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# Appendix C

# Environmental Baseline

# ENVIRONMENTAL BASELINE

***I. PREFACE:*** A brief summation of the environmental baseline conditions for listed fish species contained in the available literature is provided below. Whenever possible, additional information for each species for specific basins or geographic areas is included:

**a. CHINOOK**: Chinook salmon were abundant in Washington State near the turn of the century, when estimates based on peak cannery pack suggested peak runs of near one million fish in the Oregon Coast, Washington Coast, and Puget Sound ESUs. However, chinook salmon in this region has been strongly affected by losses and alterations of freshwater habitat. Timber harvesting and associated road building have occurred throughout this region. Agriculture is also widespread in the lower portions of river basins and has resulted in widespread removal of riparian vegetation, rerouting of streams, degradation of streambanks, and summer water withdrawals. Urban development has substantially altered watershed hydrodynamics and affected stream channel structure in many parts of Puget Sound. Within the last 50 years, over 2.5 billion spring-, summer-, and fall-fun chinook salmon have been released from state, federal, and/or tribal hatcheries in this region, with the fall run constituting the majority of these releases.

At the present time, all basins are affected (to varying degrees) by habitat degradation. Tributaries within the Olympic National Park have been least affected by human activities. For other areas, major habitat problems are related primarily to forest practices, including mass wasting resulting from sedimentation in spawning grounds, lack of large woody debris, and lack of streamside shade. Loss of estuarine areas has also contributed to the decline (see Table C.1 at the end of this appendix).

The information presented below can be found in Myers, *et al.* (1998).

The Skagit River and its tributaries--the Baker, Sauk, Suiattle, and Cascade Rivers--constitute what was historically the predominant system in Puget Sound containing naturally spawning populations (WDF et al. 1993). Spring-run chinook salmon are present in the North and South Fork Nooksack Rivers, the Skagit River Basin, the White, and the Dungeness Rivers (WDF et al. 1993). Spring-run populations in the Stillaguamish, Skokomish, Dosewallips, and Elwha Rivers are thought to be extinct (Nehlsen et al. 1991). Summer-run chinook salmon are present in the Upper Skagit and Lower Sauk Rivers in addition to the Stilliguamish and Snohomish Rivers (WDF et al. 1993). Fall-run stocks (also identified by management agencies as summer/fall runs in Puget Sound) are found throughout the region in all major river systems. The artificial propagation of fall-run stocks is widespread throughout this region. Summer/fall chinook salmon transfers between watersheds within and outside the region have been commonplace throughout this century; thus, the purity of naturally spawning stocks varies from river to river. Captive broodstock/recovery programs for spring-run chinook salmon have been undertaken on the White River (Appleby and Keown 1994), and the Dungeness River (Smith and Sele 1995). Supplementation programs currently exist for spring-run chinook salmon on North Fork Nooksack River and summer-run chinook salmon on the Stillaguamish and Skagit Rivers (Marshall et al. 1995, Fuss and Ashbrook 1995). Hatchery programs also release Suiattle River spring-run chinook salmon and Snohomish River (Wallace River) summer-run chinook salmon (Marshall et al. 1995, Fuss and Ashbrook 1995).

The peak recorded harvest landed in Puget Sound occurred in 1908, when 95,210 cases of canned chinook salmon were packed. This corresponds to a run-size of approximately 690,000 chinook salmon at a time when both ocean harvest and hatchery production were negligible. (This estimate, as with other historical estimates, needs to be viewed cautiously; Puget Sound cannery pack probably included a portion of fish landed at Puget Sound ports but originating in adjacent areas, and the estimates of exploitation rates used in run-size expansions are not based on precise data.) Recent mean spawning escapements totaling 71,000 correspond to a run entering Puget Sound of approximately 160,000 fish. Based on an exploitation rate of one-third in intercepting ocean fisheries, the recent average potential run-size would be 240,000 chinook salmon (PSC, 1994).

Currently, escapement to rivers in Puget Sound and Hood Canal is monitored by WDFW and the Northwest tribes. Populations least affected by hatcheries are in the northern part of the sound in the Nooksack, Skagit, Stillaguamish, and Snohomish River systems.

The Nooksack River has spring/summer runs in the north and south forks. The North Fork escapement is monitored by carcass surveys and is influenced by a hatchery on Kendall Creek (part of a native stock rebuilding program). Escapement to the South Fork is monitored by redd counts, and the stock is believed to have little hatchery influence. Both stocks are considered critical by WDFW because of chronically low spawning escapements. The Skagit River supports three spring runs, two summer runs, and a fall run. Mean spawning escapement of the summer/fall run has been below the escapement goal and declining. Terminal run-size has been declining, and escapement has been maintained at the expense of terminal fisheries. Of the five stocks identified by WDF et al. (1993), two are rated healthy, two depressed, and one of unknown status. On the Stillaguamish River, two runs have been identified. The combined escapement goal has been met only twice since 1978, and both runs are considered depressed. Of four runs identified in the Snohomish system, two are rated depressed, one unknown, and one as healthy. The single stock identified as “healthy” (Wallace River) is considered to be derived from hatchery strays and has experienced a severe recent decline.

The 5-year geometric mean of spawning escapement of natural chinook salmon runs in North Puget Sound for 1992-96 is approximately 13,000. Both long- and short-term trends for these runs were negative, with few exceptions. In south Puget Sound, spawning escapement of the natural runs has averaged 11,000 spawners. In this area, both long- and short-term trends are predominantly positive.

In Hood Canal, summer/fall-run chinook salmon spawn in the Skokomish, Union, Tahuya, Duckabush, Dosewallips and Hamma Hamma Rivers. Because of transfers of hatchery fish, these spawning populations are considered a single stock (WDF et al. 1993). Fisheries in the area are managed primarily for hatchery production and secondarily for natural escapement; high harvest rates directed at hatchery stocks have resulted in failure to meet natural escapement goals in most years (USFWS 1997). The 5-year geometric mean natural spawning escapement has been 1,100, with negative short- and long-term trends (except in the Dosewallips River).

The ESU also includes the Dungeness and Elwha Rivers, which have natural chinook salmon runs as well as hatcheries. The Dungeness River has a run of spring/summer-run chinook salmon with a 5-year geometric mean natural escapement of 105 fish. The Elwha River has a 5-year geometric mean escapement of 1,800 fish, but contains two hatcheries, both lacking adequate adult recovery facilities. Egg take at the hatcheries is augmented from natural spawners, and hatchery fish spawn in the wild. Consequently, hatchery and natural spawners are not considered discrete stocks (WDF et al. 1993). Both of these populations exhibit downward recent trends.

Habitat throughout the ESU has been blocked or degraded. In general, upper tributaries have been impacted by forest practices and lower tributaries and mainstem rivers have been impacted by agriculture and/or urbanization. Diking for flood control, draining and filling of freshwater and estuarine wetlands, and sedimentation due to forest practices and urban development are cited as problems throughout the ESU (WDF et al. 1993). Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in several basins. Bishop and Morgan (1996) identified a variety of critical habitat issues for streams in the range of this ESU including 1) changes in flow regime (all basins), 2) sedimentation (all basins), 3) high temperatures (Dungeness, Elwha, Green/Duwamish, Skagit, Snohomish, and Stillaguamish Rivers), 4) streambed instability (most basins), 5) estuarine loss (most basins), 6) loss of large woody debris (Elwha, Snohomish, and White Rivers), 7) loss of pool habitat (Nooksack, Snohomish, and Stillaguamish Rivers), and 8) blockage or passage problems associated with dams or other structures (Cedar, Elwha, Green/Duwamish, Snohomish, and White Rivers). The Puget Sound Salmon Stock Review Group (PSSSRG 1997) provided an extensive review of habitat conditions for several of the stocks in this ESU. It concluded that reductions in habitat capacity and quality have contributed to escapement problems for Puget Sound chinook salmon. It cited evidence of direct losses of tributary and mainstem habitat, due to dams; of slough and side-channel habitat, caused by diking, dredging, and hydromodification; and also cited reductions in habitat quality due to land management activities.

WDF et al. (1993) classified 11 out of 29 stocks in this ESU as being sustained, in part, through artificial propagation. Nearly 2 billion fish have been released into Puget Sound tributaries since the 1950s. The vast majority of these have been derived from local returning fall-run adults. Returns to hatcheries have accounted for 57% of the total spawning escapement, although the hatchery contribution to spawner escapement is probably much higher than that, due to hatchery-derived strays on the spawning grounds. In the Stillaguamish River, summer-run chinook have been supplemented under a wild broodstock program for the last decade. In some years, returns from this program have comprised from 30% to 50% of the natural spawners, suggesting that the unaided stock is not able to maintain itself (NWIFC 1997). Almost all of the releases into this ESU have come from stocks within this ESU, with the majority of within-ESU transfers coming from the Green River Hatchery or hatchery broodstocks that have been derived from Green River stock (Marshall et al. 1995). The electrophoretic similarity between Green River fall-run chinook salmon and several other fall-run stocks in Puget Sound (Marshall et al. 1995) suggests that there may have been a significant effect from some hatchery transplants. Overall, the pervasive use of Green River stock throughout much of the extensive hatchery network, that exists in this ESU, may reduce the genetic diversity and fitness of naturally spawning populations. Harvest impacts on Puget Sound chinook salmon stocks have been quite high. Ocean exploitation rates on natural stocks average 56-59%; total exploitation rates average 68-83% (1982-89 brood years) (PSC 1994). Total exploitation rates on some stocks have exceeded 90% (PSC 1994).

Previous assessments of stocks within this ESU have identified several stocks as being at risk or of concern. Nehlsen et al. (1991) identified four stocks as extinct, four stocks as possibly extinct, six stocks as at high risk of extinction, one stock as at moderate risk (White River spring run), and 1 stock (Puyallup River fall run) as of special concern. WDF et al. (1993) considered 28 stocks within the ESU, of which 13 were considered to be of native origin and predominantly natural production. The status of these 13 stocks was: 2 healthy (Upper Skagit River summer run and Upper Sauk River spring run), 5 depressed, 2 critical (South-Fork Nooksack River spring/summer run and Dungeness River spring/summer run), and 4 unknown. The status of the remaining (composite production) stocks was eight healthy, two depressed, two critical, and three unknown. The Nooksack/Samish River fall run and Issaquah Creek summer/fall run were not considered an ESA issue by the NMFS biological review team (stocks were not historically present in the watershed or current stocks are not representative of historical stocks) but were included to give a complete presentation of stocks identified by WDF et al. (1993).

## Puyallup River Basin

*Spring Chinook* — Spring chinook were historically abundant in the White River and also occurred in limited numbers in the Carbon River and mainstem of the Puyallup River (Williams et al. 1975). Prior to 1915, the White River flowed primarily into the Duwamish River, but some flow entered the Puyallup River via the Stuck River channel (Salo and Jagielo 1983). In 1915, the river was permanently diverted into the Puyallup River via the Stuck River channel. The diversion of the White River dramatically increased the spring chinook run to the Puyallup River system. More is known about spring chinook in the White River than for the other portions of the Puyallup River drainage and the discussion below focuses on the White River component of the run.

The best historic data on spring chinook abundance is from the period 1942-1950, while Mud Mountain Dam was being built on the White River (Salo and Jagielo 1983). The spawner escapements to the White River above Mud Mountain Dam averaged about 3,000 (adults and jacks) during this period. After 1950, counts decreased steadily to less than 70 fish in the late 1970s (Myers et al. 1998 citing PRO-Salmon 1994). A recovery effort that included hatchery supplementation, off-site net pen rearing, and increased stream flow in portions of the White River has been successful in rebuilding the spawning run to a geometric mean of 473 for the period 1988-1992 (Myers et al. 1998). More recent escapements have been in the range of 500-1000 (Puyallup Tribe, personal communication). Because of the recent importance of net-pen rearing and hatchery production in rebuilding the spring chinook run, the naturally spawning component of the run is probably still dependent upon hatchery production.

Based on run timing to the Puyallup River reported in Williams et al. (1975), adult spring chinook could be present in Commencement Bay, from approximately mid-March through July. Sub-adult spring chinook could possibly be present in Commencement Bay during any month of the year, although based on a lack of an active year-round sport fishery in the area; it is expected that such use is very limited.

Spring chinook historically spawned primarily in the upper tributaries of the White River and perhaps the mainstem of the Puyallup and Carbon Rivers (Williams et al. 1975). Rearing occurs in the spawning areas; and in lower mainstem reaches. Recently, the highest density of spring chinook redds has been in Boise Creek, a tributary of the White River (Puyallup Tribe, personal communication). Dunstan (1955) reported that approximately 20 percent of the White River spring chinook spent one year in freshwater, indicating that a component of the run, did consist of" stream-type" chinook. However, more recently it has been reported that nearly all of the juvenile spring chinook migrate downstream as sub-yearlings and are therefore ocean-type" chinook (Muckleshoot Indian Tribe et al. 1996). Therefore, it appears that the spring run previously had both ocean-type and stream-type chinook, but now has predominately ocean-type chinook.

