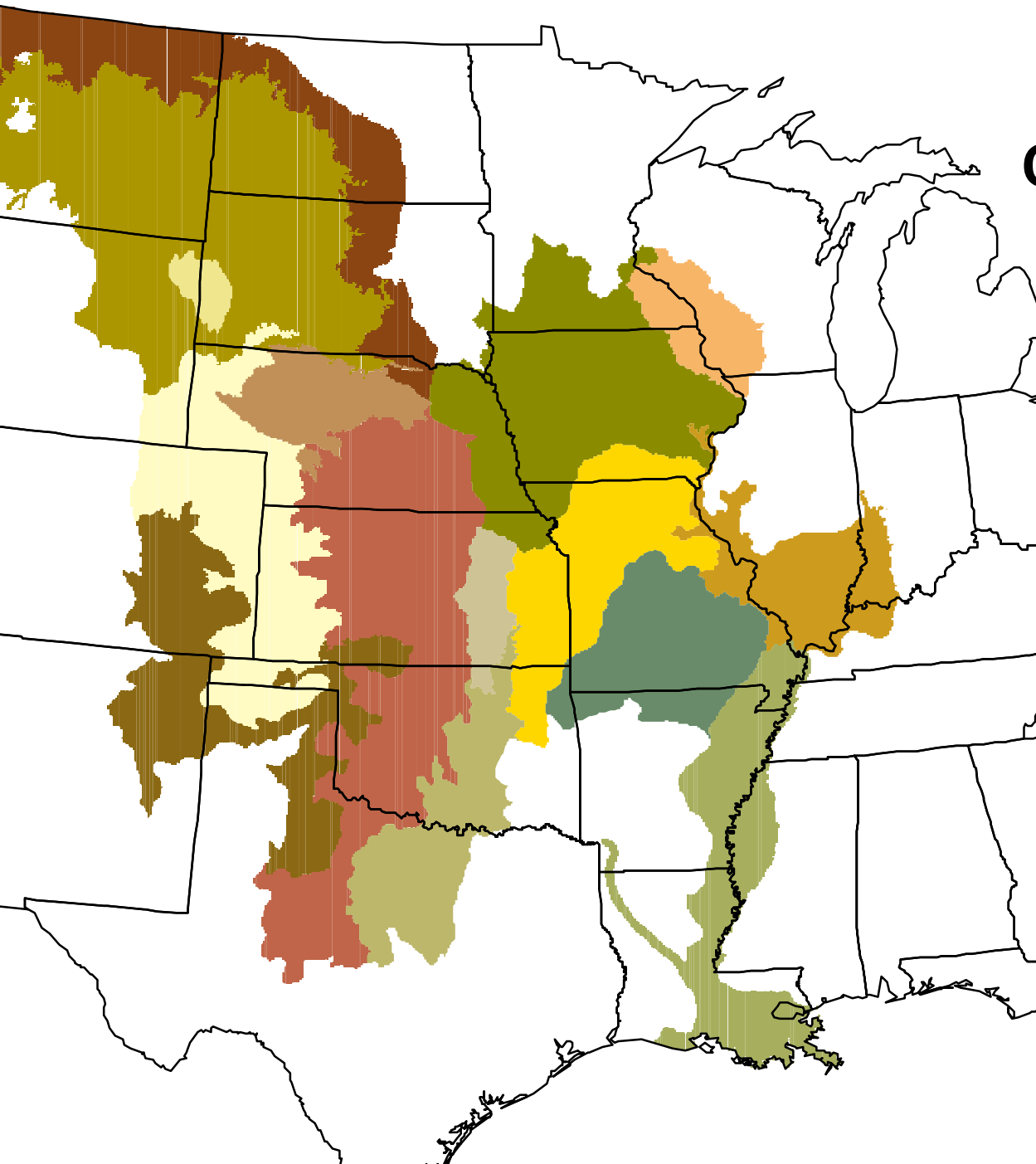
high



Ecoregion approach



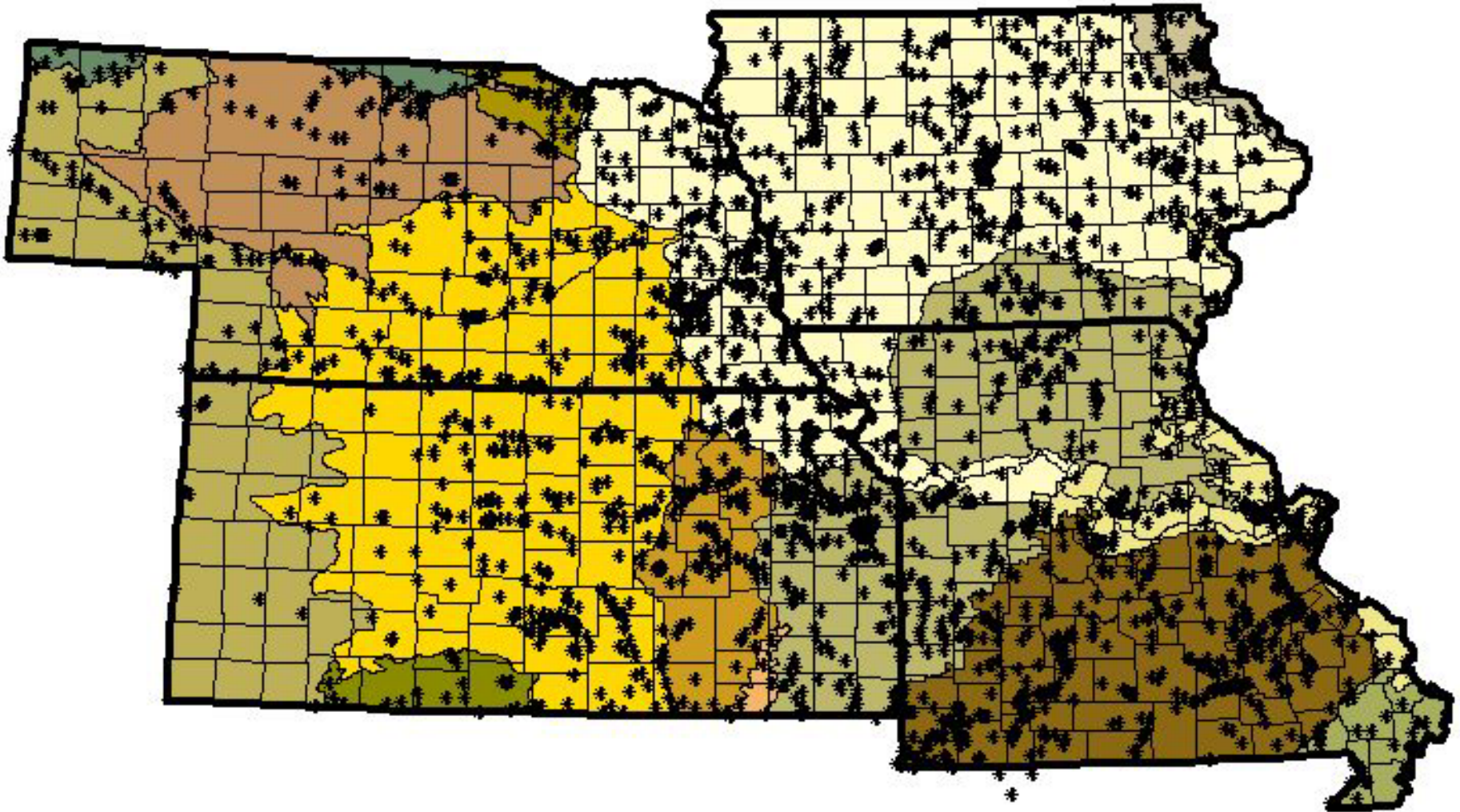
Ecoregions of the Central United States



Central US Ecoregions

- Central Great Plains
- Central Irregular Plains
- Central Oklahoma / Texas Plains
- Driftless Area
- Flint Hills
- Interior River Lowland
- Middle Rockies
- Mississippi Aluvial Plain
- Nebraska Sand Hills
- Northwestern Glaciated Plains
- Northwestern Great Plains
- Ozark Highlands
- Southwestern Tablelands
- Western Corn Belt Plains
- Western High Plains

