SENATE BILL SB 838 by Michael Hunter

Dear Senator ,

Please do not support this SB 838.

It is an outright attempt to duplicate the recent California ban on motorized gold mining. A 5-year moratorium is fully sufficient to put all related business and small-scale miners out of business. The term "moratorium" is a smoke screen to supposedly allow NEW study on the effects of small miners using any power driven pumps or suction devices. Please reject this bad bill, as there are already dozens of studies that show the above activities have no impact on fish or stream water quality. The 5-year moratorium is a farce to do another new study, which is NOT NEEDED. Please use the scientific studies that are available to make an informed decision.

At the April 15th 2013 hearing I will present a US Fish and Wildlife study from 1987 defining the Northwest Coho Salmon spawning profile. It clearly depicts the time frame, which could endanger the salmon starting at migration from the oceans to egg lay, hatch, and to smolts' return to large river/estuaries (placer miner does not occur during any of this time). I also added a note of a 2011 study from the California Fish & Wildlife which stated that small dredges that move about 3 cubic yards of material daily and are POWERED by engines between 5 & 8 HP considered individually and collectively to have an INSIGNIFICANT impact compared to the forces of nature. This supports the above Federal study that salmon mortality is connected to water levels and predators, not dredge mining. California legislators chose to ignore their own state F & W study to impose the ban on an industry that has no impact on fisheries.

I also will include the recent US Supreme Court ruling about the definition of pollutants. Currently Oregon regulatory agencies define dredge mining material/silt movement in the streambed as a "pollutant". The new Supreme Court clearly define a pollutant to - mean any "ADDITION", clarifying that material that is local and not introduced is not a pollutant.

I own a registered mineral claim in Oregon. I have an investment and the rights to extract minerals from this property. The Oregon Constitution guarantees a safeguard against encroachment on any lawful owned property rights. Please be advise the California power equipment mining ban has resulted in a large number of lawsuits filed by those persons and companies that have had property/mineral rights curtailed by the law. I foresee the same actions resulting in Oregon if this SB 838 is enacted. This is a tremendous waste of taxpayer monies to defend a frivolous and un-necessary law.

Please use good scientific information before enacting any more laws claiming to enhance salmon recovery by banning mining activity, which by study after study has shown not to be a problem. Please enter this information into the official records.

NOT A POLLUTANT, LEGISLATIVE AND REGULATORY UPDATE

ICMJ Prospecting and Mining Journal, February 2013, page 3.

A recent US Supreme Court ruling regarding the transfer of "pollutants" from one portion of a river to another is a win for miners.

The Natural Resources Defense Council sued the Los Angeles County Flood Control District, alleging the county was polluting a stream when it took polluted water from one portion of a river and transferred it to another portion of the same river through a concrete channel.

The Ninth Circuit had ruled that the water transfer violated the Clean Water Act. In a unanimous decision, the US Supreme Court reversed the decision of the Ninth Circuit.

The Court stated, "...the transfer of polluted water between two parts of the same water body does not constitute a discharge of pollutants under the CWA. 541 U. S., at 109-112. We derived that determination from the CWA's text, which defines the term 'discharge of a pollutant' to mean **'any addition of any pollutant to** navigable waters from any point source.' 33 U.S.C. §1362(12). Under a common understanding of the meaning of the word 'add,' no pollutants are 'added' to a water body when water is merely transferred between different portions of that water body."A link to the decision is available on our website under the Legislative and Regulatory Update column for February 2013.

One of the major regulatory tools agencies have used against in-stream placer miners-and suction dredgers in particular-has been struck down by this decision!

Other courts have also blocked overzealous water regulators In Virginia, District Judge Liam O'Grady ruled that the EPA exceeded its authority by attempting to regulate storm water runoff as a pollutant

And in Siskiyou County, California, Superior Court Judge Karen Dixon found that the California Department of Fish & Game overstepped its authority by requiring permits for farmers and ranchers to take water from the Shasta and Scott Rivers.

NORTHWEST SALMON SPAWNING PROFILE

Species Coho:

Enter stream during high water - under favorable conditions in July –November or later

Lay eggs in riffle small gravel pocket/redd. Several females' use same redd.
Eggs hatch in 35 to 50 days depending on water temperature
Larva in gravel about 2 -3 weeks before emerging
Fry start downstream before March/ May - holding in deep pools
Smolt rapid growth - remaining in fresh water from a few weeks to 2 years in estuaries
Most return to ocean in April or May
Survival rate - about .03 % - from egg to adult.
Major mortality is from predators and low water years.

Placer gold dredging ceases in September and resumes about May in Oregon.

No dredging occurs during salmon egg laying or larva hatch time. Most salmon/smolt are well advanced downstream before dredging occurs.

Additional Note → The suction dredge survey 2011 by the California Dept. of Fish and Wildlife determined that small dredges that move about 3 cubic yards of material daily and are **POWERED** by engines between 5 & 8 horsepower pumps considered individually and collectively to have an **INSIGNIFCANT** impact compared to the forces of nature.

