VIII.3 Fish habitat needs

"The falling waters led me, the foodful waters fed me."
— Ralph Waldo Emerson

Though the physical characteristics of a stream largely determine its ability to produce fish, survival of each new hatch is governed by many environmental factors. A relatively stable water flow, free of pollutants is important for a productive stream.

Anadromous salmonids use a variety of streams. Although each species has its own specific habitat requirements, some generalizations can be made.

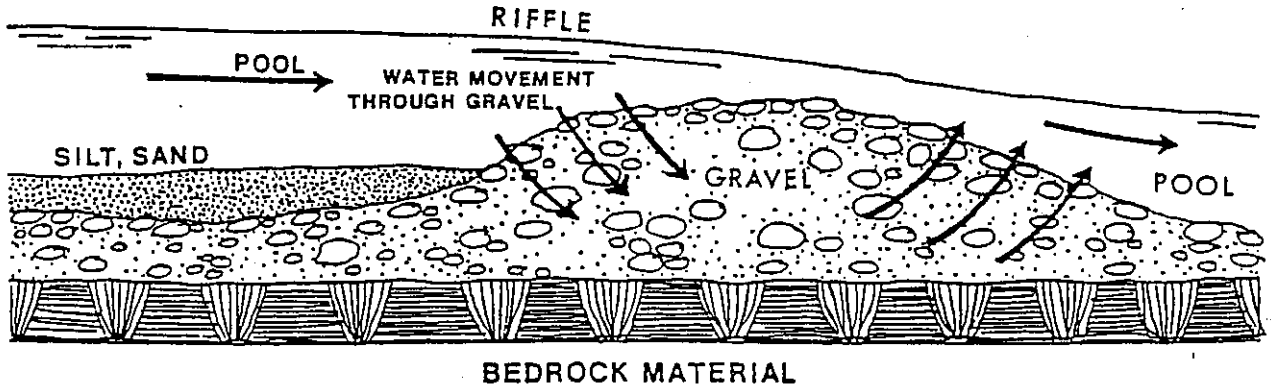
Spawning habitat

Successful spawning and development from egg to fry stages requires the following:

- Absence of barriers to upstream migration of adults
- Spawning areas, usually in a riffle, with stable, porous, sediment-free gravel of the proper size and type
- A pool-to-riffle ratio that provides spawning areas and escape cover close to each other
- Constant flow of cool, well-oxygenated water through the spawning gravel

A relatively stable water flow free of pollutants is important for a productive stream.

For anadromous fish production to occur, fish must be able to move upstream to spawning areas. Log jams and other barriers can prevent this from happening. Fish can injure themselves trying to jump barriers or become weak and



Adapted from: Province of British Columbia, Ministry of Environment, *Stream Enhancement Guide*, Vancouver, B.C., 1980.

exhausted, reducing chances for successful spawning.

In ideal spawning habitat, cool, well-oxygenated water flows freely through the gravel areas. For this to happen, spawning beds must be relatively sediment-free. The cleanest gravel is usually found at the tailout, or downstream end, of a pool. The streambed should be stable enough to withstand heavy flooding, which could disturb spawning beds.

Rearing habitat

As young fry leave the gravel to seek food, they are vulnerable to predators. High stream velocities can carry fry far downstream or strand them in floodplain pools. To enhance the survival of fry, pools for rearing, temperature regulation and cover should be close to each other. Productive juvenile rearing habitat should exhibit the following characteristics:

- Low to moderate stream gradient and velocity
- Diversity of pool and riffle habitat
- Variety of substrate types to provide habitat for juvenile fish and fish food organisms
- Undercut banks, stable natural debris, and overhanging vegetation to provide protection for juvenile fish, and leaf litter for aquatic insect production

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Facing upstream or into the current allows a fish to conserve energy while watching for food drifting downstream.

- Sufficient nutrients to promote algal growth and decomposition of organic material

As young salmonids grow, they seek progressively higher velocities, often moving from the edge of a stream to midstream to take advantage of increased insect drift. Facing upstream or into the current allows a fish to conserve energy while watching for food drifting downstream.

In winter, all species seek areas of lower water velocity. This helps conserve energy while food and growing conditions are poorer, enabling fish to better cope with winter extremes.

Habitat preferences

Though basic requirements are the same, salmonid species differ in types of habitat they use. For example, juvenile coho choose pool areas of moderate velocity in summer. They prefer eddies or backwaters near an undercut bank, root wad or log. In winter, they are found in slow, deep pools or side channel areas, seeking cover under rocks, logs and debris.

Rearing densities can increase dramatically where good streambank recovery has occurred.

During winter, spring chinook use riparian edges where vegetation has grown into a stream, providing cover and shelter. Streambanks must be covered with vegetation to provide this feature. Broken or degraded streambanks do not provide suitable winter habitat for young fish. Rearing densities can increase dramatically where good streambank recovery has occurred.

Juvenile steelhead spend from one to three years in fresh water, and their habitat needs must be considered throughout that time. In the first summer after hatching, young steelhead stay in relatively shallow, cobble-bottomed areas at the tail of a pool or shallow riffle. In winter, they hide under large boulders in shallow riffle areas.