Streams



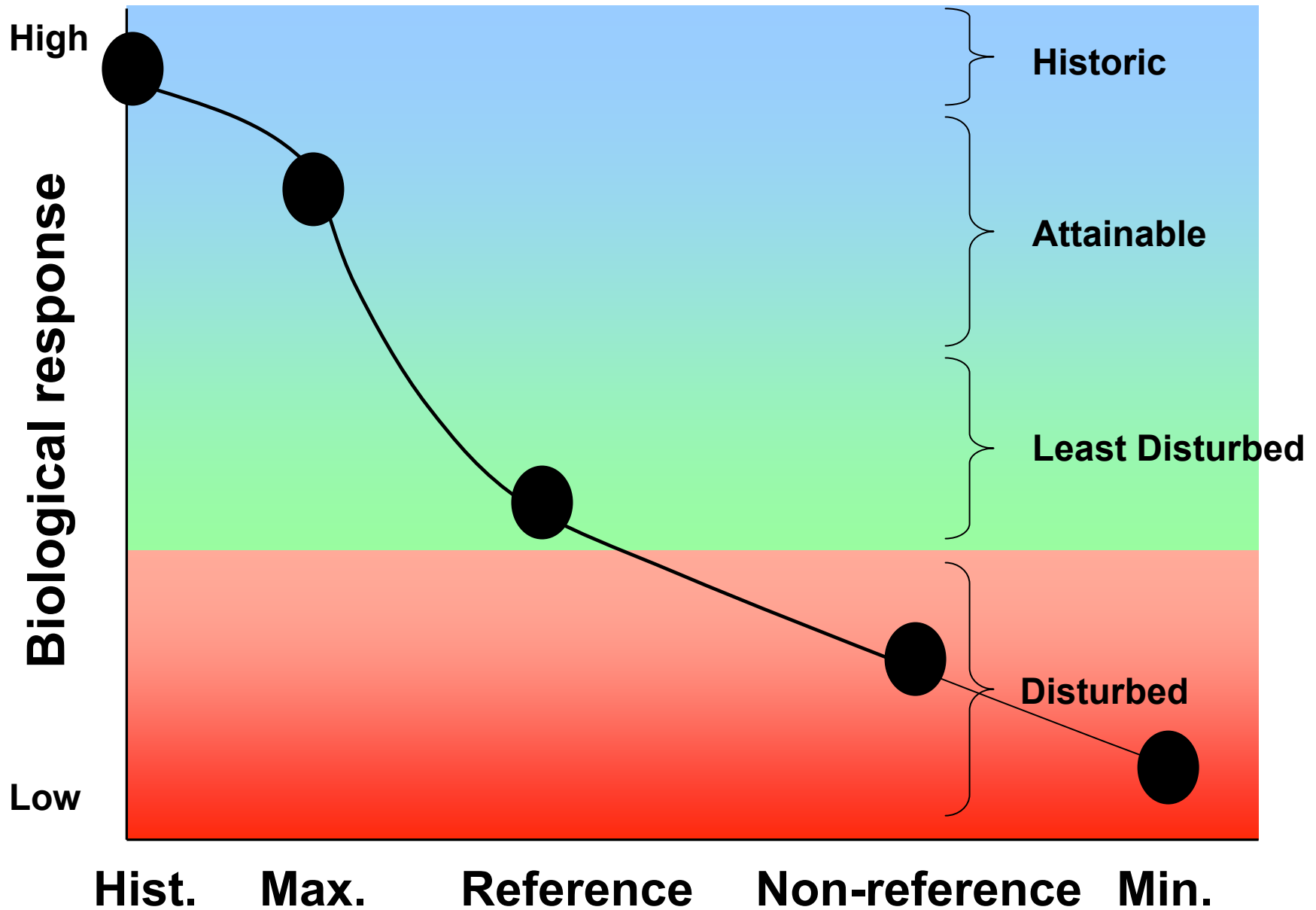
Database

- 18 sources of data
- > 54,000 sampling events
- 2235 sites
- 1965 – 2003
- 14 Level III ecoregions (Omernik 2000)
- Reference condition – best professional judgment

Parameters

- Macroinvertebrate metrics
 - Taxa richness
 - Sensitivity (USEPA RBP, Huggins & Moffet)
 - EPT
 - Ephemeroptera
 - Trichoptera
 - Dominant taxa
- Total Nitrogen
- Total Phosphorus
- Suspended Chlorophyll *a*
- Turbidity

