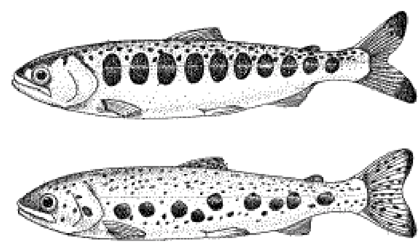
Technical Report # - Bio99 - 009

OREGON COASTRANGE REMAP
1994-1995 AQUATIC VERTEBRATE REPORT



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INTRODUCTION

The recent listing of coho salmon and steelhead as "Threatened" along the Oregon Coast and lower Columbia emphasizes the urgency to understand the conditions and availability of spawning and rearing habitats. Establishing baseline information on the existing conditions of spawning areas is essential for future monitoring efforts and trending analysis. Baseline information provides a foundation for comparisons with new data and identifies changes which suggest appropriate management strategies that benefit salmon.

During 1994-1995, the Oregon Department of Environmental Quality (ODEQ) in cooperation with the United State Environmental Protection Agency (USEPA), conducted an ecoregion study, REMAP (Regional Environmental Monitoring and Assessment Program), of the wadable streams in the Oregon Coastrange. The objective of the study was to assess the availability and conditions of salmon spawning and rearing habitat. A random site selection process was employed to allow for statistically valid inferences about conditions throughout the entire region. Comprehensive physical habitat, chemical, and biological information were collected at each location. In the future, surveys revisiting these locations will be conducted to monitor changes.

A substantial portion of the survey effort was spent gathering data on the composition and relative abundance of the aquatic vertebrate community. Aquatic vertebrates are good indicators of stream health because they respond to changes in instream habitat (Karr 1981; Karr et al 1987; Fausch 1990). The composition of the community is a living representation of the physical, chemical and biological characteristics of the stream they live in (Karr et al 1986)[1].

METHODS

Fifty-four unique survey sites were randomly selected from a population of first, second, and third order streams within the Coastrange ecoregion. Fish and amphibians were captured using single pass electofishing with a Smith-Root™ backpack shocker along a stream segment 40 times the mean channel width in length (McCormick and Hughs 1997). Stunned aquatic vertebrates were netted, placed in a bucket of cold water and allowed to recover. They were then identified, tallied, and measured for total length before being returned to the stream. The survey time was adjusted for the reach length to roughly normalize the effort between sites. The effort was distributed over all habitat types to insure an unbiased sample. Voucher specimens were collected for species that were difficult to identify in the field for verification in the laboratory. Abnormalities and incidental mortality were recorded.

Vertebrate communities were analyzed for their diversity, composition and relative abundance. Each species was assessed for its contribution to the total catch and presence across all sites. Salmonid size classes were plotted to reveal age classifications. Total catch for each species was converted into the potential occurrence of each species in all first, second or third order streams in the Coast Range. Weighting factors were applied to

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[1] Karr identified 5 factors that fish assembleges reflect: Flow regime, chemical variables, biotic factors, energy sources, and habitat structure.

sites based on their total contribution of different stream classifications to the available river miles in the Coast Range ecoregion. For example, first order streams comprise a greater portion of the total river miles in the Coastrange than second or third order streams and are given a larger coefficient to account for their greater contribution.

Principle Component Analysis (PCA) was performed on the vertebrate communities to identify groupings. Outlier sites were placed in groups based on the professional judgment of crew members. Groups were assigned labels to describe their dominant attributes and facilitate discussion. Subsequently, PCA was performed on environmental and chemical data to identified the relative contributions of different parameters in identifying site variability. Finally, environmental and chemical data ordination scores were correlated with biological groups to assist in the identification of environmental factors driving vertebrate communities.

