

# Developing numeric biological thresholds using reference site information: Role for BCG

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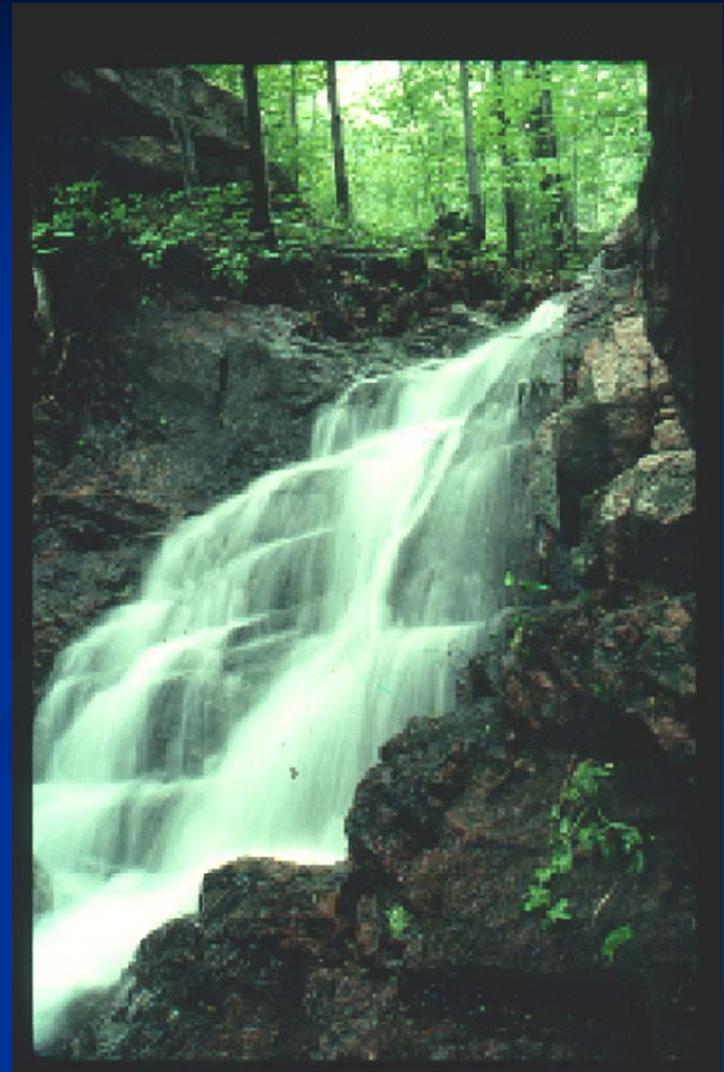
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# CWA Section 101 Objective

To Restore & Maintain  
the Chemical, Physical,  
& Biological Integrity  
of the Nation's  
Waters



# Biological Integrity

The ability of an aquatic ecosystem to support and maintain a balanced adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region

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The ability of an aquatic ecosystem to support and maintain a balanced adaptive community of organisms having a species composition, diversity, and functional organization **comparable to that of natural habitats within a region**

**CLASSIFICATION**



# Biological Integrity

## QUANTITATIVE MEASURES

The ability of an aquatic ecosystem to support and maintain a balanced adaptive community of organisms having a **species composition, diversity, and functional organization** comparable to that of natural habitats within a region

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REFERENCE

CLASSIFICATION

## Developing Reference Condition Using Reference Sites

ALL SITES

Applying Initial Screening Criteria  
Important consideration: Coarseness of filter

CANDIDATE REFERENCE SITES

Evaluating Quality and Representativeness  
Important consideration: Readjustment of filter's coarseness

REFERENCE SITES  
for Reference Condition

Applying Final Screening Criteria  
Important consideration: Coarseness of filter; Reference site variability

REFERENCE CONDITION  
for Biocriteria

# Reference Site Approach

Primary Task: Developing a representative sample of range of natural conditions (no or minimal anthropogenic disturbance) within the study area and establish reference site criteria that approximate natural condition.

