Coastal Cutthroat Trout in Washington State: Status and Management

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Introduction

The coastal cutthroat trout (*Oncorhynchus clarki clarki*) inhabits a diverse and ecologically varied suite of habitats in Washington State. Cutthroat have responded to this variability, as evidenced by their exhibiting four basic life history forms (Wydoski and Whitney 2003), anadromous, adfluvial, fluvial and resident. A summary of the status of the anadromous form of coastal cutthroat trout in Washington State was published by Leider (1997).

The Washington Department of Fish and Wildlife (WDFW) completed the salmonid stock inventory (SaSI) assessment process for coastal cutthroat trout (Blakley et al. 2000), which expanded upon the Washington Department of Game Sea-Run Cutthroat Status Report (DeShazo 1980). In the SaSI, the coastal cutthroat populations were described as "stock complexes". These complexes were defined as a group of closely related stocks located within a single watershed or other relatively limited geographic area. The number of stocks within a stock complex may never be known with any confidence. The inventory identified 40 coastal cutthroat stock complexes and determined their status (healthy, depressed, critical, unknown or extinct), origin (native, non-native or unknown) and production type (wild, cultured or unknown).

This paper is intended to provide updated information subsequent to that paper, and to document the response of the WDFW to the proposed listing of this population under the Endangered Species Act.

In response to a petition to list coastal cutthroat trout as threatened or endangered under the U.S. Endangered Species Act, Johnson et al. (1999) completed a status review of coastal cutthroat trout, focusing on the anadromous forms of the species. Subsequently, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) jointly published a proposal to list the "Southwest Washington-Columbia River" coastal cutthroat trout population as threatened in April, 1999 (64 FR 16397). The proposal to list the population was based on suspected declines in anadromous cutthroat abundance, habitat losses, and effects of hatchery-reared coastal cutthroat trout on wild cutthroat. In December, 2001, the WDFW provided information and analysis on the abundance, life history, genetics, and distribution of coastal cutthroat in the proposed distinct population segment.

A decision was ultimately made not to list the species in June, 2002 (67 FR 44934). The USFWS found that recent changes in regulations had reduced threats to the population. Also, the latest information indicating relatively healthy-sized total populations (all life history strategies) in a large portion (75 percent) of the population's range, and the production of anadromous trout from resident forms led them to conclude that the southwest Washington/Columbia River distinct population unit of coastal cutthroat trout was not in danger of becoming endangered in the foreseeable future and did not meet the definition of a threatened species.

General Distribution and Life Histories

Coastal cutthroat are widely distributed throughout Washington west of the Cascade mountain crest. Anadromous forms are generally found in streams in lower elevation and lower-gradient waters downstream of barriers to upstream migration. They are present in tributaries to the Strait of Juan de Fuca, Puget Sound and Hood Canal, in coastal streams, and in tributaries of the lower Columbia River as well as in the estuary and near-shore habitats associated with those systems.

Coastal cutthroat have a diverse range of life history forms. Several "potamodromous", or freshwater, life history strategies have been described. Fluvial, or riverine, forms migrate shorter distances within streams and rivers, utilizing larger rivers for accelerated growth. Adfluvial, or lacustrine, forms migrate into lakes to feed and grow after spawning. Resident, non-migratory forms tend to spend their lives in a small area of the headwater streams. A number of sources have described the "bewildering diversity" (Johnson et al. 1999) in size and age at migration, timing of migrations, age at maturity, and frequency of repeat spawning of coastal cutthroat trout in Washington (Blakley et al. 2000, Trotter 1997).

Anadromous, or "sea-run" cutthroat, spawn in small streams, and the juveniles undergo smoltification to adapt to life in haline environments. Cutthroat trout populations that exhibit migration to marine waters are commonly referred to as anadromous, as are Pacific salmon. Technically, however, unlike Pacific salmon, coastal cutthroat trout and some other species that enter the marine environment may be more properly termed amphidromous. Unlike strict anadromy, amphidromous individuals often return seasonally to freshwater as subadults, sometimes for several years, before returning to spawn (Wilson 1997). Nonetheless, this paper will use the term anadromous to refer to the component of the population that migrates from fresh water habitats to estuarine or marine waters for a period of time.

Johnston (1982) identified two adult return strategies for the anadromous form, termed "early-" and "late-returning". Early-returning cutthroat runs tend to peak in large streams in September and October. The later-returning form typically returns in December and January to small streams draining directly into marine waters. Spawning normally occurs from December through May depending on the stock; spawning in northern Puget Sound tributaries tends to peak later than in other areas.

Out-migration of cutthroat smolts is similar to that of wild steelhead smolts (Serl and Morrill (2004). Those species consistently have been the first migrants to reach the Cowlitz Falls project in late April or early May, reaching the 50 percent passage date in mid-May.

Michael (1983) concluded that migration from above a barrier to migration in Snow Creek, Clallam County was genetically lethal, as the migrants did not return to spawn. WDFW has been conducting some further research into the relationship between anadromous and resident cutthroat. On the Cowlitz River, Tacoma Power discontinued trapping downstream migrant salmonids at Riffe Lake after dams were built in the early 1970s, and anadromy was no longer possible in the upper Cowlitz River basin. Data from migrant traps at Cowlitz Falls show that from 1992-95 no adults were released upstream, yet cutthroat smolts were captured in downstream traps as soon as the Cowlitz Falls Fish Facility began operating in 1996 (Serl and Morrill 2004). Smolt tagging data since 1997 has revealed that these migrating juveniles produced adult returns. An analysis of the micro-chemistry of otoliths of returning adult cutthroat comparing strontium/calcium ratios determined that the fish did migrate to salt water and returned as adults (Volk 1997). Based on these results it is clear that some resident cutthroat populations can and do contribute to the anadromous population. Cutthroat smolts were counted

at WDFW out-migrant traps at Lucia Falls on the East Fork Lewis River, which is considered to be a barrier to all anadromous salmonids but steelhead. Consequently, these smolts are believed to be offspring of resident coastal cutthroat. (Rawding and VanderPloeg 2001).

Potential Factors Affecting Stock Status

No single factor that may affect stock status operates independently of others. An increase or decrease in cutthroat population size results from an interaction of habitat conditions, harvest management, hatchery operations and the pressures of inter-species competition and predation.

Habitat

The diversity of cutthroat life-history, behavior, and distribution of coastal cutthroat in Washington State exposes the species to a wide variety of natural and perturbed habitats. Habitat alterations exert dynamic pressures on populations of cutthroat, as well as on associated species. Impacts to habitats that adversely affect a sympatric species may benefit the population of cutthroat.

