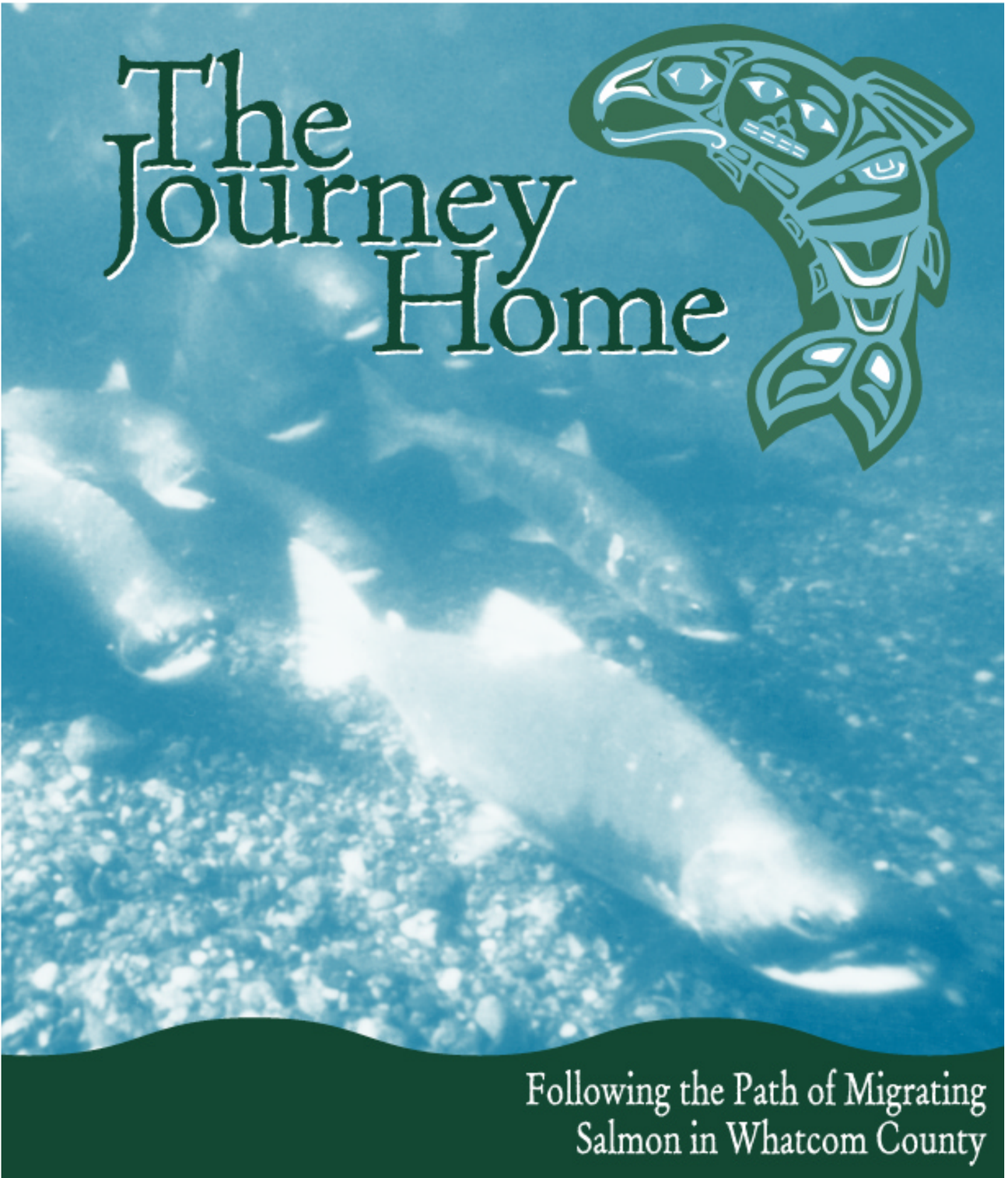
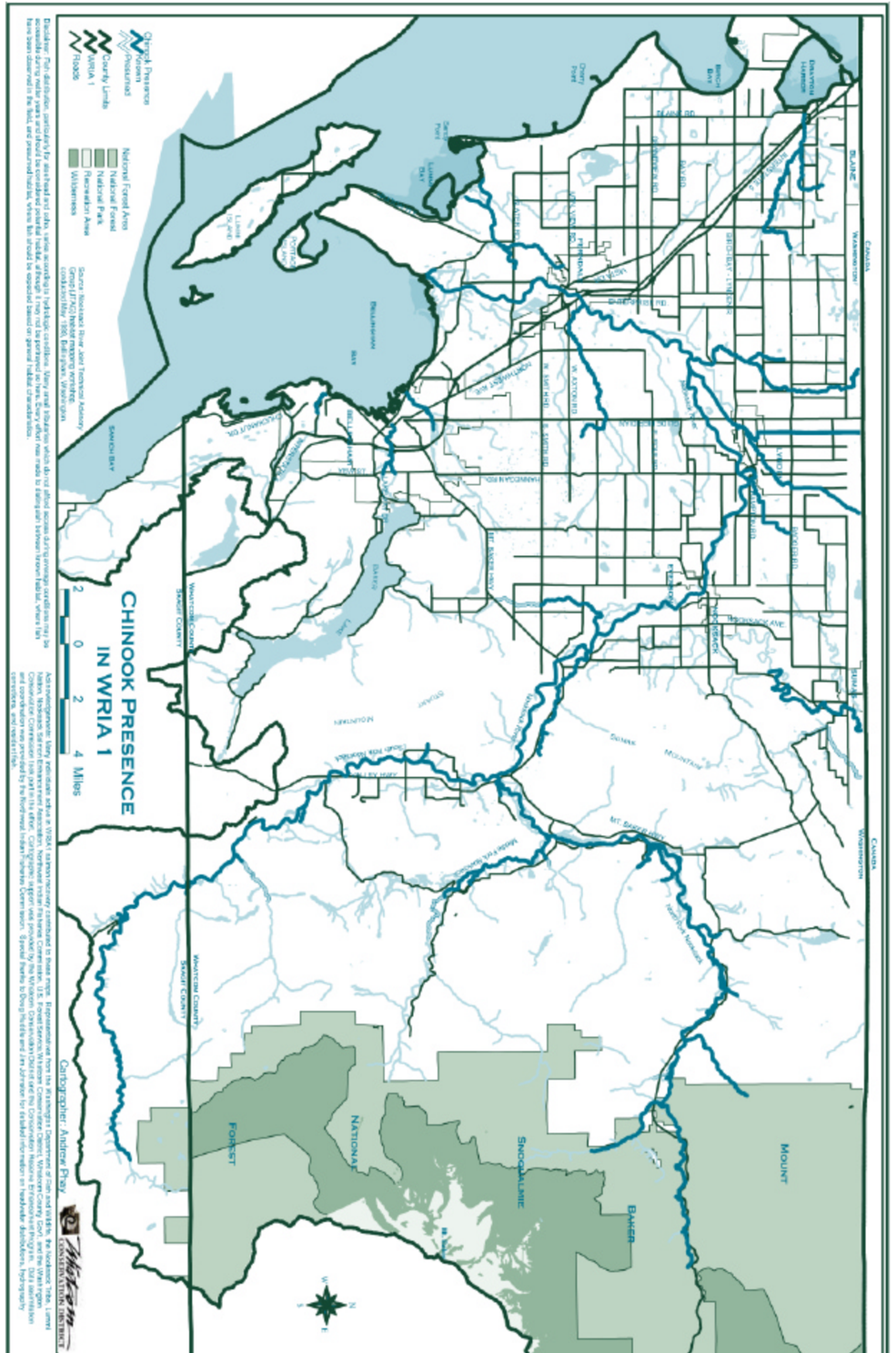
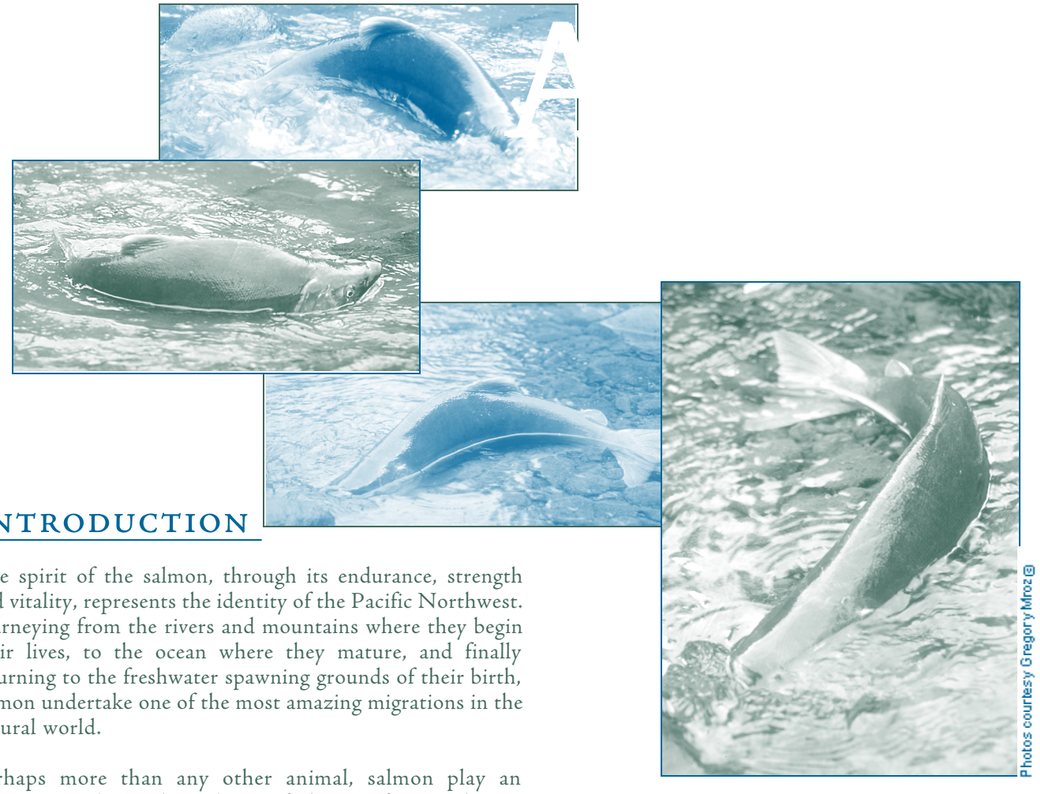

The Journey Home
Following the Path of Migrating Salmon in Whatcom County





Photos courtesy Gregory Mroz ©

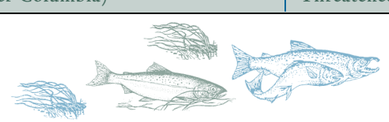
Introduction

The spirit of the salmon, through its endurance, strength and vitality, represents the identity of the Pacific Northwest. Journeying from the rivers and mountains where they begin their lives, to the ocean where they mature, and finally returning to the freshwater spawning grounds of their birth, salmon undertake one of the most amazing migrations in the natural world.