Rearing by juvenile spring chinook may occur in Commencement Bay, but the time spent in the shoreline areas of the bay is likely very limited. This conclusion is based on the size of the emigrate spring chinook that have been captured near the Puget Sound Energy water diversion on the White River (located approximately 35 miles upstream of Commencement Bay). Specifically, fish captured at that location have averaged from 77 to 86 mm in length (Puyallup Tribe, personal communication). These fish are likely a mix of hatchery and naturally spawning chinook, and their length indicates they should rapidly migrate away from the shoreline and away from the Commencement Bay estuary to the greater Puget Sound estuary. Juvenile chinook are typically considered to move from the shoreline to deeper water at a length of approximately 65-75 mm (Healy 1982, Simenstad et al. 1982).

Spring chinook from the Puyallup River system are harvested extensively in Puget Sound fisheries (Puyallup Tribe, personal communication) indicating that this race can reside for an extended-period, possibly much of their adult life, within Puget Sound.

*Fall Chinook* — The historic average run size of fall chinook has been 3,000-4,000 fish (Williams et al. 1975). The geometric mean spawner escapement for the period 1988-1992 was approximately 2,500 fish (Myers et al. 1998). Recent spawner escapements have been lower (Puyallup Tribe personal communication).

Fall chinook return to Puyallup River as early as mid-June and complete spawning by mid-October (Puyallup Tribe, personal communication). Based on this run timing, adults could be present within Commencement Bay, from about mid-May through October.

Chinook spawn throughout the larger streams in the Puyallup River system including the mainstem of the Puyallup, the lower White and Carbon rivers, and Kapowsin, South Prairie, and Voight Creeks. Fall chinook are not present in Wapato Creek, which drains to the head of Blair Waterway. The use of rearing habitats by this race is more variable than that for spring chinook. Following emergence, juveniles either emigrate immediately to Commencement Bay or remain for up to several months in freshwater.

Juvenile fall chinook use Commencement Bay from late March through mid-September (Miyamoto et al. 1980, Dames and Moore 1981, Duker et al. 1989, Port of Tacoma and Puyallup Tribe 1998, Pacific International Engineering, 1999b). Sampling data from mid-September through December is not available but juvenile chinook may be present in Commencement Bay in these later months as well. Individual fish may only use Commencement Bay for a period of days or weeks prior to moving into the greater Puget Sound estuary. Very low beach seine catches occur in March through early May, and chinook released from the hatchery before mid-May do not appear to migrate to the bay until later (Duker et al. 1989). Releases of hatchery fish after mid-May lead to immediate high catches of relatively large juveniles in Commencement Bay near the mouth of the Puyallup River (Duker et al 1989). For example, during 1983, approximately 1.3 million juvenile chinook were released from state fish hatcheries prior to Julian day 125 (May 5) (Duker et al. 1989). Release of these fish was not followed by any appreciable increase in beach seine or townet catches in Commencement Bay. Between Julian day 135 (May 15) and Julian day 148 (May 28) approximately 1.3 million more chinook were released. Following these releases, beach seine catches in the bay peaked on Julian day 150 (May 30), while townet catches peaked approximately 10 days later.

Based on the catch of juvenile chinook in the bay relative to the releases of hatchery fish, it appears that few if any hatchery chinook rear in the Commencement Bay estuary for an extended period. Further, catches are so low prior to the release of hatchery fish that it is clear that few naturally spawned fish are rearing in the Commencement Bay estuary for an extended period, given typical spawner escapements during the 1980's. Overall, most use of Commencement Bay by juvenile chinook occurs during the period Julian day 130 (May 10) and Julian day 180 (June 29). As these dates encompass fish that have migrated down the river at different times within that period, the residence time of an individual fish cannot be deduced. Shreffler et al. (1990) documented a residence time of up to 43 days in the Gog-lehi-te Wetland, but this habitat is of a very different character than the typical shoreline habitats in the bay. Peak catches of chinook occur near the mouth of the river approximately 10- 12 days earlier than at the more distant portions of the bay near Browns Point and Ruston Way (Duker et al. 1989). This interval is the best estimate of the residence time of an individual juvenile chinook within the waterways and the Puyallup River (Duker et al. 1989).

Catches of juvenile fall chinook in the Blair Waterway follow a trend similar to that in the rest of Commencement Bay. Beach seine catches in the Blair Waterway we much lower than at sites near the mouth of the Puyallup River (Duker et al. 1989). Also, use of the surface of the water column habitat (the surface 3-4 feet of the portions of the waterway distant from shore) by juvenile fall chinook salmon is greater in the vicinity of East 11 Street to the mouth of the waterway than at the head of the waterway.

Fall chinook from the Puyallup River system contribute heavily to Canadian fisheries, particularly those off the coast of Vancouver Island (Puyallup Tribe personal communication). Based on the different fisheries to which the Puyallup River system spring and fall chinook contribute, the saltwater distribution of these runs is quite different.

## **Green/Duwamish River Basin**

Grette and Salo (1986) state that a large portion of the "native" chinook run in the Green/Duwamish River were actually "natural" or "wild" fish with some hatchery genes. The hatchery stock of chinook salmon in the Green River was established by taking eggs from adults captured at a weir across the mainstem of the Green River (Becker 1967). Prior to 1900 there were few if any chinook in Big Soos Creek, the site of the Green River Hatchery (Grette and Salo 1986).

According to the WDFW (WDFW, WDW, WWTIT 1993), the Green River chinook stock status is healthy based on recent escapement levels. The escapement goal set for this stock by WDFW is 5,800; this goal has been exceeded in each of the past 4 years from 1995 to 1998. The average escapement for the past 22 years is 6,211; the lowest escapement of 1,840 occurred in 1982, and the maximum escapement of 11,512 occurred in 1989.

The Newaukum Creek summer/fall chinook stock is distinct based on geographic distribution (WDFW, WDW, WWTIT 1993). This stock is largely native but is influenced by hatchery strays whose origins are Green River Hatchery and Icy Creek. According to WDFW (WDFW, WDW, WWTIT 1993), the status of the stock is healthy, although there were declines in escapement in 1990 and 1991. Escapement levels ranged from 300 to 3,000, with an average of 1,038 from 1986 to 1998.

In the 1970s, different stocks of spring chinook were reared at the Icy Creek station; subsequently, returning adults were reported. As of 1986 they were not being raised at the state or Tribal hatcheries (Grette and Salo 1986), and there is no recent information indicating that spring chinook persist in the system (WDFW, WDW, WWTIT 1993).

**b. SOCKEYE**: Within the Columbia River Basin in Washington, historical populations of sockeye salmon existed in the Yakima, Wenatchee, and Okanogan Rivers. Construction of crib dams without fish passage facilities at Lake Keechelus and Kachess in 1904 and at Lake Cle Elum in 1905 eliminated sockeye salmon populations in these lakes. Construction of an impassable storage dam at Bumping Lake in 1910 likewise eliminated a sockeye salmon population in that lake. The native population of sockeye salmon in Lake Wenatchee was severely depleted during the early 1900's. Small dams and unscreened irrigation diversions on the Wenatchee River contributed to the decline of this population. Historically, sockeye salmon are thought to have utilized Lakes Okanogan, Skaha, and Osoyoos in the Okanogan River Basin for juvenile rearing. Sockeye salmon access to Lakes Okanogan and Skaha was blocked by dams in 1915 and 1921, respectively. Access to Lake Osoyoos remained open, but the population was severely depleted in the early 1900s. In order to preserve a portion of the sockeye salmon stocks denied access to the Upper Columbia River in 1939 by Grand Coulee Dam, all sockeye salmon were trapped at Rock Island Dam and relocated to Lakes Wenatchee or Osoyoos (or to one of three national fish hatcheries). Recent escapement data on Okanogan River sockeye salmon indicate that pre-spawning mortality between Wells Dam and spawning grounds on the Okanogan River is about 30 percent.

Historically, sockeye salmon were known to occur in Puget Sound at Baker Lake on the Baker River, a tributary of the Skagit River, and probably in Mason Lake at the base of the Kitsap Peninsula. In is uncertain whether sockeye salmon were present historically in the Skokomish River or in the Lake Washington/Lake Sammamish Basin. Baker River sockeye salmon continue to return to the lower Baker River, where they are trapped and transported above dams on the Baker River to spawn in artificial beaches provided with gravel substrate and upwelling water. Historical information indicates that sockeye salmon may once have ascended the North Fork of the Skokomish River.

Presently, the largest population of sockeye salmon in the contiguous U.S. spawns in the Cedar River, the main tributary of Lake Washington. Historical accounts concerning the presence and distribution of sockeye salmon within the Lake Washington/Lake Sammamish drainage are equivocal. Kokanee were present within this drainage historically and are known to be native.

Construction of Elwha Dam in 1910 on the Elwha River on Washington's Olympic Peninsula reportedly eliminated a native sockeye salmon population that spawned and reared in Lake Sutherland. Native sockeye salmon populations exist in Ozette and Quinault Lakes on the outer coast of the Olympic Peninsula in Washington. Although sockeye salmon may not currently run up the Dickey River to Dickey Lake (a tributary system of the Quillayute River), a sockeye salmon population existed in the lake historically.

Sockeye salmon have been identified in Washington by WDFW as occurring in Baker River, Ozette Lake, Lake Pleasant, Quinault Lake, Okanogan River, Cedar River, Lake Wenatchee, Lake Washington/Lake Sammamish tributaries, and Lake Washington beach spawners. In addition, spawning aggregates of sockeye salmon appear consistently in Columbia River tributaries: the Methow, Entiat, and Similkameen Rivers and Icicle Creek in the Wenatchee River drainage. Sockeye salmon have been periodically observed in other Washington rivers that lack accessible lake habitat, including the Nooksack, Samish, mainstem Skagit, Souk, Stillaguamish, Green, Skokomish, Dungeness, Calawah, Hoh, Queets and North Fork Lewis Rivers. Several stocks of sockeye salmon are observed yearly during spawner surveys in almost every river in Puget Sound. However, numbers of sockeye salmon are higher in north Puget Sound rivers than in south Puget Sound rivers.

All populations of sockeye salmon in this region have been affected by substantial loss and degradation of freshwater habitat, although the causes vary among populations. Much of the original sockeye salmon habitat in the Columbia River Basin has been blocked by irrigation diversions, hydroelectric development, and other human activities: accessible nursery lake habitat in the upper Columbia River in now only 4 percent of historical habitat, and only one remnant population remains in the Snake River. This has resulted in widespread extinctions of populations that formerly occupied these areas. Coastal populations have also been affected by a variety of habitat factors, particularly hydroelectric development and forest management practices.

**c. STEELHEAD:** No estimates of historical (pre-1960s) abundance specific to the Puget Sound ESU are available. Total run size in the early 1980s is estimated as approximately 100,000 winter and 20,000-summer steelhead. However, it is estimated that 70 percent of steelhead in ocean runs were of hatchery origin.

There are substantial habitat blockages by dams in the Skagit and Elwha River basins, and minor blockages (i.e., impassable culverts) throughout the region. The SASSI appendices note habitat problems, including flooding, unstable soils, and poor land management practices for most stocks in the Puget Sound ESU. In general, habitat has been degraded from its pristine condition, and this trend is likely to continue with further population growth and resultant urbanization in the Puget Sound region. Summer steelhead appear to be more at risk from habitat degradation than are winter steelhead.

Hatchery fish are widespread, spawn naturally throughout the Puget Sound region and are largely derived from a single stock (Chambers Creek). Most hatchery fish in this region originated from stocks indigenous to the ESU, but they are generally not native to their local river basins. Currently, the major threat to genetic integrity for Puget Sound steelhead comes from past and present hatchery practices.

No estimates of historical (pre-1960s) abundance specific to the Southwest Washington and Olympic Peninsula ESUs are available. However, stocks within these ESUs have not been identified as being at risk or of special concern. No major habitat blockages are know for the streams located within these ESUs, but minor blockages (i.e., impassable culverts) are likely throughout the region. Clearcut logging has been extensive throughout most watersheds in the Southwest Washington ESU. The major present threat to genetic integrity for steelhead in these ESUs comes from past and present hatchery practices.

No estimates of historical (pre-1960's) abundance for steelhead are available for the Lower Columbia River ESU. However, previous assessments have identified several stocks as being at risk or of special concern. Significant habitat blockages resulted from dams on the Sandy River, and minor blockages (i.e., impassable culverts) are likely throughout the region. Habitat problems for most stocks in this ESU include clearcut logging practices (which has been extensive), and urbanization in the Portland and Vancouver areas. Hatchery fish are widespread and escaping to spawn naturally throughout the region. Most of the hatchery stocks used originated primarily from stocks within the ESU, but many are not native to local river basins.

No estimates of historical abundance specific to the Upper Willamette ESU are available. Substantial habitat blockages resulted from Detroit, Big Cliff and Green Peter Dams on the Santiam River, and flood control dams on the mainstem Willamette. Other blockages such as smaller dams or impassable culverts are likely throughout the region. Clearcut logging, which has been common throughout most watersheds in this area, and extensive urbanization in the Willamette Valley are identified as habitat problems within this ESU. Significant water withdrawals, removal of streamside vegetation, rural and urban development, severe bank erosion, splash dams, debris removal and stream channelization have caused long-term damage to salmonid habitats within this ESU.

