

Trees to seas: Journey of the wild salmon

Instructions

Grade Level: 4-8

Materials provided:

board game, salmon illustration game pieces, student reading, and vocabulary list.

Materials needed: 1 die

Prior to playing the board game “Trees to seas - Journey of the wild salmon”, have students read the student background information. For younger students, you may want to read the information to them, and show them the attached river system drawings.

Alternatively, assign groups of students to read different sections of the background information and have them teach what they learn to the rest of the class. Also consider having students conduct research on salmon, their life cycle and the perils they face, or the historic social aspects of salmon in the native American and euro-American settlers lives. Students can then make presentations to the class. They might develop posters, “scientific illustrations” of salmon, riparian or estuary habitats, charts, graphs, photographs or other visual aides for their presentation, or a video of streamside habitat nearby. Students could present their work to a class of younger students in the school, and take them on an outing to a nearby stream.

For more information and ideas, check the last page of the **Arborleaf** for helpful organizations and new opportunities. “Discover Washington’s Natural Resources” Teacher Guide has additional information. Call DNR’s Communications office at 360-902-1027.

Salmon game pieces:

Copy, cut out, and mount on pressed paper board.



Coho male



Coho female



Chinook female



Chinook male

Connections between Trees and Salmon

Salmon, like people, depend upon trees. Although the life cycle of the different salmon species is unique, most species travel from mountain streams down rivers past dams, farms, cities, industries and shipping ports on their way to the Pacific Ocean. Salmon travel thousands of miles at sea and retrace their path to face a challenging journey back up the rivers to spawn in gravel beds of streams from which they came. All along the way, trees provide essential elements to these streams and rivers where salmon live and travel. Salmon and other fish need cool, clear water, bugs to eat, sediment-free gravel in which to **spawn**, and logs to stabilize the gravel and to hide under.

Shade, shelter, food and clean water: habitat

Trees provide shade that helps maintain a cool water temperature throughout the year. Cool water holds more oxygen. In addition, trees help keep water clean. Trees’ roots hold dirt and rocks in place on the **uplands** and on the river banks. Roots prevent soil **erosion** and help filter and hold rainwater in the ground so it doesn’t flood into the river too fast. Without trees and bushes along the streams, rivers and lakes, rain would wash the dirt into the river, silting the water. Also, small and large salmon find refuge, a place to hide, under fallen trees and overhanging branches along the waterways.

From trees and bushes leaves and needles fall into the water. They provide important sources of food to insects such as “**shredders**”, tiny plant-eating bugs that hover at the waters’ surface. In turn, shredders are an important food for young salmon, crayfish, birds and other animals.

The food chain, part of the web of life

Each snail, leaf, fungus, and fish plays an important role in stream and **riparian** ecology. If streamside trees or bushes are removed, there is less food for algae, fungi, shredders and fish. This affects the “food chain” that connects plants and animals. Here is an example: Without trees and bushes along rivers and streams, shredders would not have food, they would die; and tiny salmon **fry** would not have the shredders to eat. The young salmon would die. Herons and kingfishers would not have the young salmon to eat. Since fry are a large part of their diet, they could die. As salmon migrate from rivers to the **estuary** into the ocean and back, they eat herring and smaller fish. As you can see, each depends on certain foods to live – like the eagles, bears and people that eat the salmon, it is all part of the food chain. And when we connect many food chains together we see a whole web of life. We don’t know what will happen to the world-wide web of life if different parts of it disappear. But you’ll soon learn that people are working hard to prevent and repair damage to streams, rivers, estuaries and bays.

Life Cycle of Salmon

Salmon dig out a shallow “nest” or **redd** in the gravel bed of a stream or river. There are four layers of gravel within a **redd**: the undisturbed stream bottom; the egg pocket where salmon eggs are deposited; the bridging layer of pebble sized gravel; and the cover layer of smaller gravel. **Redds** can easily be destroyed by animals or people walking or riding across the shallow river, or by dirt washed or knocked into the water covering the redd with silt and smothering the eggs. After several weeks of incubation the eggs hatch into small larval fish called **alevin**, still with their yolk sac attached. The yolk sac provides food for the growing baby salmon. The **alevin** wiggles up through the gravel toward the running stream above. When the yolk sac is completely absorbed by the fish, it leaves the gravel and becomes a **fry**.