Challenge: anthropogenic disturbance widespread across landscape

# Reference Site Approach

## Issues to address:

Defining reference site quality

Selection of biological threshold  
protective of aquatic life

# Technical Guidance on Variability in Reference Site Population

Biological observations at reference sites are subject to three sources of variability:

Within site variability

Natural variability

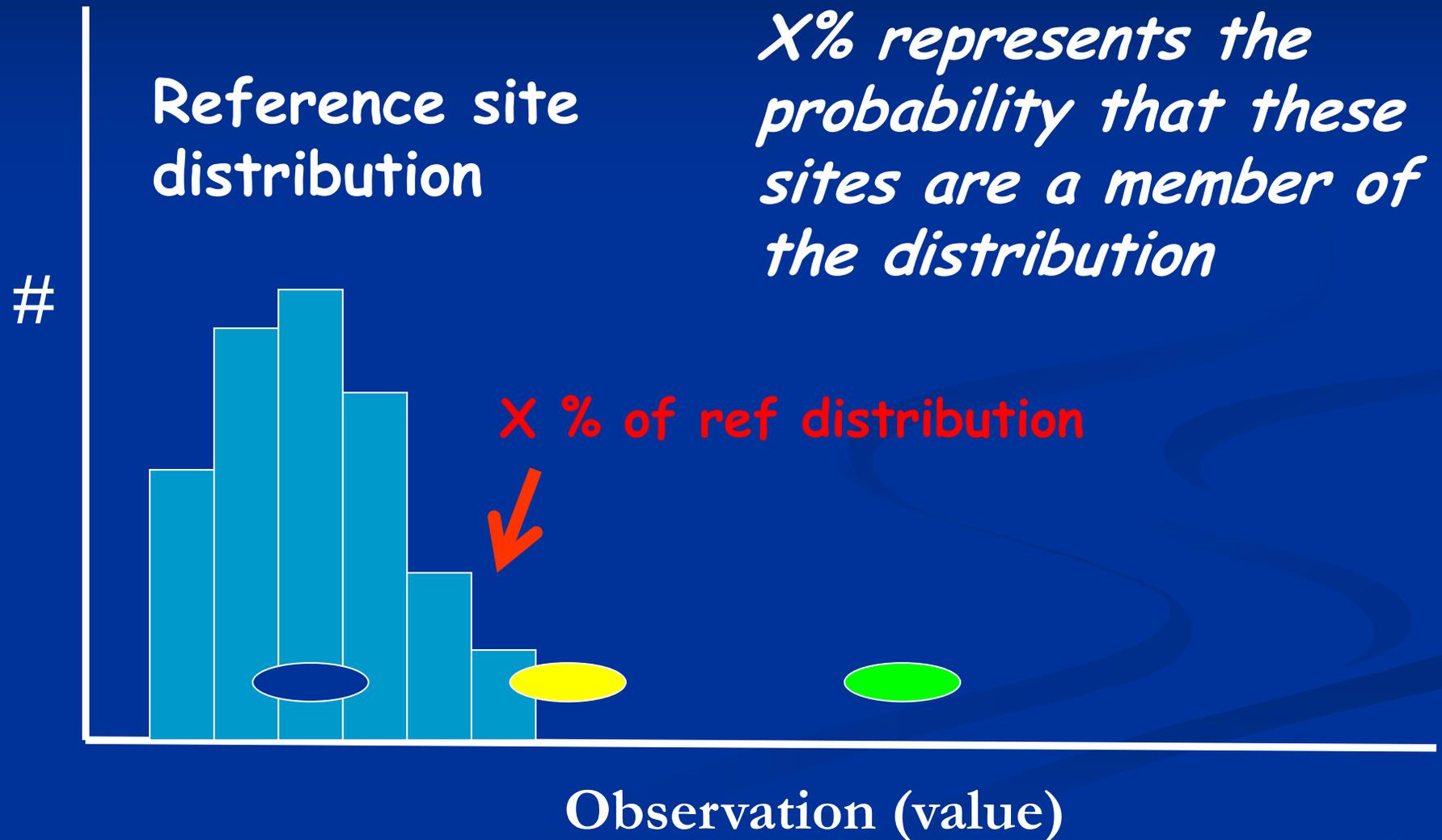
Anthropogenic disturbance

# Within Site Variability

Variations in biological observations observed across different samples at same reference site

If variability in reference site values was only due to sampling variability, a reasonable threshold to select would be a percentile of observed values at low end of distribution

# Within Site Variability



# Natural Variability

Variations in biological observations across different reference sites due to changes in the natural template (e.g. stream, size, climate)

After controlling for natural variation, a reasonable threshold to select would still be a relatively low percentile of observed values.