Theoretical disturbance gradient



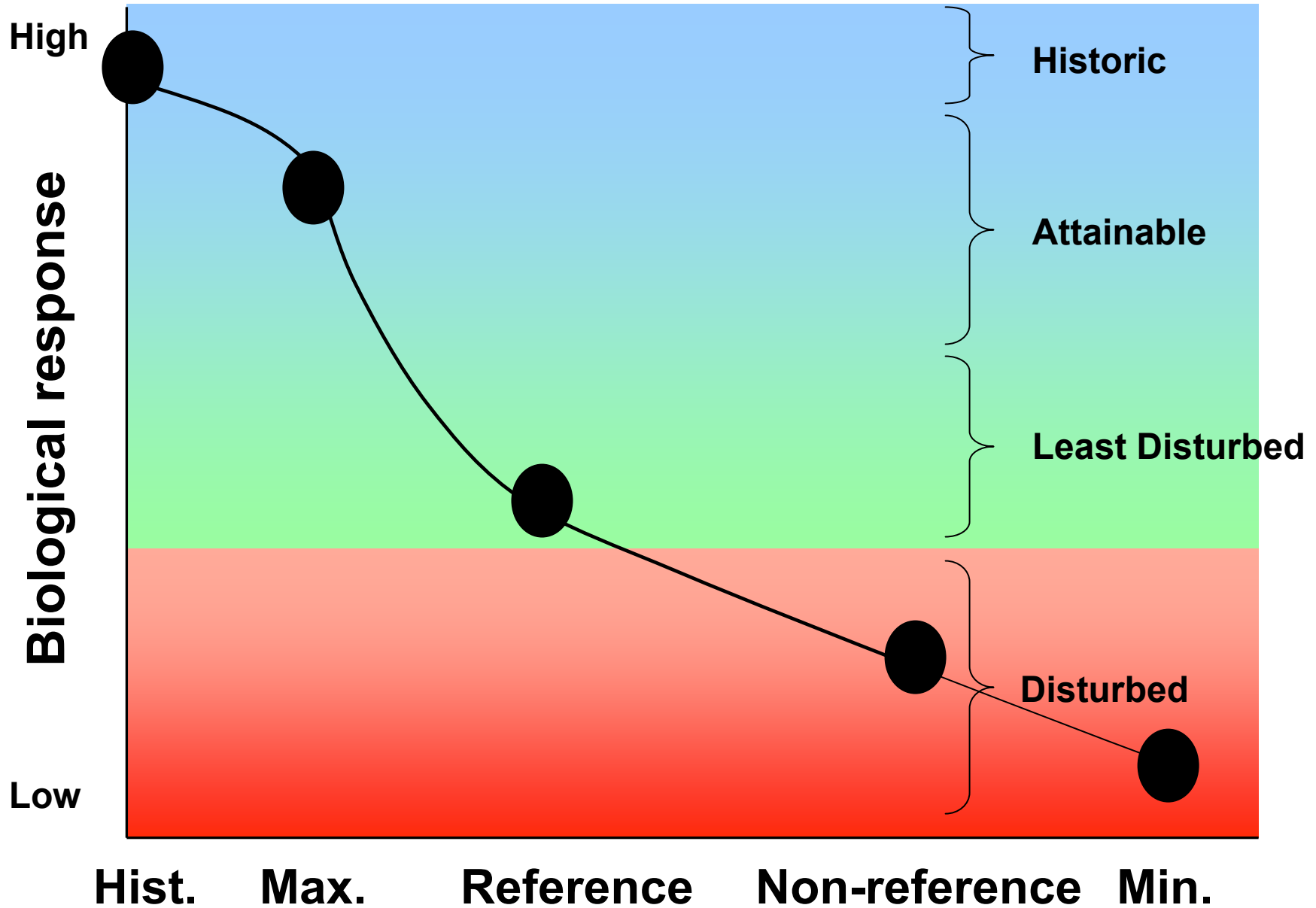
Reference conditions

- Do reference sites vary from nonreference sites?
 - Macroinvertebrate
 - Chemistry
- Two-sample T-test or Mann-Whitney U by ecoregion (6 largest).
- If reference condition does differ, then fit to a gradient.

