ALASKA'S WILD SALMON

HUMPIES © JOE SERIO, USFS

ACKNOWLEDGEMENTS

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The Alaska Department of Fish and Game (ADF&G) would like to thank Jonathan Lyman, the ADF&G employee who was principal author of the 2002 version of this booklet, and the following contributors:

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PHOTOS AND ILLUSTRATION CREDITS

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ALASKA'S WILD SALMON

ALASKA DEPARTMENT OF FISH AND GAME

Audrey Armstrong, an Athabascan artist, is teaching a new generation the ancient technique of salmon skin sewing. “Salmon skin work is a lot of work, just scraping, scraping, scraping... But when you are done with your work and your creation, it’s worth it.
Sewing (and Sharing) with Salmon, Salmonlife.org

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Introduction

The survival of Pacific salmon depends upon our ability to protect, maintain, and improve salmon ecosystems in harmony with current human development.

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It is up to each of us to learn how to protect Alaska's salmon and their habitats.

SALMON IN ALASKA

Alaska is one of the world's last great strongholds for healthy stocks of wild Pacific salmon and intact salmon-producing ecosystems. In contrast to salmon throughout the rest of their range, no populations of salmon in Alaska are listed as threatened or endangered. Our watersheds create ideal conditions for wild salmon. The land is laced with a rich mosaic of freshwater habitats that feed rivers leading to saltwater bays and the oceanic expanse of the North Pacific.

Salmon are magnificent fish with an unusual and complex life cycle. They are essential to our people, our wildlife, and even the health of our land and forests. Salmon are interwoven into our ecosystems, our economy, and our cultures. Whether drying on the racks of a fish camp on the Yukon River or tugging on the end of an angler's line, salmon are part of daily life in Alaska. You'll see them on paintings, sculpture, jewelry, and even T-shirts. Heralded in songs and dances, Native totems and icons, festivals and celebrations, wild salmon run deep within the lifeblood of Alaskans.

This strong connection of people to salmon in Alaska is unique, having been lost by declines in salmon abundance and distribution throughout Europe, the East Coast of North America, and the Pacific Northwest. A survey by The Salmon Project found three out of every four Alaskans report being strongly connected to salmon and that wild salmon were very important to them personally and to Alaska.

Salmon are a major part of Alaska's economy. Salmon provide jobs for commercial fishermen, processing line workers, hatcheries, and the many trades that maintain our fishing boats and fish processing plants, and support our coastal communities. Sport fishing is another significant economic driver in Alaska. Hundreds of thousands of resident and nonresident anglers enjoy our rich marine and freshwater salmon fisheries, filling hotels and restaurants, patronizing local tackle shops, and hiring guide services throughout the state.

Although Alaska salmon populations are relatively healthy, challenges remain due to changes in habitat, such as rising water temperatures and ocean acidification. There is still much to be understood about interactions between wild salmon and those reared in the state's hatcheries.

Fishermen are challenged by the cyclical nature of salmon runs, changing seafood markets, and changing climate. Alaskans often disagree about the best way to protect salmon, and who gets to catch them, but together we are responsible for sustaining salmon populations in Alaska. They are a biological, economic and cultural resource that nourishes us as a people and have done so since the first Alaskans arrived millennia ago.

Alaskans cherish wild salmon. This is the story of Alaska salmon and the important role played by the Alaska Department of Fish and Game in protecting, managing, and sustaining this vital resource.

Unlike many states in the union, Alaska enshrined its regard for natural resources in its constitution. Because fish and wildlife were recognized as critically important to the fledgling state, the Alaska Department of Fish and Game was created as a cabinet-level department run by a commissioner, who answers directly to the governor. The directives of the constitution were included in statute by the legislature under Alaska Statute 16.05.020. The functions of the commissioner are to manage, protect, maintain, and improve the fish, game, and aquatic plant resources of the state in the interest of the economy and general wellbeing of the people of the state.

Part of a "solid sport fishing family", Aubrey Dela Cruz also works as a fish processor on Kodiak's waterfront, while husband Randy works to fuel up seiners. — *A Salmon Family, in Sickness and in Health,* Salmonlife.org

Artist's rendition of a spike toothed salmon. Weighing hundreds of pounds, this salmon lived during the Miocene age and is one of many that existed long before today's Pacific salmon evolved.

THE EVOLUTION OF SALMON

The Evolutionary Story

Pacific salmon evolved from a shared European ancestor between 50 and 100 million years ago.

Based on several lines of evidence, many scientists believe today's diverse species of salmon in Alaska evolved from a shared ancestor with Coregoninae, or whitefish, in northern Europe between 50 and 100 million years ago. Over the next 30 million years, grayling, whitefishes, and some lesser-known salmonid species such as lenok and taimen split from this common ancestor and followed their unique evolutionary paths.

Another branch evolved into the group that includes Pacific and Atlantic salmon. These two groups diverged from a common ancestor approximately 15 to 20 million years ago. While Atlantic salmon remained a single, although highly variable, species, Pacific salmon radiated into the multiple species we know today as members of the genus *Oncorhynchus*. This evolution occurred during an epoch of repeated glaciation, known as the Pleistocene, which ended around 10,000 years before present.

Salmon that found home in rivers soon evolved into Chinook and coho salmon. Others that flourished by rearing in lakes for one or two years and returned to fresh water in their fourth or fifth year evolved into sockeye salmon. About eight million years ago, their relatives that spawned closer to the marine environment evolved into pink and chum salmon.

Alaska's trout, also part of the genus *Oncorhynchus*, broke off and five million years later divided into what we know today as rainbows and cutthroat. Another variant emerged in Asia, known as *Oncorhynchus masou*, or cherry salmon, with the freshwater variety of this species referred to as amago salmon. Cherry salmon are not found in Alaska.

Although the big evolutionary transitions in the

Pacific salmon life history occurred by about five million years ago, much of the diversity we observe, and strive to protect, in Pacific salmon is much younger. Alaska's active glacial history opened new spawning and rearing areas that provide new opportunities for salmon. Although the vast majority of Pacific salmon return home to spawn, some individuals stray from home and can colonize new habitats and form new populations. Because conditions, such as flow and temperature, differ among different streams, salmon become adapted to local conditions. These adaptations are comparable to a 'home field advantage', where local fish outperform non-local fish in their home streams.

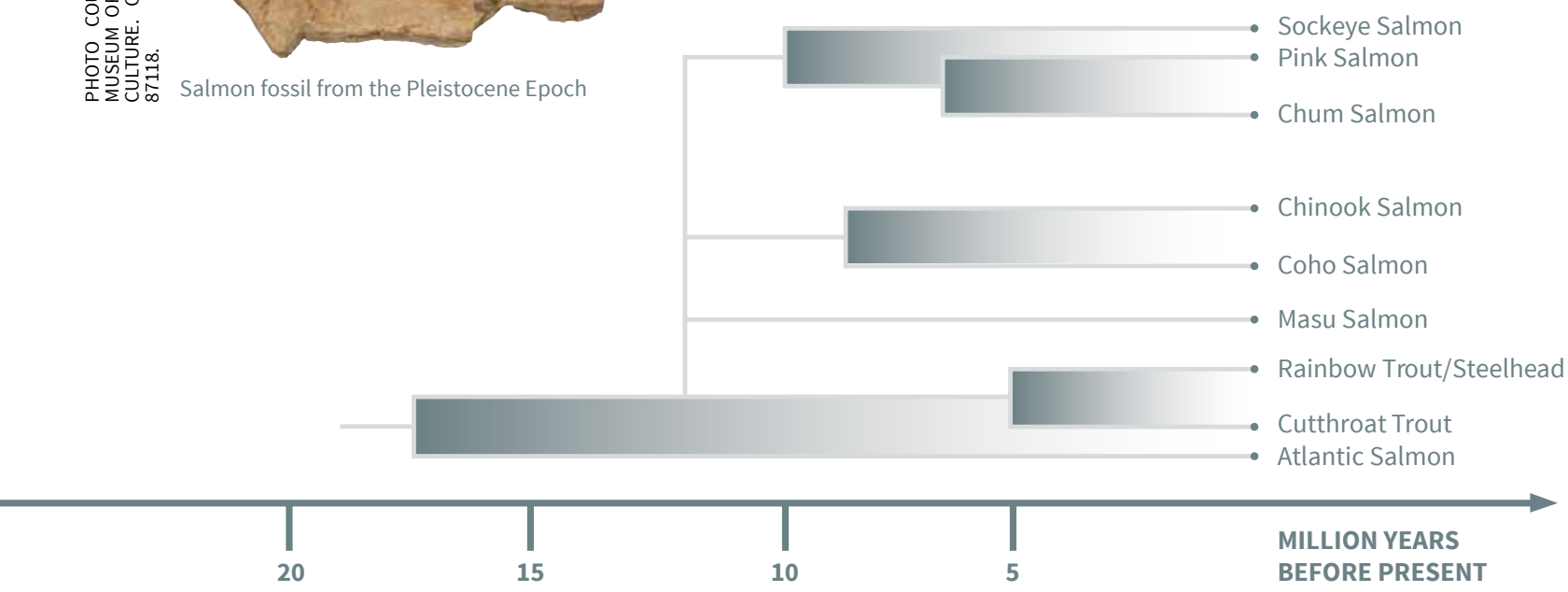
Alaska salmon come from a wide evolutionary history that is still evolving. While salmon have a long history of evolving and adapting to changes in their environment, it has only been during the last 150 years that industrialized society has altered Pacific salmon habitats. Today, the survival of Pacific salmon depends upon our ability to manage harvests and protect, maintain, and improve salmon ecosystems in harmony with human development. It remains unclear whether salmon will be able to adapt quickly enough to survive in a rapidly changing world.

Adaptability – A Perilous Gift of Nature

Scientists have two major concerns for salmon today: preserving genetic diversity so each species can adapt to changing climatic conditions, and preserving natural habitats so that local populations of wild salmon can thrive. The ability of salmon to gradually adapt to changes in their environment helped them evolve to spend a portion of their lives in fresh and saltwater. This adaptability carries a hidden price. Wild salmon need pristine fresh water for spawning and rearing, and access to clean oceans, rich with a broad variety of food. Throughout their complex life cycle, salmon must have sufficient amounts of unpolluted water and undisturbed habitat to survive. ●

PHOTO COURTESY OF THE BURKE MUSEUM OF NATURAL HISTORY AND CULTURE. CATALOG NO. UWBM VP 87118.

Salmon fossil from the Pleistocene Epoch



SALMON BIOLOGY

Salmon are anadromous, which means they spawn in fresh water, migrate to the ocean where they feed and grow rapidly, and then return to fresh water to spawn and die.

Alaska is home to seven species of Pacific salmon: Chinook salmon, sockeye salmon, chum salmon, pink salmon, and coho salmon, as well as rainbow trout and cutthroat trout. Names for these species are as diverse as the fish themselves. Chinook salmon are also known as 'king', 'spring', 'Tyee', or 'blackmouth' salmon. Some call sockeye salmon a 'red' or 'blueback', chums a 'dog' or 'keta', pinks 'humpback' or 'humpy', and coho a 'silver'.

Having multiple names can cause confusion. The Koyukon people of the middle Yukon River refer to fall chum salmon as 'silvers' because they are still silvery bright from the sea. Not to be confused with coho salmon, the name also contrasts with spring chum salmon that are more colored and once used to feed village sled dog teams, hence are called 'dog' salmon.

Most salmon are anadromous, meaning they are born in fresh water, migrate to saltwater to feed and grow, then return to spawn in the rivers and lakes where they were born. They undergo dramatic changes in color and appearance to attract mates in this last phase of their life. Chinook, sockeye, coho, pink, and chum salmon all die after spawning, a life history strategy called semelparity. This life history is exceptionally rare among the approximately 32,000 other species of bony fishes, making these species that much more special.

Pacific salmon are members of the genus *Oncorhynchus*, Latin for "hooked nose." The name refers to the enlarged nose and teeth that grow when salmon return to fresh water. These changes allow salmon to fight members of their same species on the spawning grounds. The Latin name is often shortened to just the letter "O.", followed by their common name in Russian, where western naturalists first described the different species: *O. tshawystcha* (Chinook), *O. nerka* (sockeye), *O. keta* (chum), *O. gorbuscha* (pink), and *O. kisutch* (coho).

Two species of trout in Alaska also belong to the same genus as Pacific salmon. Rainbow trout and cutthroat trout are classified as *O. mykiss* and *O. clarkii*. Unlike other members of the genus, rainbow trout and cutthroat trout can spawn multiple times, a life history characteristic called iteroparity. The term 'salmon' in Alaska implicitly refers to the members of *Oncorhynchus* that die after spawning.

Another species of *Oncorhynchus* is found only in Asia: *O. masou*, known as Masu or cherry salmon. There is some debate whether multiple species of Asian salmon exist. Current evidence suggests four *sub*species of *O. masou*, based on geographical distributions and life histories. Cherry salmon are frequently anadromous, and usually die after they spawn yet some males and stream-rearing females have been observed to spawn multiple times during their lives.

ALASKA PACIFIC SALMON IDENTIFICATION

CHINOOK SALMON: also known as king, Tyee, spring, or blackmouth

***"The chowichee of the Yukon is the king of salmon,"* wrote explorer William Dall in 1865. During the years of Russian America, barrels of oil-rich Chinook salmon were shipped to the Tsar and considered a rare delicacy.**

The Chinook salmon (*O. tshawystcha)* is Alaska's state fish and one of the most important sport and commercial species native to North America's Pacific coastal ecosystems. They are found from the Southeast panhandle to the Yukon River, and increasingly encountered as far north as Utviagvik, formerly known as Barrow. Chinook salmon are distinguished from other species by black spots on the back, dorsal fin, and both the upper and lower lobes of the tail or caudal fin. Chinook salmon also have a dark pigment along the gum line, and gave them the nickname "blackmouth" in some parts of their range.

Chinook are the biggest salmon in Alaska but do vary in size. Many anglers encounter fish between 20 and 40 pounds, but often catch Chinook that are much larger. The record sport-caught Chinook salmon was taken in the Kenai River in 1985 and weighed 97 pounds. The largest commercially caught Chinook weighed 126 pounds and was taken in 1949 in a fish trap near Petersburg.

The chances of encountering truly large Chinook salmon are becoming increasingly unlikely, as the average size of fish returning to spawn has declined since about 2000. The smaller size is primarily because fish are returning at younger ages. Six- and seven-year-old fish that were once important parts of many stocks are now largely absent and most are maturing as five-year-old or younger fish.

Chinook salmon undertake remarkable migrations to reach their spawning streams on some of the larger river systems. Chinook salmon bound for headwaters in Canada's Yukon travel more than 2,000 miles up the river. Depending on her size, female Chinook salmon produce approximately 5,000 to 14,000 eggs. The eggs can be fertilized by one or several males and deposited in gravel nests called redds.

SOCKEYE SALMON: also known as red or blueback

Sockeye means different things to different users: money in the bank for commercial harvesters, food security for a rural subsistence user or urban personal use harvester, and combat fishing for anglers lined up along the Kenai Peninsula's Russian River every summer.

Sockeye salmon (*O. nerka*) is arguably the most valuable species of the Pacific salmon given its value per pound and the amount of fish harvested. Its strong fighting ability, firm, rich meat, and bright color make it a premium product desired by consumers, industry, subsistence users, and anglers alike.

Sockeye salmon usually weigh between four and eight pounds, and are between 18 and 24 inches long. Breeding males develop a humped back and elongated, hooked jaws with sharp teeth called a kype. Both males and females turn a brilliant red on the back and sides, olive-green on the head, and white along the lower jaw. A female sockeye produces between 2,000 and 4,500 eggs.

Sockeye salmon spawn in rivers, streams, and in spring-fed upwellings or wind-circulated currents along the shores of lakes. They are largely dependent on lakes for feeding prior to migrating to sea. After emerging from the gravel, they typically stay in the lakes for one or two years before migrating out to the ocean, although there are some variations. Some sockeye salmon migrate to sea after only spending part of a summer in fresh water while others rear in rivers rather than lakes. Some spend their entire lives landlocked in fresh water. Commonly called kokanee, they are found in the upper Copper River and elsewhere in Alaska.

The name sockeye comes from 'suk-kegh,' which means "red fish" in the language of the indigenous Salish people of Canada's Fraser River.

CHUM SALMON: also known as keta or dog

The chum is the gladiator of the salmon world with undying fight! Chums make excellent smoked fish and their eggs are prized as a delicacy.

Chum salmon (*O. keta*) have the widest distribution and arguably the most diverse life history of any of the Pacific salmon. They are found throughout coastal Alaska where they frequently spawn in intertidal areas, where fresh water meets with salt, and in all major river systems. Chum salmon also migrate thousands of miles up the Yukon River into Canada and can spawn late into the fall and early winter in groundwater upwelling areas of large rivers. Chum salmon are a traditional source of dried fish for winter use and a major component of commercial fisheries, especially in Southeast Alaska where chum salmon are produced in hatcheries to enhance commercial fisheries.

Chum salmon usually weigh between 7 and 18 pounds and are between 24 and 32 inches long. Ocean bright chum salmon are greenish-blue with fine black speckles. As they near fresh water, they turn green with purple stripes. Male chums develop the famous “hooked snout” of Pacific salmon and large, canine-like teeth that help account for the name dog salmon.

A female chum salmon produces between 2,400 and 3,100 eggs. Juvenile chum salmon migrate to sea in their first summer of life, often immediately after hatching and emerging from the gravel.

PINK SALMON: also known as humpback

Extremely valuable in large numbers, the humpy is the most abundant salmon species in Alaska with commercial catches up to 219 million fish in a single season.

The pink salmon (*O. gorbuscha*) is called a ’humpy’ because of the pronounced hump that develops on the back of adult males before spawning. The smallest Pacific salmon in North America, pinks have an average weight of about three-and-a-half to four pounds, and length between 15 and 24 inches.

An adult humpback returning from sea is bright steely blue on top and silvery on the sides, with many large oval black spots on the back and tail fin.

Some pink salmon head up their natal rivers like other salmon, but many pinks spawn in intertidal areas. Females produce between 1,500 and 2,000 eggs. Once hatched, pink fry spend very little time rearing in fresh water before migrating to the ocean. Frequently their trip to sea starts immediately upon emerging from the gravel.

Pink salmon dominate Alaska hatchery production with the release of about 900 million fry each year that result in annual returns of adults that average 45 million have peaked as high as 90 million, most from Prince William Sound.

