Hooks and Ladders

(adapted from the book *Project Wild Activity Guide*, a Canadian Wildlife Federation publication)

Age: Grades 4-8

Lesson Plan Three: My Hero

Objective: To recognize that some fish migrate as part of their life cycle; to identify the stages of the life cycle of one kind of fish; to be able to describe limiting factors affecting Pacific salmon as they complete their life cycle; and to generalize that limiting factors affect all populations of animals.

Background: Everything I know about the life cycle of salmon came from my time spent at a local salmon hatchery in my neighbourhood. Having had many opportunities to sort salmon eggs, keep their environment clean, feed them and finally release them into a stream, I understand how so many limiting factors that they would encounter in the wild are eliminated in a hatchery. This exercise will give you an education in the reasons why so many salmon don't make it back to their spawning grounds where they first originated.

Additional Background: Many fish live part of their lives in one habitat and then migrate to another habitat. There are five species of Pacific salmon in North America; Chinook, coho, pink, sockeye and chum.

Once in the sea they spend several years reaching the maturity needed for their single return journey to their original hatching ground. Once there, the salmon spawn and die.

Salmon must face a myriad of hazards that serve as limiting factors in the completion of their life cycle. Sometimes the limiting factors are natural, and sometimes they result from human intervention with natural systems.

A female salmon will deposit 1,500 to 7,000 eggs in her freshwater spawn. Once the eggs have been deposited in shallow gravel and fertilized by the male they have completed their reproduction and soon die.

The eggs, before and after hatching, are susceptible to many limiting factors. Smothering silt can be washed in suddenly from watersheds damaged by a variety of land-use practices and events – including erosion following some road-building, logging

and fires. Predators can eat some of the eggs and damage hatching populations. Dropping water levels can isolate salmon offspring in streamside depressions to remain isolated and die. After hatching, the small fish – called "alevins"…begin their journeys. Some head directly to the sea. Depending on the species, young salmon may spend several months to as much as a year or more in the river before migrating to the estuary and then to the open ocean.

The small ocean-bound salmon, now called "smolts", are at once confronted by hazards on their downstream journey. Examples are dams; low water in streams; and predatory birds, mammals and larger fish. Up to 90% of the salmon that hatch never reach the sea.

When in the ocean, the salmon grow rapidly by feeding on the ocean's rich food supply. Predators such as sharks, killer whales and other marine mammals take their toll. In addition, humans fish for salmon commercially and for personal reasons, including food and recreation.

In two to five years, the Pacific salmon start the journey that will guide them back to the rivers and streams leading to their own hatching site. The upstream migration from the ocean is also a series of hazards. For example, dams hinder their journey and would block it completely if fish ladders were not installed. Fish ladders are water-filled staircases that allow the migrating fish to swim upstream around the dam. Humans who fish, eagles, bears and other predatory mammals also reduce the numbers along the way to the spawning ground. Sometimes landslides and log-jams provide unexpected new barriers. So too do the natural waterfalls and rapids that the now weighty salmon must overcome. Once back at the spawning ground the life cycle of the Pacific salmon begins anew. To maintain the Pacific salmon population, some biologists believe that only one pair of fish from each spawn must return to deposit and fertilize eggs.

Materials

A jump rope (3-5 metres long); about 150 metres of rope or string; traffic cones for marking boundaries (helpful, but optional; masking tape may be used if area is indoors); two cardboard boxes; 100 tokens (e.g. poker chips, unifix cubes) large playing area (30 metres X 15 metres)

Procedure

1. Begin by asking the students what they know about the life cycle of fish that live in their area. Do any local fish migrate to spawn? If yes, which ones? (Mullet, lake trout, striped bass, carp and salmon are examples of fish that migrate to spawn).

In this activity, students will learn about some of the characteristics of one species of fish that migrates as a part of its life cycle – the Pacific salmon.

