National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

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

RFC 101

BASIC REFERENCE CONDITION & CLASSIFICATION TECHNIQUES

Course Presenters

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RFC 101

Reference Condition and the Role of Classification: A Series of 3 Courses

Presented by

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Reference Condition and the role of classification

- RFC101 - Basic Reference Condition and Classification Techniques: Introduction, overview, concepts, and some case studies
- RFC201 - Reference Condition Case Studies: Emphasis on selection of reference sites
- RFC202 - Advanced Reference Condition Techniques: Special Circumstances and Problem Solving

RFC101 - Basic Reference Condition and Classification Techniques

- Background, concepts, context within EPA and state/tribal water programs (Larsen, ½ hr)
- Role of classification and modeling (Hawkins, ½ hr)
- Characterizing reference sites as a method to describe reference condition (Larsen, ½ hr)
- Questions/discussion (15 min)
- Break (15 min)
- Case study #1 (Yoder, Ohio, ½ hr – Tues. morning)
  (Courtemanch, Maine, ½ hr – Tues. afternoon)
- Case study #2 (Edmondson, Idaho, ½ hr)
- Case study #3 (Schuldt, Wisconsin, ½ hr)
- Questions/Discussion

RFC201 – Reference Condition Case Studies: Emphasis on selection of reference sites

- Brief Introduction (Larsen, 5 min)
- A coarse screening process for initial selection of reference sites (Lattin, ½ hour)
- Oregon's process for selection of reference sites (Drake, ½ hr)
- Arizona's reference site selection and classification (Spindler, ½ hr)
- Developing multi-state criteria for selecting reference sites (Sarver, ½ hr)
- Break
- A fine scale screening process for selecting reference sites (Lattin, ½ hr)
- Wyoming's reference site selection experience (Zumberge, ½ hr)
- A hierarchical classification for stream reaches (Sowa, ½ hr)
- Discussion

RFC202 – Advanced Reference Condition Techniques: Special Circumstances and Problem Solving

- Brief Introduction (Larsen, 5 min)
- Using historical information to assist characterizing reference condition (McAllister, ½ hr)
- Challenges in urban (MD) and agricultural landscapes (MS) (Barbour, ½ hr)
- Reference condition for reservoirs (TVA) (Hickman, ½ hr)
- Break
- Challenges in agricultural landscapes (SD) (Heakin, ½ hr)
- Challenges in agricultural landscapes (MT) (Suplee, ½ hr)

Context

- Emphasis is on goals and concepts
- Recognition that practical implementation requires compromises
- Framework for evaluating the extent to which compromises are made

What is covered

- Primary goal: How does one describe a reference condition?
- Not covered: How one uses the description of reference condition to:
  - Set narrative or numeric criteria
  - Establish management goals
  - Evaluate a bioassessment
- Go to other courses for topics not covered here

Underlying Question

- How does human activity affect aquatic ecosystems and, in particular, aquatic biota?
- What do we do about our effects on aquatic ecosystems and aquatic biota?