Shoreline modification is known to degrade nearshore habitat. Thom et al. (1994) report that approximately one-third of all saltwater shorelines in Washington State have some of kind of shoreline modification structure, such as a bulkhead. Although few changes have been made to the outer coast, anthropogenic changes to Puget Sound have occurred. The large river deltas in Puget Sound are some of the most extensively modified areas (Bortleson et al. 1980). Commencement Bay and Elliott Bay were once highly productive estuarine deltas, but are now heavily urbanized (Puget Sound Action Team 2002, 2004).

In Washington, estuary habitat losses have been caused by the cumulative effects of agriculture, logging, mining, dams, grazing, urbanization, industry, exotic species and aquaculture (Canning and Stevens 1990; Simenstad and Thom 1992; Johnson et al. 1999). By the 1990s, cumulative area loss of Washington coastal tidal wetlands was 42%, of Puget Sound estuaries was 71%, and of Puget Sound eelgrass was 70% (Simenstad and Thom 1992).

The Northwest Power and Conservation Council (2001) reported extensive losses of habitat in the lower Columbia River and Estuary as a result of dredging, filling, diking, and channelization. From 1870 to 1970, 20,000 acres of tidal swamps (with woody vegetation; 78% of estuary littoral area), 10,000 acres of tidal marshes (with non-woody vegetation) and 3,000 acres of tidal flats had been lost. The original extent of tidal marsh and swamp in the estuary has been reduced by more than half (LCREP 1999). Thomas (1983) reported the most significant losses to the estuary were in “swamps and marshes” and in “deep and medium depth water”.

Good et al. (1998) documented the extensive alteration of freshwater riparian areas due to forestry, agricultural, residential, industrial and other uses and subsequent declines in the water quality and biological integrity of their adjacent waterways. Logging results in direct impacts to cutthroat habitats from sedimentation, changes in composition of spawning gravels, loss of riparian cover and stream temperature elevation (Cedarholm et al. 1978; Martin et al. 1981). Rosenfeld et al. (2000) found that disproportionate use of small streams by cutthroat indicates that protection of small stream habitat is particularly important for long-term conservation of coastal cutthroat populations.

Changes in fish populations accompany urbanization or intense agricultural land use. The most significant and documented change in the fish community of urban streams is from coho dominance to cutthroat trout dominance. Lucchetti and Fuerstenberg (1993) and Scott *et al.* (1986) documented reductions in the percentage of coho relative to cutthroat in a number of urban streams. In healthy streams, juvenile coho account for 2 to 10 times the number of cutthroat fry. As urbanization proceeds, juvenile and adult resident cutthroat become more dominant and eventually surpass coho both in total numbers and biomass. This change in species composition has been attributed to the reliance of juvenile coho on stable channels with complex habitat created by large woody debris. These habitat conditions are less common in urban streams.

As a watershed becomes urbanized, the proportion of impervious surface in the watershed increases. Thus, hydrographs of urbanized streams peak more quickly that in natural streams and even fairly mild rain events cause redd-scouring flows. The impact on fall spawning coho is grater than on spring spawning cutthroat. This release from competition with coho allows the cutthroat to utilize the productivity of these streams to produce larger numbers of cutthroat than would normally be found in less urbanized streams. Serl (1999) investigated the effects of increased urbanization in Lake Washington tributaries. He found that the total density, length, and biomass density (g/m2) of cutthroat increased with increasing percent total impervious area.

Species Interactions

The interactions between multiple species in the aquatic environment reflect a dynamic process. The relationship between coho and cutthroat trout has been described by a number of authors (Perkins, 1982; Steward, 1983; Scott et al., 1986; Lucchetti and Fuerstenberg, 1993; Sabo 1995; Rosenfeld et al. 2000). Urbanization appears to alter the relationship between juvenile coho salmon and cutthroat trout. In these studies, coho tended to dominate in undeveloped streams, whereas cutthroat were more tolerant of conditions found in urbanized streams.

Predation by cutthroat on other species is well documented, and coastal cutthroat are effective predators on other fishes (Beauchamp et al. 1995; Jaquet 2004; Vamosi and Schluter 2002; Wydoski and Whitney 2003). Suspended materials limit the underwater visual range of fish, which may either reduce the ability of prey species to detect predators or may act as a protective cover (Gregory and Levings 1996). Gregory and Levings (1998) reported that during their seaward migration in the Fraser River system, age-0 Pacific salmon were less likely to encounter and be consumed by piscivorous cutthroat in turbid water than in clear water.

The response by cutthroat to natural and anthropogenic variability in sympatric populations of coho salmon, steelhead, and other salmonids must be viewed in the context of ecosystem dynamics. The NMFS Biological Review Team identified hybridization with *O. mykiss* as a potential risk to coastal cutthroat (Johnson et al. 1999). The team discussed the importance to risk evaluations of being able to distinguish historical natural levels of *O. c. clarki* × *O. mykiss* hybridization from levels of present-day hybridization, and recognized the difficulty in evaluating those risks due to the lack of historical information. Cutthroat trout are known to hybridize with *O. mykiss* in anadromous zones of Puget Sound and other western Washington streams (Baker et al. 2002; Marshall et al. 2004). Young et al. (2001) reported that their findings were consistent with the hypothesis that introgression between anadromous populations of

coastal rainbow and coastal cutthroat trout is limited by an environment-dependent reduction in hybrid fitness.

Harvest

Leider (1997) summarized the history of recreational fishing for coastal cutthroat trout in Washington State. As human populations have increased, stock health and angling success for cutthroat have declined, and harvest regulations have become more restrictive. Cutthroat trout are not targeted in commercial fisheries and bycatch in commercial gillnet fisheries is minimal because of the large mesh size of gillnets relative to the size of cutthroat trout (NMFS 2003).

Current sport harvest regulations have been designed to increase the likelihood that smaller fish escape the fishery, so that rearing juveniles and migrating smolts are protected, and a majority of adult females are able to spawn at least once before being subjected to harvest. The statewide general fishing season for streams, rivers and beaver ponds (1 June through 31 October) provides protection to outmigrating juvenile cutthroat. Size and bag limits (2 trout, at least 8 inches in length, may be retained) provide protection from harvest to juvenile and young adult resident cutthroat. In streams where anadromous populations and fisheries coincide, general regulations allow a daily harvest of 2 fish, with a 14-inch minimum size. Where cutthroat are encountered in marine waters, catch-and-release fishing is mandated.

In tributaries to the Hood Canal and Willapa Bay, and in most major lower Columbia River tributaries, catch-and-release regulations are imposed on the recreational trout fishery. In the lower Columbia River below Bonneville Dam, and in the Cowlitz River from the mouth to Mayfield Dam, the fishery is targeted upon returns of hatchery-origin coastal cutthroat. Regulations require the release of wild cutthroat, and allow the retention of trout greater than 12 inches in length that have had their adipose fins removed.