RESULTS

Diversity

Over 2 seasons, REMAP crews conducted surveys on 54 unique sites and 16 repeat visits. 25 unique species of fish and amphibians were collected. Individual site diversity ranged from 1 species at Joe's Creek to 11 species at Agency Creek, Trout Creek, Smith River, and Rock Creek (Figure 1). The mode for all sites was 7 species (11of 71; 15.5%). Cutthroat trout (*Oncorhynchus clarki*), Pacific giant salamander (*Dicamptedon tenebrosus*), and reticulate sculpin (*Cottus perplexus*) occupied the greatest percentage of wadable stream miles surveyed[2] (Figure 2). Cutthroat were found at the most sites (n = 38) followed by reticulate sculpins (n = 34), coho salmon (n = 30), rainbow trout (*Onchorhyncus mykiss*) (n = 29) and Pacific giant salamander (n = 27). Sculpins were the most diverse group present.

Salmonids (*Salmonidae*)

Coho salmon- A total of 1396 coho, representing 10 % of the total catch, were collected at 30 sites and 53% of the site visits (37 out of 70). The average coho catch was 36 ± 41 fish. Coho comprised 14.5% of the total catch in 1994 and 10.9 % in 1995. The maximum number of coho collected at one visit was 153 at the South Fork of Goble Creek and the minimum was two at five sites[3]. Size class data collected in 1994 on coho salmon shows two distinct classes: a group from 2 to 10 centimeters (97.6% of the 1994 coho catch; n = 738 and a group 11 to 14 centimeters (smolts) (2.4% of the 1994 coho catch; n = 18). Data collected in 1995 show similar groupings; a 3 to 10 centimeter group (99.1% of the 1995 coho catch; n = 634) and a 11 to 13 centimeter group (0.9% of the 1995 coho catch; n = 6). At Beals Creek (SVN 94031REM; 07-12-94) Cox Creek (SVN 94048REM; 08-04-94), and Unnamed tributary to the Nehalem (SVN 95045REM; 09-18-95) coho were collected in isolated pools without flowing water. 12.4% of the total

[2] This value is calculated based on a site weighting factor which takes into account the total contribution of first, second and third order streams to the total available rivermiles in the Coastrange ecoregion.
[3] Two coho were found at each of the following five sites: Drift Creek, North Fork Nehalem River, Rock Creek, South Fork Siuslaw River, and Yaquina River.

coho were collected in these streams. Calculations indicate that 9% of the coastal streams could have similar conditions. Cox Creek and Unnamed tributary to the Nehalem had dissolved oxygen concentrations of 1.6 mg/l and 1.1 mg/l respectively[4].

Cutthroat trout- A total of 1184 cutthroat, representing 9 % of the total catch, were collected at 40 sites and 77 % of the site visits (54 out of 70). The average cutthroat catch was 22 ± 35 fish. The maximum number of cutthroat collected on one visit was 171 at Salmon River and the minimum was one at seven sites[5]. Size class data collected in 1994 on cutthroat trout shows three groups: a group from 2 to 9 centimeters (54% of the 1994 cutthroat catch; n = 224), another cohort from 10 to 16 centimeters (34% of the 1994 cutthroat catch; n = 141) and a third group 17 centimeters and up (8% of the 1994 cutthroat catch; n = 47). Size class data on cutthroat trout collected in 1995 showed the same size classes as 1994 but in different abundances. The 2 to 9 centimeter group comprised 40% of the 1995 cutthroat catch (n = 308) while the 10 to 16 centimeter group made up 48 % of the catch (n = 377) and the 17 centimeter and greater group accounted for 12% of the catch (n = 87).

Rainbow trout- A total of 3720 rainbow trout, representing 28% of the total catch, were collected at 29 sites and 59% of the site visits (41 out of 70). The average rainbow catch was 91 ± 112 fish. The maximum number of cutthroat collected on one visit was 444 at Elk Creek and the minimum was 1 at Long Tom River. Size class data collected in 1994 on rainbow trout showed three groups: a cohort from 2 to 9 centimeters (81% of the total catch), a second cohort from 10-13 centimeter (13% of the total catch), and a third cohort 14 centimeters and up (6% of the total catch) (Figure 3). Size class data from 1995 for rainbow trout followed the same pattern as the1994 results with a cohort in the 2 to 9 centimeter range (81% of the total catch), another group in the 10 to 13 centimeter range (14% of the total catch), and a third group 14 centimeters and greater (5% of the total catch) (Figure 4).