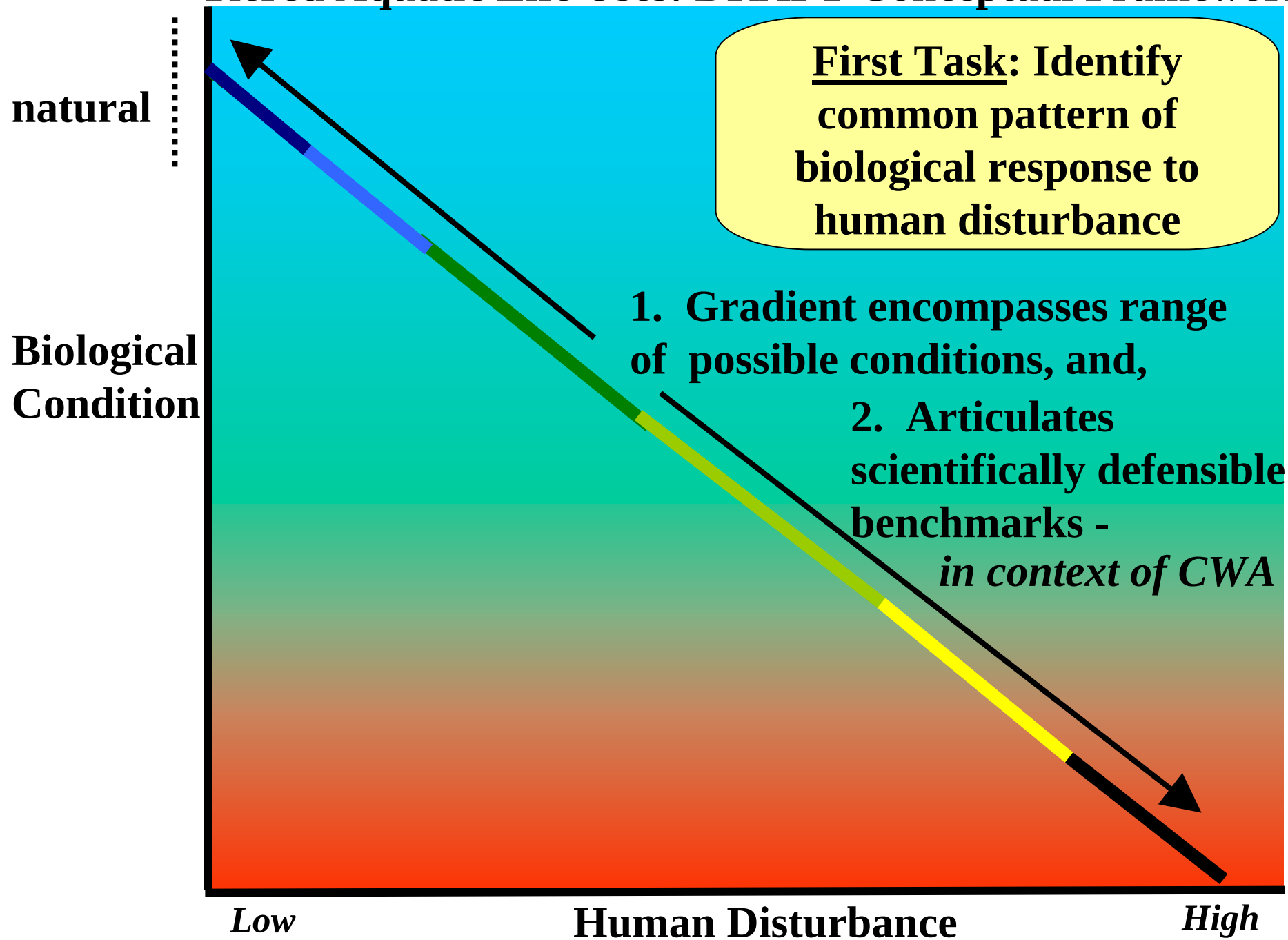
Societal Response: Clean Water Act

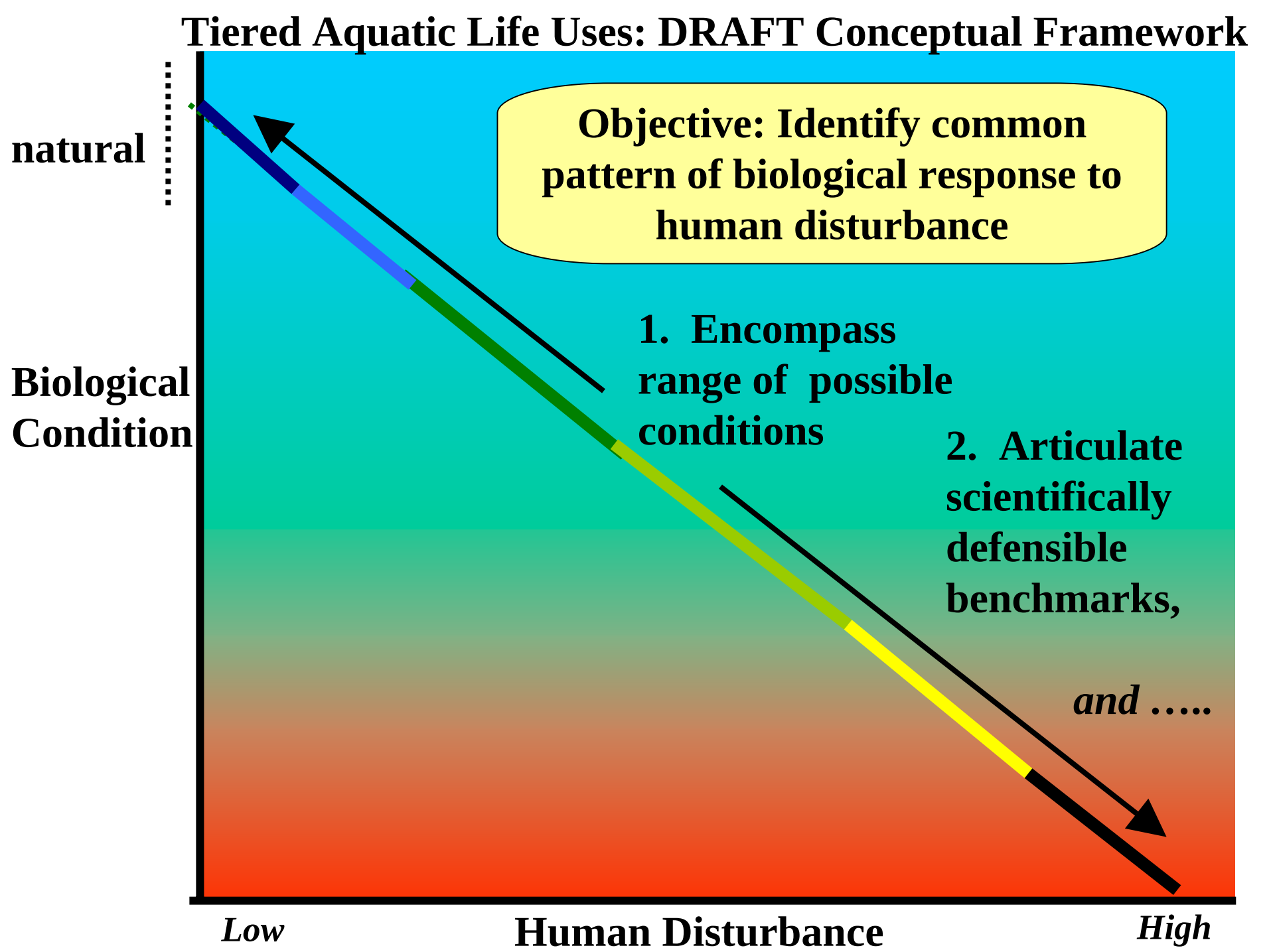
- Physical, chemical, and biological integrity objective
- Fishable/swimmable interim goal (propagation of fish/shellfish/wildlife)
- Water Quality Standards Regulation: Designated Uses; Criteria to judge attainment of uses; antidegradation
- How do we judge where we are with respect to these mandates? Need some kind of benchmark, a reference condition.

