

National Biological Assessment
and Criteria Workshop

Advancing State and Tribal Programs



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

TALU 101

The Biological Condition Gradient

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What are we talking about today?

DATA

OBSERVATION &
MEASUREMENT



Methods-driven



Yields data

INTERPRETATION

**MAKING MEANING -
MAKING
ECOLOGICAL SENSE**



**Information, knowledge
and experience-driven**



Yields pattern recognition

APPLICATION

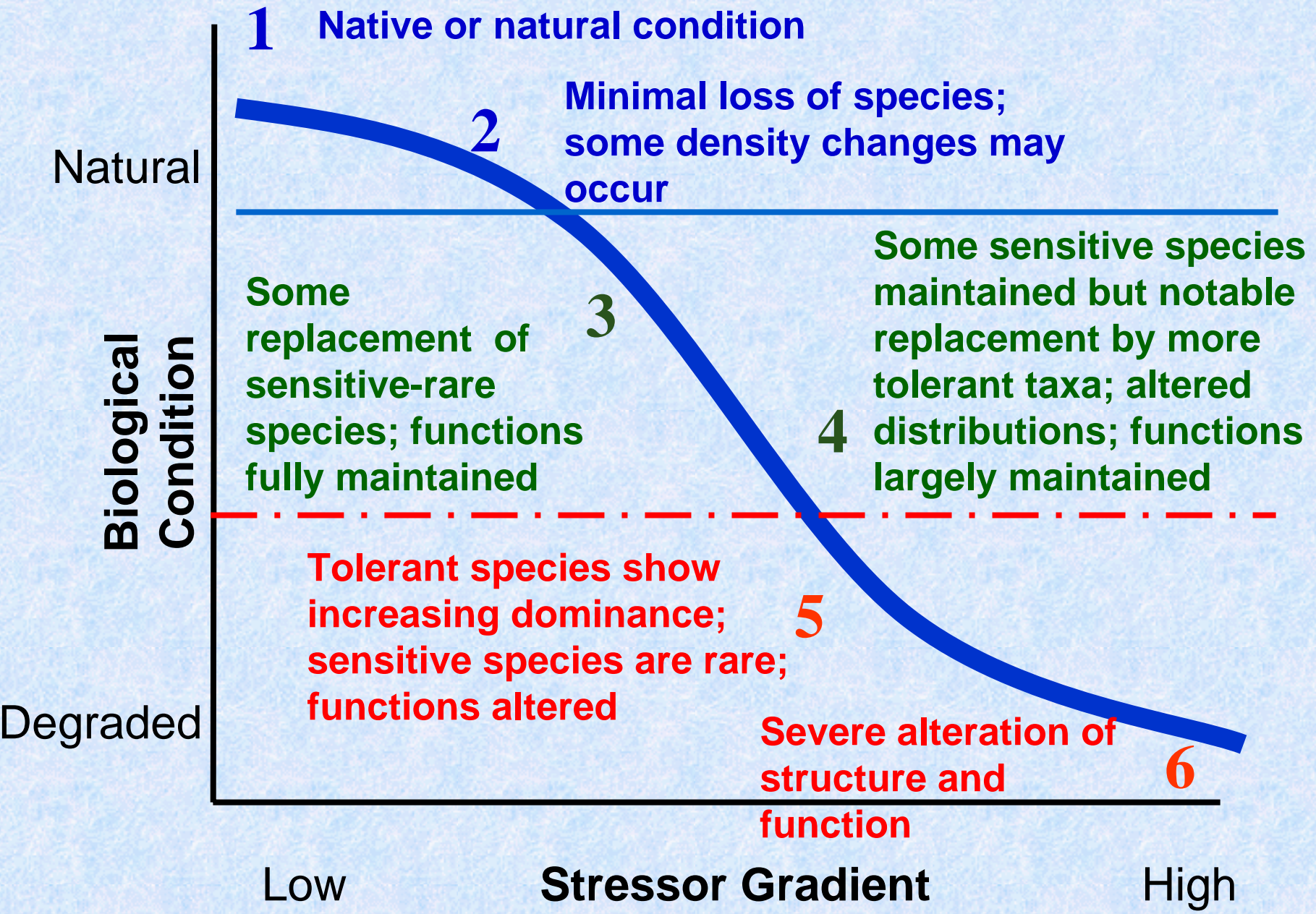
REGULATORY
CONTROL AND
ACTION-
FORCING



Socially and legally-driven



**Yields rules for fairness
and balance**



Some Sensitive Organisms in Streams



Stoneflies



Mayflies



Slimy Sculpin



Some Tolerant Organisms in Streams

Midges



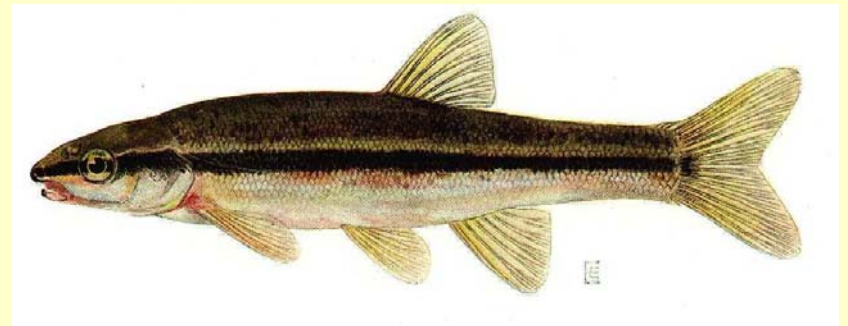
Snails



Leeches



Blacknose dace

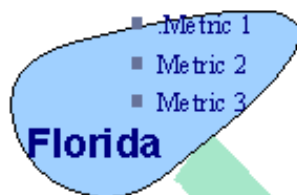


Purpose

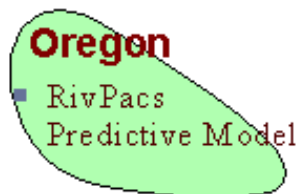
- ◆ To disclose and document current bioassessment observations and interpretations in order to:
 - ◆ **Identify testable hypotheses**
 - ◆ **Highlight emerging research needs**
 - ◆ **Build upon areas of consistent interpretation**
 - ◆ **Disclose discrepancies in interpretation and explain or resolve through research**

