

Salmon Spawning Behavior

Washington state—snow-covered mountains, dense forests of big, moss-covered trees, and salmon jumping out of the clear river—these are some of the most popular images of this area. Unfortunately, only a fraction of the original old-growth forests remain, and in many rivers, the salmon runs have been lost or are only a fraction of their original numbers.

The forests and the salmon are linked in many ways. Forests provide clear, cool shaded rivers where salmon can lay their eggs and grow as young fish. Returning salmon provide an important source of nutrients to the surrounding forest. Both the salmon and the forests need some serious attention and protection if they are to survive in their glory and diversity for future generations.

General Salmon Life History

Simply put, life history means: “...what the salmon do, where they do it, when they do it, and how they do it.” Salmon spend most of their lives in the ocean, but they return to freshwater to lay their eggs. The young fish spend some portion of their lives in fresh water before going to the ocean to feed and grow into adults. Fish that follow this pattern of living part of their lives in freshwater and part in saltwater are called **anadromous**.

There are five main species of Pacific salmon of the genus *Oncorhynchus* in Washington and Oregon, and they include chum (*O. keta*), pink (*O. gorbuscha*), sockeye (*O. nerka*), chinook (*O. tshawytscha*), and coho salmon (*O. kisutch*); Salmon life history patterns follow a basic theme (Figure 1).

Salmon evolved in habitats that are typically characterized by accessible cool, clean water with abundant woody debris or other forms of cover, relatively clean spawning gravels, food, and a balanced population of predators. In the temperate ecosystem of the Pacific Northwest, the freshwater environment is less productive than the ocean environment, particularly estuaries and coastal upwelling zones; therefore Pacific salmon evolved an ocean-feeding phase in their life history. A typical anadromous salmon life history has five main stages: (1) spawning and egg incubation, (2) freshwater rearing, (3) seaward migration, (4) ocean rearing, and (5) return migration to freshwater to spawn and die. The decaying salmon deposits nutrients from the ocean into the freshwater ecosystem (Figure 1).

A “salmon run” refers to the salmon of one species in a particular river or river drainage basin. Logging, dams, fishing, irrigation, and pollution all have contributed to declining salmon runs. A number of salmon runs have been listed as “Endangered”, meaning they might not be able to maintain their numbers without management and/or policies to protect them.

Chum Salmon Spawning Behavior

Unlike most of the other Pacific salmon, most of the chum salmon runs are doing remarkably well. Chum differ from most of the other salmon in that they have evolved to limit their freshwater life history by migrating immediately to salt water upon hatching. This life history strategy, which chum salmon share with pink salmon, reduces the mortality associated with the variable freshwater environment, but makes chum more dependent on estuarine and marine habitats.

After entering the creek and getting to the spawning area, the fish survive for 1 – 2 weeks. Females choose a nest site (also known as a redd), defend the territory, dig the nest, lay eggs, and bury the eggs. Males swim nearby fighting with other males to establish dominance and courting the female.

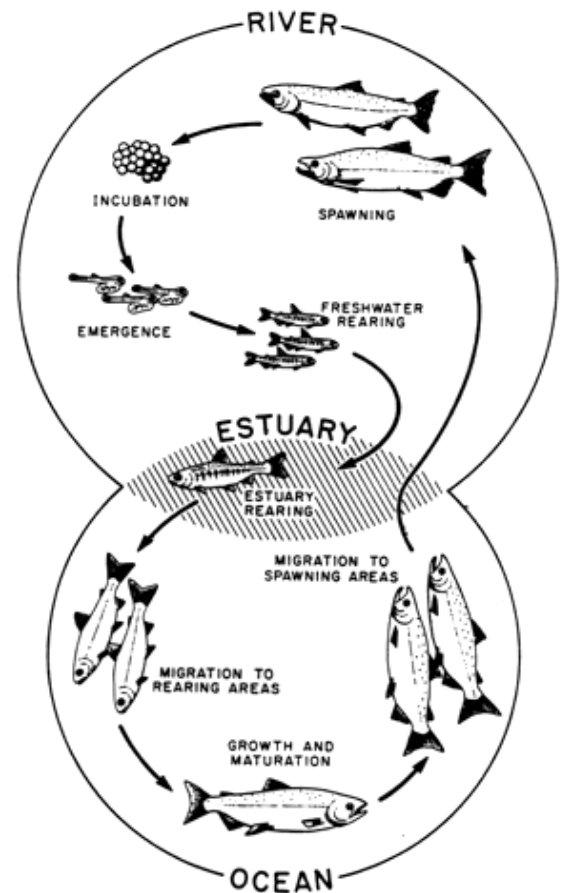
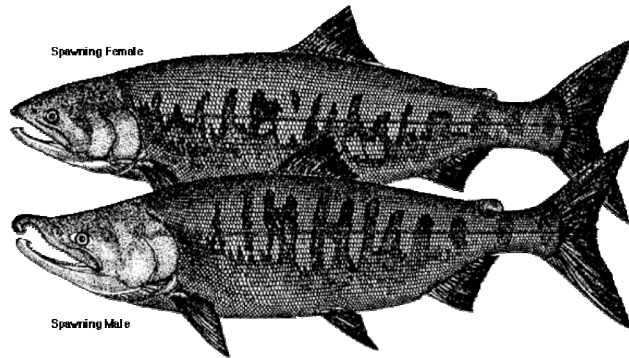


