RIPARIAN ECOSYSTEM FIELD STUDY

Objectives:
The objective of this station is to provide students with an opportunity to:

1) Explore the riparian and aquatic ecosystems in the riparian area,

2) Understand the link between riparian and stream ecosystems with the focus on the four most important components that riparian areas provide to create fish habitat and maintain water quality:
a. Shade
b. Food sources
c. Erosion control
d. In-stream structure

3) Consider the intersection of the riparian zone with the upland forest.

Activities:
There are different ways to explore riparian areas. The following six activities can be used (in any combination, feel free to use one or many) to give students an awareness of what the riparian area of a stream "looks like," and how the components of the riparian area affect Salmon. For instance, students may use the Riparian & Aquatic Area Survey to gain a general idea of the components that constitute the riparian area, then use the Riparian Mapping Activity to illustrate specific components of the riparian area that they think are important. The Soil Survey activity helps students to examine what is right under their feet and the Canopy Cover Survey guides them to look up! By evaluating what is above and below them, students are encouraged to consider how all elements of the riparian zone interact and play important roles in the creation of healthy habitat conditions for salmon and steelhead.

Note: Volunteers are responsible for communicating with the teacher to ensure that students will have the appropriate datasheets for each activity that the teacher wants covered.

Riparian & Aquatic Area Survey
Riparian Area Transect
Riparian Mapping
Riparian Profile
Soil Survey
Canopy Cover Survey

<u>Teaching Tips</u>
Through each of the above activities, (or through any combination of the activities) students should leave the Riparian Ecosystem station with a basic idea of what the riparian area is, how it relates to salmon, and why healthy riparian

ecosystems are important to the health of both the streams and the animals that live there.

In addition, and wherever possible, information that connects to the other three stations (water quality, macroinvertebrates and fish biology) should be emphasized so as to paint the most complete picture possible for students, so that they understand that the concepts covered at each of the four stations are interrelated.

Materials:
All necessary materials are listed within each activity below and on the Riparian Data Forms in the “What You Need” section of each form. Data Forms can be found at the end of this section and in the Field Trip Data Forms section of the binder.

Procedure:
All procedures are listed throughout the section within the specific riparian activities below.

For Discussion/wrap up: All discussion suggestions are listed throughout the section within the specific riparian activities below.

RIPARIAN & AQUATIC AREA SURVEY

Objective: To give students an introduction to common components which constitute the riparian and aquatic zones.

Outcome: Students will complete each of the survey categories below, and answer the wrap up questions.

Materials:
Riparian & Aquatic Area Survey (data form is available at the end of this section and in the Field Trip Data Forms section)

Form ID books/charts.

Procedure:

1) Direct students (either individually, in pairs, or in small groups) to complete the survey and answer questions.

2) Gather group together to share.

Riparian & Aquatic Area Survey Discussion Questions:

1) What features of this riparian area do you think are the most significant? Why?

2) What important features seem to be missing? How does this affect the stream (and salmon)?

3) In what ways do salmon affect this riparian area?

4) How is this riparian area similar to riparian areas near your school? How is it different?

RIPARIAN AREA TRANSECT ACTIVITY

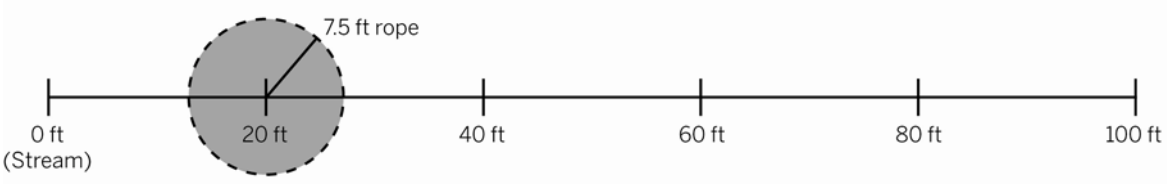
Objective: To provide students with an opportunity to 1) explore the riparian area of a stream, and 2) identify and discuss differences in the components of the riparian area that they observe.

Outcome: Students should leave this activity with an awareness of what the riparian area of a stream “looks like,” and some specific examples of its components.

Materials:
100-foot tape measure
15-foot rope with a ring attached in the middle of its length
Instructions
Data sheet (data form is available at the end of this section and in the Field Trip Data Forms section)
Plant and tree identification books or charts.

Procedure: Look for a place where students can get down to the shoreline safely. Students will set up a transect and count conifer and hardwood trees, shrubs and percentage of land occupied by grasses along the transect at each location.