ALUS Tiers Provide Consistency

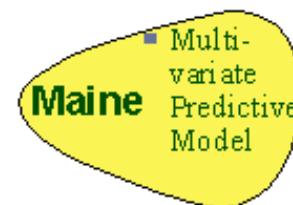
Numeric
Criteria=IBI



Numeric
Criteria=% O/E



Numeric
Criteria=P(Class X)



Local State/Tribal Bioassessment methods



1

2

3

4

5

6

Natural



Degraded

Characteristics

- A conceptual model
- A common observational scale
 - *not a prescription or mandate from EPA*
- A heuristic (tool for learning and communication)
 - *not a formula*
- A quality gradient
 - *not a “classification of data”*

2001 BCG Meeting Data Exercise

**33 biologists
from 21 states**

**six BCG
categories**

**81%
concurrency
!**

**four regions of
the U.S.**

**54 stream
invertebrate
samples**



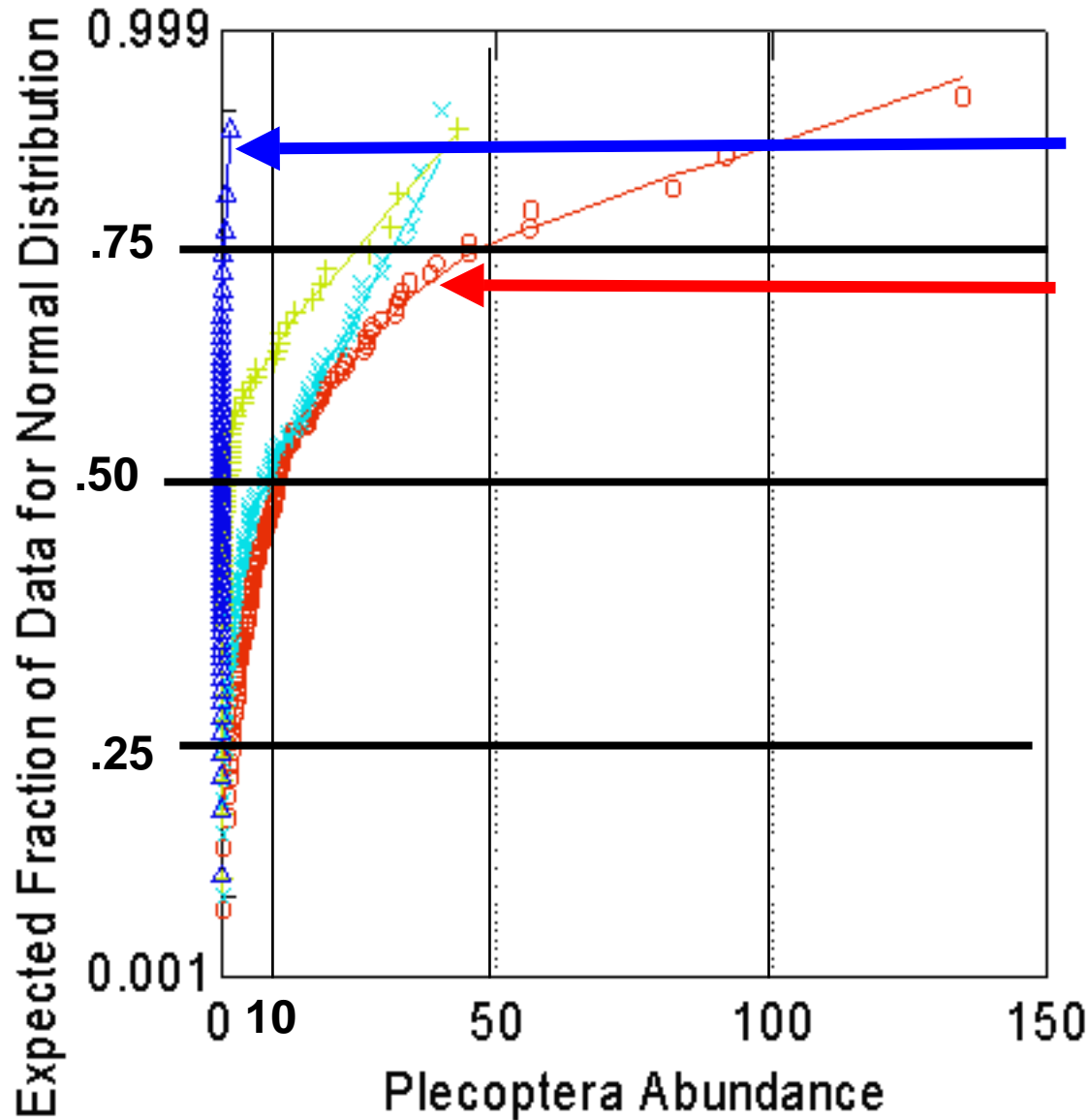
Overview of Attributes

- **Taxonomic composition and tolerance**
 - Attributes I-V
 - *Sensitive-Endemic* through *Tolerant*
- **Non-native taxa**
 - Attribute VI
- **Organism condition**
 - Attribute VII
- **Ecosystem function**
 - Attribute VIII
- **Physical-biotic interactions**
 - Attributes IX-X

Overview of Attributes

- **I - Historically documented, sensitive, long-lived, regionally endemic taxa**
 - documented presence prior to CWA
 - unique life history requirements
 - may be a listed RTE or Special Concern species
 - ex: **Brook Floater mussel; Apache trout; steelhead**
- **II - Sensitive - rare or specialist taxa**
 - may require special habitats;
 - intolerant of disturbance in environmental conditions
 - naturally low densities;
 - commonly k-strategists (slow development, longer lifespan, stable population density over time)
 - ex: ***Taeniopteryx*; slimy sculpin, bull trout; plains killifish**

