2027 Minnesota State FFA Fish and Wildlife Practicum Resource Page

Resource #1: Water on the Web Lake Ecology Primer, You would be responsible for knowing the primer home page which the link takes you to as well as the physical, chemical, and biological links found on the left hand side. You WILL NOT be responsible for knowing of the links found on these pages to additional information. You will be responsible just for the summary in each of the left hand links.

https://waterontheweb.org/under/lakeecology/index.html

Resource #2: Water on the Web: Understanding Water Quality, You would be responsible for knowing the home page which the link takes you to as well as the left hand links about different water quality components for both lakes and streams. You WILL NOT be responsible for knowing of the links found on these pages to additional information. You will be responsible just for the summary in each of the left hand links.

https://waterontheweb.org/under/waterquality/index.html

Resource #3: Biological Indicator Summary for Minnesota Waters, You will find this document starting on the next page.

Biological Indicators Overview as it relates MPCA's IBI Monitoring Program

In Minnesota, biological water-quality monitoring generally looks at **living organisms and the condition of their communities** rather than just measuring chemical properties of the water. The major biological indicators are:

Biological indicator	What is sampled	What it tells us
Benthic macroinvertebrates	Aquatic insects, worms, snails, clams, crustaceans, etc.	Excellent indicator of long-term water quality and habitat conditions
Fish communities	Species present, abundance, diversity, and condition	Indicates biological integrity, habitat quality, and cumulative environmental stress
Algae/phytoplankton	Algae species, abundance, and community composition	Indicates nutrient enrichment, especially phosphorus, and eutrophication
Aquatic plants (macrophytes)	Species composition, abundance, and distribution	Indicates nutrient conditions, habitat changes, and lake ecological condition
Periphyton	Algae attached to rocks, plants, sediment, or other surfaces	Indicates nutrient enrichment and changes in stream/lake habitat
Zooplankton	Microscopic animals such as Daphnia and copepods	Can indicate food-web changes, nutrient status, and ecological condition

1. Benthic macroinvertebrates — one of the most important indicators

For **streams and rivers**, Minnesota's biological monitoring programs place substantial emphasis on benthic macroinvertebrate communities.

Examples include:

- Mayflies
- Stoneflies
- Caddisflies
- Dragonflies and damselflies
- Aquatic beetles
- Midges
- Aquatic worms
- Leeches
- Snails
- Clams
- Crayfish

The key isn't simply **how many organisms are present**. Scientists examine the **composition of the community**.

For example, a stream containing many pollution-sensitive mayflies, stoneflies, and caddisflies generally indicates better conditions than one dominated by organisms tolerant of low oxygen and other stressors.

2. Fish communities

Minnesota also uses fish as biological indicators, particularly in streams and rivers.

Scientists can examine:

- Number of species
- Relative abundance of each species
- Presence/absence of sensitive species
- Presence of tolerant species
- Fish community composition
- Reproductive populations
- Feeding guilds
- Habitat preferences

Minnesota DNR and MPCA have developed **fish-based Index of Biological Integrity (IBI)** approaches for evaluating stream and lake biological condition.

3. Algae

Algae are particularly useful for evaluating **nutrient enrichment**.

Scientists may examine:

- Chlorophyll-a
- Algal biomass
- Species/community composition
- Cyanobacteria
- Diatoms
- Attached algae/periphyton

Large amounts of algae can be associated with excess nutrients, particularly **phosphorus**, although interpretation depends on the type of waterbody.

4. Aquatic plants

In lakes, scientists may survey the aquatic plant community.

They can evaluate:

- Number of plant species
- Native vs. invasive species
- Plant abundance
- Plant distribution
- Species diversity
- Plant community structure

Aquatic vegetation can provide information about **nutrient levels, water clarity, habitat quality, and physical disturbance**.

5. Zooplankton

Zooplankton are particularly useful for understanding the **lake food web**.

Common groups include:

- Daphnia
- Copepods
- Rotifers

Because zooplankton consume algae and are themselves consumed by fish, changes in their communities can provide clues about **nutrient enrichment and changes in predator-prey relationships**.

Minnesota's biological monitoring sampling criteria

Streams and rivers

1. **Macroinvertebrates**
2. **Fish**
3. **Periphyton/algae**

Lakes

1. **Fish**
2. **Aquatic plants**
3. **Phytoplankton/algae**
4. **Zooplankton**

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These biological measurements are often combined with **physical and chemical measurements**, such as:

- Dissolved oxygen
- Temperature
- pH
- Conductivity
- Turbidity
- Total phosphorus
- Nitrogen
- Chlorophyll-a
- Water clarity/Secchi depth
- Habitat condition

The important concept is that **chemical measurements tell you what is in the water at the time of sampling, while biological communities can provide evidence of the cumulative effects of environmental conditions over time.**

For Minnesota specifically, the **MPCA's biological monitoring program** uses biological communities to assess whether waters are meeting their designated biological and aquatic-life uses.