Michael Hunter
503-502-2382

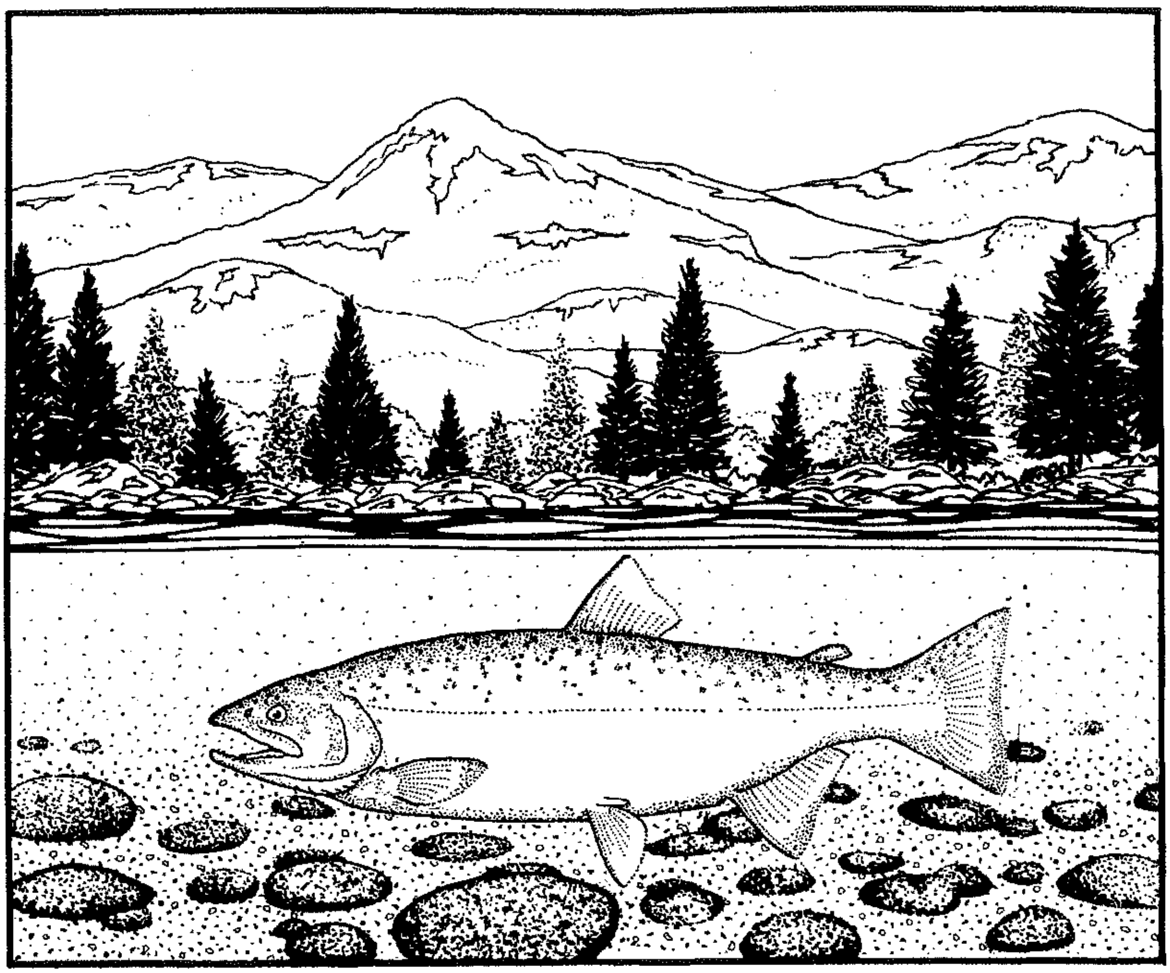
Please include this in the Record.

Biological Report 82 (11.70)
August 1987

TR EL-82-4

Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest)

COHO SALMON



Fish and Wildlife Service
U.S. Department of the Interior

Coastal Ecology Group
Waterways Experiment Station
U.S. Army Corps of Engineers

Biological Report 82(11.70)
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Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest)

COHO SALMON

by

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Waterways Experiment Station
U.S. Army Corps of Engineers
Vicksburg, MS 39180

and

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Fish and Wildlife Service
Research and Development
National Wetlands Research Center
Washington, DC 20240

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This profile may be cited as follows:

Hassler, T.J. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--coho salmon. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.70). U.S. Army Corps of Engineers, TR EL-82-4. 19 pp.

PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Boulevard
Slidell, LA 70458

or

U.S. Army Engineer Waterways Experiment Station
Attention: WESER-C
Post Office Box 631
Vicksburg, MS 39180

CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
meters (m)	0.5468	fathoms
kilometers (km)	0.6214	statute miles
kilometers (km)	0.5396	nautical miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters (m^3)	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons (t)	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees (°C)	1.8(°C) + 32	Fahrenheit degrees

U.S. Customary to Metric

Multiply	By	To Obtain
inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
statute miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
square miles (mi^2)	2.590	square kilometers
acres	0.4047	hectares
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28350.0	milligrams
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
pounds (lb)	0.00045	metric tons
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees (°F)	0.5556 (°F - 32)	Celsius degrees

CONTENTS

ACKNOWLEDGMENTS

I gratefully acknowledge the review by Thomas McMahon of the Canada Department of Fisheries and Oceans, Nanaimo, B.C. The original drawing, used with permission as Figure 1 in this profile, was produced for the following publication: McPhail, J.D., and C.C. Lindsey. 1970. Freshwater Fishes of Northwestern Canada and Alaska. Bull. Fish. Res. Board Can. 173:381 p.

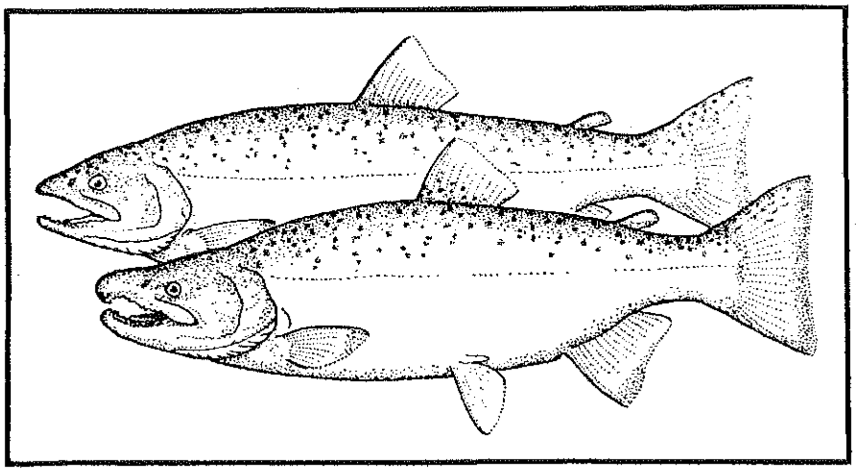

Figure 1. Coho salmon adults, with spawning phase of male at the bottom (Scott and Crossman 1973).

COHO SALMON

NOMENCLATURE/TAXONOMY/RANGE

Scientific name . . . . . Oncorhynchus kisutch (Walbaum)
Preferred common name . . Coho salmon (Figure 1)
Other common names . . Silver salmon[1], coho, sea trout, blueback, jack salmon, hooknose, silversides (Shapovalov and Taft 1954; Scott and Crossman 1973; Fry 1979)
Class . . . . Osteichthyes
Order . . . . Salmoniformes
Family . . . . Salmonidae

Geographic range: Anadromous along the Pacific coast from Chamalu Bay, Mexico (Miller and Lea 1972), to Point Hope, Alaska, through the Aleutians, and from the Anadyr River, U.S.S.R., south to Hokkaido, Japan. Most abundant between Oregon and southeast Alaska (Hart 1973). Coho salmon have been introduced (with various degrees of success) into lakes and reservoirs in Alaska, Washington, Oregon, California, Montana, and Alberta, Canada; in the Great Lakes, first successful stocking in 1966; along the Atlantic coast from Maine to Maryland; in Chile and Argentina (Scott and Crossman 1973). Major spawning rivers in the Pacific Southwest Region are shown in Figure 2. Coho salmon were rare in the Sacramento River system until the California Department of Fish and Game stocked large numbers of fry into the system in 1956-58 (Hallock and Fry 1967). Coho salmon returned to spawn but did not maintain a natural run; the fish have again become scarce and

[1] In California the "official" common name is silver salmon. In the rest of the United States and in Canada coho salmon is used. The California State Legislature had declared "silver" to be official before there was general agreement elsewhere.