Maine Macroinvertebrate Monitoring Data



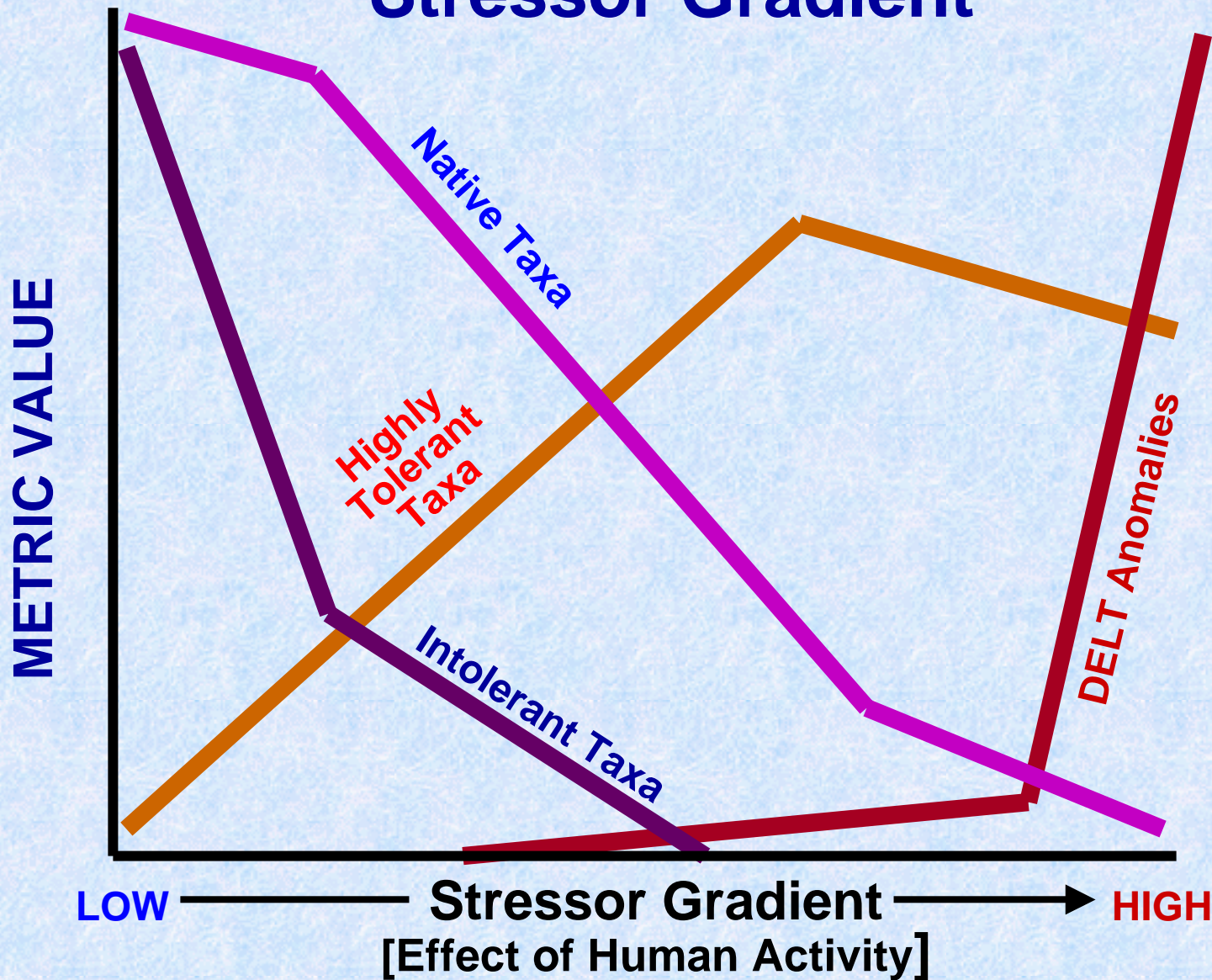
Degraded sites

Minimally disturbed sites

Use Classes

- A
- × B
- + C
- △ NA

Fish Metric Behavior Along the Stressor Gradient



Courtesy of Chris Yoder, CABB

Overview of Attributes (cont.)

- **III - Sensitive - ubiquitous taxa**

- ordinarily common and abundant
- broader range of thermal and habitat tolerance; mild pollution loads have a negative effect on populations;
- ex: ***Acroneuria*; Baetidae; Ephemerellidae; brook trout; black redhorse**

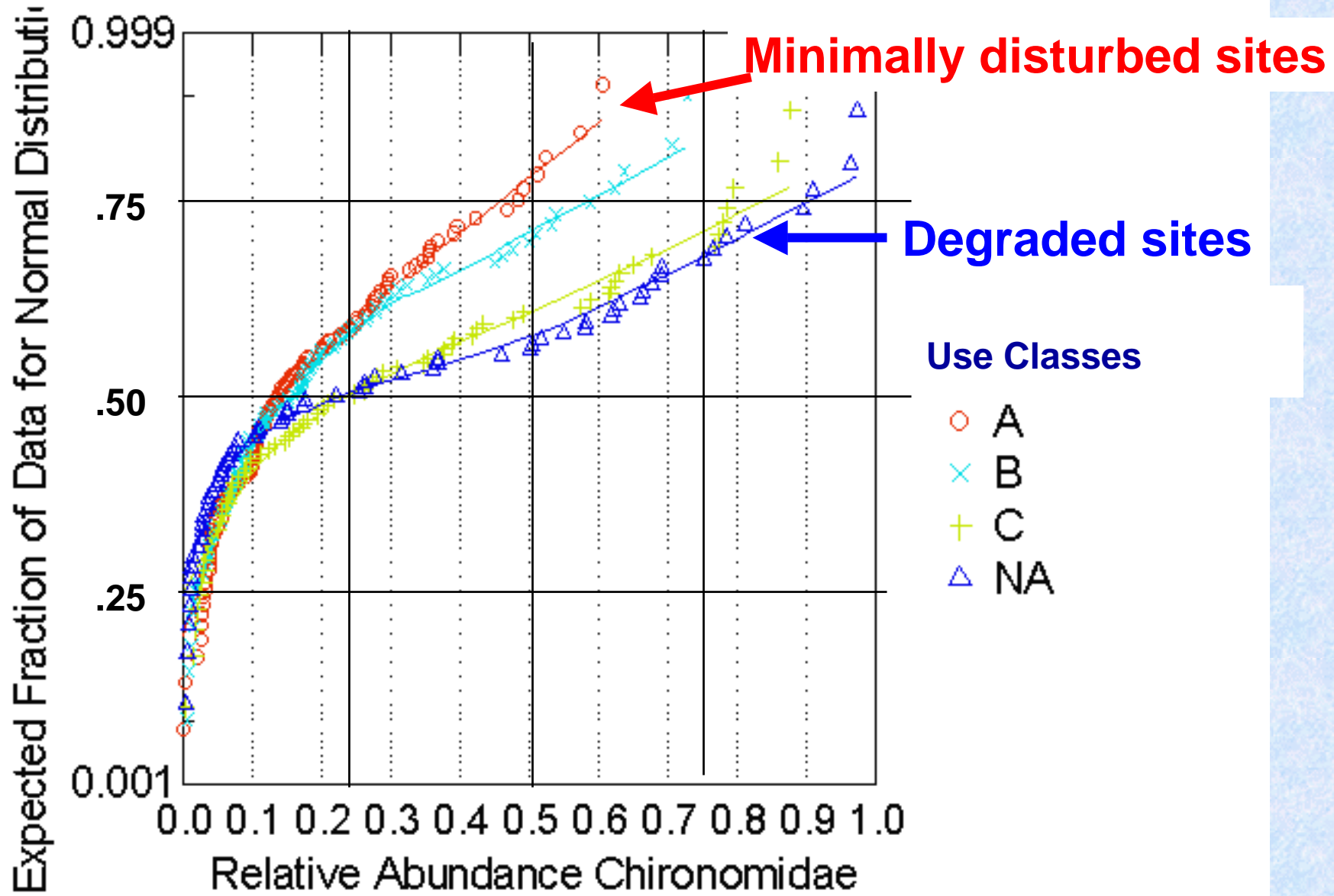
- **IV - Taxa of intermediate tolerance**