2. Set up a playing field as shown in the diagram, including spawning grounds, downstream, upstream and ocean. The area must be about 30 metres by 15 metres. Assign roles to each of the students. Some will be salmon, others will be potential hazards to the salmon. Assign the students roles as follows:

- Choose two students to be the turbine team. These are the ones who operate the jump rope, which represents the turbines in hydroelectric dams. Later in the simulation, when all the salmon have passed the turbine going downstream, these students move to the upstream side to become the waterfall-broad jump monitors (see diagram).
- Choose two students to be predatory wildlife. At the start of the simulation, the predators will be below the turbines where they catch salmon headed downstream. Later in the activity, when all the salmon are in the sea, these same two predators will patrol the area above the "broad jump" waterfalls. There they will feed on salmon just before they enter the spawning ground (see diagram)
- Choose two students to be humans in fishing boats catching salmon in the open ocean. These students in the fishing boats must keep one foot in a cardboard box to reduce their speed and maneuverability.
- All remaining students are the salmon.

  NOTE: These figures are based on a class size of 25 to 30. If the group is larger or smaller, adjust the number of people who are fishing and predatory wild animals accordingly.

3. Begin the activity with all the salmon in the spawning ground. The salmon then start their journey downstream. The first major hazard is the turbines at the dam. At most dams there are escape wires to guide migrating salmon past the turbines. The student salmon cannot go around the jump rope swingers but they can slip under the swingers' arms if they do not get touched while doing so. A salmon dies if it is hit by the turbine (jump rope). The turbine operators may change the speed at which they swing the jump rope.

   NOTE: Any salmon that "dies" at any time in this activity must immediately become part of the fish ladder. The student is no longer a fish, but becomes part of the physical structure of the human-made ladders now used by migrating salmon to get past barriers such as dams. The students who are the fish ladder kneel on the ground, a body-wide space between them.

4. Once past the turbines, the salmon must get past some predatory wildlife. The predators below the turbine must catch the salmon with both hands – tagging isn't enough. Dead salmon are escorted by the predator to become part of the fish ladder. NOTE: Later, the salmon who survive life in the open ocean will use

the structure of the fish ladder – by passing through it – to return to the spawning ground.

NOTE: Both the predatory wildlife in the last downstream area and the people in the open ocean must take dead salmon to the fish ladder site. This gets the predators and fishing boats off the field regularly, helping to ensure a more realistic survival ratio.

5. Once in the open ocean, the salmon can be caught by fishing boats. The salmon must move back and forth across the ocean area in order to gather four tokens. Each token represents one year of growth. Once each fish has four tokens (four years' growth), that fish can begin migration upstream. The year tokens can only be picked up one token at a time on each crossing. Remember, the salmon must cross the entire open ocean area to get a token. The "four years" these trips take make the salmon more vulnerable, and thus they are more readily caught by the fishing boats. For purposes of this simulation, the impact of this limiting factor creates a more realistic survival ratio in the population before the salmon begin the return migration upstream.
6. Once four of the year tokens are gathered the salmon can begin upstream. The salmon must walk through the entire pattern of the fish ladder. This enforced trip through the fish ladder gives the students a hint of how restricting and tedious the upstream journey can be. In the fish ladder, predators may not harm the salmon.
7. Once through the ladder, the salmon faces the broad-jump waterfall. The waterfall represents one of the natural barriers the salmon must face going upstream. Be sure the jumping distance is challenging but realistic. The two former turbine students will monitor the jump. The salmon must jump the entire breadth of the waterfall to be able to continue. If the salmon fails to make the jump, then it must return to the bottom of the fish ladder and come through again.

   NOTE: When playing indoors, the broad-jump waterfall may be changed into a stepping stone jump defined by masking tape squares for safety on hard floors.
8. Above the falls, the two predators who started the simulation as the predators below the turbines are now the last set of limiting factors faced by the salmon. They represent bears – one example of predatory wildlife. Again, remember that the predators must catch the salmon with both hands. If they do catch a salmon, they must then take the student they caught to become part of the structure of the fish ladder.
9. The activity ends when all the salmon are gone before the spawning ground is reached – or when all surviving salmon reach the spawning ground.

