Report on the Coastal Cutthroat Trout Science Workshop

June 6-7, 2006

Portland, Oregon

Compilation of Research and Monitoring Needs for Coastal Cutthroat Trout Throughout Their Distributional Range

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EXECUTIVE SUMMARY

The need to monitor, research, and conserve coastal cutthroat trout (*Oncorhynchus clarkii clarkii*) throughout their distributional range has been identified by a number of constituents, including state, federal, tribal, and non-governmental organizations. These trout have a complex life history, rely on large expanses of habitat within watersheds to complete their life cycle, have small adult population sizes relative to other salmonids, have been the focus of litigation and, compared to other species of salmonids, our knowledge of them is limited. To address these complex problems, a collaborative effort among state and federal partners was initiated following the 2005 Coastal Cutthroat Trout Symposium held in Port Townsend, Washington. In the spring of 2006, this group identified a goal of “developing a consistent framework to help guide and prioritize conservation, management, research, and restoration of coastal cutthroat trout throughout their native range”. This group was formalized (November 2006) and is referred to as the “Coastal Cutthroat Trout Executive Committee”. The group has proposed hosting a series of science and management cutthroat trout workshops that would identify the impediments to gathering and sharing data and moving our knowledge of this complex sub-species forward.

The first workshop, The Coastal Cutthroat Trout Science Workshop, was sponsored by Pacific States Marine Fisheries Commission (PSMFC), and was held in Portland, Oregon, June 6 and 7, 2006. There, representatives from state and federal agencies representing each jurisdiction throughout the range of coastal cutthroat trout shared information and prioritized the information needs for the sub-species. This document is a report of the outcome of that meeting. The goal of the meeting was to report on the status and current research, data gaps, impacts to populations, and monitoring efforts for coastal cutthroat trout, as well as provide recommendations for future work.

The Science Workshop covered a wide range of topics relevant to the biology and management of coastal cutthroat trout. There was clear consensus among the participants that two issues were of primary concern and were ultimately identified as the highest priorities among all participants. First, the complexity of life history of coastal cutthroat trout creates challenges for understanding all other aspects of their biology. Second, the status of the sub-species cannot be evaluated without some new or modified approaches to monitoring distribution and abundance.

Participants listed a number of potential impacts to coastal cutthroat trout and their habitats. In general, altered flow, water allocation, and loss or fragmentation of habitat were identified as threats to coastal cutthroat trout. Specifically, participants identified fish passage issues from large and small hydropower operations, loss of overwintering habitat, changes in geomorphic processes and channel geometry, channelization and simplification of habitat in estuaries, the loss of large woody debris, climate change, and impacts to small headwater streams.

Finally, consensus among participants was reached that the lack of information regarding the status and trends of coastal cutthroat trout populations is a significant problem for agencies charged with their management. A workshop devoted to monitoring coastal cutthroat trout populations throughout their distributional range was proposed as a first step to address this need.

ACKNOWLEDGEMENTS

I would like to acknowledge the members of the Coastal Cutthroat Trout Executive Committee Doug Young, Tim Cummings, Ron Ptolemy, Roger Harding, and Stephen Phillips for their work in conceiving and organizing the Coastal Cutthroat Trout Science Workshop. Pacific States Marine Fisheries Commission (PSMFC) and US Fish and Wildlife Service (USFWS) provided the financial support for the Science Workshop. PSMFC provided the funding to prepare the present document. Susan Anderson (PSMFC) provided excellent organizational support for the Science Workshop. Kathyrn Ronnenberg (USFS, PNW Research) created the range wide map used in this document. Susan Griswold provided editorial and technical assistance with document preparation. Ken Currens (Northwest Indian Fisheries Commission) provided editorial comments which significantly improved the document.