Aquatic Life Use Support and The BioCondition Gradient

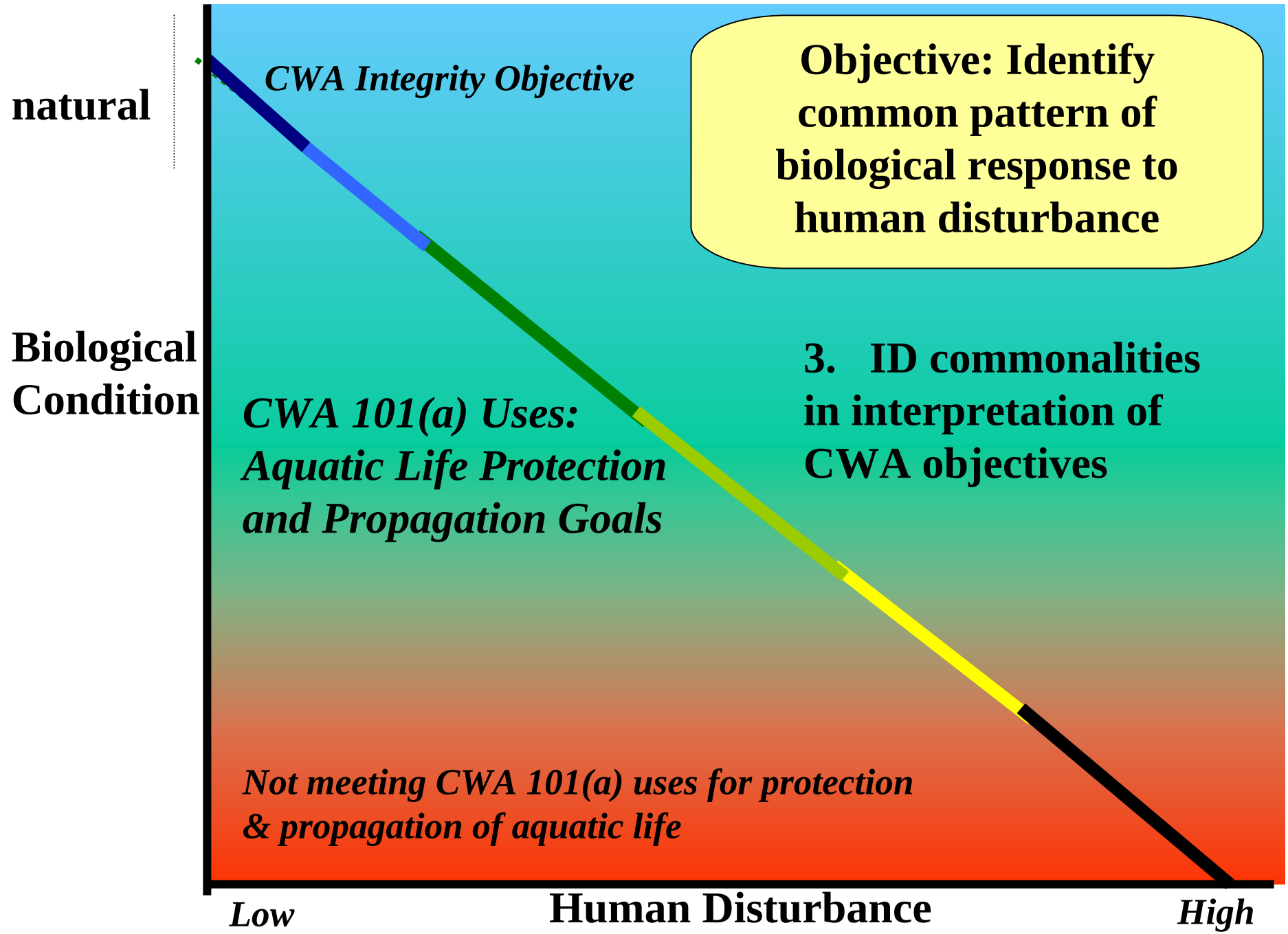
- Define biointegrity as the biological condition under no (or minimal) human disturbance
- Is there a common pattern of biological response as human disturbance increases? (The biocondition gradient)
- How might the interim goal and aquatic life uses be related to the biological condition gradient?
- Reference condition for biointegrity? Reference condition for the interim goal? Reference condition for specific aquatic life uses?

