IX Fish and Fish Habitat Assessment

Introduction

This section of the watershed assessment evaluates available information on fish populations, in-stream habitat, and migration barriers. The product of the fish and fish habitat assessment is used in the watershed condition evaluation to assess impacts to important areas of current fish use and habitat.

Fish Assessment

Methodology

The first section of this assessment will identify the species of concern and describe the biology as well as recent trends in abundance for each fish species. Additionally, information on other native and introduced fish species is analyzed. Introduced fish species are especially important because of potential interactions with native fish. Competition and predation of introduced species on salmonids are key issues that are being examined in other parts of the lower Columbia River. These issues are important to the management of aquatic resources for salmonid production. Following the section of fish species is the habitat evaluation, where existing stream survey data is used to assess instream conditions. The focus of the habitat evaluation will be a summary of sediment types, pool/riffle ratios, and large woody debris. The final section of the fish and fish habitat assessment is an evaluation of natural and man-made barriers to fish passage.

Results

Status and Distribution of Species of Concern

There are six species of concern within the Lower Columbia-Clatskanie Subbasin, including three species of salmon, two species of trout, and one lamprey (Table 9.1). In addition to the anadromous salmonids, there are resident rainbow and cutthroat trout found in many of the streams and ponds throughout the subbasin. However, only the anadromous salmonids are considered to be species of concern within the subbasin. Table 9.1 lists the species of concern, the Endangered Species Act (ESA) and Oregon Department of Fish and Wildlife (ODFW) status, as well as population trends documented by state and federal agencies. The significance of having a federal (ESA) and state (ODFW) status for each species is that the most restrictive listing takes precedence.

The ESA allows listing of distinct population segments of vertebrates as well as named species and subspecies that are threatened or endangered. Salmon, steelhead, and sea-run cutthroat trout are found throughout the Pacific States from coastal streams to as far inland as the Snake River and historically the upper Columbia River in Canada. The extent of the various species and the nature of the ocean to stream migrations makes it difficult to identify distinct population segments. The National Marine Fisheries Service (NMFS) has employed Evolutionarily Significant Units (ESUs) to solve the question of

Table 9.1: Status of Species of Concern within the Lower Columbia-Clatskanie Subbasin.

Species/Run	ESA Status	ODFW Status	ESU	Population Trends (ODFW)	Population Trends (NMFS)
Fall Chinook	Threatened	Critical	Lower Columbia River	Runs declining; some populations of wild fish extinct.	Majority of fish are hatchery-produced; trend for Clatskanie R. and Plympton Cr. is positive.
Coho	Candidate, currently under review by NMFS	Endangered	Lower Columbia River (predecisional)	Runs declining; some populations of wild fish extinct.	No remaining natural populations; long-term trend is negative; extensive hatchery introgression.
Chum	Threatened	Critical	Columbia River	Dramatic declines in run size; most production is from hatcheries.	Stable since collapse in mid-1950's; current abundance is probably 1% of historic; significant risk of extinction.
Winter Steelhead	Not Warranted	Not listed	Southwest Washington, Columbia River	Trend is low and is believed to be related to ocean conditions.	Recent hatchery returns are declining; ocean conditions are suspected to be the problem.
Coastal Cutthroat	Proposed Threatened	Critical	Southwest Washington, Columbia River	Runs declining; resident fish are replacing anadromous fish.	Likely to become endangered in the foreseeable future; proposed endangered and deferred to USFWS.
Pacific Lamprey	Not applicable	Sensitive-Vulnerable	Not designated	Observations indicate a significant decline in run sizes.	No documented studies or reports on this species.

what constitutes a distinct population segment of the species. An ESU is defined by NMFS as a population that 1) is substantially reproductively isolated from other populations of the species and 2) represents an important component of the evolutionary legacy of the species (NMFS, 1991). The ESUs that the Lower Columbia-Clatskanie Subbasin is contained within are listed for each species in Table 9.1.

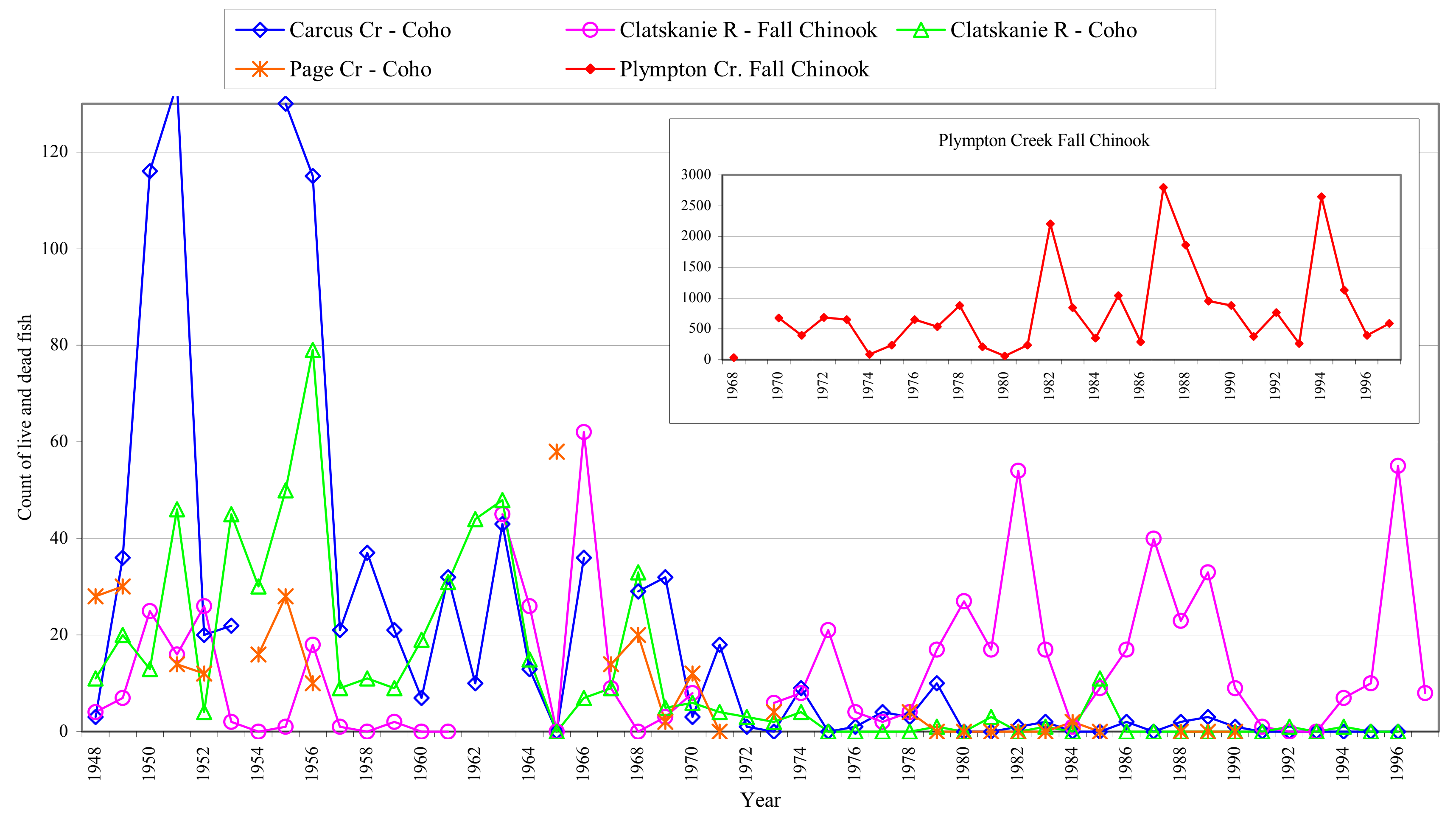
The ODFW has identified Gene Conservation Groups (GCGs) for salmonid and non-salmonid fishes (Kostow, 1995). The GCGs defined by Kostow (1995) are listed as provisional in her report, and ODFW has not made a final ruling on these designations. The GCGs are part of the implementation of the Oregon Wild Fish Management Policy and Wild Fish Gene Resource Conservation Policy. ODFW's GCGs are mentioned in the text where they differ substantially from the ESUs.

Spawning surveys have been conducted in the lower Columbia River since the late 1940's. These surveys have focused on chinook and coho salmon in tributaries of the lower Columbia River, including the Clatskanie River and its tributaries as well as several other streams of the subbasin. Figure 9.1 summarizes the spawning surveys that were conducted within the subbasin, excluding four streams for which there was very little data (Conyers Creek, Goble Creek, Lava Creek, and Tide Creek). A more thorough analysis of Figure 9.1 is provided under the Fall Chinook and Coho sections below.

Fall Chinook

Chinook salmon within the subbasin are defined as fall chinook within the Lower Columbia River ESU, and are listed as threatened under the ESA. This listing indicates that, in the opinion of biologists at NMFS, there is a significant risk of extinction for this ESU. Since 1960, most natural fall run spawning on the Oregon side of the lower Columbia River has been attributed to hatchery strays (BRT, 1997). Evidence from coded wire tag recoveries indicate that the majority of the returning fall chinook are

Figure 9.1: ODFW spawning survey results for peak live and dead fish (1948-1997).



strays from Big Creek hatchery as well as Rogue River fall-run chinook released into Big Creek and the Youngs Bay area (BRT, 1997; Kostow, 1995). Long-term population trends for Plympton Creek and the Clatskanie River are positive, with an annual change of 1 to 5% (BRT, 1997). However, trends for most of the other tributaries of the lower Columbia River are negative.

The lower Columbia River fall chinook is also listed as critical on Oregon's sensitive species list. ODFW has found that the Lower Columbia River has few remaining runs of wild chinook and that fish returns are declining (Kostow, 1995). In addition, the majority of naturally spawning tules (fall chinook) of the lower Columbia River tributaries are believed to be stray hatchery fish (Whisler et al, 1998). However, no genetic analysis has been conducted on fish within the subbasin. In light of this, Kostow (1995) provisionally lists the following streams as genuine wild populations: Hunt Creek, Plympton Creek, and Clatskanie River.

Figure 9.1 is a time series for spawning surveys for fall chinook and coho within the Lower Columbia-Clatskanie Subbasin. The lines representing fall chinook spawning counts on the Clatskanie River and Plympton Creek (inset) illustrate the positive trends documented by NMFS (BRT, 1997). However, it should be noted that both ODFW and NMFS state that the naturally spawning fish in these streams are hatchery strays and do not represent a genuine wild population of fall chinook salmon. The fish returns for Plympton Creek are graphed separately because of the stark difference in numbers of fish between this stream and other streams of the subbasin. The number of live and dead fall chinook counted in Plympton Creek is nearly 40 times the number observed in the Clatskanie River.

Distribution of fall chinook is limited to larger tributaries of the lower Columbia River. Kostow (1995) designates three of the streams of the Lower Columbia-Clatskanie Subbasin as containing habitat for spawning of fall chinook: Hunt Creek, Plympton Creek, and the Clatskanie River. Figure 9.2 is a map of fish distribution throughout the streams of the subbasin. The distribution of fall chinook is based on the findings of Kostow (1995), fisheries research reports by the Oregon Fish Commission and the U.S. Fish and Wildlife Service, and stream surveys conducted by ODFW and private consultants.

Coho

ODFW lists the lower Columbia River coho as in danger of extinction, citing a precipitous decline in returning spawners (Kostow, 1995). Streams within the subbasin are within two GCGs: the Lower Columbia and Willamette/Multnomah Channel. The Clatskanie River and Beaver Creek are listed in the Willamette/Multnomah Channel whereas Fox Creek, Nice Creek, Green Creek, Hunt Creek, and Plympton Creek are listed in the Lower Columbia GCG. This splitting of streams into two population segments is based largely on DNA analysis of scale samples from fish. The DNA analysis done by ODFW finds that anadromous salmonids in the Clatskanie River are most closely related to anadromous salmonids in the Clackamas River.

Source data: ODF stream class maps, ODFW biennial wildfish report, basin plans and spawning surveys, and Oregon Fish Commission Reports.

