commercial and personal use.

and humans who are fishing for salmon.

swordfish, killer whales, other marine mammals,

encounter many limiting factors, including

shrimp and crabs. Serving salmon may

on a net. Food supply level reduces other fish.

In the ocean, the salmon flow rapidly by feeding

A young salmon swim to the ocean

weeks of adjustment to the brackish water to

where fresh and salt water mix. After a few

weeks, the salmon will feed in estuaries.

Some, those salmon will stay in the ocean.

years before spawning downstream to the ocean.

feeding and gaining weight for many months or even

years. Salmon remain in freshwater streams

move into deeper water to find food on their

sea and the small fish known as "pox." The

form their young" pox. After a few weeks, the young

are released and strike for abundant spawning.

Newly hatch salmon, called "levens," live in

Reproduction cycle and soon die.

and female salmon have completed their

capable toreeze such as production of oxygen.

so that much production is possible. The eggs are

under the gravel bank over the creek to offer

deposited, the male fertilizes them. Then both

spawn, fertilizing the eggs, which are laid in the

The female deposits 1,000 to 9,000 eggs in her

the female cycle for Pacific salmon begins when

spectacular migration.

Salamon are examples of how another a

Many fish migrate from one habitat to another

Objective:

Ecology, population, migration, interaction,

Food chains, limiting factors

1. Describe limiting factors affecting

2. Describe migration patterns affecting Pacific

3. Describe the female cycle of one kind of fish.

Materials:

Large playing area (100 feet x 20 feet), two

Group size: 20 to 30 students or more

Duration: one 30-60 minute session

Environmental Education: Expressive Arts

Subject Area: Social Studies, Science,

grade level: 5-8

Books and ladders

Fold a slip of paper in half. Label one side

100 feet (3 x 5 cards, poker chips)

used if area is indoors) two cardboard boxes,

For making playing cards (masking tape may be

200 feet of rope or string of six plastic cones

conceptual framework, topic, reference:

Setting: outdoors or large indoor area

Appendix: Simulation, ecosystems

Key Terms: the cycle, limiting factors

The life cycle of Pacific salmon (masking tape may be

Students simulate the Pacific salmon as an activity portraying

Method:

Population of animals

- Describe the limiting factors affecting all

population as they complete the life cycle's and

describe limiting factors affecting Pacific

- the stages of the life cycle of one kind of fish.

IMPORTANT: be part of their studies. As

Students will (1) describe how some fish

- The life cycle of Pacific salmon begins when

speculative migration.

Salamon are examples of how another a

Many fish migrate from one habitat to another

Background
After 2 to 5 years in the ocean, the Pacific salmon begin the journey that guides them to their own hatching sites. Pacific salmon spawn only once in their lives. Salmon have an inherent ability to return to their original streams. Juvenile salmon imprint or memorize the unique odors of their home streams. As returning adults, they use their senses of smell to detect those odors and guide them upstream to where they were hatched. Once there, the salmon spawn and then die.

Salmon face a variety of limiting factors in the completion of their life cycle. A limiting factor is a reason or cause that reduces the population of an organism. Some limiting factors are natural, and some result from human intervention into natural systems.

Natural limiting factors include drought, floods, predators, and inadequate food supply. Throughout their lives, salmon depend on a habitat that provides plants to shade streams and deep pools of water for spawning and resting. Incorrect logging practices, grazing, mining, road building, and development often destroy streamside vegetation, erode land, and fill streams with silt that covers gravel beds.

Dams are another limiting factor that block or slow migration to and from the ocean. Salmon become disoriented by the reservoirs formed by dams and become exposed to unhealthy conditions like high water temperatures and predators. Fish ladders can be installed to help salmon through the dams. Fish ladders can be water-filled staircases that allow migrating fish to swim around the dam.

Another threat to salmon is overfishing. Overfishing, combined with habitat destruction, is viewed by biologists as a cause for the decline of salmon populations.

NOTE: All possible conditions are not covered by the design of this activity. However, the activity does serve to illustrate three important concepts: life cycle, migration, and limiting factors.
Procedure

1. Ask the students what they know about the salmon. Does the salmon migrate to the ocean and back to the ocean? Ask the students what they know about the salmon. Does the salmon need water to survive? Ask the students what they know about the salmon. Does the salmon need clean water to survive?

2. Set up a playing field as shown in Diagram B.

Procedure

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2. Set up a playing field as shown in Diagram B.
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 wildlife accordingly.

3. Begin the activity with all the salmon in the spawning ground. The salmon first move into the reservoir above the dam. They must stay in the reservoir while they count to 30. This pause simulates the disorientation that salmon face because of a lack of current in the lake to direct them on their journey. During this time the predators may catch the salmon and escort them one at a time, to become part of the fish ladder. The salmon then start their journey downstream. The first major limiting factor that the salmon encounter is the turbines at the dam. At most dams, escape weirs 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 the turbine (jump rope) hits it. The turbine operators may change the speed at which they swing the jump rope. 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 fish ladders now used by migrating salmon to get past barriers such as dams. The students who are the fish ladder kneel on the ground as shown on page 47, with one body space between them.