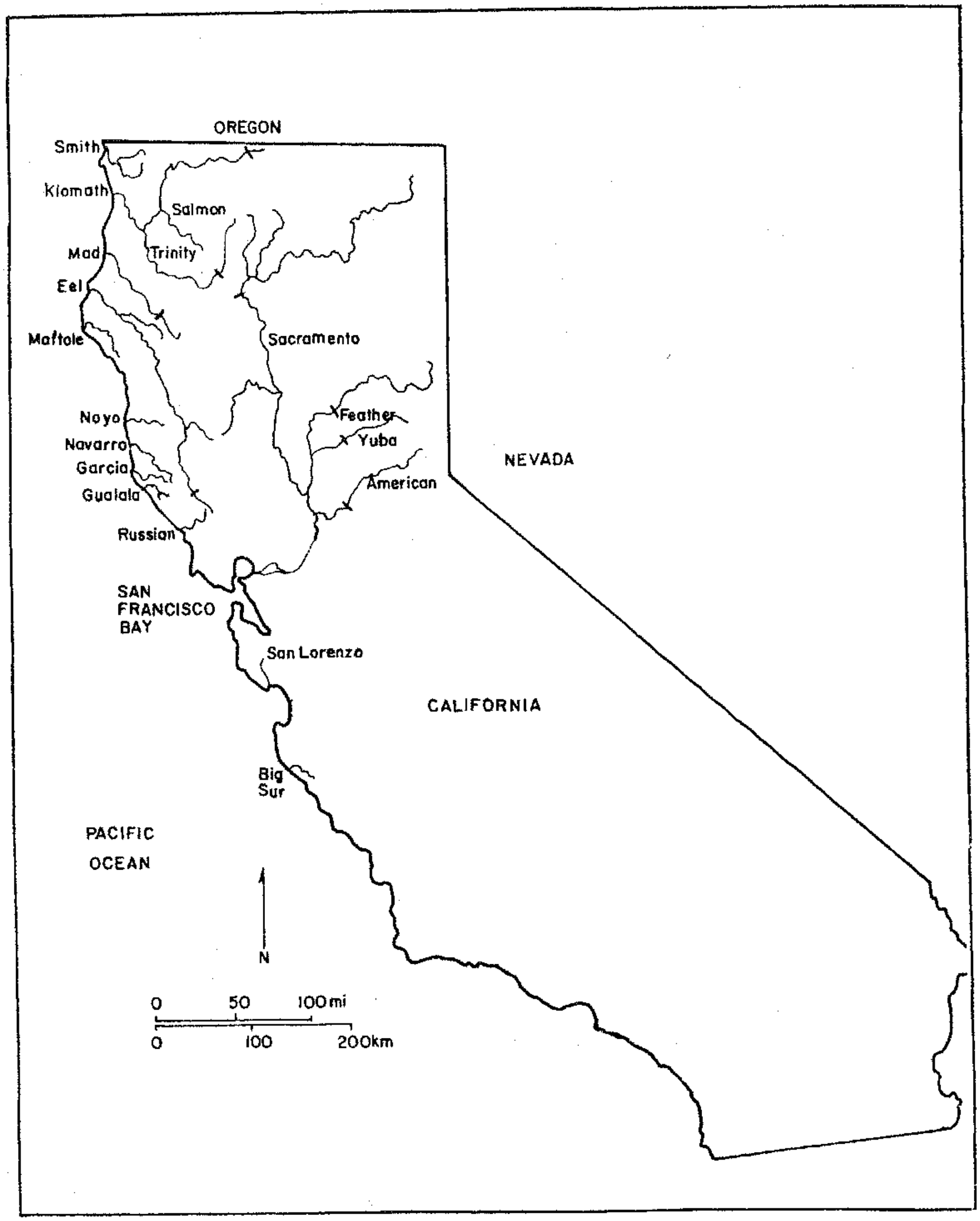

Figure 2. Major spawning rivers of coho salmon in the Pacific Southwest; the species is found in all marine waters of the region (Berger 1982). Short lines perpendicular to rivers represent impassable barriers.

any that enter the Sacramento River should be regarded as strays. Coho salmon do not enter the San Joaquin River.

MORPHOLOGY AND IDENTIFICATION AIDS

Meristic characters: dorsal 9-13, anal 13-16, pectoral 13-16, pelvic 9-11 with axillary process; adipose small, slender, and fleshy, caudal only slightly indented; cycloid scales, 121-144 in lateral line row; pyloric caeca 45-83; gill rakers 19-25 on lower limb of first gill arch; branchiostegal rays 11-15; vertebrae 58-66 (Shapovalov 1947; Miller and Lea 1972).

Body fusiform, laterally compressed; fork length (FL) usually 41 to 64 cm, maximum 80 cm (Shapovalov and Taft 1954), and weight to 13.6 kg but not usually over 6.8 kg (Rodel 1953).

The juveniles are blue-green on the back, and have silvery sides and 8-12 parr marks narrower than the interspaces; lateral line passes through parr marks; dark pigmented adipose fin; anal fin pigmented between rays resulting in black banding; orange tints on anal, pectoral, and pelvic fins (McConnell and Snyder 1972; Scott and Crossman 1973). Adults in ocean are steel-blue to greenish dorsally; sides silvery, and ventral surface white; small black spots on back, upper sides, base of dorsal fin, and upper lobe of caudal fin. Maturing males become darker, develop a bright red stripe on otherwise dull sides, and are gray to black ventrally (Scott and Crossman 1973).

Adult coho salmon have a white gum line (through which teeth project) that distinguishes them from chinook salmon (_Oncorhynchus tshawytscha_), which have black gums. Dark spots on the back, dorsal fin, and upper lobe of tail distinguish coho salmon from chum salmon (_O. keta_) and sockeye salmon (_O. nerka_); the low pyloric caeca count (≤ 83) separates the coho from any salmon except the sockeye (Fry 1979).

REASON FOR INCLUSION IN SERIES

The coho salmon supports valuable commercial and sport fisheries in the Pacific Southwest Region. According to the Pacific Fishery Management Council (PFMC), the sport fishery accounted for 58% of the total catch of coho salmon along the California coast in 1985 (PFMC 1986). Coho salmon are anadromous and thus occupy freshwater, estuarine, and oceanic habitats. They are extensively reared in hatcheries for release.

