Riparian areas

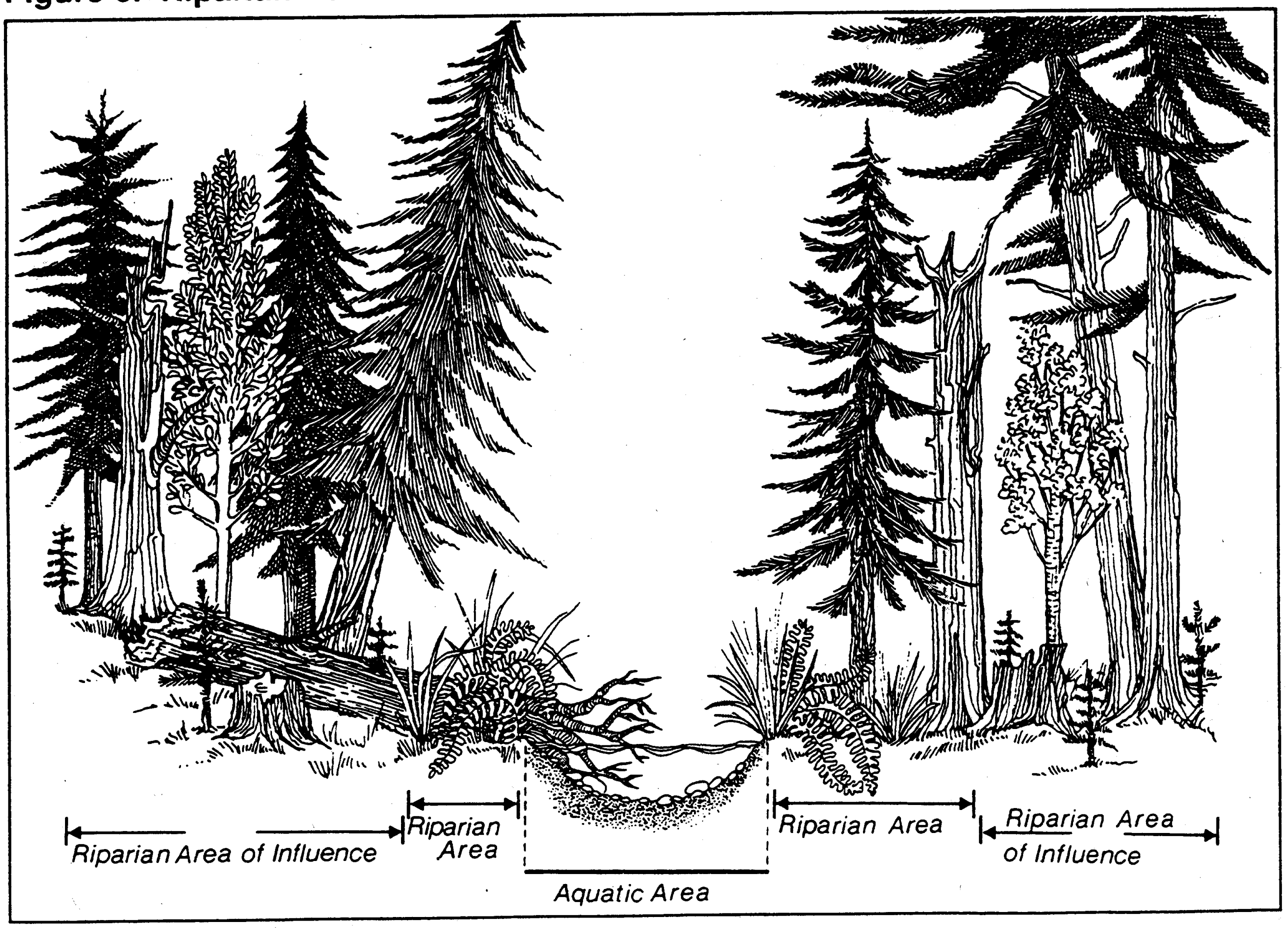
"Most people camp too close to the creek to make good coffee."
— Rube Long

Plants along the streambed influence the entire stream ecosystem. This green zone is called a **riparian area** (figure 6) and has several unique properties. A riparian area is linear, has a water transport channel and floodplain, and is interrelated with upstream and downstream ecosystems.

Riparian habitat is a combination of three areas. Each is distinctive and contributes to the entire ecosystem.