1) **Set the transect.** Organize the students into pairs. Assign one pair to stretch the transect tape measure from the water's edge or a clearly discernible high water line perpendicular to the stream into the riparian area. They should hold the two ends so that the tape is stretched out to its full 100’ length. The tape is divided into five parts, each 20 feet long. These divisions arbitrarily mark off five 20-foot "zones" in the riparian area, "Zone 1," "2," "3," etc.



2) **Count trees.** Assign one pair to place the ring on the 15-foot rope over the transect tape. Start from the 0-foot mark, and walk parallel to the transect tape towards the 100 foot mark. Each time they reach one of the 20-foot marks, have them check to see if the rope touches any trees, shrubs, etc, by using the rope to measure out a circle with a diameter of 15 feet (an area with a radius of 7.5 feet, with the attached ring as the centerpoint- see diagram below.) Identify any plants within the diameter of the area that the rope covers. Then tell the recorders (see Data Sheet) whether the plants

are conifers or hardwood trees; shrubs; or types of grasses, and the zone that they are in.

3) **Record data.** Assign one pair to record data on the data sheet provided. The recorders should fill out the information about the transect site at the top of the data sheet, add their names at the bottom of the sheet, then record numbers and types of conifers, hardwood trees and shrubs, and percentage of land covered by grass as this information is called out. Additional comments about dead wood, side channels, etc., may also be recorded. Either during the data collection or after, the recorders enter data on the graph on the reverse of the data sheet. They do this by filling shading in the box above the appropriate zone in either the conifer or hardwood category. Shade one box per tree tallied.

Riparian Area Transect Discussion Questions: Ask the group to review the data and graph, and look for patterns and changes.

1. Are there any differences in the numbers and species of plants that were found the various "zones"? What may account for these differences?

Depending on the site, students may find that grasses and shrubs are most dominant in the zones closest to the stream, with hardwoods primarily growing in the "middle zones" and conifers growing farthest away from the stream. This trend is due to the different requirements that each species has for the amount of water it needs to survive and grow.

2. How does the riparian area influence the stream?

Riparian vegetation provides cover for aquatic and terrestrial animals. Shade created by the riparian vegetation moderates water and air temperatures. This vegetation also limits water contamination, and provides the organic debris that is a major food source for aquatic and terrestrial insects. In-stream wood slows water velocities, provides protection for juvenile fish and can protect spawning areas from being scoured out during high-water events, and filters and collects large amounts of sediment and debris.

3. How does the stream influence the riparian area?

The stream provides crucial water to the many various species of plants that rely on large amounts of water for growth. Seasonal flooding or high-water events may deposit sediment and nutrients into the riparian area. The stream is also a water source for the many types of wildlife that live in riparian areas.

4. What do salmon provide to the riparian area? Nutrients from salmon carcasses provide food sources for many animals (both aquatic and terrestrial) in the riparian area. Trees and plants also obtain nutrients from carcasses.

RIPARIAN MAPPING & PROFILE ACTIVITY

Objective: To provide students with an opportunity to 1) creatively explore the riparian and aquatic zones, and 2) identify and discuss important differences in the components of the riparian area that they observe from a “birds-eye-view” or “cross section”.

Outcome: Students should leave this activity with an awareness of what the riparian and aquatic zones of a stream look like and some specific examples of its important components.

Materials:
Riparian Area Profile and Mapping Data Form (data form is available at the end of this section and in the Field Trip Data Forms section)
Pencils

Procedure:
1) Give each student a copy of the Riparian Area Profile and Mapping Data Form.
2) Giving them clear boundaries, ask them to locate an area where they can sit and draw individually.
3) Give the students 10-15 minutes to draw a map or profile.
4) Regroup the students to share and discuss their maps.

Discussion: Ask the students to share their map or profile and discuss the important components of each.

SOIL SURVEY ACTIVITY

Objective: To introduce students to the importance of soil and why it needs to be studied. To guide students through soil survey and characterization activities to assess the types of soil present at their site.

Overview/Discussion: Students can begin to consi der why understanding soi l types is important. Students learn about the types of soil that are found in riparian areas, floodplains, and in streams. By char acterizing the types of soil pres ent at their Salmon Watch site using the soils characterization key to indentify the factors that form a unique soil pr ofile, st udents can unearth t he secrets that lie beneath their feet!

Outcome:
Students will understand the importance of soil science.
Students will be able to provide reasons for studying soil.
Students will understand how soil properties are determined by the seven soil forming factors.
Students will understand the types of soil and parent materials present at their stream study site.