LIFE HISTORY

Migration and Spawning

In the Pacific Southwest, coho salmon enter small coastal streams and rivers from the Monterey Bay area northward to the Smith River (Fry 1960; Berger 1982). They begin to enter freshwater in September (Snyder 1931) but usually enter from October to March, peaking in December and January (Shapovalov and Taft 1954). Many small coastal streams in California are closed by sand bars at their mouths during a portion of the year, and fish cannot enter the stream until the bar is broken by the first heavy rains of the rainy season. In late summer and fall, coho salmon may thus concentrate in the ocean near these streams.

The homing of salmon to their natal stream after they enter freshwater is well documented and is attributable to olfactory cues that are specific for each location and are "learned" by juvenile salmon shortly before they migrate to the sea (Hasler and Wisby 1951; Hassler and Kucas 1982; Hasler and Scholz 1983). Homing may also be influenced by inheritance (Bams 1976).

In California, upstream migration of coho salmon coincides with large increases in streamflow, especially in streams in which the flow is low in summer. The fish move rapidly upstream but stop if streamflow suddenly drops. A small rise in flow then causes the fish to move again. They migrate upstream mainly in daytime, and do not travel more than 240 km above the mouth of the stream (Shapovalov and Taft 1954). Spawning usually peaks from November to January. Coho salmon spawn in riffles at temperatures of 6 to 12 ^{0}C (Briggs 1953; Shapovalov and Taft 1954). On the spawning grounds, males are more abundant than females, due to the presence of jacks (sexually precocious males); however, the numbers of females and older males are similar. Males are the more numerous in the early portion of the run and females in the later portion. Usually more than one male spawns with a female (Shapovalov and Taft 1954).

The fecundity of coho salmon varies with size of female, area, and year. Hart (1973) reported fecundity of 2,500-5,000 eggs for females 55-70 cm long in British Columbia, and Scott and Crossman (1973) listed fecundity of 2,100-2,789 eggs per female (no lengths given) in British Columbia and 1,440-5,700 eggs for females 40-70 cm long in Washington. Shapovalov and Taft (1954) developed the following fecundity formula:

$$\text{number of eggs} = 0.01153 \times FL^{2.9403}$$

Female coho salmon choose a nesting site in gravel deposits at the lower end of a pool just above a riffle (Briggs 1953; Shapovalov and Taft 1954). The female prepares a redd (an area containing several egg pockets or nests) by turning on her side and repeatedly flexing her body and tail to force gravel and fine sediments into the water column; these sediments are deposited a short distance downstream. The completed egg pocket forms an oval depression (pit) with a mound of gravel located immediately downstream.

During spawning, a dominant male salmon accompanies the female and chases away other males from the redd area. The male positions himself beside the female, both face upstream, and the eggs and sperm are released into the pit. One or more males position themselves beside the female opposite the dominant male and also release sperm (Briggs 1953; Scott and Crossman 1973). After the eggs are released, the female moves slightly upstream and repeats the nest building and spawning act. This process is repeated several times before spawning is completed in 2-7 or more days (Briggs 1953; Shapovalov and Taft 1954). A completed redd (containing several nests) covers an area of 1.7 to 5.2 m^2 (Buck and Barnhart 1986). The eggs are immediately covered with 18 to 38 cm of gravel displaced from the upstream side of the nest (Briggs 1953). The female may guard the nest for up to two weeks or until she becomes too weak to maintain a position against the current (Briggs 1953). Both the male and female die after spawning.

Eggs and Larvae

Coho salmon eggs are large, orange-red, and demersal. Scott and Crossman (1973) reported egg diameters of 4.5-6.0 mm for west coast populations; Rounsefell (1957) derived a diameter of 7.2 mm from data published by Shapovalov and Taft (1954).

The time required for coho salmon eggs to hatch is inversely related to water temperature. Shapovalov and Taft (1954) reported that eggs usually hatched in 35-50 days at the temperatures prevailing in Waddell Creek, California; in hatcheries they reported hatching in about 38 and 48 days at average temperatures of 11 ^{o} and 9 ^{o}C. Laufle et al. (1986) reported that 86-101 days were required at 4.5 ^{o}C.

Coho salmon larvae start emerging from the gravel 2-3 weeks after hatching, and continue to emerge for an additional 2-7 weeks (Shapovalov and Berrian 1940). The larvae have a large yolk sac, which they absorb while they are still in the gravel. The larvae are initially photonegative, but become photopositive as they approach emergence (Dill 1969).

Fry and Smolts

Coho salmon fry usually emerge from the gravel at night from March to May. The fry move to shallow gravel-bottomed areas near the banks of the stream, where they form schools. As the fry grow, they disperse upstream and downstream and select and defend a territory, often in relatively deep pools with overhanging logs (Shapovalov and Taft 1954). In summer, coho salmon fry prefer a mixture of different types of pools and riffles with large woody debris, undercut banks, overhanging vegetation, glides, average water temperatures of 10 to 15 ^{o}C, dissolved oxygen near saturation, and riffles with little sediment (Reiser and Bjornn 1979; Tschaplinski 1982; Murphy et al. 1984). In winter, juveniles prefer large mainstream, backwater, and secondary channel pools containing large woody debris, and undercut banks and debris along riffle margins (Murphy et al. 1984; Heifetz et al. 1986).

Coho salmon fry begin feeding as soon as they emerge from the gravel, and grow rapidly. In California, beginning in July and August, fry moved into deep pools, where feeding was reduced, and growth rate decreased (Shapovalov and Taft 1954). The period of decreased growth of fry was associated with the period of maximum stream temperature and minimum stream flow. The fry fed lightly and grew little during the rainy season (December-February) but grew rapidly in March. Rising water temperature and abundant food were associated with the increased feeding and growth.

Coho salmon stay in freshwater for a few weeks to 2 years, depending on area (Scott and Crossman 1973). In California, most of the fish migrate to the ocean in April and May, about a year after they emerge from the gravel. A few migrate as age 0 fish, but contribute few or no fish to the adult population (Shapovalov and Taft 1954). Migrating fish (mean fork length, 103-117 mm) move downstream in schools at twilight and at night.

In some areas of the Pacific northwest, coho salmon fry rear in estuaries. In southeast Alaska (Porcupine Creek-Steamer Bay Estuary) coho salmon fry entered the stream/estuary ecotone (salinity 8-25 ppt) in spring and reared there during summer, growing faster than in freshwater areas upstream (Murphy et al. 1984). Most fish moved out of the estuary area to upstream freshwater areas to overwinter. In Carnation Creek (Vancouver Island, B.C.) coho fry entered the estuary (salinity to 20 ppt) in spring and reared to fall, having high rates of survival and growth (Tschaplinski et al. 1982). In fall, most fish emigrated seaward with the first seasonal freshets. Coho fry that reared in the estuaries contributed to the populations of spawning fish which returned to the systems.