Currently, seven fish species are listed as endangered in Washington state, including runs of sockeye, chinook, pink, chum, and coho salmon; and steelhead, cutthroat and bull trout. The decline of Washington’s native salmon and trout populations cannot be blamed upon any one thing. Many hazards result in the species’ decline and disappearance.

The free-swimming young **fry** actively feed in the stream. They immediately begin to protect their space and move together in schools. On their sides, dark blotches called **parr marks** help camouflage them. After spending up to three years growing and surviving in fresh water, depending on their species, some salmon, called **non-anadromous** fish, remain in fresh water rivers all their lives. The **anadromous** salmon fry swim downstream to the ocean to mature in salt water. After their long journey, before moving into the sea, young salmon “silver” in color, lose their **parr marks** and are then called **smolt**. Salmon keep this ocean **adaptive coloration** until they return to their home streams.

Home from the sea

Salmon remain at sea for a few years to as much as seven years. Salmon feed and grow in the ocean or fresh water environment until they reach full maturity. Then they retrace their path back to the river or stream where they were born. Salmon face the same obstacles that they faced swimming down the river, and in addition, they now face large birds, bears, recreational and commercial fishers. In many places the growing human population and our residential and commercial development have altered or destroyed **riparian** habitat.

When salmon return to their home stream, they choose a spawning site and eventually mate. This process can include changes in body shape and coloration. Salmon carry out their spawning behaviors that result in fertilizing eggs with **milt** (male sperm). These behaviors evolved over uncounted generations and have resulted in today’s highly **adapted** salmon.

After the salmon spawn, most species die, and their **carcasses** provide food for fish and wildlife. The importance of salmon **carcasses** to the food chains cannot be over-emphasized. As salmon are taken out of the river by bears, eagles, racoons, crows, seagulls or other animals, bones or flesh are dropped in the forest. They are like garden fertilizer, adding nutrients from the sea to the land. They help make everything grow. In addition, insects, crayfish, other fish and vegetation in the streams are fed by the nutrients in the carcasses. It is all a part of the food web of life.

Counting wild salmon noses

Each salmon that returns home has beaten amazing odds: About one in five eggs produces a salmon fry. Of those, only one in four gets to the ocean. And nine out of 10 of those are eaten by bigger fish or mammals, or caught by recreational or commercial fishers. On average, out of 4,000 fish that started down stream, four will return.

It takes just two survivors from each spawning pair to sustain an entire salmon run. And yet our salmon runs have dropped so low in numbers that of the **salmonid** runs in Washington state, the federal government has listed seven runs as **threatened** or **endangered** under the **Endangered Species Act**, and more are due to be listed.

Hazards and Predators

Trees and plants cut from riparian areas

Riparian and water habitat loss along rivers, streams, estuaries and bays are among the most serious problems for our salmon. Although state Forest Practices rules have been changed to protect riparian habitat that helps many species, years of past logging practices caused problems. Sometimes few trees were left near rivers and streams. Lack of shade caused higher water

temperature, and without leaves or **woody debris** fish had no hiding places and few food sources. Construction of logging roads contributed to landslides, erosion and sediment runoff, often blocking access to habitat. Domestic animals, recreational vehicles, bikes and horses have gone through streams, unknowingly smashing redds or smothering them with **silt**.

Farming practices often increase soil erosion and sediment runoff. Pesticides used on agricultural crops can pollute water and poison fish. Sometimes plants in the waterways have been fertilized and grow so much that they choke the river or stream. Fish can't get through or find food. Irrigation of crops often takes more water from streams and rivers than is acceptable. Cattle, pigs, horses and other domestic animals have been allowed to wade through streams, stirring up silt and polluting the water with their wastes.