Estimates of historical abundance specific to the Middle Columbia River ESU are available only for the Yakima River-it is assumed other basins had comparable run sizes for their drainage area. The only substantial habitat blockage at present Is at Pelton Dam on the Deschutes River, but minor blockages from smaller dams, impassable culverts, etc. are likely throughout the basin. Several dams in the John Day River Basin previously blocked habitat, but they have since been modified with ladders. High summer and low winter temperatures are limiting factors for salmonids in many streams in this region. Flows below recommended levels occur in the Umatilla and John Day Rivers, extreme temperature conditions exist in the lower John Day River, and water withdrawals and overgrazing have seriously reduced summer flows in the principal steelhead spawning and rearing tributaries of the Deschutes River. There is little or no late summer flow in sections of the lower Umatilla and Walla Walla Rivers. Riparian vegetation is heavily impacted by overgrazing and other agricultural practices, timber harvest, road building, and channelization. Stream riparian restoration is needed for between 37 percent and 84 percent of the riverbanks in various basins within this ESU. Instream habitat is affected by these same factors, as well as by past gold dredging and severe sedimentation due to poor land management practices. The major present threat to genetic integrity for steelhead in this ESU is from past and present hatchery practices.

Estimates of historical abundance specific to the Upper Columbia River ESU are available from fish counts at dams (i.e., Rock Island Dam). Substantial habitat blockages occurred with the construction of Chief Joseph and Grand Coulee Dams, as well as smaller dams on tributary rivers. Habitat problems for this ESU are largely related to irrigation diversions and hydroelectric dams, as well as degraded riparian and instream habitat from urbanization and livestock grazing. Hatchery fish are widespread and escaping to spawn naturally throughout the region. In fact, this ESU might not exist today if there were not hatchery production based on indigenous stocks. The major threat to genetic integrity comes from past and present hatchery practices.

No estimates of historical abundance specific to the Snake River ESU are available. However, it is estimated that 80 percent of the total Columbia River Basin run above Bonneville Dam was of hatchery stock. There are several substantial habitat blockages in this ESU, the major one being the Hells Canyon Dam complex on the mainstem Snake River and Dworshak Dam on the North Fork Clearwater River. Minor blockages are likely throughout the region. High summer and low winter temperatures are limiting for salmonids in many streams in eastern Oregon. Flows below recommended levels occur in the Grande Ronde River, especially in late fall through early spring, and water withdrawals and low flows are severe in several areas of that basin. Riparian vegetation is heavily impacted by overgrazing and other agricultural practices, timber harvest, road building, and channelization. Prime steelhead spawning areas have been degraded by overgrazing in several parts of the Grande Ronde Basin. Instream habitat is also affected by these same factors, as well as past gold dredging and severed sedimentation due to poor land management practices. On of the most significant habitat problems facing steelhead in this ESU is substantial modification of the migration corridor by hydroelectric power development in the mainstem Snake and Columbia Rivers. As before, hatchery fish are widespread and escape to spawn naturally throughout the region. Of concern is the status of steelhead native to the North Fork of the Clearwater River. While this hatchery population is presently fairly large, it represents the only remaining gene pool for steelhead native to that tributary. This population has not had access to its native habitat for 25 years.

Steelhead on the west coast of the U.S. have experienced declines in abundance in the past several decades as a result of many natural and human factors. Forestry, agriculture, mining and urbanization have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control for domestic and hydropower purposes (especially in the Columbia River) have greatly reduced or eliminated historically accessible habitat. Loss of habitat complexity has also contributed to the decline of steelhead. Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous river systems, thereby increasing the level of predation experienced by salmonids.

**d. CHUM**: For chum salmon, quantitative estimates of historical abundance are generally lacking. At best, historical abundance can be inferred from fishery landing data. Fishery landings suggest that chum salmon abundance may be near historical levels in the Puget Sound area, but that natural populations south of the Columbia River and possibly to the north are at very low levels relative to historic abundance.

Chum salmon generally spend only a short time relative to other salmonids in streams and rivers before migrating downstream to estuarine and nearshore marine habitats. Because of this, the survival of early-life-history stages of chum salmon depends more on the health and ecological integrity of estuaries and nearshore habitats than for most other Pacific salmon. Habitat loss in the estuarine or nearshore environment is difficult to quantify because there are few historical studies that include baseline information, and these studies encompass a variety of classification methods and several time intervals to measure change. However, a recent summary of habitat loss in the some northwest estuaries is included in Table C.1 located at the end of this appendix.

Chum salmon may depend less on freshwater habitats than other Pacific salmonids, but their spawning areas still extend up to 80 rkm upstream in many rivers, and their requirements for successful spawning and rearing (such as clean, cold water and relatively sediment-free spawning gravels) are similar to other Pacific salmon. Alternations and loss of freshwater habitat for salmonids have been extensively documented in many regions, especially in urban area or habitat associated with construction of large dams.

**e. COHO**: Coho are highly migratory at each stage of their life and are dependant on high quality spawning, rearing and migratory habitat. Water depth, water velocity, water quality, cover, and lack of physical obstruction are important elements in all migration habitats. They prefer to spawn and rear in stream reaches and channels less than 4-5 percent gradient. They are found primarily in plane-bed, pool-riffle, and forced-pool-riffle stream channels, which are channels less than 4 percent. Stream reaches greater than 4 percent lope are generally not utilized by coho salmon for spawning because of their high bed load transport rate, deep scour, and coarse substrate.

During this century, indigenous, naturally-reporducing populations of coho salmon are believed to have been extirpated in nearly all Columbia River tributaries and to be in decline in numerous coastal streams in Washington, Oregon, and California. In general, there is a geographic trend in the status of West coast coho salmon stocks, with the southernmost and easternmost stocks in the work condition.

Logging, agricultural and mining activities, stream channelization, dams, wetland loss, and water withdrawals and unscreened diversions for irrigation have contributed to the decline of the coho in Washington state. Impacts of concern associated with these activities include: alteration of ambient stream water temperatures, elimination of spawning and rearing habitat, elimination of downstream recruitment of spawning gravels and LWD, removal of riparian vegetation resulting in increased stream bank erosion and degradation of water quality. Of particular concern is the increased sediment input into spawning and rearing areas that results from the loss of channel complexity, pool habitat, suitable gravel substrate and LWD. Further historical practices, such as use of splash dams, and widespread removal of beaver dams, log jams, and snags from river channels, have adversely modified fish habitat. Agricultural practices has contributed to the degradation of salmonid habitat on the West coast through irrigation diversions, overgrazing in riparian areas, and compaction of soils in upland areas from livestock. Urbanization has degraded coho salmon habitat through stream channelization, floodplain drainage, and riparian damage.

**f. BULLTROUT**: The historical range of bull trout was restricted to North America (Cavender 1978; Haas and McPhail 1991). Bull trout have been recorded from the McCloud River in northern California, the Klamath River basin in Oregon and throughout much of interior Oregon, Washington, Idaho, western Montana, and British Columbia, and extended into Hudson Bay and the St. Mary's River, Saskatchiwan.

Bull trout are believed to be a glacial relict and their broad distribution has probably contracted and expanded periodically with natural climate change (Williams et al., in press). Genetic variation suggests an extended and evolutionarily important isolation between populations in the Klamath and Malheur Basins and those in the Columbia River basin (Leary et al. 1993). Populations within the Columbia River basin are more closely allied and are thought to have expanded from common glacial refugia or to have maintained higher levels of gene flow among populations in recent geologic time (Williams et al., in press).

It is unlikely that bull trout occupied all of the accessible streams at any one time. Distribution of existing populations is often patchy even where numbers are still strong and habitat is in good condition (Rieman and McIntyre 1993; Rieman and McIntyre 1995). Habitat preferences or selection is likely important (Goetz 1994; Rieman and McIntyre 1995); but more stochastic extirpation and colonization processes may influence distribution even within suitable habitats (Rieman and McIntyre 1995).

Even though bull trout may move throughout whole river basins seasonally, spawning and juvenile rearing appear to be limited to the coldest streams or stream reaches. The lower limits of habitat used by bull trout are strongly associated with gradients in elevation, longitude, and latitude that likely approximate a gradient in climate across the Basin (Goetz 1994). The patterns indicate that spatial and temporal variation in climate may strongly influence habitat available to bull trout. While temperatures are probably suitable throughout much of the northern portion of the range, predicted spawning and rearing habitat are restricted to increasingly isolated high elevation or headwater "islands" toward the south (Goetz 1994; Rieman and McIntyre 1995).

Bull trout are now extinct in California and only remnant populations are found in much of Oregon (Ratliff and Howell 1992). A small population still exists in the headwaters of the Jarbidge River, Nevada which represents the present southern limit of the species range. Bull trout are known or predicted to occur in 45 percent of watersheds in the historical range and to be absent in 55 percent.

Migratory life histories have been lost or limited throughout the range (for example, Goetz 1994; Jakober 1995; MBTSG 1998; Pratt and Huston 1993; Ratliff and Howell 1992; Rieman and McIntyre 1993, 1995). There is evidence of declining trends in some populations (Mauser et al. 1988; Pratt and Huston 1993; Schill 1992) and extirpations of local population's are reportedly widespread.

Angling is a factor influencing the current status of bull trout. Bull trout may be vulnerable to over-harvest (Ratliff and Howell 1992; Rieman and Lukens 1979). Poaching is viewed as an important cause of mortality, especially in accessible streams that support large migratory fish.

Watershed disruption is a second factor that has played a role in the decline of bull trout. Changes in or disruptions of watershed processes likely to influence characteristics of stream channels are also likely to influence the dynamics and persistence of bull trout populations. Bull trout have been more strongly associated with pristine of only lightly disturbed basins (Brown 1992; Ratliff and Howell 1992).

Patterns of stream flow and the frequency of extreme flow events that influence substrates are anticipated to be important factors in population dynamics (Rieman and McIntyre 1993). With overwinter incubation and a close tie to the substrate, embryos and juveniles may be particularly vulnerable to flooding and channel scour associated with the rain-on-snow events common in some parts of the range within the belt geography of northern Idaho and northwestern Montana (Rieman and McIntyre 1993). Channel dewatering tied to low flows and bed aggradation has also blocked access for spawning fish resulting in year class failures.

Changes in sediment delivery, aggradation and scour, wood loading, riparian canopy and shading or other factors influencing stream temperatures, and the hydrologic regime (winter flooding and summer low flow) are all likely to affect some, if not most, populations. Significant long-term changes in any of these characteristics or processes represent important risks for many remaining bull trout populations. Populations are likely to be most sensitive to changes that occur in headwater areas encompassing critical spawning and rearing habitat and remnant resident populations.

Introduced species are a third factor influencing bull trout. More than 30 introduced species occur within the present distribution of bull trout. Some introductions like kokanee may benefit bull trout by providing forage. Others such as brown, brook, and lake trout are thought to have depressed or replaced bull trout populations (Donald and Alger 1993; Howell and Buchanan 1992; Leary et al. 1993; Ratliff and Howell 1992). Brook trout are seen as an especially important problem (Leary et al. 1993) and may progressively displace bull trout through hybridization and higher reproductive potential (Leary et al. 1993). Brook trout now occur in the majority of the watersheds representing the current range of bull trout. Introduced species may pose greater risks to native species where habitat disturbance has occurred.

Isolation and fragmentation are the fourth factor likely to influence the status of bull trout. Historically bull trout populations were well connected throughout the Basin. Habitat available to bull trout has been fragmented, and in may cases populations have been isolated entirely. Dams have isolated whole subbasins throughout the Basin (see for example, Brown 1992; Pratt and Huston 1993; Rieman and McIntyre 1995). Irrigation diversions, culverts, and degraded mainstem habitats have eliminated or seriously depressed migratory life histories effectively isolating resident populations in headwater tributaries (Brown 1992; MBTSG 1998; Ratliff and Howell 1992; Rieman and McIntyre 1993). Introduced species like brook trout may displace bull trout in lower stream reaches further reducing the habitat available in many remaining headwater areas (Adams 1994; Leary et al. 1993). Loss of suitable habitat through watershed disturbance may also increase the distance between good or refuge habitats and strong populations thus reducing the likelihood of effective dispersal.

Bull trout and Dolly Varden were once considered to be the same species. However, taxonomic work, published in 1978, identified bull trout as distinct from Dolly Varden and this determination was accepted by the American Fisheries Society in 1980. Of the two species, bull trout are larger and primarily an inland species, while Dolly Varden are generally smaller and distributed primarily in coastal areas. A summary of bull trout/Dolly Varden presence and the status of the stock is provided in Tables C.2, C.3 and C.4 (WDFW 1998), located at the end of this appendix.