Sculpins *(Cottidae)*- Sculpins were the most diverse aquatic vertebrate group surveyed during the 1994-95 REMAP field season. We collected all five species known to occur in the Coastrange (Markle et al. 1996)[6]. Estimates place Reticulate sculpins in 49 % of the wadable stream mile in the Oregon coast range. Reticulate sculpins were the most abundant and widespread sculpin collected (n = 2636 across 34 sites), followed by riffle sculpins (n = 488 across 6 sites), torrent sculpins (n = 475 across 7 sites), prickly sculpins (n = 224 across 13 sites), and coastrange sculpins (n = 99 across 5 sites). Six sites had 3 sculpin species present, 14 sites had 2 species present and 19 sites had 1 species.

Other fish groups- The remaining fish come from 7 families. The minnow family *(Cyprinidae)* was represented by two species: speckled dace *(Rhinichthys osculus)* were found at 13 sites and redside shiner *(Richardsonius balteatus)* occurred at 12 sites. The

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[4] These samples were collected in isolated pools where coho occurred.
[5] One cutthroat was found at each of the following seven sites: Beals Creek, Cox Creek, Honeygrove Creek, Lobster Creek, Middle Creek, South Fork Chetco River, and Unnamed tributary entering Wolf Creek.
[6] The systematics work available on sculpins in Oregon is incomplete but the best available reference indicates five species in the Coastrange: reticulate sculpin (*Cottus perplexus*), coastrange sculpin (*C. aleuticus*), riffle sculpin (*C. gulosus*), prickly sculpin (*C. asper*), and torrent sculpin (*C. rhotheus*)

sunfishes and basses *(Centrarchidae)* had two representative species, which are both, introduced in Oregon. Bluegill *(Lepomis macrochirus)* and pumpkinseed *(Lepomis gibbosus)* were each found at one site. Three-spined stickleback *(Gasterosteus aculeatus)* occurred at 7 sites and is the only member of the stickleback family *(Gaterosteidae)* found in Oregon. Similarly, the trout-perches *(Percopsidae)* have only one representative sandroller (*Percopsis transmontana*) which was found at one site. Largescale sucker *(Catostomus macrocheilus)* occurred at 6 sites and was the only member of the sucker family *(Catostomatidae)* found. Northern pike minnow *(Ptychocheilus oregonensis)* occurred at 1 site and was the only representative of the pike minnow family *(Cyprinidae).*

Amphibians- Amphibians were represented by two orders; frogs *(Anura)* and salamanders *(Caudata).* Three families, the true frogs *(Ranidae)*, the tailed frogs *(Ascaphidae)*[7] and the treefrogs *(Hylidae)*. Three species of ranids were collected; Northern red-legged frogs *(Rana aurora aurora)* were found at 13 sites, foothill yellow-legged frogs *(R.boylii)* at 2 sites, and bullfrogs, *(R.catesbeiana)* an introduced species, occurred at 2 sites. Tailed frogs *(Ascaphus truei)* occurred at 9 sites and are the only living member of their family worldwide.

Salamanders collected in our surveys came from two families; the newts *(Salamandridae)* and the giant salamanders *(Dicamptedontidae)*. Rough-skinned newts *(Taricha granulosa)* were found at 16 sites and were the only representative of the salamander family found. Pacific giant salamander larvae *(Dicamptedon tenebrosus)* occurred at 27 sites and were the third most prevalent aquatic vertebrate overall.

Multivariate analysis – Multivariate analysis of the aquatic vertebrate communities identified 5 site groupings (Canale 1998). These groups are classified by their dominant attributes: "Rich salmonid bearing streams (RSG)" (8 sites), "Moderate salmonid bearing streams (MSG)" (8 sites), "Rainbow trout group (RTG)"(5 sites), "Cutthroat trout group (CTG)" (8 sites), and "Sub-optimum streams (SOG)" (16 sites)[8]. No groups showed a strong association with chemical parameters. However, PCA on the environmental data shows a correlation between the RSG and CTG groups with increasing fish cover, shade, stream gradient and coarse substrate. Coarse substrate and decreasing shade and were associated with the RTG. The MSG group was positively associated with increasing fines. The SOG group was associated with less fish cover and shade, lower gradients and finer substrates.