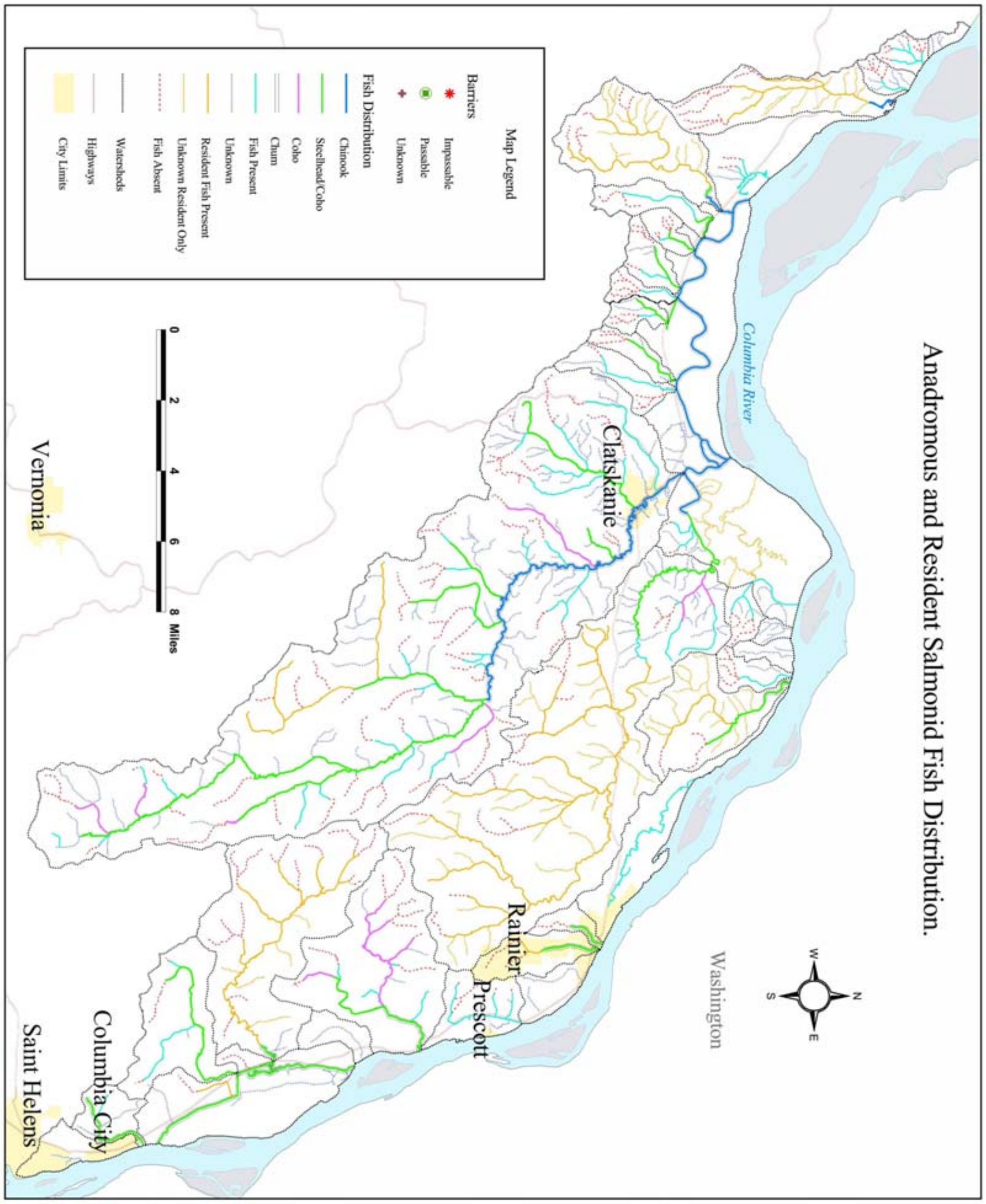


Figure 9.2: Distribution of anadromous and resident salmonids.

In 1995 NMFS designated an ESU that included the lower Columbia River and southwest Washington coast. However, the NMFS has recently proposed splitting this ESU into two separate ESUs, which would place the Lower Columbia-Clatskanie Subbasin into the coho salmon Lower Columbia River ESU (BRT, 1996). Recent reports from NMFS concluded that they could not identify any remaining natural populations of coho salmon in the lower Columbia River that warranted protection under the ESA (Weitkamp, 1995; BRT, 1996). However, the ESU is currently a candidate for listing due to concerns over specific risk factors. These risk factors are related to the Clackamas River and Sandy River natural production of coho salmon that may constitute a remnant population of native lower Columbia River coho (Weitkamp, 1995; BRT, 1996). NMFS concluded that native runs in other tributaries of the Lower Columbia River ESU are probably extinct.

Figure 9.1 illustrates the precipitous decline in coho salmon runs that is noted by both NMFS and ODFW as a trend throughout the lower Columbia River. Coho salmon spawning surveys for Carcus Creek, Page Creek and the Clatskanie River declined steadily from 1948 up to 1980. Since 1980, the run size in these streams has remained low with no further trends in either direction.

Figure 9.2 displays the distribution of coho salmon within the subbasin. Coho salmon are reportedly excellent jumpers and are known to ascend streams to the upper reaches above the distribution of most anadromous fishes. Kostow (1995) has provisionally listed the following streams as genuine wild populations of coho salmon: Hunt Creek, Plympton Creek, Green Creek, Nice Creek, Fox Creek, Goble Creek, Tide Creek, and McBride Creek (Figure 9.2). Graves (2001) includes tributaries of the Clatskanie River, Beaver Creek, and Westport Slough within the range of coho salmon (Figure 9.2). Spawning surveys in the 1990's have found adult coho in Fox Creek, with 8 live adults reported on November 12th of 1994 (Whipple, 2001).

Chum

Very little research has been done on the Columbia River runs of chum salmon, and in light of this there is not much known about the status of this species. Historically, chum salmon spawned in the lower reaches of several streams within the Lower Columbia-Clatskanie Subbasin. The Oregon Fish Commission in 1951 reported runs of 100 chum salmon in the Clatskanie River annually and excellent runs in Tide Creek prior to the construction of a tide gate at the mouth of this stream. Goble Creek also had reports of chum salmon runs, although they were probably small runs. Two decades later, Lauman et al (1972) estimated the number of adult chum salmon spawning in the Clatskanie River to be 50 fish. The chum salmon is listed by ODFW as critical on the state's sensitive species list. Kostow (1995) has cited a dramatic decline in run sizes, noting that the 1992 commercial harvest landed about 700 fish whereas the harvest prior to the 1940s was 100,000 to 600,000 fish annually.

The NMFS findings on the status of chum salmon in the lower Columbia River are similar to those by the ODFW. Beginning in the mid-1950s, commercial harvests declined drastically and now rarely exceed 2,000 fish per year (Johnson, 1997). The last significant harvest was in 1942, when over ½ million fish were caught. As of 1995, there has been no recreational or directed commercial harvests of chum salmon within the Columbia River (Johnson, 1997). Most of the production of chum salmon within the Lower Columbia River is from streams on the Washington side of the river. Since the collapse in the 1950's, chum salmon runs in the Columbia River have been relatively stable, with a run size that is probably 1% of historical levels. Despite the fact that Kostow (1995) identifies several populations of chum salmon in tributaries of the Lower Columbia-Clatskanie Subbasin, NMFS does not recognize any naturally spawning populations of chum salmon in Oregon (Johnson, 1997).

The following streams within the Lower Columbia-Clatskanie Subbasin are provisionally listed by Kostow (1995) as genuine wild populations of chum salmon: Clatskanie River, Beaver Creek, Green Creek, Nice Creek, Fox Creek, Tide Creek, McBride Creek, Plympton Creek, and Hunt Creek. However, Kostow (1995) gives no estimate of spawner abundance or population size for any of these streams. Because of a lack of data and problems with identification (the species has a very brief residence time in fresh water), very little is known about the potential for wild runs within the subbasin. Distribution of chum salmon is not included in Figure 9.2 because of the uncertainty of the status and distribution of the species. However, the provisionally listed streams for this species include the same range as the steelhead with the exception of areas above moderately steep sections of streams or above moderate instream obstacles such as low falls or beaver dams. Further research needs to be done to determine if there are actually any remaining naturally reproducing stocks of the species within the streams of the subbasin.

Steelhead

Compared to coho and chinook salmon, there are few studies of the systematics and genetic similarities or differences in steelhead within the Oregon side of the lower Columbia River. Additionally, aside from the Clackamas, Sandy, and Hood Rivers, there are few estimates of population trends for tributaries of the lower Columbia River in Oregon. The lower Columbia River steelhead is not included on Oregon's lists for species of concern or threatened and endangered species. Observations of steelhead abundance from Washington to California indicate that all populations follow a similar cycle, and that factors common to these populations are influential to trends in abundance (Kostow, 1995). Ocean conditions have been identified as the cause for the recent decline in steelhead runs throughout the coastal range of the species. Ocean productivity is known to undergo long-term cycles of periods that are favorable or unfavorable to the survival of anadromous salmonids. The ocean productivity cycle appears to be unfavorable for steelhead currently and all steelhead population abundance trends are correspondingly low (Kostow, 1995).

The Lower Columbia-Clatskanie Subbasin is in the Southwest Washington ESU for west coast steelhead. The NMFS has listed the status of the steelhead in the lower Columbia River as having a moderate risk of extinction in smaller tributaries of the Columbia River but that the population as a whole is neither presently in danger of extinction nor likely to become endangered in the foreseeable future (Busby et al., 1996). Of the 12 monitored stocks for which there is adequate adult escapement information to compute trends, all but one has been declining since the mid-1980's. Since most of the data series used for trend calculations are short, the trends are believed to reflect climate conditions (Busby et al, 1996). The main threat to the native fish of this region is from hatchery introgression (Busby et al., 1996). Based on coded wire tag recoveries from naturally spawning hatchery fish, the Clatskanie River had the highest estimated proportion of hatchery fish (82%) per total number of spawning steelhead of any stream in the lower Columbia River.

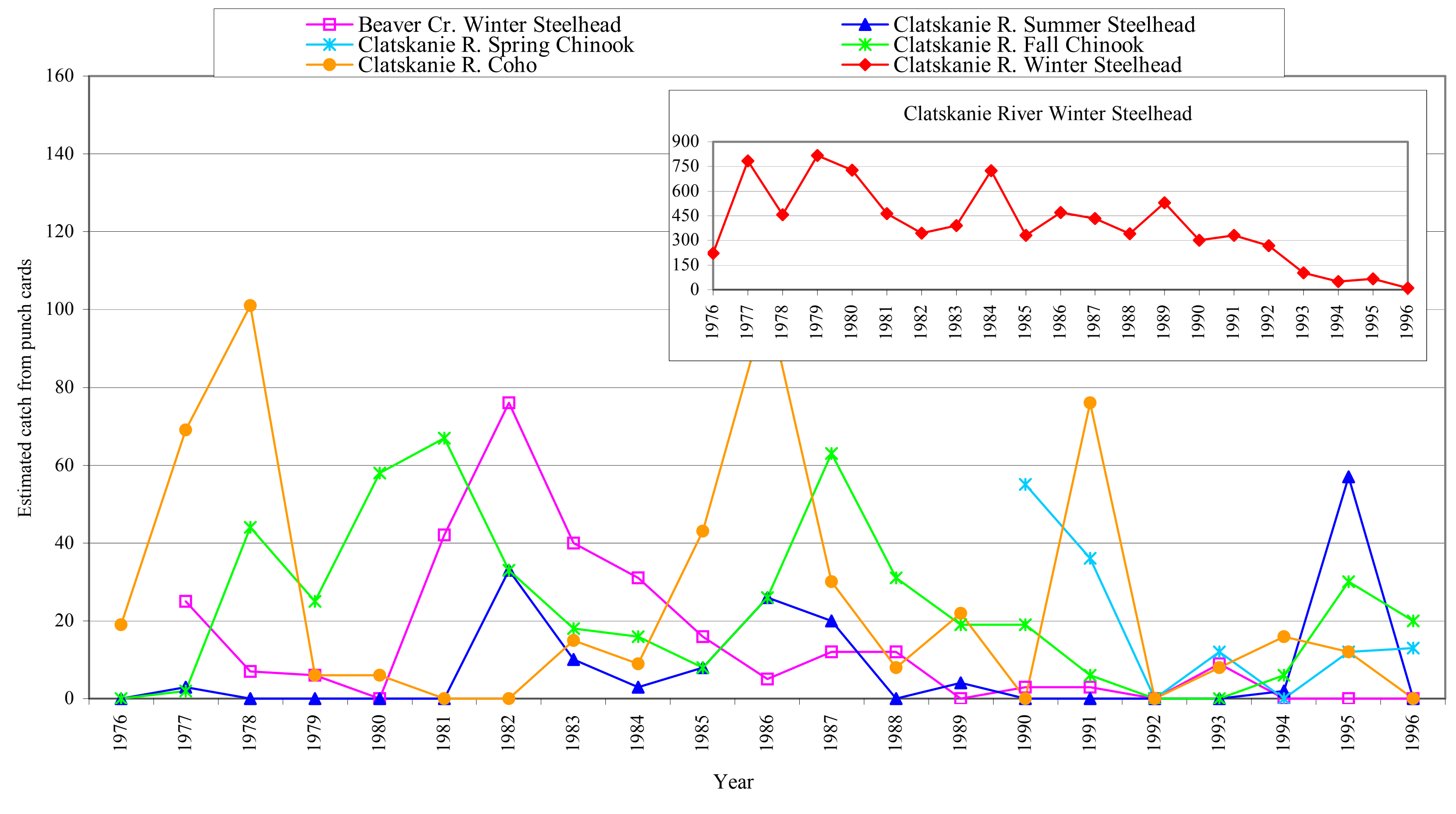
No comprehensive population surveys have been done for steelhead within the streams of the Lower Columbia-Clatskanie Subbasin. However, sport catch data exists for steelhead, coho, and chinook salmon within the Clatskanie River and Beaver Creek (Figure 9.3). Figure 9.3 illustrates the short-term trend in steelhead populations of the Lower Columbia-Clatskanie Subbasin. This declining trend mirrors the steelhead trends for the lower Columbia River tributaries that are noted in reports by NMFS and ODFW (Kostow, 1995; Busby et al, 1996). Since Figure 9.3 is based on sport catch data, these trends are only circumstantial. The numbers of steelhead caught in the Clatskanie River during the period of record are far greater than any other anadromous fish catches in either Beaver Creek or the Clatskanie River. It is obvious from the inset graph of steelhead catches that the numbers have declined sharply during the twenty years of record. Reports from the Oregon State Game Commission estimated about 1000 fish spawning in the Clatskanie River by 1951 and 2,000 fish by 1972 (Lauman et al, 1972; Oregon Fish Commission, 1951). Kostow (1995) cited observations of sport catch in Plympton Creek of about 300 adult steelhead, but Portland State University (PSU) did not find any data on sport catch of steelhead in Plympton Creek.