ALASKAN PACIFIC SALMON IDENTIFICATION FISH PHOTO ILLUSTRATIONS COURTESY OF THE ALASKA SEAFOOD MARKETING INSTITUTE. FOR ADDITIONAL INFORMATION ON THESE FISH AND OTHER ALASKAN SPECIES, VISIT THE WEBSITE: WWW.STATE.AK.US/ADFG

COHO SALMON: also known as silver

Cohos are a uniquely aggressive salmon. They will rush toward you, dive, jump into the skiff, and jump back out. A very in-your-face, take-charge kind of fish.

Coho salmon (*O. kisutch*) are found in coastal waters of Alaska from the Southeast Panhandle to Point Hope on the Chukchi Sea, and in the Yukon River to the Canadian border. Coho salmon occur in nearly all bodies of fresh water that flow to the Pacific Ocean and Bering Sea.

Adult coho salmon usually weigh eight to 12 pounds and can be between 24 and 30 inches long, with some considerably larger. Adults in salt water, or recently arrived in fresh water, are bright silver with small black spots on the back and the caudal, or tail, fin.

Coho salmon enter spawning streams from July to November, usually during periods of high runoff. Coho salmon occur throughout stream networks but are known for favoring the headwaters of streams. Adults struggle their way into small tributaries following fall rains before spawning, where the female produces between 2,400 and 4,500 eggs.

Juveniles typically spend one to three years rearing in fresh water before their seaward migration. Some juvenile Alaska coho salmon enter estuarine waters soon after hatching and are referred to as "nomads." This is an example of life history diversity that allows the species to be very resilient to environmental changes in the river. Time spent at sea varies. Some males, called "jacks," mature and return after only six months at sea, while most coho spend 18 months in salt water before returning as full-size adults.

COASTAL RAINBOW TROUT

Rainbow trout are the great-grandparents of salmon, their originator. To release a steelhead is to cradle the past in your hands and send it to the future, a promise you make to the fish, the water, and yourself.

Most coastal rainbow trout (*O. mykiss irideus*) in Alaska are the stream-resident form that stay primarily in freshwater, although some will spend periods of time feeding in estuarine or near-shore marine waters. The larger and much rarer form is steelhead, which leave freshwater as juveniles and migrate long distances in the ocean where they grow to maturity before returning to their natal stream for spawning. Depending on the area, steelhead can return to freshwater in either spring, late summer, or fall, but they always spawn in the spring. Unlike other species of Pacific salmon, rainbow trout can spawn more than once in their lifetime.

Rainbow trout are native to Alaska waters from Southeast Alaska north to Kuskokwim Bay. The color and shape of rainbow trout is highly variable and often shaded from blue-green to olive with a reddish-pink band along each side. The lower sides are usually silver, turning to pure white beneath. Small black spots dot the upper back, as well as on the upper fins and tail. Rainbow trout vary from a few inches in length to giant steelhead that can top 40 inches and weigh 20 pounds or more.

COASTAL CUTTHROAT TROUT

"Cutthroat trout are beautiful fish found in beautiful places. They have also been described as the canary in the coal mine: the first species to succumb to environmental degradation." **Dr. Robert Behnke**

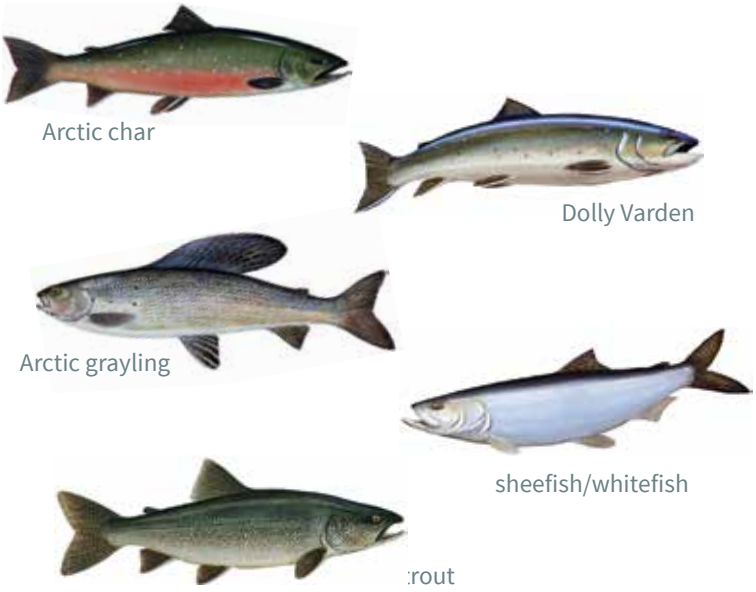
Coastal cutthroat trout (*O. clarkii clarkii*) are found year-round in streams and lakes throughout Southeast Alaska. Some are resident in streams and lakes, while others spend a portion of their lives in saltwater. Cutthroat trout can spawn multiple times in their lifetime, but due to the high energetic cost of spawning, females often do not spawn in successive years. Cutthroat trout typically produce a few hundred eggs or less, with smaller females producing fewer and smaller eggs.

The size of cutthroat trout depends on where they live. Sea-run cutthroat trout can reach lengths of 16 to 22 inches. Resident cutthroat trout are typically much smaller (10 inches or less) and can live 15 years or more. The largest cutthroat are found in lakes and can grow up to 26 inches long.

Resident cutthroat trout are golden yellow with dark spots and a vivid red slash mark under the jaw, giving the species its name. Sea-run cutthroat trout typically reside in lakes during the winter, migrate to salt water to feed in the early spring, and return to lakes in the fall. Sea-run cutthroat trout are bluish-silver with dark or olive backs and less conspicuous spots and slash marks.

OTHER WILD SALMONIDS

Other Wild Alaskan Salmonids (species related to salmon)



Fertilization takes place externally, as the sperm washes over the eggs in the redds.

Pacific Salmon Life Cycle

Most Pacific salmon start their lives as freshwater fish, then develop the ability to live and grow in the ocean where they mature. They return to intertidal and freshwater lakes and streams as adult fish to reproduce and die.

After returning from the ocean, the female's eggs begin to ripen within her. When her eggs are ripe, she locates a suitable spawning area and hollows out a redd in the gravel with her tail. Each species of salmon looks for different qualities in the habitat that they choose for redds, although all good salmon nesting habitats have some similar features: clean and well oxygenated water, consistently cold water that has the right depth and flows at the right speed, and gravel that's the right size and depth.

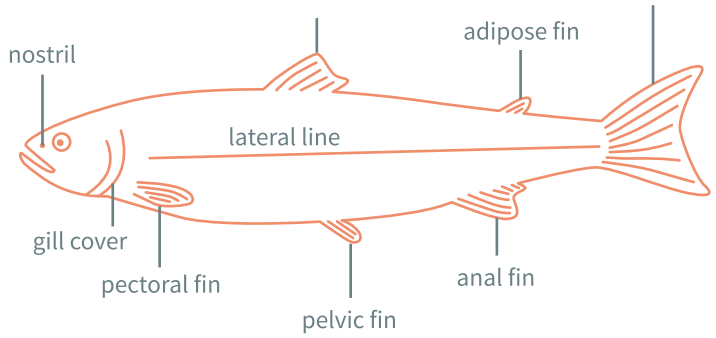
While the female is busy making her redd, male salmon hover nearby and fight for breeding rights. The winning male waits until the female settles into her redd

to expel her eggs, and then he moves next to her to fertilize the freshly laid eggs with his sperm or milt. Sometimes multiple males are involved. Positioned some distance away, satellite or sneaker males dart toward the female while she expels her eggs. The female then covers the fertilized eggs with gravel and begins building another redd to deposit more eggs. One male may fertilize several different redds. One female may build several redds, which may be fertilized by different males each time.

The eggs, now safely buried in the streambed, develop slowly. In winter or early spring, the developing salmon break though the egg's thin shell. At this stage the young salmon, called alevins, still have a yolk sac attached to the abdomen.

The alevins rely upon the yolk sac for food and depend on the surrounding gravel for protection or cover. When the young fish, now called fry, deplete their yolk sac, they struggle out of the gravel bed into the free-flowing water.

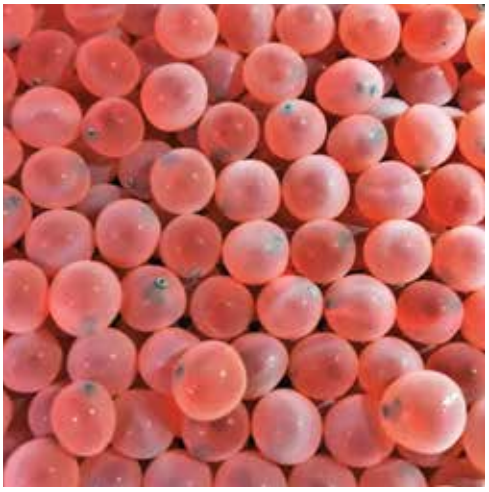
Once the fry emerge, they seek different kinds of rearing habitat. Young Chinook salmon like slow moving water along naturally vegetated banks. Juvenile coho salmon prefer still water, lakes, beaver dams, and wetlands. Most sockeye salmon rear in lakes or calm pools but some rear in rivers or immediately swim out to sea, as do all pink and chum fry. By using different rearing habitats, several salmon species can share the same watershed environment as a place to find food and cover. This is called habitat partitioning. Being able to adopt a variety of life history types is thought to make these species very resilient to changes in their habitat.



Salmon Anatomy

After one to two years for Chinook, one to five years for coho, and up to four years for sockeye, salmon become smolts. Instead of staying in the slow waters close to the bank or river bottom, smolt swim up into the surface currents. This helps them migrate downstream to saltwater estuary areas at the mouth of their home rivers. In estuaries, where fresh and salt water mix, smolts undergo a series of internal and external changes that will allow them to live in the salty environment of the ocean.

Salmon go to sea in search of food. There are not enough insects, invertebrates or other fish in fresh water to feed the great numbers of growing salmon. However, the cold waters of the North Pacific Ocean can be very productive, and salmon grow rapidly, feeding on a variety of prey species. Salmon spend different amounts of time living in estuaries or the open ocean, depending on the species and stock. After spending from six months to six years feeding and maturing there, adult salmon are



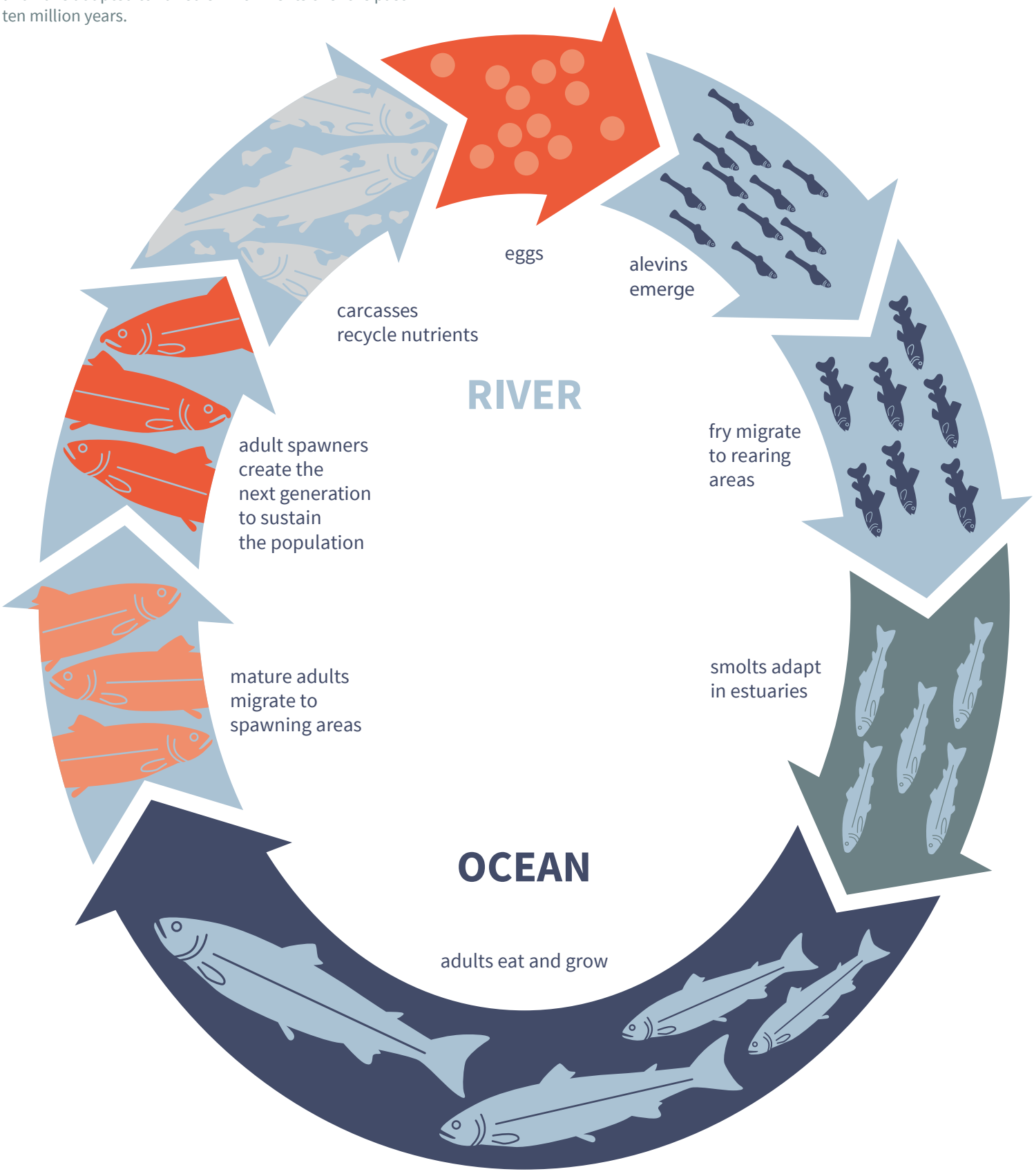
eggs

alevins

fry

THE PACIFIC SALMON LIFE CYCLE

Pacific salmon have developed a very complex life cycle and have adapted to varied environments over the past ten million years.



drawn back to spawn in the streams where they hatched.

We know that salmon have an incredible, finely tuned, sensitive sense of smell that helps guide them back to the exact stream where they were born, but scientists are still not certain how salmon find their way from the far reaches of the North Pacific to their home waters. A combination of factors, including ocean currents, the position of the sun, even the magnetic North Pole, have been considered to explain how salmon navigate back to coastal areas. It is now thought that salmon do not use a single cue, but instead rely on a variety of factors to find their natal river.

Adult salmon occasionally stray from their streams of origin and spawn in other streams. This behavior contributes to the diversity and health of wild salmon populations. It allows salmon to rapidly colonize newly accessible areas, particularly new habitat made available when glaciers recede.

TIME SPENT IN FRESHWATER AFTER HATCHING

CUTTHROAT (resident Cutthroat never migrate to saltwater)	3-5 YEARS
COHO	1-5 YEARS
SOCKEYE AND STEELHEAD	1-4 YEARS
CHINOOK	1-2 YEARS
PINK AND CHUM (migrate to saltwater immediately after hatching)	0 YEARS

TIME SPENT IN THE OCEAN

CUTTHROAT	10 TO 100 DAYS A YEAR
PINK AND COHO	6-18 MONTHS
SOCKEYE	1-4 YEARS
CHINOOK	2-7 YEARS
CHUM	3-6 YEARS
STEELHEAD	REPEATED RETURNS

Salmonids spend different amounts of time in freshwater and saltwater, depending on their species.

Salmonid fry quickly develop camouflage to blend with their environment when they emerge from the gravel. All fry, except pink salmon, develop parr marks, which are dark brown, vertical stripes along their sides. This protective coloration helps them blend and hide in the stream, river, wetland, or lake while they grow. Pink salmon hatch with the silvery color of many ocean fish and migrate out to the ocean almost immediately after emerging from the gravel.

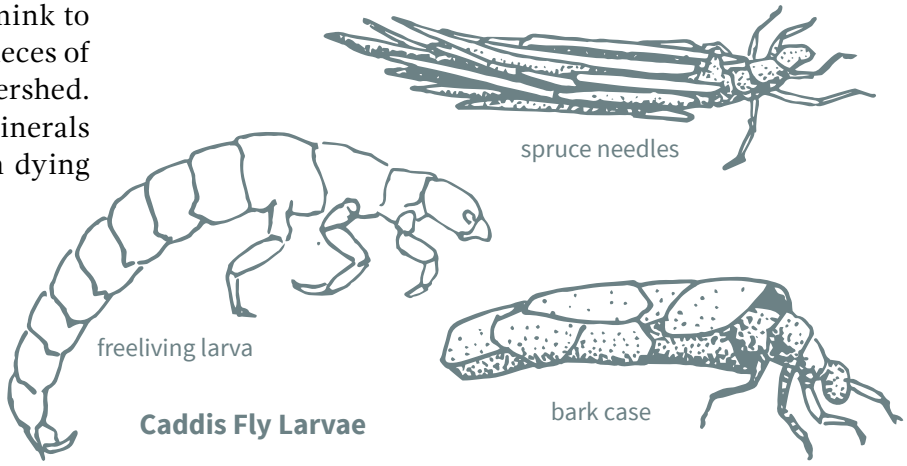
The Gift of Death

Most Pacific salmon die after spawning, all except cutthroat trout and rainbow trout. This appears to be a great waste of fish. In reality, the survival of future generations of salmon and the long-term health of entire watersheds depend upon these carcasses.

In streams, the immature form of caddisfly (larvae) feed on salmon carcasses. These larvae sometimes provide over half the food for young salmon. The remains of salmon that have been dragged onto the banks by wildlife are soon covered with other fly larvae. During heavy rains, these maggots wash back into the stream and feed fish. In this way, the death of adult salmon supports life throughout the watershed, including the young they have spawned. Flesh from carcasses also provides food directly to young salmon and other fish.

Salmon carcasses are rich in nutrients important to fish, wildlife, and plants. Because of its geologic history, much of Alaska's topsoil is thin and lacking in nutrients. Many creatures, from bears, wolves, eagles, and mink to small birds, shrews, and insects, spread uneaten pieces of salmon and salmon-rich feces throughout the watershed. This fertilizes the land and provides necessary minerals and organic material to the land and water. Each dying salmon is a gift of life to the entire ecosystem.

Salmon bring nutrients from the ocean and in death redistribute them to the land.