**<u>Chilliwak Basin</u>**

The Chilliwack River flows from its origin in the North Cascades Mountains across the Canadian/U.S. border into Chilliwack Lake in Canada. The lake outlet is the Vedder River which then enters the Fraser River. Selesia Creek is a major tributary of the Chilliwack and also enters Canada from Washington State. The Chilliwack River and Selesia Creek contain a population of bull trout/Dolly Varden which has been identified as distinct based on its geographic distribution.

Little is known about the genetic composition or life history of this stock. However, it could probably be assumed that spawn timing is similar to that in nearby streams such as the Nooksack River where spawning occurs as water temperatures drop in the fall (September through November). This stock is composed of resident, fluvial, and/or adfluvial life history forms.

The stock is assumed to be native in origin as there is no known stocking of bull trout/Dolly Varden in these rivers.

The status of the stock is unknown. Spawning escapement and relative abundance information are not available (WDFW 1998).

**<u>Nooksack Basin</u>**

The historical record of bull trout/Dolly Varden resources and fisheries in the Nooksack is incomplete. Little, if any, comprehensive information exists concerning escapement levels, population size, or past harvest levels. Bull trout/Dolly Varden in the Nooksack system are native and are probably composed of anadromous, fluvial and resident populations which, in many of the spawning areas, have the potential to commingle.

Based upon field experience of local WDFW biologists, five areas were identified as possibly containing discrete stocks. These areas were the North Fork Nooksack below the falls (RM 65), Canyon Creek, Middle Fork Nooksack below the city of Bellingham diversion dam, and the South Fork Nooksack. However, because of migration information developed on other systems, until future genetic sampling is accomplished only three stocks are recognized. These are Canyon Creek; upper Middle Fork Nooksack (above the impassable fish barrier); and the Lower Nooksack (including the North Fork, lower Middle Fork, and South Fork). All bull trout/Dolly Varden stocks in the Nooksack basin are native and maintained as wild production.

The status of all stocks tentatively identified in the Nooksack system is Unknown. Bull trout/Dolly Varden in the Nooksack River and all tributaries were protected from potential excessive sport harvest in 1990 by implementation of a 20-inch minimum size limit intended to allow females to spawn at least once. In 1994 the Nooksack and all its tributaries were closed to fishing for bull trout/Dolly Varden. The effect of these changes has apparently resulted in increases in population size based upon random sightings in spawning areas and reported incidental catch and release during sport fisheries targeting other species. (WDFW 1998).

## Skagit Basin

The Skagit River supports the largest natural population of bull trout/Dolly Varden in Puget Sound. Bull trout/Dolly Varden spawn in most, if not all, of the accessible upriver areas in the drainage. Anadromous, fluvial, adfluvial, and resident fish all exist in the watershed and, in many cases, overlap geographically. All stock and populations are native and are maintained by wild production.

Stock identification in the Skagit River is based on local fisheries biologists' experience, life history and movement information. Stocks were separated into three geographic areas based on likely reproductive isolation. This approach identified three stocks within the Skagit: Baker Lake (now a reservoir), upper Skagit River (above Gorge Dam), and lower Skagit River and tributaries. This stock identification may change as more life history and genetic information becomes available.

The status of the Baker Lake and Upper Skagit stocks is unknown. The status of the lower Skagit stock is Healthy based upon historical escapement counts in the South Fork Sauk, miscellaneous spawner/redd counts in other tributaries, sighting of adult fish in tributary areas during the spawning season, incidental smolt capture during salmon smolt enumeration efforts in the lower river, and age structure/adult movement tagging studies on adult fish that has been on-going since 1991. Currently, over 750 adult fish have been tagged in the Skagit and its tributaries.

Bull trout/Dolly Varden in the Skagit system have been protected from excessive sport angling mortalities since 1990 by a 20-inch minimum size limit. Since 1994, only the mainstem areas of the Skagit, Cascade, Sauk, Suiattle, and Whitechuck Rivers have remained open to angling for bull trout/Dolly Varden. All other areas, including tributaries, have been closed to fishing for bull trout/Dolly Varden. Sport catch information is not available except as anecdotal information collected during fisheries targeting other species, in random angler checks, or as part of the tagging effort. That information indicates that the protective measures instituted since 1990 have, apparently, had a dramatic effect in increasing population size within the drainage.

Many of the upper Skagit areas used for spawning by adults lie within either the North Cascades National Park boundary or within U.S. Forest Service boundaries designated as wilderness areas. These areas contain excellent habitat for spawning, incubation, and juvenile rearing (WDFW 1998).

**Stilliguamish Basin**

Stillaguamish bull trout/Dolly Varden have been identified as a distinct stock based on their geographic distribution. They are found throughout the Stillaguamish River basin with spawning areas in the North fork and its tributaries including Deer Creek, Boulder River and squire Creek and in the South Fork and its tributaries including Canyon, Millardy, Deer and Coal creeks. Bull trout/Dolly Varden are seen in the North Fork and its tributaries each fall during routine snorkel surveys to enumerate adult chinook salmon. In the South Fork, the waterfall near the town of Granite Falls was impassable to anadromous fish including bull trout/Dolly Varden until a fishway was constructed in the 1950s. However anecdotal information from fish surveys in the 1920s and 1930s suggests a “char” population existed in the South Fork at that time. Since construction of the fishway, large adult bull trout/Dolly Varden are commonly seen in the upper South Fork.

Anadromous, fluvial and resident fish all exist in the watershed and in many cases overlap geographically. Because of this overlap and the lack of detailed information on fish movement within the basin, all bull trout/Dolly Varden in the Stillaguamish basin are currently considered to be a single stock.

Spawn timing is unknown. However, the Stillaguamish bull trout/Dolly Varden are native and maintained by wild production.

Stock status is Unknown. There are insufficient quantitative abundance or survival data to assess status. However, with the exception of the Deer Creek segment of the population, the Stillaguamish stock appears to be stable or expanding and to be making use of the available habitat, based on limited spawner surveys of Boulder Creek and the upper Stillaguamish and anecdotal catch information (WDFW 1998).

## Snohomish Basin

Reproducing populations of bull trout/Dolly Varden have been documented in the upper Skykomish River basin. Field searches for native char in the Skykomish River system in the 1980s located them in the upper North Fork Skykomish mainstem and its tributaries between Bear Creek Falls and Deer Creek Falls. A 1993 radio-tagging study of bull trout/Dolly Varden collected at the Sunset Falls fishway on the South Fork Skykomish revealed that almost all of the fish spawned in the lower East Fork Foss River. Bull trout/Dolly Varden utilizing the South Fork Skykomish are not considered separate from those in the North Fork Skykomish.

Anadromous, fluvial and resident life history forms are all found in the Skykomish River system, at times spawning at the same time and place. Only resident fish are found in upper tributary reaches that lie above fish barrier falls (i.e., Troublesome Creek).

Spawning occurs from late August to early or mid-November but is more typically seen between the first week in October and the first week of November.

Skykomish bull trout/Dolly Varden are native and are maintained by wild production, although bull trout/Dolly Varden found in the South Fork Skykomish have only recently invaded that subbasin with the construction of the Sunset Falls trap and haul fishway in the mid-1950s.

Stock status is Healthy (WDFW 1998).

## Lake Washington Basin

The Lake Washington Basin has been highly altered from its natural state in the last century. In order to utilize Lake Washington as a commercial port, a lock system was constructed in 1916 and the average lake level was lowered 2.7 meters (8.8 feet) (Warner 1996). The lake no longer drains from its historic outlet to the south, instead it drains at the Chittenden Locks at Salmon Bay of Puget Sound. The basin has two primary river systems which feed Lake Washington.

The Cedar River, which was diverted into the southern end of Lake Washington to provide water necessary to operate the locks, historically was a tributary to the Black River (historical outlet of Lake Washington) (Warner 1996). The Black River flowed into the Green River, which then discharged into Elliott Bay of Puget Sound further to the south.

The Cedar River originates from the ridge of the Cascade Crest. It flows west into what once was a natural lake. The natural lake was enlarged by construction of Chester Morse Overflow Dam [river kilometer (rkm 59.9 and Masonry Dam rkm 57.8)] in 1901 and 1914 respectively, creating Chester Morse Reservoir (Seattle Water Department 1991). A population of adfluvial bull trout has been identified in Chester Morse

Reservoir, using Haas' linear discriminate function (R2 Resource Consultants, Inc. 1993). Lower Cedar Falls (rkm 55) forms a natural barrier to anadromous migration on the Cedar River. Lansburg Dam (rkm 35. 1), a water diversion structure constructed in 1901, further shortens upstream migration. Recent sightings of native char in the lower Cedar River and in Lake Washington are rare. An unidentified adult native char was captured in the lower Cedar River below Landsburg dam, in 1993 (E. Warner, MIT, pers. comm. 1997). Several native char approximately 410 millimeters (mm) (16 inches) in length have been observed passing through the viewing chamber at the Chittenden Locks (E. Warner, MIT, pers. comm. 1997). WDFW reports one captured by a shore angler in Lake Washington in 1992 (WDFW 1997).  It is unknown whether the lower Cedar River historically supported or currently supports a reproducing bull trout population (WDFW 1997).

The Sammamish system drains into the northern end of Lake Washington. Issaquah Creek in the upper basin discharges into Lake Sammamish, which then flows into the Sammamish River. Native char have recently been identified in the upper reaches of the system. This subpopulation appears to be at an extremely low level of abundance **and has been determined to be depressed by the Service (64 FR 58914-58915)**.

**Cedar River-Chester Morse Reservoir**

There are no data on the historic abundance of bull trout in Cedar River/Chester Morse Reservoir. Current information is very limited. Bull trout spawn primarily in the mainstem of the Cedar and Rex rivers which discharge into the reservoir, but also spawn in low numbers near the mouth of at least one steep tributary of the reservoir (Rack Creek) as well as in a tributary to the Rex River (Boulder Creek) (WDFW 1997; R2 Resource Consultants, Inc. 1993). Redd counts on these two rivers are available only for the past five years. There has been a large fluctuation in combined redd counts over this five year period, with a high count of 109 in 1993, and low of 6 in 1995 (WDFW 1997; D. Paige, SWD pers. comm. 1997). Recent redd counts show a steep decline (26, 6, and 8 in 1994, 1995, and 1996, respectively) in total number of redds (WDFW 1997; D. Paige, SWD unpub data 1997) Floods in the upper Cedar River in 1995 limited redd counts later in the season and prevented redd counts on the Rex River. However, the failure to capture any fry from outmigrant trapping in the spring of 1996, also indicated that redd construction and/or redd success for 1995 was extremely poor (D Paige, SWD pers. comm. 1997; D. Paige, SWD, unpub. data 1997). Emigrant fry trapping in the spring 1997, appeared to confirm the low redd counts in 1996, with few fry being captured,

A population estimate of between 2,300-3,100 bull trout was made in 1995, based on recent hydroacousitic surveys (1992-1993) and a 1975 littoral estimate by Wyman (WDFW 1997). Redd counts were thought to be low based on this estimate, and may indicate this subpopulation is severely impaired or in decline. Based on the recent low redd counts (which we not estimates), the USFWS believes this subpopulation has a depressed status.

Chester Morse Reservoir and its tributaries lie completely within the City of Seattle municipal watershed. This watershed has experienced substantial logging and road building in the past (WDFW 1997). An old growth harvest moratorium has existed on city land since 1985, but timber harvest still occurs on younger stands. The Cedar River watershed is primarily second growth (approximately 80 percent), with some riparian areas and large woody debris dominated by alders (Foster Wheeler Environmental 1995). Second growth stands (< 60 years) are concentrated in the lower two-thirds of the watershed above Masonry Dam. Flooding in 1990 is believed to have removed much of the large woody debris from the upper watershed. The current road densities in this watershed are approximately 4 mi/mi. At these road densities, bull trout are likely impaired (Quigley and Arbelbide 1997).

Bull trout appear to primarily spawn in the lower reaches of the upper watershed, this is especially apparent in the Rex River (R2 Resource Consultants, Inc. 1993). Spawning areas in the Rex River are affected by reservoir operation during the spring fill period, which can cause redd inundation (Foster Wheeler Environmental 1995). The impact of inundation to bull trout redds in this system is unknown. Only a small portion of the Cedar River spawning areas are potentially affected.

The combination of natural sediment transports and increased sediment due to past forest management activities has caused the river deltas to increase in size (Foster Wheeler Environmental 1995). Drawdown for municipal water supply during drought years could result in exposed river deltas with steep fronts and high gradients (WDFW 1997). These conditions may delay entry of adult spawners in to the Cedar and Rex Rivers and/or prevent spawners from reaching preferred spawning are" (R2 Resource Consultants, Inc. 1995 cited in WDFW 1997),

Entrainment of downstream migrating bull trout at the Masonry Dam Hydroelectric facility could occur because the intakes are unscreened. This may be the reason that apparently no bull trout have been found between Landsburg and the Masonry dams (Foster Wheeler Environmental 1995). Knutzen (1997) estimated bull trout entrainment from Masonry Pool is about 200 fish per year. Although currently unquantifiable it is likely additional fish may be lost due to injury suffered from passing through the Chester Morse Overflow Dam culvert, upstream of Masonry Pool (Knutzen 1997).