- may have generalist feeding strategies
- densities commonly increase in response to nutrient enrichment
- may be r-strategists (early colonizers with rapid turnover times and boom/bust populations)
- ex: **Hydropsychidae; Polycentropodidae; common shiner; mooneye; Rio Grande sucker**

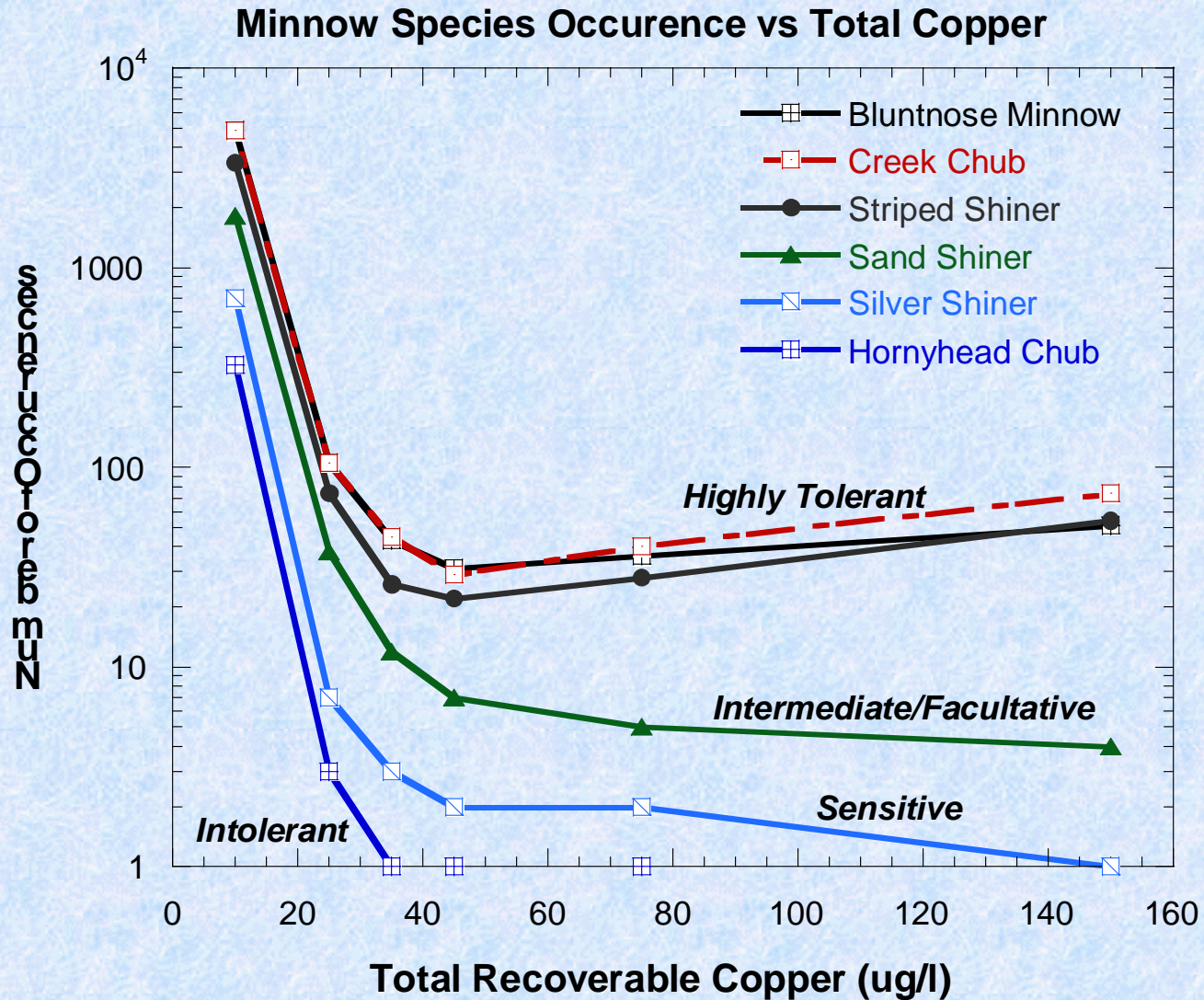
Overview of Attributes (cont.)