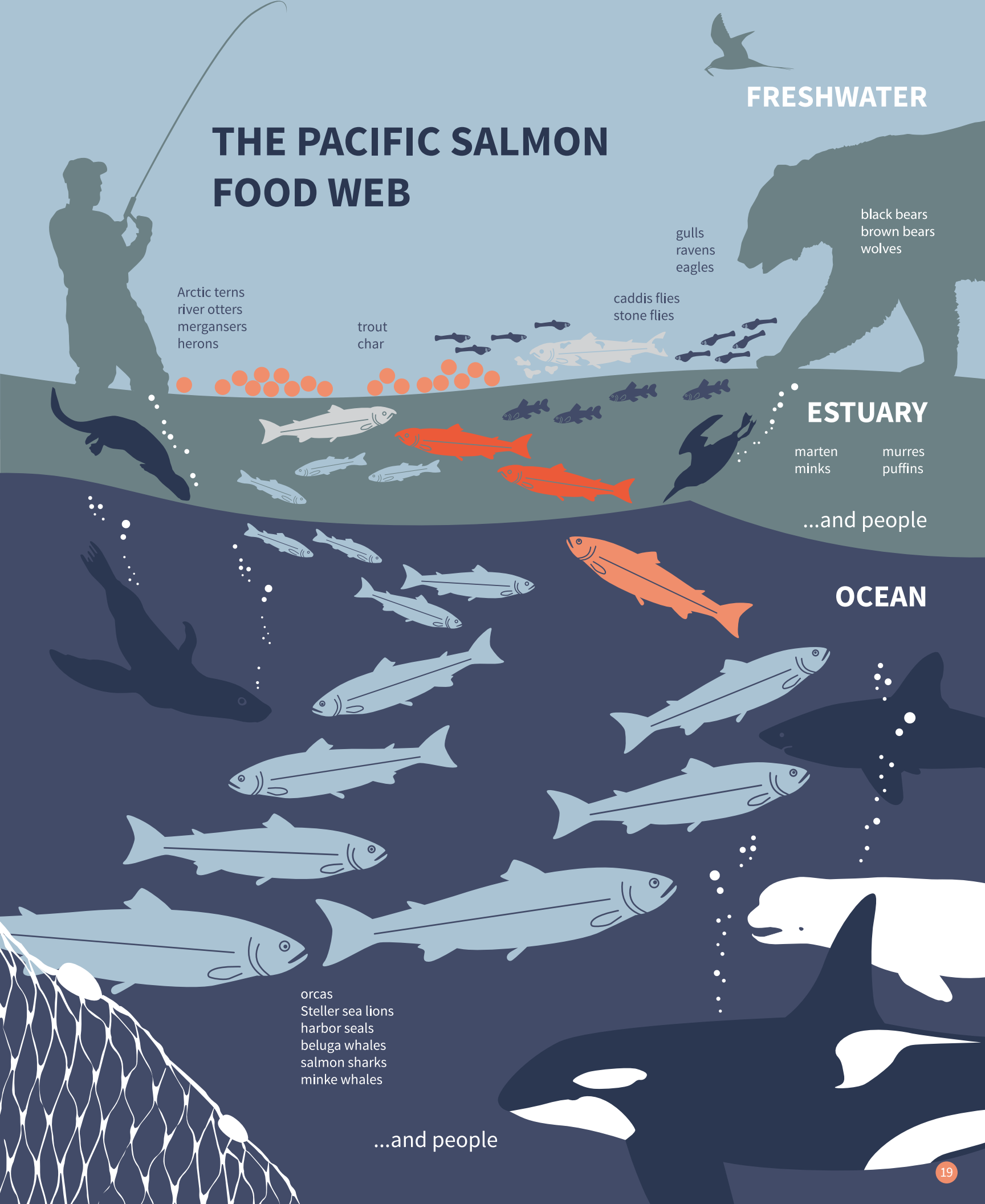


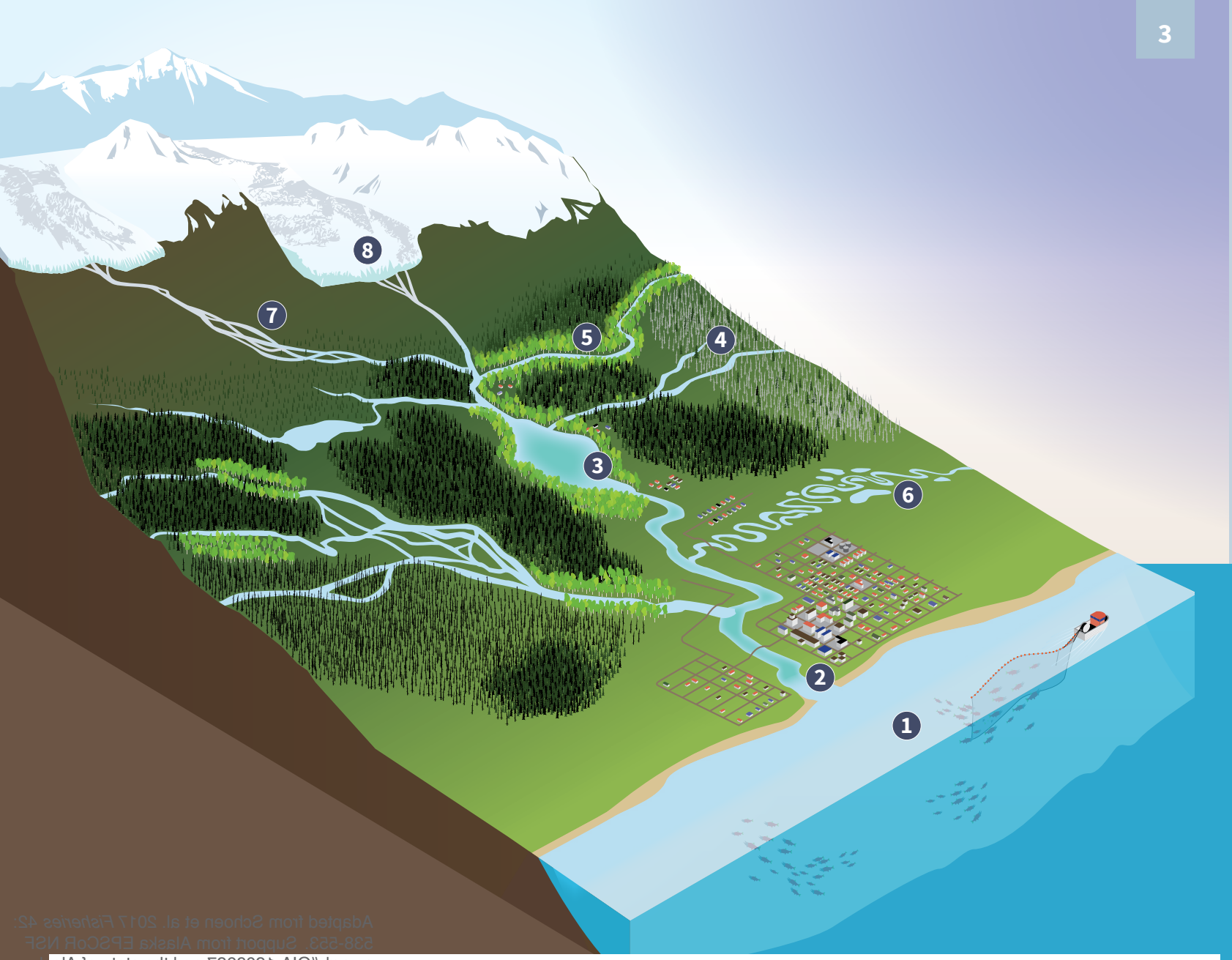
Caddis Fly Larvae

The larvae of many species of caddisfly make protective cases which are often strengthened with sand, twigs or other debris. A major food source for salmon, caddisflies are often used as models for artificial lures.

In Southeast Alaska, one researcher found that bears were responsible for planting and fertilizing their own berry bushes by eating berries and salmon, and then defecating further back from the river. The bears' feces contained both blueberry seeds and nutrients from salmon, thus creating a new crop of well fertilized berry bushes.

Salmon are important as both predators and prey in Alaska's oceans and watersheds. The great abundance of salmon and their wide-ranging migratory life cycle make them a vital component in the food web at sea, in coastal areas, and inland watersheds. Scientists are still identifying all of the connections of salmon to other living resources in Alaska. Biologists in Washington state have identified over 130 different animals and plants that utilize nutrients from salmon.


THE PACIFIC SALMON FOOD WEB
FRESHWATER
gulls
ravens
eagles
black bears
brown bears
wolves
Arctic terns
river otters
mergansers
herons
trout
char
caddis flies
stone flies
ESTUARY
marten
minks
murres
puffins
...and people
OCEAN
orcas
Steller sea lions
harbor seals
beluga whales
salmon sharks
minke whales
...and people



ALASKA'S SALMON HABITATS — A DELICATE BALANCE

Watersheds provide a variety of habitats to support the needs of salmon. We continue to enjoy salmon because the vast majority of Alaska's salmon habitats are healthy.

Watersheds

Salmon habitats vary from the vastness of the North Pacific Ocean to the smallest streams and important riparian zones needed for rearing. They include estuaries where salt and fresh water mix and connect to rivers that reach inland to lakes that are fed by surrounding wetlands, upland areas, and glaciers. All watersheds are subject to human activities and our changing climate.

Watersheds include the land that surrounds our rivers, lakes, and streams, and any area of land that collects rain and snow and eventually flows into a larger body of water. A watershed can be as small as the area between two hills or as vast as the drainage of the Yukon River—an area more than 330,000 square miles across Alaska and Canada and larger than Texas.

Human activities can change the environment and alter the quality and quantity of habitat, sometimes to the point where salmon can no longer survive. We have the power to eliminate salmon by simply not understanding their needs. We also have the power to sustain Alaska's wild salmon by conserving salmon populations and protecting their habitats.

© JONNY ARMSTRONG

Oceans are the source of all life on the Earth and cover two-thirds of Earth's surface. The Pacific is the largest of all the seven oceans.

© MARK EMERY

1 OCEANS

A clean, healthy ocean is rich with fish, marine mammals, birds, and plankton. Adult salmon migrate to the open North Pacific Ocean where, depending on the species, they spend six months to six years growing and maturing. Here, salmon have only two goals—to eat and to avoid being eaten. The abundant North Pacific is a great movable feast where salmon eat plankton, squid, herring, and other forage fish. Salmon predators in the North Pacific include everything from people to many species of birds, fish, and marine mammals.

A changing climate may greatly affect ocean currents and entire weather systems. An increase of just a few degrees in water temperature can impact the survival rate of salmon and shift their distribution. Salmon are cold-blooded and, as the ocean warms, they require more food to survive, while warmer water temperatures produce less plankton and forage fish for salmon to eat. Acidification of ocean waters further threaten the plankton critical to the diet of Pacific salmon.

Human Impacts

The greatest threat to oceans today comes from human activity. Pollution from ships, discharges from cities, agricultural runoff, and marine debris such as Styrofoam, plastic bottles, and "nurdles" (small plastic pellets which serve as raw material in the manufacture of plastic products) are worldwide threats to healthy oceans.

© JONNY ARMSTRONG

2 ESTUARIES

Estuaries are the mixing areas where fresh and salt waters meet at the mouths of streams, rivers, and bays. Alaska's tidal range may be greater than 25 feet between high and low tide. This produces many huge estuaries. Estuaries are essential nursery and feeding areas for salmon and a wide range of waterfowl and aquatic wildlife. Fingerlings, or salmon smolts, rear in both freshwater and estuarine areas for up to five years, depending on the species. The mix of fresh and salt water helps salmon emerging from freshwater streams adapt to their new marine environment. Kelp and other seaweeds, as well as eelgrass and other plants found in estuaries, provide young salmon protection from predators and harbor a rich food supply of small organisms.

© JONNY ARMSTRONG

Abundant salmon and other fish support birds and many other predators in estuaries.

Human Impact

Estuaries are a favorite recreation and development area for humans. We must manage boat harbors, houses, industrial developments, drainage systems, and recreational access in ways that allow the estuary ecosystem to remain functional.

© USFS ALASKA REGION, USDA

Larger river systems provide a range of habitats to support the varying needs of all five species of Pacific salmon. Streams, rivers, and lakes serve as salmon migration corridors and their underlying gravel beds may be spawning and rearing habitat for some species.

© MARK EMERY

The Bristol Bay sockeye fishery's success is attributable to the watershed's healthy habitat

3 RIVERS, LAKES, AND STREAMS

Alaska has more than three million lakes, 12,000 rivers, and countless streams. The world's greatest sockeye salmon fishery, Bristol Bay, exists because of the productivity of the lakes in that region. In Southeast Alaska, it is the short, steep, coastal streams and rivers that contribute the majority of salmon to fisheries in this area. Rivers, lakes, and streams have defined life in many parts of Alaska for centuries.

Human Impact

One of the biggest challenges facing salmon is the slow accumulation of habitat changes. Each of these small changes may seem relatively harmless at the time, but the small impacts collectively turn into large impacts that radically alter natural systems.

HABITAT PARTITIONING is the dividing of a stream's habitats among different species of salmon.

- Coho salmon will be found as far up a watershed as they can get.
- Coho fry use still water (lakes, ponds, and wetlands) for rearing habitat.
- Chinook salmon spawn in large gravel in fast flowing water.
- Chinook fry like water that flows about as fast as you can walk.
- Sockeye salmon prefer lakes for spawning and rearing.
- Chum salmon seek springs or upwellings of fresh water for spawning.
- Pink salmon often spawn in intertidal areas.
- Both chum and pink salmon spend little time in fresh water before migrating out to sea.

© KATRINA MUELLER, USFWS

© KBNERR

Most salmon spawn in the smaller tributaries, streams, and lakes that flow into large rivers. In Alaska, small streams and pools produce more salmon per square yard than larger rivers.

4 SMALL STREAMS AND WATER FLOWS

While large streams provide highways for returning salmon, some of the most important salmon streams are small enough to step across. The creek behind your house may hold hundreds of young salmon. Biologists have found young salmon in tiny creeks above the tree line in some watersheds. They have documented that the most productive streams may be only a foot or two across. Sometimes small streams that appear to go dry in the winter come alive with young fish during spring rains. Water still flows through the gravel under these streambeds and salmon are hatching there.

Human Impact

Development activity often does not consider small streams. Forested wetland flows, minor streams, and tiny tributaries are often diverted or filled during development without concern for salmon habitat. Culverts must be carefully designed and maintained. Improperly installed culverts such as perched culverts can change flows and water levels, blocking fish passage.

5 RIPARIAN ZONES

The riparian zone is the area on the banks of a stream and is often tangled with a variety of new and old vegetation. This area plays a big role in rearing salmon because the food for young salmon, particularly insects, is typically produced in the riparian area of the stream and in the stream's pools and riffles.

The course of many Alaska rivers refuses to stay in one place for very long. Water is constantly carving into banks and undercutting trees. Vegetation falls and trails into the water, slowing stream flows and providing cover for young salmon. This is a great place for young salmon to escape from predators and rest from the constant flow of the stream or river.

Healthy riparian areas are cluttered with bushes, downed trees, and other wild vegetation.

Watch where you walk!
Walking on riverbanks may damage salmon habitat.

Human Impact

Impacts from people occur whenever land managers or landowners modify or remove natural vegetation. Impacts may be as large as a parking lot or as small as a can of oil or bag of trash. Impacts may extend beyond the riparian area into the watershed.

© USFWS

© ALASKA DEPARTMENT OF FISH AND GAME

Damage to wetland soils due to off-road vehicle traffic can affect watershed productivity.

6 WETLANDS

Wetlands are areas that remain wet for all or part of the year. They are a vital part of every watershed. Wetlands act as sponges and absorb rainfall and runoff that is later released to the watershed. They filter some pollution, provide critical habitat for wildlife, and provide important rearing areas for fish.

Wetlands can be compared to coral reefs or old growth forest for their importance in the environment. Coho salmon seek out the quiet waters of wetlands as rearing habitat. Wetlands are essential to the life cycle of many Alaska fish and wildlife species.

Human Impact

Because of the vastness of our wetland resources, Alaska has the lowest loss of wetlands in the nation with less than one percent lost. In urban areas, however, our wetland losses rival that of urban areas in the lower 48 states.

7 UPLAND AREAS

Upland areas are the collection point for all water that will eventually flow into a watershed's aquatic system. Natural cover and vegetation help reduce erosion and serve to moderate flow and water temperature, thus stabilizing whole watersheds.

© ALASKA DEPARTMENT OF FISH AND GAME. PHOTO BY JOHN HYDE.

© USDA FOREST SERVICE

8 GLACIERS

Alaska has an estimated 100,000 glaciers that cover five percent of the state and hold about three-fourths of the state's fresh water. Melting snow pack contributes a constant supply of fresh water to salmon streams during summer months. Advancing and retreating glaciers sculpt the earth and have shaped Alaska's salmon habitat for hundreds of thousands of years.