Aquatic area: The aquatic area of streams, lakes and wetlands is generally wet. During dry periods, aquatic areas have little or no water flow. Any side channels or oxbows containing freshwater ponds are included in this area.

Figure 6. Riparian Habitat



Riparian area: The riparian area is a terrestrial zone where annual and intermittent water, a high water table, and wet soils influence vegetation and microclimate.

Area of influence: This is a transition area between a riparian area and upland cover. An area of influence has soil moisture and is characterized by a noticeable change in plant composition and abundance. Trees in this area contribute shade, leaves, woody debris and insects to a stream. In the Pacific Northwest, the area of influence includes ground covers, shrubs and understory trees (usually deciduous) on the floodplains, and canopy trees (usually coniferous) on hillsides. This stair-stepping of vegetation provides a variety of wildlife habitat.

Role of riparian vegetation

Riparian vegetation (figure 7) provides cover for aquatic and terrestrial animals. Shade created by the riparian vegetation moderates water and air temperatures. This vegetation limits water contamination, slows water velocities and filters and collects large amounts of sediment and debris. Uncontrolled sediments can kill fish and destroy spawning areas.

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 at least partially 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.

Figure 7. Functions of Riparian Vegetation as They Relate to Aquatic Ecosystems

Site	Riparian Vegetation: Component	Riparian Vegetation: Function
Above ground-above channel	Canopy and stems	• Shade—controls temperature and instream photosynthetic productivity • Source of large and fine plant detritus • 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 canopy	• Retard movement of sediment, water and floated 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.

Water wigglers

Do you know . . .

Gazing into the cold water of a small stream in winter reveals little animal activity. The stream, like the woods around it, seems lifeless. But take a closer look. Skeletons of leaves with only the main ribs remaining provide evidence of animal activity. What happened to these leaves?

The leaves are eaten by aquatic invertebrates, especially insects, that spend most of their lives in water. They change their form, grow wings and emerge from water only during spring or summer when they mate.

During late fall and winter, small streams in wooded areas are menageries of aquatic insects. This is because most of the leaves and wood (containing energy for the insects) fall into the stream during this time. At other seasons of the year, you would probably find a different assemblage of animals.

If you were to collect a handful of leaf litter or a rock from the stream or kick up some bottom material from under rocks and let the current carry the material into a fine mesh net, you would be able to collect a wide range of insects you probably had not known were present. These insects can be placed into groups according to how they feed (functional feeding groups) as explained below:

Shredders: Feed on leaves or wood that falls into streams and eat the softer plant material, leaving the leaf skeleton.

Aquatic Insect Guide

Builds a portable "house" or case to live in	Caddisfly
If case is made of material that was once living (wood, leaves, etc.)	Shredder
If case is made of mineral material (rocks, sand grains)	Scraper
Has two tails, without abdominal gills	Stonefly
If dark and uniformly colored	Shredder
If large and brightly colored and/or mottled	Predator
Has three tails (sometimes two), with abdominal gills	Mayfly
If flat, sometimes egg-shaped	Scraper
If cigar-shaped	Gathering Collector
Worm-like, without true legs	Flies
If <1 cm long, 1 pair stubby "legs," head well developed	Gathering Collector (Midge)
If >1.5 cm long, head reduced, often found in leaf litter	Shredder (Cranefly)
Antennae modified as tiny fans	Filtering Collector (Blackfly)
Free-living, 3 pairs of legs	Odonates/Beetles
If large, with gills at end of abdomen	Predator (Damselfly, Dragonfly)
If no gills, usually tough outer covering, jaws often easy to see	Beetles
Dark brown; tough outer covering	Gathering Collector (Riffle Beetle)
Color varied; abdomen soft-bodied	Predator (Beetle)

Adapted from: Bill Hastie, "What Wiggles in Winter Water," *Oregon Wildlife*, December 1983, p. 15.

Collectors: Feed on fine material in streams. Some filter the water for their food (filtering collectors), while others burrow in the stream bottom, feeding as they go (gathering collectors).

Scrapers: Feed by scraping the surface of rocks and logs, removing algae.

Predators: Feed on insects and other invertebrate animals.

Use the guide (p. A9) to help you discover what kind of insects live in your stream. Remember, this is only a general guide; it will help you identify most insects to a particular group. Ask your instructor for other references.

Now it's your turn . . .

What are those things wiggling in the water? What are they doing? In this activity you will learn about aquatic insects, how they feed, and the role they play in a stream.