DISCUSSION

Single pass electrofishing is adequate for describing the presence and relative abundance of aquatic vertebrates. However, to acquire estimates of total abundance or productivity more intensive catch and removal or mark and recapture techniques must be employed (Neilson and Johnson 1983). The 1994-95 REMAP vertebrate data does not reflect the total abundance or productivity of species at the sites we visited. Nevertheless, it does

[7] Some authors place tailed frogs in the family Leopelmatidae the ancestral group to all living frogs.
[8] Only 45 reaches were evaluated because low species diversity at several locations did not provide sufficient variability for multivariate analysis.

give a proportional representation of the community composition at the time of our visit and reveals trends within species.

The species diversity across all sites followed a distinctly unimodal distribution. In most ways it is an unextrordinary pattern which probably reflects a natural gradient of species diversity. Moreover, the small range of diversity of the coastal aquatic vertebrate community overall (n = 11 maximum) is problematic for discriminating significant differences between communities. Inferences about site quality or conditions based on a small group of organisms must be viewed critically. The inclusion of a systematic amphibian survey protocol could increase the potential species list. Water quality indices using amphibians have been successfully employed in California (Moyle et al 1998).

Our catches of coho were dominated by young of year and had only a few smolts. This is probably a consequence of the timing of our surveys which began in late June after most of the smolts had already moved downstream to larger order rivers or estuaries. Juvenile coho spend an entire year or more rearing in stream habitat (typically pools) before outmigrating to estuaries. Smoltification begins some time in spring (March) and is usually done by early June. At the time of outmigration, smolts are typically 10 centimeters or greater in length. In order to get good estimates of smolt escapement we would need to begin our surveys earlier in the season.

The occurrence of coho in isolated pools at 3 sites could be significant. Dissolved oxygen concentrations were far below the 8 mg/l threshold required to sustain salmonids. Certainly the coho in these pools utilized microhabitats with higher concentrations of dissolved oxygen but competition for these areas would significantly stress the fish. Calculations indicate that up to 9% of the Coastrange rivermiles might have isolated pools during similar seasonal conditions. While this may be a natural occurrence in some areas, increasing water demands could reduce the available fish habitat in some streams. For example, during our visit to Elk Creek, downstream of Cox Creek, we observed a 6 gallon per minute irrigation pump (relatively small) in operation for 9 hours during our visit. This represents over 3000 gallons of water being removed from the system. High demand for water could mimic drought conditions and place additional stress on fish populations.

Estimates indicate that cutthroat trout occur throughout more of the survey area than any other species. Their prevalence throughout the Coastrange makes them a useful tool for viewing changes over time. Unlike coho, resident cutthroat display a complex population structure with at least 3 discernible age classes. Shifts in age classes or relative abundance could indicate environmental or chemical change.

While cutthroat were the most widespread species, rainbow trout were the most abundant. Estimates place them in fewer than half as many stream miles as cutthroat trout. This statistic may reflect the confounding effect of stocking on many of the coastal streams. Stocking makes it difficult to make assertions about the effects of habitat modification on rainbow trout populations.

Among the aquatic vertebrates, sculpins probably hold the most promise as indictors of environmental change. Sculpin diversity and habitat partitioning facilitates their use for comparing habitat differences between sites. Unfortunately, information on the habitat preferences for different species is sparse and largely anecdotal. In addition, endemism in some species limits their utility in regional comparisons. In situ experiments, which evaluate the preferences of sculpin species to a suite of environmental and chemical variables, would greatly facilitate their use in water quality analysis. They may be particularly useful for evaluating long term shifts in temperature regimes and substrate changes.