Perhaps more than any other animal, salmon play an important role in the culture of the Pacific Northwest. They are an integral part of Native American tradition. Salmon bolster our economy, providing jobs for commercial fishers and recreation for anglers around the state. They also provide a window into wild nature for residents throughout the region.

Despite their value and importance in our culture, wild salmon stocks along the West Coast have been dwindling for the past century. Salmon are now extinct in 40% of the rivers in which they originally spawned. Salmon runs in 44% of remaining streams are at risk. The listing of salmon species as threatened under the federal Endangered Species Act has drawn attention to this crisis. Many factors have led to this species' decline. Some are natural, such as fluctuating ocean conditions or flooding. Other factors include human impacts, such as harvest practices and habitat destruction through urban development, agriculture, forestry, and mining. Hatchery programs, pollution, and the challenges posed by hydropower are also contributing to the salmon crisis. Recovering wild salmon runs will require cooperation and flexibility.

In Washington state the following salmon species are listed under the federal Endangered Species Act:	
Chum salmon (Hood Canal Summer)	Threatened
Chum salmon (Lower Columbia)	Threatened
Sockeye salmon (Lake Ozette)	Threatened
Sockeye salmon (Snake River)	Endangered
Chinook salmon (Puget Sound)	Threatened
Chinook salmon (Snake River Spring/ Summer)	Threatened
Chinook salmon (Upper Columbia Spring)	Endangered
Chinook salmon (Lower Columbia)	Threatened
Chinook salmon (Snake River Fall)	Threatened
Westslope cutthroat	Species of Concern
Steelhead (Snake River)	Threatened
Steelhead (Middle Columbia)	Threatened
Steelhead (Upper Columbia)	Endangered
Steelhead (Lower Columbia)	Threatened



The Life Cycle

anadromous - fish, such as salmon and sea-run trout, that live part or the majority of their lives in salt water but return to fresh water to spawnfish eggs.

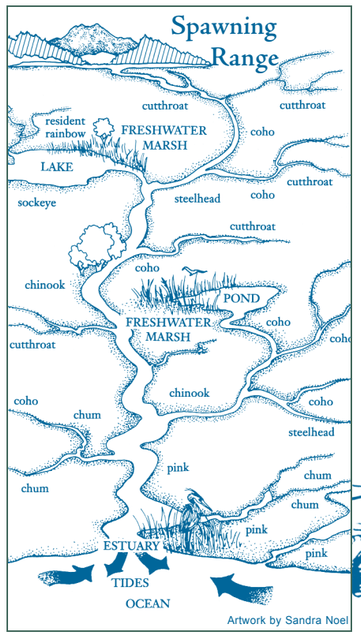
spawn - to deposit and fertilize fish eggs.

Salmon are anadromous fish. Defined by their unique life cycle, they begin their lives in fresh water streams, spend the majority of their lives in salt water, and return to the freshwater gravel beds of their birth to lay their eggs and pass on their legacy to the next generation. Because of this complex life cycle, salmon at each stage have specific habitat requirements. At every phase of their lives, they need:

- cool water temperature around 50 °F, maximum 65 °F
- adequate dissolved oxygen
- lack of pollution

Spawning/Egg

The adult female salmon works hard with her tail, fanning instream gravel, to build a nest, called a redd. It will take her up to 24 hours to build this nest, which varies in depth from 3 to 15 inches deep, depending on the species. Some redds are small, while larger ones can be over 100 square feet in size. The female will build a series of nests where she will deposit a total of 300 to 7000 eggs. Male salmon vigorously compete for the opportunity to fertilize the eggs. Once they have been laid, the tiny eggs develop through the winter in the redd, weathering the most sensitive period in their life cycle.



Habitat needs:

- stable water flow, high enough so that eggs do not dry out or become vulnerable to freezing and low enough so eggs are not washed away
- absence of excessive fine sediment, so eggs are not smothered
- cool water, adequate oxygen, lack of pollution

Alevin

During late winter and spring, the eggs hatch to become alevins (pronounced al-vin). These tiny fish have huge eyes and a yolk sac on their belly that will provide a source of food for 3-4 months while they continue to grow under the protective gravel.

Habitat needs:

- adequate flow
- stable streambed
- absence of excessive fine sediment
- instream cover for protection from predators - woody debris, boulders, undercut banks
- cool water, adequate oxygen, lack of pollution

Fry

Alevins absorb their yolk sacs and emerge from gravel as one-inch long fry. Most fry spend a year or more in their home stream eating plankton and other small insects.

Habitat needs:

- instream cover
- steady supply of food
- nutrients derived from decaying salmon carcasses
- low to moderate stream gradient and velocity
- diversity of pool/riffle habitat
- cool water, adequate oxygen, lack of pollution

Smolt

Salmon smolt prepare for migration to the sea when they are one to two years old on average, but this varies depending on the species; some go directly out to sea. At this time, the smolt are 10-15 cm long. Their scales grow larger, their color turns silvery, and their tails lengthen and become more deeply forked.

Habitat needs:

- steady current to carry them to the ocean
- stream passage free of barriers, such as dam turbines, etc.
- quality habitat in the estuary
- cool water, adequate oxygen, lack of pollution

Ocean Phase

Salmon spend one to seven years in the ocean. During this phase of the life cycle, they grow rapidly, build up strength and store fat for their return to freshwater.

Habitat needs:

- steady supply of food
- appropriate temperatures
- passage through fishing nets
- cool water, adequate oxygen, lack of pollution

Spawners

Adult salmon head back to the stream of their birth to spawn. To get there, they face a myriad of challenges including predators, fishers, dams, culverts, and inadequate water levels.

Spawners have their last meal before entering freshwater. From then on, they rely on stored fat and muscle until they spawn and die. Ninety percent of spawners that make it back upstream deposit their eggs within 100 yards of their original gravel bar birthplace. This characteristic is called homing.

Scientists attribute this uncanny ability partly to the fish's incredible sense of smell. Salmon noses are so sensitive they are able to detect dissolved substances in parts per 3,000,000,000,000,000,000!

Habitat needs:

- stream passage free of barriers, such as culverts and dams
- instream gravels of appropriate size
- absence of excessive fine sediment
- instream cover
- cool water, adequate oxygen, lack of pollution

History

Historically, salmon runs on the West Coast were extremely impressive. On the Columbia River alone, 10 to 16 million salmon returned to spawn each year. That is the current human population of Washington, Oregon, and Idaho. Imagine if all the people in these three states swam up the Columbia River at once!

Salmon have always been a staple in the Native American diet, but they symbolize much more than simply a means of subsistence. Coastal tribal peoples share a sacred relationship with salmon, reflected in their art and folklore. Traditional stories like The Tale of the Salmon Woman and The First Salmon Ceremony symbolize this importance.

Historian Ruth Underhill reflects that "in the early days the richest people in North America were the Indians of the Northwest Coast." They had everything they needed; they did not even need to plant crops or hunt unless they felt like a change of diet. "Every year, they had only to wait until the salmon came swarming up the streams. In three or four months you could get food enough to last a year."

As Euro-American pioneers settled the Northwest, they were in awe of the abundance of the fish. Small streams were literally choked with spawning salmon, and farmers would pull the fish out of rivers with pitchforks and use them by the wagon load as fertilizer for their crops. The region was rich in other resources, which attracted increasing numbers of newcomers. Railroads were built in the 1880s, bringing people to the Northwest in even greater numbers. As growth increased, signs of environmental degradation began to occur. Logging, mining, farming, and grazing were on the rise, resulting in an undeniable impact on the land.

> "Nothing can stop the growth and development of the country, which are fatal to salmon. Provide some refuge for the salmon and provide it quickly, before complications arise which may make it impracticable, or at least very difficult. Now is the time. Delays are dangerous."
>
> - Livingston Stone, a member of the U.S. Fish Commission, 1892

By 1900, the fishing industry was in full force. Canneries began to pop up around the region. Twelve out of 19 canneries on Puget Sound were located along Whatcom County's shores. Efficient canning machinery made it possible to preserve fish in great numbers. One machine could clean and scrape 60 to 85 salmon a minute. This caused the price to drop, making salmon an abundant and cheap food.

Photo courtesy of the Whatcom Museum of History and Art. Cannery Harvest, 1906

Canneries began to export salmon to locations all over the world.

As cannery production increased, fishermen invented new ways to increase the size of their catch. In the late 1800s, nets often spanned the entire width of streams. These nets were so heavy with salmon that horses were often necessary to pull loads out of the water. Because of concerns of over-harvest, regulators soon found it necessary to limit the size of nets to no more than three-quarters of the width of a stream. Then came the invention of the hydropower fish wheel. This device looked like a ferris wheel, with scoops instead of seats, that made it possible to pick up fifty thousand pounds of fish each day when the chinook were running. Fish wheels were used extensively until 1934, when they were outlawed in Washington.

But the hey-day of massive salmon harvests was coming to an end. As early as 1890, scientists began to predict the collapse of the fishery.

Over 100 years have passed, and we have only begun to heed this warning. Practices harmful to salmon have continued. Today, less than one million wild and hatchery-bred salmon return each year to the Columbia River.

Salmon Facts

Eleven species in the salmonid family are native to Washington State. These includes five species of salmon - chinook, coho, sockeye (including the resident form kokanee), chum and pink; two species of char - Dolly Varden and bull trout; two species of whitefish - mountain whitefish and pygmy whitefish; and two species of sea-run trout - steelhead and coastal cutthroat, which both have resident (freshwater) forms: rainbow trout and cutthroat trout. Native spring chinook and bull trout on the North Fork and South Fork of the Nooksack River are listed as threatened on the federal Endangered Species list.

What is the oldest known age of a salmon?

- chinook-7 years
- coho-4 years
- sockeye-7 years
- pink-2 years
- chum-6 years
- steelhead trout-8 years

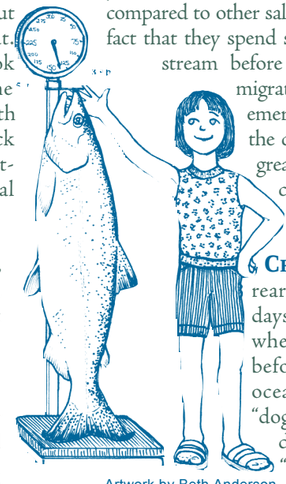
(NMFS, 2000)

Chinook: The chinook, also known as "king" salmon, is the largest salmonid in Puget Sound. On average, they grow to be 10 to 15 pounds, though it is not uncommon for them to reach 50 pounds. Rare individuals can grow up to 135 pounds!

Coho: Coho, nicknamed "silvers," are a popular sport fish. They are found in almost every coastal stream. Before migrating to the ocean for a year, young coho rear in beaver ponds, side channels, and small streams. As these wetland areas disappear, coho stocks become depressed.

Sockeye: Sockeye or "reds" also need time to mature in freshwater. The adults spawn only in streams or rivers that connect to lakes. Juvenile sockeye will live in the lake or river for 1-2 years before heading out to the ocean.