Tiered Aquatic Life Uses: DRAFT Conceptual Framework

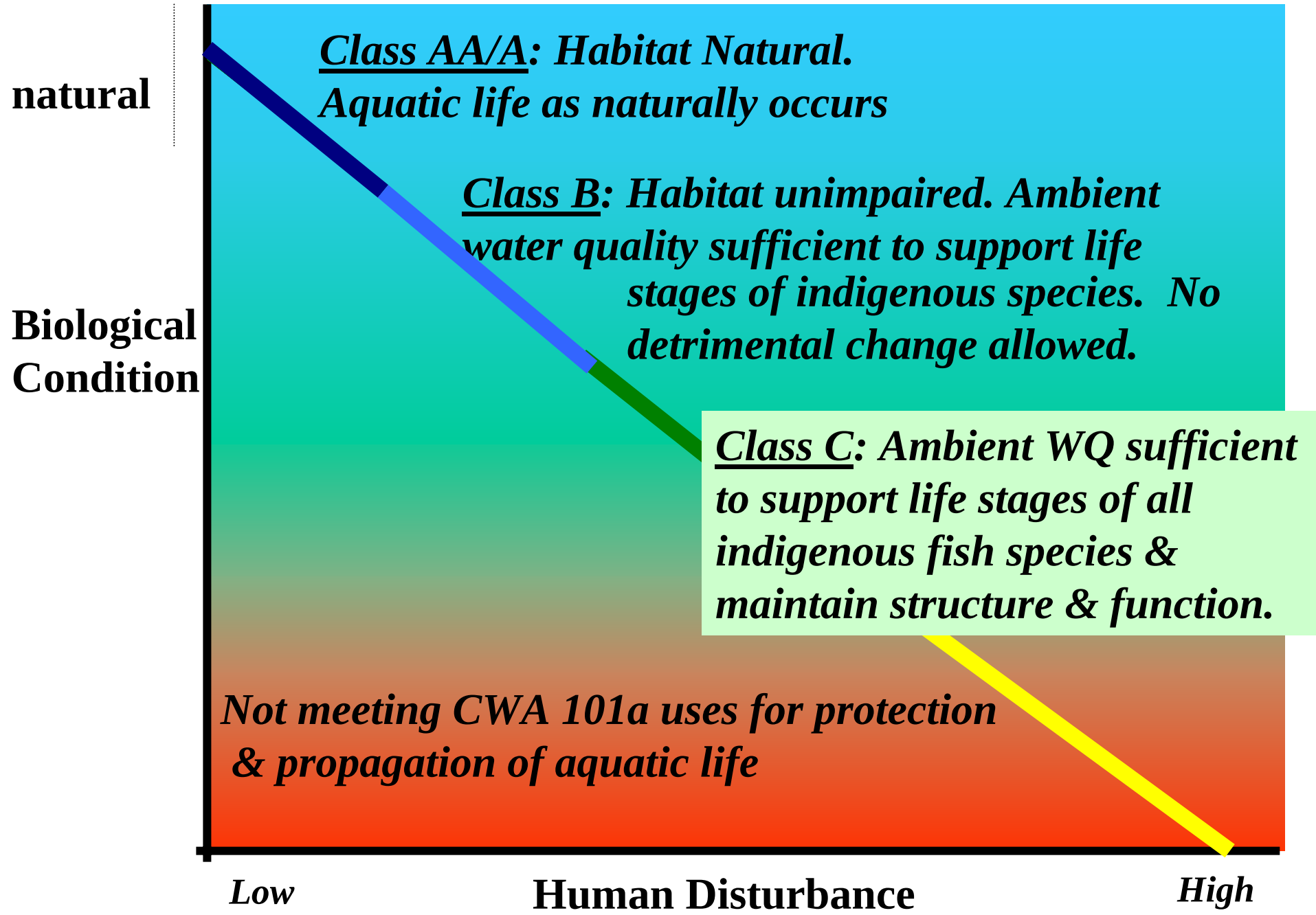



Tiered Aquatic Life Uses: DRAFT Conceptual Framework
natural
Biological Condition
Objective: Identify common pattern of biological response to human disturbance
1. Encompass range of possible conditions
2. Articulate scientifically defensible benchmarks,
and …..
Low
Human Disturbance
High

Tiered Aquatic Life Uses: DRAFT Conceptual Framework



Designated Aquatic Life Uses: Example Maine



Why reference condition?

