

START

Salmon Survival

Can you survive the challenges salmon face every day?

EGG

Turbidity

start over

Rest Your Fins

Warming Water

start over

ALEVIN

Habitat Loss

-3

Habitat Restoration

+3

ALEVINS live in fresh water

SMOLT

Rest Your Fins

Fish Ladder

+3

SMOLTS live in fresh & brackish water

Predation

start over

Rest Your Fins

OCEAN

ADULT

Predation

start over

SPAWNER

Runoff

-7

Rain Garden

+2

Drought

-5

Rest Your Fins

MIGRATING ADULT

Rec Fishing

start over

Subsistence Fishing

start over

Rest Your Fins

Commercial Fishing

start over

Invasive Fish

-5

Invasive Removal

+3

FRY live in fresh water

Disease

-3

FRY

OCEAN ADULTS live in saltwater

Ocean Acidification

-5

Prey Availability

-4

Rest Your Fins

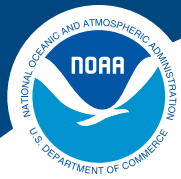
Water Conservation

+2

MIGRATING ADULTS live in fresh water



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West Coast Region

Audience

General public,
elementary school,
middle school

Required Materials

- Board game ([English](#), [español](#))
- 1 die (longer, harder version) or a pair of dice (shorter, easier version)
- A token for each player (e.g., small figurines, coins, etc.)
- A whiteboard or large piece of paper
- Whiteboard markers or pens

Optional Materials

- I'm Counting on You brochure ([English](#), [español](#))
- Salmon survival pyramid
- Good Salmon Habitat, Bad Salmon Habitat ([English](#), [español](#))
- An Incredible Journey children's book ([English](#), [español](#))

Salmon Survival Board Game

Overview

The goal of this dice game is for salmon eggs to hatch and make their way through the entire salmon life cycle. Along the way, participants will discover human-made challenges, (e.g., passage barriers, urban runoff, warming waters, etc.) natural challenges (e.g., predators, drought, disease), and salmon stewardship actions (e.g., rain gardens, water conservation, salmon ladders, etc.).

Learning objectives

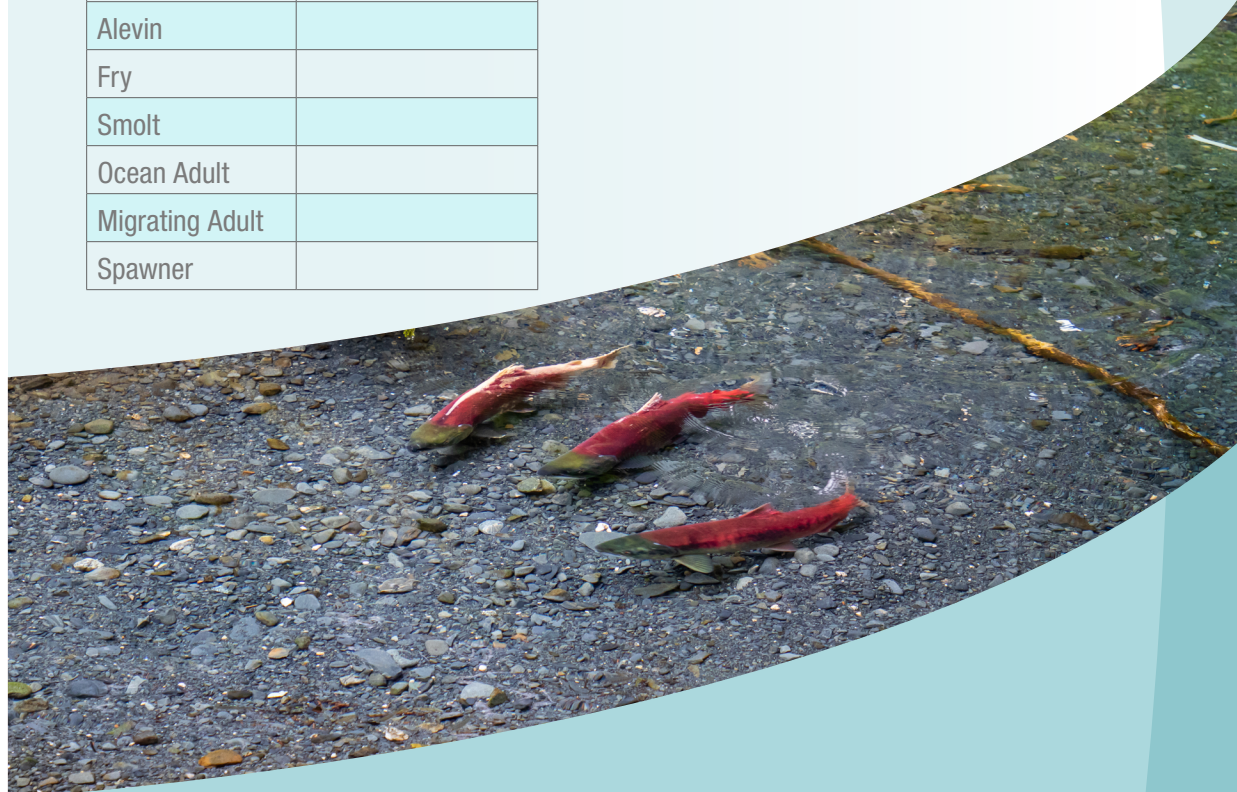
Participants will learn that:

- Salmon face many human-made and natural challenges throughout their lives.
- Most salmon will die before they return to their natal (home) stream to spawn.
- There are many ways that people can help salmon.

Preparation

1. Recreate the following table on a whiteboard, piece of paper, or spreadsheet.

Life Cycle Stage	Number of Deaths
Egg	
Alevin	
Fry	
Smolt	
Ocean Adult	
Migrating Adult	
Spawner	





Vocabulary

Anadromous—Fishes that migrate as juveniles from freshwater to saltwater and then return as adults to spawn in freshwater.

Fry—Salmon become fry when they have absorbed their yolk sac and emerge from their gravel nest (redd).

Natal stream—A salmon’s home stream; where a salmon hatched.

Redd—A gravel nest made by a spawning female salmon.

Run—Seasonal migration undertaken by fish, usually as part of their life history.

Smolt—A young salmon that assumes the silvery color of the adult and is ready to migrate to the sea.

Spawner—A mature salmon that is migrating back to its home stream to reproduce.

Additional Resources

For additional marine science activities and lesson plans, please visit: <http://go.usa.gov/xv6ut>.

Questions or Comments?

For questions or comments about this activity, please email:

wcr.education@noaa.gov.

Instructions

1. Tell participants that during the game they will experience the salmon life cycle, including some of the human-made and natural challenges that salmon might face. The goal of the game is to complete the salmon life cycle so that they can spawn the next generation of salmon.
2. Each player begins at the space labeled “egg.”
3. One player rolls the die or dice and moves the corresponding number of spaces. Each player should take a turn before the rotation starts again.
 - a. If a player lands on a space with a +, they move forward the corresponding number of spaces.
 - b. If a player lands on a space with a -, they move backward the corresponding number of spaces.
 - c. If a player lands on a space that says “start over,” they die and begin again from “egg.”
4. Players work their way around the board game until they die or reach the space labeled “spawner.”
 - a. Option: Give participants a set number of turns to become a spawner.
5. When participants “die,” record the corresponding life cycle stage on the table.
6. Share that the majority of salmon will not live to become spawners. A single female salmon can lay thousands of eggs, but only a handful survive to become spawners.

Discussion Questions

Lead a discussion using one or more of the following prompts:

1. How could low spawning numbers be problematic?
2. How could low salmon numbers affect the larger ecosystem?
3. How could low salmon numbers affect people?
4. How can endangered salmon populations recover with low spawning numbers?
5. What can individuals do to help salmon?