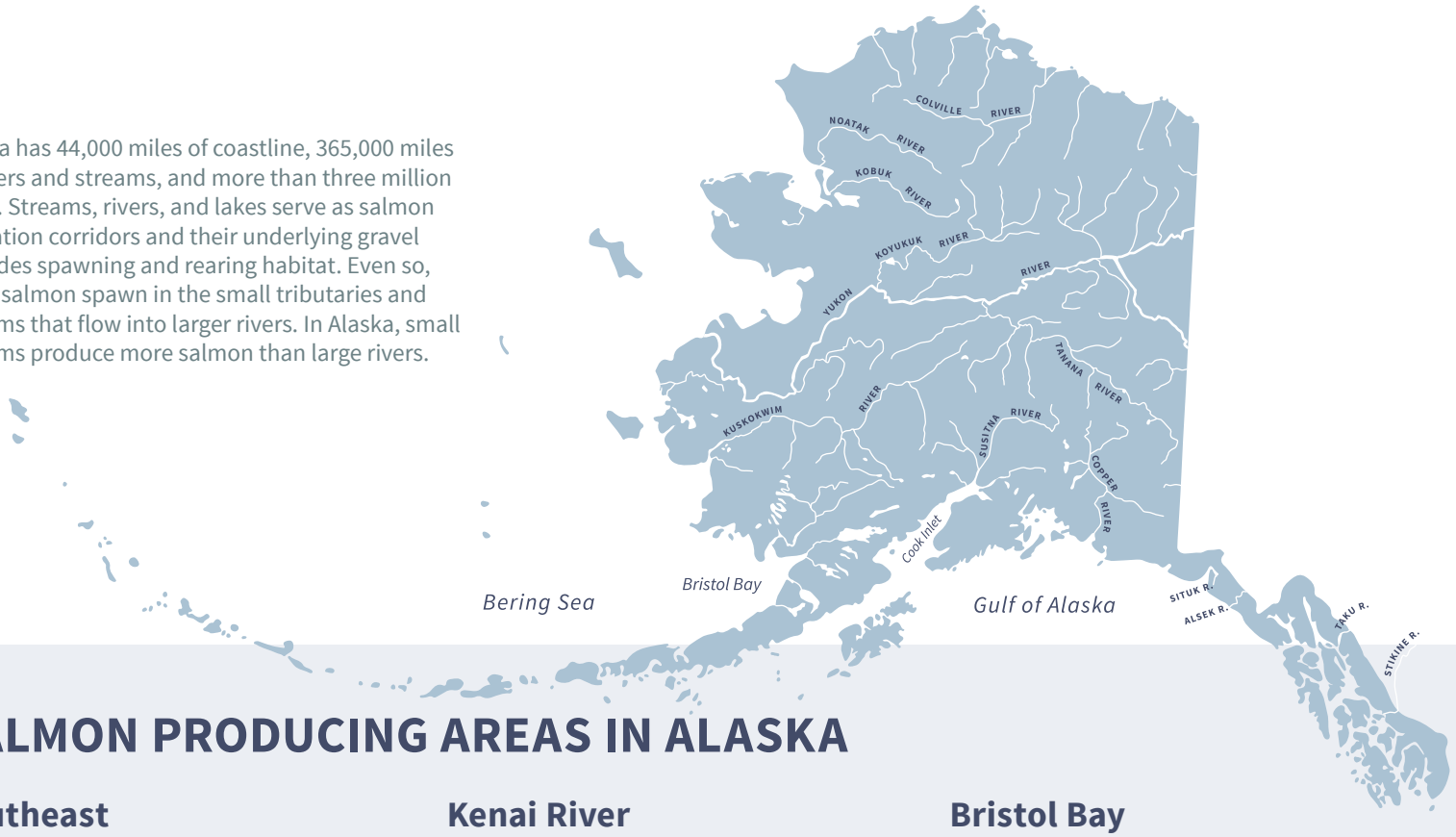
Human Impact

Many development activities in a watershed eventually have an impact on the amount and quality of water within the watershed. Roads, subdivisions, mining, forestry, energy development, other human uses, and individual behavior all eventually impact water quality.

Human Impact

Arctic and subarctic regions are warming at twice the rate of the rest of the planet, and many of Alaska's glaciers are melting at unprecedented rates.

Alaska has 44,000 miles of coastline, 365,000 miles of rivers and streams, and more than three million lakes. Streams, rivers, and lakes serve as salmon migration corridors and their underlying gravel provides spawning and rearing habitat. Even so, most salmon spawn in the small tributaries and streams that flow into larger rivers. In Alaska, small streams produce more salmon than large rivers.



SALMON PRODUCING AREAS IN ALASKA

Southeast

The Panhandle's inside waters and productive rivers make Southeast a sport angler's paradise. Nearly half of Alaska's commercially caught salmon are landed here, many around the Alsek, Taku, and Stikine rivers.

Situk River, Yakutat

At the top of the Panhandle, scenic Yakutat is a great producer of salmon and the Situk River is the premier steelhead sportfishing river in Alaska.

Copper River, Prince William Sound

Among the first Alaska salmon to reach markets each year, Copper River Chinook and sockeye salmon are high in fish oils and command a premium price. Prince William Sound and its hatcheries produce strong returns of pink and chum salmon.

Cook Inlet

Home to the great rivers of Southcentral and the Kenai Peninsula, Cook Inlet and the surrounding area have long been targeted by commercial fishermen for sockeye and pink salmon.

Kenai River

Home to all five Pacific salmon species that return to Alaska, the Kenai River is the state's most popular sport fishing spot, drawing tens of thousands of resident and nonresident anglers annually.

Susitna River

The Susitna River drainage is home to many important salmon populations within easy reach of half of the state's residents.

Kodiak

Often referred to as the heart of commercial fishing in Alaska, Kodiak island is ringed by productive salmon rivers that also support extensive sport fishing and the Island's famous brown bears.

Alaska Peninsula and the Aleutians

Extending into the North Pacific, the volcanic Alaska Peninsula divides the Gulf of Alaska and Bering Sea and supports salmon runs to Chignik and elsewhere. The Aleutians are home to the nation's largest fishing port, Dutch Harbor.

Bristol Bay

With nine major rivers fed by a system of lakes that includes Lake Iliamna, Bristol Bay supports the world's largest and most valuable commercial sockeye fishery. It is also a world-class sport fishing destination for rainbow trout and salmon.

Kuskokwim River

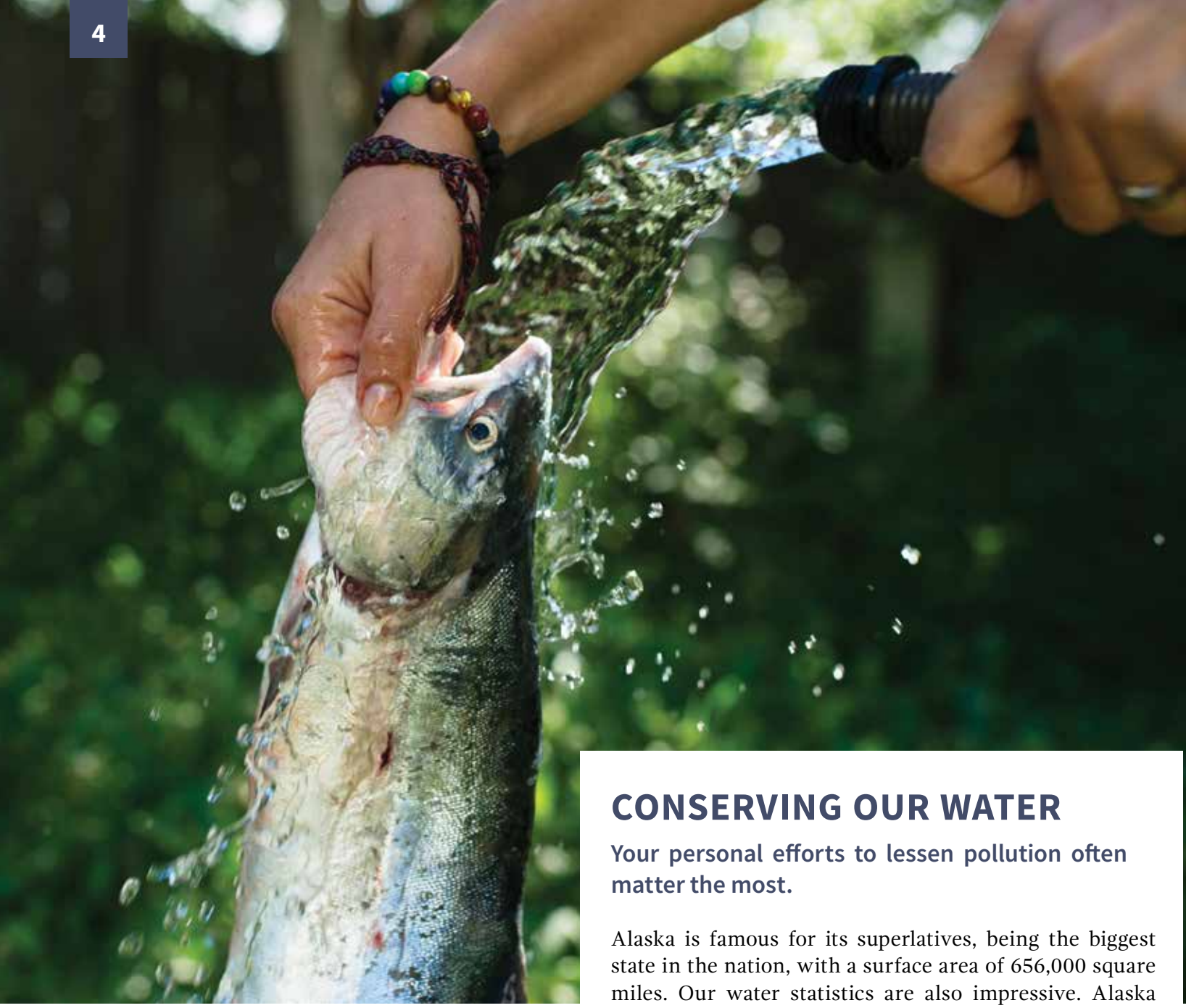
A center of Alaska subsistence fishing traditions, the Kuskokwim River has supported generations of fishermen with strong returns of both chum and coho salmon.

Yukon River

Over 1,000 miles long, Alaska's longest river hosts runs of Chinook and chum salmon that are relied upon by village residents from the river's mouth to its headwaters in Canada.

Norton Sound and Kotzebue

Though comparatively small, Alaska's northernmost salmon fisheries support residents with important subsistence harvests and commercial opportunities around the Arctic Circle.



Clean water is essential to all life.

CONSERVING OUR WATER

Your personal efforts to lessen pollution often matter the most.

Alaska is famous for its superlatives, being the biggest state in the nation, with a surface area of 656,000 square miles. Our water statistics are also impressive. Alaska contains more than 40 percent of the nation's surface water resources, more than three million lakes, over 12,000 rivers, countless streams, and an estimated 100,000 glaciers that hold three-fourths of all Alaska's fresh water. Most of our water is created by storms in the Pacific Ocean and Bering Sea, producing rain and snow that average up to one trillion gallons of precipitation every day.

Salmon need cold, clear water with adequate volume and flow for their safe passage, spawning, incubation, and rearing. People also need water to live. Individual Alaskans use nearly 29 million gallons of fresh water each day. Combined with industrial activities such as oil and mining development, manufacturing, fish processing, hatcheries, snow making, and hydropower generation, it is estimated that Alaskans need more than 400 million gallons of water every day.

© US COAST GUARD

Coast Guard inspectors board a cruiseliner. Alaska's law to monitor wastewater discharges is a worldwide model. The law provides protection for state waters through sampling, testing, and reporting of wastewater and air discharges; enforceable standards for allowable discharge; and payment for the program by the cruise ship industry.

Laws to Protect Clean Water and Habitat

"Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield of principle, subject to preferences among beneficial uses." – Alaska Constitution, Section 4

Alaska's constitution is unique among the 50 states in its commitment to sustainable management of natural resources, including salmon. Since statehood, ADF&G has been responsible for the protection of salmon habitat and for ensuring safe passage for all Alaska fish species. Strict laws and regulations govern industrial activities and development in or near fish-bearing water bodies, such as road building, logging, and mining.

Four state laws work together to protect salmon spawning and rearing habitats: the Anadromous Fish Act, the Fishway Act, the Alaska Forest Resources and Practices Act, and the Alaska Water Use Act.

The Anadromous Fish Act has been the cornerstone of the state's salmon habitat protection programs for over half a century. It requires ADF&G to identify rivers and streams that are important for salmon rearing, spawning, or migration. These are included in an Anadromous Waters Catalog that now includes almost 20,000 streams, rivers, and lakes in Alaska. For waters in the catalog, the Act requires that an individual or government agency get approval from ADF&G for projects that may be harmful to fish. These instream activities include building road crossings, filling or removing gravel, placer mining, withdrawing water, stabilizing the bank, or driving a vehicle across a waterway.

The Fishway Act complements the Anadromous Fish Act by requiring fish passage to be provided in streams frequented by all species of fish. It requires that dams or obstructions built across a fish stream allow effective fish passage; the state can seek compensation for any loss of habitat and fish production. Improperly designed or installed culverts can block or restrict movement of salmon and resident fish species such as rainbow or cutthroat trout. With Alaska's continued growth and improvements to roads and highways throughout the state, it is more important than ever to ensure culverts are designed and built so that salmon and other fish can move safely between spawning and rearing habitats.

Much progress has been made toward evaluating the performance of existing culverts, correcting past problems, and setting new construction standards. In 1998, the U.S. Forest Service agreed to submit plans for roads crossing salmon streams to ADF&G biologists for their review and concurrence. As a result, fish passage along new roads in the national forests is greatly improved.

Within state government, ADF&G and the Alaska Department of Transportation and Public Facilities have crafted an agreement establishing procedures for determining the appropriate structures such as bridges or culverts to be used when crossing water bodies used by fish. Where culverts are built, the agreement sets

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Improperly installed culverts are replaced by fish-friendly culverts to ensure that natural flow and streambed conditions are met to allow safe passage for both adult and juvenile fish.

standards for design and installation to ensure natural flows and streambed conditions that allow safe passage for both adult and juvenile fish.

The Alaska Forest Resources and Practices Act governs how timber harvest activities occur on state, private, and city land. Forest management standards are designed to prevent adverse impacts to fish habitat and water quality. The act's standards include retention of trees as buffers along salmon streams to provide habitat, ensure bank stability, and protect water quality.

The stream flow and water volume necessary for salmon passage, spawning, incubation, and rearing are protected under the Alaska Water Use Act. In Alaska, water is a common property resource, so landowners do not have automatic rights to use groundwater or surface water. The Alaska Department of Natural Resources is responsible for reviewing and authorizing the temporary or permanent use of state water resources. Alaska is one of the states providing the opportunity for private individuals, in addition to state, federal, and local governments, to legally reserve water in rivers and lakes. Instream flow reservations will play an increasing role in salmon habitat protection, making certain salmon have enough clean water for their complete life cycle.

Salmon are particularly vulnerable to the effects of pollution during their life in fresh water. The Alaska Department of Environmental Conservation (DEC) administers the federal Clean Water Act in conjunction with the federal Environmental Protection Agency. Alaska's water quality standards are designed to protect aquatic life, including salmon and their food sources. DEC monitors and regulates pollutant discharges from direct sources, such as sewage treatment plants and industrial operations, and from indirect sources, such as community storm water controls and construction projects. Through this work, DEC ensures that projects meet high water quality standards in both marine and fresh waters and protect fish from the effects of toxic pollutants as well as sediments and the impact of elevated temperatures.

The handling of oil and hazardous substances can pose a threat to water quality. The state has laws that prohibit the discharge of oil or hazardous substances, require prompt reporting when a spill does occur, and mandate containment and proper disposal of all waste materials. Alaska's oil spill response laws extend to all self-propelled ocean vessels over 400 gross tons. Alaska has a strong oil transportation system, thanks to strict state regulation and monitoring, industry investment, and the efforts of concerned citizens.

Chena River bank restoration: tree stumps, boulders, and young willows work together to reduce erosion.

In the Copper River region, volunteers help document salmon streams to add data to the State of Alaska's Anadromous Waters Catalog.

Alaska was the first state in the nation to regulate cruise ship pollution. The state's Ocean Ranger Program monitors cruise ships at sea to assess compliance with state and federal requirements to prevent marine discharges and pollution. Rangers are certified marine engineers or hold a degree in marine environmental protection.

Pollution and Contaminants

Most of Alaska's vast water resources are clean and support abundant fish and wildlife. Human activities, however, can damage or destroy the quality of salmon habitat. Personal, recreational, and industrial activities all impact the integrity of a watershed. 'Point source pollution' is industrial pollution and contaminants in our watersheds that come directly from an industry or development project, or from an industrial accident. Pollutants may also accumulate from a variety of places and activities in what's called 'non-point source pollution'.

We can harm salmon simply by not understanding or ignoring their needs for healthy habitat. Lasting impacts on watersheds and salmon streams can result from small, daily actions like over-fertilizing our lawns, washing our cars, or carelessly changing the oil. Non-point source pollution could include a homeowner using too much weed killer, dumping an old battery in a ditch, or spreading waste oil on a dusty road. The weed killer can kill plants in a stream. Battery acid and waste oil leach into groundwater and can harm fish downstream.

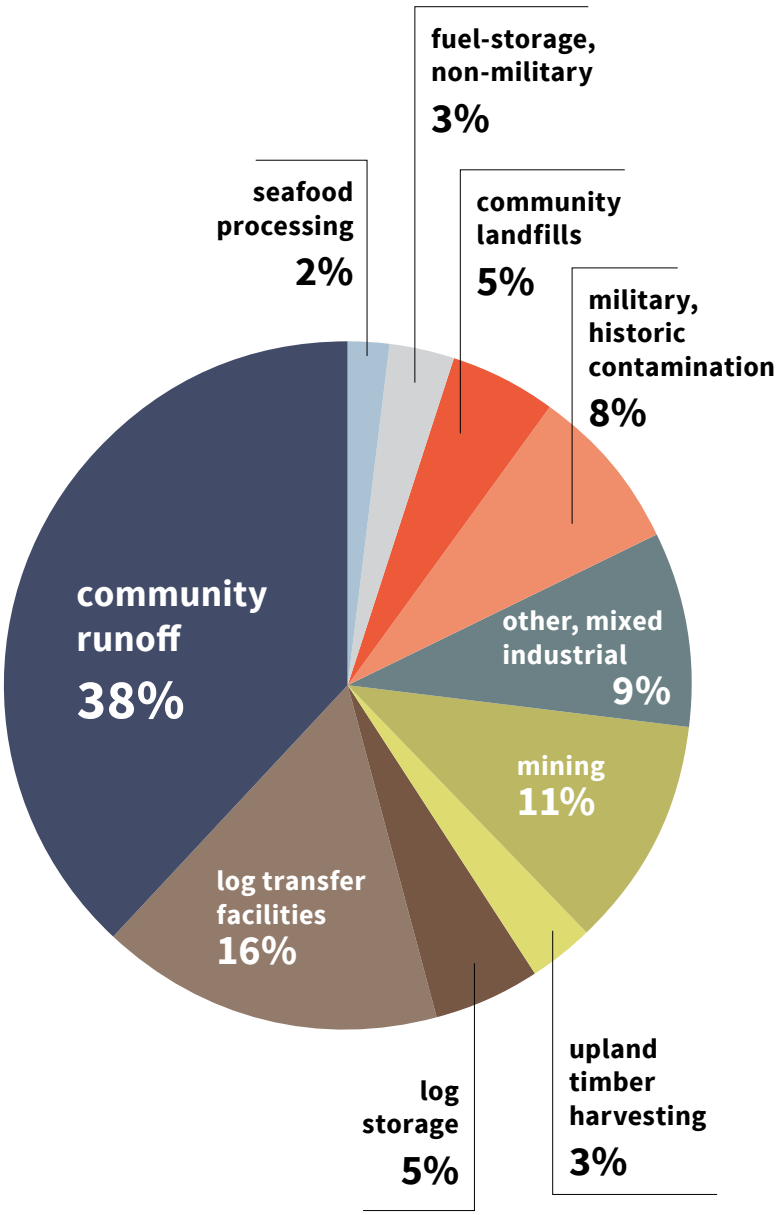
Other activities can also affect local waterways. Riding ATVs through streams can damage important riparian habitat, impacting sensitive life stages of fish such as when salmon eggs are in the gravel or migrating on their way to spawning grounds. Trampling a streambank while fishing can lead to bank erosion and sediments entering our waterways. Surface runoff carries sediment and other

The largest single source of water pollution in Alaska is stormwater runoff and erosion from pavement, parking lots and ditches, commercial and residential construction, and septic systems. The pollutants include chemicals, bacteria, and sediment.