# The Biological Condition Gradient: Biological Response to Increasing Levels of Stress

## Levels of Biological Condition

Natural structural, functional, and taxonomic integrity is preserved.

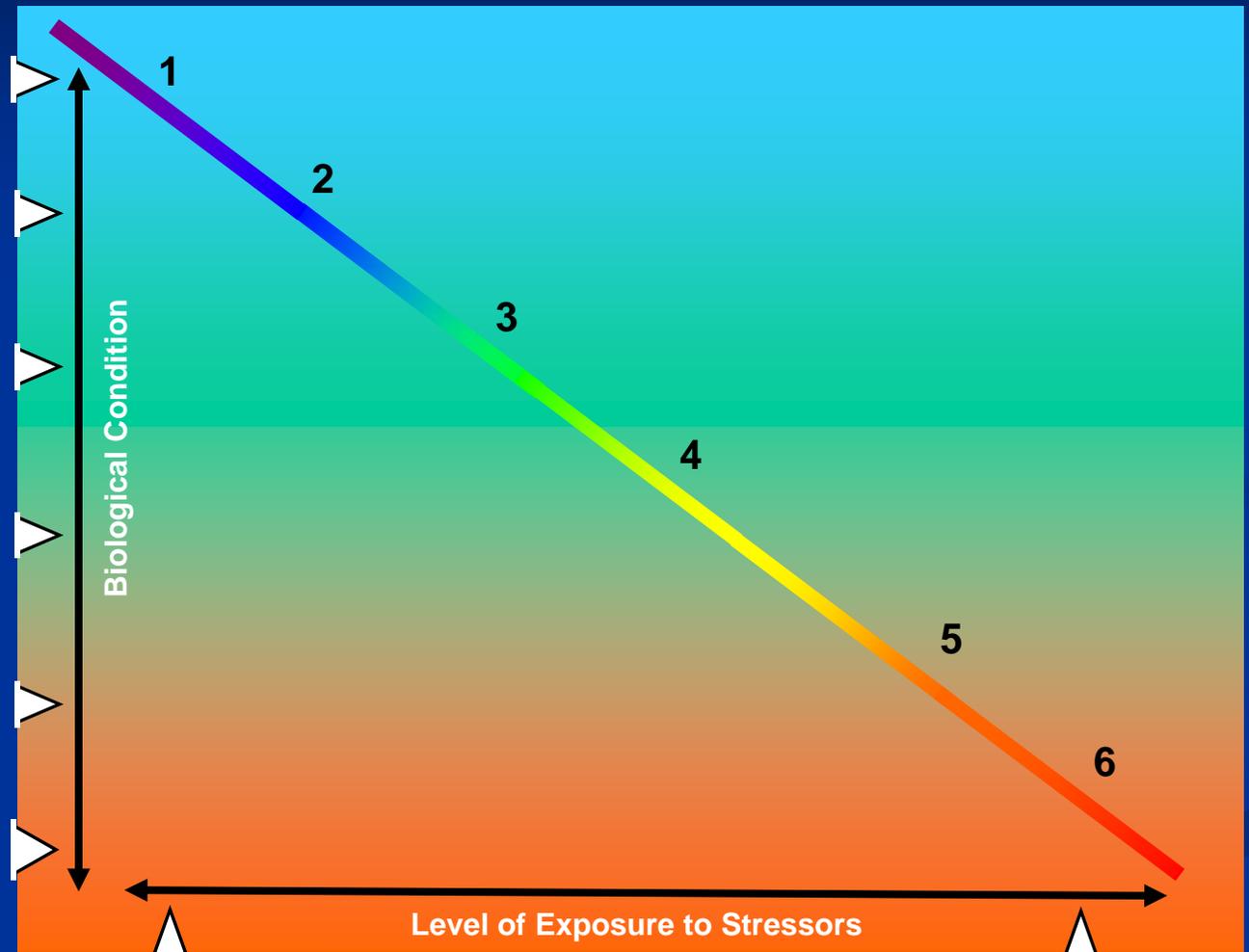
Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained.

Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained.

Moderate changes in structure due to replacement of some sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained.

Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy.

Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities.



Watershed, habitat, flow regime and water chemistry as naturally occurs.

Chemistry, habitat, and/or flow regime severely altered from natural conditions.

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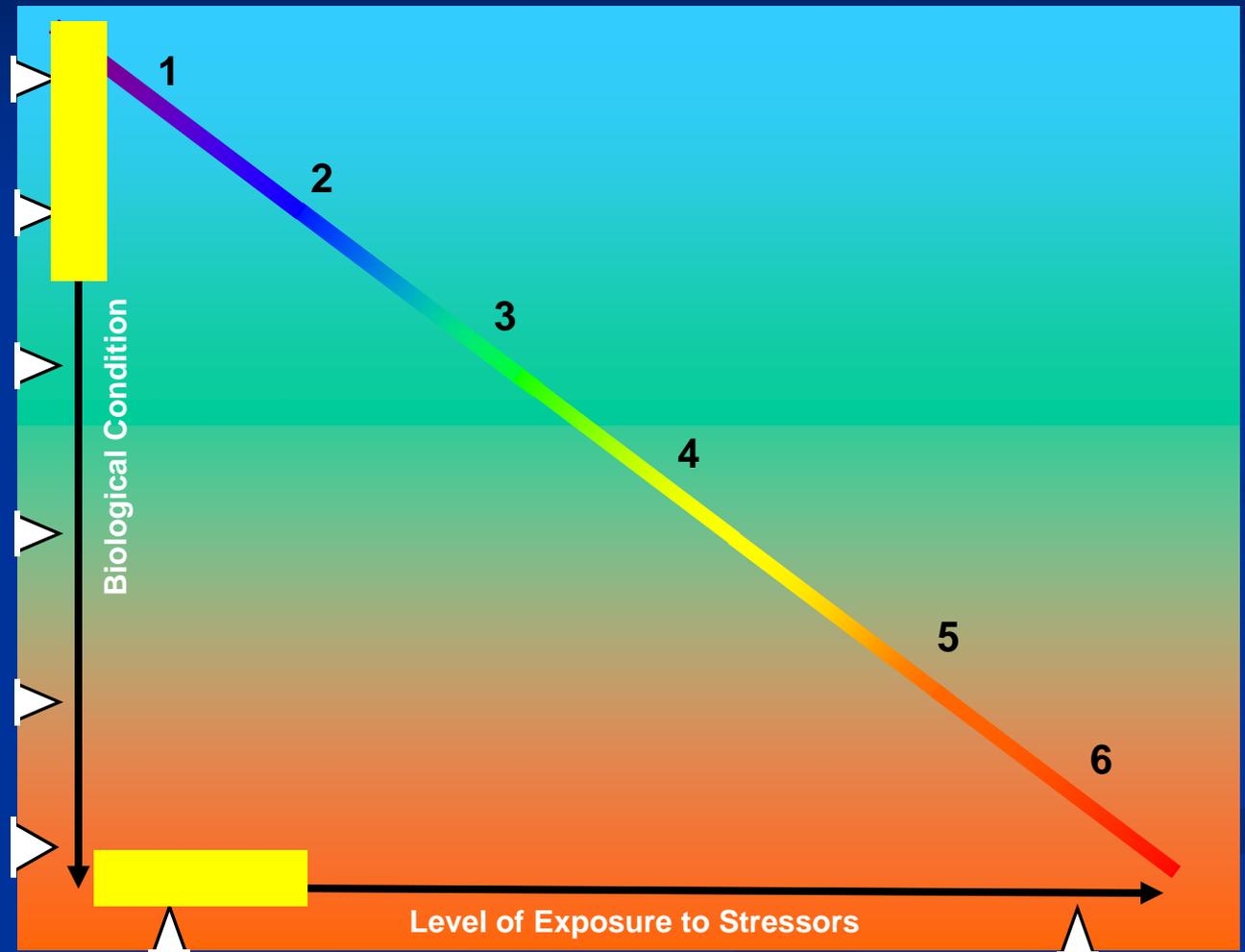
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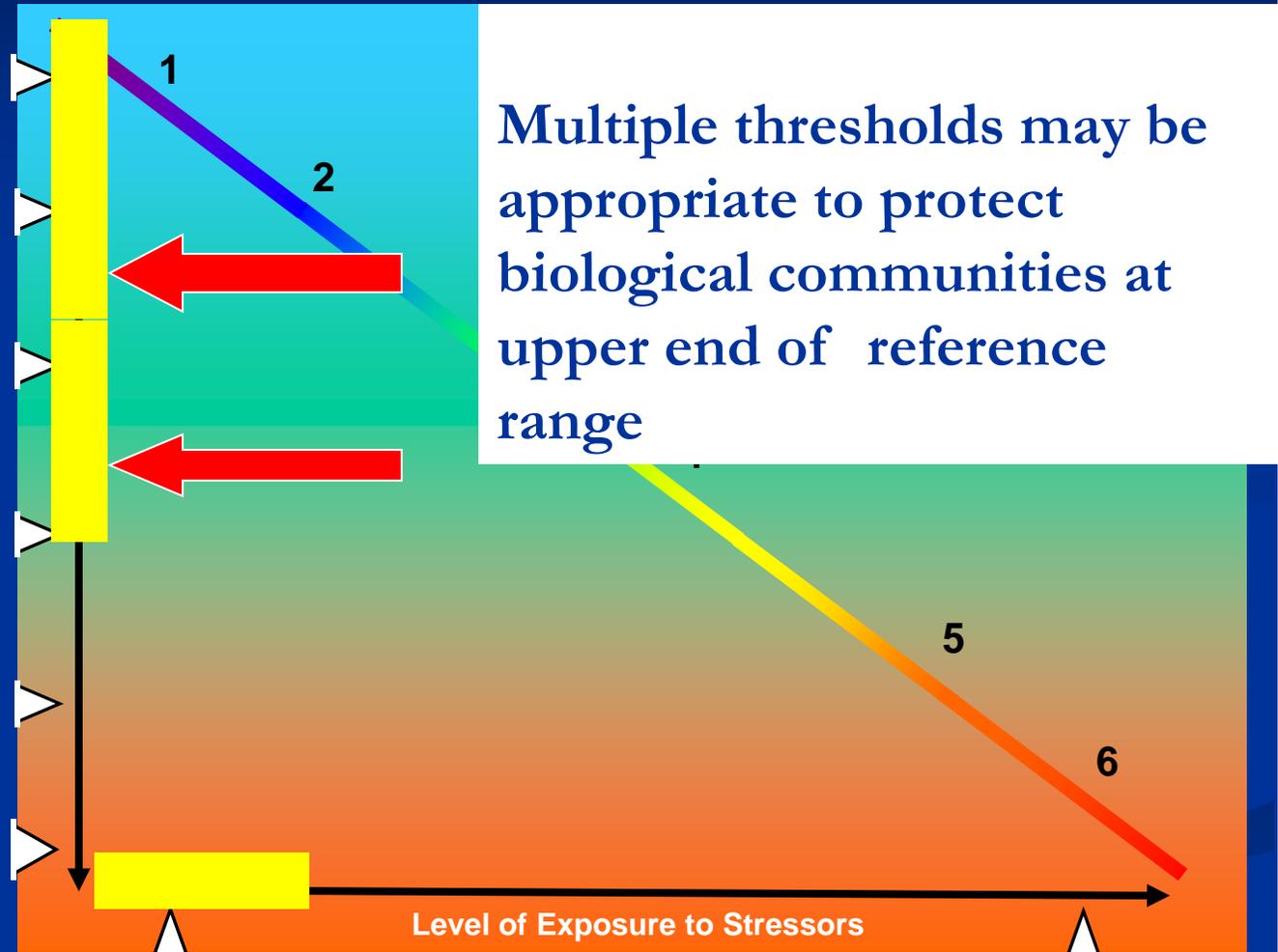
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Multiple thresholds may be appropriate to protect biological communities at upper end of reference range