Apart from their utility as indicators of environmental change, some sculpin species are important predators of salmon fry and have illicit predator avoidance responses in salmonids (Patten 1975). Laboratory experiments indicated that Torrent sculpins are capable of consuming fry up to 60 millimeter in length (Patten 1975). While salmonids and sculpins have coevolved with each other, anthropogenic disturbances which favor certain sculpin species could increase their importance as salmon fry predators.

While the occurrence of exotic fish at only 2 of 54 sites may seem insignificant, prescendense indicates otherwise. Mechanistic explanations which link exotic species with native fish reductions are difficult to find but introduced species have been correlated with the reductions of native fish stocks throughout the world (Allan and Flecker 1993). The question is do native fish decline in the presence of exotics because of direct competition and predation or both, or are exotics simply able to exploit habitat changes which are adversely effecting native species? While question is difficult to answer, the evidence for native declines in the presence of exotic species is strong. The importance of exotic fish at two of the sites we visited should not be underestimated. Our sites occurred in wadable streams where conditions for exotics are less favorable than downstream. Their presence probably indicates dispersal from downstream where densities could be much higher.

Like exotic fish, bullfrogs may be harbingers of habitat change. Their presence indicates the availability of slow moving, warm water habitat, increases in sediment and stable flow regimes. In Oregon, bullfrog tadpoles require two year to metamorphose. Impoundments or other channel alterations, which dampen seasonal high flows, allow bullfrogs to establish themselves in places that would otherwise be unsuitable (Kupferberg 1996). Conversely, most lotic amphibians native to the Pacific Northwest are adapted to fluctuating water levels, require cold water habitat, and are adversely effected by increases in fine sediment[9]. Their long life histories and site fidelity make native amphibians valuable tools for assessing changes in water quality and habitat conditions. In addition, in headwater streams, amphibians may dominate the community structure. Murphy and Hall in 1981 found that Pacific Giant Salamanders comprised over 95% of the vertebrates in small streams exceeding salmonids in importance as aquatic predators in those systems. Finally, recent attention over the decline of amphibians warrants intensified monitoring efforts in order to understand the reasons for the declines before local populations are extirpated (Blaustein and Wake 1990; Pechmann et al. 1991).

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[9] Foothill yellow-legged frogs may be found in warmer waters but require coarse unembedded substrates (pers. obser.)

In spite of the low aquatic vertebrate diversity, mulitivariate analysis identified 5 potential community types in the Coastrange. The correlation of these community types with certain environmental parameters can be used for planning restoration efforts or preventing habitat alterations which might disfavor rich salmonid areas. Efforts which maintain or increase fish cover, shade and coarse substrate are likely to benefit rich salmonid and cutthroat trout groups. Conversely, habitat alterations in the direction of decreased fish cover, less shade and increasing fines are likely to favor more tolerant warm water species.

PCA is a tool for describing variability between sites. The relationships are inferential and are not direct hypothesis tests. Furthermore, it should be noted that the links between the aquatic vertebrate groups and environmental variables can be autocorrelated with their location in the watershed. Cutthroat trout are typically found higher up in the watershed where a more closed canopy, coarse substrates and greater fish cover are found and sub-optimal groups are also likely to occur lower in the watershed where the opposite is true. Nevertheless, if a vertebrate community is significantly different from other sites with similar non-anthropogenic attributes, then some form of habitat alteration may be inferred.