Hatchery

The sole remaining hatchery production of sea-run coastal cutthroat occurs at the Cowlitz Trout Hatchery, located at river kilometer 66 on the Cowlitz River. The sea-run cutthroat program began when the hatchery was completed in 1967, with release of fish beginning in the spring of 1968. Recent annual release levels reached 277,000 smolts (Table 1). Up to 100,000 fry and fingerling plants were previously made in the Tilton River and several tributaries. After 2002 these plants were discontinued as the new 35-year Cowlitz FERC re-licensing agreement #2016 (July 18, 2003) and the Cowlitz River Fisheries and Hatchery Management Plan (August 2004) emphasized recovery of upper river wild anadromous salmonids above the dams.

The current release goal of 160,000 smolts downstream of the dams is designed to contribute to a meaningful harvest for sport fisheries. The program goal is to achieve an average 4.71% smolt-to-adult survival that includes harvest plus return of up to 5,000 fish at current production levels (WDFW, 2005). Hatchery juveniles are raised to smolt-size (4.0 fish/lb) and released from the hatchery at a time that fosters rapid migration downstream. Program fish are checked for health and signs of smolt fitness close to release time.

Table 1. Cowlitz sea-run cutthroat rack returns and percent return

Release Year	Smolts Planted	Hatchery Returns from	Percent Return to	Assumed Total Return*

		Release	Rack	
1990	69,203	1,964	2.66	3,928
1991	106,316	2,404	2.69	4,808
1992	109,645	683	0.52	1,366
1993	96,220	1,279	1.18	2,558
1994	92,381	2,232	2.06	4,464
1995	98,865	3,581	3.53	7,162
1996	82,803	812	1.00	1,624
1997	110,127	1,233	1.11	2,466
1998	140,484	5,763	4.10	11,526
1999	130,800	6,122	4.68	12,244
2000	204,572	11,434	5.59	22,864
2001	228,780	7,583	3.31	15,166
2002	277,662	21,977	0.79	43,954
2003	154,005	9,690	5.80	19,300
2004	96,940	20,733**	21.4	41,546

*Rack returns are thought to represent 50% of total return, thus average percent survival is estimated to be 4.71%. *from* Tipping, J. M., D. C. Harmon. 2001. Cowlitz Hatchery Program Evaluation Annual report for 2000. Washington Department of Fish and Wildlife. #FPA01-01.
** Total for 2004 only includes 1-salt returns.

The cutthroat trout hatchery program at the Cowlitz Trout Hatchery will be converted to an Integrated Type program, defined by the Hatchery Scientific Review Group (HSRG) as a program to demographically increase the abundance of fish while retaining the genetic adaptation and fitness of a natural population (HSRG et al. 2004). Tacoma Power (2004) proposed that the long-term objective of this program would be to produce 50,000 smolts to meet conservation and self-sustaining run goals.

Currently, wild adult cutthroat arriving at the Cowlitz Salmon Hatchery are transported above hydropower dams to Lake Mayfield and Lake Scanewa in order to spawn naturally. Wild cutthroat smolts produced from above the dams are collected at Mayfield Dam and Cowlitz Falls Fish Collection Facilities, transported downstream to the Cowlitz Salmon Hatchery stress reduction ponds, released during the spring outmigration period.

The hatchery cutthroat program was proposed for termination upon achieving the self-sustaining run size of 500 adults under the Cowlitz Fish Hatchery and Management Plan (Tacoma Power 2004), although WDFW proposed a more modest reduction to 100,000 smolts to sustain the popular and economically significant recreational fishery (WDFW 2005). A final determination on the specifics of this program has not been made.

Status and Trends

The Salmonid Stock Inventory (Blakley et al. 2000) defined a stock complex as healthy if it was experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock complex. A depressed stock complex was one whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock complex is likely. Critical status was for those stock complexes experiencing production levels that are so low that permanent damage to the stock complex is likely or has already occurred. A stock complex was defined as unknown when there was insufficient quantitative information to rate its status.

Data sufficient to determine the status of coastal cutthroat are available for few populations in the State of Washington. Most information on the presence or abundance of cutthroat is a consequence of ancillary data resulting from collection of data on other species, mainly salmon and steelhead. These data are available from creel censuses, upstream and downstream migrant trapping programs, and electrofishing surveys. The limitations of this approach are that the sampling being conducted may or may not correspond to the life history characteristics of coastal cutthroat. Those data should therefore be viewed as indices to coastal cutthroat abundance and status. The following information summarizes the known status and distribution of coastal cutthroat in Washington.

Puget Sound

Little recent information was available relative to cutthroat population status in the major Puget Sound tributaries that would permit an assessment or revision of the status ratings provided by Blakley et al. (2000). During the WDFW SaSI process, status for anadromous cutthroat in the Puget Sound, the Strait of Juan de Fuca, and Hood Canal tributaries was unknown, with the exception of the Stillaguamish River system, where the status was identified as healthy (Blakley et al. 2000). The Puget Sound Treaty Tribes and WDFW (2004:71) likewise noted that cutthroat populations were healthy in the Snohomish River system. Little information was available on the status of the non-anadromous forms. Our knowledge of population abundance, trends in abundance, population dynamics, and relationships among life history forms, productivity and status are lacking.

Several Washington streams are tributary to the Fraser River in British Columbia. Cutthroat trout are reported as ubiquitous, occurring from sea level to above 500 m in elevation, rearing in Johnson and Sumas Creeks, and spawning in Sumas Creek, Upper Johnson Creek and tributaries of the Sumas River (Puget Sound Energy 2002). Coastal cutthroat trout have been described as a "Blue-listed" species by the British Columbia Ministry of the Environment in the B.C. Provincial Vertebrate Animal Tracking List, meaning that they are considered to be a taxon of "special concern" in British Columbia (Cannings and Ptolemy 1998) due to characteristics that make them particularly sensitive to human activities or natural events.

Mueller et al. (1999) found that cutthroat trout were ubiquitous throughout Whatcom Lake during sampling for warmwater fish species in the late summer of 1998. Low catch rates for cutthroat during their survey were attributed to seasonal influences and gear-related biases. Long-term records of cutthroat trout spawning activity around Lake Whatcom from 1985-1994 suggested declines in this species (Jim Johnston, WDFW, unpublished data). The native cutthroat trout spawning population of Lake Whatcom decreased markedly from 1987 to 1999, ostensibly the result of urbanization, timber practices, and other anthropogenic influences (Mueller et al. 2001).

The status of coastal cutthroat in the Skagit River basin was classified as unknown, as healthy in the Stillaguamish River, and in the Snohomish River drainage their status was classified as unknown but may be healthy (Blakley et al. 2000). Little recent quantitative information is available to modify those determinations.

