# UNIT 5E. SALMON AS AN INDICATOR OF THE HEALTH OF A WATERSHED

| TIME | LEVEL |
|---|---|
| 45 minutes | Advanced |

| BENCHMARKS | |
|---|---|
| Next Generation Science Standards | MS-LS2-4 MS-ESS3-5 MS-LS2.A MS-ESS3.C HS-LS2.C |
| Disciplinary Core Ideas | MS-LS2.A |

## OBJECTIVE:

Students will identify characteristics of the stream needed by salmon and recognize the role of salmon as indicator species

## MATERIALS:

- reference materials
- STUDENT HANDOUT 5D-1: Stream Structure and Fish Habitat
- STUDENT HANDOUT 5E-1: Home Wet Home…, Stream Scene

## INTRODUCTION

Did you ever have a fever when you were a child? Your forehead often told your parents how you were feeling. Aquatic organisms are like foreheads, they act as "thermometers" which tell us about the state of the health of the environment that they inhabit. What in the watershed of a salmon acts as a thermometer? In this section, students learn that they can ascertain the probable state of an environment by knowing which organisms live in it.

In this section, we relate aspects of stream structure and quality to the needs of the salmon during stages in their life cycle. Then, we alter our perspective to relate the organisms inhabiting a stream to its probable structure and quality.

## KEY QUESTIONS

- ➔ How are salmon like thermometers?
- ➔ What is the relationship between a salmon and the watershed's health?

**VOCABULARY** (Brief definitions of vocabulary terms are found in the Glossary.):

spawning area riffle
indicator species substrate embedded

## PROCEDURE

STUDENT HANDOUT 5D-1: Stream Structure and Fish Habitat, explores fish habitats in the Northwest. It uses your students' prior understandings about stream structure and water quality, and then relates them to stages in the life cycle of salmon. Begin with a discussion of the idea of "indicators." You might refer to indicators of the starting line for a popular race, or atmospheric indicators of weather.

Pass out STUDENT HANDOUT 5E-1: Home Wet Home..., Stream Scene. In this activity, students relate various components of a hypothetical stream's structure to its effect on salmon. When students have finished, discuss their responses to questions (answers to Home Wet Home follows).

## EXTENSION ACTIVITY

If your students have kept pond water, then you can observe its inhabitants under different conditions of water quality. In this "heartbeat" activity, students take a sample of the pond water containing aquatic organisms which they can see and moderate its temperature or chemistry. Begin by having students transfer a sample of the pond water to a small container (like a vial or baby food jar). Next, have the students observe the movements of any organisms in their sample. For instance, copepods move in a series of jerks, and make very good organisms to observe in this activity.

Cool the container in ice or cold water, then count the number of jerks, or other movements which have been observed. Next, warm the container and make another count. If these temperatures have an effect on the organisms, then the rate of the motion might have changed. Other effects you can measure include the effects of adding salt or mud. Have your students keep records of their observations, and then share them with the class.

## EXTENSION CURRICULUM

1. Water Canaries, Project Wild Aquatic, pp. 24-30, describes an activity in which students conduct investigations on a water body. They assess its relative environmental quality through interpretations of measurements of pH, water temperature, and the diversity of the organisms found there.

2. Water Wigglers, Stream Scene, pp. 155-168, describes an activity to do in a stream, which relates the quality of the water in the stream to the macroinvertebrates found in it. If you cannot go to a stream, read the activity and adapt it to the classroom.

## BIBLIOGRAPHY

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Wading into Wetlands. 1995. National Wildlife Federation. Vienna, Virginia 22184.

# STUDENT HANDOUT 5E-1

Name

## Home wet home . . .

### *Do you know . . .*

Salmon and trout (salmonids) are important to anglers. Salmonids are also important to biologists because their presence helps indicate the health of the stream in which they live. Salmonids are one of the first organisms to be affected if their watery home starts to change or if their habitat is unsuitable. Biologists refer to sensitive animals like salmonids as "indicator" species.

