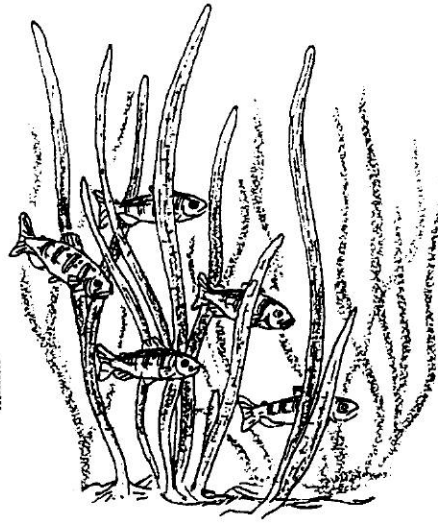


Teacher Background

Estuary

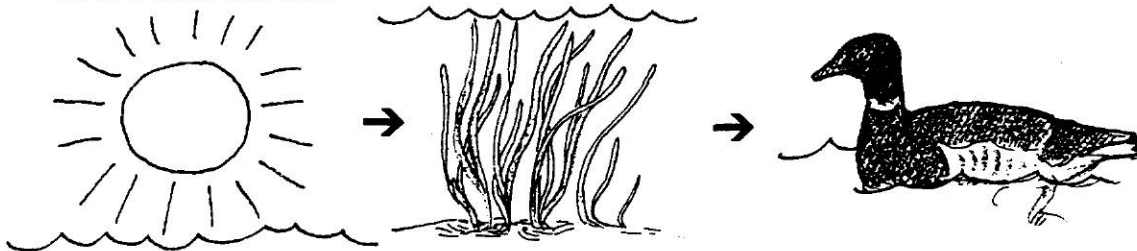


Every animal lives within its own specific habitat, i.e., the environment or "neighborhood" in which it lives. An animal's habitat satisfies its many survival needs including those for food, water, oxygen, and shelter.

Pacific salmon are unusual in that they actually have three discrete habitats during their life cycle: streams or rivers, the ocean, and the estuary where they make the transition between river and ocean and back again. Salmon find themselves under different pressures in each of these three habitats. We have discussed some of the pressures on salmon in the ocean and in the river. In the next four lessons the importance of the estuary habitat is presented.

Estuaries, the mixing zones where rivers flow into the sea, rank beside tropical rain forests as the most productive ecosystems on earth. A river is like a conveyor belt which carries dissolved and suspended materials downstream to the river mouth. When river water comes in contact with sea water, much of a river's particle load may be dropped, both by the slowing of the water and by chemical interactions with salt water. An estuary receives the fine particles carried by the river, but also many nutrients, and the result is often a shallow, fertile environment flushed by tidal action which can support dense stands of eelgrass and salt tolerant marsh grasses. Sheltered by this vegetation is a teeming community of small fishes and invertebrates which provide the food supply needed by the salmon smolts as they leave the river and prepare to venture into the marine environment. This estuary habitat can be so favorable that some species of salmon stay in an estuary for up to a year before continuing on to the ocean.

The estuary food chain is an important concept introduced in ESTUARY, the first lesson in this sequence. Living things are intimately connected to what they eat and to the organisms that prey upon them. We can represent these relationships using arrows to signify ". . . is eaten by . . ." A simplified food chain used in this lesson looks like this:

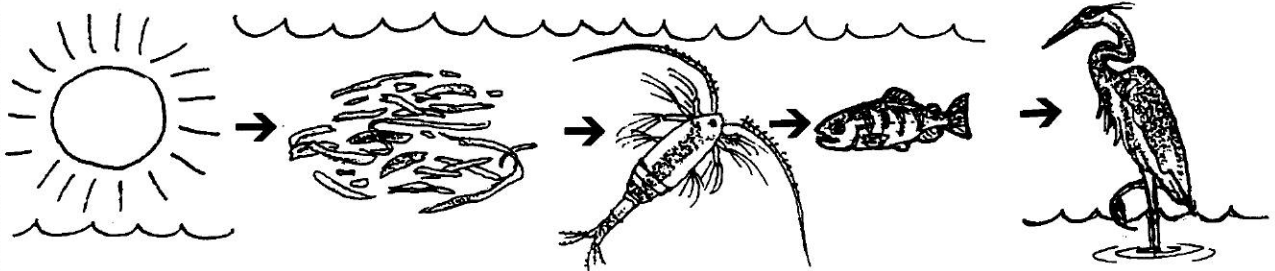


In this foodchain, the sun's energy is captured in the eelgrass. Some of the energy is transferred to the black brant when it eats the eelgrass. Thus the arrows in a food chain also represent energy transfer.

A more typical foodchain in an estuary begins not with living eelgrass as in this example, but rather with dead eelgrass or other vegetation.

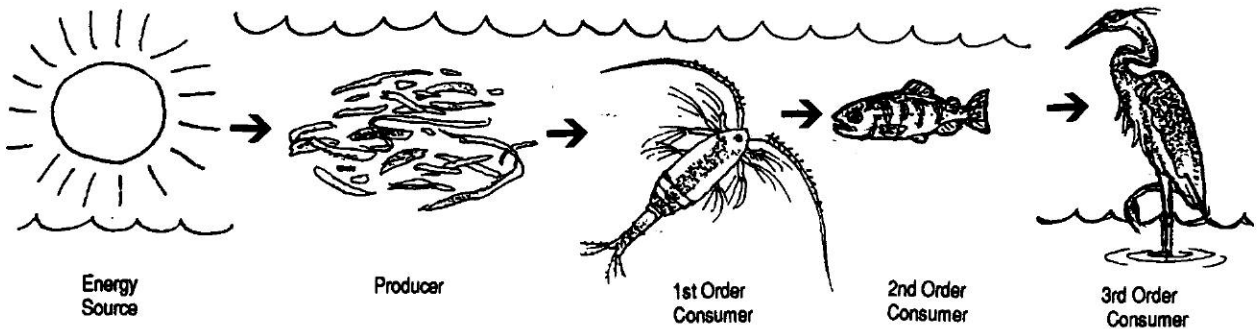
Throughout this lesson the term "detritus" is used for this dead organic material, that is, partially decomposed plant and animal remains. Detritus is an extremely important food source of in an estuary. Only a few animals such as the black brant feed directly on the large volumes of seagrass and algae produced in an estuary, but nearly all estuary animals eat these plants indirectly after they have become detritus. Detritus is processed in large quantities by a myriad of tiny invertebrates, including the important food animals for salmon.

One such detrital food chain might look like this:

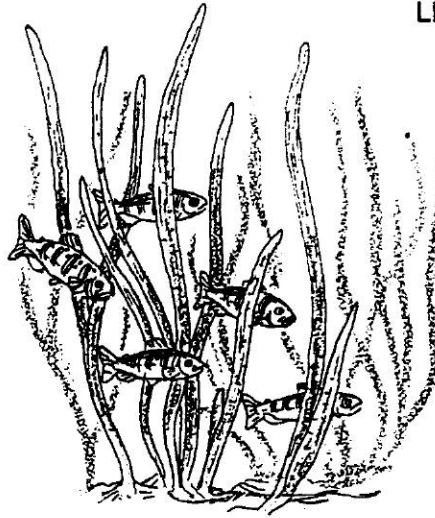


In this food chain, the sun's energy is stored in the tissues of eelgrass. After it is dead, the eelgrass is eaten by copepods, tiny relatives of shrimp which are abundant in estuaries. The copepods are eaten by salmon smolt, which are in turn consumed by herons.

The four organisms above occupy positions in the diagram called *trophic levels*. Trophic levels are discrete steps in the transfer of food energy from plants which first produce it through each of the organisms which use it. For example, we call eelgrass the "producer," because it is the original producer of all the food energy flowing through this chain. Copepod is the "first order consumer," the first to consume the food energy, while salmon smolt is the "second order consumer," etc. In actuality, there may be a number of micro-organisms at work between the detritus and the copepods but these will be disregarded here for the sake of simplicity.