Coastal cutthroat trout are found throughout the Lake Washington basin in both potamodromous and anadromous life history forms, although the proportion of the adfluvial form appears to be increasing while fewer anadromous cutthroat are migrating through the Ballard shipping locks (J. Serl, WDFW, pers. comm.). Cutthroat in this lake have apparently increased in numbers since Eggers et al. (1978) reviewed the Lake Washington fish community, and found the species to be a minor component of the lake community. Currently, they prey heavily on zooplankton, threespine stickleback *Gasterosteus aculeatus* and introduced longfin smelt *Spirinchus thaleichthys* which appear to somewhat buffer cutthroat predation on juvenile sockeye salmon *Oncorhynchus nerka* (Nowak et al 2004). Status of cutthroat trout in the Sammamish River basin has not been determined, yet populations appear to have increased in recent years (King County SWMD 1993). Cutthroat are reported to be numerous in Issaquah Creek (US Army Corps of Engineers 2003a).

In recent years, resident cutthroat trout have increased in abundance throughout the Lake Washington watershed (Paron and Nelson 2001). Widespread urbanization around Lake Washington has created marginal conditions, and cutthroat trout are able to use these habitats more successfully than other trout and salmon (Scott et al. 1986). In areas where habitat is in good condition and cutthroat trout are sympatric with other salmonids, cutthroat trout appear to take a subdominant role (Johnson et al. 1999). Apparent cutthroat trout population increases in the Lake Washington basin may reflect increased use and availability of marginal habitats, from which other salmonid species have disappeared. Seiler et al. (2003) reported production estimates from Issaquah Creek, which indicate a very large cutthroat population exists in that stream.

Anadromous coastal cutthroat have not been documented in the Cedar River watershed above the Landsburg Diversion Dam, although resident forms are present in high numbers in the watershed below the Lower Cedar Falls (NMFS 2002). It is not known what proportion of the population downstream of the Landsburg Diversion Dam is the anadromous form. There are no records indicating that coastal cutthroat trout use the fish ladder at the Ballard Locks. The presence of large cutthroat trout observed in the Cedar River downstream of the Landsburg Diversion Dam suggests that some fish may have an anadromous or potentially adfluvial life history. Resident cutthroat are widely distributed in the Taylor Creek drainage and tributaries to the Cedar River downstream of Cedar Falls. No cutthroat trout have been observed within the Masonry Pool or Chester Morse Lake and its tributary streams, suggesting that the original natural barrier to anadromous fish passage at Cedar Falls historically controlled their distribution in the watershed.

Coastal cutthroat are distributed throughout western south Puget Sound streams, although their status is unknown. We have no current quantitative data on abundance or survival with which to assess status. Hunter (1980) rated anadromous cutthroat status in many of the tributaries in this region, based on habitat quality. Within more southerly waters the following systems were ranked as good: Sherwood, Campbell, Malaney, Deer, Cranberry, Kennedy, McLane, Deschutes River, and Woodland Creeks. Those identified as fair included Goldsborough, Skookum, and

Schneider Creeks. Only Perry Creek received a low rating, while Mill Creek was rated "very good."

The anadromous life history form is likely to be found in most of the above listed systems, but presence and distribution in freshwater may be quite seasonal because of summer and fall low flows. The resident forms of this stock complex are present in virtually all perennial independent streams in western South Puget Sound.

It is expected that these fish are late-entry, based upon the relative size of the streams. The fluvial form probably inhabits all of the medium-sized streams, and the adfluvial form may be present in as many as 12 lakes within the range of this stock complex. Anadromous spawnings are unknown but are thought to be similar to the North Puget Sound Tributaries Complex, which is January through March.

The trapping of outmigrant cutthroat has occurred since 1978 at Big Beef Creek, a tributary to east-central Hood Canal. Since 1978, it appears that the production of cutthroat in this stream has generally increased (Figure 1)

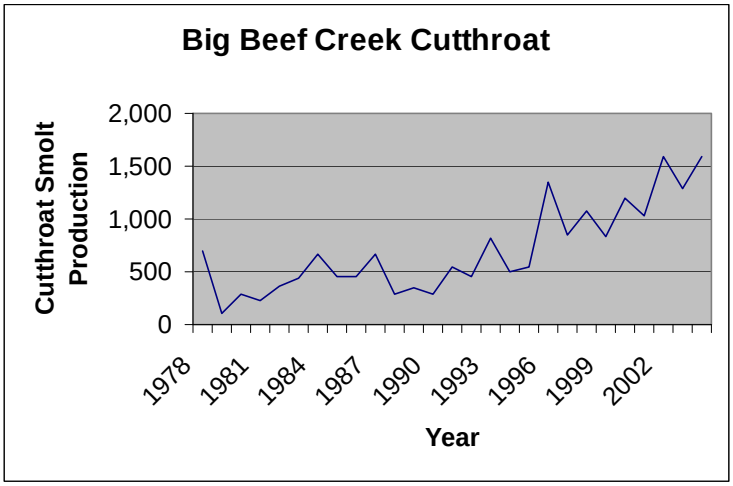

Figure 1. Estimated production of coastal cutthroat trout smolts in Big Beef Creek, Kitsap County, Washington (Hood Canal) from 1978 to 2004. (Seiler, WDFW, unpub. data)

Bernthal and Rot (2001) reported the widespread presence of cutthroat trout in several streams in Hood Canal and the eastern Strait of Juan de Fuca, but did not provide estimates of population size or status. Haring (1999) reported cutthroat presence in a number of western Strait of Juan de Fuca streams, and noted problems with impassable culverts, erosion, elevated water temperatures, and other habitat degradation in streams near Port Angeles. At Snow and Salmon Creeks, western Strait of Juan de Fuca tributaries, the late entry stock is present (Michael 1989).

Washington Coast

Blakley et al. (2000) had insufficient information to rate stock complex status for the coastal cutthroat populations in the Washington coastal tributaries. Reviews of limiting factors for salmonid habitats in Washington coastal streams all indicate a widespread presence of cutthroat, but no information was available on population size or status (Smith 2000; Smith and Caldwell 2001)

The southwestern cutthroat populations are composed of cutthroat stocks from Willapa Bay and Grays Harbor. Hunter (2001) collected data on juvenile cutthroat abundance and distribution throughout the southwestern portion of the range, and concluded that cutthroat are widely distributed and abundant.

Adult abundance information reported by NMFS (Johnson et al. 1999) showed increasing trends for eight of 10 populations examined. Sport fishing data for this same region show an increase of both catch per unit effort and size during the same period. Adult trap information from the West Fork Hoquiam River from 1985-2000 indicates stable adult abundance with indications of increasing trends based on the last two years that had the highest counts on record (Figure 2).