Pink: Pink salmon are commonly referred to as "humpies," because each male develops a large hump on his back during spawning. They are the smallest of the anadromous Pacific salmon, averaging 3-5 lbs. Their two-year-long life cycle creates two different lines: fish that hatch in even years return to spawn only in even years, while odd-year-born fish return only in odd years. Pinks do not have a very precise homing instinct as compared to other salmon. This may have to do with the fact that they spend such a brief amount of time in the stream before heading to the ocean. Pink fry migrate to the sea immediately after they emerge from the redd. Because of this, the closer pinks spawn to saltwater, the greater their chance of survival. In some cases, they even spawn directly in saltwater.



Artwork by Beth Anderson

Chum: Like pinks, chum fry do not rear in freshwater. After only a few days, they migrate to the estuary, where they stay for a few months before heading out into the open ocean. Chum have the nickname "dog" salmon. This could be because during spawning they develop "teeth," which resemble canine teeth. Another explanation could be because their flesh is not particularly tasty, and historically they were fed to the dogs. Chum are not

Common Name (nickname)	Scientific Name (pronunciation)	Average Size	♂	♀
Chinook (king, tyee, blackmouth)	Oncorhynchus tshawytscha (on-ko-rink-us tau-wee-cha)	10-15 lbs. (up to 135 lbs.)		
Coho (silver)	Oncorhynchus kisutch (on-ko-rink-us ki-sooch)	6-12 lbs. (up to 31 lbs.)		
Sockeye (red, blueback)	Oncorhynchus nerka (on-ko-rink-us ner-ka)	5-8 lbs. (up to 15 lbs.)		
Pink (humpie, humpback)	Oncorhynchus gorbuscha (on-ko-rink-us gor-boo-scha)	3-5 lbs. (up to 12 lbs.)		
Chum (dog, calico)	Oncorhynchus keta (on-ko-rink-us kee-ta)	10-15 lbs. (up to 33 lbs.)		
Steelhead	Oncorhynchus mykiss (on-ko-rink-us my-kiss)	8-11 lbs. (up to 40 lbs.)		
Cutthroat trout (blueback)	Oncorhynchus clarkii (on-ko-rink-us clark-ee-i)	1-4 lbs. (up to 6 lbs.)		

The Legend of Salmon Woman and her Children

Once a long time ago, when the world was still young, the Xwlemi People all lived in a village at the mouth of the River. They followed Raven, who was a good leader, for he held the interests of his people above his own. It was soon after the Big Flood and the animals had not multiplied, so the people ate only fish. Some of the people began to complain, "Fish, fish, fish, we are sick of fish!" Salmon Woman heard them complain, and she was angry. She gathered up her children and took them back to the ocean, leaving the people with nothing but roots to eat. Soon the people were starving. They pleaded with Raven to go find food. Raven stocked his canoe with food and water and went out into the unknown ocean... out past the islands now known as the San Juans. Raven became lost in the fog, ran out of food and water and began to starve. Finally he went to the bow of his canoe, raised his arms and began to sing his death song.

Salmon Woman heard Raven's Death Song and was moved that he was willing to give his life for his people. She transformed into a woman and called for help. Raven rescued her from the water but told her they would both perish, for he was out of food. To show her gratitude, Salmon Woman told him to dip his hat into the water. He did as she said and caught some of her children in the hat. She made a fire from the seats and cooked some of her children and fed Raven. He regained his strength but told her he was still lost. So she told him to pour out the remaining children; they would show him the way back to the river. They began swimming and jumping ahead of the canoe all the way back to the mouth of the river, for they were happy to return to the river.

The people were happy to see the salmon return and held a large feast to honor Salmon Woman. She became Raven's wife and told the people that her children were her gift to them. They could have as many as they wanted, as long as they fished from the river. But they were never to get them from the spawning beds. The people were happy. Each year Salmon Woman's children came to the village, and the people had plenty to eat before the fish went upstream to the spawning beds. Each year the salmon returned to their mother's house under the oceans.

Raven was a good leader, and his people prospered. As time went by, the animals had multiplied, and the people were able to hunt again. Raven and the men of the village prepared for a big hunt. But Raven's brother, Bear, was not allowed on the hunt because his wife was in a very strong spiritual condition; she was expecting a child. In keeping with the beliefs of the people, while Bear's wife was pregnant, Bear could not hunt or fish or touch any hunting or fishing gear. If any of the power of creation was on Bear, it might affect anything that Bear touched. That was the rule. Raven said that he would hunt and fish for Bear's family until the baby was born. The men left to hunt. Bear stayed behind.

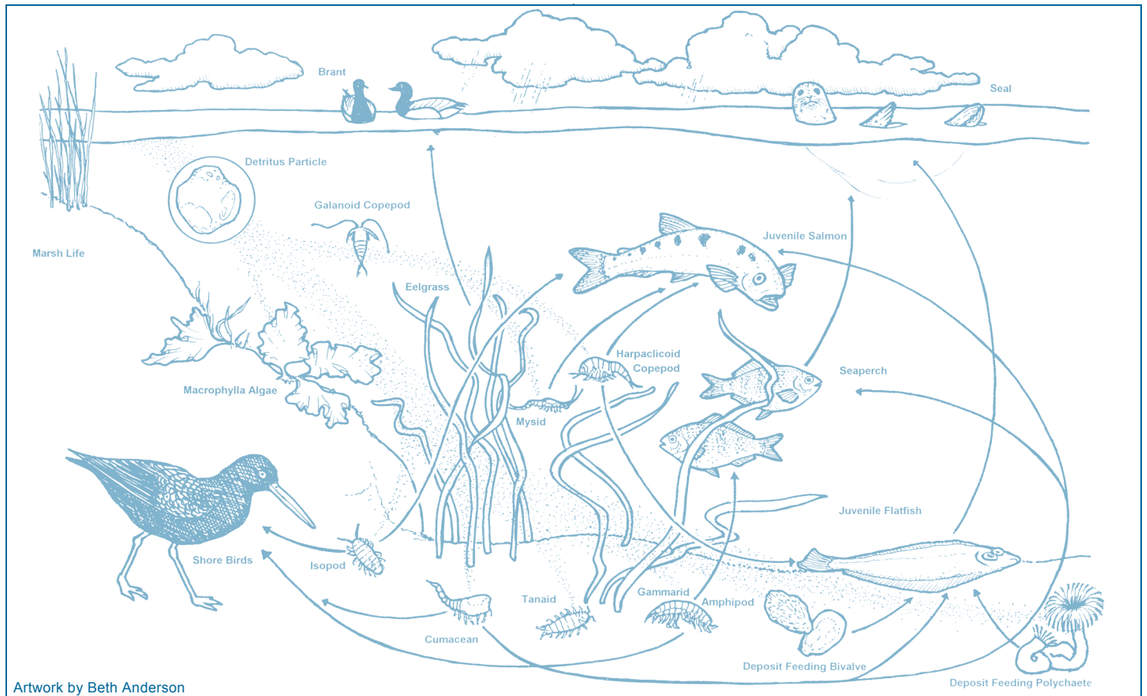
But two days into the hunt, Bear's children were crying for food. Bear had no salmon to feed his children. He decided he would ignore the rule. He would fish with his hands away from the village where no one would see him. Bear went upstream to the spawning beds far away from the village. When he got there he could see all the Salmon Children – Chinook, Coho, Sockeye, Pink, Chum and Steelhead. Bear got down on all fours and crawled out into the river. He reached out and grabbed the Salmon Child named Chinook. When he touched the Chinook, all of its kind rolled over and died. Bear was so pleased at how easy it was to catch the fish he did not notice all the dead fish floating downstream. As he reached out and grabbed each species of salmon, all of its kind would roll over and die and drift downstream.

The people of the village were frightened as they saw all the dead salmon children floating by in the river. When the men returned from the hunt they heard the people crying and wailing. Raven's wife was very angry. She said, "You must punish whoever has done this or I will take my children out to the Big Water and never come back." Raven could not find his brother, Bear, and realized he must be in the river touching all the fish.

Raven led the people up the river to the sleeping place of the salmon. As they approached, he saw his brother Bear reaching for the Steelhead. He told him to stop, that all the fish were dying. Bear said the salmon were easy to catch while they slept. But Raven stopped him before he touched the Steelhead. To this day the Steelhead doesn't die when he spawns – he is the only salmon who can return to the ocean. Raven then reached in his medicine bag and took his black paint powder and threw it on his Brother Bear, turning him into the black bear. "Because you have done this, from this day forward you will walk on all fours. You will fish only here in the spawning beds. If you come into the village again, you will be hunted for food."

This appeased Salmon Woman. But from that day forward, to protect her children, she allowed only one species of her children to be in the river at one time. To honor Salmon Woman and to make sure that everyone would always remember to respect her children, Raven ordered that there be a big ceremony, to be repeated every year, to remind the elders and teach the young about the generous gifts of Salmon Woman and her children.

* A Northwest Native American legend as told by Marguerite Which-Ta-lum. The legend of Salmon woman is told on the totem: raven on top; salmon woman in the center; and bear on the bottom, holding a fish. This totem carving can be viewed at Bellingham's Maritime Heritage Park.

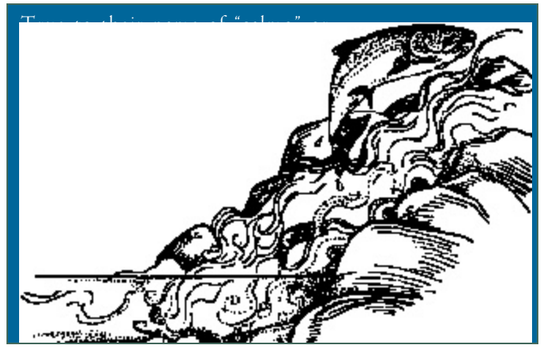


Artwork by Beth Anderson

Salmon play a vital role in the ecosystems of the region. Over 130 other wildlife species have a direct or indirect link to salmon in the food web at one or more stages in the salmon life cycle. Insects and birds dine on salmon eggs. As salmon grow larger, they become a tasty treat for amphibians, reptiles, birds, and mammals such as raccoon, otter, mink, bear, sea lion, seal, and whale. At the end of their lives, salmon are not done playing an ecological role. Their carcasses provide an important source of nutrients for over 70 species, including the next generation of juvenile salmon. When the salmon suffer, it is a sign that the entire ecosystem is deteriorating.

particularly good jumpers, therefore they are extra-sensitive to culvert blockages.

Steelhead: Steelhead are the anadromous form of rainbow trout. They live one to four years in freshwater before migrating to the ocean. They are different from other salmonids in that they often survive after spawning and return to spawn in later years.



Coastal cutthroat: Another anadromous trout, coastal cutthroat, are not prone to long ocean migrations. The fish stay close to shore in the bays and estuaries of Puget Sound.

Each species of salmon has adapted in unique ways to make use of the streams and rivers in our area. Both chinook and pink salmon use large rivers. Chinook are able to migrate hundreds of miles upstream. Some species travel over 1,000 miles from the Pacific Ocean all the way to Idaho to spawn. Chum, which are not strong jumpers, remain in smaller streams in lowland areas. Coho and cutthroat trout also share these smaller streams, but work their way to the headwaters.