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# Natural Variability

Issue: There is a wide range of biological values within the reference site distribution and further work may be needed to parse out classification

Multiple thresholds within the reference site database may be appropriate

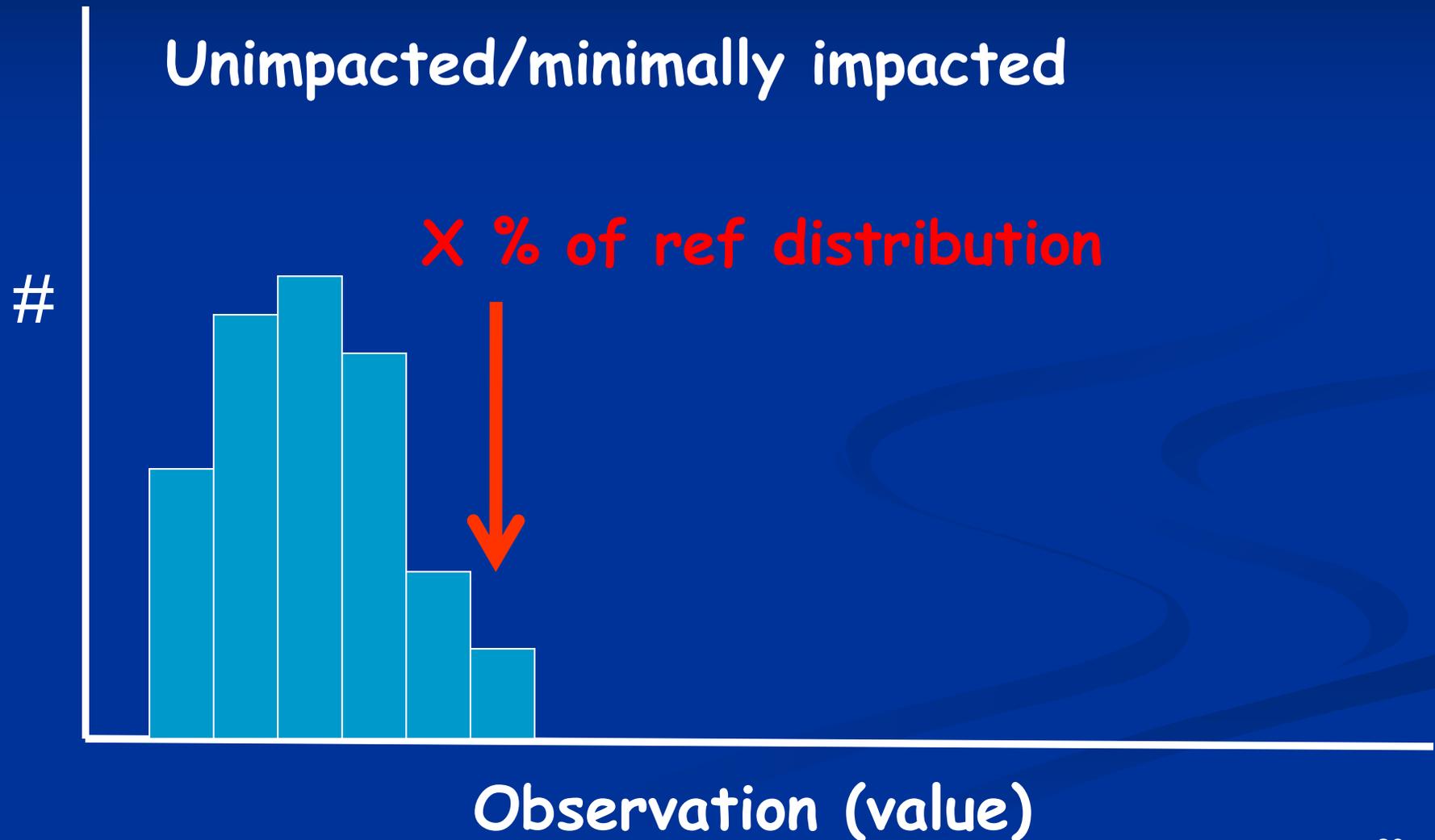
Problem solve: work through scenarios with data sets