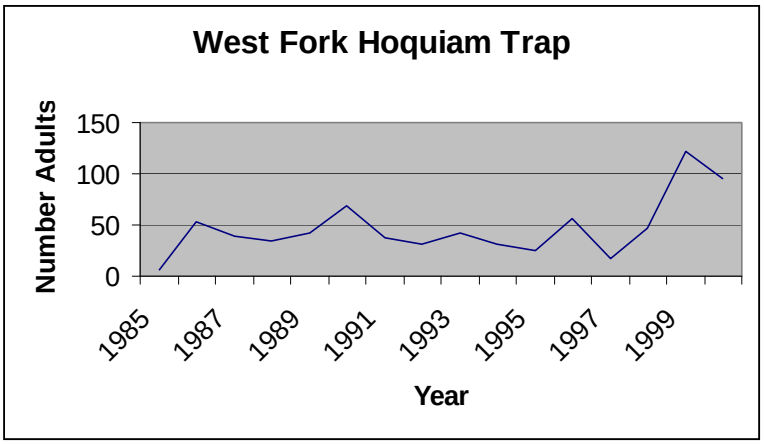

Figure 2. Number of wild adult cutthroat captured at West Hoquiam River trap, 1985-2000. Data from Quinault Indian Nation Department of Natural Resources.

Perhaps the best indication of the status of adult cutthroat in southwestern Washington is the increasing trends of repeat spawners in the population. These trends were seen in the both Grays Harbor (West Fork Hoquiam trap) and Willapa bay stocks (Hunter 2001). Indications are that all forms of coastal cutthroat in the southwest coastal region of Washington are abundant and healthy.

Limited information is available for the production of juvenile cutthroat trout in the southwestern Washington coastal streams. The WDFW downstream migrant trap at Bingham Creek, a tributary of the East Fork Satsop River in the Grays Harbor watershed, has been operated since 1982. Figure 3 displays the estimated production of cutthroat smolts from Bingham Creek. The data indicate that the production of cutthroat in this small stream is relatively stable, although somewhat cyclical.

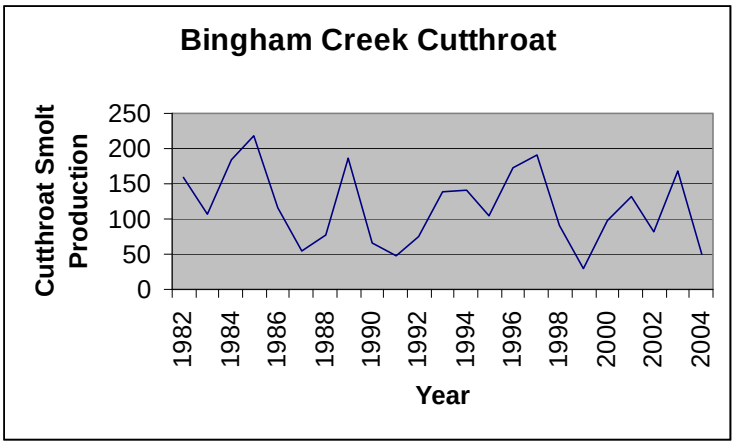

Figure 3. Estimated production of coastal cutthroat trout smolts in Bingham Creek, Grays Harbor County, Washington from 1982 to 2004. (Seiler, WDFW, unpub. data)

Examination of the existing data led WDFW to conclude that the southwest Washington coastal cutthroat are one of the healthiest cutthroat populations in the state (Fuller 2001). Adult abundance, juvenile production, and the distribution of both the resident and anadromous forms are at levels at or above other distinct populations segments.

Based on surveys conducted by Weyerhaeuser Corporation and the Quinault Indian Nation in the West Branch Hoquiam River, it is believed that coastal cutthroat trout are abundant and widespread in Chehalis River/Grays Harbor (Blakley et al. 2000). Cutthroat status remains unknown in the upper Chehalis River basin (US Army Corps of Engineers 2003a).

Lower Columbia River

Southwest Washington/Lower Columbia River cutthroat trout were proposed as threatened in April 1999 (64 FR 16397). The U.S. Fish and Wildlife Service and NOAA Fisheries expressed concern about the severe habitat degradation resulting in extremely low population sizes of anadromous coastal cutthroat trout in lower Columbia River streams, indicated by low incidental catches of coastal cutthroat trout in salmon and steelhead recreational fisheries, and by low trap counts in a number of tributaries throughout the region.

The SaSI process identified native, wild cutthroat stock complexes as depressed in several lower Columbia River tributaries. A stock complex was identified as depressed when its production was below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock complex was likely (Blakley et al. 2000). These stocks included cutthroat in the Grays, Elochoman, Cowlitz, Coweeman, Toutle, and Kalama rivers, and Abernathy, Germany, Mill, Coal, and Skamokawa creeks. Insufficient trend information was available to assess status of anadromous stocks in the Lewis and Washougal rivers, Salmon Creek, and small tributaries from the Lewis River to Bonneville Dam. Resident forms of cutthroat are found throughout these watersheds (Wade 2002).

In their review of coastal cutthroat trout, the Northwest Power Planning Council (2004) states that anadromous, fluvial, and resident life history forms distribute themselves throughout lower Columbia tributary watersheds. They reported that freshwater forms are well distributed with relatively high abundance, in comparison to anadromous forms in the same streams.

Creel surveys continue to be directed towards salmon and steelhead fisheries, and do not measure sea-run cutthroat effort separately. It has been noted that angler effort in traditional cutthroat waters and anglers utilizing traditional sea-run cutthroat gear in creel-surveyed waters has declined greatly (Rawding 2001). This shift in effort, coinciding with regulations prohibiting the retention of wild cutthroat in an increasing number of lower Columbia River tributaries, results in harvest trend data being a poor indicator of overall stock status (Fuller 2001).

Status determination of Columbia River coastal cutthroat stocks through the use of adult cutthroat trap captures from structures designed for salmon and steelhead does not represent an accurate picture of cutthroat numbers in this population. Trap count numbers for the majority of sea-run cutthroat adults in the region should only be considered relative index numbers. In general, adult sea-run cutthroat trapping does occur, but the traps used have bar spacing designed to hold adult salmon and steelhead, therefore, smaller cutthroat and resident trout easily escape. In addition, sea-run cutthroat have been observed bypassing fish ladders and jumping falls on Lower Columbia streams (Rawding 2001).

While the Columbia River adult cutthroat populations estimates have declined from previous years, distribution of juvenile populations, and estimates of outmigrating smolts indicate that cutthroat are found in all areas with cutthroat habitat and in numbers within the range of other healthy populations with mixed species.