Habitat Requirements and Concerns

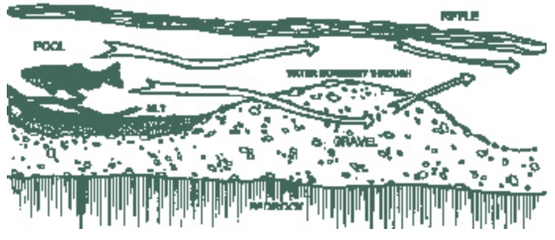
In order to save what remains of the region's salmon populations, it is crucial that we preserve remaining high-quality habitats and restore degraded areas in streams, estuaries, and marine areas.

Freshwater Environment

Healthy habitat in the stream requires water to be a cool temperature, with high levels of dissolved oxygen. The stream must also have a stable flow throughout the year and be free of pollution. Young salmon also need "pool/riffle" formations in their habitat. Pools are relatively deep areas in the stream that provide shelter for the salmon, a slow current, and a place to rest. Riffles are shallow, gravelly areas with a swift current where salmon deposit their eggs. The constant flow in the riffle carries oxygen to eggs buried underneath a protective layer of gravel. Aquatic insects are often abundant in riffle areas, producing food for salmon fry. There must be adequate cover in the stream to provide shelter from predators. This comes in the form of woody debris and undercut banks.

riparian zone- the border of a stream or river above its banks

The riparian area, which is the vegetation that borders a stream, is rich habitat for birds and animals. This area also plays an important role in the freshwater ecosystem. Trees and shrubs provide shade near the water's edge, which helps keep water temperatures cool. The riparian area also serves to release ground water into the stream throughout the dry season. Streams without healthy riparian corridors can dry up just when the salmon need the water to spawn. In this ever-changing environment, branches and leaves that fall from trees provide nutrients for the stream and the insects that become food for salmon. The larger pieces of this woody debris provide salmon with places to hide from predators.



The roots of riparian vegetation stabilize the soil to prevent erosion. Removal of this vegetation causes instability, increasing erosion and turbidity. High turbidity can cause an increase in cloudiness of the water, which interferes with the salmon's vision and their ability to find food and hide from predators. Suspended sediment can also damage the gills of fish and ruin spawning beds by covering gravel beds and smothering eggs.

Healthy salmon habitat requires healthy forests. The forest canopy absorbs tremendous amounts of water. The vegetation and soil acts as a sponge, stabilizing stream flows and filtering contaminants. As vegetation is removed, flows increase and can become polluted with contaminants and suspended sediments. Heavy flows, especially when seasonal rainfall is high, can scour the riverbed, destroying habitat and nesting eggs.

Other threats to the riparian area are posed by invasive plant species. These plants, such as reed canary grass, Himalayan blackberry, and Japanese knotweed, were introduced into this area. These plants did not evolve with other local plants and animals and often provide poor habitat for the wildlife that uses the riparian area. Additionally, invasive plants are very aggressive and can out-compete native riparian plants, including young trees that are a necessary part of a healthy stream ecosystem. Many local restoration efforts focus on eliminating or subduing these invaders so that native shrubs and trees can once again take root, providing needed shade and debris to the stream system.

estuary - where freshwater meets the ocean

Estuarine and Nearshore Environments

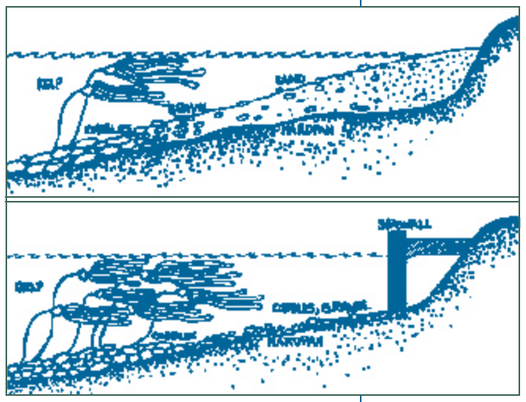
An estuary forms where a river meets the sea. Estuaries are the richest and most productive areas of the coastal environment. Estuarine mudflats and eelgrass provide a home for tiny invertebrates, which support shellfish, fish, waterfowl, and other wildlife.

For salmon, estuarine habitat is especially important for young smolt as they acclimate to the saltwater environment. The length of time spent in the estuary varies by species. Chinook, chum, and pink salmon smolt spend about a month in the estuary, while other species like cutthroat generally spend several months before they emerge and enter the open ocean. Adult salmon also use the estuary to reacclimate to freshwater before returning upstream.

Forage fish species, such as herring, sand lance, and surf smelt, are an important part of the nearshore environment, as they are a food source for a wide variety of organisms, including salmon. These small fish, usually nine inches or smaller, spawn in intertidal and subtidal beach gravel and vegetation, making them vulnerable to shoreline development.

In Northwest waters, forage fish have met a similar fate as salmon. It is important that we examine this link between declining fish populations throughout the food web if we hope to recover salmon populations.

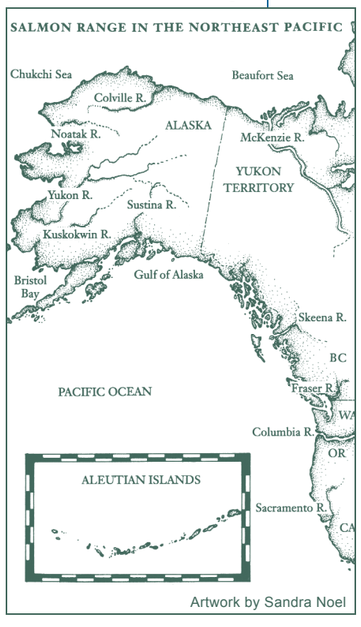
Fine beach sand and gravel are needed by sand lance and surf smelt for spawning, while herring spawn in eelgrass. Many of the best beaches and nearshore areas for forage fish spawning have been affected by the existence of man-made structures. Docks and jetties can interrupt the flow of sediments along the shore robbing some beaches of much-needed gravels. The lights and shadows from large industrial docks may also scare fish such as herring away from traditional spawning areas. Bulkheads and seawalls can also cause negative impacts on a healthy nearshore environment. Bulkheads change the way that waves hit the shore. Instead of wave energy being dissipated as the wave rolls up the beach, it hits the bulkhead, causing the wave to turn back on itself. Over time, this action causes a scouring of the beach, as fine sand and gravels are pulled out with the waves. The large rocks and hardpan beneath are not suitable for beach-spawning fish such as sand lance. The loss of fine substrates can also result in the loss of eelgrass beds, which are used by herring for spawning.



Marine Environment

Salmon spend 40-75% of their lives in the ocean, traveling thousands of miles. Scientists tracking migration patterns have found that many travel from the streams of their birth in the Pacific Northwest, up into the North Pacific Ocean and into Alaska and the Bering Sea before returning to spawn. One chinook tagged in the Aleutian Islands was recovered a year later in Salmon River, Idaho. It had traveled about 3,500 miles! A steelhead trout also tagged in the Aleutians was found 6 months later, 2,200 miles away in Washington State.

While in the ocean, salmon feed on many small creatures. These food sources, such as zooplankton and small fish, require a narrow range of ocean temperatures to flourish. When ocean temperatures rise just a few degrees above normal, zooplankton production is reduced, and salmon may struggle to find food. This is becoming an area of concern as ocean temperatures worldwide grow warmer.



Artwork by Sandra Noel

Local Stocks

Historically, the mainstem of the Nooksack River was a complex system of braided channels, sloughs, and wetland habitat where wildlife flourished. The river flowed into both Lummi Bay and Bellingham Bay, offering a plethora of rearing habitats for young salmon. Abundant woody debris slowed the flow of the river during floods and provided cover to protect salmon from predators. Thick and healthy vegetation covered the land, adding to the health of this thriving ecosystem.

As Euro-American settlers moved into the area, trees and vegetation were cleared. Levees and dikes were built, converting 3,500 acres of former wetland habitat into farmland. Huge log jams, up to 3/4 mile in length, had built up in the upper reaches of the Nooksack River. Though they provided excellent salmon habitat, the jams were cleared in the late 1870s to improve river navigation. All of these practices changed the structure of the Nooksack.

Today, degradation continues in the Nooksack basin. As a result of non-point pollution from households, livestock, leaking septic tanks, farms, and lawns, the Nooksack violates state water quality standards for fecal coliform, chromium, mercury, fine sediment, minimum flow requirements, and temperature. Land use practices, such as extensive logging and associated road building, have caused three-quarters of the streams in the Nooksack River Basin to be deemed unstable, which increases levels of erosion and instream sediment. The Lummi River has been reduced so greatly in size that out-migrating smolt are blocked from access to prime estuarine rearing habitat in Lummi Bay. In the Nooksack basin, there has been an 80% decline in wild salmon since the 1950s. Much of this decline is likely to be attributed to habitat degradation and overfishing.

North Fork Nooksack

The North Fork of the Nooksack River is glacially fed and generally has cold water. The land is characterized by steep slopes and unstable bed materials. The rainy weather adds to this instability, sending large amounts of sediment into the river. Logging practices can lead to even more instability and erosion is identified as the greatest factor affecting the productivity of salmon on the North Fork of the Nooksack. The high level of sedimentation lowers the likelihood of fry emergence from the redd. The North Fork Nooksack chinook are threatened. The Washington State Salmon and Steelhead Stock Inventory (SASSI), released in 1994, estimated that 200 North Fork Nooksack chinook of native origin return each year. Recovery efforts hope to bring this number up into the thousands.

Middle Fork Nooksack

Similar issues affect habitat on the Middle Fork Nooksack. One obstacle unique to the Middle Fork is a dam, which diverts water for domestic use through a pipeline to Lake Whatcom. This dam blocks anadromous salmon from access to over ten miles or about 20% of historic habitat that was available in the upper reaches of the Middle Fork Nooksack River.

A stock is designated "critical" when it has declined to the point that it is in danger of significant loss of genetic diversity or at risk of extinction. Out of twelve salmon stocks designated critical in Washington State, two are chinook stocks in Whatcom County. These stocks are native to the North and South Forks of the Nooksack River. North Fork and South Fork Nooksack native spring chinook and bull trout are listed as threatened on the federal endangered species list.

South Fork Nooksack

The 1994 SASSI reported that the South Fork Nooksack chinook run averages only 340 returning adult spawners per year. The Acme Watershed Analysis, released in 1997, determined that nearly 100% of large woody debris was removed from the South Fork during the 20th century. Armoring and diking occurred along 60% of the channel length. Close to 86% of slough and wetland habitat has been lost, and there has been a 57% reduction in gravel bars. Maximum depths of pools in this fork of the Nooksack were historically 30 feet deep; now they are less than half that - only 13 feet. Because the South Fork is not glacially fed, high water temperature is a greater concern than in the North Fork, making the need for shade from a healthy riparian area very important. Water temperatures are often at lethal levels when adults are returning upstream to spawn. The South Fork Nooksack chinook are also threatened, and fish managers hope to bring their numbers back into the thousands.