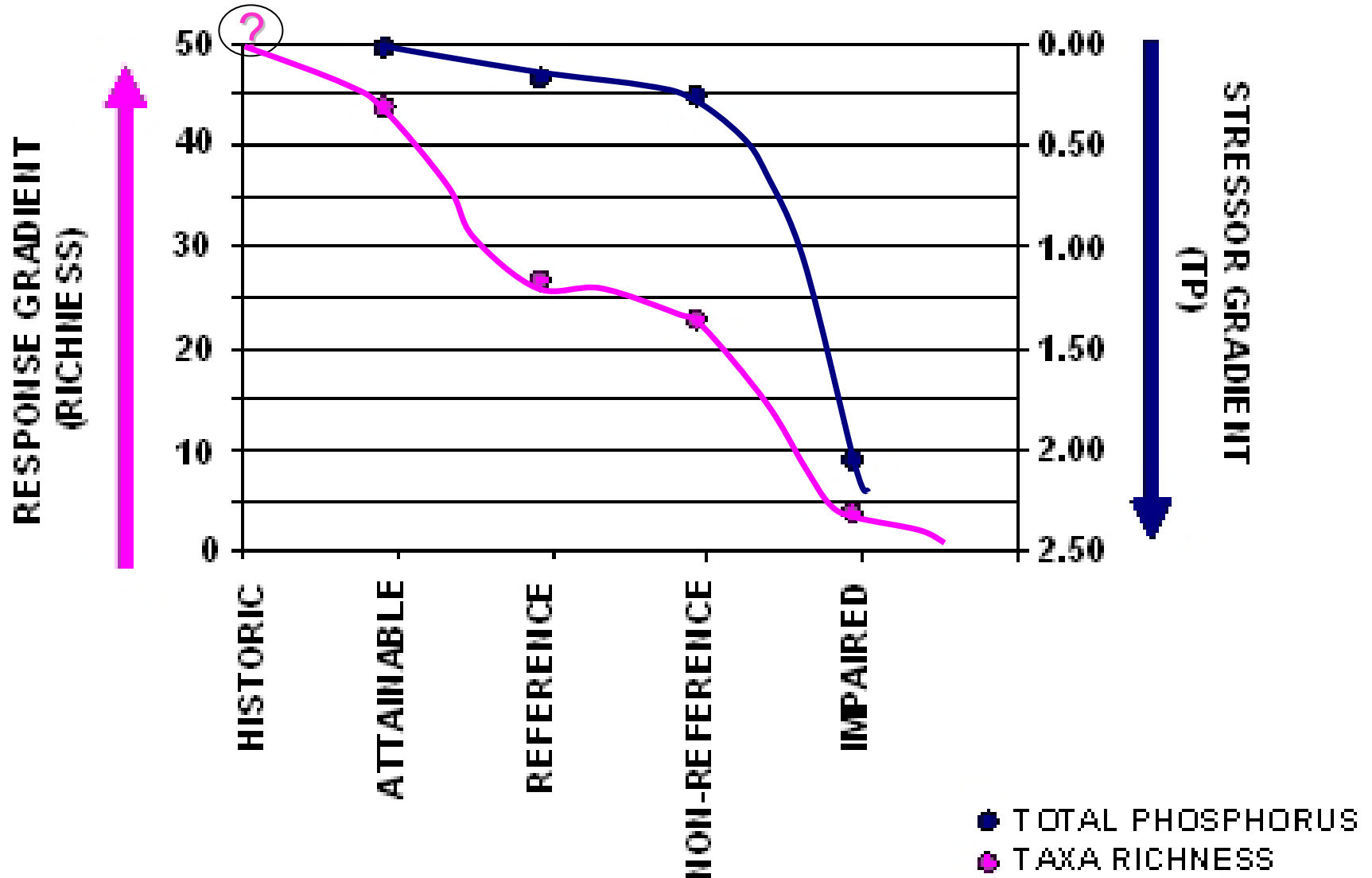
Results: Reference conditions

- Differed from nonreference conditions for
- Western Corn Belt Plains
 - Bug metrics: taxa richness, sensitive, EPT, Ephemeroptera, Trichoptera
 - TP, turbidity
- Flint Hills
 - Bug metrics: taxa richness, sensitive, Trichoptera, dominance
 - TN, TP, suspended Chl*a*