Fish distribution for steelhead is illustrated on the map of Figure 9.2. Steelhead distribution is similar to coho but not as extensive. Kostow (1995) designates the following streams as steelhead inhabited: Plympton Creek, Clatskanie River, Nice Creek, Fox Creek, Tide Creek, and McBride Creek. In addition to these streams Graves (2001) identifies the following streams as within the distribution of steelhead: Beaver Creek, Conyers Crek, Goble Creek, Green Creek, Lava Creek, Little Clatskanie River, Merrill Creek, Miller Creek, OK Creek, Olsen Creek, Page Creek, Ross Creek, South Fork Goble Creek, Tandy Creek, West Creek, and the Westport Slough.

Sea-run Cutthroat Trout

Sea-run cutthroat trout are listed as critical on the Oregon sensitive species list. The ODFW does not have consistent indicators of trends in abundance for most populations of sea-run cutthroat trout. This species has received limited attention in comparison to the spawning surveys for chinook and coho salmon that have been conducted since the 1940s. Spawner abundance for sea-run cutthroat trout is based largely on creel surveys. Angler surveys conducted in the lower mainstem Columbia during the 1970s typically observed annual catches of up to 5,000 fish (Kostow, 1995). By the late 1980s, angler surveys indicated an average annual catch of 500 fish within the same area (Kostow, 1995). Since 1994 regulations have required anglers to release all wild sea-run cutthroat trout in the lower Columbia River and its tributaries. In 1972 ODFW estimated that 500 sea-run cutthroat trout spawned annually in the Clatskanie River (Lauman et al, 1972). No other estimates have been found for the Clatskanie River or any other streams of the Lower Columbia-Clatskanie Subbasin.

Figure 9.3: Sport Catch of Salmon and Steelhead within the Lower Columbia-Clatskanie Subbasin.



The number of anadromous adult cutthroat trout in Lower Columbia River streams is almost universally very low (Johnson et al, 1999). Data for these estimates comes from the Hood and Sandy Rivers in Oregon as well as several streams in Washington. Trends in anadromous cutthroat trout abundance for the Lower Columbia River streams in Oregon are all negative. However, no estimates of the percentage of hatchery coastal cutthroat trout in natural spawning escapements in the lower Columbia River are given.

Distribution for sea-run cutthroat trout has not been identified for the lower Columbia River. However, it can be safely assumed that the distribution of the species is similar to steelhead and coho. Cutthroat trout are believed to be able to navigate barriers, but they may not be able to jump as well as coho salmon.

Pacific Lamprey

The Pacific lamprey is designated as sensitive-vulnerable on the Oregon Sensitive Species list. The rational for this listing comes from observations of ODFW biologists that abundance has decreased markedly over the last several decades (Kostow, 1995). However, no adequate time series counts of abundance exist within the lower Columbia River.

The Pacific lamprey is currently not listed on the ESA nor has it been recommended for listing. PSU was unable to identify the distribution of the anadromous Pacific lamprey. ODFW has not yet identified the distribution for this species. However, it can be assumed that the distribution will at least be similar to that for chinook salmon and possible coho salmon. The ability of Pacific lamprey to navigate instream barriers is not well documented.

Hatchery Influence

Since the late 1800's, hatcheries have been used as a means to increase the production of anadromous salmonids within the Columbia River. Several streams of the Lower Columbia-Clatskanie Subbasin have been out planted with salmon, steelhead, and cutthroat trout (Table 9.2). The data on stocking dates, hatchery location, and species comes from ODFW records. It is possible that fish were stocked or introduced into the streams of the subbasin prior to these records.

The majority of the fish stocked within the subbasin came from Big Creek and Klaskanine River hatcheries. Occasionally, fish were stocked from the Sandy River, Tanner Creek and Bonneville Hatcheries. None of the stocks planted within the streams of the subbasin are native or naturally reproducing fish. However, Plympton Creek has had a fish weir for many years that is used to collect fish for hatchery spawning in the Big Creek hatchery. In addition, Big Creek and the Klaskanie River are within the same ESU for each of the species of concern, indicating that these streams have stocks that are very similar to native stocks of the subbasin.

Table 9.2: Stocking history for the streams of the Lower Columbia-Clatskanie Subbasin.

Stream	Species	Stocking Dates	Native or Exotic (stock or hatchery)
Beaver Creek	Chinook	1990-1993	Big Creek
Beaver Creek	Cutthroat	1959-1962, 1966, 1971-1972, 1974, 1991	Big Creek
Beaver Creek	Rainbow Trout	1959, 1971	
Beaver Creek	Coho	1980-1981, 1983, 1985-1990	Big Creek, Klaskanine River, Sandy River, Tanner Creek
Beaver Creek	Steelhead	1968	
Bishop Creek	Coho	1981	Bonneville Hatchery
Carcus Creek	Steelhead	1987-90	Big Creek, Klaskanine River
Carcus Creek	Coho	1987-1988	Big Creek
Clatskanie River	Steelhead	1968-1975, 1977-1996	Big Creek, Klaskanine River, Skamania
Clatskanie River	Cutthroat	1950,1960-1962, 1966, 1969-1974,1985-90	Big Creek
Clatskanie River	Rainbow Trout	1951, 1959	
Clatskanie River	Chinook	1988-1997	Big Creek
Clatskanie River	Coho	1949-1950, 1977-1978, 1980-1984, 1987-1990	Big Creek, Klaskanine River, Sandy River, Tanner Creek.
Conyers Creek	Coho	1981-1983, 1988	Big Creek, Sandy River, Tanner Creek
Conyers Creek	Steelhead	1986-1988	Klaskanine River
Conyers Creek	Chinook	1994-1995	Big Creek
Division Creek	Steelhead	1985-1986	Big Creek, Klaskanine River
Fall Creek	Coho	1981, 1985, 1987	Big Creek, Tanner Creek
Goble Creek	Rainbow Trout	1950	
Goble Creek	Coho	1981	
Little Clatskanie	Steelhead	1986	Klaskanine River
Little Clatskanie	Coho	1986, 1988-1989	Big Creek
Lost Creek	Coho	1981, 1983, 1986-1987	Big Creek, Klaskanine River, Sandy River, Tanner Creek
Merrill Creek	Coho	1981	
Miller Creek	Coho	1987-1988	Big Creek
Miller Creek	Steelhead	1985-1990	Big Creek, Klaskanine River
Page Creek	Coho	1987-1988	Big Creek
Page Creek	Steelhead	1985-1990	Big Creek, Klaskanine River
Plympton Creek	Coho	1977	
Roaring Creek	Coho	1981-1982	Tanner Creek
Stewart Creek	Coho	1988-1990	Big Creek
Stewart Creek	Chinook	1990	Big Creek
Tide Cr	Coho	1981	
West Creek	Coho	1981, 1983	Big Creek, Tanner Creek
West Creek	Steelhead	1983	Big Creek

Life History of Species of Concern

Life histories of the species of concern are summarized in Table 9.3. The following sections describe the life histories of the species of concern within the geographic range of the lower Columbia River. Where information specific to the lower Columbia River was not available, generalized information for Oregon was used.

Fall Chinook Salmon

The chinook salmon of the Lower Columbia-Clatskanie Subbasin are called fall chinook, or tules, because of the timing of their return to fresh water and the mature condition of the fish. Within the subbasin, most of the adult chinook salmon return from September to November, fully mature and ready to spawn (Whisler et al, 1998). Most of the returning fish are naturally spawning hatchery fish, but scattered naturally spawning fish that are believed to be wild are occasionally observed. Hatchery fish tend to spawn

Table 9.3: Life histories of species of concern for the Lower Columbia-Clatskanie Subbasin.

Species	Location/Preferred Habitats	Spawning Time	Smolt Migration	Spawning Behavior	Other Notes
Fall Chinook	Spawn in mainstem of larger streams in gravel beds. Low velocity habitats with cover are required for rearing.	September to November	Migrate within the first summer or fall.	Adults return to river fully mature and ready to spawn (tules). Mature at ages 3 and 4, earlier than coastal and upriver fish.	Juveniles migrate to sea within first year of life and spend most of their oceanic life in coastal waters. Fish counted before Dec. 1st are hatchery fish.
Coho	Spawn in low gradient habitats with abundance of gravel, in the mid to upper reaches of small streams. Rearing in deep pools with cover.	Late November to late January	Migrate in the spring at age 1.	Adults have a strong tendency to home to their natal stream. They are good jumpers often ascending to the upper reaches of streams.	NMFS was unable to identify any remaining natural populations of coho salmon in the Lower Columbia River. Hatchery stock introgression is the main problem.
Chum	Spawn in the lower reaches of streams above tidewater; shallow, slow-running streams and side channels where there is gravel.	October to January	Low tolerance for fresh water, migrate soon after emergence.	Return to river fully mature and ready to spawn.	Very little remaining habitat in Oregon because of estuary and floodplain developments. Not very well documented in Oregon.
Winter Steelhead	Spawn in mid to upper reaches of small streams in gravel beds. Instream cover and habitat complexity are important factors.	January to March	Migrate in the spring at age 2.	Ocean maturing type, enters stream well developed and spawns shortly after entering.	Considerable variation in age at smoltification and adult migration.
Coastal Cutthroat	Spawn in gravel beds of pool tail-outs. Initially utilize marginal habitats until they are large enough to compete with more aggressive salmonids.	Late winter to late spring	Migrate in the spring at age 2.	Typically makes more than one trip to salt water, with most fish spawning after second trip.	Very little straying during spawning, but many fish migrate back and forth from salt water at least once before spawning. Not very well documented especially in Oregon.
Pacific Lamprey	Similar to salmonids; cold, flowing water and clean gravel.	April to July	Larvae spend several years in streams before migrating.	Adults only spawn once dieing afterwards. Spawn in similar habitats as salmonids in lower sections of streams.	Historically abundant in streams where salmonids spawn. Adults are parasitic on other fish.

about a month earlier than wild fish, an artifact of historical hatchery practices of selecting the first fish to return to the river. Hatchery introgression has resulted in a predominance of early returning fall chinook runs in the streams of the subbasin (Whisler et al, 1998; BRT, 1997; Kostow, 1995). Spawning takes place in gravel beds of large streams and tributaries to the Columbia River (distribution is described in the preceding section). Chinook salmon are good jumpers, but tend to spawn in the lower reaches of smaller rivers and streams. Juvenile chinook salmon spend less that a year in fresh water, migrating to sea within the first summer or fall. Ocean migrations of fall chinook from the Columbia River are north along the Washington Coast. Juveniles remain in coastal waters for 3 to 4 years before returning as mature adults ready to spawn.

Other runs of chinook that may occasionally turn up in the subbasin include Rogue River "brights". These fish were introduced into Big Creek, as well as streams of the Youngs bay area, to provide Oregon's commercial fishermen with a run of chinook salmon from the Columbia River that migrate south along the Oregon coast and return to the river brighter than local populations (Kostow, 1995). A majority of spawners in streams of the subbasin may be Big Creek hatchery strays, based on coded wire tag analysis, as well as Rogue River "brights", which are also fall-run chinook salmon (BRT, 1997).

Coho

Unlike chinook salmon, coho salmon are not identified by run timing. Within the Lower Columbia-Clatskanie Subbasin, coho salmon spawn from late November to late January (Ollerenshaw, 2000). Naturally spawning hatchery fish return earlier than wild fish, usually before December 1st (Ollerenshaw, 2000). Adult coho are excellent jumpers, often ascending to the upper reaches of streams, but prefer low gradient habitats with abundant gravel beds for spawning (Kostow, 1995). Coho have a well developed homing ability, and a low percentage of returning adults are found to stray from their natal streams (Weitkamp, 1995). However, hatcheries have had a substantial impact on wild coho within the lower Columbia River. Johnson et al (1991) determined that they could not identify any remaining wild runs of coho salmon within the lower Columbia River and that hatchery populations did not represent native stocks of coho. In light of these findings, genuine wild runs of coho salmon within the lower Columbia River are believed to be extinct. Within the Lower Columbia-Clatskanie Subbasin, coho spend one year in fresh water and migrate to estuaries in the spring as one-year-olds. Juvenile coho salmon prefer open pool habitats and often congregate in large schools.

Chum

Chum salmon, unlike coho salmon, are not very well adapted to surmounting instream barriers. Spawning takes place in the lower reaches of the streams above tidewater, with redds dug into gravel beds of the mainstem and side channels (Johnston, 1997). The preferred spawning habitats are shallow, slow moving sections of streams with abundant gravel. The timing of spawning is from October to January, with the adults returning to the streams fully mature and ready to spawn. Juvenile chum salmon have a low tolerance for fresh water, and migrate to estuaries soon after emerging from the gravel beds. Chum salmon were once abundant in the Clatskanie River and a few other streams of the subbasin. Juveniles are dependent on estuarine and floodplain habitats for rearing. However, these areas were the first habitats to be developed by early settlers. Most of the estuarine and floodplain habitats within the lower Columbia River have been developed and this is believed to be an important factor limiting chum salmon production (Johnson, 1997).

Steelhead

Steelhead are the anadromous form of rainbow trout and often co-inhabit streams with the resident form, or rainbow trout. Genetic analysis of the two forms has shown that when the two are found in the same stream, they are more similar to each other than the anadromous form is to other steelhead from other geographic areas (Busby et al, 1996). For this reason, Busby et al has included resident forms as part of the ESUs where they have the opportunity to interbreed. Resident populations above long-standing natural barriers, and those that have resulted from introduction of non-native rainbow trout, would not be considered part of the ESUs (Busby et al, 1996).

Naturally spawning steelhead within the Lower Columbia-Clatskanie Subbasin are all winter run steelhead. They spawn from January to March, returning to the stream well developed and spawning within a short period of time. Winter steelhead within the lower Columbia River generally spend two years in fresh water and two years at sea before returning as mature adults. Steelhead are also able to spawn more than once, although the percent of repeat spawners is typically low. Steelhead spawn in the upper reaches of small to large steams, digging out redds with gravel beds. The range of steelhead in fresh water is similar to coho but they are not as inclined to pass large instream barriers. Juveniles prefer riffle habitats and fast moving water. Migration of smolts takes place typically in the spring after two years in fresh water.