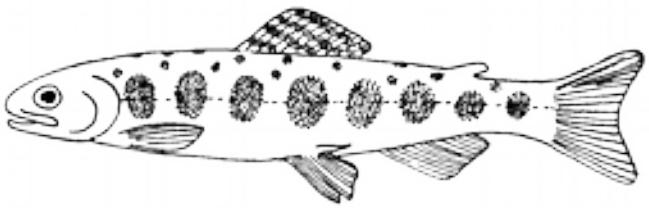
Because salmonids are so significant, fish biologists have developed many ways to improve stream habitat to enhance fish survival. In some cases, biologists can produce a fishery where none was previously found.

The ecological requirements of salmonids are:

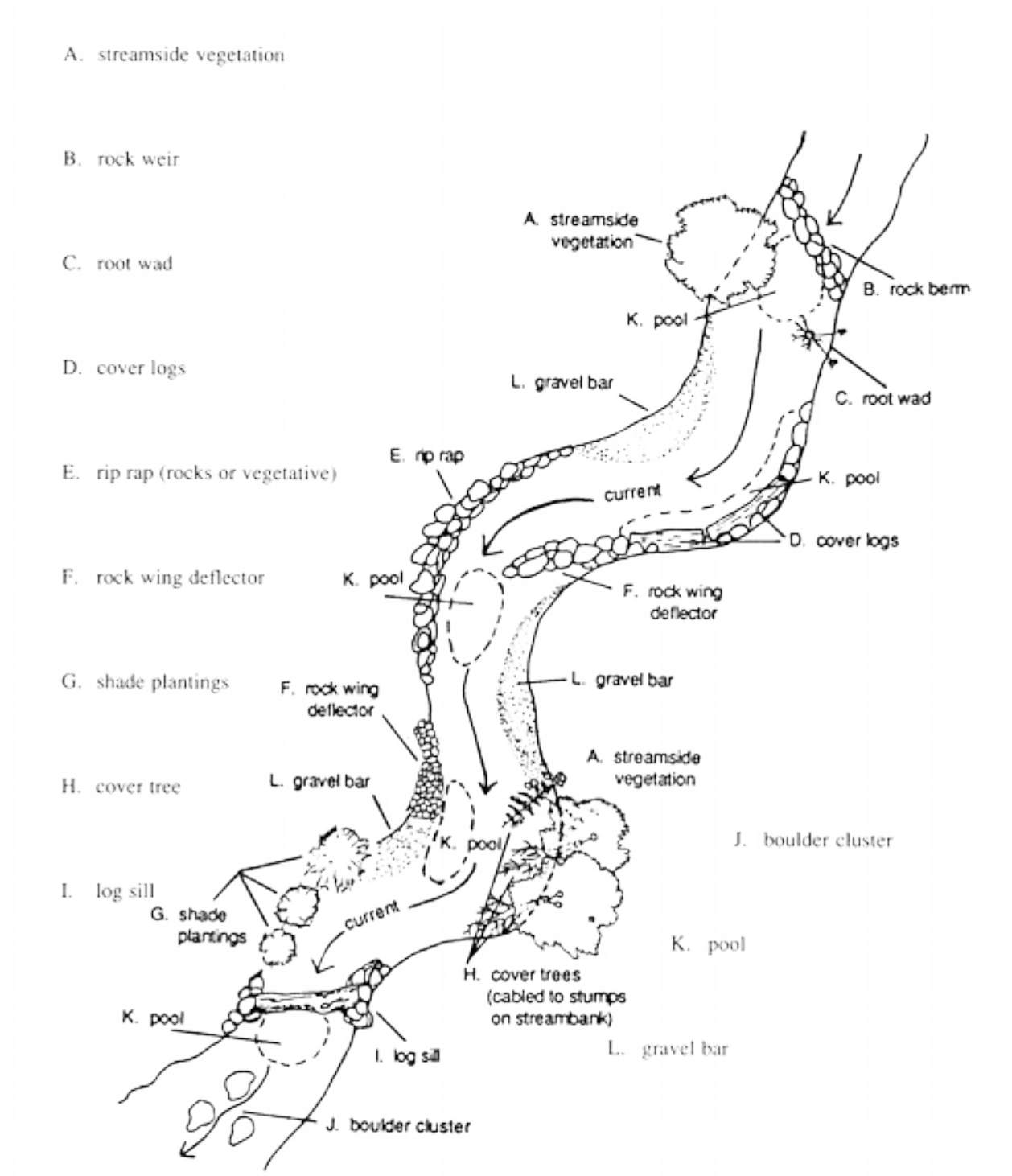
- Cool, clear, well-oxygenated water
- Sections of gravel bottom for spawning
- Occasional pools for feeding and resting
- Adequate food (aquatic and terrestrial insects, the latter usually falling from streamside vegetation)
- Cover for protection from predators

### *Now it's your turn . . .*

The figure on the next page shows several ways a stream can be modified to improve salmonid habitat. Each structure or management technique has been used to meet the special needs of these sensitive fish. Next to each feature, describe fully the contribution each will provide for fish.