Extensions

1. Walk participants through the [salmon life cycle pyramid](#) and the data from the board game. Talk about the distribution of this data and compare it to real data.
2. Discuss how games and models can be used to help simulate or illustrate real data. In the field, scientists collect data about many different plants, animals, and environmental conditions. For example, they might count the number of salmon returning to their home stream; the temperature of the ocean in different locations and seasons; the amount of fish being caught by commercial fishers; etc.
 - a. How is the game data similar and different to what happens in real life?
 - b. How could the game data be made more accurate? Answers may include: complete more rounds and/or have a bigger sample sizes/more participants



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Credit: Tim J Keegan, Flickr



Credit: waltarrrr, Flickr



Credit: Chesapeake Bay Program



Credit: David Craig, Flickr



Credit: US Fish and Wildlife Service



Credit: USFWS Fish and Aquatic Conservation, Flickr



Credit: Ryan Somma, Flickr

Warming Water

Climate change, dams, and industrial discharge can increase water temperature. Salmon eggs will not hatch if the water is too warm. Warm water also makes salmon more susceptible to predators, parasites, and disease.

Turbidity

Logging, agriculture, mining, road building, urbanization, and construction can increase sediment in waterways (turbidity). Salmon eggs rely on a steady flow of clean, cold water to deliver oxygen and remove waste. Eggs in turbid water are less likely to hatch.

Habitat restoration

Salmon cannot survive in warm water. Plants shade the water and help keep water cool. Wood and roots from shoreline plants help shelter young fish from predators. Plants also filter runoff and hold soil in place to minimize erosion.

Habitat loss

Salmon habitat has been impacted by logging, mining, grazing, irrigation, road construction, and urban development. In most western states, about 80-90% of the historic riparian habitat has been eliminated. As of 2017, Washington and Oregon have lost 33% of their wetlands, while California has lost 91%.

Disease

Fish, just like other animals, are subject to a variety of diseases. These include environmental and nutritional diseases as well as infectious diseases caused by bacteria, viruses, or parasites. Warming water temperatures make salmon more susceptible to disease.

Predation

At every stage of their lives, salmon are susceptible to predators. While they are in estuaries and their bodies are adjusting to saltwater, salmon are particularly vulnerable to predators. Common predators include sea birds, bears, seals, sea lions, toothed whales, larger fish, otters, and sharks.

Invasive species

An invasive species can be any kind of plant or animal that is not native to an ecosystem and also causes harm to the ecosystem. Invasive fish, such as smallmouth bass, channel catfish, and brook trout eat young salmon and outcompete them for food.

Invasive species removal

By removing invasive species, salmon have a much better chance of surviving. Invasive fish can eat salmon or outcompete them for food. Invasive plants can prevent salmon from migrating and reduce the amount of oxygen available in the water.



