

Hooks and Ladders!



Objectives

Students will: 1) recognize that some fish migrate as part of their life cycle; 2) identify the stages of the life cycle of one kind of fish; 3) describe limiting factors affecting American eels as they complete their life cycle; and 4) generalize that limiting factors affect all populations of animals.

Method:

Students simulate American eels and the hazards faced by eels in a physical activity portraying their life cycle.

Background

Many fish live part of their lives in one habitat and then migrate to another habitat. Some make their migratory journeys to mature and reproduce. Both the Atlantic and Pacific salmon are familiar examples of migrating fish, but the American eel is an example of a migrating fish which lives part of its life in West Virginia.

It is believed that American eels spawn only once in their lifetime. Encoded within their genetic fiber is an instinct that drives them from the time of hatching along a monumental journey from their saltwater spawning beds upstream into freshwater streams. Once in the rivers, they spend several years reaching the maturity needed for their single return journey to their original hatching ground. Once there, the eels spawn and presumably die.

Eels must face a myriad of

hazards that serve as limiting factors in the completion of their life cycle. Limiting factors reduce the populations of living organisms. Sometimes the limiting factors are natural and sometimes they result from human alteration of natural systems.

The female American eel produces more than 10 million eggs in late winter in the Sargasso Sea

continue their journey upstream.

As they head upstream, the eels still face dangers from predators. They also encounter dams, human-made obstacles to their journey. Eels have the ability to leave the water temporarily on damp nights and bypass small dams on land. Large dams however, may

pose insurmountable obstacles. To aid the upstream migrations of eels and other migratory fish, humans have constructed fish ladders at some dams. These ladders vary in design according to the fish species and size of the dam. "Salmon ladders" are a series of small, stair steps up which the fish can jump. Eel ladders are typically much simpler and may consist of a tube angled up the

dam with fabric inside on which the eels climb. Additional hazards for eels include low water in streams, and predatory birds, mammals, crabs, reptiles, amphibians and larger fish.

After living 20 or more years in streams throughout the eastern United States and eastern Canada, unknown factors cause eels to begin their return journey to the Sargasso Sea. Just before they begin their trek, they change color from a yellow-green into a bluish-silver, they stop eating, and their eyes grow larger. These changes aid them in their sole goal to reach their spawning grounds and reproduce. They usually travel by night, especially on



Young eels, or elvers gather at the base of a dam before going upstream.

located northeast of Puerto Rico in the Atlantic Ocean. The eggs, before and after hatching, are susceptible to many limiting factors. Predators eat some of the eggs. Instinct tells the newly hatched larvae to head toward the mouth of the Gulf Coast and Atlantic Coast rivers of the United States. Carried by ocean currents, the small eels take about one year to reach the American coasts. During this journey, they transform into a transparent, eel-like shape called a glass eel. Many eels meet their demise at the hand of natural predators along the way. Once they reach the mouths of the rivers, they transform again into tiny eels called elvers. The elvers



Eelers climb out of the water and up the slope of a dam.

ing boundaries -- sports field marking lime can also be used (masking tape may be used if area is indoors); two cardboard boxes; 100 tokens (3 x 5 cards, poker chips, etc.); jump rope

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? (Striped bass, suckers, carp and salmon are examples of fish that migrate to spawn.) In this activity, students will learn about one species of fish that migrates - the American eel.

2. This is a physical activity!

Set up a playing field as shown in the diagram. Assign roles to each of the students. 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.

- Choose two students to be predatory wildlife. At the start of the activity, the predators will be stationed in the open ocean to catch the eel larvae as they drift in the ocean currents toward the U.S. coast. After all the “eels”

have started their upstream journey, the “predators” wait in the ocean for the return of the adult eels on their way to the Sargasso Sea.

- Choose two students to be predators located between the eel ladder and the stream area.

- Choose two students to be humans catching eels in freshwater streams. These students must keep one foot in a cardboard box to reduce their speed (humans are less maneuverable in water than fish).

- All remaining students are eels.

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 eels in the spawning ground. When

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cloudy or moonless nights. Along the way, humans try to catch the eels to sell to markets, mainly in Europe. They still face the threat of natural predators. And on the way downstream they run into the same dams they successfully navigated (unlike many other eels) on their trip upstream. If the dam produces hydroelectric power, they may get washed into the spinning turbines and die.