The Alaska's Forest and Resources Practices Act (AS 41.17.010) requires retention of some trees, called 'buffers', along anadromous streams to protect fish habitats from erosion and other problems.

pollutants into wetlands, streams, rivers, lakes, and eventually into our estuaries and oceans. This non-point source pollution can be a major problem for salmon in densely populated areas. Today many communities are taking action to prevent this and to restore watersheds that have already been impacted.

POLLUTANT SOURCES IN ALASKA'S WATERS



FROM 2001 ALASKA CLEAN WATER ACTIONS (ACWA) REPORT. DEC

WHAT YOU CAN DO

Things you can do to keep salmon populations healthy in Alaska:

- Only use fertilizers exactly as directed or avoid their use if possible.
- Dispose of hazardous wastes properly.
- Don't pour waste oil, paint thinner, paints, or solvents onto the ground or down drains.
- Contact your local landfill to learn where to dispose of hazardous waste.
- Recycle used oil and antifreeze.
- Don't block the passage of fish on local creeks and streams.
- Keep natural vegetation along small streams and rivers near your yard.
- Don't fill in or pollute low-lying wetland areas.
- Use developed trails away from riverbanks when hiking or to access fishing spots.
- Never drive ATVs across salmon streams except at authorized crossings.
- Fuel your boat carefully, preferably away from the water.
- Operate your boat near the middle of rivers to minimize damage to the banks.
- Keep livestock away from riverbanks.
- Join a local community group to help restore or monitor a stream in your neighborhood.

Community Stream Restoration

The restoration of degraded habitat and fish passage access is performed by multiple partners that share a common goal to protect fish populations from the impact of thousands of road culverts, dams, and water diversions across our state. Volunteers, landowners, land managers, U.S. Fish and Wildlife Service, local government and tribal groups, and nonprofit partners all work with ADF&G to restore riparian habitat and fish passage.

© KENAI WATERSHED FORUM | STREAM WATCH

Monitoring monofilament disposal units, placing barrier fencing to protect sensitive river banks, and collecting trash along the Kenai River are all accomplished by volunteer networks.

© COPPER RIVER WATERSHED PROJECT

Volunteers help with hedge brush layering, a technique which combines layers of cuttings with soil to revegetate and stabilize both streambanks and slopes.

Invasive Species

Salmon that make their home in Alaska rivers and lakes can be threatened by non-native predatory species illegally released into their waters and non-native plants that take root in their spawning grounds. These are invasive species and they can have direct and negative impacts on salmon.

Moving nonindigenous fish or plants to where they do not belong can harm native species. Invasive species can dominate ecosystems, damage habitat, and cause health and economic problems. Invasive species are a worldwide problem that cost nations billions of dollars to control and are the second major cause of species extinctions in the world.

While the broad impacts of invasive species in Alaska are unknown, we have a lot to lose should the threats at our borders become established. Northern pike are among the biggest threats to Alaska salmon. Native to waters north of the Alaska Range, pike were illegally introduced to the Kenai Peninsula, Anchorage, and Matanuska-Susitna lakes in theory to boost fishing opportunities. Instead they have devastated salmon.

The introduction of Atlantic salmon in the Pacific Northwest and British Columbia through industrial fish farms threaten wild salmon and trout. Atlantic salmon that escape net pens could out-compete Pacific salmon and trout for food, habitat for spawning and rearing, and potentially could became established in our waterways.

The state legislature banned fish farming in Alaska waters in 1990 to prevent these types of threats to wild salmon stocks. Tighter controls on fish farming in the Pacific Northwest have reduced the number and volume of Atlantic salmon escapees. In 2017, a failed net pen released about 250,000 Atlantic salmon into Puget Sound, prompting the state of Washington to phase out farming of Atlantic salmon species in its waters.

Our changing climate makes it easier for invasive species to become established. Although not currently present in Alaska, introduced species such as New Zealand mudsnails, and zebra and quagga mussels could make habitats inhospitable to salmon. Elodea, an aquatic plant native to North and South America, has already been identified in numerous waterbodies throughout the state.

An invasive northern pike fitted with a radiotag (note the antenna exiting the abdomen) is released to help track pike movements to support eradication efforts in Southcentral Alaska.

You Can Stop Invasives

Personal awareness, cooperation, and fast action are all needed to solve this growing problem. You can help stop invasive species by never releasing or moving fish, plants, or even water unless it came from that particular water body. Dispose of aquarium fish, pets, and plants responsibly not by dumping them into waterways where they may survive and establish themselves in Alaska waters.

You can help stop the spread of invasive hitchhikers with these simple procedures: **CLEAN** all mud, plants, and fish from fishing gear, boats, and trailers, preferably with hot pressurized water. **DRAIN** all water from boats, coolers, and holding tanks before moving them between waterways. And **DRY** everything that came in contact with the water before entering new waterways. ●

Elodea, or water weed, in a lake in the Matanuska-Susitna Valley.

© MARK EMERY

THE HARVEST OF SALMON

"Fishing is a part of our circle. It's part of our food chain, it's part of our family time, it's part of our traditional potlatches and dinners, our ceremonies, everything is related to salmon."

Faye Ewan, an elder of Kluti Kaah in *Salmon Life*

The harvest of salmon is an important part of Alaska history and will play a major role well into our future. From the first Alaskans that made a home here to the first commercial salmon canneries to today's personal use dipnetters and anglers, catching salmon is vital to the economic and cultural health of Alaska.

State regulations define four categories of users who may harvest salmon: commercial, subsistence, sport, and personal use. To participate in subsistence and personal use fisheries, you must be an Alaska resident. Commercial and sport fish licenses are available to nonresidents as well as to Alaskans.

While a priority is provided for subsistence uses in Alaska, commercial fishing accounts for the vast majority of salmon harvested. Commercial salmon fishing provides jobs for fishing families, the processing industry, and the sale of wild salmon products. Sport, subsistence, and personal use account for about two percent of the total statewide annual salmon catch but varies depending on the region and species. These fish are a principal food source for many families and are important to the cultural and spiritual vitality of many Alaskans.

The harvest of salmon has always been and continues to be vital for many Alaskans.

© ALASKA DEPARTMENT OF FISH AND GAME

Native Traditions

Salmon have been intimately tied to Alaska Native cultures for at least 11,800 years, when archaeologists have dated its earliest known use. Since first harvested by Alaska Natives, much has changed in the way of techniques and tools, but the foundations of harvesting salmon have remained relatively unchanged. The annual cycle of harvests, sharing and cooperation, local and traditional knowledge, and cultural values characterized human-salmon relationships then and continue to do so today.

The harvest of salmon and other wild animals and plants by Alaska's Native peoples has for millennia followed a pattern based on the seasons of the year. The salmon run from early summer to late fall, depending on the species and region of the state. Family-based groups migrated seasonally between winter hunting grounds and summer fishing camps, using the arrival of specific species of animals, weather patterns, and other indicators as guides.

One foundation of living with and from salmon is that of sharing. The practice of giving and receiving salmon with no expectations of reciprocity is common across time and regions. Sharing and helping with harvesting and processing activities were, and continue to be, extremely important to subsistence ways of life. Alaska Native

Athabascan canoes and fish racks on the beach at Russian Mission on the lower Yukon River in 1895.

NAMING SALMON

The Haida people of the Southeast Panhandle and Canada's Haida Gwaii tell the story that salmon came from a mythical house, *Ta Iná̲ang Náay*, before Raven put them in the rivers. The Haida language uses the word *chii'n* for salmon and *ts'iing* for spawned-out salmon. In nearby Metlakatla, the *Sm'algya x* language of the Tsimshian people uses the word *yee* for Chinook and *misoo* for sockeye.

Most Alaska Native languages are divided into two major language families, each containing several related but distinct languages, and all with different and often multiple words that describe salmon. The Athabascan language family is found along the coast from Southeast Alaska to Cook Inlet and in the Interior of Alaska. The Tlingit of the Southeast archipelago use the word *x̲áat* for salmon, *t'á* for Chinook, and steelhead are known as *aashát*.

There are eleven Athabascan languages in Alaska, in addition to those spoken in Canada and the lower 48 states. Copper River salmon are prized among the first salmon to return each year, and the Ahtna of this area use the word *luk'ae* for salmon and have words that describe the first salmon caught in summer, *tsaedi*, and the last, *k'ets'eni*. For the Eyak people, Chinook are known as *te'ya'lee* and their sockeye as *cha'ch'*.

The Inuit-Yup'ik-Unangan languages are found from Prince William Sound to the west and north all around the coast of Alaska. The Inupiaq use the word *iqalugruaq* for Chinook, and the Yup'ik call them *kiagyaq* or *taryaqvak*. They also have a word to describe Chinook running under smelt, *aciirturtet*. In the Unangan Aleut language, salmon are *amiyuung*, large Chinook are *aamasuuk*, and the word *kiimadgi-x* describes fatty winter salmon with small roe.

To learn more about these languages and their names for salmon, visit UAF's Alaska Native Language Center at *www.uaf.edu/anlc* which has links to online dictionaries for most Alaska Native languages.

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values include taking care of one another, distributing food to those who need it, showing respect for Elders and respect for salmon, and sustaining relationship within and between villages.

The sharing of salmon and other subsistence resources was the basis of the subsistence economy in many pre-contact Alaska communities. Over the past 200 years, these economies have increasingly incorporated cash, whether through wage work, sale of art or crafts, or commercial harvest of salmon or other species. Today, residents of subsistence communities rely on some amount of cash to purchase fuel, nets, boats, freezers, and ammunition to enable subsistence harvests.

Over the thousands of years that people have harvested salmon in Alaska, bodies of knowledge have been gathered and passed down through generations. This knowledge, gained by repeated observations over long time periods, includes salmon biology, life histories, harvesting and processing, as well as how to handle, show respect for, and live with salmon. Local and traditional knowledge of salmon is often highly specific to a particular place.

For many Alaska Native cultures, how to exist in the world is guided by a belief system that sees humans as equal with animals, including salmon, connected by mutual respect and kinship. This relationship has long been critical to human survival in Alaska. If salmon are not treated respectfully, they will not return to provide themselves as food.

Fish traps on the Chilkoot River in northern Southeast Alaska in 1894.

Fish drying rack at Quartz Creek on the Kenai Peninsula, 1915. Fish drying racks are still widely used in villages and fish camps at salmon harvest time in Alaska.

THE CONNECTION OF CAMP

BY LAUREL IVANOFF

YUKON RIVER — Pulling up to camp is like pulling up to home and family, even when no one is there. The buildings, nestled by towering cottonwood and black spruce trees, contain stories within them. The trees encircling the camp are like family members providing protection, comfort and solid presence. Rooted. Established. Strong. The ground and the water around these buildings supported generations of life and their stories continue today. Salmon has been taken from the muddy waters of the Yukon River and cut, dried and smoked. Cut, dried, and smoked. Cut, dried and smoked. This place, for Ben Stevens and his family, has provided. Fish is food. And the byproduct of connection to family and the earth is a benefit highly valued in the chase for food. It's this connection that has Ben returning, year after year, with his own children.

Ben Stevens grew up spending the entire month of July at his family's fish camp 30 miles upriver from Stevens Village, on the upper Yukon. A month spent with five to seven families in this place provided a year-long supply of fish for each family. Raised by his grandmother, Hilda Stevens, Ben helped with the entire operation from setting nets to hauling smoked and dried bales of salmon to the boat. "If you asked me what I did, I did it all," Ben said of the days helping his family. "I packed water, chopped wood, gutted fish, and rotated the fish in and around the smokehouse." He said the one thing he didn't do, and still does not do today, is taste test the fish.

"That, I bring to an elder. We have to test," Ben said. "As the fish are starting to dry, we take a piece to an elder and say, 'Naqh.' It means here. They would taste it, chew it. It's kind of a quality assurance thing."

One time he got to the fish camp and found that the snow had caved in the roof of the smokehouse. "The fish were already in the river, so just for temporary measure we threw a tarp over and started fishing," he said. "Later I brought a piece to an elder and she nibbled on the fish and said, 'Hm. It tastes like your smokehouse is a little warm. Or hot. Do you have a tarp on your smokehouse?' I was blown away," he said.

Ben is also struck by the amount of work done "by those that have gone before us." Yet when reflecting on his time as a child, spending his summer at camp, he thinks of peace. Family. Place. He feels a connection to his grandfather, Winthrop Silver, and the uncles who came around. They'd tell stories while working. They'd tell stories by the fire pit. "I learned a lot about the way our ancestors walked on the earth," he said of his childhood. And the connection is the reason why Ben continues to bring his son and nephews to the fish camp.

"They need a connection with their ancestors, and the ground they walked on," he said. So a few times each summer, Ben travels the five hours from Fairbanks to take a few teenage boys to his family's camp. They set the net. The boys gut the fish. They make and tend to a fire. They hang salmon in the smokehouse. They don't catch nearly as many kings as they used to. They can't, even if they wanted to. But he still takes them. It's simply in him to launch the boat. To travel the 30 miles upriver from Stevens just like he used to as a child. To show the young men how to fish. How to provide. Ben tries to do for the boys what his grandpa and uncles did for him.

And during those trips, he sees connections being made. "I see a sparkle in my son's eye when we're cutting and he wipes fish blood off of his nose," Ben said. "He's learning something new – the way I was taught."

Ben realizes he's also giving his children a connection to a place. To the earth. "Being so close to the land and the animals brings a calm to one's soul," he said. "It's so messed up when you're in the cities and you're distracted by all those things that are not real. We look at the TV and we see images and we see things that are not necessarily all that important. So when we get away from all that, we connect to things that are important to us. It brings a calm and a peace in a way nothing else can.''

One day Ben ran into an old lady who knew his grandma Hilda. He told her he was sad his kids aren't growing up and receiving love like he did from his grandma. He wishes they could feel a fraction of it. He said the old lady looked at him and said, "They do feel that love. They get it through you."

So he will continue. Each summer Ben will gather the boys, his old dog Sheenjik, and pack his truck. They'll drive to the river and launch the boat. They'll boat upriver, past Stevens Village, and on to the place that means so much to him. The place that is nestled by towering cottonwood and black spruce trees. The place where fish blood has spilled and where stories are shared. The place where his son's eye twinkles when he gets to use the sharpest knife on the cutting table. The place where salmon is cut, dried and smoked.

Learn more about The Connection of Camp at **www.salmonlife.org**

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Traditions, spiritual connections and family ties are reinforced by fishing together and are values which cannot be measured in dollars.

© NATHANIEL WILDER

Many families in Alaska's rural communities depend on subsistence salmon fishing to survive. In Alaska, subsistence use of fish and wildlife is a priority. During times of shortages, subsistence use has priority before sport, personal use, or commercial fishing.

© NATHANIEL WILDER

Most families preserve salmon in traditional ways, drying them on wooden poles or smoking them in sheds. Not only do dried and smoked salmon taste good, they keep without refrigeration. Electric freezers are available in most of rural Alaska, but they are expensive to buy and operate, and are not big enough to hold the hundreds of salmon that families harvest and need every year.

Subsistence – A Way of Life

In Alaska, both state and federal laws provide a priority for subsistence fishing over other uses. Under state law, subsistence is a right granted to all Alaskans to continue their traditional hunting and fishing way of life.

Many Alaskans engage in customary and traditional harvest of salmon and other fish, wildlife, and plant resources. Fish, game, and plants are often used for food, clothing, tools, transportation, arts, and crafts, particularly in rural and Alaska Native communities. These uses are known as subsistence. Subsistence harvests of salmon account for less than one percent of the annual Alaska salmon harvest, depending on the region and species, but they are very important to the families, communities, and cultures that depend on them. Despite spirited debate over the allocation and management of subsistence in Alaska, subsistence salmon fishing is widely regarded as essential.

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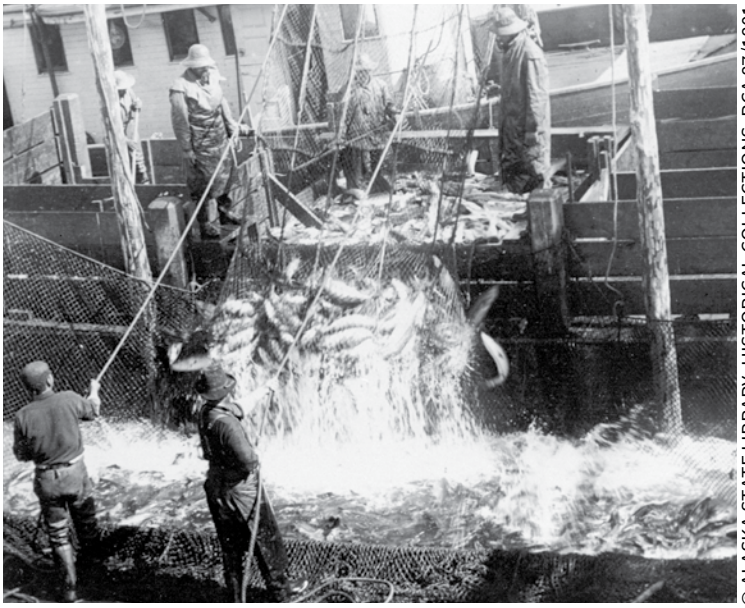
ADF&G Division of Subsistence estimates that salmon contribute about 90 pounds per person per year to the subsistence diet in rural Alaska. Along the state's western coast and interior rivers, this average harvest approximates 200 pounds per person per year.

© ASDAL

Every summer, Alaskans line up along the Kenai and Kasilof rivers, and other locations to harvest salmon for personal use with dipnets up to five feet in diameter.



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Transferring ('brailing') salmon from a fish trap, 1912. The misuse of fish traps led to huge declines in salmon populations prior to statehood.