- **V - Tolerant taxa**
 - often tolerant of a broad range of environmental conditions
 - often r-strategists or opportunist taxa; densities may increase greatly in absence of competition and predation
 - ex: **leeches; gastropods; white sucker; green sunfish**
- **VI - Non-native taxa**
 - species that do not naturally occur in a given locale or ecosystem
 - ex: ***Corbicula*; zebra mussels; rudd**
- **VII - Organism condition**
 - DELT anomalies and parasites of fish;
 - evidence of reproduction; sex ratios; biomass of YOY

Maine Macroinvertebrate Monitoring Data



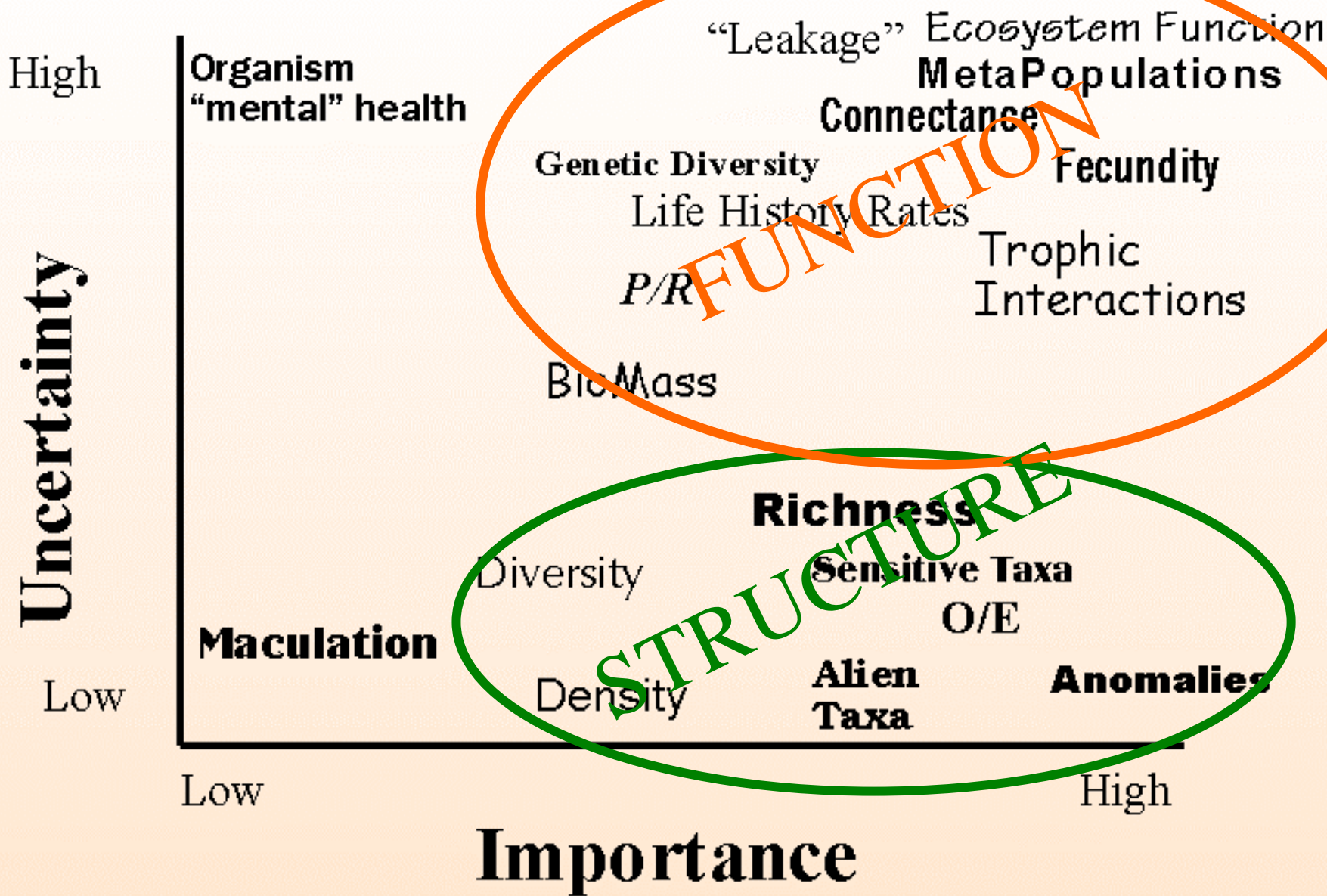
Ohio Fish Monitoring Data



Overview of Attributes (cont.)

- **VIII - Ecosystem Function**

- processes required for normal performance of a biological system
- may be applied to any level of biological organization
- Not commonly measured directly by state/tribal programs
- **Examples:**
 - **Individual-** % organisms with ...(anomalies, disease, parasites, etc.)
 - **Population-** fecundity, age class distributions, sex ratios, presence/absence
 - **Community-** structural composition and complexity
 - **Ecosystem-** Primary and secondary production, P/R, immigration and emigration, trophic complexity, resource leakage