Freshwater invertebrates, especially insects, are a major food source for fish. In the same way food availability affects the distribution of fish in a stream, invertebrates live in that part of the stream that provides the right food source.

1. When you arrive at the stream, look for different habitats where fish and insects live. Examples are pools where the water is deep and the surface is fairly quiet, riffles where the water is shallow and ripples over the rocks, and backwaters at the stream's edge that are shallow and quiet. These habitats are identified primarily on the characteristics of water flow. The size of rocks in the stream, the amount of leaf or fine woody litter, and large woody debris (branches or logs) also help determine the distribution and abundance of invertebrates.

2. Take samples from each of the habitats you find. Using a D-frame aquatic sampling net (or other collecting device), collect a sample from a 1-square-foot area immediately upstream from the net opening.

As you collect in the sample area, be aware of the several microhabitats listed below that serve as homes for aquatic invertebrates. If present, include these in your sample.

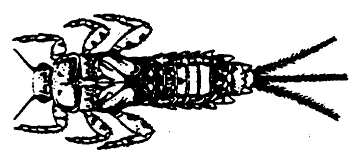
- **Coarse organic matter**—Primarily leaf, needle and fine wood litter (>1 millimeter diameter).
- **Fine organic matter**—(<1 millimeter to 0.45 millimeter). Stir up the bottom to a depth of 1 to 2 inches, allowing the current to carry particles and organisms into the net.
- **Rocks**—Remove insects by rubbing with your hands or scrape the rocks with a razor blade. Allow the current to carry invertebrates into the net.
- **Large wood**—Water-logged branches and logs.

Invertebrates are often found in patches, so *at least three samples per habitat* would be ideal to get an average count per habitat.

3. Samples from each habitat should be washed into a 1-millimeter sieve. Wash the material from the sieve into an enamel tray or shallow pan. Use a key to separate invertebrates into functional feeding groups: shredders, scrapers, filtering collectors, gathering collectors, predators.

4. Count the kinds of invertebrates and the numbers of each kind for each functional feeding group. Enter these numbers on the data sheet. From these numbers, the percentage of each group/habitat will be calculated.

For a better idea of the variety of organisms, list invertebrates within each functional feeding group by "kind." Riffle beetles and mayflies are different kinds. If you can tell two different types within a "kind"(e.g., two different caddisflies), but do not know the specific names, simply list them as "caddisfly A" or "caddisfly B."



Team members ______________________

Date ______________
Stream ______________
Site ______________

Data sheet for feeding groups

Numbers of Organisms/Functional Feeding Group

		Habitat type:		Habitat type:		Habitat type:	
		Kinds	Numbers	Kinds	Numbers	Kinds	Numbers
Shredders							
Filtering collectors							
Gathering collectors							
Scrapers							
Predators							
Miscellaneous							
Substrate (% composition)	Boulders (>12")						
	Cobble (3"–12")						
	Gravel (0.2"–3")						
	Sand } <0.2"						
	Silt } <0.2"						
	Clay } <0.2"						
	Organic material						
Notes							

Questions

1. Would a riffle habitat aquatic insect sample containing 1,000 blackfly larvae (filtering collector) show a greater diversity than one containing several species representative of all four functional feeding groups (shredders, grazers, collectors, and predators)? Why or why not?

2. What kind of stream habitat conditions could contribute to low aquatic insect diversity?

3. What kind of stream habitat conditions contribute to a high aquatic insect diversity?

4. Which functional feeding group would you expect to be predominant in a small stream with a nearly closed canopy of deciduous trees? Why?

5. A slow-moving, shallow stream with a muddy bottom would best support which functional feeding group? Why?

6. Describe a stream situation that would illustrate prime habitat for the greatest diversity of aquatic insects.

Riffles and pools

Do you know . . .

All Pacific salmon are **anadromous**. They begin their lives in freshwater, migrate to the ocean, and return to freshwater to spawn and die. Salmon are important to Oregon's commercial and recreational fisheries.

The salmon life cycle begins when eggs are deposited and fertilized in the gravel of cool, clean rivers and streams. Until they hatch, the cold (40° to 65°F) water flowing through the gravel delivers oxygen and carries away wastes. The gravel itself protects the eggs from predators.

In late winter or spring, the eggs hatch. The young fish, called **alevins**, are less than one inch long. They still depend on cold, well-oxygenated water for their survival and stay in the gravel for shelter. During this time they are fed from a **yolk sac** that protrudes from their bellies. As the yolk sacs are used up, the fish, now called **fry**, emerge from the gravel in late spring or summer, approximately one to three months after hatching.