Species	Freshwater Life Phase	Month
		J F M A M J J A S O N D
Spring Chinook	Upstream Migration	
	Spawning	
	Intragravel Development	
	Juvenile Rearing	
	Juvenile Out Migration	
Summer Fall Chinook	Upstream Migration	
	Spawning	
	Intragravel Development	
	Juvenile Rearing	
	Juvenile Out Migration	
Coho	Upstream Migration	
	Spawning	
	Intragravel Development	
	Juvenile Rearing	
	Juvenile Out Migration	
Pink	Upstream Migration	
	Spawning	
	Intragravel Development	
	Juvenile Rearing	
	Juvenile Out Migration	
Chum	Upstream Migration	
	Spawning	
	Intragravel Development	
	Juvenile Rearing	
	Juvenile Out Migration	
Sockeye	Upstream Migration	
	Spawning	
	Intragravel Development	
	Juvenile Rearing	
	Juvenile Out Migration	

Salmon are most visible during the fall when popular spots at the Maritime Heritage Center and Arroyo Park are packed with curious people looking for spawners migrating upstream. But salmon are present in streams and rivers of the Nooksack Basin year round.

How Humans Impact Salmon

Natural conditions and human influences affect the distribution of salmon populations. Natural conditions include barriers, such as landslides, log-jams, beaver dams, and impassable waterfalls, which may block salmon from access to upstream headwaters. Flooding and changing ocean conditions can cause fluctuations in fish population sizes, as can predation from seals, sea lions, and other marine mammals. Salmon have faced these challenges for thousands of years, and they adapted to flourish. It was not until the massive harvests, combined with habitat destruction that came with European settlement, that salmon populations declined.

Many human activities adversely impact salmon populations. Any one factor by itself is not to blame, yet when added together the impact can be devastating. On a given river there may be a gravel mining operation, a logging site, a farm, an industrial facility, a hatchery, a dam, and a town with roads and parking lots. When the impacts of all these activities are combined, salmon suffer.

Salmon recovery depends on many things. It requires that we take a look at the way we live and how we impact the land. We can not expect to make the human landscape more amenable to salmon without examining the way we live on the land. As we look at our actions - our transportation system, how we make electricity, grow food and use natural resources, we can see there is a lot of room for improvement to lessen our impact on the land.

Urbanization

There are almost six million people living in Washington State. Population projections show that number could double in the next 50 years. Most growth is concentrated around the Puget Sound, where several species of salmon are threatened or endangered. In urbanized areas, impervious surfaces, polluted storm water, point-source pollution discharges, and channel alteration make it more and more difficult for salmon to survive.

Impervious Surfaces

In a natural landscape, the land acts like a sponge, absorbing rainwater, with only 10% runoff. In urbanized areas where natural ground cover has been removed, 55% of precipitation runs off. Water runoff from yards, streets, and parking lots flows directly into storm drains and ditches. This water, carrying oil, detergent, pet waste, and other pollutants, runs into streams and creeks without a chance for it to be absorbed and naturally filtered.

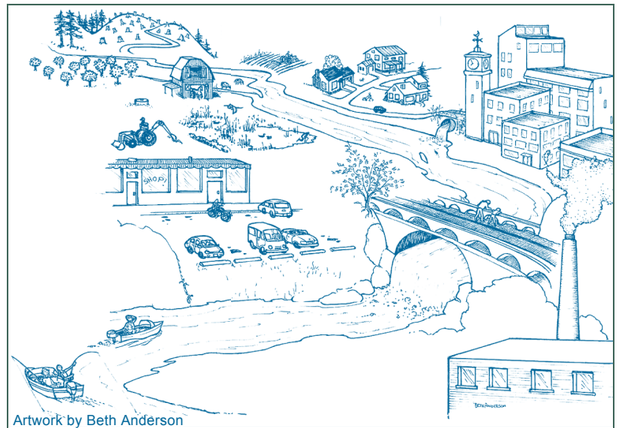
Culverts

Pipes built to funnel stream water under roads and other developed areas are called culverts. If a culvert is too high, or during seasonal low flows, salmon may not be

the culvert and are blocked to higher reaches of streams. have trouble navigating the ls that are presented by some vements to culverts around , such as replacing them with widening the diameter or dding fish ladders could open to 3,000 miles of spawning grounds that are currently inaccessible to fish.

elization

streams in the region have been ened to facilitate road building, d drainage, and flood control. Keeping a dynamic stream running on a straight path is difficult. It disrupts the natural function of the stream, increases the velocity of water flow making it difficult for salmon to swim upstream, perpetuates bank erosion, and reduces rearing and spawning habitat. Sometimes stream banks have been lined, with cement to help keep this erosion in check. This virtually wipes out viable habitat for salmon.



Artwork by Beth Anderson

Salmon do not live just in streams; they live in watersheds. It is important that we understand that streams do not flow just from the mountains to the oceans. Drops of water that fall on every inch of the watershed make their way into streams and rivers. This means that every activity in the watershed can affect stream health whether it occurs a foot from the stream or a mile away. We all need to look at how we can change our habits to live responsibly in our watersheds. The great thing is that the actions we take to improve our environment will protect salmon, while at the same time safeguarding human health with a clean water supply.

Promising efforts are underway to restore the often ignored streams that run through urban areas. Streams in Bellingham reflect this trend. Walk along your neighborhood stream and take a look at what the salmon face. Note where streams are overgrown with invasive species, strewn with trash or where sections disappear into underground cement channels. Whatcom Creek, which winds through the heart of Bellingham's downtown, is receiving a lot of attention from dedicated citizen volunteers, school children and a City of Bellingham sponsored Washington Conservation Corps crew. Tires, trash, and invasive species are being removed, while native plants are being put in their place to transform this degraded backyard ditch to a thriving stream ecosystem at the center of the community. Small tributary streams such as Fever Creek are still faring poorly in local restoration efforts. Without clean tributaries, the integrity of Whatcom Creek will always suffer. Flowing through South Bellingham, Padden Creek has been channelized and culverted intensively. A study to consider the feasibility of "day-lighting," or opening up the creek to run its natural course, is currently underway.

Pollution

Pollution is a Puget Sound-wide problem, though contaminants are found in higher concentrations in urban areas. Pollutants come from a variety of sources including stormwater runoff, industrial and municipal wastewater, shipyards, boatyards, marinas, sewage treatment plants, pesticide runoff, and household chemicals.

Pollution reaches our waters either from a direct "point" source, such as a pipe that discharges waste into a water body, or as runoff. Because runoff comes from an entire drainage area, the pollutants it carries-such as soil, fertilizers, pesticides and oil - can be difficult to trace to their individual sources. That's why runoff is sometimes called "non-point" source pollution.

Toxic pollution is of particular concern, because it can harm humans, animals, and fish. Since the mid-1980s, scientists have been studying the effects of toxic chemicals on anadromous salmon. Studies have shown that these chemicals accumulate in the tissues of salmon as a result of contaminants in their food sources. Toxic pollution in small quantities can magnify as it moves up the food web. This accumulation has been shown to cause a chemical modification of DNA and the alteration of immune functions. Dioxins, specifically, have been found to decrease the growth rate of fish and detrimentally affect the egg sac.

It's not just farmers!

Did you know? A recent study by the U.S. Environmental Protection Agency found the presence of commonly used pesticides, such as diazinon and 2,4-D (found in

weed & feed products and other herbicides), in urban streams throughout Washington. In this study, 23 pesticides used by homeowners were found in the water and stream sediments. Around Puget Sound, urban dwellers buy more than one million pounds of pesticides each year. This is more than three times the amount applied by local farmers.

Art courtesy of Dave May

Pollution Prever
Cars are one of tors to polluted rubber from ti asbestos from b ways, washing

act, use trans- pool or tor oil, Don't pour it on the ground or in a storm drain. Did you know that one quart of motor oil can foul the taste and smell of all the water you and 29 of your friends could drink in your lifetimes? Check your car periodically for leaks. A well-maintained car is easier on the environment! Soapy water kills macroinvertebrates, the food for our fish, so wash your car on your lawn or at a designated car wash area, not on the street where the soapy, oily water runs directly into storm drains and into streams.

What You Can Do!

To lessen your impact from pesticides, pick weeds by hand. If you choose to use chemicals, do not apply them when it's raining. Plant native plants in your yard; they don't need as much water or care, and can reduce your need for pesticides. Another type of pollution that can also pose a threat to stream health, is the fertilizer used on home and commercial landscapes. Fertilizers encourage growth in your garden, but also in our streams and lakes. They cause algae to grow more than it would naturally, which depletes oxygen and can suffocate fish. Use "natural organic" or "slow release" fertilizers, which last longer, enhance soil life, and don't wash off into streams as easily.

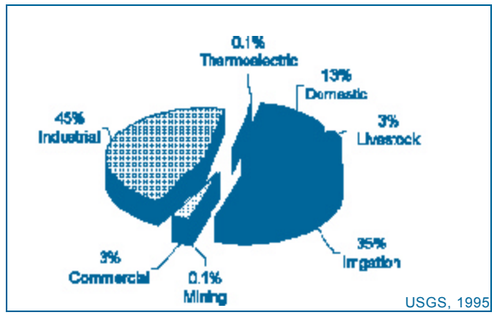
Pesticides are a type of pollution often found in salmon streams. They are harmful because they can kill the insects that are food for salmon. Some of these chemicals also cause changes in salmon behavior such as interfering with their ability to swim, feed, avoid predators, and defend territories. All of these changes make it more difficult for salmon to complete their life cycle. Pesticides may also interfere with a salmon's immune system, hormones, and development processes.

There are many ways to combat pollution in our waterways. The federal Clean Water Act set a national goal to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" and to "eliminate discharge of pollutants" into navigable waters by 1985. Under this mandate, the National Pollution Discharge Elimination System (NPDES) continues to work toward this goal for point-source pollution with a system that requires any facility that discharges wastewater to obtain a permit. In Whatcom County, over 100 NPDES discharge permits have been issued to a wide range of facilities including pulp mills, aluminum smelters, sewage treatment plants, boatyards, hatcheries, gravel pits, and dairies.

As for non-point-source pollution, it is up to each individual to prevent pollution at the source - by reducing chemical use, driving less and numerous other changes. Remaining polluted runoff can be treated by improved stormwater filtration systems in existing and new development.

Water Use

Providing water to a growing population in Puget Sound is also a salmon issue. With all the rain we have in the Pacific Northwest, it is sometimes hard to believe that our water supply is limited. When you look at how much water we use for industry, agriculture, residential, and recreational uses, its understandable why there is not always enough water to go around.



Water removed from streams for all these uses causes stream levels to fall. Smaller streams often run dry, which makes it impossible for spawning salmon to migrate upstream. A constant flow of water is also necessary for the eggs after they are deposited. Without water, the eggs will not last long.