# STUDENT HANDOUT 5E-1



## Answers to STUDENT HANDOUT 5E-1: Home Wet Home…

A. streamside vegetation
*Provides cover in addition to shade for temperature regulation. In autumn, leaves drop into stream and eventually provide food for invertebrates that are eaten by fish.*

B. rock weir
*Slows the water, traps gravel for spawning, and creates pools.*

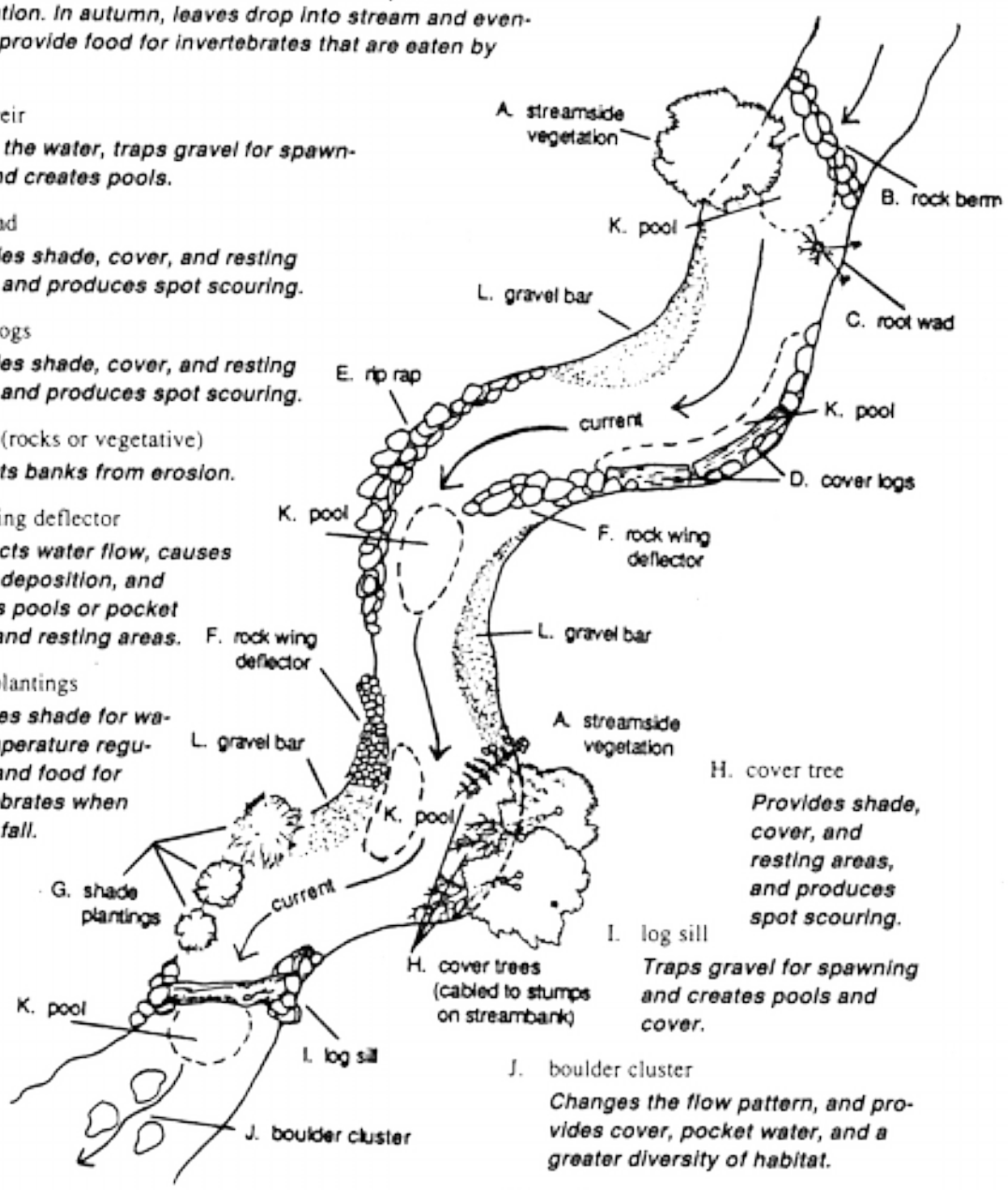
C. root wad
*Provides shade, cover, and resting areas, and produces spot scouring.*