**Sammamish River/Issaquah Creek**

Little is known about historical distribution and abundance in this system, More recently, a one year survey of Lake Sammamish in 1982-83 reported no char (WDFW 1997). Two unidentified adult native char were observed in the headwaters of Issaquah Creek in October 1993 and were approximately 580 to 660 min (23 to 26 inches) long. Anglers have claimed to have once fished for 'Dolly Varden' in this area approximately 15 to 20 years ago. If this is a historical subpopulation, it may no longer be viable.

Land Ownership: Within the Lake Washington Basin, there are approximately 800 acres (<0.5 percent) in Federal ownership (Forest Service and National Park Service);

13,800 acres (4 percent) in State ownership; and 352,200 acres (96 percent) in private ownership (includes City and County lands) (USGS 1996).

Habitat in the upper Issaquah Creek drainage consists of primarily second growth timber, Pool/riffle ratio appears to have recovered from previous management activities, stream temperatures range from about 6 to 9 degrees C and ground water is abundant in this area. Highway development and urbanization have contributed to heavy siltation and water quality problems within portions of the Issaquah Creek drainage (Williams et al. 1975).

Portions of Issaquah Creek and the Sammamish River are included on Washington State's 1998 proposed 303(d) list for not meeting temperature, fecal coliform and dissolved oxygen standards (WDOE 1997).

## Green/Duwamish River

Bull trout are not believed to spawn in the Green/Duwamish River system. Bull trout that are occasionally found in the Duwamish River are believed to enter the river from other systems, spending time in the Duwamish Waterway but not migrating upriver to spawn.

WDFW does not monitor the bull trout in this system because, according to its records, bull trout do not spawn in this system.

The following account summarizes the information available on the status of bull trout by basin within Clallam, Jefferson, Grays Harbor, Mason, Thurston, Kitsap and Pierce Counties. However, in many rivers and streams, little or no information is available on population status, and surveys for bull trout have not been conducted. For the purposes of section 7 consultation, it is assumed that if bull trout have been documented in a basin, the potential exists that they may occur anywhere in the basin during some portion of their life history.

## Chehalis River/Grays Harbor Basin

The Chehalis River system is a large drainage, draining portions of the Olympic Mountains, the Black Hills, and the Willapa Hills before entering the Pacific Ocean. Native char, which can be either bull trout or Dolly Varden (*Salvelinus malma*), are believed to be distributed in tributaries west of and including the Satsop River in the Chehalis system (Mongillo 1993). Currently, no char in this basin has been positively identified as a bull trout. Native char have been caught by steelhead anglers along the Wynoochee and Satsop rivers in the past (USFWS 1998). Native char have also been caught in the anadromous zone of smaller systems that flow into Grays Harbor, such as the Hoquiam and Humptulips rivers. However, it is assumed these are strays from the Chehalis River system (WDFW, in litt. 1997). The Chehalis and the Columbia rivers probably represent the southern extent of the range of native char on the Washington coast (WDFW 1998). Native char in the Chehalis/Grays Harbor system may have anadromous, fluvial and resident life histories.

There are no current or historical abundance data available for native char in the Chehalis River/Grays Harbor Basin. WDFW (1998) classified this subpopulation's status as unknown.

**Coastal Plain/Quinault River Basin**

The principal rivers draining this basin are the Quinault, Moclips, Copalis, and Raft rivers. With the exception of the Quinault River, these are primarily low elevation streams draining the coastal plain of the Olympic Peninsula.

The Quinault River drains the western slopes of the Olympic Mountains, entering the Pacific Ocean at Taholah on the Quinault Indian Reservation. Little information exists on the abundance and status of native char within the mainstem East Fork drainage, but it is likely that two bull trout subpopulations are present. One subpopulation occurs above the anadromous barrier on the mainstem/East Fork Quinault and is likely a resident life history form. The second subpopulation of char resides below this barrier, as well as in the North Fork Quinault River, lower Quinault River, and Lake Quinault. These char we likely to be both migratory and resident life history forms (WDFW 1998).

The subpopulation above the anadromous barrier lies completely within Olympic National Park (ONP), where their habitat is in pristine condition. Both bull trout and Dolly Varden (*S. malma*) have been identified above this barrier on the East Fork Quinault. WDFW (1998) has rated this subpopulation status as unknown.

The other subpopulation of native char occurs in the lower Quinault River, Lake Quinault, the East Fork below the anadromous barrier, and the North Fork Quinault. An angler survey was conducted in 1994-1995 during the summer fishing season which randomly sampled fisherman in a 40-mile area in the lower river. The survey included the North Fork and mainstem below the anadromous barrier. Landing rates were very low for native char. Snorkel surveys on the North Fork also indicated low abundance of native char. Based on this limited information, the status of char in the Quinault "are believed to be at low levels of abundance" (Meyer and Averill 1994). WDFW has rated this subpopulation status as unknown (WDFW 1998).

Approximately 8 mi (13 km) of the mainstem and all of the North Fork Quinault lie within ONP and are pristine char habitat. The roughly 45 miles of mainstem habitat outside of the park boundaries has been degraded by intense logging activities on Olympic National Forest and Quinault Indian Reservation lands (WDFW 1998). The Lower Quinault River is on the Washington State's proposed 1998 303(d) list for not meeting temperature standards (WDOE 1997).

Native char have been caught by anglers in the anadromous zone of the Moclips River and Copalis River (WDFW 1998). It is unknown whether a resident component to the population may exist in these rivers. No char has been positively identified as a bull trout. The status of this subpopulation is unknown WDFW 1998). Habitat is likely limited due to low flows and associated high temperatures which can inhibit summer rearing in the Copalis (Phinney and Bucknell 1975) and habitat has been substantially degraded by past logging activities WDFW 1998) in both watersheds.

There is essentially no information with regards to native char for the Raft River system (USFWS 1998). It was listed by Mongillo (1993) as part of the present distribution of native char and was given an "unknown" status rating. Fish in this system may be strays from other areas and may have entered the river to forage or overwinter (WDFW, in litt.1997).

**Queets River Basin**

The Queets River drains the western slopes of the Olympic Mountains, flowing southwesterly and entering the Pacific Ocean near the village of Queets. Native char in this system may consist of anadromous, fluvial and resident life histories. Bull trout and Dolly Varden have both been identified in the mainstem Queets (Meyers et al., 1998,). Few efforts have been made to directly monitor the native char in this system; hence only limited information exists on the abundance and status of the subpopulation.

The majority of the Queets mainstem is in ONP and remains in near pristine condition (WDFW 1998). However, tributaries outside of ONP have been degraded by logging and these drainages suffer from siltation from slides and road building, decreased large woody debris input and increased temperatures from the reduction of riparian areas (Phinney and Bucknell 1975; USFWS 1998).

WDFW rates this subpopulation's status as healthy (WDFW 1998). However, past data collected by the Quinault Indian Nation indicates the population may be declining, and recent monitoring data cannot be rigorously compared. to those data. Therefore, the Service's opinion is that the status of this subpopulation could just as likely be depressed, and should be considered unknown.

**Hoh River and Goodman Creek Basin**

Abundance data are lacking for the Hoh River, but it is widely believed the Hoh River may contain the largest subpopulation of native char on the Washington Coast (Mongillo 1993). Native char within the Hoh River are believed to have anadromous and resident life histories. However, interviews with anglers and WDFW employees indicate that this subpopulation "has been greatly reduced" since 1982 (WDFW 1998). Most recently, a one day snorkel survey conducted in 1994 and 1995 on the South Fork Hoh located 41 "adult" native char (fish ~ 12 inches) respectively (Meyer and Averill 1994; Meyer et al. 1998; USFWS 1998). WDFW has rated this subpopulation status as unknown (WDFW 1998),

The upper mainstem and upper South Fork Hoh River are within the ONP where habitat is considered to be in excellent condition (WDFW 1998). The lower South Fork and the mainstem below the confluence have been degraded by extensive logging activities.

Intensive logging activity on steep terrain has resulted in slope instability and high silt loads (WDFW 1998). There has also been a loss of riparian vegetation and large woody debris in parts of the mainstem, South Fork, and several tributaries, which has reduced cover for fish and elevated summer low-flow temperatures above those considered optimal for salmonids (WDFW 1998).

Numerous creeks in the lower Hoh River are on Washington State's proposed 1998 303(d) list for exceeding temperature standards (WDOE 1997).

Goodman Creek is a small watershed just north of the Hoh River. A small section of the lower drainage lies within ONP. Native char utilizing this system are believed to be anadromous, but information on abundance and status is lacking. Based on the degraded instream habitat, low flows and high water temperatures, it is thought that fish in this system may be strays from a larger system such as the Hoh River.

This watershed has been extensively logged (Phinney and Bucknell 1975, WDW 1992). Natural low flows in the summer (WDW 1992) in conjunction with loss of riparian vegetation from past logging may create a thermal barrier for migrating char.

**Quillayute River Basin**

The Quillayute system is accessible to migratory fish except for an isolated area above Sol Duc Falls (river mile 65). The only known subpopulation of native char within the Quillayute watershed exists above this barrier.

This subpopulation of char lies completely within the ONP boundaries. Cavender (1978) analyzed samples from this subpopulation and determined them to be Dolly Varden based on morphological and genetic evidence. Between 1994 and 1995 a total of 49 native char were collected 'in the upper Sol Duc River, but these samples yielded inconclusive results in differentiating bull trout from Dolly Varden. No bull trout have been identified at this time. WDFW (1998) has assigned this subpopulation an unknown status.

**Elwha River Basin**

The abundance of bull trout within the Elwha watershed has not been well documented. Bull trout within the basin probably exhibit fluvial, adfluvial, and resident life history patterns. There may also be an anadromous component to the population below Lake Aldwell. The construction of two dams divided the Elwha River into three relatively isolated sections. Bull trout have probably been isolated into two subpopulations by dams, one above and one below the dams. It has not been determined if the char observed below the lower-most dam are bull trout or Dolly Varden. WDFW (I998a) has assigned this subpopulation an unknown status.

Storage of heat in Lake Mills and Lake Aldwell has increased water temperatures in the lower river (USDI 1994). Average daily water temperatures below Elwha Dam can exceed 15 degrees C during several months of the year (D. Morrill, Lower Elwha S'Klallam Tribe, unpublished data 1995). The dams have eliminated sediment input (spawning gravel replacement) and limit nutrient and organic matter from flowing downstream. This has likely limited benthic invertebrate production in the lower river, which in turn limits the growth and survival of fish (USDI 1994).

## Angeles Basin

The Angeles Basin is made up of several small independent drainages. However, Morse Creek is the only drainage known to have native char. The headwaters drain from ONP and then flow through suburban areas of Port Angeles before entering the Strait of Juan de Fuca. Native char in this system are believed to be anadromous. Abundance and status information is lacking for this system (WDFW 1998).

## Dungeness River Basin

The Dungeness watershed drains the northeastern part of the Olympic Peninsula. The majority of the Dungeness watershed lies in a rain shadow created by the Olympic Mountain and as a result, much of this area has limited rainfall (USDA 1995b).

The abundance of bull trout in the Dungeness Basin has not been well documented. Information on historic levels is anecdotal at best and information on current levels is extremely limited. The Dungeness Basin has been divided into two subpopulations based on the existence of a falls at river mile 18.8, which is considered a migratory barrier. Anadromous, fluvial and resident life history forms may be present. Historically, native char were reported as "very common and widespread from the lower to the upper watershed" (Mongillo 1993). WDFW determined that the Upper Dungeness population is healthy and that the lower Dungeness/Gray Wolf River population status is unknown has assigned this subpopulation a status of unknown (WDFW 1998). The Service believes the subpopulation has a depressed status.

The portion of the watershed within the ONP is in excellent condition. However, the lower Dungeness River has been negatively impacted by agriculture, urban development and timber harvest practices. As a result of these activities, erosion has caused extensive gravel aggradation and channel braiding, which has led to reduced water depth, increased water temperature and velocity, and destabilized river bedload (USDA 1995; WDFW 1997). Landslides into Gold Creek have also contributed large amounts of fine sediment to the system (USDA 1995). Construction of extensive flood control dikes and channelization of the lower river have reduced bedload stability and have subjected rearing fish to extreme conditions WDFW 1998).

Irrigation withdrawals from the Dungeness River have occurred for more than 100 years (Dungeness-Quilcene Water Resources Management Plan 1994 cited in USDA 1995). Impacts from irrigation withdrawals occur below river mile 11 (river km 17.7) during the critical low flow period between August and October WDFW 1998). These impacts could hinder migration and movements of adult bull trout. The rainshadow location exacerbates late summer low flow situations (USDA 1995b). The lower Dungeness River is on Washington State's proposed 1998 303(d) list for not meeting instream flows (WDOE 1997).

## Skokomish River Basin

The Skokomish River Basin drains the east slopes of the Olympic Mountains into Hood Canal.

