The influence of stressors on the UCFR Fishery

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Stressor:
A variable that represents a challenge to homeostasis.

Stress:
A sustained reduction in metabolic efficiency and community and food web diversity.

Odum 1985, Schimel et al. 2007, Valett and Ely 2018
Levels of Biotic Organization

Organism

Population

Community

Ecosystem
Early Warning Retrospective

Diagnostic

Bioaccumulation
Contaminants present in the environment at a higher concentration than naturally occurs
Early Warning

Histological Abnormalities
Short-term, physiological signs of distress at an organism-level

Diagnostic

Bioaccumulation

Non-Specific

Retrospective
Early Warning Retrospective

Histological Abnormalities

Bioaccumulation

Diagnostic

Non-Specific

Indicator Species
Increased dominance of generalist and opportunistic species

Histological Abnormalities

Bioaccumulation
Early Warning Retrospective

Diagnostic

Histological Abnormalities

A

Bioaccumulation

B

Non-Specific

Indicator Species

Early Warning

C

Sensitive Assemblages

Loss of stress-intolerant species and decrease in species diversity

D

Retrospective

Non-Specific
Early Warning Retrospective

Diagnostic

Non-Specific

Histological Abnormalities

Bioaccumulation

Ecosystem Distress Syndrome
Cumulation of community and ecosystem-level stress response

Indicators
Species

Sensitive Assemblages
Historical Monitoring Incorporates the chronic character of many stressors.

**Diagnostic**

- **A** Bioaccumulation
- **B** Histological Abnormalities
- **C** Early Warning
- **D** Indicator Species
- **E** Sensitive Assemblages
- **F** Ecosystem Distress Syndrome

**Non-Specific**

**Early Warning Retrospective**
Early Warning Retrospective

Diagnostic

Non-Specific

Histological Abnormalities

Bioaccumulation

Ecosystem Distress Syndrome

Historical Monitoring

Indicator Species

Sensitive Assemblages
Population distribution
Community composition
Food web energetics
Composite measure of habitat

Water quality
- Nutrients, metals, algal abundance, temperature

Reach morphology
- Water depth, substrate type, flow, riffles, pools

Riparian vegetation
- Species composition, % cover, land use

In-stream habitat
- In-stream habitat features, bank entrenchment
Community: Assemblage, diversity, and composition

• Expand CPUE methods:
  - boat electroshocking
  - seining
  - minnow traps

• Biometrics relying on CPUE
  • Species diversity and richness
  • Beta diversity
  • Sorenson diversity index
Figure 2. Six focal reaches of RiFSS project on the Upper Clark Fork River, MT. Note: Flow runs from Warm Springs to Bonita.
Food Web

- Otoliths
  - Aging and growth curves

- Stable Isotope Analysis
  - $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$
  - Isotopic niche

- Gut contents
  - Species interactions
  - Diet requirements
Food Web

Good Habitat Bad
Early Warning Retrospective Diagnostic

Non-Specific

Population

Early Warning

Community

Ecosystem Distress Syndrome

A B C D E F
Early Warning Retrospective

Diagnostic

Non-Specific

Ecosystem Distress Syndrome

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