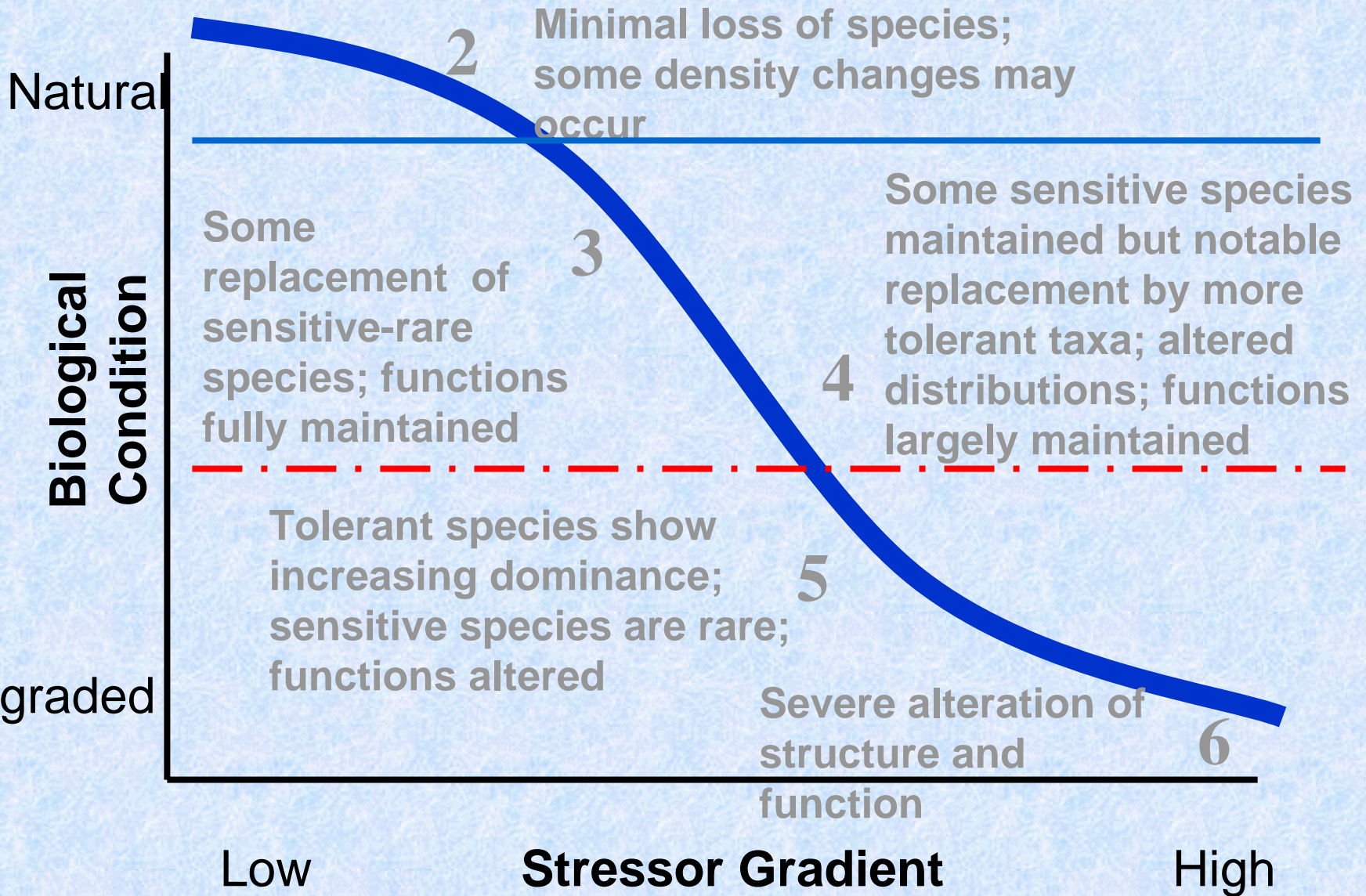


Overview of Attributes (cont.)

IX- Spatial and temporal extent of detrimental effects and X- Ecosystem connectance

- physical:biological interactions
- *Cross-cutting attributes*
- Provides linkage to the “Human Disturbance Gradient”
- Expands the interpretation to larger spatio-temporal scales
- Informs the management perspective (e.g., prioritization)

1 Native or natural condition





Second order stream in a minimally disturbed, forested watershed

A Tier 1 Community



Stoneflies

Dragonflies,
Damselflies

Mayflies

Beetles

Midges

Caddisflies

1 inch



ME Example

ALUS 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

1 Native or natural condition

Natural

2 Minimal loss of species;
some density changes may occur

3 Some replacement of sensitive-rare species; functions fully maintained

4 Some sensitive species maintained but notable replacement by more tolerant taxa; altered distributions; functions largely maintained

5 Tolerant species show increasing dominance; sensitive species are rare; functions altered

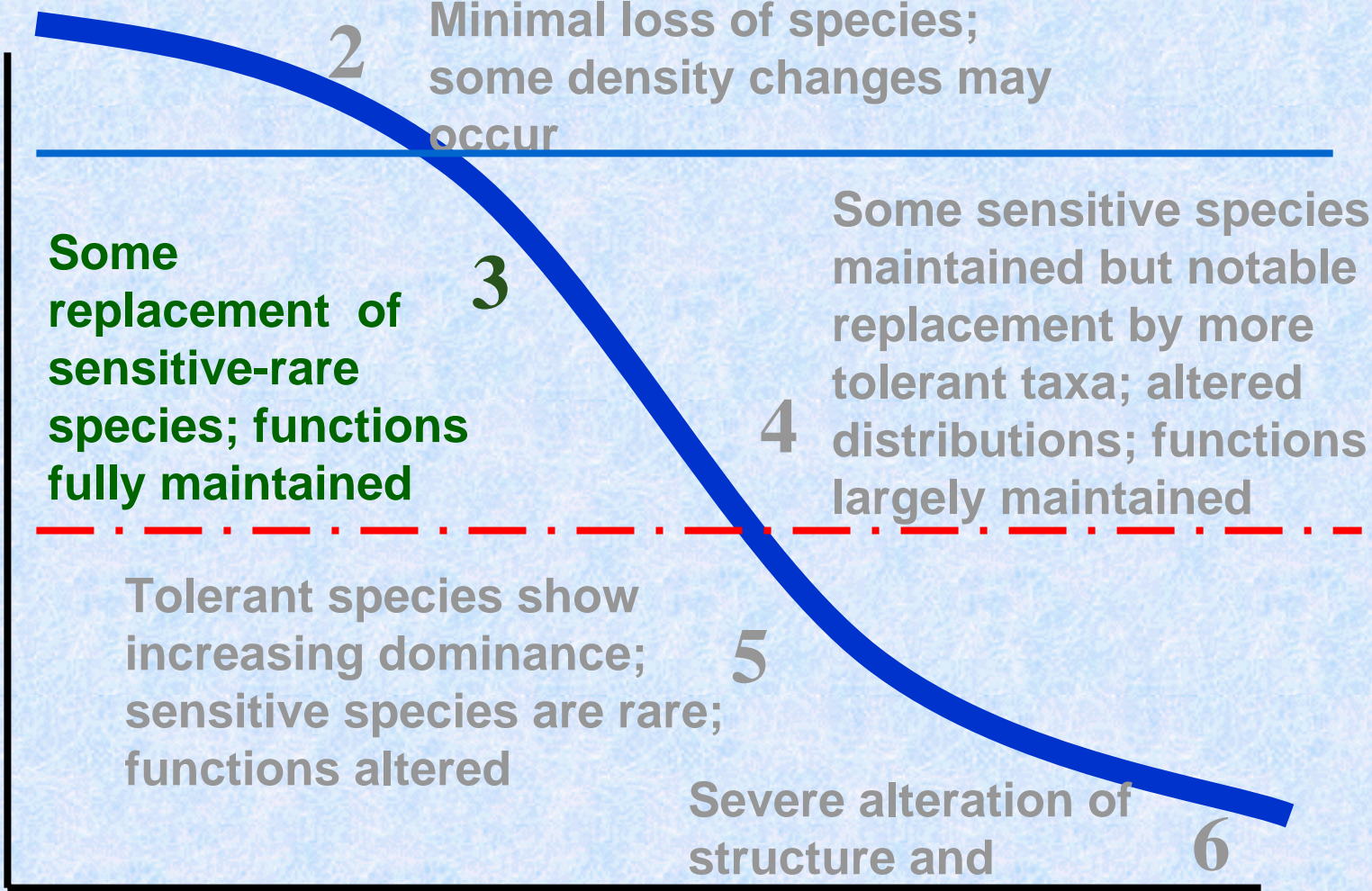
6 Severe alteration of structure and function