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Alaska' s seafood Industry contributes more private sector jobs than any other industry in the state. From spring to fall, salmon provide harvesting and processing jobs throughout Alaska.

Personal Use Fishing

Personal use fishing uses gillnets or dipnets to put salmon on the plates of Alaska's families. Thousands of Alaska families harvest their share of wild or hatchery salmon in personal use fisheries that are mostly accessible along Alaska's road system. A common trait of both personal use and subsistence fishing is to use effective techniques to harvest high volumes of food as efficiently as possible.

Commercial Salmon Fishing

Alaskans had two main reasons to become a state: they wanted to vote for president, and they wanted control over their fish and game. Alaska's purchase from Russia in 1867 was once mocked as "Seward's Icebox," but its supporters included commercial fishermen who knew that icebox was packed with fish. As canning technology was developed, attention turned to Alaska's abundance of salmon. Canneries spread up the west coast from California and were built in Klawock and Sitka in 1878. Within a decade, salmon canneries spread from Southeast Alaska to Cordova, Kenai, Kodiak, Chignik, and Bristol Bay.

Many early commercial fishermen were Italian and Norwegian immigrants from San Francisco and Seattle, and fished with gillnets from sailboats and hand-operated purse seines. Native fishermen competed with them with their knowledge of local currents and tides. In the 1890s, canneries introduced floating fish traps that were so effective they soon accounted for half their catch.

As the industry grew, salmon catches soared in the early twentieth century, but fishing was mostly unregulated. Weaknesses in some runs hinted there may be problems ahead. Tougher rules were imposed in 1924, but poorly enforced. The salmon industry peaked in 1936 with 129 million salmon landed.

Salmon runs in the following years fell. Lack of effective control of fisheries allowed the salmon packers to overharvest the runs. Not enough salmon escaped upriver to spawn and caused the stocks to collapse. Alaska was declared a federal disaster area due to poor fishing in 1953 and, six years later, the catch fell to a record low 25 million salmon.

In 1959, Alaska became a state and brought a strong conservation mandate to rebuild its salmon runs. The Alaska State Legislature banned fish traps to conserve and rebuild salmon populations. ADF&G biologists were required to manage runs for spawning escapement, which places a priority on allowing fish to return to fresh water to spawn.

HOMEWARD STORY

BY KRISTIN VANTREASE

You start off small, spherical, orange, translucent. Immediately, you are surrounded by family, hundreds of your brothers and sisters. The water around you, clear and fresh, flows steadily. Your dying mother has swept out a redd for you, a temporary home in a gravelly stream until you emerge from your rubbery casing.

My life also revolves around the seasons; every summer my family migrates to Bristol Bay with the salmon. I'm young. Still a small fry. Too young to be at sea, I stay on land with my mom and cousins at our fishcamp — a place called Graveyard Point. Our shack is between the beach and the tundra. Carried from the rocky beach, the scent of rotting salmon rides the wind to my doorstep: it smothers me, bowls me over.

As a fry you leave the redd for the first time. You are the tiniest fish, translucent as glass and just as fragile. The journey to the lake is perilous. Lake Iliamna nourishes you in its clear frigid waters for years.

Pilot Bread and peanut butter: that's the taste Graveyard left on my tongue. Dirt and mud: those are the stains that Graveyard left on my clothes. Splinters in my feet: those are the marks that Graveyard left on my body from the boardwalks that connect the cabins and abandoned canneries across the tundra. At Graveyard, we harvest the rain in barrels and take steam baths, sweating the dirt and salmon out of our skin. The bears wander around our cabins at night while the dogs bark.

Then it's time to leave. Now a Smolt, you head to the ocean. You spend two to six years, you grow, mature, dodge seals, salmon sharks, nets. You have near misses. Your silvery body shows the raking teeth marks of a sea lion. Your scales adjust into a mended patchwork quilt carrying the memory of your brush with death.

I return to Portland because I believe it is my home. I take classes, live with friends, find a job, yet feel unsettled. On my father's fishing boat in the summer, home is wherever the harbor is. I thought I wanted Portland, but after traveling home to Alaska for Christmas, cross country skiing through moonlight, my suspicions are confirmed: I must move home.

While on your way home, you swim blindly into a net. The webbing slips effortlessly over your nose and then catches your gills. The diamond shape of the web holds you tight, and despite your thrashing efforts you cannot escape. Trapped.

I fly out into the tundra scape of the Lake Clark wilderness in a Super Cub with my father. Below, I see the infinite snaking of rivers. They are in no hurry to get anywhere, but still, they will make it to the ocean. The rivers weave together to form a tapestry that blankets the land, some small as threads, others as wide as a silvery liquid highway.

Almost immediately, the net pulls you through the water. You break through the surface, and rain slides off your scales. Suspended now in mid air instead of water, gloved handsreach into your ribbed, red, gills and free you. That same hand reaches down, picks you up, and then, while throwing you into the fish hold, misses. You are overboard. Shaken, but still swimming.

For three generations, my family has depended on wild salmon from Bristol Bay. Within our district, the Kvichak River is a notoriously difficult region to fish. Beneath the murky waters, a labyrinth of mudflats lies waiting to trap boats as soon as the tide ebbs. My grandfather left the dustbowl of Oklahoma to fish for sockeye salmon in a wooden sailboat. Wooden corks, canvas sails.

From the instant your scales touched freshwater, the change began. The pigment from your flesh leaches into your scales, until each is full vermilion. Your tail and head darken to pine green. Your back, once a gentle slope, is now sharply arched. Curved also, are your mouth and teeth. Your upper lip hooks around your lower like a shepherd's staff. Your teeth protrude, irregular and snaggled.

The wooden sailboats gained outboard motors and were eventually abandoned altogether for aluminum and fiberglass boats. Now I work with my father and brother on a 32 foot aluminum boat powered by diesel and a John Deere engine. Daily, we intercept salmon by the thousands of pounds on their journey back to the spawning grounds.

In this transformed state, you journey home. The path is ever upstream, but you beat against the current with your tail. By the day your body gets weaker. Your once orange flesh is now pale and pinkish grey. You will lay your eggs in the stream you were born, and those, too, will be orange, colored from the very pigment leaving your flesh.

We are deep in salmon: three generations deep, and on board the boat, knee deep. Being a part of this process of labor and harvest centers me in Alaska. It reminds me that life is meant to be cyclical, full of flux. Some seasons good, some seasons bad – fishermen know this better than anyone. I live with one foot in the river, and one foot on land knowing the importance of both. And, at the end of the day on the boat, as I lie in my bunk, all I see when I close my eyes are the lithe, silver bodies of sockeye salmon.

Read the full Homeward Story at **www.salmonlife.org**

Alaska also implemented a new hatchery program in the early 1970s to supplement wild salmon returns, using both state-operated and private nonprofit hatcheries. Voters approved a limited entry program to cap the number of fishermen who could fish commercially for salmon and other species.

It took almost 20 years of strict state management, sacrifices by all fishing groups, and favorable climatic conditions to rebuild populations of wild salmon. Fishermen set a new record with a statewide catch of 133 million salmon in 1984, and the harvest soared to 280 million salmon in 2013.

Commercial salmon fishing remains vital to Alaska in many ways. The statewide fishing industry provides thousands of jobs and brings hundreds of millions of dollars into the state each year. The value of commercial fishing to Alaska is measured in more than dollars. Commercial salmon fishing supports the state's fishing families and entire communities including 11,000 permit holders, their crews, and over 20,000 processing workers annually.

Concerns remain in the fishing industry. Changing marine conditions have affected survival rates and escapement, reducing fishing opportunities. Fluctuations in fish prices have shaken fishermen, families, businesses, and entire communities. A worldwide increase of farmed salmon has eroded traditional markets but opened opportunities to reach new consumer markets for Alaska's wild salmon.

A new generation is rising to the challenge, responding to changing consumer demands and finding expanding markets. Customers now recognize the value of Alaska's wild and sustainable salmon in the marketplace.

Alaskans are looking at new products and new ways to handle, process, preserve, and market our commercially-caught salmon. These efforts are helping to ensure the future strength and stability of our salmon fisheries, fishermen, and fishing communities.

This salmon was taken from a gillnet.

A seiner hauls the 'purse' aboard' in Amalga Harbor.

The troller is an enduring symbol of salmon fishing tradition.

When it came time to vote for statehood, Alaskans gave two major reasons for becoming a state: they wanted to be able to vote for the president and they wanted control of their fish and wildlife resources. Banning fish traps was one of the first laws adopted in Alaska.

Commercial Fishing Methods

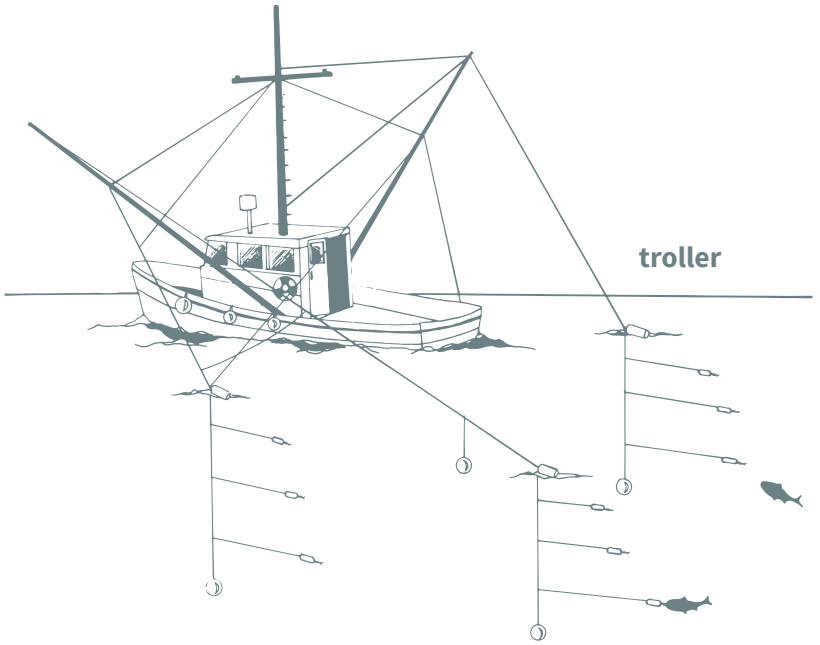
The main methods to commercially catch Alaska salmon use the following gear: troll, gillnet, and purse seine'.

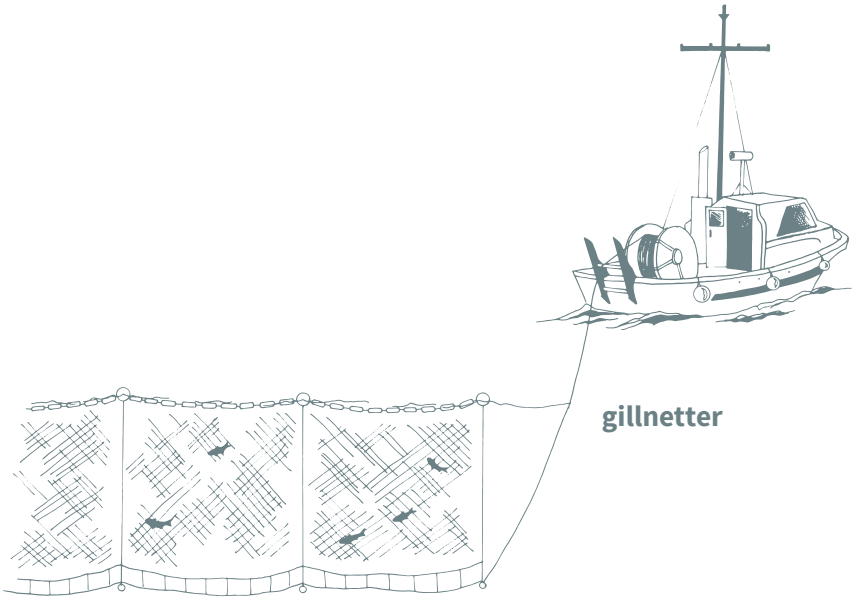
TROLLERS catch salmon with a hook and line. They use up to six lines, each with a lure or baited hook, slowly towed through the waters of Southeast Alaska. Trollers harvest mostly Chinook and coho salmon, although chums have become increasingly important. Chinook and cohos are dressed at sea and packed in ice before being delivered. Many troll-caught salmon are sold in the fresh market while some now freeze their catch.

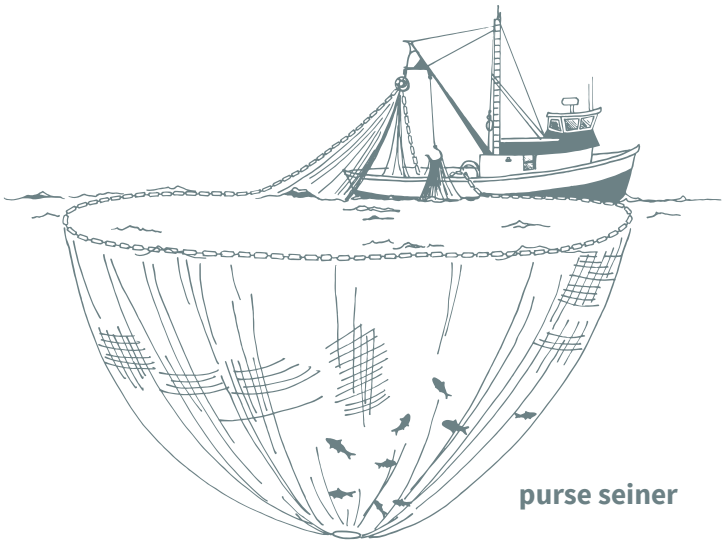
GILLNETTERS use a long, curtain-like net to harvest salmon. When the salmon hit, their heads poke through the net and get caught by their gills. There are two types of gillnets: driftnets are free-floating behind fishing boats and setnets are anchored along the coastline or offshore and worked by fishermen on the beach or from skiffs. Major sockeye fisheries in Bristol Bay, Copper River, Cook Inlet, and elsewhere are conducted using gillnets.

PURSE SEINERS use a large, deep net that surrounds and traps schooling salmon. A high-powered skiff pulls the net into a circle, and the line at the bottom of the net is drawn closed to contain the fish in what looks like a purse. A winch gathers the net full of fish and pulls it onto the boat. Large volume harvests of pink salmon in Southeast and Prince William Sound are primarily caught by purse seines.

Catching salmon may be the first step, but maintaining quality is also important. With Alaska's high-volume salmon harvests, fish quality once suffered. Processors now want fish to be held in ice or refrigerated sea water. Fishermen using all gear types have modified their boats and harvesting techniques, including shorter delivery times, to meet the challenge and produce top quality salmon demanded by the market.







Sport Fishing

Izaak Walton is famous for writing the first book on fly fishing in 1653, which remains in print today. The *Compleat Angler*, or *The Contemplative Man's Recreation* celebrates, "the gallant fisher's life, it is the best of any. 'Tis full of pleasure, void of strife, and 'tis belov'd of many."

During the early nineteenth century, Naval officers on voyages of exploration fished for relaxation. During Alaska's gold rush, a rod and reel were often part of a prospector's kit. In Juneau, miners fished on the Fourth of July, their one day off each summer. Today anglers come from around the globe to pursue Alaska's world-famous salmon and trout.

Fishing and fish viewing are major parts of the most rapidly growing portion of Alaska's economy—tourism. Sport fishing, guided and unguided, are among the top reasons visitors come to Alaska. More nonresident sport fishing licenses are sold each year than resident licenses. While a growing number of anglers are releasing a portion of the fish they catch, most still fish to fill the freezer and family smoker. The fact that most Alaskans eat fish defines sport fishing here.

Anglers fish year-round for Chinook, or king salmon in Southeast and Southcentral Alaska. In western Alaska, they stalk resident rainbow trout as soon as the ice goes out in the rivers. In downtown Anchorage, anglers leave work on their lunch hour to cast for kings or silvers in Ship Creek. They stand shoulder to shoulder on the Kenai River casting for sockeye. They line up one behind the other to cast for kings on Susitna's Willow Creek. Wild rainbow and cutthroat trout are also a highly valued sport fish in Alaska. On Prince of Wales Island, they fly fish for steelhead trout every month of the year in the Thorne River. Some days it seems that everyone in Alaska has gone sport fishing.

Tourism is playing an increasing role in Alaska's economy and sport fishing generates hundreds of millions of dollars annually. In 2007, 475,000 resident and nonresident anglers spent nearly $1.4 billion on licenses and stamps, trip-related expenditures, pre-purchased packages, and fishing gear. Angler spending supported 16,000 jobs in Alaska that generated $545 million of income.

Staff introduce youth to sport fishing at ADF&G-sponsored events.

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The number of jobs related to sport fishing is growing. Jobs as fishing guides, lodge owners and staff, air taxi operators, and specialty processors in all areas of Alaska is affecting the way many rural residents view sport fishing. Sport fishing for salmon is a vital part of life in Alaska.

Sport Fish Hatcheries

The ADF&G Division of Sport Fish manages fishery enhancement programs with a goal to reduce pressure on wild fish stocks and increase sport fishing opportunities around the state. The Ruth Burnett Sport Fish Hatchery in Fairbanks and the William Jack Hernandez Hatchery in Anchorage each rear Chinook and coho salmon, rainbow trout, Arctic char, and Arctic grayling for stocking lakes, streams, and terminal marine fisheries throughout Interior and Southcentral Alaska. Annually, the Division of Sport Fish releases approximately 4.5 million fish. The division also partners with regional, private nonprofit hatcheries to enhance sport fishing opportunities on Kodiak Island and in Southeast Alaska. Funding for these enhancement programs primarily comes from the sale of sport fishing licenses and stamps, excise taxes and import duties on boating and fishing equipment, as well as a tax on motorboat and small engine fuel.

RELEASING FISH

If you don't plan to keep the fish you catch as food, you must use good catch-and-release techniques. Being careful with your catch ensures that if you release it, the fish will survive. Taking care with undersized or unwanted fish also helps ensure there will be fish for all of us in the future. Being careful with your catch also means that if you do take your fish for food, you will have the best tasting fish. In many areas in Alaska, regulations prohibit fish from being taken out of water if they are to be released. Check your local regulations.