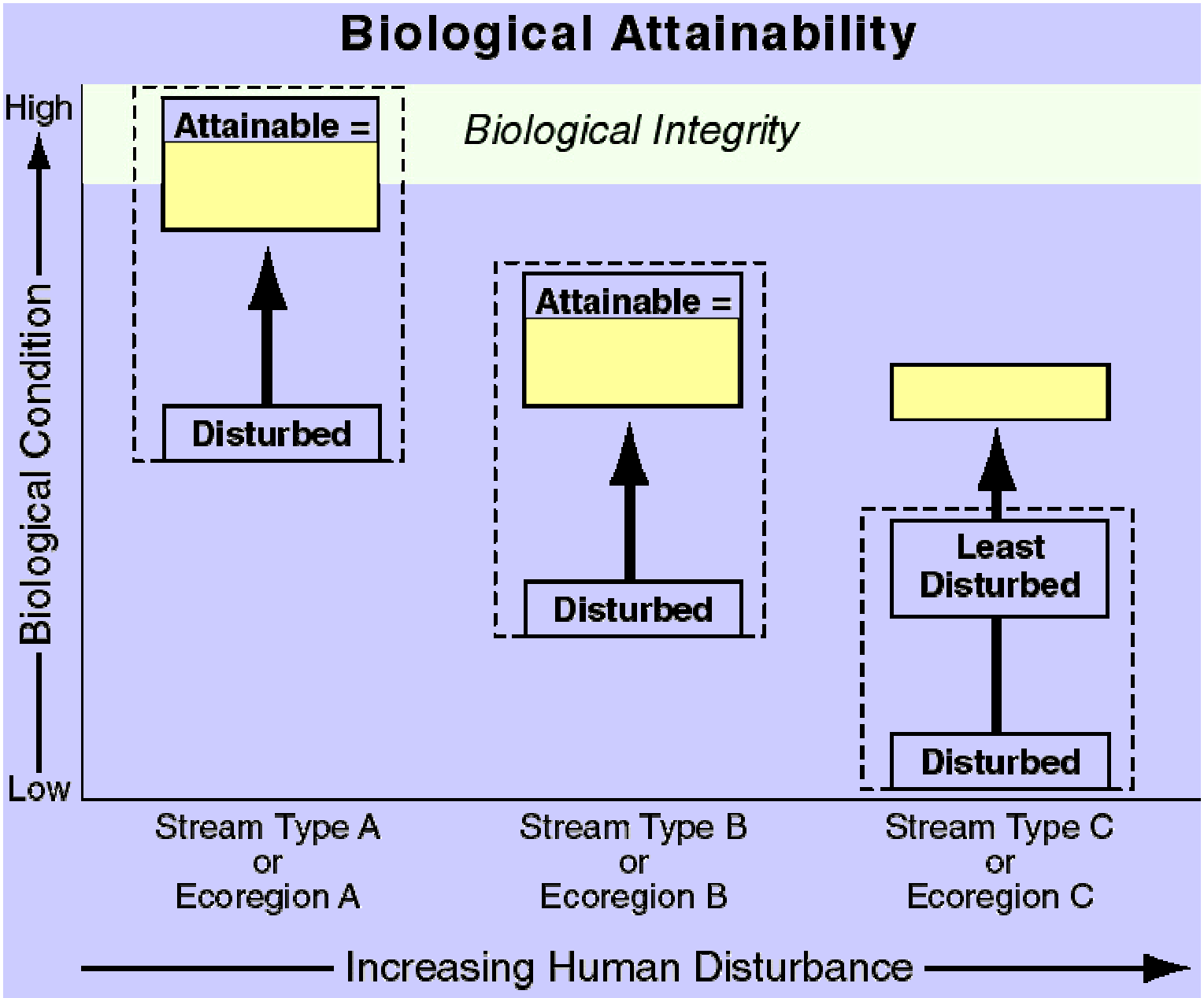
- For TALU: establish framework for defining aquatic life use thresholds (i.e. biological criteria)
- For Watershed Management (BMPs;TMDLs): establish a basis for setting targets for protection, restoration, or management actions
- For Bioassessment: estimate degree of effect from human disturbance: are aquatic life uses met?
- For sample surveys: set criteria to judge extent of use attainment

Operational Definitions of Reference Condition

- Minimally Disturbed Condition-condition in the absence of significant human disturbance (e.g., “natural”, “pristine”, or “undisturbed”)
- Least Disturbed Condition-found in conjunction with the best available physical, chemical, and biological habitat given today’s state of the landscape
- Best Attainable Condition-this condition is equivalent to the ecological condition of (hypothetical) least disturbed sites where the best possible management practices are in use

Reference Condition vs. Reference Sites

- Characterizing reference sites is one method of describing a reference condition
- As will be discussed, reference site description is not the only method


Biological Attainability
High
Biological Condition
Low
Attainable =
Biological Integrity
Disturbed
Attainable =
Disturbed
Least
Disturbed
Disturbed
Stream Type A
or
Ecoregion A
Stream Type B
or
Ecoregion B
Stream Type C
or
Ecoregion C
Increasing Human Disturbance

Distinguishing minimally and least disturbed

- Minimally Disturbed: An absolute. Some regions might have no sites that meet minimal disturbance criteria.
- Least Disturbed: Relative. No matter how disturbed the region, some sites are likely less disturbed than others.
- Could use a “proportion of the resource” criterion for least disturbed: The 5% of the resource that is least disturbed; the 1% of the resource that is least disturbed