Coho salmon fry undergo a characteristic transformation from parr to smolts before they migrate to the ocean. Distinct morphological, physiological, and behavioral changes accompany this transformation (Hoar 1976; Folmar and Dickhoff 1980). The onset of smoltification and migration is associated with fish age and size, and environmental conditions -- primarily increasing day length and water temperature (Wedemeyer et al. 1980). The characteristic changes associated with smoltification and migration are reversible if coho salmon are prevented from entering seawater (Zaugg and McLain 1970; Woo et al. 1978).

Ocean Residence

The oceanic migration patterns and ocean harvest distributions of adult coho salmon along the North American Pacific coast, as judged by recoveries of marked smolts and coded-wire tags (Figures 3 and 4), indicate that coho salmon remain closer to their river of origin than do chinook salmon, but may nevertheless travel several hundred miles. For example, marked coho salmon from Waddell Creek, California, were caught 322 km to the north (Taft 1937), and others have been captured as far as 1,930 km from their point of origin (Laufle et al. 1986). Coho salmon are pelagic and readily move and disperse from one marine area to another (Fraidenburg et al. 1985). Along the California coast, coho salmon probably remain within the limits of the Continental Shelf or within about 160 km from shore (Shapovalov and Taft 1954).

Adult coho salmon usually spend two growing seasons at sea before they return to freshwater to spawn. At Waddell Creek, California, Shapovalov and Taft (1954) found that the fish returned either as precocious males (16% of run) in the season after downstream migration (i.e., after one growing season in freshwater and one in the ocean), or as females and males (84% of run) in the second season after downstream migration (after one growing season in freshwater and two in the ocean).

Factors that influence the return of adult salmonids to their natal streams are among the least understood facets of salmon biology. Biologists believe that high seas navigation is innately controlled, and that the role of extrinsic environmental factors increases in importance as the salmon approach their home estuary (Brannon 1981). Orientation in the ocean is believed to involve magnetic and celestial information, interpreted by the innate latitudinal and calendar senses of the fish (Brannon 1981; Quinn 1981). The length of day, rate of change in day length, sun position, and light polarization are suggested cues. Nearshore migration may be enhanced by onshore winds that concentrate river water close to shore, where olfactory cues further guide the salmon (Banks 1969).

Survival

Survival of coho salmon varies by area and year. At Waddell Creek, California, the estimated survival was 1.16% to 1.56% from eggs to smolts, 0.98% to 7.72% from smolts to adults, and 0.02% to 0.30% from eggs to adults (Shapovalov and Taft 1954). Murphy (1952) developed a method for estimating survival of coho salmon in California during their last year of ocean life. The applications of his method to coho salmon counts (1939-50) at Benbow Dam Counting Station (South Fork, Eel River) yielded estimates of third-year survival of 16% to 57%. Jensen and Hyde (1971) modified the method for situations where the sex ratio was other than 1:1. The Washington Department of Fisheries predicted an average production of 75 smolts per female coho salmon (Laufle et al. 1986). The prediction applied only to 3-year-old fish that spent 2 years at sea south of central British Columbia.

GROWTH CHARACTERISTICS

In California, coho salmon migrate to the ocean at age 1 and return to freshwater either as precocious males in the season after downstream migration (age 1/1 -- one

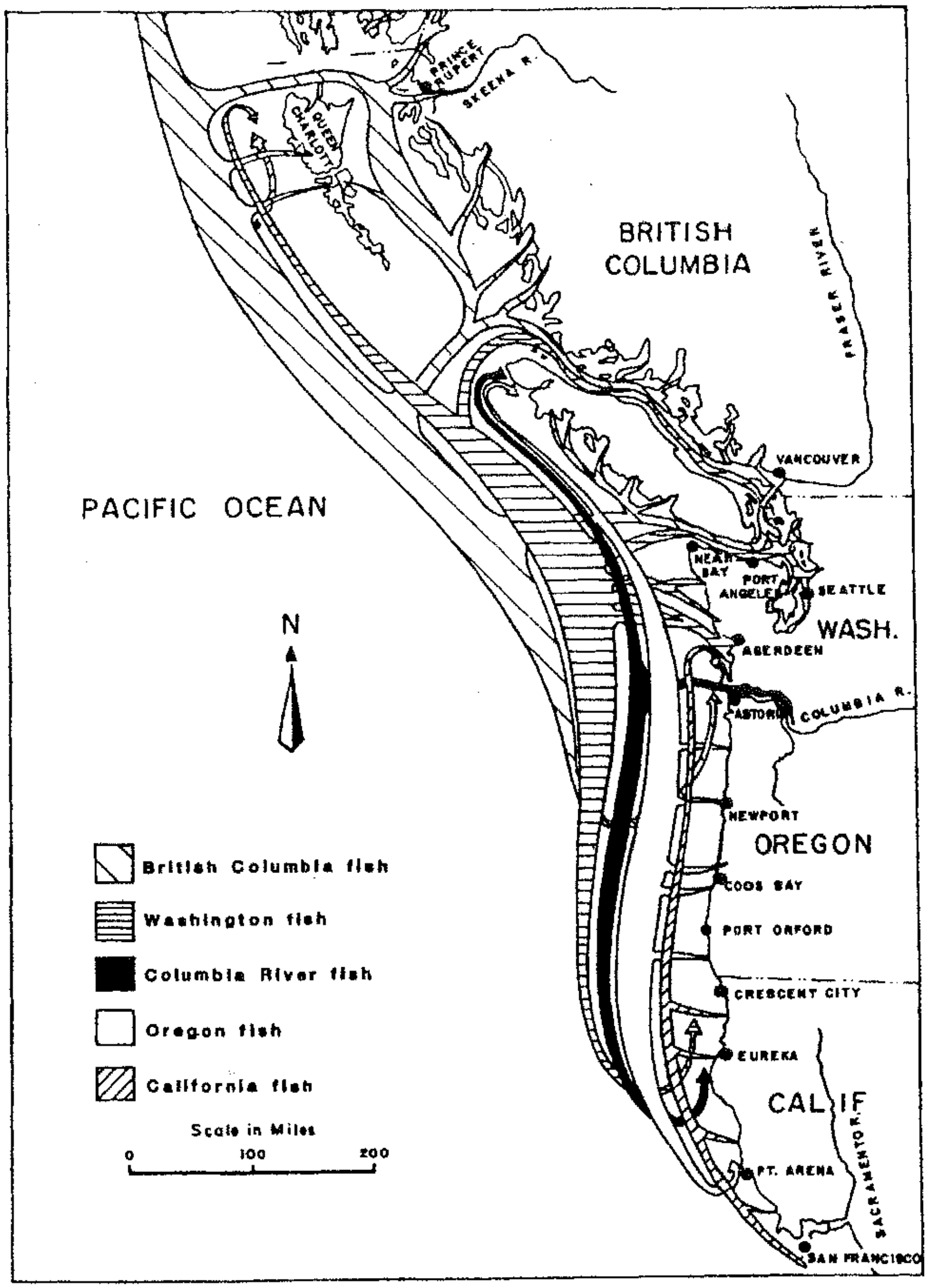

Figure 3. Oceanic migration patterns of adult coho salmon along the west coast of British Columbia, Washington, Oregon, and northern California, as determined from tagged and marked hatchery smolts (Wright 1968).