Figure 1. Generalized Pacific salmon life history, showing freshwater, estuary, and ocean components (from Nicolas and Hankin as modified by Spence et al 1996)

Digging the nest or “redd”

To choose a site, females “nose” their way along the bottom occasionally stopping for a test dig. In addition to good gravel, they prefer to spawn above turbulent areas in places called riffle crests and away from other females.

Once the redd site is established, the female guards the territory from other females and starts digging. To dig the fish turns on its side and flexes repeatedly, driving the tail on to the gravel bottom. In this manner, she digs a cone shaped



hollow 10" to 20" deep. Sand and gravel are generally flushed from the redd leaving clean gravel and cobble.

Between digs the female turns and swims to the back of the nest. She also weaves over the nest in a circular and figure eight pattern. As the nest develops, she will also “probe” the nest with her belly. When she can drop her belly deep enough into the redd, the digging is done.

Courtship displays

Male courtship consists of establishing dominance among competing males and courting the female. In the principal display, the male makes a quick approach along side the

female, stops and “quivers” for 1-2 seconds. This can be observed and is best described as the fish is vibrating. The male does the “cross over” display, repeatedly swimming from one side of the female to the other, crossing over her back.

As the nest nears completion the female decreases her turning, circling, and weaving between digs. The male increases his quivering and crossing over. When the female is ready to deposit eggs, she goes to a “crouch” position inside the redd. This is a probe, with the belly deep in the redd, but with the mouth held wide open. The male immediately moves along side. The female releases eggs and the male releases milt. It takes about 10 seconds to deposit the eggs and both fish quiver throughout. The female immediately starts to cover the redd. The first few digs are gentle and drive the eggs down into the gravel. The rest are full digging strokes and cover the eggs deep in gravel.

As soon as the redd is covered, the female starts to dig a redd just up stream, further covering the eggs in the nest below. Often she will dig 4-5 nests one just above the next, depositing eggs in each one. The whole process takes 30-40 hours, after which the female lives her short life guarding the territory. The final redd, or set of nests, generally looks like a 5-10 foot length of disturbed gravel with a depression at the upstream end. The eggs are buried throughout the disturbed gravel, not just where the depression is. After spawning, the male moves on to find another female. In this way, a dominant male might fertilize several redds.

When dense aggregations of fish simultaneously occupy a relatively small area, only a few females will be able to establish and occupy territories. When females must compete for spawning sites, there are several tactics that females can employ while they search for an appropriate nest site. The most energy-conservative behavior is to move among existing territory holders (like a pinball) until a suitable site is located. A more costly strategy is to attack and evict a territorial female.

When male/female ratios are low, males can move from one sexual partner to the next and consequently most of their instream movement, other than courtship activity or intrasexual aggression, will be searches for females. As the male/female ratio increases, intrasexual competition for females can change the amount of time some males will have to spend searching for females. Male chum salmon use physical force—open mouth rushes, bites, and body blocks to exclude or usurp sexual rivals from females. Occasionally, these displays escalate into ritualized battles complete with stereotypic displays. The ability of a male to win these contests and otherwise defend or obtain new mates depends primarily on his relative size and to a lesser extent, his physical condition. When there is such competition among the male, smaller males must resort to other tactics. These so-called satellite males assume the coloration of females (horizontal dark lines, they can change this coloration almost instantaneously) to avoid being chased off by the dominant male. Generally, there will be one or two satellite males and there is a hierarchy among the satellite males. These males detect when egg release occurs and they dart up to the spawning pair and release milt, sometimes fertilizing up to 25% of the eggs. Typically 2 or 3 different fish succeed in fertilizing a portion of the eggs (Schroder, S.L. 1981 the role of sexual selection in determining overall mating patterns and mate choice in chum salmon. PhD. Dissertation, Univ. of Washington. Seattle, 274p.)