Sea-run Cutthroat

Relatively little is known about the distribution of sea-run cutthroat trout in Oregon, but creel surveys and historic accounts indicate that it was once abundant in the lower Columbia River. Similar to steelhead, the cutthroat trout has resident and anadromous forms that co-inhabit many coastal streams including tributaries of the Columbia River. Johnson et al (1999) found that resident forms of cutthroat trout are not reproductively isolated from sea-run cutthroat trout within the same stream system. Therefore, the ESUs for sea-run cutthroat trout include resident fish above barriers that permit some one-way migration (i.e. downstream migration of smolts but not upstream migration of adults).

Sea-run cutthroat trout spend less time in salt-water than other anadromous salmonids. The residence time in salt-water is short, and in some populations of cutthroat trout, migration is limited to tidewater and estuarine habitats (Trotter, 1997; Johnson, 1999). Cutthroat trout that migrate out to sea spend this time near their natal stream in coastal waters (Trotter, 1997). Residence time in salt-water is typically limited to the summer, with most fish over-wintering in fresh water and then migrating back to sea the following spring. In the Columbia River populations, about half of the fish that return to spawn are first year migrants (Trotter, 1997). Adults return to freshwater and spawn from late winter to late spring, depending on stream flow and temperature. Sea-run cutthroat trout can spawn more than once, with reports of 41% survival after spawning in some Washington streams (Johnston and Mercer, 1976). Spawning habitat is typically the tail-out of deep pools where abundant gravel exists. If coho salmon or steelhead are found within the same stream, then cutthroat will seek spawning gravels above the reaches utilized by these species (Trotter, 1997).

The majority of juvenile sea-run cutthroat trout migrate to sea during the spring as two or three year olds. Juveniles utilize a variety of instream habitats, depending on the presence of other larger salmonids, including juvenile coho salmon and steelhead. Juveniles of coho salmon and steelhead dominate juvenile cutthroat trout in both pools and riffles (juvenile coho salmon prefer pools and steelhead riffles). Where all three species exist, the cutthroat trout will inhabit suboptimal habitats until they reach a size that allows them to compete with other salmonids.

Pacific Lamprey

The Pacific lamprey, like salmon, steelhead, and cutthroat trout, are anadromous, spending part of their life at sea and returning to fresh water to reproduce. Little information about the life history of the species within the lower Columbia River was found, but it is believed to be historically widespread throughout the same streams utilized by anadromous salmonids. Spawning habitat is similar to salmonids, including cool, flowing water and clean gravel (Kostow, 1995). The timing of spawning is from April to July and the adults die shortly after spawning (NMFS, 2000). The juveniles, or larvae, prefer slow moving waters with abundant fine sediments and are filter feeders on algae and organic matter. Pacific lamprey larvae spend several years in fresh water before migrating to salt water, where they are parasitic on other fish.

Other native fishes and introduced fishes

Because of the economic value of salmon, steelhead, and cutthroat trout to commercial and sport fisheries, there have been numerous studies on and hatchery efforts to maintain stocks of those species. However, few studies have documented the extent or abundance of native and introduced non-salmonid fishes within the lower Columbia River. In 1970 a study was conducted in the sloughs of the lower Columbia River to evaluate the quality of the warm water fisheries (Fies, 1971). The study involved gill netting of fish species within a total of sixteen sloughs that are within the Lower Columbia-Clatskanie Subbasin or within islands of Columbia River adjacent to the subbasin. Fies (1971) focused on the distribution of various non-salmonid fishes within the sloughs of the Oregon side of the lower Columbia River. This is the only report PSU found that contains population estimates and distribution for non-salmonid fishes within the Lower Columbia-Clatskanie Subbasin.

Figure 9.4 is a map of the locations sampled and the relative abundance of the nine most numerous species caught by gill netting. The number of gill net sets is not the same for every site and the fishing effort has not been factored into the abundance estimates. Sloughs were sampled from May through November, with all but two sites sampled within the first two months; Magruder and Beaver Sloughs were sampled in August and November. Magruder and Beaver Sloughs are within diking districts; tide

Source data: T.T. Fies, 1971. Surveys of Some Sloughs of the Lower Columbia River.
Oregon State Game Commission, Fishery Division.

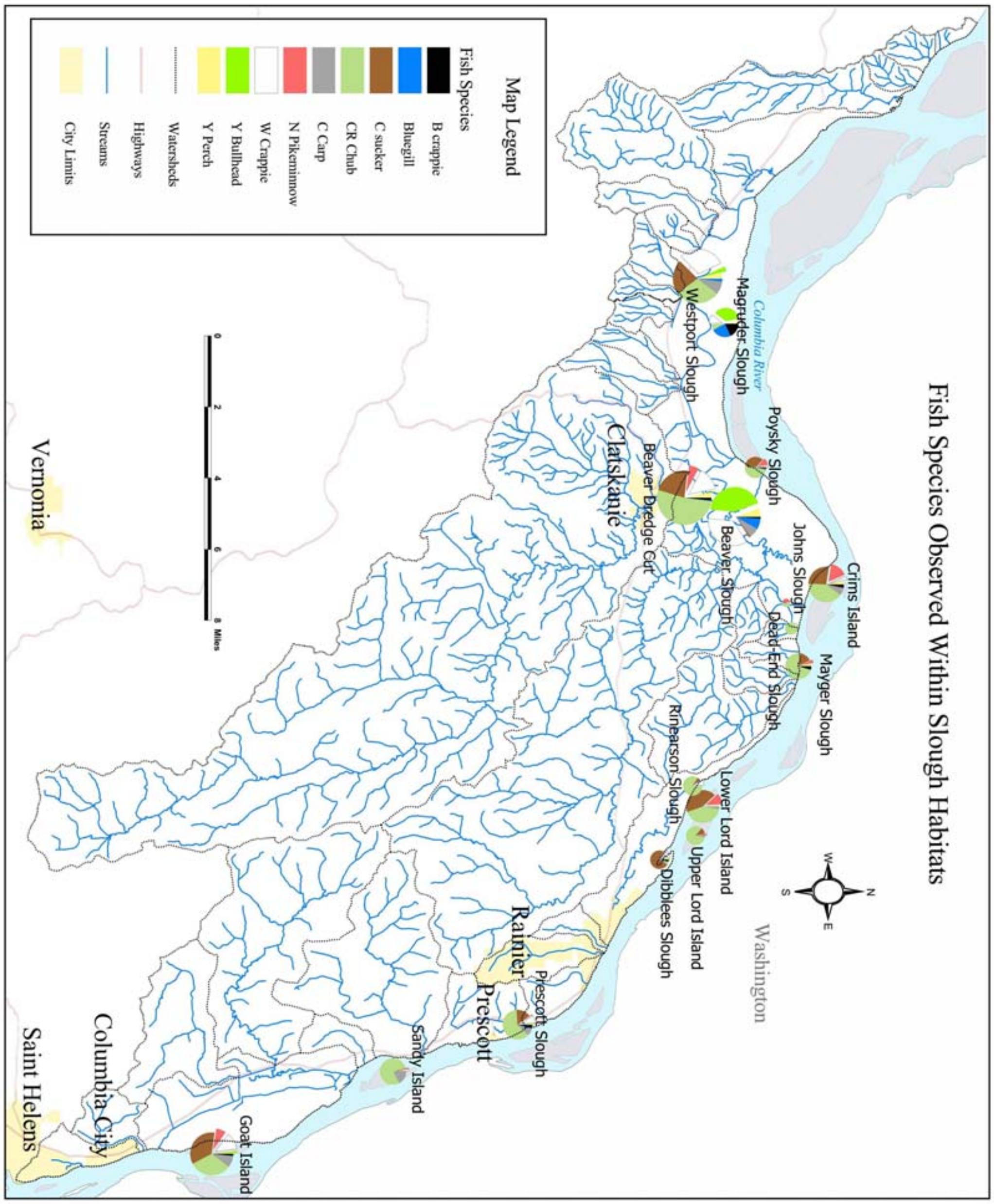


Figure 9.4: Distribution of fish introduced and native fishes within the sloughs of the subbasin.

gates and pump houses control flow into and out of these sloughs. Crims Island, Lord Island, Sandy Island and Goat Island are all within the main channel of the Columbia River. The size of the pie charts represents the total catch of the nine most abundant species for each sample site or slough.

Figure 9.5 summarizes diversity and abundance of fishes observed by Fies (1971), and Table 9.4 summarizes the biology of these species. Four species are not included in Figure 9.5 and Table 9.4 because they were observed less than 1% of the time: channel catfish, chiselmouth, cottid, and sand roller.

Five out of the sixteen fish species in Figure 9.5 and Table 9.4 are native to the Northwest and are commonly observed in the lower Columbia River. The two most abundant species observed by Fries (1971), the Columbia River chub and the coarsescale sucker, are commonly found in the Columbia River and were caught in the majority of the sloughs sampled (Figures 9.4 & 9.5). These two fish prefer slow moving waters and back channels of rivers that are the expected conditions of sloughs of the Columbia River.

The white crappie, yellow bullhead, and common carp were the next most abundant fish caught and are all exotic species. White crappie were found within thirteen of the seventeen sloughs that were sampled. White crappie are voracious predators, and adults 15cm or longer feed almost exclusively on small fish. Bullheads are a type of catfish and some species of catfish are known to be predators of small fish. For instance, the channel catfish has been found to be a significant predator of juvenile salmonids within the reservoirs of the Columbia River (Zimmerman, 1997). The common carp is known to be an opportunistic feeder and may eat the eggs of other fish, including salmonids. These three species are also noted as having a high tolerance for turbidity and low levels of dissolved oxygen (Edwards et al, 1982; Edwards and Twoney, 1982; Stuber, 1982).

The northern pikeminnow is the most significant piscivorus predator of juvenile salmonids within the Columbia River (Zimmerman, 1997). However, the pikeminnow was found to be sixth most abundant species captured by gillnets. Pikeminnows were common in sloughs of islands within the Columbia River. They were also common within the Beaver Dredge Cut and Poysky Slough, the latter being located along the shore of the Columbia River.

Table 9.4: Summary of life history of native and introduced fish observed within the sloughs of the subbasin.