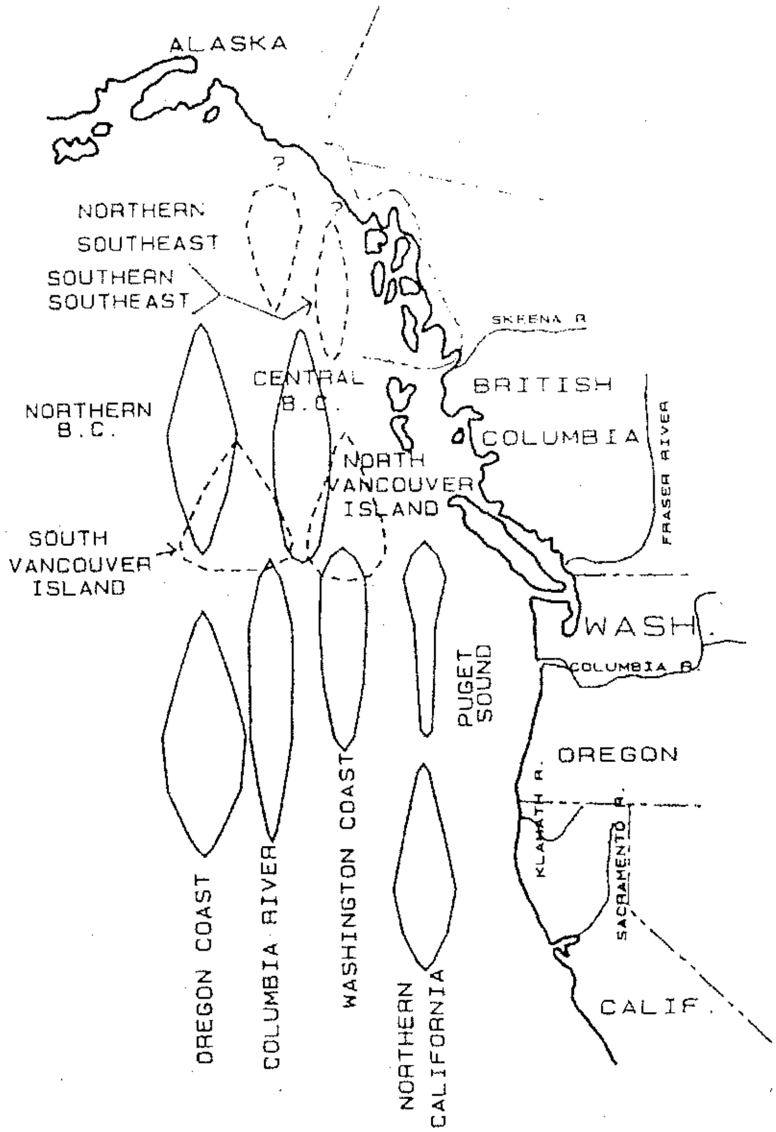

Figure 4. North-south ocean harvest distribution of coho salmon stocks in ocean fisheries, based on recoveries of coded-wire tags. This figure is meant to show the extent of north-south overlap in stock distributions and does not represent east-west distribution. The width of each bar indicates the importance of the harvest in each area to a stock. Question marks indicate where harvest distribution is uncertain (Fraidenburg et al. 1985).

Columbia River) are managed for maximum use of hatchery production, consistent with the achievement of the annual escapement goal for Oregon coastal natural stocks (PFMC 1986). Attainment of this management objective requires that aquatic and riparian habitats that support coho spawning and rearing be protected, rehabilitated, and enhanced; that stock size be assessed, hatchery production be maximized (in quality and quantity), and ocean harvest rates be controlled (Oregon Department of Fish and Wildlife 1985). Wright (1981) suggested that the salmon fishery needs to be regulated for optimum yield. He believes that optimum yield may be reached by using area and season closures, minimum size limits, and gear restrictions. A more direct method would be through the establishment of limited entry or catch quotas. Oregon and Washington initiated a limited entry of new fishing boats into the existing fleet and California has a moratorium on their entry (PFMC 1984). Catch quotas have been instituted in Oregon, Washington, and California (PFMC 1987).

ECOLOGICAL ROLE

In freshwater, coho salmon and steelhead (*Salmo gairdneri*) are similar in geographic distribution, spawning locations, food habits, and the length of time the young spend in freshwater (Milne 1948), although steelhead usually remain in freshwater longer than 1 year. Hartman (1965) reported that in spring and summer, most coho salmon live in pools and most steelhead live in riffles. Several investigators have reported that the species also segregate by depth; coho salmon live near the stream surface and steelhead near the bottom (Hartman 1965; Peterson 1966; Edmundson et al. 1968; Bustard and Narver 1975). Although coho salmon hatch earlier and are larger at first, steelhead fry grow faster and by late summer the size difference is small. Interspecific competition is probably not serious because of the initial difference in size, differences in habitat preference, and the difference in age at emigration to the sea (Fraser 1969).

Coho salmon occupy fresh, brackish, and sea water habitats during different life stages. Yolk-sac larvae remain in the gravel for several weeks while they are nourished by the yolk. The fry begin feeding as soon as they emerge from the gravel, and grow rapidly. Coho fry feed mainly on drifting aquatic and terrestrial insects (Shapovalov and Taft 1954; Demory 1961; Mundie 1969; Scott and Crossman 1973). In Alaska, coho fingerling fed on sockeye salmon fry (*Oncorhynchus nerka*), even though sticklebacks were more abundant (Roos 1960).