D. cover logs
*Provides shade, cover, and resting areas, and produces spot scouring.*

E. rip rap (rocks or vegetative)
*Protects banks from erosion.*

F. rock wing deflector
*Redirects water flow, causes gravel deposition, and creates pools or pocket water and resting areas.*

G. shade plantings
*Provides shade for water temperature regulation and food for invertebrates when leaves fall.*




H. cover tree
*Provides shade, cover, and resting areas, and produces spot scouring.*

I. log sill
*Traps gravel for spawning and creates pools and cover.*

J. boulder cluster
*Changes the flow pattern, and provides cover, pocket water, and a greater diversity of habitat.*

K. pool
*Provides a resting area.*

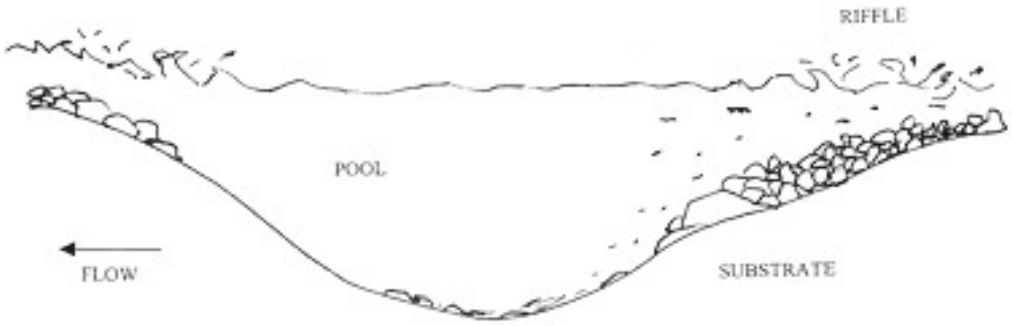
L. gravel bar
*Provides spawning habitat.*

# STUDENT HANDOUT 5D-1

## Stream Structure and Fish Habitat

Streams are unique, constantly changing environments that support an array of aquatic life. The organisms that live in a stream are adapted to the changes and fluctuations that occur in a stream over time. Here we will discuss the structure of a stream and how aquatic animals, such as insects and fish, use the stream to their advantage.

**Stream Structure**
The way water moves through a stream is heavily influenced by the land that is surrounding and underneath the stream channel. The stream channel or bed consists of the area that cradles the water. If this area is narrow the water moves quickly, if it is wide the water slows down. The depth of the stream also influences water movement, and the reverse is also true: the water alters the depth of the stream. The stream bed itself is constantly changing. When the water level is high and the stream is moving quickly, rocks and soil in the stream bed are easily moved. Banks can be carved away or gravel can be scoured out. When the water slows, rocks and soil are deposited at the bottom of the stream.




The land at the bottom of the stream is called the stream substrate. Examples of substrate are bedrock, gravel, or silt. When you look at a river bottom you can see the substrate change in relationship to the movement of the water. Where the water is moving quickly there is usually more rock and where the water slows you see finer particles like sand and silt.

As the water moves through the stream channel, it changes its speed, depth, and temperature depending upon the surrounding conditions. When water enters an area that is deep and wide, it spreads out and slows down as it fills the channel. This area is called a pool. When the channel narrows and is shallow, the water moves swiftly, forming small waves or white water. This area is called a riffle.