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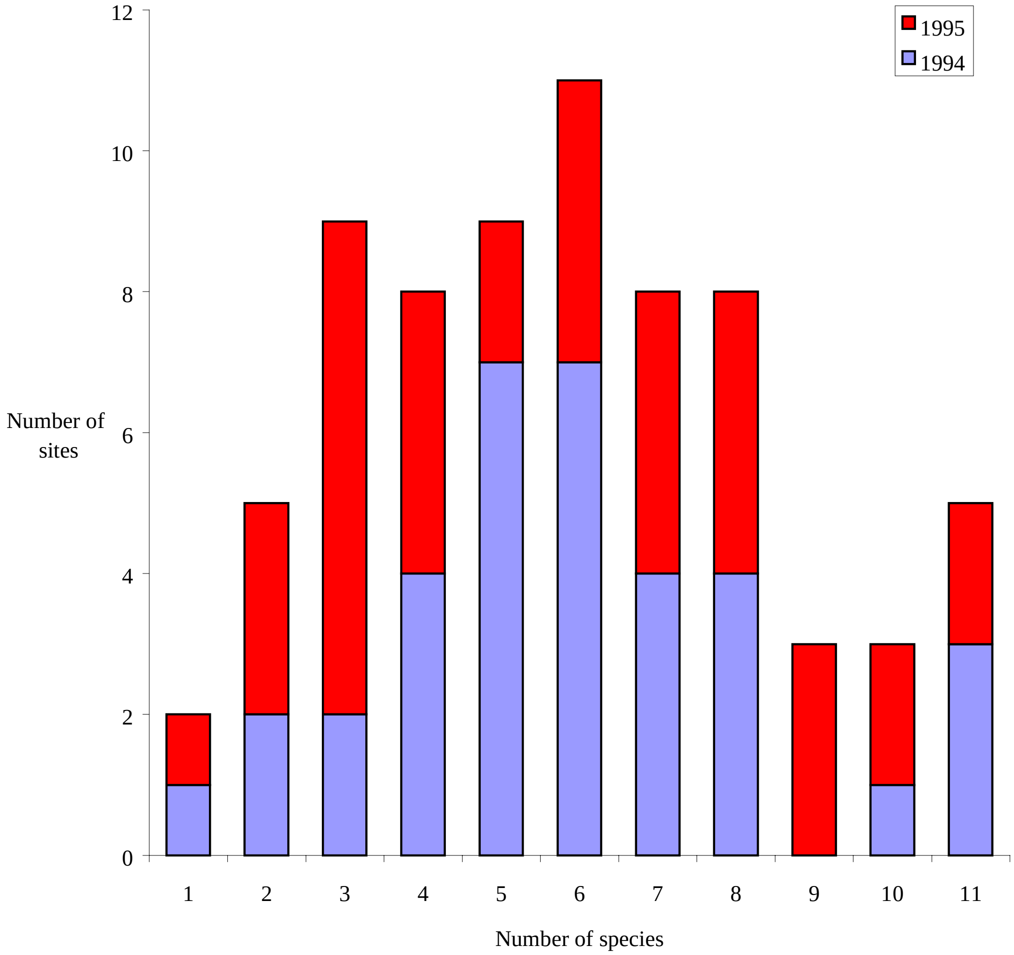