The fry of some species head directly for the sea, but others might stay in freshwater for a few months to a few years. Fry depend on streamside vegetation and the turbulent water at the beginning of pools for cover. Aquatic invertebrates provide most of the food for salmon fry.

When they are ready to migrate to the sea, they go through **smoltification**, a physiological change, and are known as smolts. Smolting prepares them for life in saltwater. Once in the sea they spend up to five years, depending upon the species, feeding and growing before they are ready to return to fresh water.

Salmon return to spawn in the same stream where they hatched. No one knows for certain how they find their way back to the same stream, although one theory is that they can smell or actually taste the water chemistry of their home stream. When they enter fresh water, salmon stop feeding. Their journey upriver is made on the energy stored while living in the ocean.

Salmon spawning beds are generally found in the shallow headwaters of a stream and other suitable areas in the mainstems of streams. Weeks or months after they have reached the gravel beds, the female digs a nest, or **redd**. Here she deposits up to 5,000 eggs. The male fertilizes the eggs by covering them with **milt**, a milky substance that contains the sperm. The female finishes the spawning process by covering the eggs with gravel. After spawning, the salmon's life is finished. Within a short time, it dies and the carcass drifts downstream, decaying and contributing its nutrients to the stream from which it originally came.

Note: Trout, with the exception of steelhead and some cutthroat, are not anadromous. However, they are closely related to salmon and have needs similar to those of salmon during their time in fresh water.

Now it's your turn . . .

Think about the last time you were at a stream. Let's review some of the things you might have observed or remember about good fish habitat.

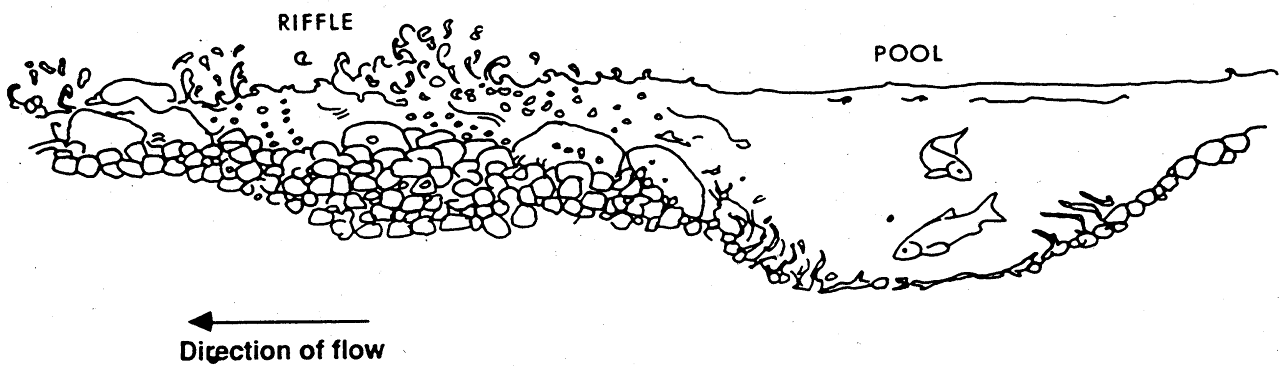
- What is dissolved oxygen? Why is it important to streams and fish?
- What are pools? What are riffles? What kind of habitat do they provide for fish? Since salmonids spawn in gravel, and gravel is usually found in riffles, riffles are often called "spawning habitat." The amount of gravel and riffles in a stream (if of good quality) determine the number of salmonids that can spawn there. The places in a stream that provide a place to eat, a place to rest, and a place to hide are called "rearing habitat."

- Stonefly and other aquatic insect larvae live on, around, and under rocks in the bottom of a stream. Some are shredders, feeding on decomposing leaves. Others are scrapers, grazing on algae growing on the rocks. Still others are predators that eat other invertebrates. To move to new rocks these aquatic insects detach themselves and drift downstream. Because they are carried by the current, most are found where the current is strongest. Salmonid fry eat these larvae (or floating sandwiches) as they drift past.

Look carefully at the drawings. Answer the questions based on your own experience and the introductory information in this exercise.

Questions

Refer to this diagram as you answer questions 1 and 2.



1. Will the dissolved oxygen concentration be higher at the bottom of the pools or in the riffles?

2. Which would give more shelter or protection to salmonid eggs, pools or riffles? Why?