Degraded

Low

Stressor Gradient

High





Third order stream, downstream of agricultural impacts

ME Example

ALUS Tier 3

Agricultural NPS

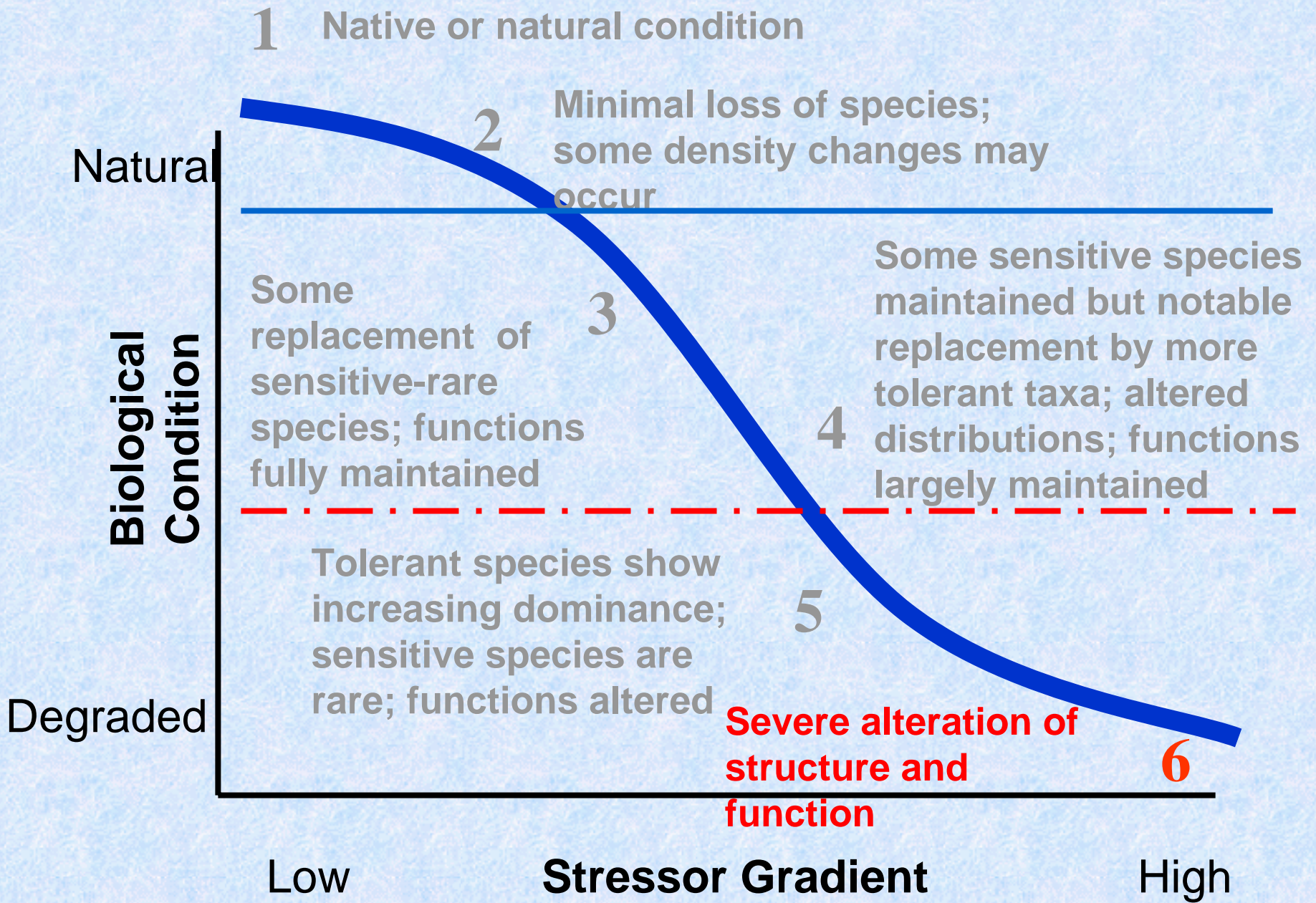
- **Generic Richness**

- Total = 58
- EPT = 21 (36%)
- Mayfly = 7
- Stonefly = 1
- Caddisfly = 13
- Midges = 12

- **Abundance**

- Total = 835
- Mayfly = 220
- Stonefly = 16

- **II - Sensitive- rare, specialist**
 - Serratella 8
 - Leucrocuta 5
- **III - Sensitive - ubiquitous, generalist**
 - Baetis 127
 - Ephemerella 67
 - Acroneuria 16
 - Acentrella 6
 - Stenonema 5
- **IV - Intermediate tolerance, opportunistic**
 - Simulium 203
 - Hydropsyche 92
 - Rheotanytarsus 62
 - Chimarra 40
- **V - Tolerant Taxa**
 - Cricotopus 33
 - Polypedilum 32