To assist you in teaching about food chains, several food chains are diagrammed on the graphic: ASSORTED FOOD CHAINS. You may turn these into transparencies, and possibly cut these into smaller units for matching or arranging exercises.



Lesson Plan

Estuary

Student Objectives:

- In this lesson and the three lessons which follow, students will examine the estuary environment as a habitat for salmon smolts and learn the importance of estuary wetlands for salmon and other wildlife.
- They will assemble a diagram of an estuary food chain which includes salmon smolt.

Materials:

- One copy per student, ESTUARY
- Graphic: ASSORTED FOOD CHAINS
- Optional Video: ESTUARY
(ESTUARY 91591 (VHS) 12 min. available from: your local ESD or film distributor. By Bullfrog 1979)

Procedure:

1. The optional film or video, ESTUARY, makes a good introduction to this important habitat. It is equally good shown at the end of this sequence of lessons to integrate all the concepts presented. You may, in fact, want to use it with your class more than once.
2. Introduce the concept of a food chain by using an example familiar to the students. The diagram below and some more typical estuary food chains are included in the graphic, ASSORTED FOOD CHAINS.

Grass → Grasshopper → Spider → Bird

Over the diagram, label the trophic levels in the food chain. Grass produces the food energy initially, therefore it is the "producer". Grasshopper is a "1st Order Consumer," Spider is a "2nd Order Consumer," and Bird is a "3rd Order Consumer."

Producer → 1st Order → 2nd Order → 3rd Order Consumer
Grass → Grasshopper → Spider → Bird

Ask the students where the energy in this food chain comes from originally. (*The sun*) Place the sun in the diagram before grass.

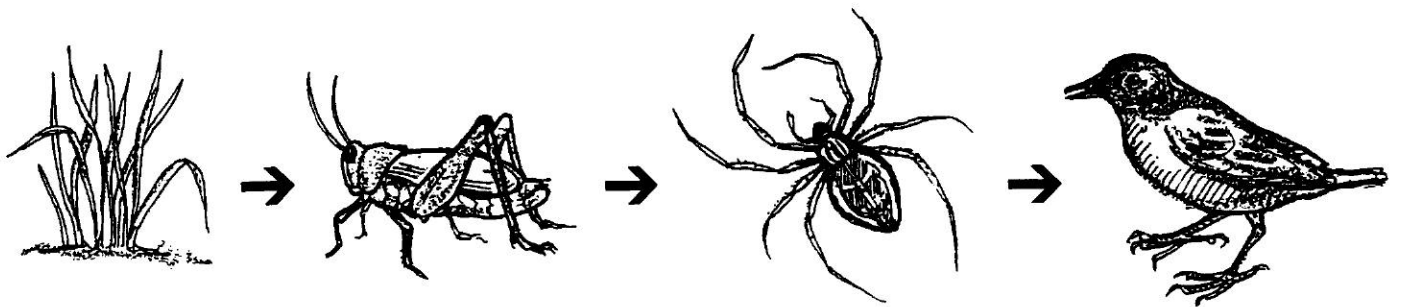
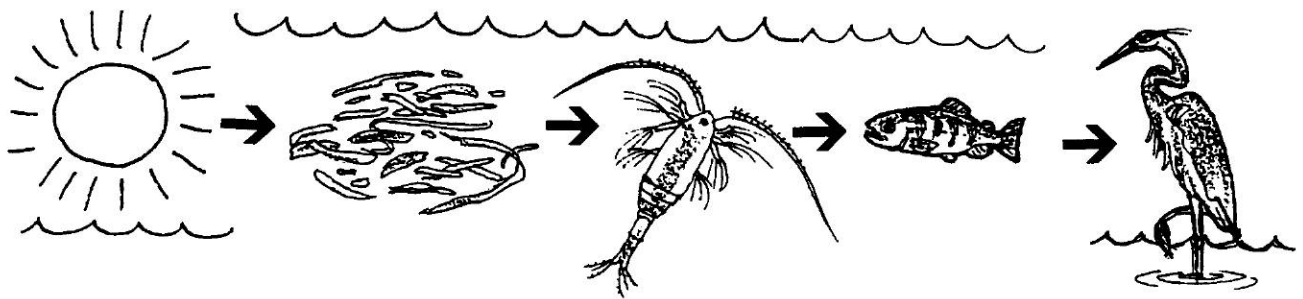
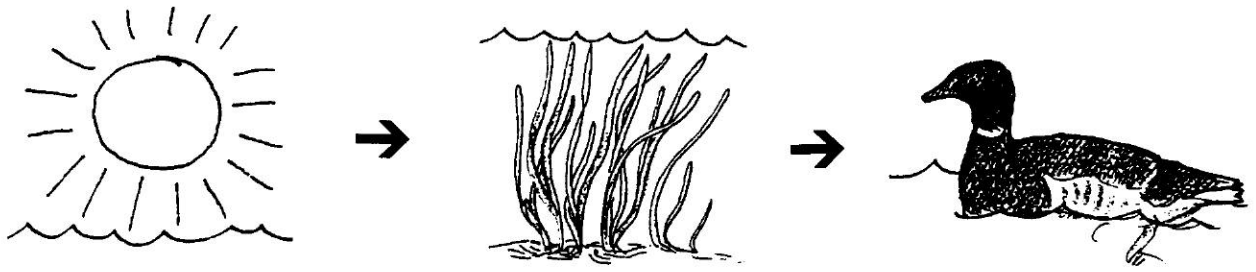
LESSON PLAN