Water is currently undervalued in our state. If we are going to have an adequate water supply for people and fish, we will need to acknowledge the true worth of this resource - which may mean paying more for it. Paying the true cost of water may encourage conservation on individual, commercial and governmental levels. It is important to designate minimum instream flows for each stream to ensure that fish survive. Flow levels have been set for less than one-third of Washington's major rivers. For rivers with flow levels in place, the goals are often not met. In the future, actions need to be taken to ensure instream flows are set and achieved.

Did you know? Americans routinely over-water their lawns by 20-40%. An average Puget Sound lawn needs about one inch of water per week, whether split into several shorter waterings or all at once. Place a cup on the lawn to catch falling water to determine how long you need to leave the sprinkler running. Also consider letting your lawn go brown during the summer months. It will come back green once the rains start up again. When mowing "cut it high, and let it lie." Cut grass 2" to 3" high. The longer blades encourage root growth and provide shade, making the soil more absorbent. Leaving the cuttings on the lawn will act as a natural fertilizer.

Hydropower

In Whatcom County, there are a number of small hydroelectric projects on the Nooksack and two large dams on the Skagit River.

Up to 80% of electricity in the Northwest is produced by water that rushes through hydroelectric dams region-wide. While dams provide many benefits to humans, such as relatively clean power, improved navigation, flood control, and irrigation, they have raised quite a controversy regarding their impacts to the environment.

Going downstream, juvenile salmon face many obstacles posed by hydroelectric projects. Salmon smolt often get caught in churning turbines. Others get injured or die in the turbulent, high-pressure area under the dam's spillway. This can cause a condition similar to a scuba divers case of "the bends," in which young salmon absorb too much nitrogen into their bloodstream. The rate of survival for fish passage around a dam is about 90%, but when fish face multiple dams, their likelihood for survival decreases.

Dams can also cause problems for migrating adult salmon by blocking access to spawning grounds in the upper reaches of rivers. Fish ladders, a series of stair-stepped pools, provide a detour around dams, but adult salmon are often unable to find their way to the fish ladder.

Not only are dams an obstacle to salmon, but they cause a variety of alterations to freshwater habitat. Dams degrade riparian vegetation and increase sedimentation. They significantly alter the river structure by slowing the current and forming reservoirs or lakes above dams. The slack water warms, often to a point that is too warm for salmon and encourages predators like introduced largemouth bass. In addition, without the swift current to lead salmon downstream, they can become disoriented and have trouble finding their way to the ocean.

Recent studies have highlighted the challenges posed to salmon by dams. Strategies have been put in place to reduce their impact on fish, such as fish screens to keep young fish from getting caught in turbines, strobe lights to direct the salmon, and improved turbine technology. In drastic cases, fish have been collected and trucked or barged around dams. Fish managers are also trying to help salmon by using reservoirs in their favor. Releasing water during out-migration of young salmon can help speed downstream migration of juvenile salmon.

As we examine the feasibility of dam removal, alternative sources of energy and other questions, we can reduce the need for such an extensive system of dams. We can use less energy and water. We can also restore wetlands, which naturally absorb water, providing many of the flood control benefits the dams were built to provide.

Hatcheries

Hatchery programs have been in place in the Northwest for over 100 years. In an attempt to replace the thousands of miles of spawning beds that were blocked or flooded by dams, Congress passed the Marshall Act in 1938 to provide federal funding to construct hatcheries. Their original intent was to sustain salmon populations and counteract the effects of habitat degradation, while providing greater harvest opportunities for commercial, recreational, and tribal fishers. By the 1950s, however some in the scientific community became concerned that hatchery salmon were harming wild salmon runs. Today, hatcheries continue to play a big role in fish management. Over 100 million hatchery salmon were released in Washington State in 1999.

Problems arise because hatchery smolt are selected to be large in size and are sometimes able to out-compete the smaller native fish for food and cover. Though they may be larger, hatchery fish are not superior to wild fish. Hatchery fish are more susceptible to disease and lack the genetic diversity that enabled native salmon to thrive before human development began to occur. Wild fish are better adapted to survive in the ocean. In addition, broodstock (fish collected and spawned artificially to provide eggs for propagation) are often transplanted from one river to another and have not evolved for their new stream. By contrast native fish, which have always returned to the same stream, have adapted to specific conditions in that stream over thousands of years. They are genetically predisposed to know how to find food, hide from predators and find spawning grounds in their stream.

A positive move in hatchery management practices is being made in Whatcom County. In a cooperative project between the Nooksack Salmon Enhancement Association, Lummi Indian Nation, Nooksack Tribe, government, and local businesses, fry originating from native broodstock are planted in ponds on the North Fork of the Nooksack River. These "acclimation ponds" become home to fry hatched from the Kendall Creek hatchery, giving the young salmon an opportunity to imprint on the stream. When they return to spawn as adults, they bypass the hatchery and spawn in the wild, helping to rebuild the natural run.

Fishing

Fishing is an important part of Washington's culture and economy. It provides jobs for commercial and tribal fishers around the state and positive recreational experiences for sport fishers young and old. Washington is among the top three commercial fishing states in the country. Bellingham Bay is a major port for Puget Sound and a home base for many who fish in Alaska. Sadly, because of historic over-harvest, today's fishing fleets are very limited in the amounts of salmon they are allowed to catch.

Fisheries management restrictions include:

- shortened fishing seasons
- limited locations where fish can be caught
- fixed quotas on the number of fish that can be caught
- limits on the size of fish that can be kept
- restrictions on the size of mesh used in nets
- marking of hatchery fish and returning unmarked catch

In 1974, the federal court case U.S. v. Washington, decided by U.S. District Court Judge George Boldt, drastically changed fishery management. Known as the Boldt Decision, this decision decreed that half of the state's marine/freshwater harvest goes to tribal fishers; the remaining half is divided between non-native commercial and recreational fishers. Washington's salmon and steelhead fisheries are co-managed by state and tribal governments. These regulators analyze information on stock status and set goals to ensure that

> "You can't find a more complicated fishery than Puget Sound in the world." -
>
> Bruce Sanford,
> Washington Department
> of Fish and Wildlife

enough fish survive harvest in order to spawn and uphold the long-term health of the run.

Puget Sound is possibly one of the most complicated fisheries to regulate in the world. Rules vary by species and stock. For a single species, such as chinook, regulations are different for the Skagit River stock than they are for the Nooksack River stock. Management gets even more complicated, because

There are three types of commercial fishing boats used in our waters.

- Trollers catch fish by slowly trailing baited lines through the water
- Gillnetters use a net that entangles fish by the gills
- Purse seiners use a net to catch fish at the surface. The net may be up to one kilometer long and 300 meters deep and is used to encircle surface schooling fish. During retrieval, the bottom of the net is closed or "pursed" by drawing a purse line through a series of rings to prevent the fish escaping.

Photos courtesy of Buck Meloy

anadromous fish travel through many jurisdictions. Salmon that spawn in streams in Washington travel through Canadian waters to Alaska and back again. At every stage of this journey, they must avoid being caught in a fisher's net.

Fish management is constantly changing. Each year, governmental and tribal co-managers study scientific information and computer models that forecast fish populations for the season. These forecasts are compared with conservation goals, international and tribal treaties and Endangered Species Act requirements to set regulations. During each fishing season, co-managers monitor the waters and adjust rules as needed.

To find out more about commercial and recreational fishing regulations, check out the "Fishing in Washington" pamphlet at http://www.wa.gov/wdfw or call the Washington State Fishing Hotline at (360) 902-2500.

Past over-harvest has resulted in ever more stringent guidelines and dwindling opportunities for fishing around the Sound. For commercial and sport fishers, chinook troll harvests have fallen from more than 500,000 fish in the mid-1970s to zero in 1994 and increased to only a few thousand in 1995-98. The length of seasons has been shortened from 139 days on average in 1971-1975, to only 14 days in 1996 and 46 days in 1997.

Agriculture

Agricultural land covers 37% of our state. In Whatcom County, 1,228 farms cover 103,600 acres. While farming is a critical part of our rural landscape, providing us with the very basis of life, we now know that certain agricultural practices can degrade watersheds and salmon habitat.

The following problems are prevalent on agricultural land in Whatcom County:

- Wetlands are often drained, or water is directed into a channel, to maximize the amount of land for agriculture. This reduces the amount of habitat available to salmon.
- Water is diverted out of streams to irrigate crops, reducing stream flow.
- Riparian vegetation is often removed to maximize cropland. Livestock can add to this problem as they trample stream banks and wade through streams. Without a healthy riparian area, water temperatures rise, and runoff from fields flows into streams at much higher levels carrying excess nutrients, sediment, animal waste, and pesticides.
- Streams are dredged, removing sediment and vegetation to increase drainage.
- Dredging can destroy redds, habitat, and fish. Any instream dredging requires a Hydraulic Permit (HPA) from the Washington Department of Fish and Wildlife, which helps to minimize damage to fish and their habitat.

Whatcom County is one of the leading dairy counties in the nation, with over 60,000 cows in production. Each dairy cow can produce waste equivalent to 20 humans. The most common way to deal with animal waste is to store it in manure lagoons through the winter and apply it to farmland from spring through fall. Animal waste heavily impacts water quality on Bertrand, Fishtrap, Kamm, California, and Dakota creeks. A state law passed in 1998 requires dairy farms to have formal plans for handling manure in place by 2004.

With the help of the Whatcom Conservation District and the U.S. Department of Agriculture Natural Resources Conservation Service, Whatcom County farmers are adopting best management practices to reduce their impact on salmon.

The Conservation Reserve Enhancement Program (CREP) run by the Whatcom Conservation District, a federal/state partnership, has been launched to help farmers restore riparian habitat buffers along streams and lessen their impact on salmon. This voluntary and flexible program provides financial aid to plant trees and shrubs and put in fencing along the riparian area. These buffers, which are typically 50-150 feet wide, help to stabilize the stream, prevent erosion, reduce runoff of chemicals and waste to streams, increase wildlife habitat, and provide shading. In Whatcom County, 21 landowners have enrolled over 230 acres with at least 15 miles of stream buffers in the CREP program. Many of these projects are very large, including one that covers 42 acres, requiring 19,000 seedlings. If you are interested in learning more about this program, please contact the Whatcom Conservation District at (360) 354-2035.

Additional Best Management Practices:

- Filter strips - grass or other vegetation planted around or throughout crops to filter runoff
- Cover cropping - crops planted after harvest that prevent erosion and runoff through the winter
- Riparian set-asides - to buffer streams
- Livestock fencing - prevents animals from entering streams

Forestry

Half of Washington's land area, about 21 million acres, is covered by forests. Half of that land is managed primarily for timber production by state, private, and industrial foresters. This makes Washington a major source of timber for North America and the world.

Forested land, especially the riparian area, provides many crucial functions in the stream ecosystem. Trees keep the water cool, stabilize the soil, and replenish nutrients. Forests absorb water, filter pollutants, and slow down runoff to minimize erosion. As healthy forests are depleted, water temperatures rise and sedimentation increases, causing salmon habitat to be degraded. Forestry practices, such as insecticide and herbicide application, add to the degradation as a source of water pollution.