Dams and other development

Hydroelectric dams are another big challenge to salmon. Where there once was a fast moving river, there is now a slow-moving lake behind the dam. This delays salmon **migration**, attracts predators in search of easy prey killing fry, or salmon that have not yet spawned. Dams also interfere with young salmon on their way to sea, crushing them in turbines.

Construction of buildings and homes inside and outside our cities replaces habitat of native fish and animals. Water rapidly runs off **impermeable surfaces** – roads, driveways, buildings and parking lots – and adds **non-point source pollution** such as oil, anti-freeze and other harmful toxic substances into storm drains and into rivers. The more than 100 years of road building and development have resulted in at least 2,400 barriers to fish passage at road crossings. These structures block fish from about 3,000 miles of spawning and rearing habitat.

Fishing and natural predators

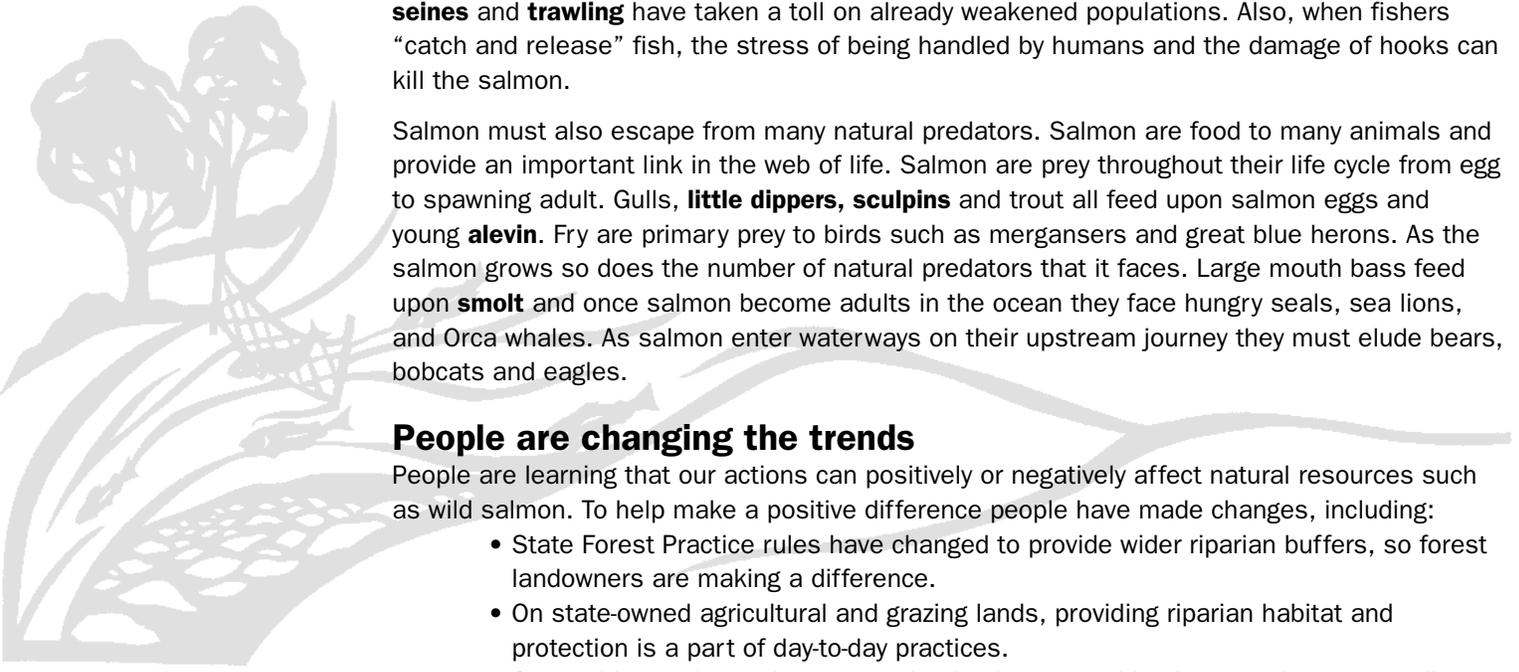
Over-fishing in oceans and rivers also leads to declining salmon populations. **Gill nets, purse seines** and **trawling** have taken a toll on already weakened populations. Also, when fishers “catch and release” fish, the stress of being handled by humans and the damage of hooks can kill the salmon.

