Activity 25: NatureMapping for Watersheds

Audience:

K-12 and adults

Time:

Flexible

State Essential Learning Requirements

Science: 2.1, 2.2

Social Sciences Geography: 1.1, 2.3, 3.1

Materials:

Guidelines to collect data provided in the Appendix.

Overview:

Students and adults are encouraged to collect data that helps define and describe their watershed and to report this data to the public NatureMapping data base. NatureMappers as citizen scientists have access to expert data and receive support to answer scientific questions they pose. Complete guidelines are available for fish species and wildlife data collection and reporting. Draft guidelines are available on data collection for fish and streams, and water quality parameters. The NatureMapping section of WILD Activities will be updated as NatureMapping for Water, Fish and Streams is completed.

Objectives:

- To define the watershed in terms of fish, wildlife and habitat
- To investigate using inquiry, the state of fish, wildlife and habitat.
- To analyze and interpret fish and wildlife data.

Critical Questions Addressed:

3. Recovery

Resources (attached)

- NatureMapping Guidelines for Fish and Wildlife
- NatureMapping Guidelines for Fish and Streams
- NatureMapping Guidelines for Water Quality
- Optimal Water Quality Standards for Salmon
- Macroinvertebrate Data Collection for Salmon Web

Directions:

Protocols for data collection are provided in the NatureMapping Guidelines. Check the NatureMapping website for more directions at NatureMapping Website:

http://www.fish.washington.edu/naturemapping

Click on Education Modules

Choose from Wildlife, Water, etc.

Optimal Water Quality Standards for Aquatic Ecosystems

This brief guide to water quality pertains to rivers and streams in the Pacific Northwest. In general, these guidelines relate to conditions favored by salmonids. Water quality is somewhat relative and the guidelines herein are not absolute. However, the following standards should be helpful for teachers and students.

Dissolved Oxygen (DO)

Dissolved Oxygen is a critical water quality parameter indicating the health of an aquatic system. DO is the measurement of oxygen dissolved in water which is available for fish and other aquatic life. The DO content of water results from the photosynthetic and respiratory activities of the biota in the system, and the mixing of atmospheric oxygen through wind and stream current action.

Optimal Levels

The optimal level for salmonids is greater than 5 mg/l. 7-8 mg/l are acceptable. 3.5-6 mg/l is poor. Levels below 3.5 mg/l are likely fatal to salmonids.

Generally, a DO level of under 3 mg/l is stressful to most vertebrates and other forms of aquatic life.

Fecal Coliform

Fecal Coliform bacteria indicate the likely presence of water-borne pathogenic (disease causing) bacteria or virus. Fecal Coliform bacteria are thus indicators of fecal pollution problems. Fecal Coliform bacteria are present in the intestinal tracts of warm blooded animals, including humans. Fish are a cold blooded species and do not produce Fecal Coliform. Fecal Coliform is measured in colonies per 100ml.

For the State of Washington to classify a river as having Class A (Excellent) water quality for salmonid utilization, fecal coliform organisms should not exceed 100FC/100ml, on average. Less than 50 FC/100ml is optimal.

For Class A marine waters, fecal coliform organisms should not exceed 14 FC/100ml.

Human Sanitation Levels

Drinking water	0 FC/100ml
Swimming	200 FC/100ml
Partial body contact	1000 FC/100ml

pH

The pH test measures the hydrogen ion concentration of water. It provides a gauge of the relative acid/base nature of a water sample. The scale is logarithmic, thus there is a ten-fold change in acidity or alkalinity per unit change. For example, water with a pH of 5 is ten times more acidic than water with a pH of 6.

Optimal Levels

pH values between 7.0 and 8 are optimal for supporting a diverse aquatic ecosystem. A pH range between 6.5 and 8.5 is generally suitable. Acid conditions caused by acid rain is highly detrimental to aquatic macro invertebrates and fish. If pH declines below 6.5 fewer salmon eggs hatch and aquatic insects levels drop. pH levels should not vary from natural conditions more than .2 due to human activities.

Biochemical Oxygen Demand

Biochemical oxygen demand is a measure of the quantity of oxygen consumed by the respiration of microorganisms which are in the process of decomposing organic materials (algae and other dead aquatic plants). The excessive input of nutrients such as fertilizers (phosphates and nitrates) into an aquatic system can cause algal blooms. The decomposition of large volumes of organic materials by microorganisms can cause a biochemical oxygen demand which lowers dissolved oxygen to levels dangerous for fish. Massive fish kills (death by strangulation) result.

Temperature

Temperature exerts many fundamental effects on water chemistry. For example, colder water can hold more dissolved oxygen than warm water. For fish, no single environmental factor affects their development and growth more than water temperature. Many biological processes such as spawning and egg hatching are geared to annual temperature changes.

Optimal Levels

*Optimal level for hatching salmonids-approx. 9 degrees centigrade.

*Optimal temperatures for adult salmon- approx. 12 degrees centigrade.

Successful salmonid spawning has occurred in waters between 2-21 degrees centigrade, however, for a stream or river to be rated Class A, temperatures should not exceed 18 degrees centigrade. Temperatures which exceed 21 degrees are not acceptable.