Field investigations targeted at juvenile cutthroat in the Columbia River tributaries were conducted between June and October of 2000 and 2001 (Mongillo and Hallock 2001). Results from these investigations at 156 sampling sites showed that coastal cutthroat were widely distributed throughout the Columbia River region both above and below anadromous zones and in areas they were projected to be found. As expected, cutthroat were not seen above Bonneville Dam on the Washington side, with the exception of Spring Creek, a tributary to the White Salmon River. These investigations also showed that relative abundance, expressed as cutthroat per square meter, and the percent of streams with cutthroat were similar to other systems that were found not warranted for listing.

A juvenile trap study was conducted on three independent drainages to the lower Columbia River (Seiler and Peterson 2001). Juvenile traps were set in Germany, Mill and Abernathy creeks during the spring outmigration of 2001. For these three streams, the total outmigration estimate of coho was approximately 22,000 and 20,000 steelhead, while the cutthroat estimate was approximately 1,600 smolts. The coho to cutthroat ratios in this study are some of the lowest observed in systems with abundant coho juveniles (13.7:1). Based on the size of the drainage and the number of competing species, both coho and steelhead, cutthroat production in these streams are better than expected.

The lack of effective upstream and downstream passage through two reservoirs and dams below Cowlitz Falls effectively eliminated anadromous production in the upper watershed in the 1960s. The completion of the Surface Collection System and Fish Facilities at the Cowlitz Falls Dam in 1996 marked the beginning of a unique opportunity to restore anadromous salmonids to an estimated 240 linear miles of historically productive habitat in the upper Cowlitz and Cispus watersheds. Estimated production of cutthroat smolts resulting from juvenile catches at the facility are displayed in Figure 4 (Serl and Morrill 2004, 2005). This monitoring has documented cutthroat smolts originating from existing natural populations in the watershed above the Cowlitz Falls Dam since 1997. Elsewhere in this drainage, Wade (2000) identified a

"healthy" population of resident cutthroat trout in Winston Creek, in the Mayfield/Tilton subbasin.

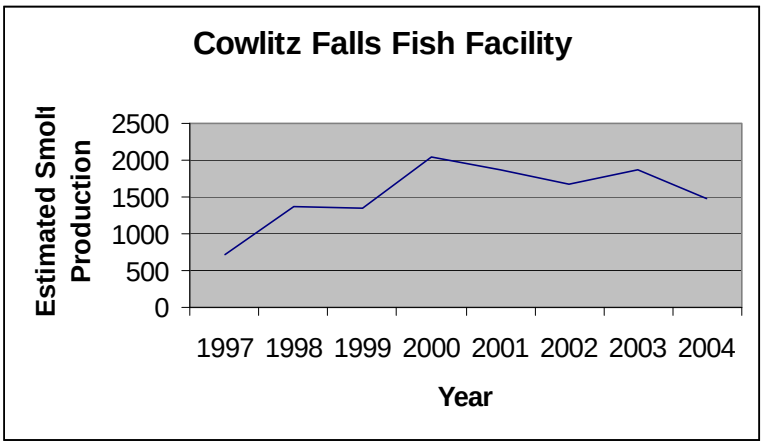

Figure 4. Estimated production of cutthroat from Cowlitz Falls fish collection facility data 1997-2004.

A fish collection facility was constructed on the North Fork Toutle River about a quarter mile above the confluence with the Green River so adults can be trucked above the sediment retention structure (B. Glaser, WDFW pers. comm.). Catches at the trap are displayed in Figure 5. WDFW staff speculate that declining adult cutthroat catches at this facility in recent years may be a function of the efficiency of the adult trap there. The trap is old and consistently fills with sediment. Considerable maintenance is required to ensure that it is working properly, and the trap may not be effectively trapping cutthroat.

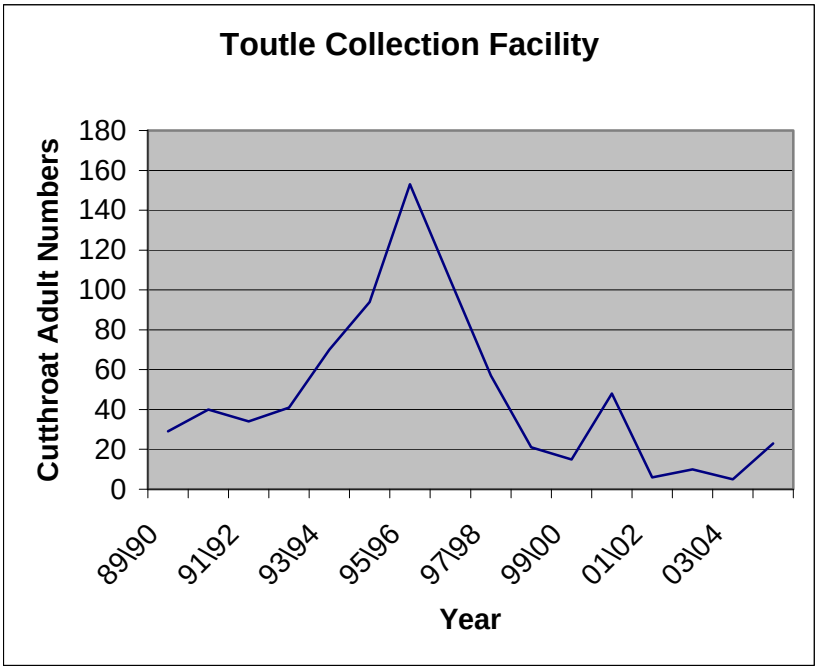

Figure 5. Adult cutthroat trapped at the Toutle Collection Facility, 1989-2004.

Data for adult coastal cutthroat trout trapped at the falls on the Kalama River are displayed in Figure 6. The trap spacing allows small coastal cutthroat trout to pass undetected, so the

numbers are considered to be an index of abundance (P.L. Hulett and C. Wagemann, WDFW Kalama Research, pers. comm.).

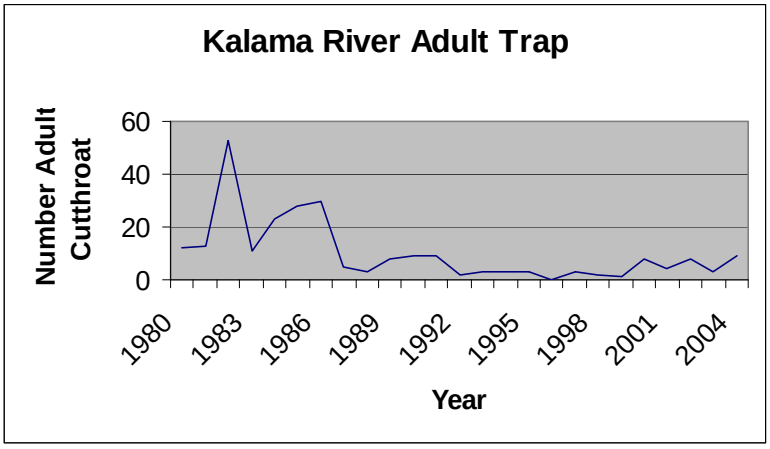

Figure 6. Adult cutthroat counts at Kalama River upstream migrant trap, 1980-2004.