**A Chain Reaction**

If we look at how the structure of the stream bed influences the movement of the water and how the water influences the stream channel, we can see that there is a chain reaction that occurs when a change takes place in a stream. When the bank of a stream gives way, the soil falls into the water. The water carries the soil particles downstream to a slow moving section of the river where the particles drift to the bottom, becoming substrate. This new substrate makes the stream bed shallower. The water begins to move a little more quickly in the shallow area. As the water moves more quickly, some of the deposited soil is stirred up and carried further downstream. The area where the bank originally eroded also widens the stream channel, slowing the water a bit as it passes.

**Fish Habitat**

Their riffles, pools, different substrates help to characterize streams. If we think about the needs of fish like salmon and trout, we can identify what stream characteristics they need. Fish need oxygen to breathe. They don't breathe oxygen from the air like we do; they breathe it from the oxygen in the water called dissolved oxygen. Oxygen can be added to the water when it interacts with air.

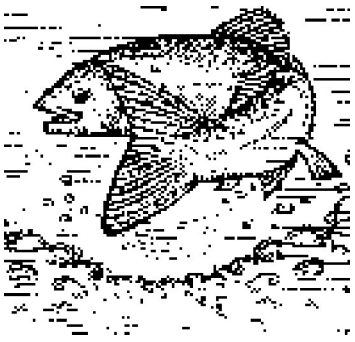
**Question:** Does the water mix more with the air in a riffle or a pool?

The "white water" of a riffle adds fresh oxygen to the water, so our fish need streams with riffles and adequate dissolved oxygen. Salmon and trout are also in need of cool water. The speed or velocity of the water in a stream helps keep it cool as does the depth.

**Question:** Would shallow or deep water warm up more quickly in the summer sun?

When the water level in a stream goes down in the late summer, the temperature goes up. Shallow water warms up more quickly than deep water. Our fish need cool water so they need streams that have deep pools to keep the water cool and that have water moving all summer long. In addition, shade from the plants along the bank of a stream keeps the temperature down. These plants in the riparian area (the area along the stream) are important not only for shade but also to help stabilize the bank and provide a food source for aquatic insects.

Salmon and trout also need places in the stream to lay their eggs. Like birds, these fish build nests or redds, to protect their eggs while they develop. The eggs need cool water and oxygen to develop.



**Question:** Think about the substrate of a stream. Where would you want to hide your eggs? Where will they get cool water and oxygen? Where will predators not find them and they won't wash away?

Salmon use gravel as the substrate for their nests. They dig a depression in the small rocks, lay their eggs, and cover them up with gravel. Gravel allows water to circulate through the rocks bringing oxygen to the eggs. It also hides the eggs from predators and keeps the eggs from drifting downstream.

The best location for their redds is found at the end of a riffle where the water is beginning to slow down as it enters a pool but is oxygen rich. It is also in this area where aquatic insects hide, the future food source for young salmon.
Juvenile salmon spend time in the stream eating and growing before heading to the ocean. These small fish need to protect themselves from predators and from strong currents that might push them downstream.

**Question:** Where in the stream can a young fish hide? Where will food be found?

Young salmon vary in the use of the stream depending upon species. In general, young salmon stay close to the banks or near fallen logs or rocks to hide from predators. They find their food, aquatic insects, drifting in the current. As the salmon get bigger they venture into faster water to find more insects being carried downstream.

**Salmonids and Physical Stream Characteristics**

Physical stream characteristics useful in differentiating habitat preferences of salmonids.

| | SPECIES | | | |
|---|---|---|---|---|
| **Habitat preference** | **Coho** | **Chinook** | **Steelhead** | **Cutthroat** |
| % pools | 50–80 | 50–100 | < 50 | 40–60 |
| % gradient | <3 | < 2 | >1–5 | 1–20 |
| Stream order | 2–5 | ≥ 5 | 2–5 | > 2 |
| Maximum temperature | <65°F 18°C | < 68°F 20°C | < 73°F 23°C | < 65°F 18°C |

Physical stream characteristics useful in evaluating stream quality preferences for salmonids.

| **Characteristics** | | | | |
|---|---|---|---|---|
| Cover | woody structure | pool depth | boulders & wood | wood, volume, boulders |
| Channel profile | flat | moderately flat | steep | undercut banks |
| Riparian | Presence of riparian vegetation important for all species. Vegetation type (fir, alder) and age of vegetation determine quality. | | | |

*Stream Scene, Oregon Dept. of Fish & Wildlife, 1992*