Materials:
Riparian Soil Survey Data Form (data form is available at the end of this section and in the Field Trip Data Forms section)
Soil Auger
Spray Bottle

Procedure:
Identify a location where an auger can be used to expose a soil profile.

1) Remove the surface vegetation.
2) Place the auger at the top of the soil and turn the auger one complete revolution (360°) to dig into the ground. Do not turn the auger more than one complete circle (360°) to prevent the soil from being compacted.
3) Remove the auger with the sample from the hole
4) Keeping the soil sample inside the auger, identify if you have more than one soil horizon in your sample. If no, use the soil characterization key to identify your sample. If yes, use the soil characterization key to identify all different soil horizons.
5) For each soil horizon found, collect a small sample in your hand (about the size of a ping-pong ball). Using the spray bottle, moisten the soil and work between your fingers until it is the same moisture throughout. Begin the soil characterization key.

CANOPY COVER SURVEY ACTIVITY

Objective: To introduce students to the concept of a forest canopy and guide students to understand the role that the forest canopy plays in the health of the stream and fish habitat conditions.

Overview/Discussion: The overhead canopy cover in a forest plays an important role in affecting the amount of sunlight that reaches either the forest floor or the stream channel. In the forest, when a large amount of sunlight is allowed to penetrate areas of the canopy, a dense understory can develop. Along a stream, when a large amount of sunlight breaks through the forest canopy, the water in the stream may heat up more rapidly which can create conditions that are inhospitable for fish and other aquatic species. Scientists classify forest canopies as open (10-39% of the sky is obstructed by tree canopies), moderately closed (40-69% of the sky is obstructed by tree canopies) or closed (70-100% of the sky is obstructed by tree canopies).

A densiometer is used to measure the amount of light that penetrates the forest canopy. A simple densiometer is a device with a mirror apparatus inside that reflects the canopy above. It works somewhat like a periscope. The viewer sees a mirror image above, which allows him/her to estimate how much of the sky above is blocked by tree canopies.

Outcome:
Students will understand what a forest canopy is.
Students will conduct a survey to determine the density of the forest canopy at their study site.
Students will be able to make connections between forest canopy cover and stream health.

Materials:
Spherical Densiometer
Compass
Canopy Cover Data Form (data form is available at the end of this section and in the Field Trip Data Forms section)

Procedure:
With a partner take one sample of canopy cover in each cardinal direction.
1) Imagine your Spherical Densiometer (SD) has letters in each square proceeding alphabetically corresponding to the data sheet.
2) Hold the SD 12”-18” in front of your body at elbow height, so that operators head is just outside of grid area. Do your best to keep the SD steady by utilizing the provided level.

3) Tell your partner which lettered boxes to fill in based on the boxes covered more than 50% by shade. (Your partner may want to hold the data form up next to the SD to make it easy to relay the letter of the shade covered boxes.)
4) Repeat step 3 for North, South, East and West.
5) Add shaded boxes for all directions, the result is your estimated canopy cover for your location.

Functions of Riparian Vegetation as They Relate to Aquatic Ecosystems

Riparian Vegetation Site Component Function		
Above ground-Above channel	Canopy and stems	Shade- controls temperature and in-stream photosynthetic productivity Source of large and fine plant debris Source of terrestrial insects
In channel	Large debris derived from riparian vegetation	Control routing of water and sediment Shape habitat—pools, riffles, cover Substrate for biological activity
Streambanks	Roots	Increase bank stability Create overhanging banks--cover
Floodplain	Streams and low-lying cover	Retard movement of sediment, water, and floating organic debris in flood flows

Source: William Meehan et al., *Influences of Riparian Vegetation on Aquatic Ecosystems With Particular References to Salmonid Fishes and Their Food Supply*, 1977, p. 137.

Stream food chains depend on organic debris for nutrients. In small headwater streams, 99 percent of the energy for organisms comes from the vegetation along the stream, and only 1 percent from photosynthesis. The leaves, needles, cones, twigs, wood, and bark dropped into a stream are a storehouse of readily available organic material that is processed by aquatic organisms and returned to the system as nutrients and energy.

A diverse population of insects depends on this varied food base. Sixty to 70 percent of the debris is retained and processed in the headwaters by bacteria, fungi, insects, and abrasion, with very little leaving the system until it has been processed.