In 1998, a rotary screw trap on the Kalama River, calibrated for steelhead production, estimated sea-run cutthroat numbers at 2,153 (± 1,453 95% C.I.) smolts. This trap and other smolt traps calibrated for sea-run cutthroat trap efficiencies are being tested and historical sea-run cutthroat smolt estimates from the region are being re-analyzed. Further validation of the assumptions made concerning trap efficiencies and additional data proofing are being undertaken. The estimates that have been developed to date strongly suggest anadromous sea-run cutthroat smolt production and out-migration are robust from this tributary (Rawding 2001).

Cedar Creek is a third order tributary to the Lewis River and located in Clark County, Washington. In 1998, the WDFW installed an adult trap in the Cedar Creek fishway at Rkm 4.0 to monitor adult steelhead escapement. Later that year the adult monitoring program was expanded to include other species, including sea-run cutthroat trout. In March 1998, a rotary screw was installed to estimate steelhead, coho salmon, and sea-run cutthroat smolt production in this watershed. Upstream (Figure 7) migrant data are presented for cutthroat at the Cedar Creek trap; cutthroat smolt data were expanded to an estimate of outmigration size for the rotary trap from 2001-2004, and are displayed in Figure 8 (S. VanderPloeg, WDFW, pers. comm.). The estimates that have been developed to date strongly suggest anadromous sea-run cutthroat smolt production and out-migration are robust from these tributaries (Rawding 2001).

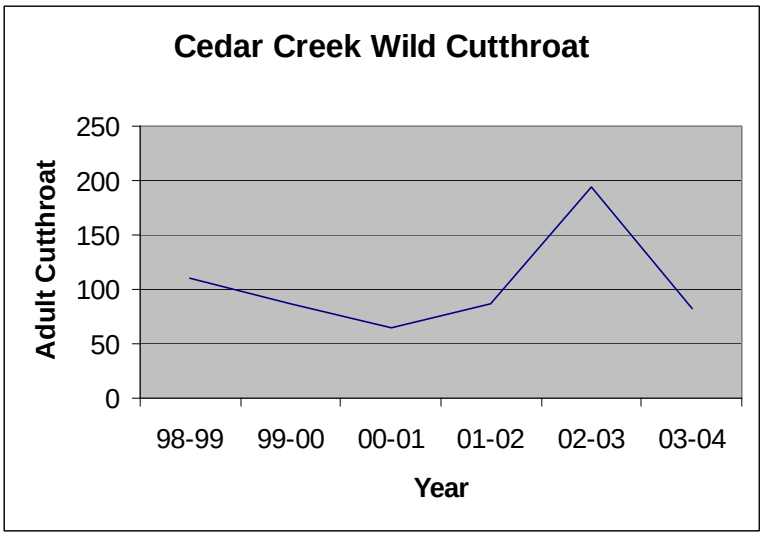

Figure 7. Adult cutthroat trapped at the Cedar Creek trap from 1998-2004.

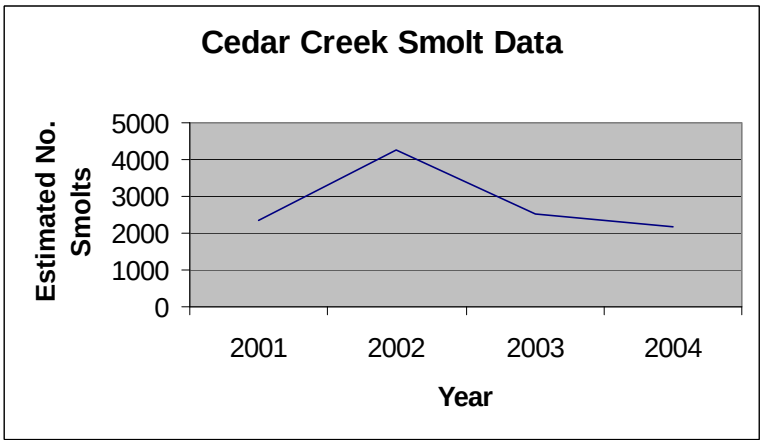

Figure 8. Total cutthroat smolt migration estimated from collections at Cedar Creek rotary trap, 2001-2004.

Byrne et al. (2002) reported anadromous cutthroat in the Washougal River and its tributaries up to Dougan Falls, with resident forms found throughout the watershed. Stock status was unknown due to insufficient data, but habitat conditions are generally poor.

The small Columbia River tributaries between the Lewis River and Bonneville Dam contain coastal cutthroat trout. Blakley et al. (2000) identified populations in 9 streams, but were unable to describe population status due to insufficient information on the stocks.

The Wind River may have historically supported small populations of cutthroat. Data on run sizes and specific spawning locations are not available. Spawning would likely have been limited to the mainstem of the Wind River below Shipherd Falls and possibly portions of the Little White Salmon River. Cutthroat may still exist in the lower river, but straying from other systems may also account for their presence in the Wind (Washington Conservation Commission 1999).

Rawding (2000) noted that it was likely that anadromous cutthroat historically used the White Salmon River below the Condit Dam, but were believed to be extirpated. Resident cutthroat are found in the waters above Condit Dam.

Connolly et al. (2002) collected information on coastal cutthroat in Columbia River tributaries between Bonneville and The Dalles dams by interviewing professional fish biologists and reviewing published and unpublished reports. They found that the distribution of coastal cutthroat trout above Bonneville Dam is poorly documented and the current monitoring efforts are insufficient to allow determination of population status. Jewett Creek, near the towns of White Salmon and Bingen, appears to be the easternmost tributary on the Washington side of the Columbia River with a documented coastal cutthroat population.

Resident cutthroat were recorded in McCreedy and Summit creeks, tributaries to the Klickitat River, during census work in the 1980s (Sharp et al 2000). In the late 1990s, known locations of resident cutthroat were reinvestigated with no cutthroat trout observed. Coastal cutthroat were generally reported in the lower watershed below the confluence of the Little Klickitat River.

Separation of Distinct Populations

Johnson et al. (1999) considered a number of possible configurations for 'evolutionarily significant units' (ESUs) of cutthroat populations, and concluded that the available information supported a scenario with six ESUs. The proposed ESU designations included populations in the Puget Sound, Olympic Peninsula, Southwestern Washington/Columbia River, Upper Willamette River, Oregon Coast, and Southern Oregon/California Coasts.