Coho salmon grow rapidly in the ocean, where they feed on both invertebrates and fishes. The food of juvenile coho salmon along the Oregon and Washington coasts in 1980 comprised seven major prey groups (Emmett et al. 1986). In late May to early June, the salmon fed primarily on fish; crab larvae, calanoid copepods, and the gammarid amphipod *Artylus tridens* were of secondary importance. In early July, fish and the euphausiid *Thysanoessa spinifera* were the primary forage; crab larvae and hyperiid amphipods were secondary. In late August to early September, hyperiid amphipods and the pelagic gastropod *Limacina* sp. were the primary forage; crab larvae and fish were secondary. Diet overlap with juvenile chinook salmon was highest from late May to early June and lowest from late August to early September. During late May to mid-July, chinook and coho salmon ate similar fish species as the primary prey but during late August to early September, proportionally more fish were eaten by chinook salmon than by coho salmon, which ate more *Limacina* sp. The growing season in freshwater and one in the ocean) or as females and males in the second season after downstream migration (age 1/2 -- two growing seasons in the ocean). (An alternate method of expressing these ages yields 2_2 and 3_2, where the integer is total age and the subscript is year of life at outmigration.)

In California, coho salmon average 10.3 to 11.7 cm FL at outmigration. The fish average 40.6 cm at age 1/1 (all males), 64.7 cm at age 1/2 (males), and 63.9 cm at age 1/2 (females) when they return to spawn (Shapovalov and Taft 1954).

THE FISHERY

Coho salmon are consistently caught along the California coast from the Monterey Bay area to Oregon. Trolling in ocean waters is the only form of commercial fishing permitted in California. Gill netting was permitted in the Klamath and Smith rivers until the early 1930's and in the Sacramento River until 1957 (Fry 1977). Sport fishing for salmon is permitted in the ocean and in river systems that have a salmon run. However, parts of some river systems and some tributaries are closed to salmon fishing.

Coho salmon provide an extensive commercial and sport fishery along the California coast (Table 1). Along the Pacific coast (California, Oregon, Washington) in 1976-85, nearly 13% of the estimated total coho salmon catch by trolling and 4% of the sport catch were caught off California (PFMC 1986). The average ex-vessel value of coho (expressed in 1985 dollars) ranged from $3.12 per pound in 1979 to $1.57 per pound in 1985, and the annual dressed weight value of the catch ranged from $3,276,000 to $125,000 (PFMC 1986). The ocean sport fishery effort (number of angler trips) was 185,600 in 1985 and 123,600 in 1984, and averaged 242,200 in 1971-75.

Table 1. Annual ocean commercial (troll) and sport catch of coho salmon (thousands of fish and thousands of pounds) off California (PFMC 1986).

	Catch by commercial trolling		Sport catch
Year	Numbers	Pounds[a]	Numbers
1976	622	2,844	58
1977	45	283	14
1978	316	1,295	41
1979	184	1,198	15
1980	50	302	21
1981	84	477	9
1982	92	552	26
1983	60	266	28
1984	47	349	19
1985[b]	11	81	15

[a]Dressed weight.
[b]Preliminary.

The Pacific Fishery Management Council manages coho salmon as a unit in a region extending from Leadbetter Point, Washington (about 40 km above the mouth of Columbia River), to the U.S.-Mexico border. The area is referred to as the Oregon Production Index (OPI) area. Coho salmon in the OPI area, which originate in the Columbia River and in Oregon and California coastal streams and hatcheries, are intermixed in the ocean and contribute to fisheries off the southern coast of Washington and the coasts of Oregon and California. Most of the production of coho salmon in California is from hatcheries, which produce about 1 million of the 63 million juvenile coho salmon produced annually in hatcheries in the OPI area (Greenley 1985).

Coho salmon fisheries in California and Oregon (south of the intensity of feeding (as measured by percent stomach fullness) increased for coho salmon from May to September. Peterson et al. (1982) found that the major food of juvenile coho salmon along the Oregon Coast was the euphausiid *T. spinifera*, hyperiid amphipods, and fishes. The diet overlap between juvenile chinook and coho salmon was also high.

Mortality of coho salmon may be high during emergence and downstream migration. Shapovalov and Taft (1954) suggested that the factors responsible for losses after the fish emerged in Waddell Creek included predators, drying stream channels, and disease. They stated that high water temperatures, pollution, and lack of suitable food also caused losses in other California streams. Predators in California streams, other than fish, included garter snakes and the American dipper, *Civilus mexicanus*. In west coast areas, coho salmon are attacked by lampreys and preyed on by larger coho, cutthroat trout (*Salmo clarki*), steelhead, Dolly Varden (*Salvelinus malma*), squawfish, and sculpins. Kingfishers, loons, mergansers, and other birds and small mammals sometimes eat juveniles (Scott and Crossman 1973). High seas predators of salmon are seals, sharks, sea lions, and other salmon.

Production of juvenile coho salmon in coastal streams varies with stream and year. Annual production rate in three Oregon streams for 4 consecutive years averaged about 9 g/m^2 per year (Chapman 1965). Monthly production was 1.9-2.8 g/m^2 after emergence, declined to 0.2-0.3 g/m^2 in winter, and then increased to 0.5-0.6 g/m^2 before emigration. Biomass averaged 5-12 g/m^2 just after emergence, and then declined and remained at about 2-4 g/m^2 until emigration of smolts the following spring. Monthly coho salmon production in a California stream from June to October over a span of 3 years averaged 0.05 g/m^2 (Burns 1971).

ENVIRONMENTAL REQUIREMENTS

Temperature

In California, coho salmon usually migrate upstream when stream flows increase and water temperatures are 4-14 °C, and spawn when temperatures are 6-12 °C (Briggs 1953; Shapovalov and Taft 1954). Coho salmon prefer cold water; 25.8 °C is their upper lethal limit (Table 2). Godfrey (1965) reported that coho salmon were caught in the ocean at water temperatures of 4-15.2 °C. Emmett et al. (1986), who determined food of juvenile coho salmon in the ocean from fish caught in a purse seine, indicated that feeding and water temperature may be related. The number of juveniles captured was smallest and the percentage of fish with empty stomachs highest when surface water temperatures had increased and averaged 15.2 °C.

Depth

Coho salmon spawn in 0.1-0.54 m of water in California (Briggs 1953; Buck and Barnhart 1986). As the fry grow they move into progressively deeper riffles and pools (Table 2).

Velocity

Water velocity in coastal streams may exceed the swimming ability of migrating coho salmon during storm runoff. Adults can migrate at water velocities of 2.44 m/s (Table 2) but are retarded at velocities of 3-4 m/s (Reiser and Bjornn 1979). In California, coho salmon spawn in water moving at velocities of 0.18-0.76 m/s (Briggs 1953; Buck and Barnhart 1986).

Dissolved Oxygen

Dissolved oxygen (DO) concentrations are important to all life stages of coho salmon. When DO was of $\leq$ 5 mg/L, the incubation period was lengthened and newly hatched fry were smaller than average (Shumway et al.