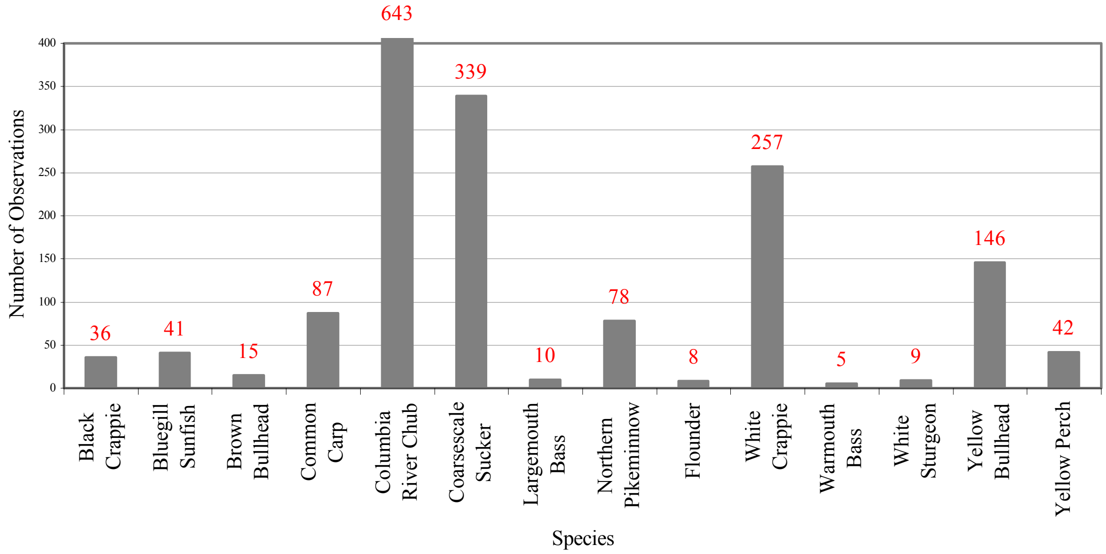
Species	Exotic	Predator	Temp[1]	Turbidity	Low D.O.[2]	Feeding Behavior	Preferred Riverine Habitats	Habitat Limitations/Tolerances	Reproductive Strategy
American Shad	Yes	No	Cold	Unknown	Intolerant	Juveniles feed on insects while in freshwater.	Spends most of its life at sea spawning and rearing in open water of large rivers.	Spawning and incubation range 11-23C; Prefers high D.O.; Tolerant of dredging activities.	Spawn in open water of mainstems at night; Do not ascend barriers well.
Black Crappie	Yes	Yes	Warm	Low Tolerance	High Tolerance	Adults 15cm or longer feed almost exclusively on small fish.	Sloughs and backwaters and pools of streams with vegetation over mud or sand and clear water.	Tolerant of low D.O. (3.3mg/L); Prefers lower turbidity than white crappie. Temp. range 17-30C.	Build nests in shallow water of pools, reservoirs, or lakes near vegetation or other
Bluegill Sunfish	Yes	No	Warm	Moderate Tolerance	Extreme Tolerance	Opportunists on insects and vegetation.	Low velocity pools, but can tolerate velocities up to 45 cm/sec.	Tolerant of extremely low D.O. levels (<1.0mg/L) for short durations and low to moderate turbidities (<50ppm); Temp. range 22-34C.	Build nests in quiet, shallow waters at depths of 1-3m.
Brown Bullhead	Yes	Potential	Warm	Catfish are generally very tolerant	Catfish are generally very tolerant	Other species of catfish, such as the channel catfish, are significant predators on juvenile salmonids.	Pools and sluggish runs over soft substrates in creeks and small to large rivers.	Other bullheads are tolerant of extremely low D.O. (~0.2mg/L) and high turbidity (>100ppm); Temp. range 18-29C.	
Common Carp	Yes	No	Warm	Extreme Tolerance	Extreme Tolerance	Opportunists on insects and vegetation.	Enriched, relatively shallow, warm, sluggish and well vegetated waters with a mud or silt substrate.	Extreme tolerance of turbidity; Temp. range 20-28C; Tolerant of extremely low D.O. (~0.5mg/L).	Spawn in shallow water on vegetation.
Columbia River Chub (Peamouth)	No	*No				Feed on a variety of small, aquatic invertebrates.	Slow-flowing areas of small to medium rivers; most common in vegetation.		Spawn in shallow water of streams over gravel of rubble bottoms. Hybridize easily with other minnows.
Coarsescale (Largescale) Sucker	No	Potential				Bottom feeders on aquatic invertebrates, diatoms, and other plant material, but may feed on salmonid eggs.	Slow moving portions of rivers and streams.		
Largemouth Bass	Yes	Yes	Warm	Low Tolerance	Tolerant	Juveniles feed on small fish, adults feed primarily on fish and crayfish.	Large, slow moving rivers or pools of streams with soft bottoms, some aquatic veg, and relatively clear water.	Low gradient, deep pools with vegetation or cover; Tolerant of low D.O. (5mg/L); Temp. range 24-30C.	Builds nests on a variety of substrates, but prefers gravel, in water depths less than 1m.
Northern Squawfish	No	Yes	Cool	Low Tolerance	Intolerant		Similar to salmonids; clean, cool runing streams with a mix of pool and riffle habitats.	Similar to salmonids; cool temperatures, high D.O., and low turbidity.	
Flounder	No								
White Crappie	Yes	Yes	Warm	High Tolerance	High Tolerance	Adults 15cm or longer feed almost exclusively on small fish.	Low-gradient, slow moving water or pools with sand or mud bottoms and moderate to high turbidities.	Tolerant of severe turbidity and low dissolved oxygen (~3.3mg/L) but prefers moderate turbidity; Temp. range 17-30C	Build nests in shallow water of pools, reservoirs, or lakes near vegetation or other cover.
Warmouth Bass	Yes	Yes	Warm	High Tolerance	Extreme Tolerance	Crayfish, fish, and insects are the main food sources.	Slow moving or still waters having a soft substrate and dense aquatic vegetation or other cover types.	Require low gradients and abundant cover; Tolerant of extremely low D.O. (~0.7mg/L); Temp. range 25-30C.	Nests constructed in shallow water near cover
White Sturgeon	No	No	Cool				Estuaries of large rivers, spawning in fresh water.		
Yellow Bullhead	Yes	Potential	Warm	Catfish are generally very tolerant	Catfish are generally very tolerant	Other species of catfish, such as the channel catfish, are significant predators on	Pools, backwaters, and sluggish current over soft substrate in creeks and small to large rivers.	Other bullheads are tolerant of extremely low D.O. (~0.2mg/L) and high turbidity (>100ppm); Temp. range	
Yellow Perch	Yes	Yes	Cool	Low Tolerance	Moderate	Larger individuals (>120mm) feed on aquatic insects, fish, and crayfish.	Pools and slack water areas with moderate amounts of vegetation (>20% of area).	Tolerant of low D.O. (~5mg/L); Prefer clear water and sluggish currents; Temp. range 19-24C.	Spawns in shallow water over vegetation or coarse substrates.

1. Temperature ranges are: warm >24C, cool 18C-24C, cold <18C.

2. D.O. levels below 7mg/L are considered low. This is the optimal oxygen level for rainbow/steelhead at 15 degrees Celsius (Raleigh, R.F., T. Hickman, R.C. Solomon, and P.C. Nelson. 1984. Habitat Suitability Information: Rainbow Trout. U.S. Fish Wildl. Serv. FWS/OBS-

* The peamouth hybridies easily with other minnows including the redside shiner, a documented predator of juvenile salmonids (Living Landscapes, "Freshwater Fishes of the Columbia Basin in British Columbia, Peter M. Trogge, 1999. Royal BC Museum).

Figure 9.5: Abundance of non-salmonids and introduced fish species within sloughs of the
Lower Columbia-Clatskanie Subbasin.



Habitat Assessment

Methodology

Two types of stream surveys have been conducted within the subbasin, standard stream surveys and stratified random sampling surveys. The main difference between the two survey types is the extent of the surveys. Stratified random sampling surveys cover a single randomly chosen reach of a stream. The standard survey typically begins at the stream mouth or some other predefined point and covers several stream reaches, often encompassing the entire length of the stream. Six stratified random surveys have been conducted within the subbasin ranging from 527 meters to 1144 meters in length and including five separate streams: the Clatskanie River, Carcus Creek, a tributary of Conyers Creek, Keystone Creek, and Beaver Creek. The more extensive standard aquatic surveys have been conducted on Hunt Creek, West Fork Hunt Creek, Plympton Creek, West Creek, Conyers Creek, Carcus Creek, and the Clatskanie River. Besides the data gathered from ODFW, no other survey data was found for streams of the subbasin. Eleven streams of the Lower Columbia-Clatskanie Subbasin have been surveyed by the ODFW since 1990 (Figure 9.6).

The aquatic inventory data is used to provide an initial context for evaluating measures of habitat quality for fishes. The ODFW aquatic inventory data provides a snapshot in time of the condition of aquatic habitat and its influence on the life histories of fishes. The actual conditions of the habitat are dependent on both natural and human influences such as climate, vegetation, geology, and land use. In light of this an evaluation of instream habitats should consider the influential factors such as climate, soils, slope, and hydrological regime. These factors and others have been considered in

Source data: ODF stream class maps, ODFW biennial wildfish report, basin plans
and spawning surveys, and Oregon Fish Commission Reports.

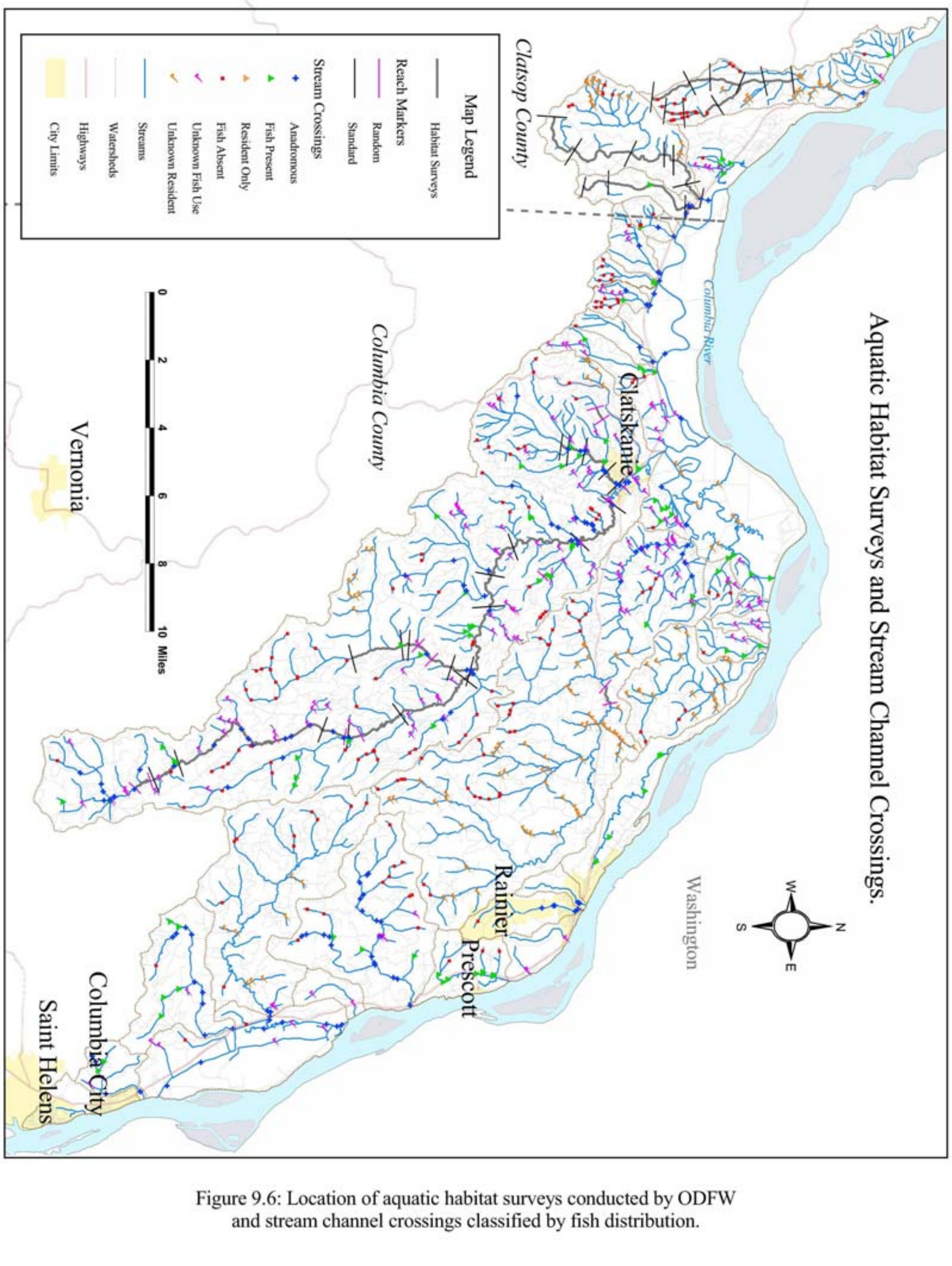


Figure 9.6: Location of aquatic habitat surveys conducted by ODFW
and stream channel crossings classified by fish distribution.

the ODFW habitat benchmarks that are used to evaluate the quality and quantity of habitat for aquatic species. Within this section habitat factors are evaluated for whether or not the conditions are desirable for salmonids based on the ODFW Habitat Benchmarks in Table 9.5. The rating system in Table 9.5 is designed specifically for watersheds on the west side of the Cascade Mountains in Oregon.

ODFW has compiled the habitat data into reach level summaries that can be used for screening level assessments. The habitat benchmarks in Table 9.5 are applied to these reach level summaries of stream conditions. Habitat complexity is a key factor in streams that support healthy stocks of anadromous salmonids. Table 9.5 identifies key habitat types and evaluates habitat complexity by assessing the quantity and quality of pool and riffle habitats as well as the amount of instream structure provided by large woody debris. Riparian conditions are also evaluated with the intent of assessing the amount of stream shading and the potential for large woody debris recruitment. Desirable habitat conditions are rated as good and undesirable conditions are rated as poor. Values that fall in the middle of the range of poor and good are designated as fair. For example, the desirable number of pool habitats within a stream reach is more than 35% of the total area of the stream channel.

Table 9.5: ODFW Habitat Benchmarks.

Habitat Factor	**Benchmark**	
Pools	**Poor** (Undesirable)	**Good** (Desirable)
Pool Area (% total stream area)	<10	>35
Pool Frequency (channel widths between pools)	>20	5-8
Residual Pool Depth		
Small Streams (<7m width)	<0.2	>0.5
Medium Streams (>=7m & <15m width)		
Low Gradient (slope <3%)	<0/3	>0.6
High Gradient (slope >=3%)	<0.5	>1.0
Large Streams (>=15m width)	<0.8	>1.5
Complex Pools		
(pools w/wood complexity >3km)	<1.0	>2.5
Riffles		
Width/Depth Ratio (active-channel based)	>30	<10
Gravel (% area)	>15	<8
Silt-Sand-Organics (% area)		
Volcanic Parent Material	>15	<8
Sedimentary Parent Material	>20	<10
Channel Gradient < 1.5%	>25	<12
Shade (reach average %)		
Stream Width <12m	<60	>70
Stream Width >=12m	<50	>60
Large Woody Debris (15cm X 3m minimum		
Pieces/100m Stream Length	<10	>20
Volume/100m Stream Length	<20	>30
"Key" Pieces (>60cm and 10m long)/100m	<1	>3
Riparian Conifers (30m from both sides)		
Number >20in dbh/1,000ft Stream Length	<150	>300
Number >35in dbh/1,000ft Stream Length	<75	>200

After the habitat benchmarks are applied to the stream reaches the data are then evaluated to give a single score to each stream for each of the five main categories in Table 9.5. This final score or overall condition rating is based on the following criteria:

- **Good:** All parameters rated good or fair
- **Fair:** Parameter ratings were mixed
- **Poor:** Most of the parameters rated as poor
- **ND:** No data

A score of "Good" indicates that the surveyed section of stream has desirable conditions for the specific habitat factor. A score of "Fair" indicates that portions of the stream have undesirable conditions for the specific habitat factor. The "Poor" rating indicates that the stream fails to meet the minimum desirable conditions for that habitat factor throughout the length of the stream survey. Several of the stream surveys have missing data or habitat factors that were not evaluated. These surveys are will have the capital letters ND, which stand for no data, in the table of results under the habitat factor that was not evaluated.

Reach summaries are evaluated using the rating system in Table 9.5 and then assigned a value of 1 for poor, 2 for fair, and 3 for good. A weighted value is then calculated based on the percent of the stream survey that the reach represents. The weighted reach level ratings are then summed for each stream survey and the result is rounded to the nearest integer to give an overall rating for the stream or section of stream surveyed during that year.