Salmon must also escape from many natural predators. Salmon are food to many animals and provide an important link in the web of life. Salmon are prey throughout their life cycle from egg to spawning adult. Gulls, **little dippers, sculpins** and trout all feed upon salmon eggs and young **alevin**. Fry are primary prey to birds such as mergansers and great blue herons. As the salmon grows so does the number of natural predators that it faces. Large mouth bass feed upon **smolt** and once salmon become adults in the ocean they face hungry seals, sea lions, and Orca whales. As salmon enter waterways on their upstream journey they must elude bears, bobcats and eagles.

People are changing the trends

People are learning that our actions can positively or negatively affect natural resources such as wild salmon. To help make a positive difference people have made changes, including:

- State Forest Practice rules have changed to provide wider riparian buffers, so forest landowners are making a difference.
- On state-owned agricultural and grazing lands, providing riparian habitat and protection is a part of day-to-day practices.
- Some cities and counties are purchasing homes and businesses that repeatedly are damaged by naturally occurring seasonal floods, and they are replacing them with public parks, and green belts with riparian vegetation.
- Industries are changing their buildings to prevent spills and outfalls from letting chemicals or toxic products go into rivers or harbor areas.
- Citizen groups are monitoring streams, estuaries, bays and rivers, and when they find damaged areas, they work with landowners to repair them and plant native riparian trees and plants.
- Some cities and towns have passed **ordinances** to protect riparian areas as living classrooms.



As you can see, protecting and planting trees and other vegetation are a big part of these efforts. Trees are essential, from the top of forested hills, through farms; and throughout cities along the rivers, all the way to the edge of the estuaries. Trees make the difference.

Each of us can make a difference. We can change the ways we work and play, learn to be more careful in the ways we use our natural resources: the land, water, animals and plants.

The wild salmon journey is just one adventure in nature. Look around you and you can find millions of other stories!

Vocabulary List

adaptation – the ability to change to meet changing conditions.

alevin – the newly hatched salmon, getting food from the yolk sac attached, still within the gravel.

anadromous – fish which spawn in fresh water and spend much of their lives feeding in the ocean, in salt water.

carcass – a dead animal.

culvert – a pipe that moves water from one side of road or embankment to the other, i.e. steel pipe, concrete pipe.

endangered species – a group of animals or plants whose numbers have dropped so low that there is a high chance that they will become extinct - that is, to completely disappear from the earth.

Endangered Species Act – federal law to protect native animal and plant species for extinction.

estuary – A region where saltwater of the ocean is greatly mixed with freshwater from a river or other runoff from the land, often a part of a delta at the mouth of a river.

fry – Life stage of trout and salmon between full absorption of the yolk-sac and a somewhat defined fingerling or parr stage, which generally is reached by the end of the first summer of growing in freshwater.

gill netting – fishing practice that involves the use of nets designed to catch a specific species of fish. The mesh in these nets is sized so that only the desired fish is caught, others will either be too small to get caught in the net and simply swim through it, or they will be too big and bounce off the net.

habitat – A place where a plant or animal species naturally lives and grows. It includes food, space and shelter.

homing – the instinct of salmon to return to the waters where they were incubated and reared as young. Minerals, trees, soils, rocks give off chemical properties

that make an imprint or smell they identify as their home stream.

impermeable surfaces – A surface that does not allow water to penetrate (concrete, asphalt).

macroinvertebrates – Small organisms that are big enough to be seen, that include aquatic or water stages of immature insects like beetles, dragon flies, mayflies, stoneflies.