Linking Reference Condition to BioCondition Gradient

- Minimally disturbed ➔ Biological Integrity
- Least disturbed ➔ specific aquatic life uses
- Attainable goal ➔ might be better than least disturbed

Characterizing Reference Condition

- Minimally disturbed sites >> Biointegrity
- Least disturbed sites>> Least disturbed condition
- Historical reconstruction from times with minimal stress
  - Early journals/surveys, land survey records, old photos,…
  - Paleo-reconstruction
- Best ecological judgment (including models)
  - Use knowledge gained from regions with minimal disturbance
- Restoration experiments
- Infer from data distributions
  - Y-intercept from “dose-response” curves
  - Shape of “dose-response curves

What do we mean by "Characterizing Reference Condition"

- Translating concepts to numbers
  - Assemblage composition and structure
  - Frequency distribution of indicator scores
  - Reference condition is not a single number, although we might extract a single number from a distribution as a biological criterion.

Is reference condition representative?

- Mimic natural gradients of the region of interest….

Some examples…..

- Translating concepts to numbers
  - Assemblage composition and structure
  - Frequency distribution of indicator scores
  - Reference condition is not a single number, although we might extract a single number from a distribution as a biological criterion.

Second order stream in a minimally disturbed, forested watershed

Maine DEP

ME Example BCG Tier 1

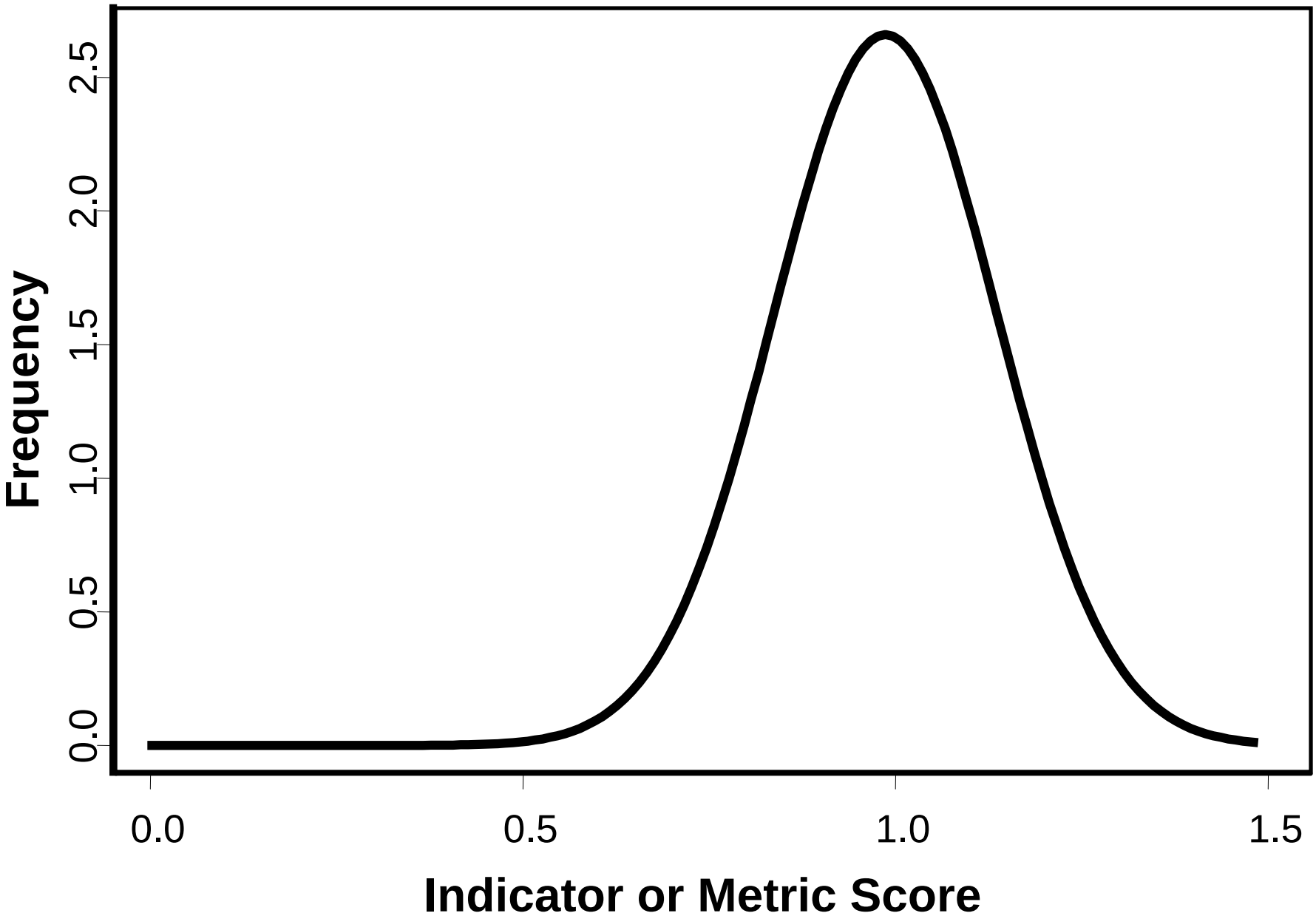
Intact watershed

- **Generic Richness**
  - Total = 51
  - EPT = 25 (49%)
  - Mayfly = 8
  - Stonefly = 6
  - Caddisfly = 11
  - Midges = 10
  - **Abundance**
  - Total = 312
  - Mayfly = 157
  - Stonefly = 57