# Anthropogenic Disturbance

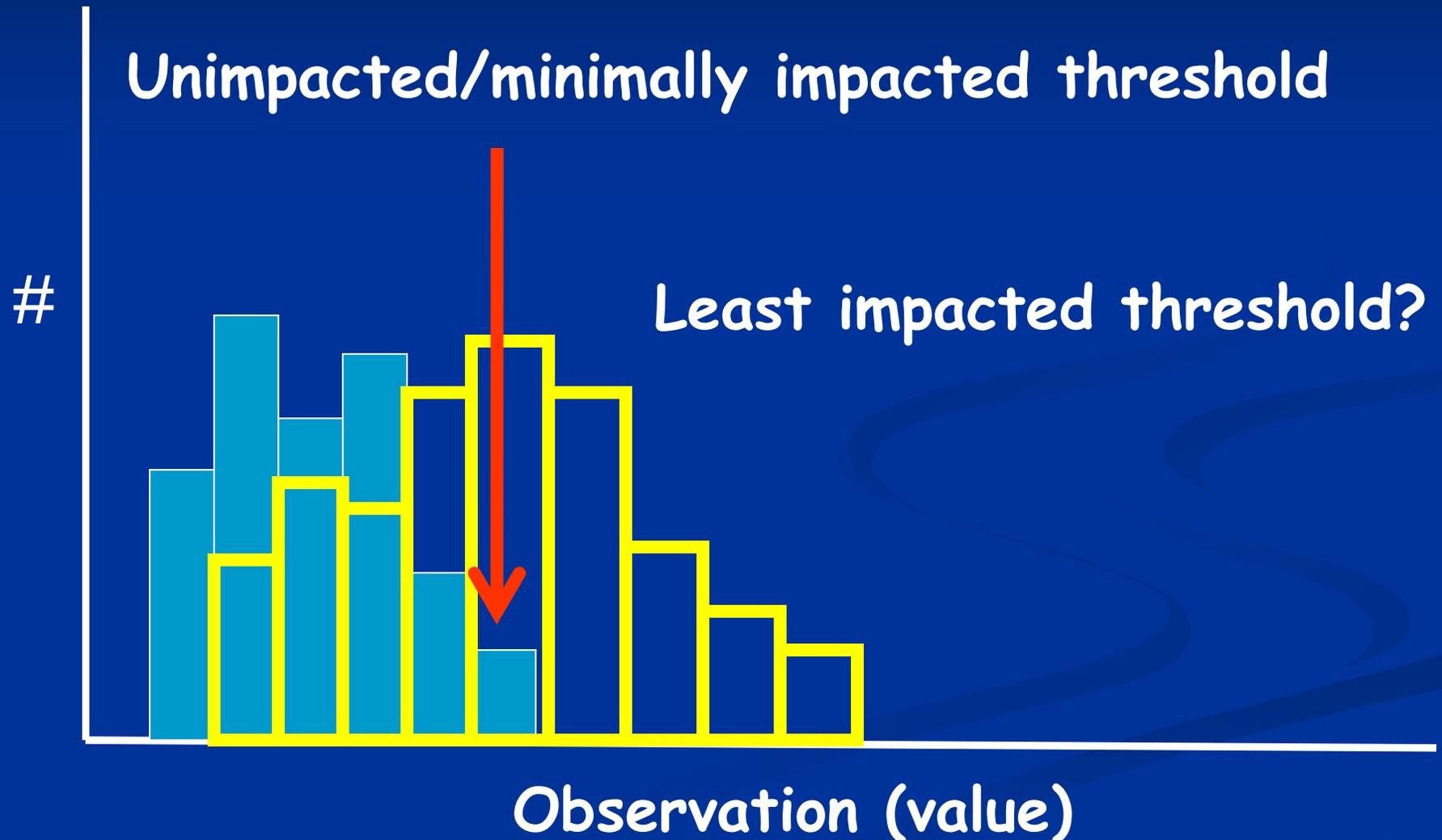
Influences the degree to which reference sites approximate natural conditions

Reference sites that are disturbed by human activities may require a higher percentile