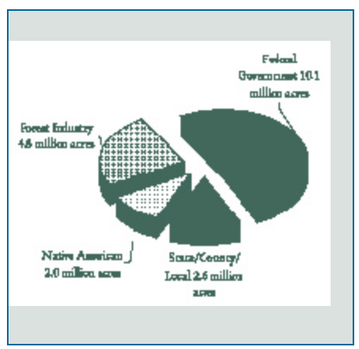
Another set of impacts by forestry comes from the extensive network of logging roads that exist throughout much of the Northwest. Many of these roads are old and poorly located, winding their ways across multiple stream channels and traversing steep, unstable slopes. Landslides from logging roads have destroyed significant amounts of salmon habitat. Poorly designed culverts also obstruct fish passage. Improvements in road location, design, construction, and maintenance are lessening the impacts of roads, but more changes will be required in the future to support salmon habitat. This can mean decommissioning or removing old roads, which is often the best way to reduce sediment delivery to streams and rivers.

Impacts from forestry can include:

- changing the hydrologic cycle
- increased erosion from landslides, roads, and clear cuts
- altering the amount of large woody debris in a stream
- increasing stream temperature
- obstructions to fish passage (culverts)

The U.S. Forest Service, Washington Department of Natural Resources, Lummi Nation, Nooksack Salmon Enhancement Association, Trillium Corporation, Crown Pacific Corporation, and others are involved in road removal projects locally, including revegetation, culvert removal, and other impact reduction techniques.

Forestry practices prior to the 1970s were relatively unregulated, and clear cuts were allowed right up to the stream bank's edge. Removal of instream debris was a common practice, providing more logs for market while clearing waterways for navigational purposes. Fish biologists viewed instream debris as material that could scour the streambed in a storm event or block migrating fish and therefore encouraged this practice up until the 1980s, when the habitat value of instream debris was discovered.



In 1974, the state's Forest Practices Act was passed, setting up a system to regulate forest practices on state and private lands. It established the Forest Practices Board to make forestry rules protect the public resources while maintaining a viable timber industry. The current rules require Department of Natural Resources (DNR) permits for all forestry practices, such as logging, road building, and pesticide application. These permits apply to most state and private lands, excluding very small harvests.

Photo courtesy of Greg Tieman

In the late 1980s, with the pending listing of endangered species such as the northern spotted owl and chinook salmon, various stakeholders came together to work on the Timber, Fish and Wildlife (TFW) Agreement. The idea of TFW was to develop proposals for better logging rules by consensus, then bring them before the Forest Practices Board for approval. A number of positive changes resulted from TFW negotiations over ten years, including the change from reviewing harvest applications on a permit-by-permit basis to now allowing for watershed analysis addressing impacts of multiple timber practices in one watershed. Despite these beneficial changes, consensus proposals for new salmon rules never emerged. The environmental community and some Washington Tribes decided to leave the TFW salmon negotiations and submit science-based rule proposals directly to the Forest Practices Board. In 1999, the Washington State Legislature directed the Forest Practices Board to adopt rule proposals called Forests & Fish. The Forest Practices Board has adopted Forests & Fish as an emergency rule and is currently formalizing a final rule package that will become effective on June 30, 2001.

What You Can Do!

As consumers we must support the changes in forestry. This means reducing our use of wood and paper products and reusing resources when it is possible. Recycle! Buy recycled products. Americans use 50 million tons of paper annually, which means we consume more than 850 million trees! If everyone in the U.S. recycled even 1/10 of their newspapers, we would save 25 million trees every year. These changes may require us to open our pocketbooks to spend a bit more on products that are sustainable. When buying wood, look for products certified by the Forestry Stewardship Council which contains wood from responsibly managed forests.

Regulations for timber harvests, such as buffer widths near streams, depend on the type of waterbody. More trees are required to be left along fish-bearing streams, while discretion is left to individual landowners for smaller, non-fish-bearing streams. This can pose problems, because often these smaller streams are headwaters to fish-bearing streams and directly affect downstream water quality and temperature. Under Forests & Fish, clear-cutting is allowed along many of these non-fish-bearing streams.

Forestry regulations aimed at protecting salmon have steadily improved over the past few decades. Monitoring and research are needed to make sure that rules are adequately protecting public resources. Moves are constantly being made towards sustainable forestry. An innovative eco-forestry project is now being undertaken in the South Fork Valley of the Nooksack Basin. The Evergreen Land Trust, in cooperation with Crown Pacific Corporation, is using sustainable forestry practices to cut selected trees. They leave older trees and snags to stabilize the soil and provide wildlife habitat. Trees are harvested, while a diverse forest ecosystem remains standing. As projects like these become economically viable, the face of forestry will continue to change.

Mining

Mining for crushed stone, sand, and gravel is significant to Washington's economy. In 1991, state revenues from mining these materials were over $135 million. These important resources are used extensively in asphalt and cement to build houses, schools, roads, and other construction projects.

Every year an average of 40,000 pounds of new minerals are consumed for each person in the United States. In Whatcom County, current mineral extraction focuses on limestone, olivine, sand, gravel, and building stone, with historic extraction of coal, gold, sandstone, clay, and peat. Whether it is for precious metals, such as gold or silver, or for sand and gravel, mining often takes place in or near a stream and has an impact on salmon and habitat. While instream mining for gravel has been very active in the past, currently, there is little instream mining in Whatcom County. This is because federal and state permitting requirements make it very difficult for companies to receive the necessary permits.

Sand and gravel mining occurs along nearly every major river in Washington state. Instream gravel mining can change the characteristics of a stream, removing vital spawning gravels, changing the shape of the channel, and disrupting or removing riparian vegetation. Gravel mining increases bank erosion, removes spawning gravel for salmon, and disrupts pool/riffle habitat. Fuels and lubricants used in gravel mining operations can also be a source of water pollution.


Photo courtesy of Brain Raven, www.ravenscience.org

Approximately 210 tons of sand and gravel are used to build the average western Washington home. That's the weight of 84 orca whales! Sand, gravel, and crushed rock are used to make basements, foundations, streets, driveways, sidewalks, and patios.

By supporting low impact development, we can limit driveways, sidewalks and other impervious surfaces, therefore reducing the demand for aggregate materials as well as reducing harmful effects of runoff.

Recreation

People in the Northwest love to play outside. Time spent hiking and camping is often time spent near water. Off-road vehicle use and horseback-riding may require river-crossings and fishing, swimming, tubing, and rafting occur right on the water. Many of these activities disrupt crucial riparian vegetation. Others disturb salmon while they are spawning and may crush redds, suffocating salmon eggs. While enjoying the splendors of the outdoors, it is important that we remember the creatures living there.

Local stewards, conservation groups and enforcement officers are working to educate recreators to tread lightly while playing in rivers and streams. River guides, as well as, tubers, hikers and others

What You Can Do!

- While in the water, avoid walking over gravel where salmon have possibly spawned. Step on larger rocks and boulders. If you encounter spawning salmon, try to move away as quietly as possible. Because deeper pools and logjams are crucial habitat, avoid lingering in these areas.

- Ride ATVs and bicycles on trails, not in streams.
- Control animal access to streams. Keep your pets on a leash near the water. Also, scoop pet feces and put them into the trash.
- Leave logs and driftwood in and around the river. Bring your own wood for campfires.
- Know and follow fishing regulations. If you suspect that someone is fishing illegally or disturbing spawning salmon, call the Washington State Patrol Office in Whatcom County at (360) 676-2076.

are learning what it takes to enjoy the outdoors while preventing damage to fish habitat. Actions we take will work to prevent closing these cherished waterways to human use, as was necessary for a few days during the peak of the summer 2000 recreation season.

Restoration

Habitat restoration is a crucial part of salmon recovery. Since every stream is different, it is important to understand the specific needs of each run. In Whatcom County, scientists are working on watershed assessments to do just that. They are assessing the size and location of local salmon populations by counting downstream migrating smolt and adult spawners travelling upstream. Land use and barriers affecting each run are also being examined. This effort will help prioritize pristine areas for protection and specific needs for restoration projects.

Beginning in the headwaters of the Nooksack basin and moving downstream, there are many different types of restoration projects. In the forested mountains, restoration focuses on sediment control and road improvement. This includes re-vegetation, slope stabilization, storm-proofing of culverts and abandonment of roads that are no longer in use. In the lowlands, on urban and agricultural land, riparian restoration is crucial. Crews plant trees and shrubs along the stream banks, battling weeds and foliage-eating creatures such as voles and deer. After a planting is over, the work is not complete, as sites require monitoring and re-planting for at least five years.

After a century of altering the structure of the Nooksack River, recovery groups are now working to restore critical functions in the ecosystem. This includes opening the floodplain to allow natural meanders and putting large woody debris and boulders back into the river. The Nooksack Recovery Team is planning an artificial log-jam of historic proportion to be engineered in the upper reaches of the Nooksack South Fork.

Restoration and education go hand in hand. Without the support of an aware and mindful community, water quality will not improve, and restoration efforts will be futile. The Nooksack Salmon Enhancement Association is one organization dedicated to salmon education. They offer presentations to schools, service organizations, local clubs and other community groups. Their Students for Salmon program gives 3rd through 12th grade classes an opportunity to learn about salmon and habitat restoration including a hands on site study and planting session. The Whatcom Conservation District sponsors the Stream Team, a program that offers classes on salmon recovery for adults. A series of classroom sessions cover a wide variety of topics, which provide participants with the tools to go outside and restore streams in their neighborhood. The City of Bellingham provides watershed awareness, salmon, and stewardship education programs to area students. Salmon education is also being incorporated into schools around the county. As schoolchildren learn stream stewardship they will have an opportunity to improve water quality in the future.

Restoration projects include:

- re-vegetation of the riparian area along streams
- instream restoration - placement of large woody debris, boulders and other stream structures
- "day-lighting" streams - taking out water diversion tunnels and culverts to allow streams to run a natural course with pool/riffle habitat, riparian vegetation, etc.
- culvert improvement
- sediment reduction in forestry lands
- fencing to keep livestock out of streams

The Nooksack Recovery Team

The Nooksack Recovery Team is a non-profit organization of diverse members that works to coordinate salmon restoration in the Nooksack basin. Since 1994, member organizations such as Native American tribes, governmental agencies, private industries, and conservation groups - have combined staff and funds to initiate 430 restoration projects.

The following organizations are members of the Nooksack Recovery Team:

- ARCO Products Cherry Point Refinery
- Bloedel Timberlands
- Crown Pacific Corporation
- Georgia-Pacific Corporation
- Intalco Aluminum Corporation
- J. Hancock/The Campbell Group
- Lummi Nation
- Mt. Baker-Snoqualmie National Forest
- Natural Resource Conservation Service
- Nelson Brothers, Inc.
- Nooksack Salmon Enhancement Association
- Nooksack Tribe
- Northwest Ecosystem Alliance
- Public Utility District #1
- TOSCO
- Trillium Corporation
- WA Dept. of Ecology
- WA Dept. of Fish & Wildlife
- WA Dept. of Natural Resources
- Washington Trout
- Whatcom Conservation District

What You Can Do!