- **II - Sensitive- rare, specialist**
  - Taeniopteryx 48
  - Epeorus 13
  - Hexatoma 8
  - Probezzia 8
  - Isoperla 7
  - Pteronarcys 1
  - Capniidae 1
  - Chloroperlidae 1
  - Glossosoma 1
  - Brachycentrus 1
- **III - Sensitive - ubiquitous, generalist**
  - Ephemerella 127
  - Acentrella 13
  - Stenonema 8
- **IV - Intermediate tolerance, opportunistic**
  - Hydropsyche 24
  - Cheumatopsyche 5
- **V - Tolerant Taxa**
  - Polypedilum 8

Maine DEP-Log 249

Frequency distributions describe a reference condition



Reference Variability: Classification and Modeling

- All streams are the same……each stream is unique
- Goal: Site specific prediction
- Natural variability produces a range or distribution of reference condition scores
- We account for natural variability through classification and modeling (Ecoregion, size, elevation, gradient…, e.g., RC = f(classification/model + residual))

Goal: site specific prediction

- Prediction = f(classification/model + residual)
  - Account for site-to-site natural variability
- Classification/model based on natural features
- Goal: Model such that residual from prediction = within-site variability

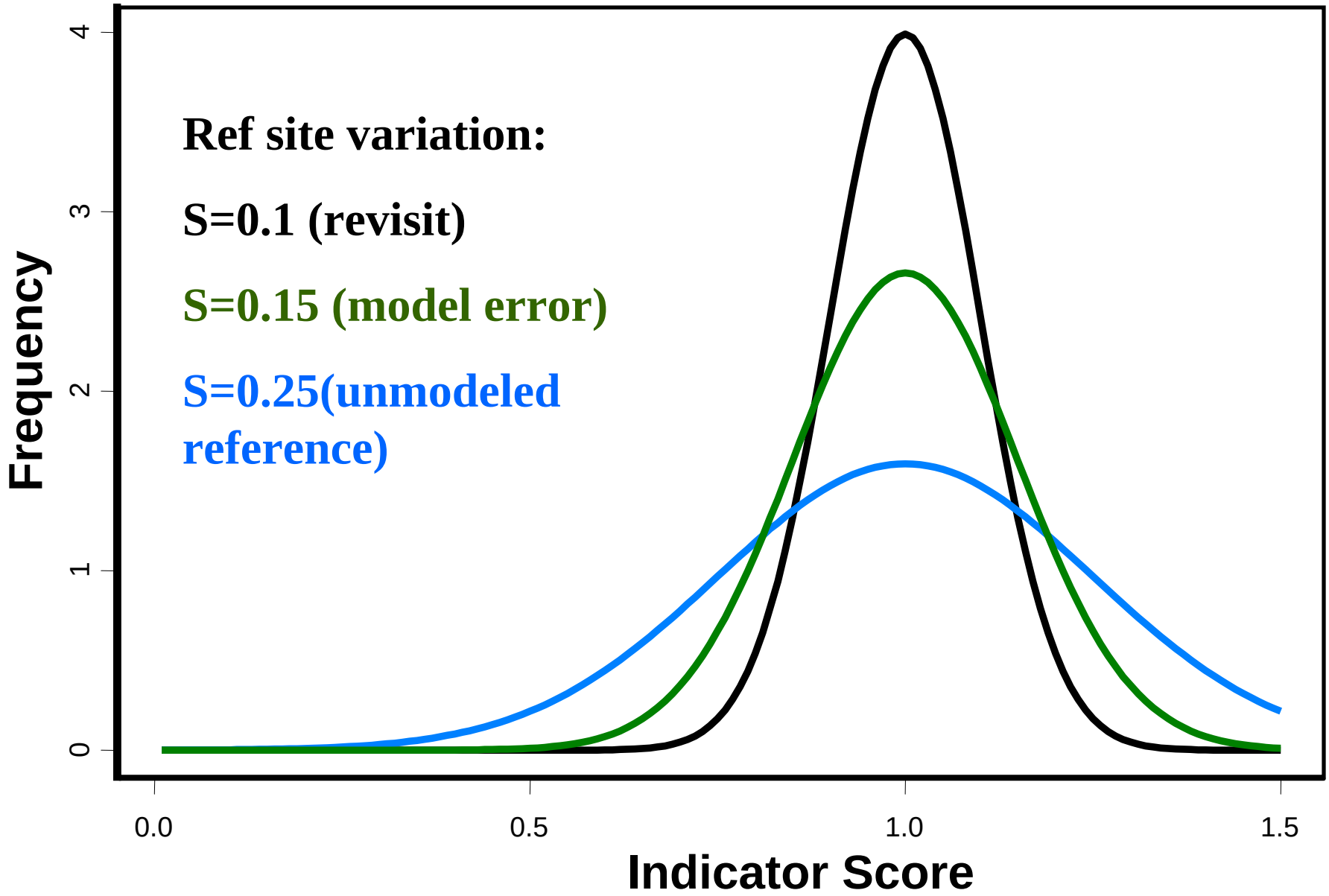
Regional vs. site specific

- Set of regional reference sites: likely highly variable
- Classification/model based on natural features helps account for natural variability
- Site specific: take into account regional uniqueness as well as site scale factors: if successful, greater precision…