3. Explain that in an estuary the most important producers are eelgrass and algae, but that most animals only feed on them after the plants are dead. Showing your students a container of partially composted leaves and grass may help them recognize that detritus is found on land too.
4. Assign your students the student text, ESTUARY, which includes the task of diagraming a salmon smolt food chain.

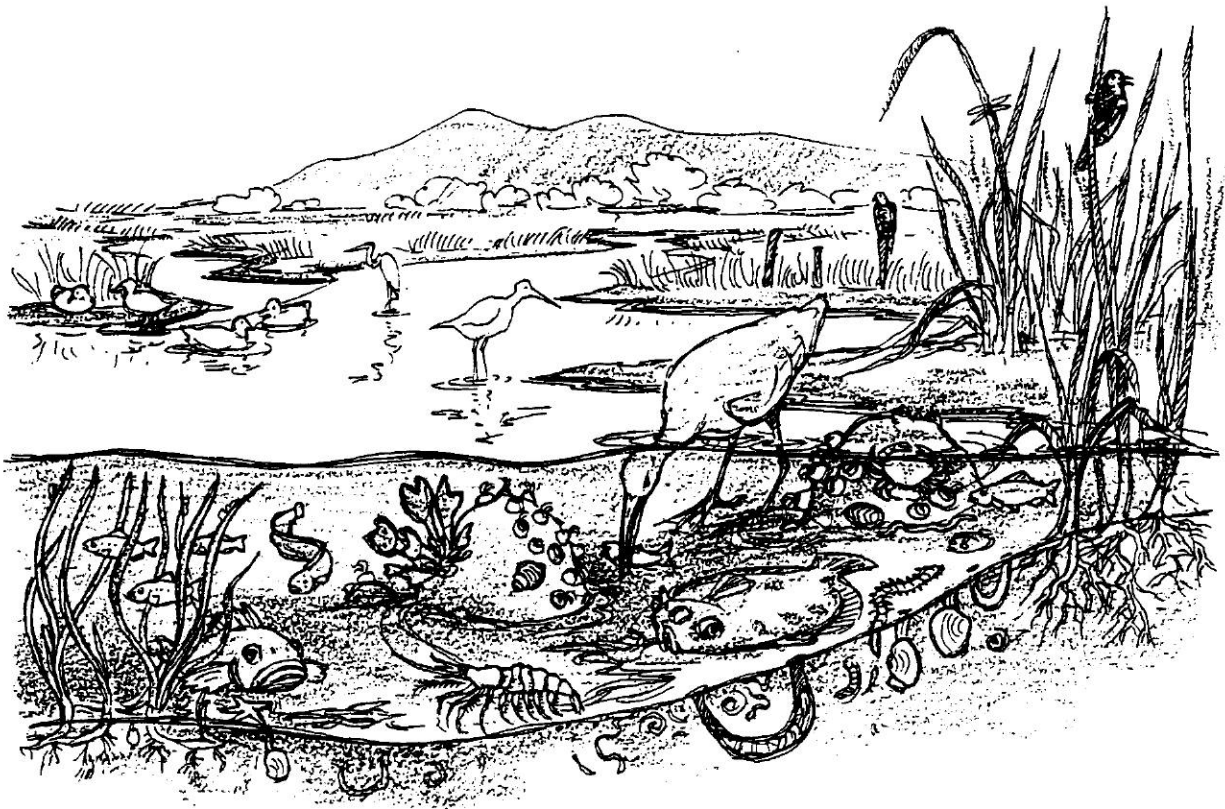
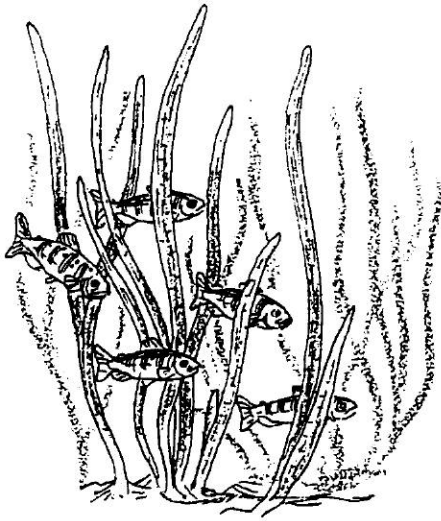
Answer Key:

1. salmon smolts
2. Puget Sound as a whole is a mixing zone of salt and fresh water.
3. Dead eelgrass (detritus)
4. Great Blue Heron

ASSORTED FOOD CHAINS



The Estuary



It is early summer again. It has been three months since thousands of tiny salmon fry wriggled out of the gravel on the bottom of the Skokomish River. If you had walked along the river's banks this past spring, you might have spotted them darting for cover or hovering quietly in the shadows.

Now they are quick, silvery fish about five inches long. Fat from feeding on tiny water bugs, they are finally ready to leave the river and begin the sea-going phase of their lives.

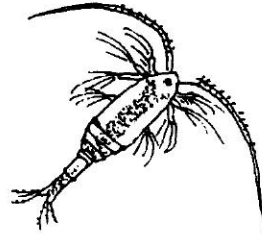
1. What are salmon called when they are ready to move from a fresh water to a salt water environment?

The young salmon are clustering near the wide, shallow region near the river's mouth, called an estuary. An estuary is a zone where fresh water from a river mixes with salt water from the ocean. Some parts of the estuary are under water at some times and out of the water at other times. These places are called estuarine wetlands. Estuarine wetlands are extremely important places for young salmon.

2. Some people refer to all of Puget Sound as an estuary. Why could they do this?

Estuaries are ideal environments for salmon as they prepare to make their ocean migration. Some salmon species stay in an estuary as long as a year before moving out.

As Hyak's children move into the estuary, they find their dinner waiting. The shallow water and muddy bottom is teeming with small, shrimp-like animals which eat dead eelgrass. One kind are called marine copepods, and the salmon smolt find them delicious.



As the small fish fill their bellies, some of them become a meal for other animals lurking in the estuary, birds like herons and kingfishers, or larger fish. We have a special name for the relationship of animals to the organisms they eat, and to the animals which eat them. We call this relationship a food chain.

On the work page you will find all the parts in the salmon smolt food chain. Cut out the parts and glue them in their correct positions on the following chart.

Energy Source	Producer	1st Order Consumer	2nd Order Consumer	3rd Order Consumer

3. Which organism first produced the food?

4. Which animal is at the "top" of the food chain (the last animal in the food chain)?