4. Once past the turbines, the salmon must pass some predatory wildlife. The predators, who have moved from the reservoir area to the area 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. Later, the salmon that survive life in the open ocean will pass through the fish ladder to return to the spawning ground. NOTE: Both the predatory wildlife in the downstream area and the people fishing in the open ocean must take dead salmon to the fish ladder site. This action moves the predators and fishing boats off the field regularly, helping to provide 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 1 year of growth. Once each fish has four tokens (4 years’ growth), that fish can begin migration upstream. The year tokens can be picked up only one at a time on each crossing. Remember, the salmon must cross the entire open ocean area to get a token. The “4 years” that these trips take make the salmon more vulnerable; thus they are more readily caught by the fishing boats. For this simulation, the impact of this limiting factor creates a more realistic survival ratio on the population before the salmon begin the return migration upstream.

6. When four of the year tokens have been gathered, the salmon can start 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 face the broad-jump waterfall. The waterfall represents one of the natural barriers salmon 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 on hard floors.
same limiting factors discussed in this activity. In varying degrees, they will face the challenges of fresh water and nutrient imbalances. Salmon, like the salmon, stripped bass, or striped bass reproduce in fresh water and migrate to and from salt water. The striped bass is more widely distributed than the Atlantic salmon. The striped bass, rather than salmon, is the striped bass recommended for this activity. The activity can also be adapted to other

Variation: Striped Bass

- What general principles about this species does this activity reinforce, and what does this activity reveal about the effectiveness of conservation measures? would it be all successful, and why? The losses were less, why? The losses were greater, why? The role of the predator is and why? The role of the parasites is and why? The apparent survival of the striped bass in this exercise suggests that the natural predators and parasites are able to keep the striped bass population in check. The activity also illustrates the importance of conservation efforts in maintaining healthy ecosystems. The activity can easily be adapted to other species and conservation efforts.

Variation: Atlantic Salmon

- Other human activities, such as delving of coastal areas and harvesting, and changes in land use and water quality affect salmon populations. The students can observe the changes in habitat and discuss their potential impact on the salmon populations.

10. Next engage the students in a discussion about how the salmon's environment affects their survival and the importance of conservation efforts. What can we do to ensure the future survival of the salmon? The activity ends when all the salmon are gone before the spawning ground is reached—students all wonder why is there no salmon?

9. Structure of the fish ladder

- The structure of the fish ladder is an example of how human intervention can help salmon migrate. The students can observe how the ladder works and discuss its importance in salmon conservation.

8. Above the falls, the two predictions were

Hooks and Ladders

Ecological Knowledge
Extensions

1. Write a report on the life history of one of the species of salmon (e.g., chinook or king, chum or dog, pink or humpback, coho or silver, sockeye or red, Atlantic). 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. Compare how the life cycle of a Pacific salmon is similar to and different from the life cycle of one or more local fish.


5. Visit fish hatcheries that work with migratory species and investigate how they function.

6. Explore ways that dams can be modified to let fish safely pass downstream and upstream. Design the “perfect” fish ladder.

7. Investigate and discuss commercial fishing for salmon. Investigate and discuss personal, including recreational, fishing for salmon.

8. Find out about laws protecting migratory species, including fish.

9. Consider this approach, and try the activity again:

In the past 100 years, salmon have experienced many new, human-caused limiting factors. Dams, commercial fishing, timber harvest, and road construction have had a tremendous impact on salmon populations. In 1991, the Snake River sockeye salmon was placed on the federal endangered species list. In the past, tens of thousands of sockeyes would make the 900-mile return trip from the sea to Idaho’s mountain streams and lakes. There they spawned and died. Their offspring hatched and began their early development in fresh water. The actual migration to the Pacific Ocean could be completed in as few as 9 days. Today that trip takes more than 60 days. In 1991, only four Snake River sockeye salmon returned to their spawning grounds.

To simulate these increases in salmon limiting factors, play several rounds of “Hooks and Ladders.” Allow each round to represent the passage of 25 years. Start in 1850. In that year, do not include dams or commercial fishing operations in the scenario. As time passes, add the human commercial fishing operations. Build dams (jump ropes) as the scenario progresses into the 21st century.

Describe some of the possible effects on salmon from increased limiting factors as a result of human activities and interventions. Discuss possible positive and negative effects on both people and salmon from these increases in limiting factors affecting salmon. When the activity reaches “the present,” predict what might happen to salmon in the future. Recognizing the complexity of the dilemma, discuss possible actions, if any, that might be taken to benefit both people and salmon.

10. Find out if salmon exist in your state. If so, are they native or were they introduced?

Evaluation

1. List, describe, and illustrate the major stages in a Pacific salmon’s life cycle.

2. Identify and describe some of the limiting factors that affect salmon as they complete their life cycles.

3. Identify and describe some limiting factors that might affect other animal populations.