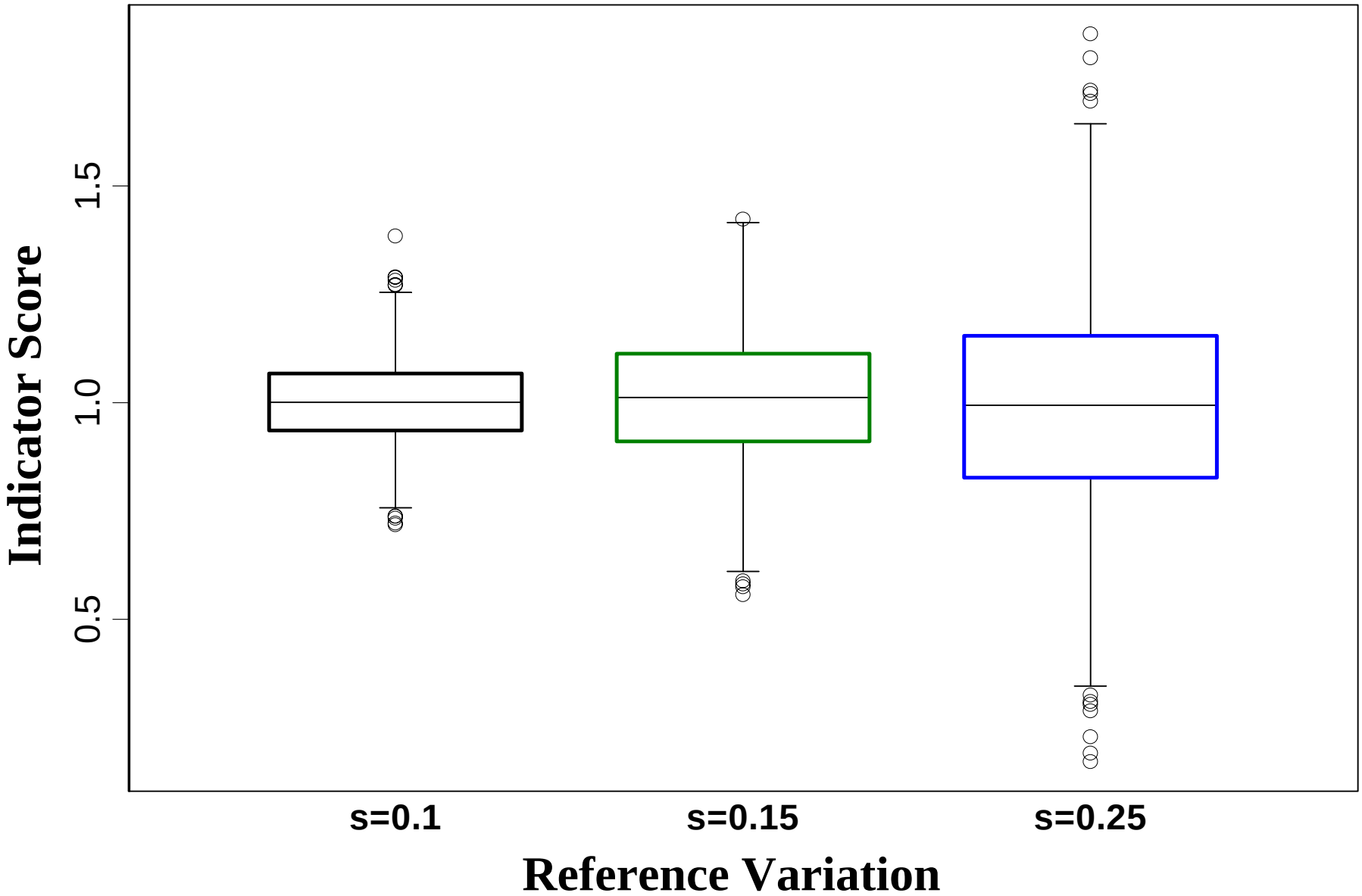
Measuring predictive progress

- Estimate site scale variation by revisits to sites across time and by different crews.
  - Sets target
- Estimate among site variation by including multiple sites in survey.
- Model among site variation and estimate prediction error.
- Compare prediction error with site scale variation.
  - Ambitious goal reached when equal, or nearly so.

Evaluation of models and classification: a framework



Evaluation of models and classification: a framework



Summary

- Overview and context for reference condition
  - What do we mean?
  - Why do we do it?
- Operational definitions of reference condition
- How do we characterize or describe a reference condition?
- A framework for evaluating classification and modeling