The Evolutionarily Significant Unit that was proposed for the southwest Washington/Columbia River consisted of coastal cutthroat trout populations in southwestern Washington and the Columbia River, excluding the Willamette River above Willamette Falls. Baker (2000) analyzed genetic data from 19 cutthroat populations from the Washington coast and Columbia River tributaries. A dendrogram produced from that analysis showed four apparent groups; north coast, south coast, lower Columbia River and mid-Columbia River (Figure 9). He concluded the cutthroat within the proposed SW Washington/lower Columbia River distinct population segment might be separated into two populations segments, based on genetic, spatial, and behavioral differences between cutthroat in the Columbia River and in southwestern Washington (i.e., Grays Harbor and Willapa Bay). He also found that coastal cutthroat from the Washougal and White rivers were distinct from lower Columbia River populations.

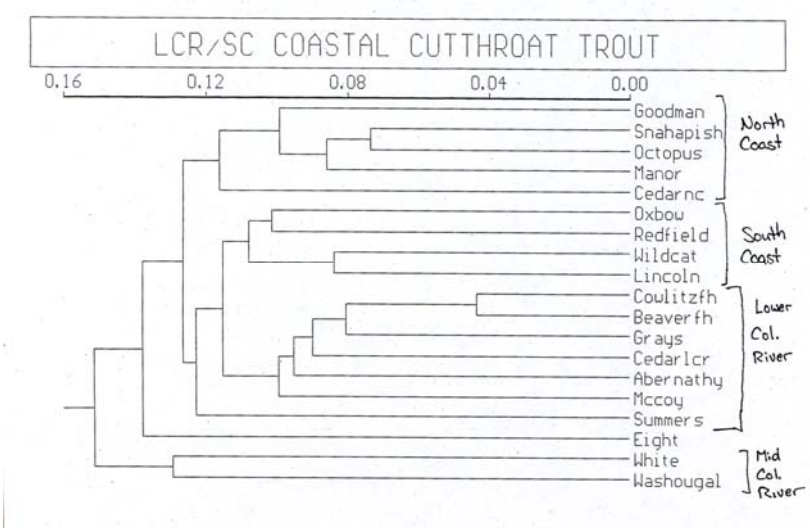

Figure 9. Results of allozyme analysis of 19 coastal cutthroat populations from the Washington coast and lower Columbia River (Baker 2000).

Because the genetic data were not conclusive, Rawding (2001 *in litt*.) compared populations of wild anadromous cutthroat in the Columbia River and in southwest Washington Coast as to length of fish, age at return, salt water residence time, and length at age. The differences in freshwater age structure, saltwater age structure, length, and length at age all suggest that Columbia River and southwest Washington anadromous cutthroat trout utilize different environment, and that these are different groups.

Cutthroat Harvest Management

The biological objectives of current fishing regulations in Washington State are to 1) provide protection for juvenile and out-migrating smolts, and 2) to allow a majority of adult female cutthroat trout to spawn at least once prior to being available for harvest. Fisheries managers have implemented seasonal closures, minimum-size and daily creel limits, and catch-and-release regulations to achieve these objectives.

Resident, juvenile and smolting cutthroat are protected under the statewide general fishing season closure from November through May, annually. In small streams, a daily creel limit is applied, allowing anglers 2 fish with a minimum size of 8 inches (20.3 cm), 10 inches (25.4 cm) or 12 inches (30.5 cm), depending on the characteristics of the population. Populations in anadromous waters are protected under a daily creel limit that allows the harvest of 2 fish over 14 inches (35.6 cm).

In the Cowlitz River, the sole waters where hatchery-origin anadromous cutthroat trout are stocked, and in the Columbia River below Bonneville Dam, regulations restrict anglers to the harvest of fin-clipped hatchery fish only; all wild (unmarked) cutthroat trout must be immediately released.

In 1998 the Washington Fish and Wildlife Commission adopted catch-and-release rules for cutthroat in all Washington marine waters. Catch-and-release regulations for cutthroat trout are also in effect for most Hood Canal, Willapa Bay, and lower Columbia River tributaries.

Discussion

Leider (1997) noted that "confident assessment of the status of coastal cutthroat trout in most areas of the state is limited at this time." The situation has changed little in the ensuing years, because resources are not available to survey and assess the populations, or to compile and analyze existing data. Most of the coastal cutthroat stock complexes in the 2000 SaSI were identified as unknown, as there simply was insufficient information to rate them (Blakley et al. 2000). Many of these are historically small populations, which may be especially vulnerable to negative impacts. I reiterate their conclusion that there is a pressing need to collect more information on them.

The available monitoring information suggests that cutthroat are widespread and ubiquitous, and that all life history strategies are represented within suitable habitat. At the upper limits of the range of the coastal cutthroat in the Columbia River, there has been an apparent population decline, potentially due to habitat degradation, impediments to fish passage, and historical harvest management.

The paucity of data available on the demographics of most cutthroat populations necessitates a conservative approach to the management of the species. The angling regulations currently in place in Washington State are designed to provide recreational angling opportunity on healthy, self-sustaining populations of cutthroat that have contributed to the replenishment of the stock. These regulations appear to accomplish the goals of providing recreational opportunity while providing adequate protection to the stock complexes. A management plan has been developed for the limited production of sea-run cutthroat in the Cowlitz River drainage to mitigate for the recreational fishery impacted by the building of the dams on that system, and to conserve the wild populations in the lower Columbia River tributaries.

We have a limited understanding of the dynamics of cutthroat populations relative to freshwater habitats, saltwater productivity, interactions with sympatric species, and responses to anthropogenic influences. Likewise, we are just beginning to understand the factors and conditions that influence anadromy or residency within a given population of cutthroat trout.

The interests of this unique subspecies of cutthroat trout will best be served by managers and biologists developing a better understanding of its life history, genetics, population dynamics, and habitat. Education of the public, anglers, and agencies on the biological and management requirements of the species will aid in the development of initiatives and approaches to manage and conserve coastal cutthroat and the species associated with them.

Acknowledgments

I am indebted to the WDFW field biologists who have maintained data files on coastal cutthroat, a species for which very modest resources have been made available. The preparation of this report would have been impossible without their efforts, analyses and insight. Dave Seiler, John Serl, and Bryce Glaser provided their expertise on coastal cutthroat, and their data sets for upstream and downstream migrant counts. This paper was greatly improved by the comments and edits of Bruce Baker, Ann Blakley, Bob Gibbons, Molly Hallock, Keith Keown, J. Hal Michael, Larry Phillips, John Serl, and Jim Uehara (WDFW).

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