Construction of upper Cushman Dam by Tacoma Public Utilities (TPU) has blocked anadromous fish access into the park since 1926 (HCCC 1995). Except for a small area of its headwaters, the South Fork Skokomish lies outside of the park boundary. There is an anadromous barrier (falls) at river mile 25 (river km 40.2) near Rule Creek (WDFW 1998).

Bull trout have been isolated into at least two subpopulations within the Skokomish system by construction of the dam. A third subpopulation maybe isolated above Staircase Rapids (river mi 30) in the upper North Fork, but recent evidence suggests the rapids may not be a migratory barrier during parts of the year (Brenkman 1997). There are no historical abundance data for this system, and current abundance data are limited to the Cushman Reservoir subpopulation.

Char in the South Fork/Lower North Fork Skokomish River may have anadromous, fluvial and resident life history forms. Very limited abundance data are available for this subpopulation. WDFW (1998) has rated the status of this subpopulation as unknown. Based on the extremely low numbers of char recorded in recent surveys, the Service believes the subpopulation has a depressed status **(64 FR 58914)**.

The South Fork watershed has been heavily logged and loss of streamside cover from forest practices was identified as a limiting factor to salmon production in this section of the Skokomish River by Williams et al. (1975). Alterations in natural flows, as a result of the intensity of logging and road building in the upper reaches of the South Fork, has led to chronic flooding problems in the lower watershed (HCCC 1995). This area is subject to extremely low summer flows and extremely high winter flows. Extensive erosion, aggradation of sediments, and bedload movement are now common in the South Fork and the mainstem of the Skokomish River (HCCC 1995). Lack of large wood recruitment is also noted as a major problem for this habitat. Lower North Fork stream habitat for all salmonids have been heavily impacted by the operation of the lower Cushman Dam.

The subpopulation above Cushman Dam is isolated from the rest of the Skokomish system. The construction of upper Cushman Dam created a large reservoir out of the much smaller natural lake (Lake Cushman) (FERC 1996). The reservoir apparently provides adequate habitat and food base for this subpopulation (WDFW 1998). The reservoir supports a population of landlocked chinook salmon (HCCC 1995; WDFW 1997) which may act as an important forage base for bull trout.

WDFW (1998) has rated the status of this adfluvial subpopulation as healthy. However, since the last three years of adult counts have been below the seven-year average count (302), and there is no record of historic escapement to gauge the recent adult returns, the Service believes that a "healthy" rating may be premature at this time.

A subpopulation is assumed to be isolated by Staircase Rapids. As stated previously, there is some debate over whether this is a complete isolating barrier. Large adult char of the Cushman Reservoir subpopulation are up to approximately 18-25 inches (45.7- 63.5 cm) in length have been observed above the rapids during spawning times (Brenkman 1998). WDFW (1998) has assigned this subpopulation a status of unknown. The majority of critical spawning and early rearing habitat is within the ONP boundary and is considered to be in excellent condition.

## Nisqually River Basin

Native char in the Nisqually River are identified as a subpopulation based on their geographic distribution. Although habitat is available for all life history forms, it is not known which forms inhabit this river system. Only isolated reports of individual native char have occurred in recent times. One juvenile native char was sampled by the Nisqually Tribe in the lower reaches while stream sampling for juvenile salmon in the mid-1980s. This char was identified as a Dolly Varden. Electroshocking surveys by Mt. Rainier National Park (MRNP) staff in October and November 1993 indicated a possible bull trout specimen from Tahoma Creek, a tributary on the upper Nisqually (Samora and Girdner 1993).

The WDFW (1998) rates this subpopulation as "unknown" status, due to a lack of long-term monitoring data. The Service believes the status of the Nisqually River subpopulation is depressed, as native char occur in very low numbers in comparison to historic levels **(64 FR 58914-58915)**.

Logging, hydro power and land development have negatively impacted the habitat along the mid to lower reaches of the Nisqually River. Logging near unstable slopes has created major landslides which have increased sedimentation and temperature and degraded spawning and rearing habitat (Williams et al. 1975).

## Puyallup River Basin

The lower reaches of the Puyallup, White and Carbon rivers pass through extensive urban, residential, or agricultural zones. All three rivers have their headwaters within MRNP. Upper reaches are often blocked by dams and water diversions, with spawning and rearing areas degraded by land management activities. Surveys conducted in the Park have documented presence of native char in all three rivers (Samora and Girdner

1993). One specimen from Ranger Creek, a tributary to the Carbon River, was positively identified as a bull trout (Samora and Girdner 1993).

The current distribution of native char in these subbasins generally approximates historic distribution, but population sizes are not as large as in drainages to the north. However, key habitats throughout these river systems have been eliminated or seriously degraded due to human activities (USFWS 1998).

The WDFW (1998) delineates native char in the Puyallup River as a distinct stock because of the probable geographic isolation of their spawning populations, although spawning locations are unknown. Life history types we unknown for this subpopulation, although habitat is available for anadromous, fluvial and resident forms. Recent documentation of char presence is available in Mowich Creek (WDFW 1998) and the Puyallup River (WDW 1992).

The WDFW (1998) rates the Puyallup subpopulation as "unknown" status, due to a lack of quantitative population trend data. The Service believes the status of this subpopulation is depressed, based on available information that indicates native char occur in very low numbers in comparison to historic levels (**64 FR 58914-58915)**.

Urban development, agriculture and logging activities have reduced summer flows, decreased riparian canopy, increased winter peak flows and increased stream sedimentation in the Puyallup River Basin. These activities have severely affected major tributaries used by steelhead, and have likely adversely affected areas used by native char. Diking in the lower Puyallup has eliminated historic floodplain interactions and led to a need for additional bank protection and constant gravel removal in attempts to prevent flooding. These flood prevention activities usually further reduce channel stability and the quality of fish habitat (WDFW 1998).

Native char occur in the mainstem White River and the following tributaries: Clearwater River, West Fork White River, Huckleberry Creek, Greenwater River (Noble and Spalding 1995), Frying Pan Creek (Samora and Girdner 1993) and Pinocle Creek (WDW 1992). Presence has not been documented in other tributaries (Noble and Spalding 1995). Spawning locations are unknown.

Historically, bull trout in the White River drainage were fluvial or anadromous; today they are mostly fluvial (Noble and Spalding 1995). Very little historical or current information on population estimates or distribution is available. Urban development, agriculture and logging activities have reduced summer flows, decreased riparian canopy, increased winter peak flows and increased stream sedimentation on the White River. Migratory movements have also been compromised because downstream movement is limited by the Buckley Diversion Dam, which is a barrier to migratory fish (Williams et al. 1975). Native char are known to occur in the Carbon River and the tributaries Chenuis Creek, Ranger Creek, and Ipsut Creek. The WDFW (1998) rates this subpopulation as "unknown" status. The Service concurs, primarily because of the lack of historical information regarding the abundance of native char in this river system.

## Yakima River Basin

In the past, wild bull trout/Dolly Varden occurred throughout the Yakima River subbasin, but they are now fractured into isolated stocks. Although bull trout/Dolly Varden were probably never as abundant as other salmonids in the Yakima basin, they were certainly more abundant and more widely distributed than they are today. Currently, nine bull trout/Dolly Varden stocks have been identified in the basin. Distinct stocks are present in the Yakima River, Ahtanum Creek, Naches River, Rimrock Lake, Bumping Lake, North Fork Teanaway River, Cle Elum/Waptus Lakes, Kachess Lake, and Keechelus Lake. All nine bull trout/Dolly Varden stocks in the Yakima basin are native fish sustained by wild production, as there are no hatchery bull trout/Dolly Varden stocks in Washington State.

There is no information to indicate whether these are genetically distinct stocks. The stocks are treated separately due to geographical, physical and thermal isolation of the spawning populations. More or fewer stocks may be identified after additional data are collected and comprehensive genetic information is available.

Three bull trout/Dolly Varden life history forms are present in the Yakima basin: adfluvial, fluvial and resident. Adfluvial stocks occur in Rimrock, Bumping, Kachess, Keechelus and Cle Elum/Waptus lakes. There is a fluvial stock in the mainstem Yakima River, and a resident stock in Ahtanum Creek. Fluvial/resident forms occur in the Naches River drainage and in the North Fork Teanaway drainage. It is possible that anadromous forms also occurred in the Yakima basin in the past. Run timing of the Keechelus Lake stock and the spawning population in the South Fork Tieton River (part of the Rimrock Lake stock) is distinct. Run timing for other Yakima stocks is not distinct from other Washington State bull trout/Dolly Varden or is unknown.

Of the nine stocks identified one is Healthy, one is Depressed, six are Critical and one is Unknown. Additional data are needed to determine the status of the unknown stock (WDFW, 1998).

## Wenatchee River Basin

Currently ten bull trout/Dolly Varden stocks have been identified in the Wenatchee River watershed. They are the Icicle, Ingalls, Chiwaukum, Chikamin, Rock, Phelps, Nason, and Panther creeks stocks and the Little Wenatchee, Chiwawa and White rivers stocks. A population in the Napecqua River is thought to be extinct. Adfluvial, fluvial and resident life forms are present.

The bull trout/Dolly Varden in the Wenatchee River watershed are native. No hatchery introduction of bull trout/Dolly Varden has occurred.

Bull trout/Dolly Varden spawn and alevins rear in cold, headwater reaches where annual heat budgets are too cold for steelhead and chinook salmon. The stocks spawn in thermal isolation, because water temperature between spawning sites is too warm.

Four of the ten bull trout/Dolly Varden stocks have been classified as Healthy with the remaining six listed as Unknown based on the trend of available abundance data.

Nearly all suitable spawning habitat is currently used by bull trout/Dolly Varden and present spawning distribution is nearly the same as the distribution prior to European settlement. This habitat is naturally limited because adequately cold water is limited and found in high gradient; headwater reaches where access and flow are limited.

Habitat quantity ebbs and flows with climate, precipitation, and forestation changes. The worst scenario is a warming; drying climate where the forest is removed (e.g., wildfire, disease/parasite, logging, etc.) (WDFW, 1998).

**Entiat River Basin**

Currently two bull trout/Dolly Varden stocks have been identified in the Entiat River Watershed. They are the Entiat River and Mad River stocks. The two stocks are isolated from one another because the water temperature between them is too warm for bull trout/Dolly Varden.

The bull trout/Dolly Varden in the Entiat River watershed are native. No hatchery introductions of bull trout/Dolly Varden have occurred.  Bull trout/Dolly Varden also have been definitively identified in Lake Keechelus.

The Entiat River bull trout/Dolly Varden stock has been classified as Unknown while the Mad River stock has been classified as Healthy based on the trend of available abundance data.

Suitable spawning habitat is currently used by bull trout/Dolly Varden, and present spawning distribution is the same as the distribution prior to European settlement. Habitat is naturally limited because adequately cold water is limited and found in high gradient; headwater reaches where access and flow are limited.

Habitat quantity ebbs and flows with climate, precipitation, forestation changes. The worse scenario is a warming; drying climate where the forest is removed (e.g., wildfire, disease/parasite, logging, etc.) (WDFW, 1998).

**Methow River Basin**

Currently 17 bull trout/Dolly Varden stocks have been identified in the Methow River watershed. They are the Gold Creek, Beaver Creek, Twisp River, East Fork Buttermilk Creek, West Fork Buttermilk Creek, Reynolds Creek, Lake Creek, Wolf Creek, Goat Creek, Early Winters Creek, Cedar Creek, Lost River, Monument Greek, Cougar Lake, First Hidden Lake, Middle Hidden Lake, and the West Fork Methow River stocks. Adfluvial, fluvial and resident life history forms are present.

The bull trout/Dolly Varden in the Methow River watershed are native. No hatchery introduction of bull trout/Dolly Varden has occurred.

Bull trout/Dolly Varden spawn, and alevins rear in cold, headwater reaches where annual heat budgets are less than 1600 degrees C, the upper limit of steelhead and chinook salmon distribution. The stocks spawn in thermal isolation, because water temperature is too warm downstream between spawning sites.

Adfluvial, fluvial and resident forms are present. In addition to genetics, the environment plays a role in determining life form. The resident form is found in the coldest reaches or above passage barriers. Below such barriers in warmer, richer water resident emigrants likely transform into the fluvial form, which are forced to spawn in unsuitable habitat below barriers. Some resident fish enter Cougar Lake and First and Middle Hidden Lakes and become adfluvial fish.

The status of bull trout/Dolly Varden stocks in the Methow River watershed has been classified as Unknown with the exception of the Lost River stock which has been classified as Healthy based on the trend of available abundance data. The stock in the South Fork of Beaver Creek was extirpated by brook trout introgression. This also probably occurred in Eightmile Creek.

Nearly all suitable spawning habitat is currently used by bull trout/Dolly Varden and present spawning distribution is nearly the same as the distribution prior to European settlement. This habitat is naturally limited (less than 5 percent of the subbasin total) because adequately cold water is limited and found in high gradient; headwater reaches where access and flow are limited.

Habitat quantity ebbs and flows with climate, precipitation, forestation changes. The worst scenario is a warming; drying climate where the forest is removed (e.g., wildfire, disease/parasite, logging, etc.) (WDFW, 1998).