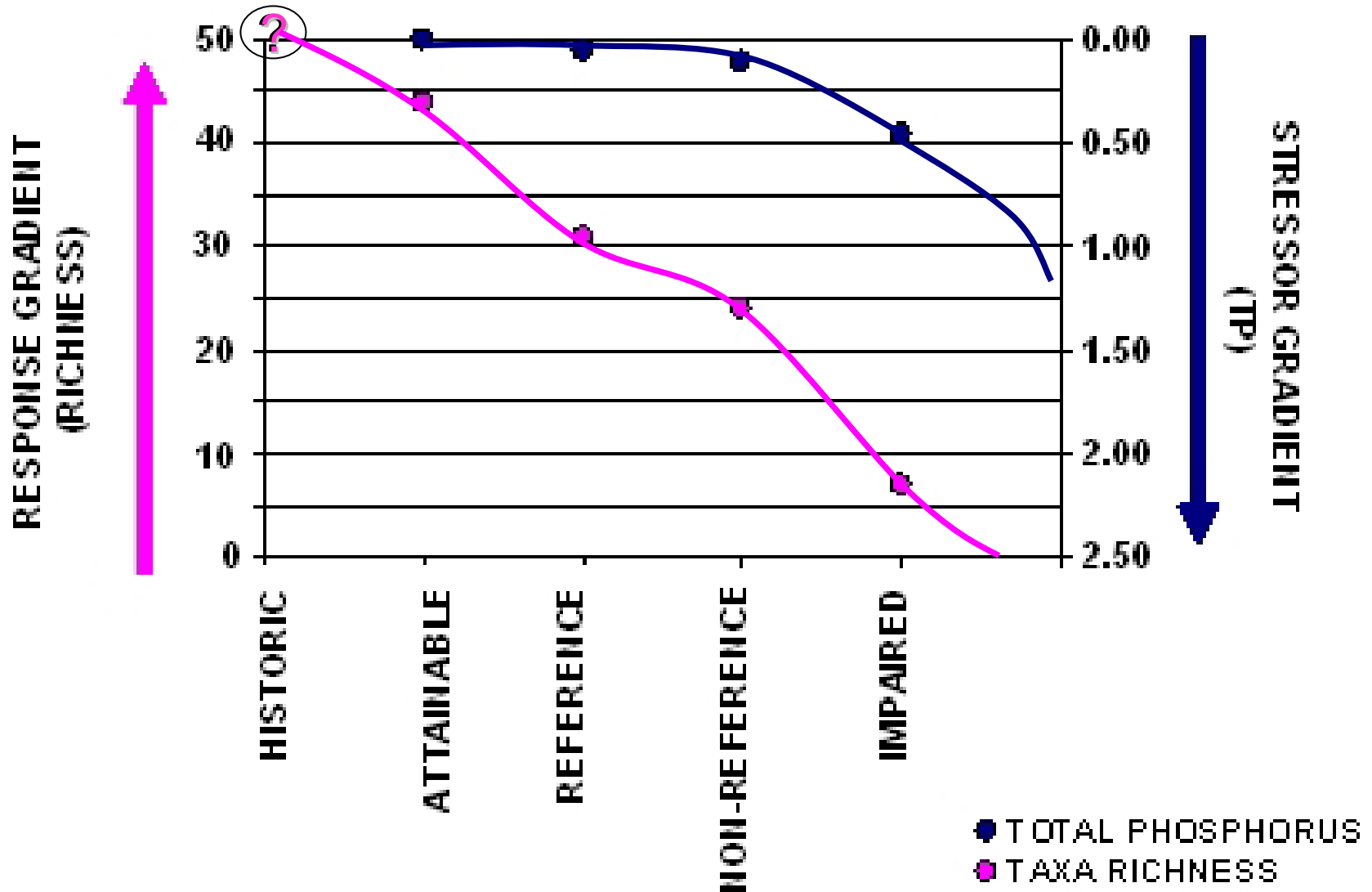
Theoretical disturbance gradient



Disturbance gradient, WCB



Disturbance gradient, FH



Future work

- **Fish metrics**
 - **Examine using same approach.**
- **Historic LU/LC: Kansas State Board of Agriculture Biennial Reports, 1876 – current.**
 - **To better define the large-scale disturbance gradient through time.**
 - **Plot reference watershed condition on this disturbance time scale.**