Riparian areas have a high number of edges (habitat transitions) within a very small area. The large number of plant and animal species found in these areas reflects habitat diversity. Since they follow streams, riparian areas are linear, increasing the amount and importance of edge effect. Extensive edge and resulting habitat diversity yield an abundance of food and support a greater diversity of wildlife than nearly any other terrestrial habitat.

Floodplains

Floodplains are an important part of a riparian area. Floodplain vegetation that shades or directly contributes material to a stream is considered part of the riparian area.

Stream channels rely on natural flooding patterns. Frequency of flooding and groundwater supply are the major factors controlling the growth of floodplain trees. Floodplains and backwaters act as reservoirs to hold surplus runoff until peak floods are past. This controls and reduces downstream flooding. Floodplains also spread the impact of a flood over a larger area as vegetation helps collect debris and sediment.

Composition of riparian plant communities depends on the water pattern (fast or slow moving or dry or wet periods). Both wet and dry phases are necessary in this area to complete the stream's nutrient cycle and food chain. Flooding is critical to the exchange of nutrients and energy between the stream and the riparian area.

When healthy, vegetated banks in the riparian area act as natural sponges. They help maintain soil structure, allow increased infiltration, and reduce bank erosion. Vegetated streambanks also contribute to aquifer (groundwater) recharge. Precipitation is filtered through the riparian soils and enters underground reservoirs called aquifers. Good cover slows the flow and increases percolation into underground aquifers. Stored water is then available during drier periods to maintain and improve minimum flow levels. A major benefit of this aquifer recharge is maintenance of year-round streamflow.

Riparian vegetation uses large amounts of water in transpiration. Often, vegetation needs the most water during the period of lowest streamflow. At these times vegetation may actually reduce streamflow.

Soils in riparian areas and floodplains

Soil types in both riparian areas and associated floodplains can tell a lot about the current and historic conditions of the stream. In addition to providing helpful information about current soil composition, an understanding of soil types can reveal the location of historic streambeds, floodplain location, and moisture content of the soil. Examining the types of rock materials found within the soil can unearth gravel, cobble, sand, loam, or clay. Certain soil types such as gravels and cobbles might indicate that you are standing on an ancient flooplain!

Wildlife in riparian areas

Riparian ecosystems provide the essentials of wildlife habitat—food, water, and cover. In general, the area within two hundred yards of a stream is used most heavily by wildlife. In western Oregon, of 414 known species of wildlife, 359 use riparian ecosystems extensively and 29 species are tied exclusively to this area. While riparian areas cover less than one percent of the land in eastern Oregon, 280 of 379 species use this area extensively.

Riparian areas provide migration routes and corridors between habitats for many animals. The riparian area provides cover, food, and water during these movements. Woody plant communities in the riparian area provide cover, roosting, nesting, and feeding areas for birds; shelters and food for mammals; and increased humidity and shade (thermal cover) for all animals.

Birds are the most common and conspicuous form of wildlife in a riparian ecosystem. In this important breeding habitat, as many as 550 breeding pairs have been found per 100 acres. Bird density is just one indicator of the

productivity of a riparian area.

Mammals of all sizes are found in riparian areas. Many rodents are parts of various food chains. Some, such as beaver, may modify riparian communities. Amphibians and reptiles are another indicator of riparian quality. Nearly all amphibians depend on aquatic habitats for reproduction and overwintering. Certain turtles, snakes, and lizards also prefer riparian ecosystems.

Animal populations in riparian areas are affected by the size and diversity of available habitat. Adjacent land-use activities may have a direct impact on wildlife population size within a riparian area. Fish populations can be an indicator of watershed and riparian ecosystem health. Large woody materials, such as fallen trees and limbs, create pools, and protective cover—necessary components of fish habitats. This woody debris also increases the diversity of invertebrates, which are a basic part of the food chain on which fish depend.

People in riparian areas

Since the land along streambanks and floodplains is often fairly flat, riparian areas are attractive locations for roads. Roadbuilding may increase sedimentation, which can adversely affect aquatic life, especially fish. Runoff from roads can carry oil, antifreeze, and other contaminants into the stream. Road construction can also damage valuable wildlife habitat. Traffic, a hazard in itself, may disturb or displace many wildlife species.

Roads probably have a greater and longer lasting impact on riparian areas than any other human activity. Routes should be selected and designed with careful consideration of potential long-term impacts.

Riparian vegetation is often cleared for farming purposes. This often weakens bank structure, making it more susceptible to erosion and a contributor to sediment deposition downstream. Landowners who convert riparian areas to farmland for short-term gains in agricultural production may lose in the long run. The loss of vegetation on stabilized banks could cause the stream to wash away that same valuable land during periods of high flow.