FOR RELEASE:

- **Use heavy tackle and strong line to land fish quickly.**
- **Wet your hands before touching a fish to prevent breaking their protective slime layer.**
- **Keep fish to be released in the water.**
- **Use a soft knotless net.**
- **Back the hook out the entrance hole.**
- **If a fish is deeply hooked, cut the line and leave the hook in. It will rust out in a few days.**
- **Support your catch facing into the current until it swims from your hands.**

© ALASKA DEPARTMENT OF FISH AND GAME

WHAT ANGLERS CAN DO TO MAINTAIN HEALTHY SALMON HABITAT

Many of the forces that affect the return of salmon to spawning areas are beyond our control. One thing anglers can do to help salmon is to protect streambanks while fishing.

- **Always launch and retrieve boats at a developed launch site.**
- **Select an exposed site, such as a gravel bar, when beaching your boat to avoid crushing bank vegetation.**
- **Minimize damage from boat wakes whenever possible by lowering speed and traveling in mid-channel.**
- **Fuel your boat where accidental spills won't discharge into the river.**
- **Use developed trails, ladders, and boardwalks to access a river.**
- **Avoid trampling and damaging vegetation along the water's edge.**
- **Move away from the water's edge when walking up and down stream.**
- **Use hip boots or chest waders to fish in the river and to avoid standing on the bank.**
- **Remember that fish habitat and bank stability are often determined by the amount and quality of streamside vegetation.**
- **Participate in local discussions on land use regulations and the need to protect fish habitat.**
- **Tell friends and visitors of the importance of maintaining riverbanks.**

ANGLER IMPACT INFORMATION COURTESY KENAI RIVER CENTER

Safeguarding Sport Fishing and Salmon Habitat

Sport fishing has inspired generations of anglers who are committed to fishery conservation. The Kenai River is an outstanding example of successful salmon stewardship. Tens of thousands of salmon and trout fishing fans visit the Kenai each year. To prevent and restore habitat damage along the riverfront, residents along the Kenai have partnered with ADF&G and other local, state, and federal agencies including the U.S. Fish and Wildlife Service (USFWS), Kenai Peninsula Borough, the cities of Kenai and Soldotna, and the Kenai River Sport Fishing Association.

The commitment to safeguard Kenai River riparian salmon habitat includes trails that direct anglers to habitat-friendly fishing sites, elevated light-penetrating grated walks and stairways, stream-side protection structures, floating docks, restrooms, viewing platforms, and interpretive signs.

Root wads, cabled spruce tree revetments and live willow stakes help restore river banks (top), while elevated, grated walkways and ramps provide access to the river without trampling vegetation (bottom).

From 1995-2016, ADF&G and USFWS have partnered on 669 fish habitat rehabilitation and protection projects on the Kenai River, many of them funded by the Alaska Sustainable Salmon Fund. These projects removed over one mile of structures detrimental to rearing salmon, conserved almost 12 miles of fish habitat, and rehabilitated four miles of shoreline. In total, almost five million dollars has been spent by ADF&G, the USFWS, and other partners and landowners since 2004 in streambank restoration and protection.

Additional efforts to protect and improve river habitat came with the purchase of over 5,200 acres of land. The nearly $13.5 million spent for this land acquisition came from the Exxon Valdez Oil Spill Trustee Council, ADF&G, the Alaska Legislature, The Conservation Fund, and The Nature Conservancy.

Through these shared stewardship efforts, anglers can now enjoy many parts of the Kenai River without harming the habitat needed to sustain future fish populations and maintain good fishing. ●

© CECILIA KLEINKAUF

ADF&G researchers in the Mark Age and Tag lab in Juneau track salmon with thermal marks and microscopic coded wire tags and collect age data to help managers set harvest goals. Below, ADF&G researchers trap salmon for tagging.

MANAGEMENT AND RESEARCH

The primary management objective each year is to ensure that sufficient numbers of salmon are allowed to pass through fisheries to reach the spawning grounds in order to sustain salmon populations, salmon ecosystems, and salmon-dependent communities, industries, and human cultures.

Alaska's salmon management program has three pillars: sound science, conservation management, and habitat protection. Legal protections for salmon habitat, discussed in chapter four, play a critical role in sustaining Alaska's salmon stocks. Just as important is the work of ADF&G to manage salmon harvests to ensure conservation and sustainable use. To do this requires the best available scientific information and thoroughly trained managers who can make difficult decisions when data are uncertain.

The ADF&G bases its salmon management program on a very simple principle: each year, enough returning salmon must be allowed to reach their spawning grounds to sustain salmon populations and the ecosystem. Called escapement, biologists set a minimum number of salmon needed to return to fresh water to produce the greatest long-term harvestable yield. Each river is different, and the right number of salmon is assessed with long-term data and our understanding of habitat limitations and capacity. Within a season, ADF&G biologists and agency partners carefully estimate the number of salmon returning to spawn. Fishery managers can allow more

fish to be caught when returns are strong and restrict or close fishing when escapement is weak.

Salmon are counted using surveys from airplanes, weirs, streamside counting towers, fish wheels, tagging projects, sonar, and input from fishermen. Harvests are monitored and compared to prior years to gauge the strength and timing of the run. ADF&G biologists and agency partners work year-round to research, analyze, and monitor the salmon resource to fulfill the mandate they've been given. This is a complex task that relies on a variety of data including genetic studies, fish marking, tagging analyses, and harvest information.

Salmon Science

Scientific knowledge, including local and traditional knowledge, provides the foundation for effective conservation, management, and harvest practices. New research is continually adding to our understanding of the complexity of the life cycle of salmon. Understanding the biology and ecology of salmon is essential to their conservation. Knowledge of environmental shifts, climate changes, migration routes and habits, predator and prey relationships, problems from parasites, disease, and pollution are all important to salmon science. Scientists use everything from satellites to microscopes to observe, test, measure, and analyze salmon and the environmental conditions necessary for their survival.

Although we have learned much about salmon and trout in Alaska and throughout their range, much remains to be understood. In particular, our ability to predict, or forecast, the number of salmon coming back to fresh waters remains difficult and is complicated by unforeseen conditions. For example, the marine heatwave called "the Blob," which occurred from 2013-2016, is believed to have contributed to poor returns of many stocks that went to sea during these years.

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Data are collected to understand implications of changing temperature regimes for salmon populations in Southcentral Alaska.

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Counting towers along clearwater streams provide an unobstructed view from which to make direct counts of migrating fish.

© ALASKA DEPARTMENT OF FISH AND GAME. PHOTO BY TED OTIS.

This picket weir is used to ground-truth counts of sockeye salmon documented by a remote video counting tower on Chenik Lake in Lower Cook Inlet.

The William Jack Hernandez Sport Fish Hatchery in Anchorage is a fully enclosed, recirculating aquaculture system that uses the best available technology to conserve water and reduce heating demand for the production of Chinook and coho salmon, rainbow trout, Arctic grayling, and Arctic char. With over 100 rearing tanks, there is space for production of more than six million sport fish each year, supporting $20 million a year in economic impact on local communities.

Salmon in a Changing Climate

Scientific and traditional evidence is increasingly showing that the climate is changing. Warming temperatures, increased acidification of water, loss of sea ice, coastal erosion, and altered stream flows, among other factors, are affecting freshwater and marine salmon habitats, species distributions and abundance, and food webs.

These changes have direct and indirect effects on wild salmon. Increases in temperature and changes in water chemistry may impact salmon, the prey they depend on, and the species that depend on salmon as their own food. Increased water temperatures also attract invasive species, new competitors, and predators. Rural cultures and lifestyles may be threatened by changes in freeze-up and break-up that may affect customary and traditional uses of salmon and other species.

The marine heatwave in the Gulf of Alaska that elevated water temperatures to unprecedented levels from 2013 to 2016 coincided with wildly erratic returns of salmon around the Gulf. Usually strong odd-year returns of pink salmon soared in 2015 with a catch of 188 million pink salmon. The next year, while expected to be weaker, the catch fell well below forecast to just 38 million pink salmon.

As the Arctic becomes more ice-free during the summer and fall months, scientists and fishermen have documented an expanded range of salmon. All five species of Pacific salmon in Alaska have now been documented within drainages of the North Slope. Where few observations other than pink and chum salmon had previously been made, now the abundance of some species appears to be increasing. Warming water elsewhere is attracting predators of salmon and competitors for salmon prey such as increased abundance of squid in marine waters. Warmer water may also promote the growth of invasive plants like elodea in lakes.

Declining snowpack and glacial discharges may limit water flows or increase siltation in some streams to the detriment of salmon. In other locations, post-glacial rebound—the rise of land previously depressed by the huge weight of ice sheets—may result in gains or losses to salmon habitat. Glacial retreat can also expand salmon habitat elsewhere by uncovering new lakes and streams.

Ocean waters have become more acidic. Juvenile salmon feed on small zooplankton, some of which may not be able to maintain their protective shells as the acidity of water increases. Later in life, salmon generally feed on

larger prey, but these also rely upon organisms that will be challenged to survive as water becomes more acidic.

There is much to learn about our changing environment. It is not known if multi-year bouts of warm water, called "marine heatwaves," will become more frequent in the North Pacific. While the chemistry of ocean acidification is well established, research into the consequences of ocean acidification to salmon and other organisms, and the function of aquatic food webs, is still in the early stages. The complexity of aquatic food webs may prevent us from fully understanding the consequences of acidification to salmon prior to increases in acidity being realized.

Alaska scientists are researching these changes that affect healthy populations of salmon and are working to monitor their physical, chemical, biological, and socio-economic impacts. Informed by science, Alaska's biologists are working to integrate indigenous and local knowledge, and consideration of Alaska's economic interests, as part of a program of monitoring, education and outreach, research, response, and adaptation to the challenge of a changing climate.

Eggs and sperm are collected from salmon, later fertilized, incubated and hatched, and the juvenile offspring reared to smolt size.

Hatchery Management

Alaska's modern hatchery program began in response to depressed commercial fisheries in the early 1970s and was intended to increase salmon abundance and enhance regional fisheries. It was also designed to protect wild stocks with a rigorous permitting process.

Hatcheries work by acting as a nursery to fish during their early life stages by improving the survival of eggs and young salmon. Egg survival is very low in nature, usually less than 10 percent, while in hatcheries survival is usually 90 percent or higher. In Alaska, most salmon are reared in hatcheries until they are ready to go to the ocean as smolts. These salmon, typically released into saltwater, fend for themselves and are subject to the same elements for survival as their naturally-spawned counterparts. Although egg to fry survival may be higher in hatchery fish than wild fish, survival from smolts to adult may be higher in wild fish.

Alaska's commercial salmon harvests have improved greatly since the inception of Alaska's hatchery program. Hatchery contributions of adult salmon have been as high as 77 million fish, mostly pinks and chums, which in some years can be half the entire commercial fishery catch. Most of Alaska's 29 hatcheries are operated by private nonprofit hatchery associations, which are primarily self-funded through the sale of a portion of the returning fish.

By design, only nearby stocks are generally permitted as broodstock so hatchery-produced fish are relatively adapted and have largely local genetic profiles compared to hatcheries from the Pacific Northwest that have operated without such considerations. Hatcheries are required to be located away from significant wild stocks. Requests for increases in hatchery production are approached with consideration of potential risks to wild stocks. Intentional breeding or manipulation of stock characteristics is prohibited and large numbers of broodstock are used to maintain genetic diversity and avoid inbreeding effects.

© DIPAC

DIPAC Staff feed chum salmon fry reared in floating pens at the Thane release site in Gastineau Channel.

Hatchery Regulations to Protect Wild Stocks

While misuse of hatcheries elsewhere has contributed to the decline of wild salmon, Alaska's hatchery program is carefully regulated, researched, and monitored to minimize adverse impacts on wild stocks. In Alaska:

- Hatchery production levels, sources of broodstock, and transportation and release of fish by hatcheries is strictly regulated.
- The state genetics, pathology, and management staff review every release of hatchery-produced fish in Alaska.
- The genetic integrity of wild and hatchery stocks is maintained by requiring the use of local wild stocks as founder broodstock for hatchery production.
- Hatchery practices are monitored by state pathologists who routinely inspect hatchery facilities, examine sick or dead fish, and recommend corrective action.

Most hatchery-produced fish are thermally marked on the ear bone or "otolith." This allows biologists to detect straying, determine the percentages of hatchery and wild stocks in the catch, and manage fisheries to avoid overharvesting wild stocks.

© DIPAC

Coded-wire tagging of a juvenile salmon.

© DIPAC

Adipose fins are clipped so tagged fish can be identified later in life.

© ANDREW HENDRY

A Policy for Sustainable Salmon

Adopted by ADF&G and the Board of Fisheries in 2000, Alaska's Sustainable Salmon Fisheries Policy established core guiding principles for Alaska's salmon management and research. The policy directs salmon managers and the Board of Fisheries to follow a systematic process for evaluating the health of salmon stocks throughout the state and to respond promptly with research and management action plans if a stock is found to be chronically weak. The guiding principles are used to gauge the sustainability of specific salmon stocks and the overall effectiveness of the state's approach to salmon conservation and management.

The Sustainable Salmon Fisheries Policy requires "safe passage" for salmon throughout freshwater, estuary, and ocean habitats. ADF&G works with other agencies such as the U.S. Fish and Wildlife Service and the public to prevent habitat loss and rehabilitate damaged areas. Important habitats are identified, monitored, and protected. Spawning adults need cold, clean water with the right oxygen content, flow, and gravel type. Disturbances and silt accumulation can kill developing eggs or prevent spawning altogether. Some young fry need creek banks with natural vegetation, trailing branches, logs, boulders, and undercut banks to help slow the water and provide cover. Others require still water, wetlands, ponds, and lakes. Estuarine areas provide crucial rearing habitat for salmon smolts.

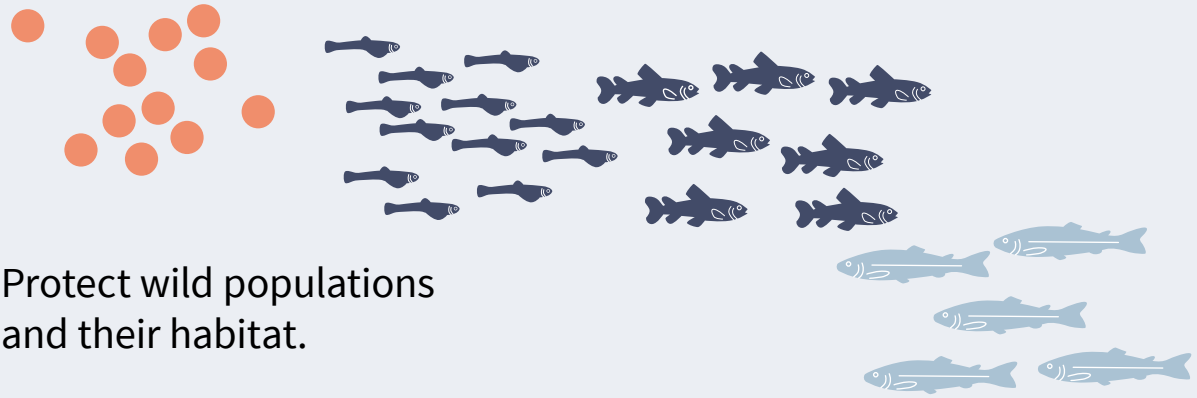
ADF&G biologists survey and manage returning salmon populations to ensure adequate numbers of fish reach the spawning grounds to sustain the population and ecosystem. Management is based on the best available data. New research continually adds to our understanding of salmon ecosystems, genetics, and the effects of climate change.

Many agencies, user groups, and the public work cooperatively to minimize human impacts to salmon. Activities that cause salmon mortality including pollution and habitat damage must be regulated or curtailed. The Alaska Board of Fisheries passes regulations that control fish harvest. ADF&G biologists work to ensure escapement needs are met and to protect salmon streams from damage. The ADF&G works with other state and federal agencies to address activities that have the potential to degrade salmon habitat such as logging, road building, mining, dam construction, and pollutant discharges.

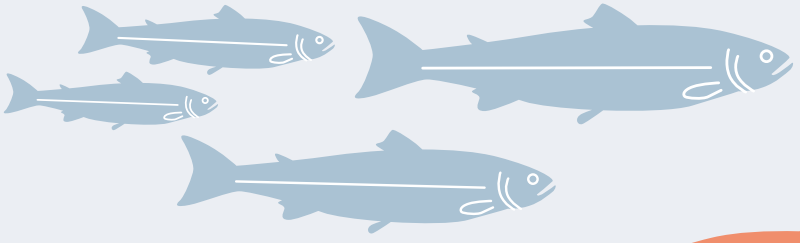
There is always uncertainty in predicting biological systems. Alaska's policy says when in doubt, management decisions will favor protection of salmon. Today, Alaska salmon populations remain healthy, but not even Alaska is immune to loss of salmon as human demands expand and encroach on natural ecosystems. Commitment to the rules and spirit of Alaska's Sustainable Salmon Fisheries Policy will secure the wealth of Alaska's salmon for future generations.

5 GUIDING PRINCIPLES

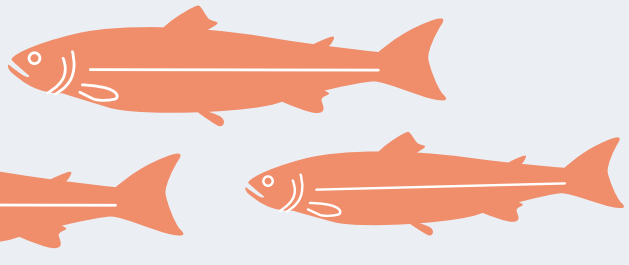
SUSTAINING ALASKA'S SALMON TO ENSURE THEY REMAIN HEALTHY AND ABUNDANT



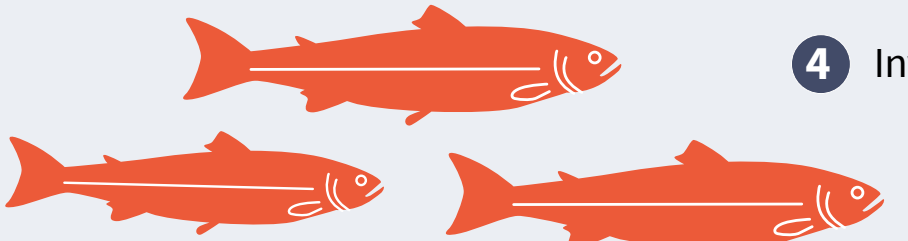
1. Protect wild populations and their habitat.