Figure 1. Aquatic vertebrate species diversity across sites

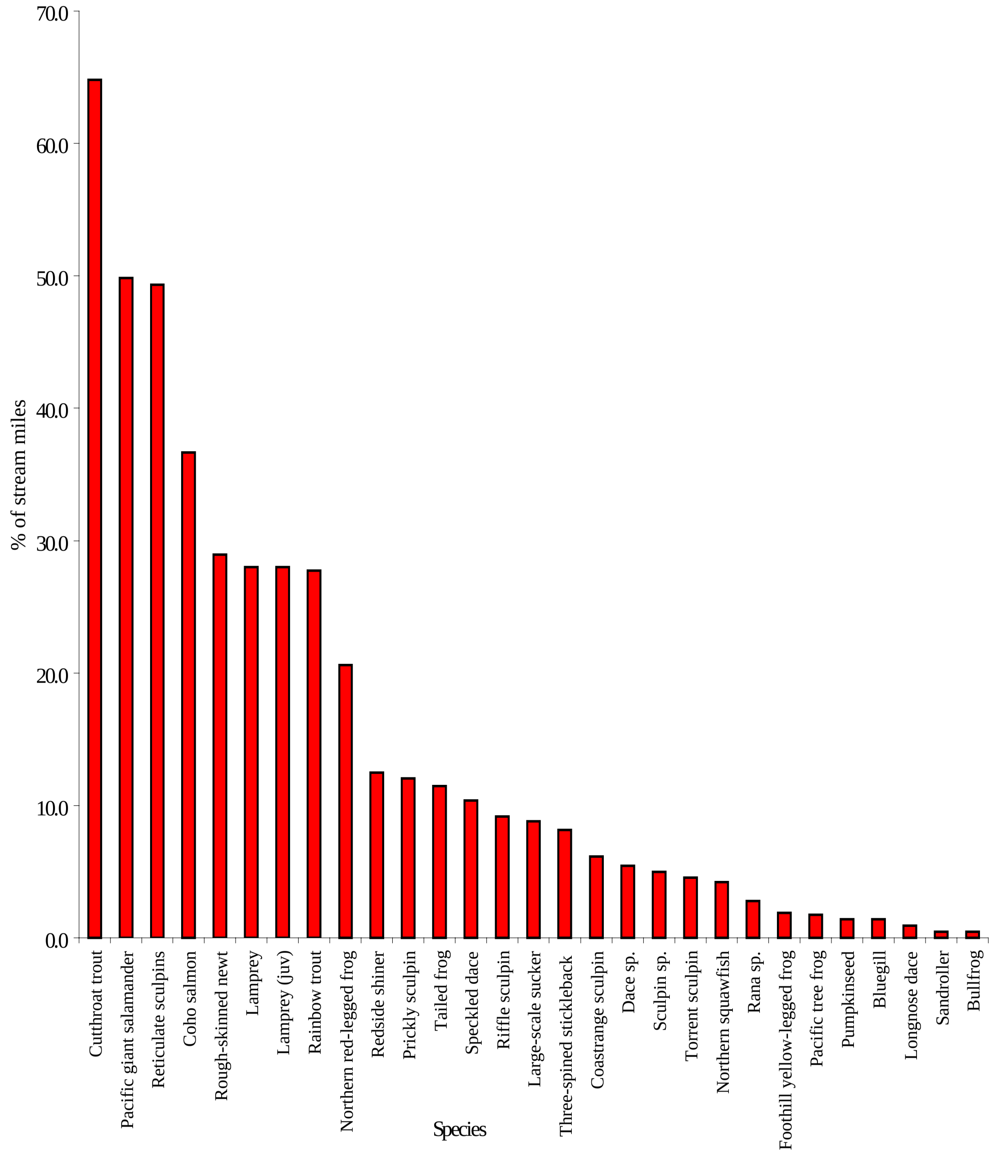

Figure 2. Estimated percentage of stream mile occurrence for aquatic vertebrates in the Oregon Coastrange