The Nooksack Salmon Enhancement Association (NSEA) is a local conservation group, which employs a dislocated natural resource worker crew and a Washington Conservation Corps crew, in addition to many dedicated volunteers that work on over 180 restoration sites throughout the county. To get involved in volunteer restoration efforts, contact NSEA at (360) 715-0283.

City of Bellingham Greenways Volunteers work along streams and trails to improve habitat. To volunteer contact Greenways Volunteers at (360) 676-6801.

Processes and Regulations Affecting Salmon

Overlapping environmental laws and numerous agencies charged with different aspects of salmon recovery create a confusing public arena for salmon recovery planning. In addition to the regulations discussed above, several federal- and local-level laws and processes affect salmon.

In 1973, Congress passed the Endangered Species Act (ESA), recognizing that fish, wildlife, and plants hold aesthetic, ecological, educational, historical, recreational, and scientific value. This act provides a means to protect species and their habitats when their numbers approach extinction. Species may be designated under two categories:

- Endangered - any species which is in danger of extinction throughout all or a significant portion of its range
- Threatened - a species likely to become endangered in the foreseeable future

Endangered listings trigger full protection of the ESA, while threatened listings allow more flexibility in recovery efforts.

The National Marine Fisheries Service (NMFS) is responsible for ESA implementation for marine species, including anadromous fish. Section 4(d) of the ESA establishes protective regulations for fourteen species of West Coast salmon. NMFS is responsible for issuing the 4(d) Rule for listed species. With this rule, NMFS can define which activities are allowed and prohibited - called "take" prohibitions. "Take" is defined as "harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing or collecting any listed species or their habitat." Violation of the 4(d) rule is punishable by federal fines or other penalties. These rules may affect activities such as water use, development, road construction, farming practices, in-stream mining, and discharge of pollutants. To find out more, look at the citizen's guide to the 4(d) rule at www.nwr.gov/salmon/salmesa/4ddocs/citguide.htm.

Washington State laws, such as the Shoreline Management Act, the State Environmental Policy Act, the Growth Management Act, the Hydraulic Code, and the Wild Salmonid Policy, also work to protect fish and their habitat. Construction activity in or near state marine and fresh waters requires a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife. This permit is necessary for activities such as gravel and debris removal, dredging, etc. and for construction of bridges, piers, docks, marinas, and other structures.

Local management is also carried out in each watershed to focus on local issues and needs. The state legislature passed the Watershed Management Act (EHSB 2514) which provides governing watershed management. Another state law, the Salmon Recovery Planning Act (EHSB 2496), governs salmon recovery and restoration priorities by county.

Conclusion

Salmon travel hundreds of miles upstream through polluted urban waterways and underground diversion pipes, around dams, over rapids and waterfalls, struggling through degraded habitat areas to renew the cycle of life. While they face multiple obstacles, they are also strong and resilient creatures. If salmon are to have any chance to display this strength and rebound to sustainable numbers, we as a community must take the necessary steps to recover the places they call home - our streams, rivers, wetlands, estuaries, and oceans.

We all have a role to play in this recovery. Whether as a city dweller, industrial worker, farmer, fisher, or teacher, we can learn from the salmon and their steadfast and unwavering struggle to return upstream. We can reflect a bit of this effort in our own choices, by paying attention as we go about our daily lives, taking small steps and then larger ones, to prevent pollution and habitat degradation. We can support our lawmakers to write strong legislation protecting these critical areas and encourage government agencies to enforce the laws. As we take this opportunity to unite personal commitment and legal influence to catalyze environmental change, our region will become a better place for not only salmon, but for ourselves.

Definitions

Alevin: newly hatched salmonid still dependent on yolk sac; remains in streambed gravel until yolk sac is absorbed

Anadromous: fish, such as salmon and sea-run trout, that hatch in fresh water, live part or the majority of their lives in salt water but return to fresh water to spawn

Best Management Practices: a range of methods designed to prevent, reduce or treat polluted runoff

Broodstock: fish collected and spawned artificially to provide eggs for propagation or transplant

Critical: when a stock of fish has declined to the point that it is in danger of significant loss of genetic diversity or at risk of extinction

Endangered: any species which is in danger of extinction throughout all or a significant portion of its range

Estuary: where freshwater meets the sea

Fecal Coliform Bacteria: bacteria common to the intestinal tract of mammals; Indicates waste from lifestock or humans and may be a sign of disease-causing pathogens from a variety of sources, such as agriculture or leaking septic tanks

Habitat: the specific environment in which an organism lives and on which it depends for food and shelter

Impervious Surfaces: surfaces, such as streets, parking lots and rooftops that can block rain from soaking into the ground and increase the volume of water running, often polluted, into streams and lakes

LWD (Large Woody Debris): Trees and large branches that have fallen into a stream and may form an important structural element of the stream and its fish habitat

Non-Point Source Pollution: pollution from runoff, leaking septic systems, landfills, etc.

Point Source Pollution: a discharge from a specific polluter, such as a factory, or sewage treatment plant

Resident Fish: one which spends its entire life cycle in fresh water

Riffle: a shallow, gravelly area of streambed with a swift current; used for spawning by salmonids and other fishes

Riparian Zone: the border of a stream or river above its banks

Salmonid: members of the family Salmonidae; includes salmon, trout, chars, and whitefish

Sediment: fine soil or mineral particles

Spawn: to deposit and fertilize fish eggs

Stock: a race or run of a fish species that spawns at a specific time or in a specific stream from others of its species

Stormwater Runoff: rainwater that washes contaminants over the land and into our waterways

Threatened: a species likely to become endangered in the foreseeable future

Turbidity: a measure of material, usually fine sediments, suspended in water; determined by passing light through a sample

Watershed: all of the land that carries rainfall to a given river, creek, lake or bay.

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A special thank you to Heather Higgins-Aanes, Wendy Cole, Virginia Naef, Alan Soicher, Wendy Scherrer, Jeff Jewell, Jeff Grizzell, Bruce Sanford, Jim Hansen, George Boggs, and the many others who offered their time and knowledge to make this booklet possible.

Printed by Premier Graphics, Bellingham, WA.

Produced through funding from the Public Involvement and Education Project, financed by proceeds from the Washington State Water Quality Account and administered by the Puget Sound Water Quality Action Team

Puget Sound Water Quality Action Team
Office of the Governor

Funding support also provided by the Whatcom Community Foundation

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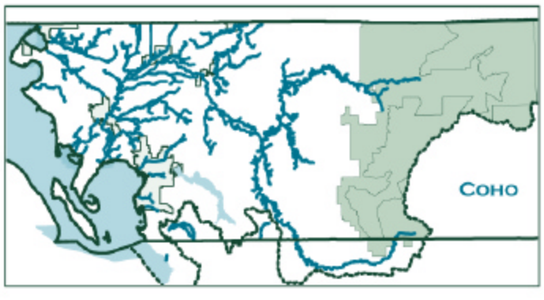
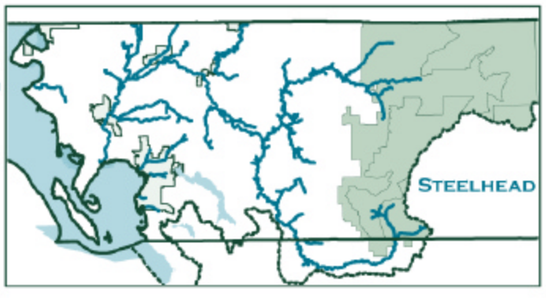
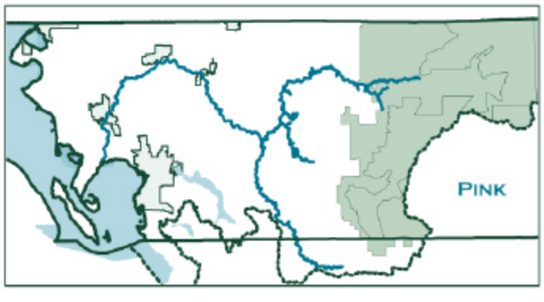
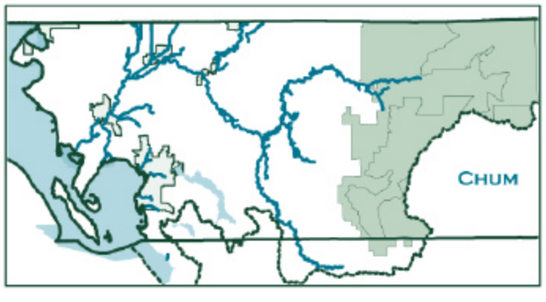
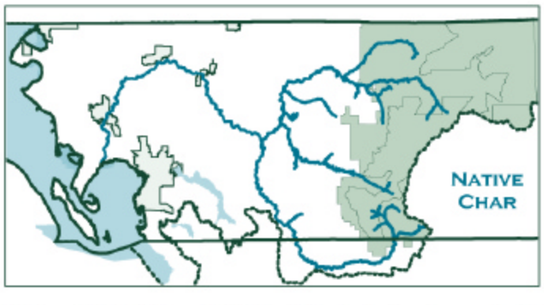
Fish Presence in WRIA 1

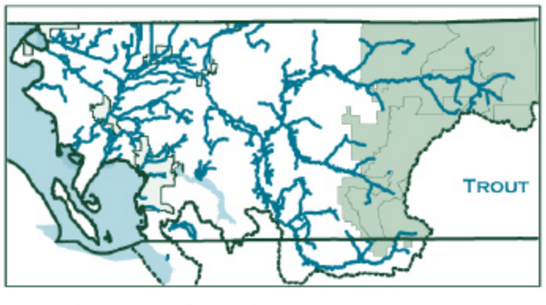












County Limits
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Source: Nooksack River Joint Technical Advisory Group (JTAG) habitat mapping workshop, conducted May 1999, Bellingham, Washington.

Disclaimer: Fish distribution, particularly for steelhead and coho, varies according to hydrologic conditions. Many small tributaries which do not afford access during average conditions may be accessible during wetter years and should be considered potential habitat, although it may not be portrayed so here. Every effort was made to distinguish between known habitat, where fish have been observed in the field, and presumed habitat, where fish should be expected based on general habitat characteristics.

Acknowledgements: Many individuals active in WRIA1 salmon recovery contributed to these maps. Representatives from the Washington Department of Fish and Wildlife, the Nooksack Tribe, Lummi Nation, Nooksack Salmon Enhancement Association, Northwest Indian Fisheries Commission, U.S. Forest Service,Whatcom Conservation District, Whatcom County Gov't, and the Washington Conservation Commission took part in the effort. Cartographic support was provided by the Whatcom Conservation District and the Conservation Reserve Enhancement Program. Data assimilation and coordination was provided by the Northwest Indian Fisheries Commission. Special thanks to Doug Huddle and Jim Johnston for detailed information on headwater distributions, hydrography corrections, and resident fish.

Whatcom Conservation District
Cartographer: Andrew Phay

The Journey Home

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Cover art By Lucy Everyhope / Cover photo courtesy of Department of Ecology

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