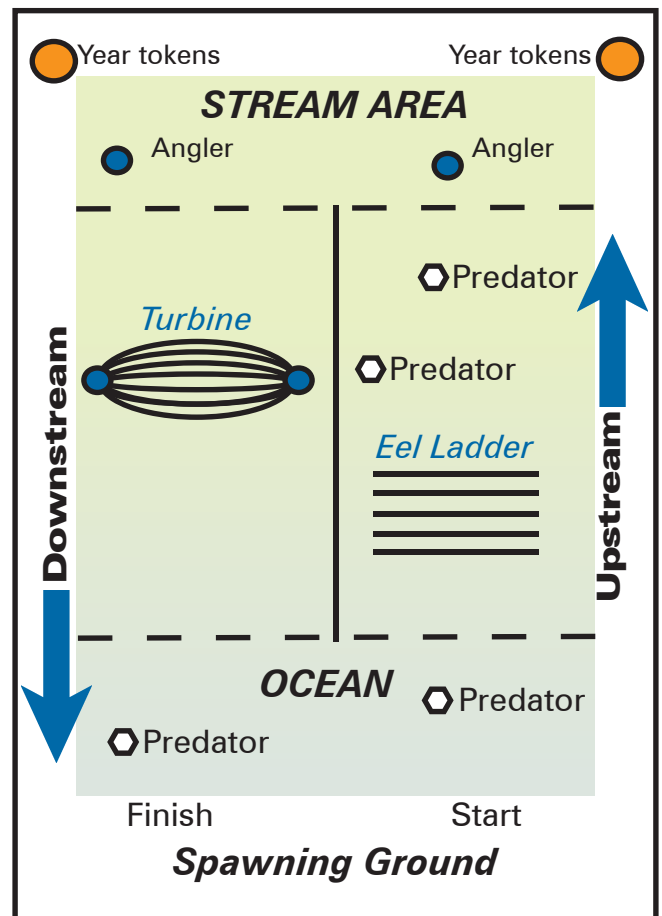
Once they reach the coastal estuaries, the eels head to the spawning grounds. During this trek, they face an array of predators before reaching the eel-grass-covered Sargasso Sea to spawn and die.

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

The major purpose of this activity is for students to gain an understanding of some of the complex characteristics of the life cycle of one aquatic species, the American eel.

Materials

large playing area (100 feet x 50 feet); about 500 feet of rope or string, or six traffic cones for mark-



the leader says go, the eels run into the ocean and must stay there while they count to 20. This simulates the time eels spend drifting in the clockwise currents in the Sargasso Sea before heading to American shores to the west. During this time, the predators may chase the eels, trying to tag them lightly and escort them to the established boundary before returning to the game. After counting to 20, the eels then start their journey upstream.

4. The students must hop with legs together over the series of five lines (made of rope or marking lime) representing the eel ladder. This gives the students an idea of how restricting and tedious the upstream journey can be. Ocean predators cannot cross the line separating the ocean from the rivers.

5. Once past the eel ladder, the eels must get past some predatory wildlife. The predators must tag the eels lightly and escort them to the established boundary before returning to the game.

6. Once the eels cross the line into the stream area, they must move back and forth across the

stream area to gather five tokens. Each token represents one year of growth. The year tokens can only be picked up one token at a time on each crossing. Remember, the eels must cross the entire stream area to get a token. During this time, they can be caught by commercial eelers (anglers). The eelers need only to lightly tag an eel, who then walks to the boundary of the playing area. For purposes of this simulation, the impact of this limiting factor creates a more realistic survival ratio on the population before the eels begin the return migration downstream.

7. Once an eel has five tokens, that eel can begin migration downstream. [Note: this is a shortened time from what eels normally spend before migrating downstream.] They soon “run” into a dam. The eels must make it through the turbine. At some dams there are escape weirs to guide migrating fish past the turbines. The students cannot go around the jump rope swingers, but they can slip under the swingers’ arms if they do not get touched while doing so. An eel dies if it is hit by the turbine (jump rope). An

eel which dies walks to the boundary of the playing area.

8. The eels that successfully negotiate the turbine continue their downstream trek and cross the line separating the river from the ocean. The two predators who started the simulation as the predators are now the last set of limiting factors faced by the eels.

9. The activity ends when all the eels have either died or have successfully crossed the line into the spawning ground.

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

- The apparent survival-mortality ratio of eels
- 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 (remember, the female lays more than 10,000,000 eggs) made the journey successfully

•What seemed realistic about this simulation and what did not

11. Ask the students to summarize what they have learned about the life cycle of eels, the eels’ migration, and limiting factors that affect eels. Make sure the students have a clear working definition of limiting factors. Encourage the students to make the generalization that all animals - not just American eels - 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.

This activity was adapted with permission from Project WILD, 2001 (Council for Environmental Education). Teachers and youth group leaders may obtain a Project WILD guide by attending a workshop. For more information, call 304-558-2771.



Eel ladder on Shenandoah River. The round, white pipe releases water from upstream, attracting eels to the ladder. The metal ladder has fabric inside which the eels crawl up.