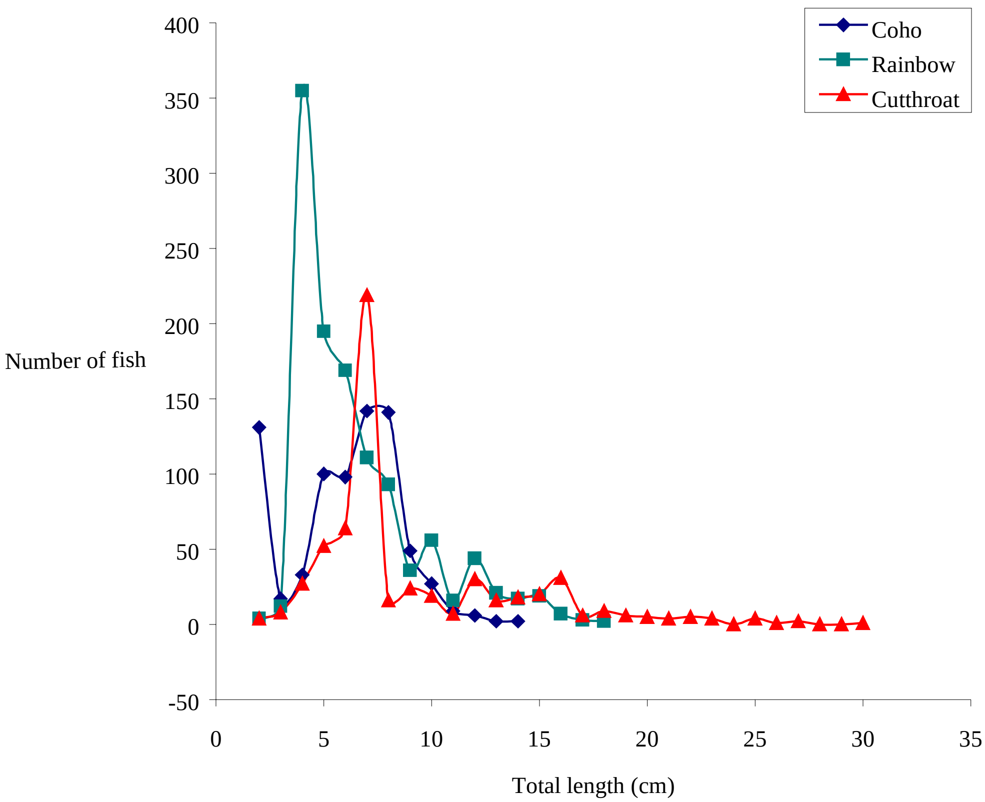

Figure 3. Salmonid size class distribution for 1994

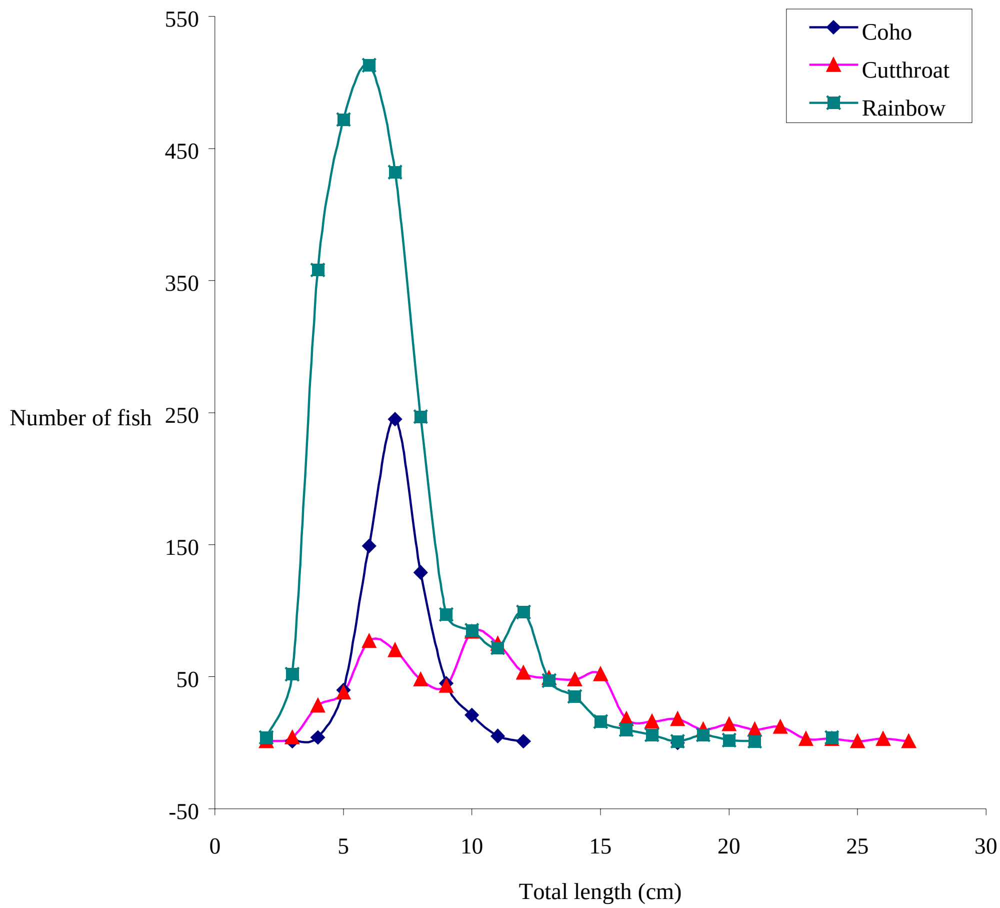

Figure 4. Salmonid size class distribution