# Anthropogenic Variability



# Anthropogenic Variability



# The Biological Condition Gradient

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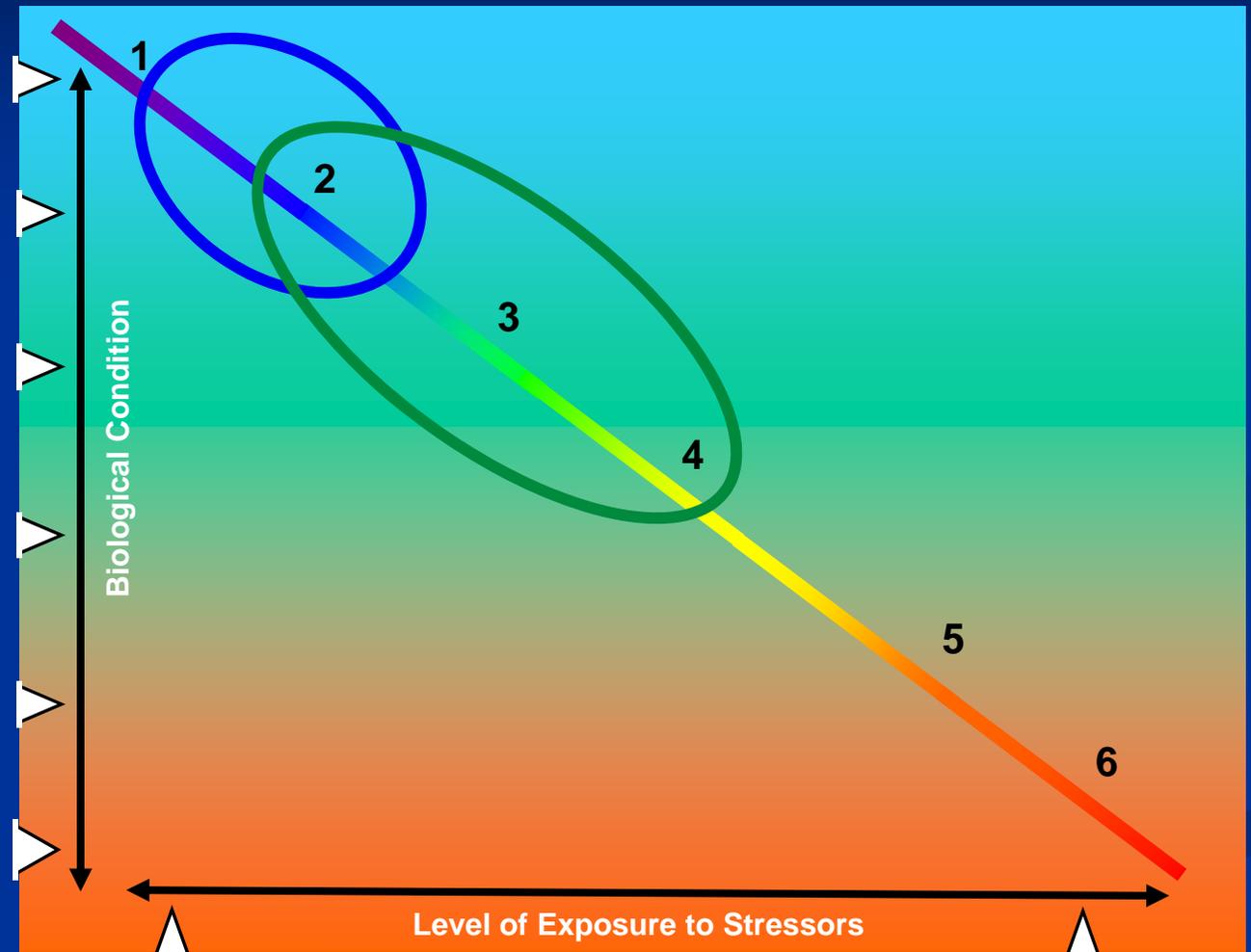
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# Anthropogenic Disturbance

Issue #1: Measurements of human disturbance (especially in reference sites) are not generally available or well defined.

Issue #2: Human disturbance and natural templates are often correlated. Difficult to discriminate between variability due to natural vs human disturbance.

# Status of Effort

Work in progress: example reference data sets will be used to work through different scenarios

Objective: clarify and update technical guidance