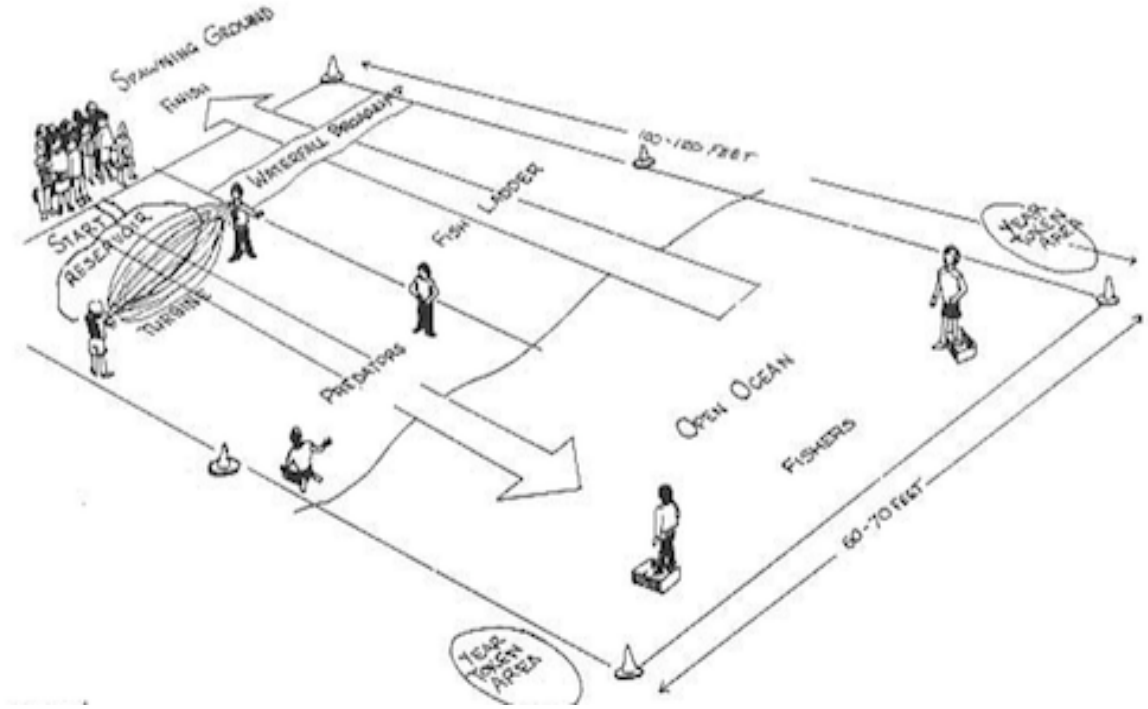
Next engage the students in a discussion. Explore topics such as:

- the apparent survival-mortality ratio of salmon
- the students' feelings throughout the activity
- the role of the barriers
- the role of the predatory wildlife and the people fishing
- where the losses were greatest
- where the losses were least
- what the consequences would be if all the eggs deposited made the journey successfully
- what seems realistic about this simulation and what did not.

Ask the students to summarize what they have learned about the life cycle of salmon, the salmon's migration, and limiting factors that affect salmon. Make sure the students have a clear working definition of limiting factors. Encourage the students to make the generation that all animals – not just Pacific salmon – are affected by limiting factors. Ask the students to give examples. They might mention availability of suitable food, water, shelter and space; disease; weather; predation and changes in land use as well as other human activities.

Extensions:

1. Write a report on the life history of one of the species of salmon. Create a mural showing the life cycle of this salmon.
2. Research and illustrate the life cycle of any local fish. If possible, look for one that migrates.
3. Visit fish hatcheries that work with migratory species and investigate how they function.



More info contact: info@enufsaid.com