milt – The milk colored substance that contains male salmon's sperm. Also, to fertilize the eggs with milt.

mudflats – Flat un-vegetated wetlands where saltwater and freshwater get mixed. Mudflats are subject to periodic flooding and minor wave action.

non-anadromous – fish that spend their entire lives in fresh water.

non-point source pollution – generally caused by the actions that people do every day these are pollutants from many sources that are washed from land by rain and melting snow into streams, lakes, rivers, marine waters and ground water. They are not from a specific pipe or drain.

oncorhynchus – Scientific name for the salmon. In Washington State there are seven salmon species.

ordinance – A law passed in a city or town that places rules about what actions are to take place within its boundaries.

osmoregulation – Physical changes that occur in the salmon when gills and kidneys change to adapt from fresh water to salt water, and, upon their return from the sea, from salt to fresh water.

parr marks – Dark blotches on the sides of fry that provide them with camouflage protection.

predator – An animal which feeds on other living animals.

prey – An animal that is eaten by other animals for food.

purse seine – A commercial fishing technique used to catch fish by encircling them with a small mesh net. The mother vessel contains a large net that is cast out using a smaller high speed boat in order to quickly encircle a school of fish and catch them.

redd – The nest of various fish such as salmon and trout.

reservoir – An artificial lake in which water is impounded for domestic and industrial use, irrigation, hydroelectric power, flood control or other purposes.

riparian area – Area of land next to streams, rivers, lakes and ponds which is full of trees, bushes and other vegetation that offers critical fish and wildlife habitat and water quality.

salmonid – The group of fish including all salmon, trout, char, whitefish and grayling.

shredders – Common name for macroinvertebrates that eat leaves, needles and other vegetation found floating in streams and rivers.

smolt – a young salmon when it first migrates to the ocean, the salt water.

threatened species – a group of animals or plants whose numbers are so low that they could become endangered if they are not protected.

trawl – a large funnel-shaped fishing net that is pulled behind a fishing vessel or boat to catch fish.

uplands – the lands not covered by fresh or salt water. The lands above the oceans, rivers and waterways, from the riparian areas on up the landscape.

woody debris – logs or dead branches that fall into or hang into rivers and streams and provide cover for fish, and provide food for insects and plants that fish feed upon.

water oozle (little dipper) – a small bird that lives along streams of Washington and is known to "fly under water" when in search of its prey.

Small Headwater Streams

- About 3/4 of all stream miles
- Affect and provide
 - water quality
 - gravel quality
 - woody debris: regulates flow of sediment and stream power, provides insect habitat

Mid-sized Tributaries

- About 1/5 of all stream miles
- Provide most miles of salmon habitat
- spawning gravels and rearing pools
- Large woody debris source
- cover from predators
- channel stability and shade

Flood plains

- Provide current and future meandering streams
- Provide side channels and pools for salmon

River

- Less than 1/20 of all stream miles
- Salmon habitat
- off-channel rearing and spawning areas
- migrating corridors
- rearing habitat

Estuary (delta)

- Salmon habitat
- juvenile rearing
- predator / pray interaction
- acclimation to saltwater by fry/smolt
- diverse food supply
- acclimation to freshwater by adult
- adult staging before upstream migration
- Brackish water habitat for many plant and animal species

Forest Uplands

River flood plain

Tidal flood plain

Estuarine Delta

Marine shore

Deep open water –
a **direct extension of the estuary environment**

A Riparian Area

- Trees, shrubs and brush provide:
 - shade to maintain cool water temperatures
 - predator roosts, nest cavities
 - nutrients that fall into stream (leaves, twigs, insects, etc.)
 - cover and food for large and small wildlife
 - roots that prevent erosion by holding the bank, and provide stream habitat
- Gravel that is necessary for salmon spawning
- Large woody debris that provides habitat protection

Coastal Basin Aquatic Ecosystem

Aquatic ecosystem continuum-upland forests, river flood plain, and estuary to marine shore and open waters