Credit: Tennessee Valley Authority



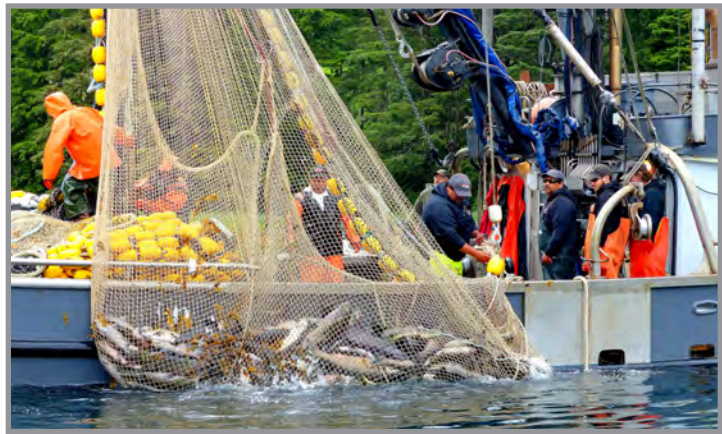
Credit: Amit Patel, Flickr



Credit: Mandy Lindeberg, Alaska Fisheries Science Center



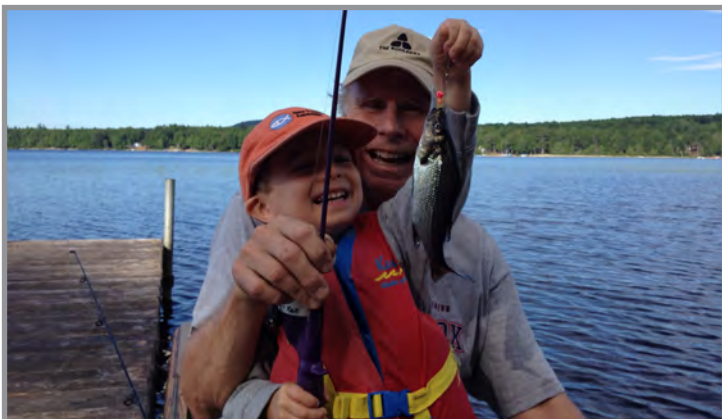
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Fish Ladder

Fish ladders allow salmon to pass dams and other passage barriers. These ladders are water-filled and allow fish to swim up a series of steps.

Passage Barriers

Dams, culverts, tidegates and other barriers can impede fish from migrating both downstream and upstream.

Ocean Acidification

Ocean acidification is primarily caused by increases in carbon dioxide through the burning of fossil fuels. When the oceans become too acidic, salmon lose their sense of smell. When they lose their sense of smell, salmon are less likely to find prey or to avoid their predators.

Prey Availability

When the oceans are cold, salmon primarily feed on Pacific sand lance and smelts, which triggers their growth spurt. When waters are warmer, there is less food available, and they primarily eat juvenile anchovies and rockfish, which are less-desirable.

Subsistence Fishing

Subsistence fishing is a type of fishing in which most of the fish is eaten by the fisher and their family. The fish that is caught is not sold for profit. Subsistence fishers often use traditional fishing methods such as rod and tackle, fishing arrows and harpoons, cast nets, and small fishing boats.

Commercial Fishing

Commercial fishing is catching fish and other seafood for a profit. Commercial fishing can be done in a simple manner with small boats and little technical equipment. It can also be done on a large scale with powerful deep-sea boats and sophisticated industrial equipment.

Sustainable Seafood

Sustainable seafood programs, such as FishWatch and Seafood Watch, provide facts about which seafoods are the most sustainable. This helps consumers make informed decisions when buying fish at a market or ordering it at a restaurant.

Recreational Fishing

Recreational fishing is also known as sport fishing or angling. Fishers catch fish for fun, for competition, or to eat. Rods, reels, hooks, baits, and small boats are typically used to catch the fish. The fish are often released back into the water or cooked by the fishers. Recreational fishing does not include selling or trading fish.



Credit: Shever, Flickr



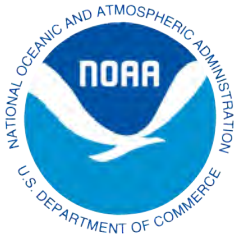
Credit: US Fish and Wildlife Service, Flickr



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Rain Garden

Rain gardens are a natural solution to pollution. The combination of soil, roots, and vegetation help filter stormwater runoff from parking lots, rooftops, and roads. After going through the rain garden, the filtered water goes back into the soil.

Drought

Drought can harm salmon at many points during their life cycle. When rivers and streams dry up, salmon eggs will die. If there is not enough water in streams and rivers, salmon cannot migrate to the ocean or back to their home streams.

Water Conservation

When we conserve water, more water is left in our waterways. Water conservation is especially important during drought, when salmon might not have enough water to complete their migrations.

Runoff

Rain cannot soak into hard surfaces such as roadways, parking lots, and rooftops. So rain streams across these surfaces and picks up oil, grease, heavy metals, pesticides, and other toxic chemicals. These pollutants flow directly into waterways. Stormwater runoff from urban roadways is so toxic that it can kill adult fish in as little as 2.5 hours.

NOAA Fisheries

Under the Marine Mammal Protection Act and the Endangered Species Act, NOAA Fisheries works to recover protected marine species while allowing economic and recreational opportunities.

Contact wcr.education@noaa.gov for more information.