**Upper Columbia River Basin**

Limited information exists for bull trout/Dolly Varden within Washington in the Upper Columbia River system. Based on the information available, stocks have been identified as occurring in the Franklin D. Roosevelt Lake, Pend Oreille, South Salmo and Granite Creek drainages. Bull trout/Dolly Varden have been observed in Cedar Creek (north of Cedar Lake, Stevens Co.). While bull trout/Dolly Varden have been observed in the Canadian portion of Cedar Creek, none have been observed in Washington. Recent sampling conducted by the U.S. Forest Service in the East Fork Cedar Creek found only brook trout. Habitat in the Washington portion of Cedar Creek is not suitable for bull trout/Dolly Varden due to extensive agricultural and logging activities. Based on the available information a Cedar Creek stock has not been designated in Washington.

The bull trout/Dolly Varden in the Upper Columbia River system are native. No hatchery introduction of bull trout/Dolly Varden has occurred.

Currently no trend data exist for the bull trout/Dolly Varden stock in the Upper Columbia River system in Washington. Until trend data are obtained for these stocks they are assigned a status designation of Unknown (WDFW, 1998).

**Additional Information**

According to Richard Smith of USFWS (personal communication, February 2000), 127 bull trout utilized the ladders at Rocky Reach Dam in 1999 (93 passed the dam between May and July of that year); 56 bull trout used the ladders at Rock Island Dam that same year between late April and early September; and an unknown number (possibly significant) of bull trout used the ladders at Wells Dam. Similarly, 83 bull trout were recorded using the ladders between May and July 1998 at Rocky Reach Dam and 48 bull trout were recorded utilizing the ladders at Rocky Island Dam between mid-May and early August of 1998. In addition, Grant County PUD electroshocked one bull trout in each of their pools during a fish survey in 1999, and a WDFW fish biologist observed 16 bull trout between early May and mid-July 1998. The WDFW biologist also observed 49 bull trout within the pools between late April and early June 1999 (Smith, R., personal communication, February 2000).

**Lower Columbia River Basin**

Bull trout/Dolly Varden in the Lewis River have been identified as a distinct stock based on their geographic distribution. Currently only small populations of bull trout/Dolly Varden have been found in the Merwin, Yale and Swift reservoirs above Merwin Dam. WDFW (1998) believes that prior to dam construction the Lewis River also contained anadromous and fluvial bull trout/Dolly Varden. The bull trout/Dolly Varden populations studied to date have been found to be adfluvial. Some genetic sampling has been undertaken, but is it unknown if the stock is genetically distinct.

Currently there is no upstream passage of fish among the three dams. Some fish move downstream when water is spilled over the dams.

Bull trout/Dolly Varden in the Merwin Reservoir are thought to be present as a result of water spilled over Yale Dam and are not believed to spawn in Merwin Reservoir. Adult bull trout/Dolly Varden are seen concentrated at the base of Yale Dam in the fall each year. WDFW (1998) believes these fish reared in Yale Reservoir and attempt to return to it to spawn.

Cougar Creek is the only known spawning location for bull trout/Dolly Varden in Yale Reservoir. Spawning usually occurs from September through October. Spawning only occur in Rush Creek and Pink Creek in Swift Reservoir. Spawning here occurs from late August through mid-September.

Lewis River bull trout/Dolly Varden are native and maintained by wild production.

Stock status is Depressed due to chronically low abundance (WDFW 1998).

**g. CUTTHROAT TROUT**: According to WDFW (1998), the southwestern Washington-Lower Columbia River region historically supported healthy and highly productive coastal cutthroat trout populations. Coastal cutthroat trout, especially the freshwater forms, may still be well distributed in most river basins in this geographic region, probably in lower numbers relative to historical population sizes. Severe habitat degradation throughout the Lower Columbia River area has contributed to dramatic declines in anadromous cutthroat trout populations and two near extinctions of anadromous runs in the Hood and Sandy rivers.

Trends in anadromous adults and outmigrating smolts in the southwestern Washington portion of this DPS are all declining. Returns of both naturally- and hatchery-produced anadromous cutthroat trout in almost all Lower Columbia River streams have been declining markedly over the last 10-15 years. Indeed, the only anadromous cutthroat trout population in the Lower Columbia River to show increases in abundance over the last 10 years is the North Fork Toutle River population, which is thought to be recovering from the effects of the Mt. Saint Helens eruption. In spite of its increasing trend, WDFW states that its population numbers are still critically low (approximately 100 total adults in run).

Serious declines in the anadromous form have occurred throughout the Lower Columbia River, and it has been nearly extirpated in at least two rivers on the Oregon side of the basin. Available information suggests that in many streams the freshwater forms of coastal cutthroat trout are well distributed and occur in relatively high abundance in comparison to anadromous forms in the same.

Degraded habitat has been associated with more than 90 percent of documented extinctions or declines of Pacific salmon stocks (Gregory and Bisson 1997). Major land-use activities, including agriculture, forestry, urban and industrial development, road construction, and mining, have resulted in the alteration and loss of salmonid habitat and a subsequent loss in salmon production (Meehan 1991, NRCC 1996). The small streams often used by coastal cutthroat trout are particularly sensitive to changes in riparian vegetation, and they also are the ones most easily altered by human activities (Chamberlin et al. 1991). Evidence from two long-term studies, the Alsea Watershed study in Oregon and the Carnation Creek study in British Columbia, suggests that coastal cutthroat trout populations may be slow to recover from land-use activities such as timber harvest. Both of these studies have shown that coastal cutthroat trout numbers declined considerably after timber harvest and had not returned to their previous levels more than 10 years later (Moring and Lantz 1975, Hartman and

Scrivener 1990, Gregory et al. in press *cited in* Reeves et al. 1997). On the other hand, coastal cutthroat trout abundance can increase following logging in shady headwater streams, presumably because of increased primary productivity under more intense sunlight (Hall et al. 1978, Murphy and Hall 1981).

The effects of urbanization also may be seen in coastal cutthroat trout population structure. Scott et al. (1986) compared two streams near Bellevue, Washington: land use in one basin was primarily urban development, while upland areas in the other basin were largely rural. The species composition of the fish community in the two drainages was not the same, and one striking difference was the predominance of early life-history stages of coastal cutthroat trout in the urbanized creek drainage. However, the difference in fish community structure was not matched by an expected increase in outmigration rates and decreased growth rates of coastal cutthroat trout in the urbanized creek relative to the control creek.

Since coho salmon and coastal cutthroat trout habitat use overlaps a great deal, effects of changes in habitat quantity and quality on coho salmon probably have had similar effects on coastal cutthroat trout production. Beechie et al. (1994) estimated that since European settlement, 24-34 percent of coho salmon rearing habitat has been lost in the Skagit River, Washington, with most of the habitat lost from side channels and sloughs. Three major causes of coho salmon habitat loss identified by Beechie et al. (1994) are, in decreasing order of importance, hydromodification (diking and dredging), blocking culverts, and forest practices. Similarly, McHenry (1996) estimated that since European settlement, Chimacum Creek, Washington, (northwestern Puget Sound) has lost 12 percent, 94 percent and 97 percent of its spawning, summer-rearing, and winter-rearing habitats for coho salmon, respectively. McHenry (1996) stated that these habitat losses were due to logging, agricultural clearing, channelization, drainage ditching, groundwater withdrawal, and lack of woody debris.

Only in the last 25-30 years has the importance of riparian vegetation to the aquatic ecosystem received much attention. Riparian vegetation provides several functions important to healthy salmonid habitat such as providing cover, maintaining stream temperatures, stabilizing streambanks and channels, maintaining undercut banks, providing an allochthonous source of energy, and contributing structural components that influence channel morphology (Murphy and Meehan 1991). In its assessment of factors leading to steelhead declines, NMFS (1996) reported that approximately 80-90 percent of the original riparian habitat in most western states has been eliminated. In Washington and Oregon, up to 75 percent and 96 percent of the original coastal temperate rainforest has been logged, respectively (Kellogg 1992). Only 10-17 percent of old-growth forests reportedly remain in the Douglas fir regions of these two states (Speis and Franklin 1988, Norse 1990). California has reportedly lost 89 percent of the state’s riparian woodland to various land use practices (Kreissman 1991). Fisk et al. (1966) stated that over 1,600 km of streams within California had been damaged or destroyed as fish habitat by 1966.

One of the most important structural components of small streams in coastal watersheds that is contributed by riparian vegetation is large woody debris (LWD). In most river basins, the frequency and distribution of LWD has been altered through a number of human activities, many related to logging (NRCC 1996). The loss of LWD from streams results in subsequent declines in pool frequency and increases in riffle habitat (Swanson and Lienkaemper 1978, Bisson and Sedell 1984, Bisson et al. 1987, Gregory et al. 1991). FEMAT (1993) reported that there has been a 58 percent reduction in the number of large deep pools on national forest lands within the range of the northern spotted owl in western and eastern Washington. Similarly, there has been as much as an 80 percent reduction in the number of large deep pools in streams on private lands in coastal Oregon (FEMAT 1993). Overall, the frequency of large pools has decreased by almost two-thirds between the 1930s and 1992 (FEMAT 1993, Murphy 1995). Reductions in pool habitat are often related to declines in the number of age-1 and older coastal cutthroat trout (Bisson and Sedell 1984, Hartman and Scrivener 1990, Fausch and Northcote 1992, Reeves et al. 1993, Connolly 1997).

Descriptions of predevelopment conditions of rivers in Washington and Oregon that had abundant salmonid populations suggest that even big rivers had large amounts of instream LWD, which contributed significantly to trapping sediments and nutrients, impounding water, and creating many side channels and sloughs (Sedell and Luchessa 1982, Sedell and Froggatt 1984). Stream cleaning of LWD for navigation, flood control, and transport of logs occurred from the mid-1800s through the mid-1970s in many areas. In addition, past logging practices sometimes left excessive accumulations of debris in small streams that adversely affected fish production (Narver 1971, Brown 1974). Debris in streams was often viewed as something that would either impede or block fish passage and destroy channels by scour during storm-induced logjam failures. Until about 25 years ago, up to 90 percent of the funds for fish-habitat enhancement went for removal of wood debris in streams (Sedell and Luchessa 1982).

Beavers also had a key role in creating and maintaining many of these off-channel habitats. Beaver dams obstructed and redirected channel flows, flooded side-channels, and created large depositional areas for fine sediment storage (NRCC 1996). The use of these 150 sloughs and other off-channel habitats by coastal cutthroat trout was probably extensive, as suggested by their present use of these freshwater habitats for overwintering and feeding (Cederholm and Scarlett 1982, Hartman and Brown 1987, Reimchen 1990, Garrett 1998).

Some of the most productive salmonid habitat has been lost by blockages to migration. The most recognized barriers to migration are dams, but many smaller barriers exist as well. Blocked or improperly maintained culverts present obstacles to coastal cutthroat trout migration and seriously reduce the amount of habitat available for spawning and rearing. In Washington, an estimated 2,400 blocked culverts have eliminated more than

3,000 miles of stream habitat (WDFW 1995). Studies by Washington Trout (unpubl. data *cited in* White 1997) suggested the problem may be underestimated and that 80 percent of all culverts in the Puget Sound basin may block fish passage. Furthermore, culverts designed to allow the passage of adult salmon may create water velocities that exceed the swimming ability of juveniles except during periods of low flow (NRCC 1996). The impact of migrational barriers on coastal cutthroat trout production may be particularly severe since the majority of their life cycle is spent in fresh water, and they depend upon a variety of habitats for every life-history stage. Another potential migration barrier identified by NRCC (1996) is unscreened water diversions that may entrain downstream migrants.

The declines in the number of returning Pacific salmon and the nutrients they contribute to streams also may have placed additional limitations on coastal cutthroat trout production in fresh water. Consumption of carcasses and eggs by coastal cutthroat trout may have been particularly important in nutrient-poor headwater streams (Bilby et al. 1996), where coastal cutthroat trout spawning and early rearing typically occurs. The decreased availability of this nutrient-rich food source may have contributed to a reduction in growth and overwintering survival of coastal cutthroat trout juveniles.

Conditions of freshwater habitats in which coastal cutthroat trout live today are very different from historical conditions. The 1998 “Washington State Coastal Cutthroat Stock Inventory” (WDFW 1998) identified numerous land-use practices or habitat factors that have had a detrimental impact on coastal cutthroat trout habitat for 20 recognized coastal cutthroat trout stock complexes in Washington. Dominant land-use practices and habitat factors cited in this report include logging practices, road building, passage obstructions (e.g., dams and blocking culverts), water diversions, mining, livestock grazing, harvesting, and poaching. In Oregon, activities identified as impacting critical coastal cutthroat trout habitat are logging, grazing, road building, and land-development activities that impact water quality and flows (Kostow 1995). In most cases, separating the relative impact of one land-use activity from another is difficult since most salmon populations are subject to the cumulative effects of multiple land uses (Palmisano et al. 1993). Generally, the changes from each land use activity affect fish habitat similarly, despite differences in the activities themselves (Meehan 1991). Development and land-modification activities can act concurrently or sequentially to limit coastal cutthroat trout population size or growth during different life-history phases. In Washington, Oregon, and Northern California, the cumulative effect of these activities has led to large reductions in spawning habitat and in summer- and winter-rearing habitat for coastal cutthroat trout (Gerstung 1997, Hooton 1997, WDFW 1998).