Older steelhead juveniles prefer the heads of pools and riffles with large boulder substrate and woody cover in the summer. The turbulence created by this substrate is also important cover

Table 2. Salmonids and Physical Stream Characteristics

Physical stream characteristics useful in differentiating habitat preferences of salmonids.

Habitat preference	SPECIES			
	Coho	Chinook	Steelhead	Cutthroat
% pools	50–80	50–100	< 50	40–60
% gradient	<3	< 2	>1–5	1–20
Stream order	2–5	≥ 5	2–5	> 2
Maximum temperature	<65°F 18°C	< 68°F 20°C	< 73°F 23°C	< 65°F 18°C

Physical stream characteristics useful in evaluating stream quality preferences for salmonids.

Characteristics				
Cover	woody structure	pool depth	boulders & wood	wood, volume, boulders
Channel profile	flat	moderately flat	steep	undercut banks
Riparian	Presence of riparian vegetation important for all species. Vegetation type (fir, alder) and age of vegetation determine quality.			

in these areas. During winter, older steelhead juveniles are found in pools, near streamside cover and under debris, logs or boulders.

Cutthroat habitat requirements are similar to those of steelhead, and although chinook juveniles tend to rear in large streams, their requirements parallel those of coho.

Limiting factors

Limiting factors must be considered for all phases of a salmonid's life cycle. The quantity and quality of riffle areas and spawning gravels in a stream are limiting factors for spawning production. The quantity and quality of juvenile nursery areas or pools is a limiting factor for rearing juvenile salmonids and producing smolts ready for migration to the ocean.

Limiting factors establish the salmonid carrying capacity of a stream.

When spawning grounds are limited, excessive numbers of adults in spawning beds dislodge previously deposited eggs. If too many juveniles exist in rearing areas, competition for food and space force some to move into less suitable areas. These areas may have limited food and shelter from predators.

These limiting factors establish the salmonid carrying capacity of a stream. Within the limits of the habitat available, salmonid populations fluctuate from year to year because of varying environmental factors.

Streamflow, for example, causes wide variations in survival and production of coastal salmonid populations. Extended low flows may keep adults from moving into streams, drain their limited energy reserves and affect upstream distribution and spawning success. High winter flows can destroy eggs and alevins by scouring spawning beds or depositing sediments. Low stream flows during winter incubation periods can cause

exposure and freezing of spawning beds. Low summer flows often not only increase temperatures, but also reduce rearing areas for juveniles.

Stream temperatures may also affect survival indirectly. Abnormally high temperature conditions during migration have contributed to outbreaks of disease among adults, causing them to die before spawning. High winter temperatures increase the rate of development from egg to fry, and may cause fry to emerge from the gravel before the spring increase in food supplies.

A critical issue in eastern Oregon is the buildup in streams of heavy ice (anchor ice). Anchor ice can trap fish in pockets where they freeze and die. Healthy riparian systems and stable streambanks help to reduce heavy anchor ice and winter mortality of juvenile fish.

Recommended habitat conditions

As a stream is surveyed and analyzed, these habitat needs and limitations must be considered to ensure the best possible management of the resource. Table 2 lists habitat and stream quality preferences of various species of salmonids. These preferences are useful in determining which salmonids are best suited for particular streams.

Following is a list of other conditions that may improve the quality of fish habitat in streams. This list was prepared by the Riparian Habitat Subcommittee of the Oregon and Washington Interagency Wildlife Committee. Included is an explanation of how each contributes to salmonid health and survival.

Between 60 and 100 percent of a stream surface should be shaded from June to September during the hours of 10:00 A.M. to 4:00 P.M.

- Solar radiation is greatest during this season and time of day. Streamside vegetation provides shade to keep water temperatures from becoming lethal during hot summer months. Streambank vegetation is also important habitat for terrestrial insects and is the main nutrient source for aquatic insects. These are both important sources of fish food. Shade is most important on small streams (less than 50 feet wide). Water depth and turbulence help compensate for the lack of shade on large streams.

Stream banks should have 80 percent or more of their total linear distance in a stable condition.

- Stable, well-vegetated streambanks help maintain stream channel integrity. They provide cover for fish and reduce temperature increases from solar radiation. In winter, they keep water temperatures slightly warmer, reducing ice buildup and decreasing winter mortality of juvenile fish. Sediments from streambanks are reduced, protecting the water quality of the entire system. Vegetation reduces bank erosion and helps hold the soil in place. Sediments are trapped and mature grasses and forbs form a strong sod.

No more than 15 percent of stream substrate should be covered by inorganic sediment.

- Aquatic insects, developing salmonid eggs and recently hatched fry still in the gravel depend on a continuous supply of cool, oxygen-rich water for survival. Fine sediments in large amounts clog the spaces between gravels. This prevents water from percolating through and causes fish and insect mortality. If pools are filled with sediments, rearing and hiding habitat is reduced or eliminated.

Adapted from: Province of British Columbia, Ministry of Environment, *Stream Enhancement Guide*, Vancouver, B.C., 1980; and Riparian Habitat Subcommittee of the Oregon/Washington Interagency Wildlife Committee, *Managing Riparian Ecosystems (Zones) for Fish and Wildlife in Eastern Oregon and Eastern Washington*, Portland, December 12, 1978.

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