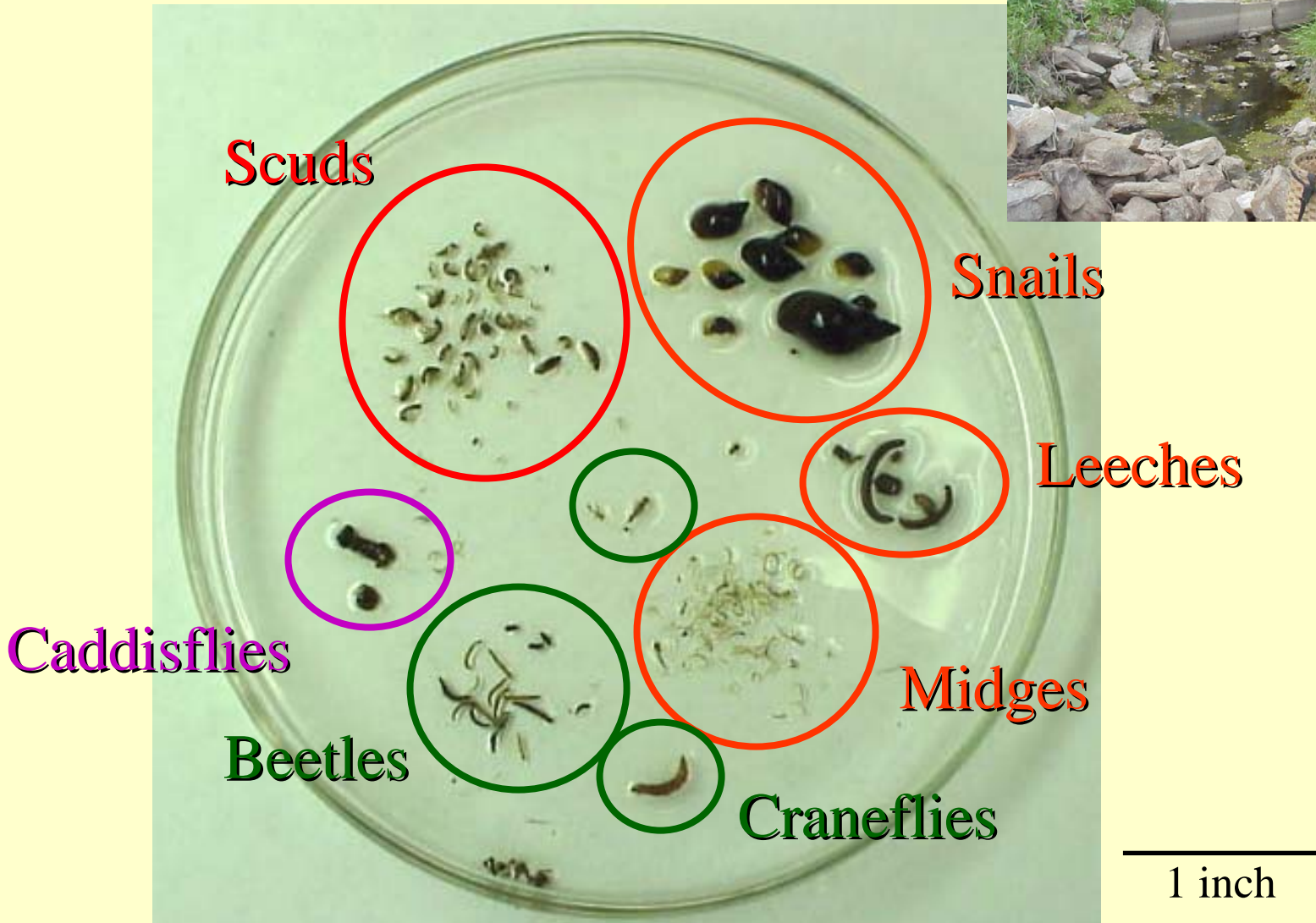


Third order stream draining a shopping mall



**Second order stream through a
cow pasture**

A Tier 5-6 Community



Scuds

Snails

Leeches

Caddisflies

Midge

Beetles

Craneflies

1 inch

ME Example

ALUS Tier 6

Toxic discharge

- **Generic Richness**

- Total = 8
- EPT = 0 (0%)
- Mayfly = 0
- Stonefly = 0
- Caddisfly = 0
- Midge = 3
- Snails = 2

- **Abundance**

- Total = 74
- Mayfly = 0
- Stonefly = 0
- Snail = 52

- **II - Sensitive- rare, specialist**

- none

- **III - Sensitive - ubiquitous, generalist**

- none

- **IV - Intermediate tolerance, opportunistic**

- none

- **V - Tolerant Taxa**

- Helisoma 48
- Thienemannimyia 16
- Physa 4
- Cricotopus 2
- us 2
- ia 1
- la 1

TIER 1 COMMUNITY

Vs.

TIER 6 COMMUNITY

- **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

- **II - Sensitive- rare, specialist**
 - none
- **III - Sensitive - ubiquitous, generalist**
 - none
- **IV - Intermediate tolerance, opportunistic**
 - none
- **V - Tolerant Taxa**
 - Helisoma 48
 - Thienemannimyia 16
 - Physa 4
 - Cricotopus 2
 - Ablabesmyia 1
 - Helobdella 1



Results of Regional BCG Workgroups:

ARID WEST

GREAT PLAINS



Attribute I- Historically documented, sensitive, long-lived, regionally endemic taxa

MAINE

yellow

brook

lampmussell

stickleback

WASHINGTON

spotted frog

steelhead

ARIZONA

spring snail

Gila trout

KANSAS

hickorynut
mussell

blue sucker

Attribute II- Sensitive-rare taxa

MAINE

Taeniopteryx

longnose dace

WASHINGTON

Drunella dodsi

bull trout

ARIZONA

Drunella

cutthroat trout

KANSAS

*Pseudiron
centralis*

Plains killifish

Summary of 2001 Group Consensus

- **Tiers 1 & 2 meet CWA biointegrity goal**
- **Tiers 1 thru 4 meet Interim Goal**
 - S&F maintained by replacement and redundancy;
 - some sensitive taxa still supported
 - balanced distribution of major groups
- **Tiers 5 & 6 do not meet the Interim Goal**
 - loss of function
 - sensitive taxa lost
 - hyperdominance or 'unnatural' distributions
- **High importance attributes should be retained (function, connectance, etc) even if not well-assessed now.**



Things we're thinking about

- Should non-native taxa be in Tier 1?
- How can Attribute VIII- *Ecosystem Function*, be made clearer and more useful?
- How does the Biocondition Gradient relate to the Endangered Species Act?
- How do we transition from ***describing what we see*** to ***establishing thresholds***?