Results

The overall habitat ratings for streams surveyed within the subbasin are presented in Table 9.6. Surveys that were conducted as random surveys covering a single reach of a stream are indicated with an asterisk. These random surveys cover a small portion of the total length of a stream channel and therefore should only be used to indicate habitat conditions within that section of stream. Surveys conducted on Beaver Creek, Keystone Creek, and the tributary of Conyers Creek covered a single reach and most likely do not accurately represent the conditions throughout these streams.

The reach level summaries of habitat factors that were used to calculate the overall habitat ratings of Table 9.5 are contained in the Appendix Tables 9.1a - 9.3a. Surveys conducted prior to 1993 did not always include riparian conifer counts and large woody debris estimates. Some of the LWD data were collected for the Clatskanie River, but none of the data were collected for the Carcus Creek and Willark Creek surveys in the early 1990s (Appendix Table 9.2a). In addition, complex pools were not identified during these three surveys. These are pools that have a specified amount of woody debris for cover. However, the stratified random surveys of Carcus Creek and the Clatskanie River contain all of the data identified in the ODFW benchmarks of Table 9.5.

Table 9.6: Summary of habitat ratings for eleven streams of the subbasin based on stream. Ratings are based on the sum of reach level weighted averages.

Stream	**Overall Habitat Ratings**				
	Pools	**Riffles**	**LWD**	**Conifers**	**Shade**
*Beaver Creek	**Good**	**Fair**	**Poor**	**Poor**	**Good**
Carcus Creek '90	**Good**	**Good**	**ND**	**ND**	**Good**
*Carcus Creek '98	**Good**	**Fair**	**Poor**	**Poor**	**Fair**
Clatskanie River '91	**Good**	**Fair**	**Poor**	**ND**	**Good**
*Clatskanie River '98	**Good**	**Poor**	**Poor**	**Poor**	**Good**
Conyers Creek	**Good**	**Poor**	**Poor**	**Poor**	**Good**
Hunt Creek	**Poor**	**Poor**	**Fair**	**Poor**	**Good**
*Keystone Creek	**Poor**	**Fair**	**Poor**	**Poor**	**Good**
Plympton Creek	**Poor**	**Poor**	**Good**	**Poor**	**Good**
*Trib of Conyers Creek	**Poor**	**Poor**	**Good**	**Poor**	**Fair**
West Creek	**Fair**	**Good**	**Fair**	**Poor**	**Good**
West Fork Hunt Creek	**Fair**	**Fair**	**Good**	**Poor**	**Good**
Willark Creek	**Fair**	**Good**	**ND**	**ND**	**Good**

Large woody debris is lacking throughout many of the streams surveyed. Only three stream surveys counted an adequate number and volume of LWD within the stream channel: the tributary of Conyers Creek, Plympton Creek, and West Fork Hunt Creek. However, only a third of a mile was surveyed on the tributary to Conyers Creek, and the West Fork of Hunt Creek is not accessible to anadromous salmonids. The Clatskanie River have an undesirably low level of LWD throughout most of the survey length and the 1998 survey of Carcus Creek that covered 1,038 meters, about ¼ of the stream accessible to anadromous fish, also found undesirable levels of LWD. In addition, riparian conifers greater than 20 inches in diameter at breast height are largely absent from the riparian zones (area within 30 meters of stream channel on either side) of all the segments streams surveyed. The results from the Riparian and Wetlands Assessment (Section V) confer with the stream surveys, indicating that there are few large conifers within the riparian zones of the subbasin. Riparian zones are the primary source for large woody debris (LWD), an important component of stream habitats.

Three out of thirteen stream surveys reported desirable conditions within riffle habitats and five stream surveys reported undesirable conditions. In the 1990 survey of Carcus Creek riffle habitats were rated good below the falls of this stream. However, the 1998 survey, which overlaps part of one of the reaches surveyed in 1990, rated riffle habitats as fair indicating that one of the habitat factors is undesirable for salmonids. Within this section of Carcus Creek, riffle habitats declined in desirability between the years of 1990 and 1998. Morgan and Fulop (1998) have noted the potential for increased sedimentation from recent logging activity. The most commonly observed problem with riffle habitats was an excess of fine sediments as can be seen in the Appendix Table 9.2a. The Carcus Creek survey of 1990 is the only stream survey that consistently found desirably low levels of fine sediments within riffle habitats. Percent gravel measured in riffle habitats also rated low in most of the streams surveyed but on average fell between the levels of the desirable and undesirable benchmarks. Excessive deposition of fine sediments from upstream erosion can lead to a low percent of gravel in surface substrates.

Pool habitats rated highly for nearly half of the surveys, which include four streams: the Clatskanie River, Carcus Creek, Conyers Creek, and Beaver Creek. Hunt Creek, Keystone Creek and the tributary of Conyers Creek have an undesirable combination of pool habitat factors. However, both the Keystone Creek survey and the tributary of Conyers Creek survey covered about a third of a mile of stream channel.

Riparian shading is surprisingly high for nearly all of the streams segments surveyed. This is contrary to the findings of the Riparian and Wetlands Assessment (Section V) found that riparian zone buffers did not provide adequate shade in many areas of the subbasin. Riparian shade is estimated during stream surveys by evaluating the canopy closure.

Stream Channel Crossings and Migration Barriers

Methodology

Natural and manmade barriers to fish passage were identified by reviewing ODFW reports and data sets, U.S. Fish Commission Reports, and through watershed council workshops. Potential barriers have also been identified from stream channel crossings by roads but no evaluation of fish passage was conducted for stream crossings. Stream crossings were identified by GIS overlay analysis of the streams and roads layers. Types of stream crossings consist of bridges, culverts, and fords. Bridges have been identified from county road surveys, and ODOT cartographic data. All other road crossings are assumed to be culverts, but no evaluation of the size, slope, or condition of these crossings was conducted. Stream crossings were overlayed on the fish distribution layer to identify culverts that are potential barriers to the passage of anadromous fish.

Results

Migration barriers have been included on the map of fish distribution introduced in the *Status and Distribution of Species of Concern* section of the fish assessment (Figure 9.2). Natural barriers in the form of falls exist on several streams including: Beaver Creek, Tide Creek, Green Creek, Carcus Creek, Lava Creek, Plympton Creek, Hunt Creek, and Fall Creek. The falls on the Clatskanie River were modified to include a fish ladder that has allowed anadromous fish passage since the early 1950's. Goble Creek has a falls that were identified by Parkhurst (1950) as being a barrier to fish passage but ODFW has included areas above these falls as habitat for coho and steelhead. The status of the falls a barrier needs to be investigated.

Man made barriers include on dam, several tide gates, levees, and pump stations. Although there are several reservoirs within the subbasin that were identified within the Channel Modifications Assessment, only has a dam that has been rated as a barrier to fish passage. The City of Rainier reservoir on Fox Creek is located about two miles from the mouth of the stream and has a dam that is impassable to anadromous and residential fish.

The other manmade barriers are focused within diking districts near the cities of Clatskanie, Rainier, and St. Helens. Historic floodplain habitats along the Columbia River have been modified for agriculture, residential, and industrial use by constructing levees, relocation channels, and installing pump stations and tide gates. The location of these structures is indicated on Figure 9.2.

Stream channel crossings by roads are an essential part of the subbasin providing access to rural residences, agricultural lands, and industrial and non-industrial forests of the subbasin. Table 9.6 summarizes the number of stream crossings per watershed sorted by fish distribution. Stream channel crossings by roads over stream segments identified as habitat for anadromous fish are listed in the column labeled anadromous. Fish present indicates that the stream has fish and is believed to be accessible to anadromous fish, but has not been identified by ODFW, NMFS, or the watershed council as spawning habitat. The categories unknown and unknown resident indicate that fish presence or absence has not been determined by ODFW or the watershed council, and in the case of unknown resident the stream is also inaccessible to anadromous fish due to an instream barrier.

An assessment of fish passage has not been conducted for the stream crossings

Table 9.6: Summary of stream crossings sorted by watershed and fish distribution.

Watershed	Anadromous	Fish Absent	Fish Present	Resident	Unknown	Unknown /Resident	Stream Miles
Beaver Creek	9	34	3	96	23	54	110.7
Clatskanie Floodplain	8	2	12		18	10	54
Clatskanie River	58	68	33	9	80	14	215.9
Clifton			1		1		5.6
Deer Island	8	2		2	4		18.6
Eilertsen Creek		6	2				3.9
Flume Creek		1	3		2		5.5
Fox Creek	5	2					4.7
Goble Creek	20	11	3		4		24.4
Graham Creek		3	4		5		7.2
Green Creek		4		11		19	22.4
Hunt Creek	1	17		5		16	23.9
Hunter					2		2.2
McBride Creek	4		2		2		6
Merrill Creek	9	1	5		2		10.5
Neer Creek		3	8				7.6
Nice Creek	2						2.2
Niemela Creek					5		2.7
OK Creek	3	8	1		4		5
Olsen Creek	3	1			2		5.6
Owl Creek					3		3.2
Plympton Creek	1	6		2		15	24.7
Rinearson Slough			5				6.6
Ross Creek	2	3	1				3.1
Speer Creek		1	1				5.1
Tandy Creek	2	1					5.1
Tank Creek		3	3		3		5.5
Ternahan Creek					4		2.3
Tide Creek	3	10		21	2	8	34.2
West Creek	3		1				5.4

identified within Table 9.6. However, the classification for road crossings of stream channels within the distribution of anadromous fish will help to prioritize field evaluations of stream crossings.

Conclusions

Anadromous salmonids within the Lower Columbia-Clatskanie Subbasin have declined substantially from historic levels. Under the ESA, two species of salmonids are listed as threatened, one is a candidate, and another is proposed threatened within the lower Columbia River (Table 9.1). The ODFW lists one species of salmonid as endangered and three as critical within the lower Columbia River. In addition, ODFW lists the Pacific Lamprey as sensitive-vulnerable.

Fall chinook salmon were once abundant within the Clatskanie River, Plympton Creek, and Hunt Creek but current runs are substantially smaller than historic levels (Kostow, 1995; BRT, 1997; Whisler et al, 1998). Although, long-term population trends for Plympton Creek and the Clatskanie River are positive, spawning surveys and coded wire tag studies conducted by ODFW indicate that the majority of chinook salmon on the spawning grounds are hatchery fish (BRT, 1997; Whisler et al, 1998). Spawning surveys conducted by ODFW illustrate the trend identified by the NMFS and Kostow.

ODFW lists the lower Columbia River coho as in danger of extinction, citing a precipitous decline in returning spawners (Kostow, 1995). However, NMFS reports that they could not identify any remaining natural populations of coho salmon in the lower Columbia River, but the status of the species is still under review. The major areas of concern within the lower Columbia River coho ESU are the Clackamas and Sandy Rivers. These streams may be the only remaining natural runs of coho within Oregon along the lower Columbia River. Adult and juvenile coho salmon have been found in many of the streams of the subbasin but are believed to be either hatchery strays or offspring of hatchery stock.

Chum salmon within the lower Columbia River are listed threatened under the ESA and critical by ODFW. As recently as 1942 commercial harvests of chum salmon exceeded ½ million fish annually, but by the mid-1950s onward commercial harvests rarely exceeded 2,000 fish annually (Johnson, 1997). ODFW provisionally listed several streams of the Lower Columbia-Clatskanie Subbasin as spawning habitat for chum salmon, but NMFS does not recognize any naturally spawning wild populations of chum salmon within the subbasin (Johnson, 1997; Kostow, 1995). A total of nine streams are provisionally listed by Kostow (1995) as habitat for chum salmon.

Steelhead have exhibited a declining trend throughout the coast range of the species that is believed to be caused by fluctuations in ocean conditions (Busby et al. 1996). The specie is not listed under the ESA nor is it listed by ODFW. Even though the status of steelhead has not warranted listing by NMFS or ODFW, hatchery programs have had a significant impact on wild populations of steelhead within the lower Columbia River. The Clatskanie River has the highest rate of hatchery straying of any stream within the Oregon side of the lower Columbia River. Coded wire tag studies show that

82% of the fish on the spawning grounds of the Clatskanie River are returning hatchery fish. A lack of population data exacerbates the analysis of the steelhead population trends and status. No comprehensive population studies have been done for steelhead within the streams of the lower Columbia-Clatskanie Subbasin.

Sea-run cutthroat trout are currently proposed threatened under the ESA and listed as critical by ODFW. Very little information exists on the population size, trends, or status within the lower Columbia River or streams of the subbasin. However, anecdotal information from recreational fishing records, long-time residents, and senior fisheries biologists indicate that the population has declined substantially within the past century. Trends in anadromous cutthroat trout abundance are considered to be negative by NMFS and ODFW (Johnson et al. 1999; Kostow, 1995).

Pacific lamprey is listed by ODFW as sensitive-vulnerable but has not yet been considered by NMFS. The opinion of ODFW biologists is that the species has declined substantially from historic levels and the species warrants further investigation. No population estimates were found for Pacific lamprey within the lower Columbia River.

There are numerous other species that coexist with the species of concern within the streams of the Lower Columbia-Clatskanie River. Spawning surveys and sport catch records have documented the abundance of the species of concern but only one study was found that examines the abundance and distribution of other native and introduced fishes within the subbasin. Fies (1971) conducted gill net surveys within the sloughs of the lower Columbia River to assess the stock of warm water game fishes. The data from his study indicates that there are at least sixteen non-salmonid species commonly occurring within the sloughs and lower floodplain reaches of streams within the subbasin. Five of these sixteen species are native fish, the others exotic. Several of the exotic fishes are predators of small fish and pose a threat to migrating juvenile salmonids. Northern pikeminnows (a native to the Columbia River), white crappie, black crappie, and largemouth bass are all predators and found within the sloughs and floodplain habitats of the subbasin (Fies, 1971). Fies (1971) found yellow bullhead to be abundant. A similar species, channel catfish, were found to be significant predators on juvenile salmonids within the reservoirs of the Columbia River (Zimmerman, 1997). Other exotic fishes may compete with native fishes for habitat or food reducing growth rates of native fish and potentially decreasing survival. However, no analysis has been conducted by Fies (1971) or others addressing the potential harm from introduced and/or native fishes on salmonids within the subbasin.