For coastal cutthroat trout, quantitative estimates of historical abundance generally are lacking. However, biologists familiar with coastal cutthroat believe that degradation and outright destruction of riverine and estuarine habitat for the subspecies has been widespread. Specific quantitative assessments of habitat degradation or attempts to evaluate the response of coastal cutthroat populations to specific changes in habitat are rare.

Finally, conditions of freshwater and estuarine habitats in which coastal cutthroat trout live today are very different from historical conditions. Logging, road building, passage obstructions, water diversions, mining, livestock grazing, harvesting, and poaching have had a detrimental impact on coastal cutthroat trout habitat. The loss of coastal wetlands to urban or agricultural development has also directly reduced the productivity of cutthroat populations.

## II. *Overview of Environmental Baseline Conditions - Lower Columbia River Basin*

The current status of the listed species in the Lower Columbia River area, and their risk of extinction, have not significantly changed since the species were listed. The Corps is not aware of any new data that would indicate otherwise. The environmental baseline, to which the effects of the proposed action are added, "include the past and present impacts of all Federal, State or private activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation process" (50 CFR section 402.02). The biological requirements of the listed species are currently not being met under the environmental baseline. The species status is such that there needs to be significant improvement in the current environmental baseline conditions, including the condition of any designated critical habitat. A substantial proportion of the shallow water habitats that support migration, smoltification, and rearing have been lost or degraded by shoreland development, diking, dredging, and filling activities. A primary goal of habitat recovery in the Columbia River estuary should be to increase the survival and recovery of salmon by restoring the spatial and temporal diversity and connectivity of habitats available that provide these biological requirements.

To a significant degree, the risk of extinction for salmon stocks in the Columbia River basin has increased because complex freshwater and estuarine habitats needed to maintain diverse wild populations and life histories have been lost and fragmented. Estuarine habitat has been lost or altered directly through dredging, filling, and diking. It has also been removed indirectly through the effects of dredging and flow regulation on sediment transport and on the salinity ranges of specific habitats within the estuary. Not only have rearing habitats been removed, but also the connections among habitats needed to support tidal and seasonal movements of juvenile salmon have been severed. One example is the diking and filling of floodplains formerly connected to the tidal river, which have removed large expanses of low-energy, off-channel habitat for salmon rearing and migrating during high flows. Similarly, diking of estuarine marshes and forested wetlands within the estuary has removed 65 percent to 75 percent of these important off-channel habitats. Sherwood et al. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. The total volume of the estuary inside the entrance has declined by about 12 percent since 1868. This study farther estimated an 80 percent reduction in emergent vegetation production and a 15 percent decline in benthic algal production. Sherwood et al. (1990) also analyzed early navigational charts and noted profound changes in the river entrance from year to year. The pre-development river mouth was characterized by shifting shoals, sandbars, and channels forming ebb and flood tide deltas. Prior to dredging and maintenance, the navigable channel over the tidal delta varied from a single, relatively deep channel in some years to two or more shallow channels in other years.

Flow regulation, water withdrawal and climate change have reduced the Columbia River's average flow and altered the seasonality of Columbia River flows, sediment discharge and turbidity, which have changed the estuarine ecosystem (NRCC 1996; Sherwood et al., 1990; Simenstad et al., 1990, Weitkamp, 1995). Annual spring freshet flows through the Columbia River estuary are approximately one-half of the traditional levels that flushed the estuary and carried smolts to sea, and total sediment discharge is approximately one-third of 19th Century levels. Decreased spring flows and sediment discharges have also reduced the extent, speed of movement, thickness, and turbidity of the plume that extended far out and south into the Pacific Ocean during the spring and summer (Cudaback and Jay, 1996). Changes in estuarine bathymetry and flow have altered the extent and pattern of salinity intrusion into the river and have increased stratification and reduced mixing (Sherwood et al., 1990).

Development has changed the circulation pattern in the estuary and increased shoaling rates. Sediment input to the estuary has declined due to the altered hydrograph and the estuary is now a more effective sediment trap (Northwest Power Planning Council, 1996). Although the Columbia River is characterized as a highly energetic system, it has been changing as a result of development and is now similar to more developed and less energetic estuaries throughout the world (Sherwood, et al., 1990).

Based on these factors, Corps finds that habitat characteristics of the Lower Columbia River ecosystem are not properly functioning relative to the identified biological requirements and essential critical habitat elements.

Additional information on the environmental baseline of the Columbia River can be found in "*The Columbia River System Operation Review*" Final Environmental Impact Statement, dated November 1995. The document was written by US Department of Energy (Bonneville Power Administration), US Department of the Interior (Bureau of Reclamation), and US Department of the Army (North Pacific Division Corps of Engineers).

**Table C.1** Estuarine Loss in various Western Washington Coast Estuaries (NMFS 1998).

| **ESTUARY** | **ESTUARINE AREA LOST (unless otherwise noted)** |
|---|---|
| Fraser River Estuary, Canada | 39% loss of tidal marshes (23 square km) Simenstad 1983) |
| Grays Harbor, Washington | 3,840 acres of marsh (Seliskar and Gallagher 1983)<br>14,579 acres (30%) of aerial extent (NRCC 1996)<br>Original marsh loss- 2200 acres; marsh creation of 1100 acres Boule and Bierly 1987) |
| Puyallup River, WA | 100% of inter-tidal estuarine habitat (i.e. area between mean low and mean high water) (Simenstad 1983).<br>2347 acres (95%) of aerial extent (NRCC 1996) |
| Samish River, WA | 96.4% of intertidal habitat (Simenstad 1983)<br>371 acres of aerial extent( 79% (NRCC 1996) |
| Skagit River Delta, WA | 80% of original marshland (Simenstad 1983)<br>988 acres (25%) of aerial extent (NRCC 1996) |
| Willapa Bay, WA | 6200 acres (40%) of emergent mush (Seliskar & Gallagher 1983)<br>2600 acres vegetated wetlands (Boule and Bierly 1987)<br>6300 acres of tidelands and marshlands lost to industry and highways, 300 acres lost to agriculture, 6600 acres lost to pasture, hay, and silvaculture production (Phillips1984) |
| Nooksack, WA | 37 acres gained (3% increase) (NRCC 1996) |
| Lummi WA | 1359 =as (95%) of aerial extent (NRCC 1996) |
| Stilliquamish WA | 148 acres (20% increase) of aerial extent gained (NRCC 1996) |
| Snohomish, WA | 9390 acres (74%) of aerial extent (NRCC 1996) |
| Duwamish WA | 633 acres (98%) of aerial extent (NRCC 1996) |
| Nisqually, WA | 395 acres (28%) of aerial extent (NRCC 1996) |
| Skokomish, WA | 173 acres (33%) of aerial extent (NRCC 1996) |
| Dungeness, WA | no change in extent ( NRCC 1996) |
| Columbia Rim Estuary (OR/WA) | 700 acres of salt marshes (Seliskar 1983)<br>3272 acres of tidal swamps (Seliskar end Gallagher 1983)<br>43% loss of tidal marshes (Simenstad 1983)<br>43% of tidal marshes and 76% of tidal swamps (Boule & Bierly 1987)<br>33,000 acres of tidal estuary (40%) (Kaczynski and Palmisano 1993)<br>65% of tidal swamps and marshes (NRCC 1996) |

**Table C.2** Washington State bull trout/Dolly Varden stock list presented by river basin (WDFW 1998).

## *PUGET SOUND*

| **TRANSBOUNDARY INDEPENDENTS** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
|---|---|---|---|
| Chilliwack/Selesia Cr | Native | Wild | Unknown |
| **NOOKSACK** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Lower Nooksack | Native | Wild | Unknown |
| Canyon Cr (Nooksack) | Native | Wild | Unknown |
| Upper MF Nooksack | Native | Wild | Unknown |
| **SKAGIT** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Lower Skagit | Native | Wild | Healthy |
| Baker Lake | Native | Wild | Unknown |
| Upper Skagit | Native | Wild | Unknown |
| **STILLAGUAMISH** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Stillaguamish | Native | Wild | Unknown |
| **SNOHOMISH** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Skykomish | Native | Wild | Healthy |
| **CEDAR** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Chester Morse Lake | Native | Wild | Unknown |
| **DUWAMISH/GREEN** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Green R | Native | Wild | Unknown |
| **PUYALLUP** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Puyallup | Native | Wild | Unknown |
| White R (Puyallup) | Native | Wild | Unknown |
| Carbon | Native | Wild | Unknown |
| **NISQUALLY** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Nisqually | Native | Wild | Unknown |
| **HOOD CANAL** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| SF Skokomish | Native | Wild | Unknown |
| Lake Cushman | Native | Wild | Healthy |
| Upper NF Skokomish | Native | Wild | Unknown |
| **STRAIT OF JUAN DE FUCA** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK'STATUS** |
| Dungeness/Gray Wolf | Native | Wild | Unknown |
| Upper Dungeness | Native | Wild | Healthy |
| Lower Elwha | Native | Wild | Unknown |
| Upper Elwha | Native | Wild | Unknown |

**Table C.3** Washington State bull trout/Dolly Varden stock list presented by river basin (WDFW 1998).

## *WASHINGTON COAST*

| **QUILLAYUTE** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
|---|---|---|---|
| Sol Duc | Native | Wild | Unknown |
| **HOH** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Hoh | Native | Wild | Unknown |
| **QUEETS** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Queets | Native | Wild | Healthy |
| **QUINAULT** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Quinault | Native | Wild | Unknown |
| **MOCLIPS/COPALIS** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Moclips | Native | Wild | Unknown |
| Copalis | Native | Wild | Unknown |
| **GRAYS HARBOR** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| Chehalis/Grays Harbor | Native | Wild | Unknown |

**Table C.4** Washington State bull trout/Dolly Varden stock list presented by river basin (WDFW 1998).

## *COLUMBIA RIVER*

| LOWER COLUMBIA | STOCK ORIGIN | PRODUCTION TYPE | STOCK STATUS |
|---|---|---|---|
| Lewis | Native | Wild | Depressed |
| **UPPER COLUMBIA** | **STOCK ORIGIN** | **PRODUCTION TYPE** | **STOCK STATUS** |
| White Salmon | Native | Wild | Unknown |
| Klicktitat | Native | Wild | Unknown |
| Touchet | Native | Wild | Unknown |
| Mill Cr | Native | Wild | Healthy |
| Upper Tucannon | Native | Wild | Healthy |
| Asotin Cr | Native | Wild | Unknown |
| Wenaha | Native | Wild | Unknown |
| Yakima | Native | Wild | Critical |
| Ahtanum Cr | Native | Wild | Critical |
| Naches | Native | Wild | Critical |
| Rimrock Lake | Native | Wild | Healthy |
| Bumping Lake | Native | Wild | Depressed |
| NF Teanway | Native | Wild | Critical |
| Cle Elum/Waptus Lake | Native | Wild | Unknown |
| Kachess Lake | Native | Wild | Critical |
| Keechelus Lake | Native | Wild | Critical |
| Ingalls Cr | Native | Wild | Unknown |
| Icicle Cr | Native | Wild | Unknown |
| Chiwaukum Cr | Native | Wild | Unknown |
| Chiwawa Cr | Native | Wild | Unknown |
| Chikamin Cr | Native | Wild | Healthy |
| Rock Cr | Native | Wild | Healthy |
| Phelps Cr | Native | Wild | Healthy |
| Nason Cr | Native | Wild | Unknown |
| Little Wenatchee | Native | Wild | Unknown |
| White R (Wenatchee) | Native | Wild | Unknown |
| Panther Cr | Native | Wild | Healthy |
| Entiat | Native | Wild | Unknown |
| Mad R | Native | Wild | Healthy |
| Gold Cr | Native | Wild | Unknown |
| Beaver Cr | Native | Wild | Unknown |
| EF Buttermilk Cr | Native | Wild | Unknown |
| WF Buttermilk Cr | Native | Wild | Unknown |
| Reynolds Cr | Native | Wild | Unknown |
| Lake Cr | Native | Wild | Unknown |
| Wolf Cr | Native | Wild | Unknown |
| Goat Cr | Native | Wild | Unknown |
| Early Winters Cr | Native | Wild | Unknown |
| Cedar Cr (Methow) | Native | Wild | Unknown |
| Lost R | Native | Wild | Healthy |
| Monument Cr | Native | Wild | Unknown |
| Cougar Lake | Native | Wild | Unknown |
| First Hidden Lake | Native | Wild | Unknown |
| Middle Hidden Lake | Native | Wild | Unknown |
| WF Methow | Native | Wild | Unknown |
| FDR Lake | Native | Wild | Unknown |
| Pend Oreille | Native | Wild | Unknown |
| S Salmo | Native | Wild | Unknown |
| Granite Cr | Native | Wild | Unknown |