2. Allow enough escapement to sustain production and maintain the ecosystem.

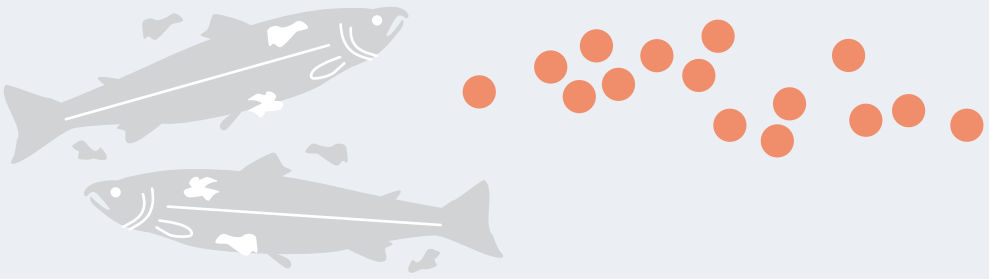


3. Regulate human activities that affect salmon.



4. Involve the public.

5. Where there is uncertainty, manage conservatively.



ADF&G works cooperatively with universities and nongovernmental organizations to conduct activities of mutual interest such as research, monitoring, restoration, and education.

PARTNERS FOR SALMON

Individuals, communities, tribes, businesses, and harvesters, as well as state, federal, and nongovernment organizations are all partners in sustaining Alaska's salmon runs today and for the future.

Partnerships are an important aspect of salmon conservation. By protecting and restoring healthy salmon habitats, we support jobs in commercial and sport fishing businesses and subsistence and personal use of wild salmon for food and celebrations. Each salmon that Alaskans harvest to sell or put on the table represents the healthy functioning natural ecosystem that salmon need. Just as ecosystems sustain businesses and families, we in turn sustain those ecosystems by helping to protect and restore salmon habitat.

Public Involvement

Your active participation is essential in this partnership. If you live or recreate near streams or wetlands, contact your local ADF&G biologist to inquire about best practices to minimize impacts. Ask what you can do to help sustain Alaska's wild salmon. There may be opportunities to assist or start your own stewardship projects such as cleaning up streams or educating anglers how to avoid trampling vegetation. Become well-informed about salmon conservation issues, share your knowledge with others, and participate in public decision-making processes.

Another powerful tool to support salmon stewardship is our purchasing dollar. Choosing to buy and asking for wild Alaska salmon over imported, farmed salmon for you and your family makes a difference. You send a signal to the marketplace that you prefer seafood that is wild and natural. You also support Alaska fishing families, seafood businesses, and the communities that depend on intact salmon ecosystems for their livelihood. As a consumer, you participate in salmon stewardship by casting your economic vote in the marketplace for free-flowing rivers, healthy estuaries and oceans, and for local fishing economies.

International Partners

Some partnerships span international borders. After decades of negotiations between the U.S. and Canada regarding the management and allocation of salmon stocks that originate in one country and are harvested by the other, the two countries ratified the Pacific Salmon Treaty in 1985. The treaty establishes general principles and guidelines for the conservation and allocation of salmon stocks in the treaty area, roughly between Yakutat and Oregon's Columbia River.

For Alaska, the important chapters of the treaty include transboundary rivers including Southeast's Alsek, Taku, and Stikine rivers; the boundary waters adjacent to the lower Panhandle and British Columbia; and Chinook salmon throughout the geographic range of the Treaty.

Ten-year fishery agreements under the treaty were signed in 1999 and 2009 by Alaska, Washington, Oregon, treaty tribes, and Canada. The treaty now includes the adoption of Alaska's successful abundance-based management plan for salmon; agreements for endowment funds to restore and protect salmon habitat and improve enhancement; improved communication and cooperation between the U.S. and Canada; and provisions for sharing scientific information. A new ten-year agreement takes effect in 2019.

The U.S. and Canada formed another partnership in 2002 with the signing of the Yukon Salmon Treaty. This amendment to the Pacific Salmon Treaty established protection for Yukon River salmon by setting harvest quotas and created restoration, conservation, and management programs for Yukon River Chinook and chum salmon stocks.

STATE AGENCIES

Alaska Board of Fisheries

The Alaska Board of Fisheries adopts regulations to meet the needs of Alaskans while making sure fish resources are protected. The process of making regulations involves thousands of Alaskans each year including harvesters and processors, fishing guides, community members, state agencies, and tribal governments. Everyone is welcome and encouraged to participate in the public board process.

Hundreds of proposals are submitted to the board each year that could change salmon management plans and regulations. Resolving conflicting proposals is not easy. Proposals that affect who gets to catch fish are among the most difficult that come before the board.

The board resolves conflicting proposals in a series of public meetings each fall and winter. People from all sides of the issues get a chance to speak, and ADF&G staff comment on the best science or past practices on each proposal. The board then makes decisions about who may harvest, what gear may be used, and when fishing may occur.

Board decisions are written into proper legal language and submitted to the Alaska Department of Law for review. Following this review and approval, the lieutenant governor formally signs the regulations into law.

Alaska Department of Public Safety

The Division of Alaska Wildlife Troopers is dedicated to policing and enforcing the state's fish and wildlife laws and regulations, including those on commercial and sport fisheries. As "Guardians of the Last Frontier," their mission includes reducing illegal harvests and sales of Alaska salmon and other fish and wildlife, safeguarding habitat, and boating safety education and enforcement.

Alaska Department of Environmental Conservation

The Department of Environmental Conservation (DEC) works with industries and the public to address environmental and public health risks to Alaskans. DEC implements statutes and regulations affecting air, land, and water quality, and is the lead state resource agency for implementing the federal Clean Water Act. DEC's regulatory and statutory authority is vitally important to maintain high quality fish and wildlife habitats through pollution prevention.

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Seven public members serve on the Alaska Board of Fisheries. The members are appointed by the governor and approved by the legislature.

Alaska Seafood Marketing Institute (ASMI) promotions around the world highlight the unique characteristics of Alaska's abundant, wild-caught seafood. ASMI is the State of Alaska's official seafood marketing arm.

Alaska Department of Natural Resources

The Alaska Department of Natural Resources (DNR) manages natural resources other than fish and game, such as oil, mining, and timber, as well as state owned land and water. Examples of marine and estuarine uses authorized by DNR include setnet lease sites for commercial fishing and mariculture sites for the shellfish farming industry; lodge sites and access for the tourism industry; access for public and private entities across state lands and waters; water use rights; and access and support camps used in timber development.

Marketing Alaska's Salmon

Alaska Seafood Marketing Institute (ASMI) is the State of Alaska's official seafood marketing arm, promoting the rich flavor, quality, and sustainability of Alaska's abundant, wild caught salmon and other seafood around the world.

Alaska salmon is savored at fine restaurants and sushi bars from New York to Seattle, Tokyo and Beijing, and the capitals of Europe. Salmon steaks and salmon burgers take their place on barbecue grills across the United States each summer. In addition to its flavor and natural color, Alaska salmon is also celebrated for its health benefits, rich with vitamins as well many important minerals and omega-3 fatty acids.

Despite its growing popularity at home, most Alaska salmon is exported. Alaska salmon and salmon roe have long been popular in Japan. Canned sockeye and pink salmon remain traditional items in the British diet and cold smoked sockeye and keta salmon are both very popular in Europe. Salmon roe is also prized as caviar in Eastern and Southern Europe.

The marketplace for Alaska salmon is changing, partly in response to large scale salmon farming around the world. Alaska is still the world's largest producer of wild salmon, but competes with farmed and wild salmon from around the globe. With substantial competition, efforts to maximize the market position of Alaska salmon have been critical to supporting its value and the strong prices paid to Alaska's fishing communities and families.

Thanks to increased awareness and appreciation of their wild, natural, and sustainable attributes, a commitment to quality enhancement, and consumer product innovations, Alaska salmon have benefitted from strong global demand. Since Alaska salmon are actively managed by ADF&G, all salmon harvested in the state are independently certified as sustainable. The Alaska Responsible Fisheries Management and Marine Stewardship Council provide credible standards for sustainable fishing and supply chain traceability.





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LEFT PHOTO © ALASKA DEPARTMENT OF FISH AND GAME

SALMON RELATED PROGRAMS

Several state and federal agencies, boards, programs, international organizations, tribes, universities, and private research groups are all working together to protect salmon in Alaska. Attempting to understand salmon migration patterns, a changing climate, high seas harvests, interactions between wild and hatchery salmon, issues on international waters, and habitat protection, the following programs work to protect wild Pacific salmon:

KENAI RIVER CENTER is a multi agency center that includes permitting, information, and education to protect the rivers of the Kenai Peninsula, its watersheds, and its fish. Participants include the Kenai Peninsula Borough Planning Department, ADF&G's Division of Habitat, the state's Division of Parks and Outdoor Recreation, and the Environmental Protection Agency Watershed Coordination section.

SITKA SOUND SCIENCE CENTER is dedicated to increasing understanding and awareness of Southeast Alaska's aquatic and land based ecosystems, including those critical for salmon. Built upon the former Sheldon Jackson College legacy as a research and educational center, Sitka's maritime tradition and commercial, charter, sport, and subsistence fishing all still play vital roles in the economy and culture of the community.

PRINCE WILLIAM SOUND SCIENCE CENTER works to maintain the region's environments and economies for generations to come by better understanding how the region's ecosystems work and how to address challenges such as climate change. The Science Center is conducting long term research into wild salmon and their interactions with hatchery fish and other programs involving the region's salmon and other fish.

BRISTOL BAY SCIENCE AND RESEARCH INSTITUTE conducts research of the region's renewable natural resources with an emphasis on its salmon and other fish stocks. The Institute has brought resources to important research needs that sometimes fall "between the cracks" of agencies with declining budgets. The goal is to ensure sustainability and foster economic and social benefits to the residents and communities of Bristol Bay.

UNIVERSITY OF ALASKA offers graduate and undergraduate education programs in fisheries through its many campuses. The Fairbanks based College of Fisheries and Ocean Sciences unified statewide academic and research programs in fisheries, oceanography, and marine biology and is a world leader in research and training of the next generation of fisheries managers and biologists. The Sitka based Fisheries Technology Program responded to a shortage of fisheries technicians and skilled workforce and has partnered with industry and regulatory agencies to develop programs that meet the need for highly qualified personnel.

ALASKA SEA GRANT COLLEGE PROGRAM, one of 33 Sea Grant programs nationwide, is a statewide program headquartered at the University of Alaska Fairbanks. Sea Grant has been in Alaska for almost 50 years, working to support healthy coastal resources, strong economies, and vibrant communities through research, education, and outreach via Marine Advisory agents who live and work in eight coastal communities across Alaska.

NORTH PACIFIC RESEARCH BOARD provides grants for fisheries and ecosystem research in the North Pacific, Bering Sea, and Arctic Ocean to federal, state, private or foreign organizations, and individuals. The program coordinates research efforts to address fishery management and marine ecosystem information needs.

NORTH PACIFIC ANADROMOUS FISH COMMISSION was established by the U.S., Canada, Japan, Korea, and the Russian Federation to protect and conserve salmon and steelhead by prohibiting the direct take of salmon on the high seas, minimizing the incidental catch and retention of anadromous fish and promoting cooperation to conduct research, sharing information, and enforcing fishing prohibitions and limits. The North Atlantic Salmon Conservation Organization plays a comparable role on the opposite side of the continent.

PACIFIC SALMON COMMISSION was formed by a treaty between the U.S. and Canada to conserve and achieve optimum production of Pacific salmon and recommend regulations so that each country benefits. The Treaty's **NORTHERN FUND** provides funding and coordination of salmon research, habitat restoration, and enhancement projects between Alaska and Canada.

ALASKA SUSTAINABLE SALMON FUND is administered by ADF&G and manages the state's allocations from the federal Pacific Coastal Salmon Recovery Fund. The federal fund was established by Congress in 2000 to protect, restore, and conserve Pacific salmon and steelhead populations and their habitats.

GULF WATCH ALASKA serves as a sentinel system by detecting, identifying, and predicting changes in the Gulf of Alaska marine ecosystem. Formed by the *Exxon Valdez* Oil Spill Trustee Council, the program provides information to the public, resource managers, industry and policy makers, and helps develop tools and technologies to improve management and address problems that arise from natural and human causes.

FEDERAL SUBSISTENCE BOARD is an eight member panel that oversees subsistence management on federal waters and lands in Alaska, which includes about two thirds of the state. The board includes representatives of the U.S. Fish and Wildlife Service, National Park Service, U.S. Forest Service, Bureau of Indian Affairs, and Bureau of Land Management; an appointed chair; and two subsistence users. They are advised by ten regional councils each including up to 13 subsistence users. Alaska's Commissioner of Fish and Game serves as a liaison to the board.

ARCTIC COUNCIL includes countries of the Arctic region: the U.S., Canada, Russia, Norway, Sweden, Finland, Iceland, and Denmark, and representatives from the six indigenous groups in the region. The Arctic Council's efforts emphasize assessment of the health and ecological risks associated with contaminants; wildlife and habitat protection and conservation of biodiversity; protection of marine environments; and the assessment of impacts of a changing climate on the Arctic region.

UNITED STATES ARCTIC RESEARCH COMMISSION guides the nation's scientific research in the Arctic including its natural resources, habitat, watersheds, and the impact of climate change, as well as research into the biological, health and social sciences as they apply to people of the region. The commission works with Arctic residents, international Arctic research programs, local institutions, and regional governments to obtain the broadest possible view of Arctic research needs.

INTER-TRIBAL FISH COMMISSIONS were formed by tribal or first nations peoples in the Yukon, Kuskokwim, and Chugach regions to conserve, restore, and provide for tribal use of fisheries based on indigenous knowledge systems and scientific principles. The commissions view fisheries as essential to their cultural, nutritional, economic, and spiritual well being and way of life.

INDIGENIZING SALMON SCIENCE AND MANAGEMENT is a program at the University of Alaska's College of Fisheries and Ocean Sciences that documents the breadth and depth of traditional Native values, knowledge, management, and governance connected to salmon and uses this wisdom to improve the current salmon management systems in Alaska.

APPENDIX

References

The Alaska Department of Fish and Game maintains an extensive online library of current and historic publications on Alaska commercial, sport, subsistence, and personal use fisheries as well as habitat and biological studies at **www.adfg.alaska.gov/sf/publications**.

A comprehensive synthesis of current knowledge about the State of Alaska's Salmon and People (SASAP) was undertaken by teams of scientists, indigenous knowledge experts, and data managers from 2016-2018. SASAP results and data are available online at **www.alaskasalmonandpeople.org**.

Noteworthy scientific developments in the conservation and management of Pacific salmon are posted at salmon-net.org. Designed by collaborators at the University of Alaska Fairbanks, University of Washington, and Simon Fraser University, this page connects people outside of academia to peer-reviewed science on such subjects as salmon ecology and evolution, watershed ecology, and fishery economics and management.

Salmon Life is a storytelling movement crafted by The Salmon Project to celebrate Alaska's many connections to salmon and is the source of the inserts on commercial and subsistence fishing in this publication. More stories and photographs of the importance of salmon in the lives of Alaskans are available at **www.salmonlife.org**.

The Alaska Seafood Marketing Institute website provides information on salmon harvest trends, health and nutrition, sustainability, and current issues of concern at **www.alaskaseafood.org**.

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Glossary

ADAPTABILITY • the ability of salmon to gradually change to take advantage of new habitat opportunities

ALEVIN • the first life stage of a salmonid after hatching from the egg

ANADROMOUS • a fish that begins its life in fresh water, migrates to the ocean to grow and mature, and returns to spawn and die in the same body of fresh water

CARCASS • the remains of a salmon after death

CONSERVATION • the preservation of natural resources for future use

DIVERSITY • variety in species

DRESSED FISH • fish with the head, tail, and viscera (guts) removed but the skin and bone retained; some keep the tail on

ECOSYSTEM • the complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space

ESCAPEMENT • salmon that must be allowed to reach the spawning grounds to reproduce to ensure sustainable populations

ESTUARY • the area at the mouth of rivers or streams where fresh and salt waters mix, creating a very rich environment

EVOLUTION • changes over time that occur through successive generations as a species adapts and develops over geologic time

FINGERLING • a salmon fry soon to begin changing into a smolt

FRY • a young salmon just emerged from the gravel

GENETICS • the study of heredity among living things

HABITAT • the area in the environment where an organism lives (includes food, water, shelter, and space)

HABITAT PARTITIONING • the dividing of a stream's habitats among different species of salmon.

INTERTIDAL • the area of land exposed between high and low tides

LARVAE • the wormlike immature form of many insects such as maggots

MIGRATORY • undertaking a migration; to rove nomadic

NATAL • the place of birth, origin

PARR MARKS • the protective coloration (vertical bars) on young salmon prior to their becoming smolts

PREDATOR • an animal that lives by eating another for food

PREY • an animal hunted or caught for food

REDD • a hole or depression a female salmon digs in river gravel as a nest for her eggs

RIPARIAN • the area near or along a river or waterbody

SALMONID • any fish of the family Salmonidae, including salmon, trout, and whitefish

SMOLT • a young salmon residing in an estuary area preparing to outmigrate to the ocean

SPAWN • the act of fish mating to reproduce young

SPECIES • a class of individuals that resemble one another and are capable of reproducing together

STOCK • a breeding population of salmon from a single watershed

SUBSISTENCE • The noncommercial, customary and traditional uses of fish, wildlife, and wild plants by Alaskans for a variety of economic and cultural purposes, including food, handicrafts, and sharing; subsistence uses are particularly important in rural and Alaska Native communities

TRIBUTARY • a stream or river flowing into a larger stream or river

UPLAND • the area above and away from a waterbody

VEGETATION • plants

WATERSHED • the area of land in which all of the water that falls as snow or rain eventually flows into the same streams or rivers and back to the sea

WETLANDS • An area of land that remains wet for at least a part of the year

FACTS ABOUT SALMON

- Salmon are among the most adaptable of fish species as long as their habitat remains healthy and sufficient during each life stage.
- No populations of salmon in Alaska are listed as threatened or endangered.
- All Pacific salmon are probably descended from rainbow trout.
- Salmon carcasses contribute to the health of much of the watershed.
- 75% of Alaskans have a personal connection to wild salmon and 90% of Alaskans feel that salmon are connected to Alaska values.
- Salmon fisheries support more than 11,000 commercial permit holders, 20,000 processing workers, and 16,000 sport fishing jobs in Alaska.

Wild Pacific salmon are vital to Alaska's ecosystems, economy, and many ways of life. The Alaska Department of Fish and Game (ADF&G) is responsible for research and management of Alaska's salmon. Learning about salmon is an important step towards protecting them now and into the future. The ADF&G, together with our partners, produced this book to educate the public and to highlight the importance of sustaining and protecting wild Pacific salmon.