Habitat surveys conducted by ODFW have been limited to ten streams within the Lower Columbia-Clatskanie Subbasin, and three of the surveys covered relatively short segments of streams. However, two habitat factors, LWD and riparian conifers, rated poorly in a majority of the streams surveyed. Of the streams surveyed five of eleven streams had insufficient LWD and two more contained levels that were in between desirable and undesirable levels. In the same regard conifers 20-inches or larger in dbh were largely absent from the riparian zones of all the streams surveyed. There are an undesirably low number of large conifers for recruitment of large woody debris. Morgan and Fulop (1997) noted potential instream habitat problems within the upper Clatskanie River because little LWD exists within the stream.

Riffle habitats were evaluated as desirable in only two streams. The main problem in riffle habitats was high levels of fine sediments indicating excessive erosion from within the stream channel or the adjacent hillslopes. Morgan and Fulop (1997) expressed concern of potential habitat problems from considerable logging activity in recent years on Carcus Creek. They also noted that silt and sediment deposits had increased in the upper Clatskanie River between surveys in 1997 and 1998.

Stream channel crossings and migration barriers have been identified throughout the subbasin but no evaluation was conducted for fish passage of stream channel crossings by roads. Migration barriers in the form of falls exist on several streams including Beaver Creek, Tide Creek, Plympton Creek, Carcus Creek, and Green Creek. One man made barrier was identified on Fox Creek which is a dam belonging to the City of Rainier. Migration barriers also have been identified within the historic floodplains along the Columbia River. Flood control and agricultural developments have modified these key habitats and are probably an important factor in the decline of at least the chum salmon.

Data Gaps

Stream channel crossings are the most significant data gap in this section. The sheer number of stream channel crossings by roads makes it impractical to survey each and every one. Therefore the identified crossings were overlaid on fish distribution maps to create a priority ranking for evaluation of these features. Stream channel crossings by roads of streams that are identified as anadromous fish habitat are the highest priority for field observations.

Interspecies interactions between salmonids and exotic fish species as well as native fish species is an issue being investigate within the reservoirs of the Columbia River. This may be an important factor in the recovery of anadromous salmonids of the Lower Columbia-Clatskanie Subbasin but more information is needed to assess the impacts of non-native fishes.

A fair amount of information exists for chinook salmon, coho salmon, and steelhead populations. However, relatively little is known about the distribution or abundance of chum salmon, sea-run cutthroat trout or Pacific lamprey.

References:

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. USDOC, NOAA, NMFS.

Fies, T.T. 1971. Surveys of Some Sloughs of the Lower Columbia River. Oregon State Game Commission, Fishery Division.

Graves, D. 2001. Chum Salmon Distribution, GIS layer. Pacific States Marine Fisheries Commission.

Graves, D. 2001. Coho Salmon Distribution, GIS layer. Pacific States Marine Fisheries Commission.

Graves, D. 2001. Fall Chinook Salmon Distribution, GIS layer. Pacific States Marine Fisheries Commission.

Graves, D. 2001. Winter Steelhead Distribution, GIS layer. Pacific States Marine Fisheries Commission.

Johnson, O.W., T.A. Flagg, D.J. Maynard, G.B. Milner, and F.W. Waknitz. 1991. Status Review for Lower Columbia River Coho Salmon. National Marine Fisheries Service, Northwest Fisheries Science Center.

Johnson, O.W., W.S. Grant, R.G. Kope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status Review of Chum Salmon from Washington, Oregon, and California. National Marine Fisheries Service, Northwest Fisheries Science Center.

Johnson, O.W., M.H. Ruckelshaus, W.S. Grant, F.W. Waknitz, A.M. Garret, G.J. Bryant, K. Neely, and J.J. Hard. 1999. Status Review of Coastal Cutthroat Trout from Washington, Oregon, and California. National Marine Fisheries Service, Northwest Fisheries Science Center.

Kostow, K. (editor). 1995. Biennial Report on the Status of Wild Fish in Oregon. Oregon Department of Fish and Wildlife (ODFW).

Lauman, J., A.K. Smith, and K.E. Thompson. 1972. Supplement to: The Fish And Wildlife Resources Of The North Coast Basin, Oregon, And Their Water Requirements. Oregon State Game Commission.

McMahon, T.E. 1983. Habitat suitability index models: Coho salmon. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-82/10.49.

Meehan, W.R., and T.C. Bjornn. 1991. Salmonid Distributions and Life Histories, in Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. (W.R. Meehan, ed.). American Fisheries Society, Special Publication 19.

Morgan, B. and J. Fullop. 1998. 1997 Oregon Lower Columbia River Coho Spawning Gound Surveys and 1998 Coho Juvenile Survey Results. Oregon Department of Fish and Wildlife, Columbia River Management.

Ollerenshaw, E. 2000. 1999 Oregon Lower Columbia River Coho Spawning Ground Surveys and 2000 Coho Juvenile Survey Results. Oregon Department of Fish and Wildlife.

Oregon Fish Commission. 1951. Lower Columbia River Fisheries Development Program: Reports on the Clatskanie River & Scappoose Creek Area. State of Oregon Fish Commission.

Parkhurst, Z.E., F.G. Bryant, R.S. Nielson. 1950. Special Scientific Report – Fisheries: Survey of the Columbia River and its Tributaries. USDI, Fish and Wildlife Service.

Raleigh, R.F., T. Hickman, R.C. Solomon, and P.C. Nelson. 1984. Habitat Suitability Information: Rainbow Trout. U.S. Fish Wildl. Serv. FWS/OBS-82/10.60.

Swanston, D.N. 1991. Habitat Requirements of Salmonids in Streams, in Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats (W.R. Meehan, ed.). American Fisheries Society.

Trogge, P.M. 1999. Living Landscapes, Freshwater Fishes of the Columbia Basin in British Columbia. Royal B.C. Museum.

Trotter, P.C. 1997. Sea-Run Cutthroat Trout: Life History Profile. Pages 7-15 *in* J.D. Hall, P.A Bisson, and R.E. Gresswell, editors. Sea-run cutthroat trout: biology, management, and future conservation. Oregon Chapter, American Fisheries Society, Corvallis.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status Review of Coho Salmon from Washington, Oregon, and California. USDOC, NOAA, NMFS.

West Coast Chinook Salmon Biological Review Team (BRT). 1997. Review of the Status of Chinook Salmon (*Oncorhynchus tshawytsch*a) from Washington, Oregon, California, and Idaho under the U.S. Endangered Species Act. Prepared for the National Marine Fisheries Service.

West Coast Coho Salmon Biological Review Team (BRT). 1996. Draft Status Review Update for Coho Salmon from Washington, Oregon, and California. USDOC, NOAA, NMFS.

Zimmerman, M. P. 1997. Comparative food habits of smallmouth bass, walleyes, and northern squawfish in the Lower Columbia River basin. Pages 106 - 134 *in* D.L. Ward, editor. Evaluation of the northern squawfish management program. Oregon Department of Fish and Wildlife. Final report to the Bonneville Power Administration.

Appendix Tables

Fish and Fish Habitat Assessment

Stream	Reach	Date	Length Sampled (meters)	Gradient	CHT	Width	Pool Area		Pool Frequency		Residual Pool Depth		Overall Pool Rating	Complex Pools	
							Pctpool	Benchmark	Cwpool	Benchmark	Residpd	Benchmark		Compool_k	Benchmark
Beaver Creek	281	9/22/1998	1049	0.7	lm	10.6	42	Good	8.6	Fair	0.21	Fair	Good	1.9	Fair
Carcus Creek '90	1	8/27/1990	716	1.2	mh	2.6	17.5	Fair	7.1	Good	0.3	Fair	Good	ND	ND
Carcus Creek '90	2	8/27/1990	247	1.1	fp2	3.5	31.2	Fair	9.9	Fair	0.7	Good	Good	ND	ND
Carcus Creek '90	3	8/28/1990	1614	1.2	fp2	2.7	27.6	Fair	4.9	Good	0.3	Fair	Good	ND	ND
Carcus Creek '90	4	8/29/1990	299	1.7	lc	3.3	20.9	Fair	5.7	Good	0.2	Fair	Good	ND	ND
Carcus Creek '90	5	8/29/1990	1838	1.7	lc	2.9	26.1	Fair	6.1	Good	0.4	Fair	Good	ND	ND
Carcus Creek '98	293	11/13/199	1038	1.7	fp3	4.0	28	Fair	5.7	Good	0.61	Good	Good	5.6	Good
Clatskanie River '91	1	9/12/1991	3477	0.6	fp1	6.3	42	Good	4.6	Good	0.8	Good	Good	ND	ND
Clatskanie River '91	2	9/17/1991	3084	1.1	fp2	5.5	36	Good	4.9	Good	0.7	Good	Good	ND	ND
Clatskanie River '91	3	9/18/1991	1734	1.9	fp2	7.9	32	Fair	5.3	Good	0.9	Good	Good	ND	ND
Clatskanie River '91	4	9/19/1991	2167	0.8	fp1	6.5	65	Good	4.5	Good	0.8	Good	Good	ND	ND
Clatskanie River '91	5	9/25/1991	5233	1	fp1	6.4	50	Good	5.2	Good	0.5	Fair	Good	ND	ND
Clatskanie River '91	6	9/26/1991	1317	3	mm	6.9	42	Good	6.2	Good	0.4	Fair	Good	ND	ND
Clatskanie River '91	7	9/30/1991	6361	1.9	fp3	7.0	51	Good	6	Good	0.4	Fair	Good	ND	ND
Clatskanie River '91	8	10/3/1991	1338	1.9	fp2	6.0	23	Fair	12.7	Fair	0.2	Fair	Good	ND	ND
Clatskanie River '91	9	10/7/1991	9936	0.9	fp2	6.2	56	Good	10.4	Fair	0.4	Fair	Good	ND	ND
Clatskanie River '91	10	10/23/199	1604	0.8	fp2	4.2	59	Good	16.4	Fair	0.3	Fair	Good	ND	ND
Clatskanie River '98	308	9/14/1998	1144	1.5	lm	5.9	41	Good	6.1	Good	0.53	Fair	Good	4.3	Good
Clatskanie River '98	350	9/19/1998	1022	0.6	lm	4.4	38.5	Good	12.5	Fair	0.44	Fair	Good	3.9	Good
Conyers Creek	1	8/7/1995	1006	0.2	lm	3.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Conyers Creek	2	8/14/1995	3231	0.5	lm	3.7	35.2	Fair	7.8	Good	0.7	Good	Good	0	Poor
Conyers Creek	3	8/15/1995	943	0.7	lc	3.3	19.7	Fair	10	Fair	0.5	Fair	Good	0	Poor
Conyers Creek	4	8/15/1995	366	2.6	mm	3.8	15.7	Fair	12.7	Fair	0.5	Fair	Good	0	Poor
Conyers Creek Tributary	160	10/14/199	527	7.5	mv	1.8	5	Poor	24.6	Poor/Low	0.22	Fair	Poor	0	Poor
Hunt Creek	1	8/15/1994	1247	6.8	msm	3.0	0	Poor	0	Poor/High	0	Poor	Poor	0	Poor
Hunt Creek	2	8/16/1994	2545	8.3	sc	3.5	0.5	Poor	131.1	Poor/Low	0.6	Good	Poor	0	Poor
Hunt Creek	3	8/17/1994	1848	7.7	mv	2.1	1.2	Poor	111.3	Poor/Low	0.6	Good	Poor	0	Poor
Hunt Creek	4	8/18/1994	579	12.7	smh	1.3	0	Poor	0	Poor/High	0	Poor	Poor	0	Poor
Keystone Creek	270	9/9/1998	567	3.8	mv	1.2	4	Poor	102.6	Poor/Low	0.33	Fair	Poor	0	Poor
Plympton Creek	1	8/30/1994	990	3.8	mm	8.0	7.6	Poor	10.3	Fair	0.6	Fair	Fair	0	Poor
Plympton Creek	2	8/30/1994	1575	6.7	mv	7.8	5.6	Poor	16	Fair	1.7	Good	Fair	0	Poor
Plympton Creek	3	8/31/1994	1013	2.9	fp3	5.5	7.9	Poor	19.1	Fair	0.8	Good	Fair	1.3	Fair
Plympton Creek	4	9/1/1994	1839	5.1	mv	6.4	3.4	Poor	26.5	Poor/Low	1.2	Good	Poor	0	Poor
Plympton Creek	5	9/8/1994	3644	5.1	mv	4.8	8.8	Poor	86.1	Poor/Low	1	Good	Poor	0	Poor
Plympton Creek	6	9/12/1994	1778	2.5	fp3	5.7	55.9	Good	83.3	Poor/Low	0.8	Good	Fair	0	Poor
West Creek	1	6/26/1996	339	2.6	lc	3.8	22.9	Fair	7.4	Good	0.4	Fair	Good	0	Poor
West Creek	2	7/8/1996	4370	8.1	sv	2.7	15.1	Fair	4.1	Poor/High	0.5	Fair	Fair	0	Poor
West Creek	3	7/15/1996	270	3.7	mh	1.8	16.9	Fair	25	Poor/Low	0.7	Good	Fair	0	Poor
West Creek	4	7/15/1996	938	5	mh	1.5	6.8	Poor	100.9	Poor/Low	0.4	Fair	Poor	0	Poor
West Fork Hunt Creek	1	6/11/1996	1469	8.7	sv	3.1	7.9	Poor	5.4	Good	0.3	Fair	Fair	0	Poor
West Fork Hunt Creek	2	6/18/1996	961	7.4	mv	2.5	8.5	Poor	6.6	Good	0.3	Fair	Fair	0	Poor
West Fork Hunt Creek	3	6/24/1996	1333	10.4	sv	1.8	3.7	Poor	20.9	Poor/Low	0.3	Fair	Poor	0	Poor
Willark Creek	1	9/11/1990	917	1.6	lm	2.3	32	Fair	4.4	Poor/High	0.2	Fair	Fair	ND	ND
Willark Creek	2	9/11/1990	694	1.8	lm	2.3	31.5	Fair	4.4	Poor/High	0.2	Fair	Fair	ND	ND
Willark Creek	3	9/11/1990	211	2.5	fp2	2.2	26.1	Fair	7	Good	0.2	Fair	Good	ND	ND