Table 2. Preferred habitat requirements for coho salmon in streams (Reiser and Bjornn 1979).

Variable	Value and unit
Temperature	
Adult migration upstream	7.2 - 15.6 °C
Spawning	4.4 - 9.4 °C
Incubation	4.4 - 13.3 °C
Upper lethal	25.8 °C
Preferred range	11.8 - 14.6 °C
Water depth	
Adult migration upstream (minimum)	0.18 m
Spawning (minimum)	0.18 m
Age 0 fish (preferred)	0.30 - 1.22 m
(60% of riffle should be submerged)	
Water velocity	
Adult migration upstream (maximum)	2.44 m/s
Spawning	0.31 m/s
Age 0 fish (preferred)	0.09 -<0.30 m/s
Riffle velocity for rearing	0.31 - 0.46 m/s
Pool velocity for rearing	0.09 - 0.24 m/s
Adult swimming speeds	
Cruising	0 - 1.04 m/s
Sustained	1.04 - 3.23 m/s
Darting	3.23 - 6.55 m/s
Invertebrate food organisms	0.15 - 1.22 m/s
Dissolved oxygen	
Weight gain in fry stage (4-9 mg/L)	70% - 100% gain in 19 - 28 days
Food conversion (9 mg/L maximum tested)	4 - 9 mg/L
Juvenile swimming speed (maximum)	100% saturation
Incubation	Near saturation (>5 mg/L)
Space (area)	
Average size of redd	2.8 m^2
Recommended area per spawning pair	11.7 m^2
Year 1+ fish	2.4 - 5.5 m^2/fish
Substrate size	
Spawning	20% fine sediment <6.4 mm in riffle substrate
Silt loads	<25 mg/L preferable
Other	
Cover	Good overhead and submerged
Riffle:pool ratio	1:1

1964). Sustained swimming speeds of juvenile coho salmon were reduced when DO was 7 mg/L or below at 10-20 °C (Davis et al. 1963). In Waddell Creek, California, oxygen saturation was usually above 85% during adult migration (Shapovalov and Taft 1954). High dissolved oxygen concentrations are also important for fish growth (Table 2).

Substrate

Substrate particle size is important for coho salmon spawning and egg incubation. Reiser and Bjornn (1979) reported that gravel 1.3-10.2 cm in diameter was acceptable as coho salmon spawning substrate. Productive redds in Prairie Creek drainage, California, were in gravel of 3.8-12.7 cm (Briggs 1953). Spawning coho salmon in Trinity River, California, preferred gravel of 7.5-15.0 cm that was usually <20% embedded (Buck and Barnhart 1986). Most redds were within 10 m of cover and half were within 5 m.

Turbidity

Turbidity can interfere with all life stages of salmonids. Turbidities of 4,000 mg/L cause salmonids to cease moving, and levels of 80-400 mg/L are considered detrimental (Bell 1973). Streams with turbidities of <25 mg/L should provide good fish habitat (Table 2). Prolonged exposure to highly turbid water may cause thickening of gill lamellae, clogging of gills, curtailment of feeding, and avoidance of areas by fish (Cordone and Kelley 1961; Bell 1973; Reiser and Bjornn 1979). Coho salmon fry (30-65 mm long) subjected to chronic turbidities of 25-50 mg/L showed gill-tissue damage after 3-5 days exposure, and growth was reduced at turbidities of only 25 mg/L (Sigler et al. 1984). Silt deposits are more damaging than silt suspended in the water column. The deposits can restrict oxygen flow to eggs and fry, trap fry trying to emerge, reduce the quality of spawning habitat in other ways, and destroy food supplies (Cordone and Kelley 1961; Bell 1973).

Other Factors

Fish habitat is continuously being destroyed or degraded by many types of developments and natural causes. Human activities such as timber harvest, livestock grazing, mining, road construction, urbanization, and water and harbor development have adversely affected salmon habitat (Berger 1982). Salmon stocks throughout the Pacific Region have declined dramatically because of these activities and overfishing.

State, Federal, and private agencies are developing and using a number of restoration and enhancement programs to increase salmon stocks. Current knowledge of how management practices on forest and range lands influence the habitat requirements of salmon and trout, the effects of various land uses on this habitat, and methods for restoration and enhancement of habitat was compiled by Meehan (1979). Information on improvement of aquatic habitat inventory techniques was summarized by Armantrout (1982). Current methods and techniques for the rehabilitation of habitat used by anadromous salmonids was compiled by Hassler (1981, 1984). Methods to evaluate habitat rehabilitation projects were developed by Buell (1986).

Resource managers need to consider the seasonal habitat requirements for juvenile coho salmon when assessing land and water development plans. Productive summer habitat, such as small estuaries, may enhance winter survival of juvenile coho salmon by producing fish in good condition. The relation between overwinter survival and fish body lipid content indicates that energy stored in body fat in fall contributes to higher winter survival (Mason 1976). Clearcut logging has been shown to increase stream productivity and salmonid standing crop during summer

(Murphy and Hall 1981); however, these increases may be nullified if winter habitat is adversely affected.

Coho salmon fry in estuaries are relatively unaffected by events occurring upstream. The fry have rates of growth and survival that are better than and independent of those of stream fry (Tschaplinski 1982). The estuaries can thus produce large, fast-growing fry, regardless of upstream events, which contribute to the adult stock. Practices which may destroy or alter estuarine habitat should be avoided or minimized.

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15. Supplementary Notes

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16. Abstract (Limit: 200 words)

This species profile summarizes taxonomy, morphology, distribution, abundance, life history, and environmental requirements of coho salmon in the Pacific Southwest (California). Coho salmon are anadromous and enter freshwater in fall to spawn, after living in the ocean for two growing seasons. Spawning peaks in November to January. The fry hatch in spring and migrate to the ocean in about a year. Juvenile coho require a mixture of pools and riffles, abundant instream and bank cover, water temperatures of 10-15°C in summer, dissolved oxygen near saturation, and riffles with relatively little sediment and with abundant aquatic and terrestrial insects for food. Coho salmon support an extensive commercial and sport fishery. Habitats that support coho salmon are continually being destroyed or degraded; State, Federal, and private agencies are working to restore and enhance these habitats.

17. Document Analysis a. Descriptors

Salmon	Growth	Depth
Estuaries	Sediments	Oxygen
Fisheries	Suspended sediments	Feeding habits
Animal migration	Life cycles	

b. Identifiers/Open-Ended Terms

Coho salmon
Oncorhynchus kisutch
Environmental requirements

c. COSATI Field/Group

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