Nutrients- Total Phosphate & Nitrate

Phosphates and nitrates are associated with many nonpoint pollution sources, such as livestock manure and urine, failing septic systems and synthetic fertilizers. Eutrophication occurs, which causes excessive nutrient loads in the water. This can artificially stimulate plant growth resulting in algal blooms which speed up the aging process of aquatic systems.

Optimal Levels

Nitrates levels in unpolluted water bodies should generally be below 1 mg/l.

Phosphates in unpolluted water bodies should generally be below 1 mg/l.

Turbidity

Turbidity is the measurement of the light scattering properties of water. Suspended solids (including total dissolved solids) in water can reduce the transmission of light either through absorption or scattering. High turbidity can have a strong negative affect on submerged aquatic vegetation, benthic organisms and the ability of juvenile salmon to catch prey.

Optimal Levels

Since salmonids rely greatly on their visual abilities, generally, the lower the turbidity the better. Salmon will avoid water with high silt loads which cloud the water and will cease to move through water where visibility is extremely low. Thus high turbidity can delay salmon migration.

Total Solids

Total Solids are the sum of the dissolved solids (derived from soluble rocks and soil) and the suspended solids (silts, clays, plankton, etc.) contained in a water sample. Human activities can increase these levels. In the Nisqually River, glacial activity brought on by warm weather can greatly increase total solids loads. Rapid changes in total solids levels are stressful to fish.

Optimal Levels

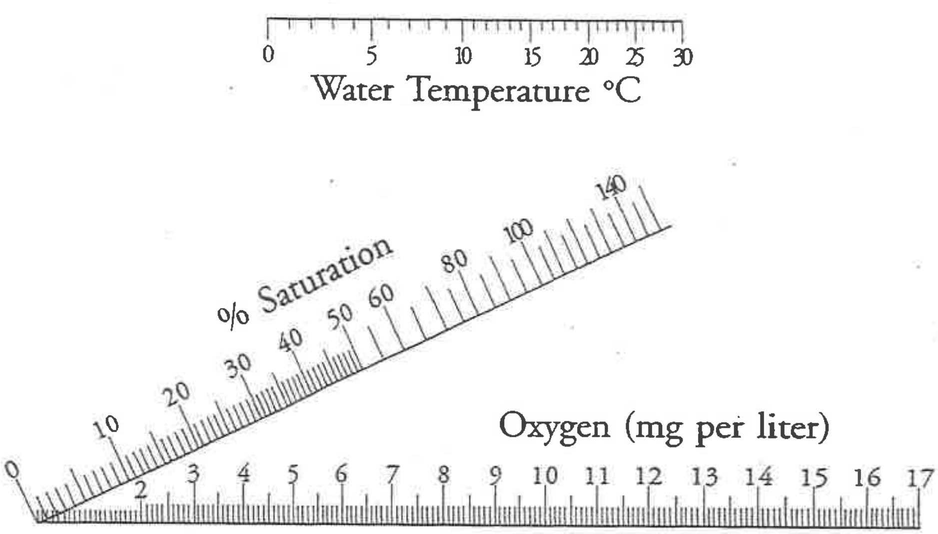
A total solids level of 25 mg/l or less is optimal. 25- 80 mg/l is acceptable. 80- 400 mg/l is poor. A total solids load of over 500 mg/l can be fatal to salmon over a period of several weeks.

**Reviewed by Catie Mains, Fish Program, WDFW

Optimal Water Quality Standards for Aquatic Ecosystems

For a quick and easy determination of the percent saturation value for dissolved oxygen at a given temperature, use the saturation chart below. Pair up the mg/l of dissolved oxygen you measured and the temperature of the water in degrees C. Draw a straight line between the water temperature and the mg/l of dissolved oxygen. The percent saturation is the value where the line intercepts the saturation scale. Streams with a saturation value of 90% or above are considered healthy.

Oxygen Saturation Chart



I Salmonid Water

	Instream Dissolved Oxygen
A. Embryo and larval stages	
No production impairment	11
Slight production impairment	9
Moderate production impairment	8
Severe production impairment	7
Limit to avoid acute mortality	6
B. Other Life Stages	
No production impairment	8
Slight production impairment	6
Moderate production impairment	5
Severe production impairment	4
Limit to avoid acute mortality	3

II Non-Salmonid Waters

	Instream Dissolved Oxygen
A. Early Life Stages	
No production impairment	6.5
Slight production impairment	5.5
Moderate production impairment	5
Severe production impairment	4.5
Limit to avoid acute mortality	4
B. Other Life Stages	
No production impairment	6
Slight production impairment	5
Moderate production impairment	4
Severe production impairment	3.5
Limit to avoid acute mortality	3

III Invertebrates

No production impairment	8
Moderate production impairment	5
Limit to avoid acute mortality	4

From Monitoring Guidelines to Evaluate Effects of Forestry Activity on Streams in the Pacific Northwest and Alaska. US Environmental Protection Agency, Region 10, Seattle, WA.