Stream	Reach	Width/Depth Ratio		Gravel (% area)		Silt-sand-organics (% area)			Overall Riffle Rating	LWD Pieces/100 m		Volume LWD/100m		Key Pieces/100 m		Overall LWD Rating
		Wdratio	Benchmark	Pctgravel	Benchmark	Pctsndoc	Categ	Benchmark		LWDpiece1	Benchmark	LWDvol1	Benchmark	KeyLWD1	Benchmark	
Beaver Creek	281	25.7	Fair	15	Fair	40	G	Poor	Fair	2.3	Poor	2.3	Poor	0	Poor	Poor
Carcus Creek '90	1	10.5	Good	59	Good	11	G	Good	Good	ND	ND	ND	ND	ND	ND	ND
Carcus Creek '90	2	10.5	Good	60	Good	10	G	Good	Good	ND	ND	ND	ND	ND	ND	ND
Carcus Creek '90	3	11.5	Good	44	Good	8	G	Good	Good	ND	ND	ND	ND	ND	ND	ND
Carcus Creek '90	4	13.5	Good	35	Good	7	V	Good	Good	ND	ND	ND	ND	ND	ND	ND
Carcus Creek '90	5	13.5	Good	46	Good	7	V	Good	Good	ND	ND	ND	ND	ND	ND	ND
Carcus Creek '98	293	22.2	Fair	14	Poor	10	S	Fair	Fair	13.8	Fair	14.3	Poor	0.1	Poor	Poor
Clatskanie River '91	1	20.3	Fair	32	Fair	39	G	Poor	Fair	4.4	Poor	4.1	Poor	ND	ND	Poor
Clatskanie River '91	2	16.7	Fair	29	Fair	23	G	Fair	Good	6	Poor	3.6	Poor	ND	ND	Poor
Clatskanie River '91	3	31.3	Poor	22	Fair	14	S	Fair	Fair	5	Poor	5.6	Poor	ND	ND	Poor
Clatskanie River '91	4	24.0	Fair	24	Fair	26	G	Poor	Fair	3.9	Poor	3.8	Poor	ND	ND	Poor
Clatskanie River '91	5	20.0	Fair	29	Fair	20	G	Fair	Good	5.3	Poor	5.1	Poor	ND	ND	Poor
Clatskanie River '91	6	22.0	Fair	17	Fair	11	S	Fair	Good	4.4	Poor	1.2	Poor	ND	ND	Poor
Clatskanie River '91	7	17.7	Fair	22	Fair	17	S	Fair	Good	2.7	Poor	3.6	Poor	ND	ND	Poor
Clatskanie River '91	8	12.8	Good	13	Poor	12	S	Fair	Fair	0.5	Poor	0.1	Poor	ND	ND	Poor
Clatskanie River '91	9	25.5	Fair	23	Fair	32	G	Poor	Fair	1.2	Poor	0.9	Poor	ND	ND	Poor
Clatskanie River '91	10	14.5	Fair	29	Fair	33	G	Poor	Fair	1.4	Poor	2.6	Poor	ND	ND	Poor
Clatskanie River '98	308	31.4	Poor	11	Poor	24	S	Poor	Poor	10.2	Fair	5	Poor	0.1	Poor	Poor
Clatskanie River '98	350	16.1	Fair	41	Good	38	G	Poor	Fair	6.2	Poor	1.7	Poor	0	Poor	Poor
Conyers Creek	1	ND	ND	33	Fair	66	G	Poor	Fair	0	Poor	0	Poor	0	Poor	Poor
Conyers Creek	2	52.1	Poor	52	Good	30	G	Poor	Poor	2.4	Poor	4.5	Poor	0.2	Poor	Poor
Conyers Creek	3	69.6	Poor	31	Fair	33	G	Poor	Poor	16.1	Fair	30.2	Fair	2.1	Fair	Good
Conyers Creek	4	47.0	Poor	22	Fair	31	S	Poor	Poor	17.8	Fair	43.6	Good	2.5	Fair	Good
Conyers Creek Tributary	160	13.2	Good	14	Poor	23	S	Poor	Poor	19.4	Fair	25.1	Fair	1.5	Fair	Good
Hunt Creek	1	ND	Poor	35	Good	21	V	Poor	Poor	19.7	Fair	14.3	Poor	0.4	Poor	Poor
Hunt Creek	2	ND	Poor	30	Fair	25	V	Poor	Poor	21.6	Good	18	Poor	0.4	Poor	Poor
Hunt Creek	3	ND	Poor	28	Fair	39	V	Poor	Poor	20.5	Good	27	Fair	1	Fair	Good
Hunt Creek	4	ND	Poor	22	Fair	36	V	Poor	Poor	57.7	Good	20.8	Fair	0	Poor	Fair
Keystone Creek	270	7.5	Good	24	Fair	38	S	Poor	Fair	9.5	Fair	5.2	Poor	0	Poor	Poor
Plympton Creek	1	16.0	Fair	30	Fair	33	S	Poor	Fair	7.3	Poor	9.9	Poor	0.5	Fair	Poor
Plympton Creek	2	42.7	Poor	23	Fair	21	S	Poor	Poor	32.1	Good	59.8	Good	3.4	Fair	Good
Plympton Creek	3	40.8	Poor	43	Good	26	S	Poor	Poor	19.6	Fair	18.3	Poor	0.2	Poor	Poor
Plympton Creek	4	26.7	Fair	23	Fair	25	V	Poor	Fair	42.7	Good	106.5	Good	6.4	Good	Good
Plympton Creek	5	40.0	Poor	25	Fair	38	V	Poor	Poor	32.1	Good	43.5	Good	1	Fair	Good
Plympton Creek	6	22.9	Fair	6	Poor	90	V	Poor	Poor	34.4	Good	50.3	Good	1.5	Fair	Good
West Creek	1	20.2	Fair	38	Good	29	S	Poor	Fair	3.8	Poor	2.6	Poor	0.3	Poor	Poor
West Creek	2	20.6	Fair	26	Fair	18	S	Fair	Good	44.8	Good	95.6	Good	2.5	Fair	Good
West Creek	3	12.2	Good	43	Good	36	V	Poor	Fair	12.6	Fair	12	Poor	0	Poor	Poor
West Creek	4	22.7	Fair	23	Fair	21	V	Poor	Fair	12.9	Fair	12.5	Poor	0.3	Poor	Poor
West Fork Hunt Creek	1	23.5	Fair	31	Fair	9	V	Fair	Good	33.6	Good	45	Good	0.7	Fair	Good
West Fork Hunt Creek	2	51.0	Poor	29	Fair	14	V	Fair	Fair	38.9	Good	38.2	Good	1	Fair	Good
West Fork Hunt Creek	3	79.2	Poor	28	Fair	16	V	Poor	Poor	24.1	Good	21	Fair	0.5	Fair	Good
Willark Creek	1	20.0	Fair	53	Good	16	S	Fair	Good	ND	ND	ND	ND	ND	ND	ND
Willark Creek	2	20.0	Fair	51	Good	18	S	Fair	Good	ND	ND	ND	ND	ND	ND	ND
Willark Creek	3	9.0	Good	61	Good	17	S	Fair	Good	ND	ND	ND	ND	ND	ND	ND

Stream	Reach	CHT	Width	Conifers # >20in dbh		Conifers # >35in dbh		Overall Conifers Rating	Stream shading		Bank	Percent
				Con_20plus	Benchmark	Con_36plus	Benchmark		Shade	Benchmark	Bankerosi	Pctscchnla
Beaver Creek	281	lm	10.6	142	Poor	41	Poor	Poor	76	Good	66	0.0
Carcus Creek '90	1	mh	2.6	ND	ND	ND	ND	ND	68	Fair	1.4	7.3
Carcus Creek '90	2	fp2	3.5	ND	ND	ND	ND	ND	48	Poor	0	0.0
Carcus Creek '90	3	fp2	2.7	ND	ND	ND	ND	ND	77	Good	1.2	5.7
Carcus Creek '90	4	lc	3.3	ND	ND	ND	ND	ND	95	Good	10.8	0.0
Carcus Creek '90	5	lc	2.9	ND	ND	ND	ND	ND	98	Good	2.5	1.3
Carcus Creek '98	293	fp3	4	0	Poor	0	Poor	Poor	64	Fair	9	6.0
Clatskanie River '91	1	fp1	6.3	ND	ND	ND	ND	ND	66	Fair	12.2	15.2
Clatskanie River '91	2	fp2	5.5	ND	ND	ND	ND	ND	66	Fair	10.2	5.4
Clatskanie River '91	3	fp2	7.9	ND	ND	ND	ND	ND	79	Good	15.8	0.2
Clatskanie River '91	4	fp1	6.5	ND	ND	ND	ND	ND	59	Poor	19	13.6
Clatskanie River '91	5	fp1	6.4	ND	ND	ND	ND	ND	79	Good	10.6	10.8
Clatskanie River '91	6	mm	6.9	ND	ND	ND	ND	ND	71	Good	0.6	0.3
Clatskanie River '91	7	fp3	7	ND	ND	ND	ND	ND	71	Good	5.4	2.7
Clatskanie River '91	8	fp2	6	ND	ND	ND	ND	ND	78	Good	2.3	0.7
Clatskanie River '91	9	fp2	6.2	ND	ND	ND	ND	ND	74	Good	7.6	3.3
Clatskanie River '91	10	fp2	4.2	ND	ND	ND	ND	ND	81	Good	2.9	0.3
Clatskanie River '98	308	lm	5.9	20	Poor	0	Poor	Poor	83	Good	2	11.4
Clatskanie River '98	350	lm	4.4	183	Fair	0	Poor	Fair	82	Good	6	0.3
Conyers Creek	1	lm	3.1	ND	ND	ND	ND	ND	56	Poor	50	0.0
Conyers Creek	2	lm	3.7	0	Poor	0	Poor	Poor	75	Good	17.3	4.3
Conyers Creek	3	lc	3.3	0	Poor	0	Poor	Poor	80	Good	22.2	1.1
Conyers Creek	4	mm	3.8	0	Poor	0	Poor	Poor	78	Good	12.2	0.0
Conyers Creek Tributary	160	mv	1.8	0	Poor	0	Poor	Poor	66	Fair	5	9.0
Hunt Creek	1	msm	3	0	Poor	0	Poor	Poor	98	Good	7.8	8.7
Hunt Creek	2	sc	3.5	138.8	Poor	18.1	Poor	Poor	97	Good	4.3	7.6
Hunt Creek	3	mv	2.1	0	Poor	0	Poor	Poor	99	Good	0.7	7.3
Hunt Creek	4	smh	1.3	181	Fair	60.3	Poor	Fair	89	Good	45.5	13.5
Keystonee Creek	270	mv	1.2	81	Poor	20	Poor	Poor	81	Good	46	14.4
Plympton Creek	1	mm	8	0	Poor	0	Poor	Poor	99	Good	2.1	0.0
Plympton Creek	2	mv	7.8	90.5	Poor	30.2	Poor	Poor	96	Good	3.4	9.7
Plympton Creek	3	fp3	5.5	0	Poor	0	Poor	Poor	96	Good	8.9	15.0
Plympton Creek	4	mv	6.4	90.5	Poor	30.2	Poor	Poor	96	Good	2.9	5.6
Plympton Creek	5	mv	4.8	205.1	Fair	24.1	Poor	Fair	90	Good	14	9.9
Plympton Creek	6	fp3	5.7	91	Poor	0	Poor	Poor	72	Good	24	0.2
West Creek	1	lc	3.8	0	Poor	0	Poor	Poor	61	Fair	22.8	0.5
West Creek	2	sv	2.7	61	Poor	0	Poor	Poor	81	Good	24.2	12.5
West Creek	3	mh	1.8	0	Poor	0	Poor	Poor	83	Good	3.2	22.9
West Creek	4	mh	1.5	91	Poor	0	Poor	Poor	86	Good	0.7	4.8
West Fork Hunt Creek	1	sv	3.1	41	Poor	0	Poor	Poor	67	Fair	0.9	19.0
West Fork Hunt Creek	2	mv	2.5	107	Poor	15	Poor	Poor	81	Good	0	23.7
West Fork Hunt Creek	3	sv	1.8	110	Poor	0	Poor	Poor	84	Good	0	20.7
Willark Creek	1	lm	2.3	ND	ND	ND	ND	ND	95	Good	1.9	1.1
Willark Creek	2	lm	2.3	ND	ND	ND	ND	ND	91	Good	5.7	6.3
Willark Creek	3	fp2	2.2	ND	ND	ND	ND	ND	100	Good	0	0.0