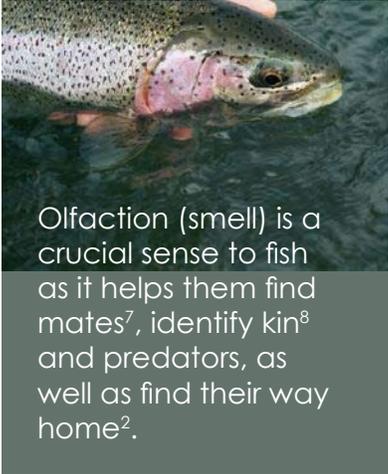


Salmon Ecology 101



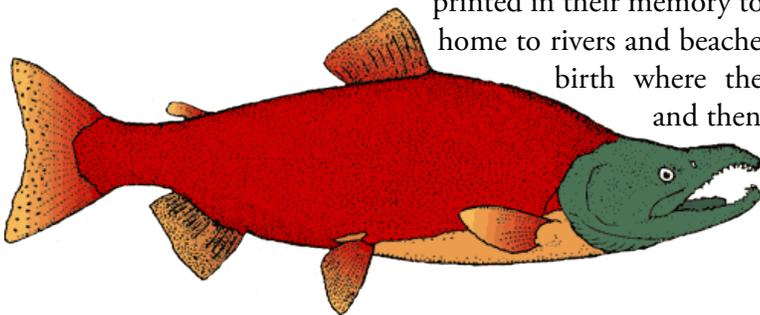
Olfaction (smell) is a crucial sense to fish as it helps them find mates⁷, identify kin⁸ and predators, as well as find their way home².

More than 20,000 species of bony fishes currently dominate earth's waters; of those, 1% migrate between fresh and salt water¹. Each summer, millions of Pacific salmon make incredible migrations from the North Pacific and Bering Sea back to freshwaters of their birth to spawn. Their embryos develop overwinter in rocky nests, called redds, and in spring emerge as "fry". After a few months to a few years rearing in freshwater, depending on the species, young salmon migrate to sea. As they migrate they "imprint" or memorize a complex map of smells

which helps them find their way back home². Once they reach the food-rich sea, salmon grow quickly, increasing their weight over a hundred to a thousand times³. After 1 - 7 years feeding in the sea, salmon begin maturing and start their long migration home. They appear to use both the sun and the earth's magnetic field to navigate through the vast ocean⁴. Once they near freshwaters they rely on both their amazing sense of smell and the map of scents imprinted in their memory to navigate home to rivers and beaches of their birth where they spawn and then die.



Recently hatched salmon and eggs.



The sockeye salmon (*Oncorhynchus nerka*) are the only salmon to rear in a lake 1 - 2 years before going to sea. The world's largest wild sockeye salmon runs are found in Bristol Bay, Alaska.

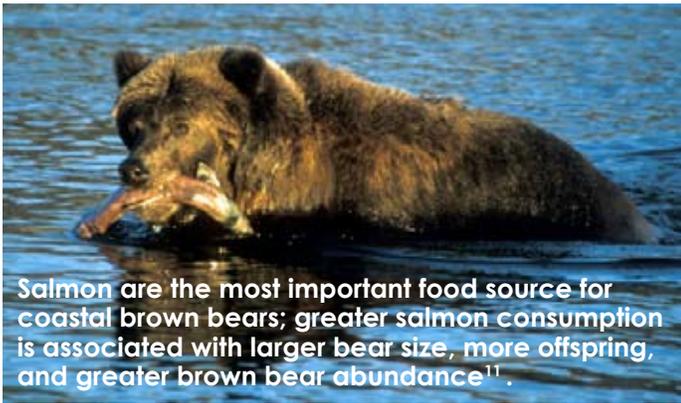
Returning salmon transport millions of tons of nutrients from the nutrient rich marine environment to the nutrient poor ecosystems of the Pacific Rim⁵, increasing production at all levels of the food chain, from bacteria and algae communities⁶ to top predators, such as bears.