Livestock, like wildlife, area attracted to shade, water, and forage in riparian areas. If mismanaged—allowing the area to be grazed excessively or at the wrong time—livestock can severely affect the riparian area's value. Livestock can compact the soil near the water, reducing its infiltration capacities. When riparian vegetation is damaged—either by trampling or overgrazing—shading is reduced, erosion potential is increased as streambanks slough away, water tables are lowered, and water quality is affected. Animal wastes may also threaten water quality. Livestock can be managed, thus the impact of livestock can be reduced by controlling access and grazing levels along stream banks. By utilizing good management techniques, ranchers can actually increase economic gains as well

as enhance the value of their property.

Residential and commercial development has occurred near riparian areas throughout history. Development in these sites has generally degraded the value of the resources. Degradation has included filling and altering of stream channels, removing vegetation for building construction, and paving large amounts of land for roadways.

Some problems associated with development can be avoided by good planning and site design. Residential communities can be planned with riparian area values in mind. Construction sites can avoid steep slopes, wetlands, and sensitive biological sites. Areas that offer the amenities of a relatively healthy riparian area often have an increased real estate value.

Construction of campgrounds and recreation sites in riparian areas encourages use by anglers, birdwatchers, hikers, boaters, and others. This use, especially irresponsible acts like littering or erosion caused by improper use of off-road vehicles, may conflict with the welfare of wildlife and reduce water quality.

Streams and their riparian areas are the source of domestic water for many cities. High water quality is important for these uses. To maintain it, riparian areas must be carefully managed. Mining in and near streams has severe impacts on riparian ecosystems. Mining often increases sedimentation and disrupts spawning areas by moving large amounts of gravel, rock and soil. In addition, mining may introduce poisonous or toxic heavy materials into streams.

Forest canopy in riparian areas

The upland forest that sits adjacent to the riparian area along a stream provides an important function. Although it is not directly connected to the stream, the upland area that contains taller trees also provides valuable shade that keeps streams cool. A dense overhead canopy cover can shade the riparian area as well as the stream channel to reduce the potentially harmful effects of water warming from the sun. By assessing the canopy cover, or density of shading that is associated with upland trees, instream and riparian health can be better understood.

Timber harvest in riparian management areas

Timber harvest in riparian areas requires careful management. Until the Oregon Forest Practices Act, which regulates state and private land, was enacted in 1971, clearcuts commonly went to the stream's edge. In addition to removing trees that shade streams, the understory and groundcover were heavily damaged. A future source of woody debris in streams was eliminated and erosion increased. Historically, direct destruction of spawning grounds occurred by dragging logs through streams, building roads along banks, and transporting logs down streams and rivers. These practices affected water flow, bank erosion,

siltation, and temperature fluctuations.

Modern forest management calls for the maintenance of vegetation buffer strips along the sides of streams, lakes, estuaries, and wetlands. These riparian management areas (RMAs) are designated by the Oregon Forest Practices Act, the State Board of Forestry, and federal management agencies because they protect fisheries, domestic water supplies, and recreational water use.

A riparian management area includes both sides of a stream and usually includes the riparian area and riparian area of influence. Its width on each side of the stream is required by law to average three (3) times the stream width. It cannot average less than twenty-five feet, nor require an average of more than one hundred (100) feet. Width may vary with terrain and other circumstances and is generally the average width over the length of the stream where logging operations will occur.

Not all streams are protected, however. To qualify for protection, streams must fit guidelines set by the Oregon Forest Practices classification system. Under the Oregon Forest Practices Act, all forest activities—including road-building, timber harvesting, chemical use, and slash disposal—must be planned, approved, and completed in a manner that protects riparian areas, as well as other forest resource sites. The act is enforced and records show that only a very small number of forest operations are conducted in violation of the Act's rules.

The Oregon Forest Practices Act provides other regulations for responsible timber harvest management. Seventy-five percent of the initial shade potential that existed over an aquatic area must remain to protect stream water temperatures. Fifty percent of the original tree canopy material must be left to provide organic material essential to a stream and a source of insects for fish food. All downed timber in an aquatic and riparian management area is to be left to provide instream structure as habitat for fish and aquatic insects and den sites or burrows for other forms of wildlife. All snags (dead standing trees) not designated as a safety hazard, as well as future down logs or instream woody debris, must be left to provide habitat for insects, birds and small animals. Live conifer trees must be left in the riparian management area, preferably in clumps, to provide better wildlife habitat.