Salmon as Fertilizer

Over 20 million fish spawned in the Kvichak River watershed of Alaska in 1980⁹. Assuming an average fish weight of 5.9 pounds, this equals about 118 million lbs. of biomass that salmon distributed throughout the watershed including important nutrients estimated at about 55,000 lbs. of Phosphorus, 40,000 lbs. of Nitrogen, and 590,000 lbs. of Calcium¹⁰.

Anadromous salmon are a "keystone" species in both aquatic and terrestrial environments, meaning they influence survival or reproduction of other species. More than 40 species of vertebrates, including salmon, trout, birds and mammals directly benefit from



Salmon are the most important food source for coastal brown bears; greater salmon consumption is associated with larger bear size, more offspring, and greater brown bear abundance¹¹.

annual salmon runs by feasting on salmon, their eggs, carcasses, or their young¹². Growth rates for juvenile salmon, trout and char all increase after the arrival and subsequent death of salmon¹³. Further, over 30% of the carbon and nitrogen in juvenile coho salmon have been traced to salmon derived nutrients¹⁴. Thus, even as carcasses, salmon help ensure overwinter survival of many freshwater fish by



Salmon Link Aquatic and Terrestrial Ecosystems

Predators and scavengers also transport salmon nutrients into forests with up to 40% of the nitrogen in streamside plants traceable to salmon¹⁵.

providing nutrients at summers end.

Scientists can usually tell what watershed a salmon is from by using genetic tools or biomarkers, like parasites or disease resistance. Even within a single watershed, populations

of fish spawning in different habitats often show remarkable differences in many adaptive traits including spawn timing, size and age at maturity, and behavior, in addition to differences in their genetic makeup. This occurs for 4 main reasons: 1) salmon home precisely, thus little genetic interchange or gene flow occurs among populations; 2) environmental factors causing mortality (Natural Selection) vary among habitats, e.g., bears catch and eat more fish in small shallow streams than in deep ones; 3) anadromous salmon only spawn once then die, if they get eaten by a bear prior to spawning their genes are out of the gene pool, and 4) most traits such as run timing are heritable- similar to you inheriting your mother's nose or eyes! The fact that salmon spawning in different habitats of the same watershed show differences in important adaptive traits underscores the fact salmon populations are not necessarily interchangeable or replaceable. "Biodiversity"¹⁶ is a term used to describe all the variation observed among salmon

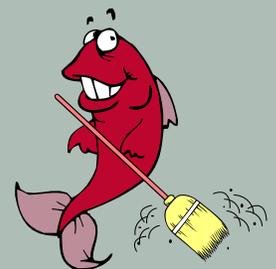


More than 1.7 billion salmon have been harvested from Bristol Bay since the fishery began in 1893; over 1.6 billion or 94% of those salmon were sockeye. Not only is it the world's largest sockeye salmon fishery, but is one of the few fisheries of the world that is recognized as sustainable. The larger run of fish harvested annually is actually comprised of hundreds of smaller unique breeding populations that are adapted to their home or natal streams. The differences among all the smaller populations is termed biodiversity. This biodiversity helps sustain the fishery as fish production varies due to climate variation. Some salmon populations produce more fish under warmer climates while others produce more during cooler climates¹⁶

populations and the high biodiversity observed among Alaskan salmon populations is considered an important factor in the long term sustainability of the fisheries¹⁶.

Salmon Clean House?

When a female salmon returns "home" to spawn, she chooses a site and prepares her redd (nest). She turns on her side and digs in the gravel using her strong tail, sweeping away fine sand and silt that could suffocate her eggs^{17,18}. Large numbers of salmon spawning in a river help maintain spawning habitats by coarsening gravel through silt removal which in turn reduces gravel movement during floods¹⁹, both factors that can kill developing eggs. Annual cleaning of spawning areas is therefore an important task!



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