It should be recognized that a voluntary effort that tackles difficult scientific and monitoring issues for a non-listed non-commercial sub-species requires considerable leadership and good will from Federal and State agencies. USFWS, PSMFC, and representatives from state agencies (California, Oregon, Washington, Alaska), and the Province of British Columbia were equal partners in framing the science meeting and its desired outcome. Bringing this task to completion, i.e., developing "a consistent framework to help and prioritize conservation, management, research, and restoration throughout the native range of coastal cutthroat trout" will require continued leadership, coordination, and commitment into the future.

This work is dedicated to those who are captivated by the beauty, diversity, and mystery of coastal cutthroat trout and their habitats.

SCOPE AND MISSION OF THE PRESENT DOCUMENT

This document is intended to be a resource for researchers and mangers who are interested in the biology and conservation of coastal cutthroat trout throughout the sub-species distributional range from northern California to Alaska. The intention of this document is to report the scientific issues, data gaps, and priorities for future work discussed among a dozen participants representing state, provincial and federal fish management agencies during the Coastal Cutthroat Trout Science Workshop held on June 6-7, 2006, in Portland, Oregon. The document is considered a "living document" and will be updated periodically to reflect the activities and outcomes of the Coastal Cutthroat Trout Executive Committee.

TIME LINE OF MANAGEMENT AND CONSERVATION ACTIVITES FOR COASTAL CUTTHROAT TROUT

1946 Fish counts on Winchester Dam are initiated. Cutthroat trout are enumerated by visual counts.

1946 Oregon Fish and Game Commission describe coastal cutthroat trout as the “problem child” of the state's fisheries.

1976 British Columbia Fish and Wildlife Branch holds first Pacific Northwest Coastal Cutthroat Trout Workshop in Victoria that is attended by representatives from Alaska (Jones), Washington (Johnston) and Oregon (Geiger).

1988 Sport Fish Division of Alaska Department of Fish and Game begins research program on coastal cutthroat trout.

1995 First Sea-run Coastal Cutthroat Trout Symposium, organized by Lower Umpqua Flycasters, held in Reedsport, Oregon.

1996 Umpqua River cutthroat trout listed as a “threatened” sub-species by National Marine Fisheries Service.

1997 Oregon Department of Fish and Wildlife discontinues stocking hatchery coastal cutthroat trout into coastal waters and the lower Columbia River where coastal cutthroat trout reside.

1999 Status review of cutthroat trout in California, Oregon, and Washington completed by National Marine Fisheries Service and propose the delineation of six Evolutionary Significant Units (ESU’s).

2000 Umpqua River Coastal cutthroat trout authority transferred to USFWS. Umpqua coastal cutthroat trout delisted based on inclusion in Coastal Oregon Evolutionary Significant Unit.

2000 Lower Columbia Southwest Washington coastal cutthroat trout petitioned for listing under the Endangered Species Act (ESA).

2001 Petition for listing Lower Columbia Southwest Washington coastal cutthroat trout denied.

2005 Coastal Cutthroat Trout 2005 Symposium held in Port Townsend, Washington.

2006 Coastal Cutthroat Trout Science Workshop held in Portland, Oregon.

2006 Coastal Cutthroat Trout Executive Committee formalized.

INTRODUCTION

Background

The need to monitor, research, and conserve coastal cutthroat trout (*Oncorhynchus clarkii clarkii*) throughout their distributional range has been identified by a number of constituents, including state, federal, tribal, and non-governmental organizations. Coastal cutthroat trout are found in coastal streams from California to Alaska, a landscape facing increased habitat alteration, urbanization, and overfishing. These trout have a complex life history, rely on large expanses of habitat within watersheds to complete their life cycle, have small adult population sizes relative to other salmonids, have been the focus of litigation and, compared to other species of salmonids, our knowledge of them is limited.

Coastal cutthroat trout are one of the fourteen recognized sub-species of cutthroat trout (Behnke 1992). They reside in the coastal zone of the Pacific Northwest region and are the only coastal member of the genus *Oncorhynchus* that does not support a commercial fishery. Thus, these trout routinely fall to a lower priority in terms of agency resources. As a result, the existing knowledge about these fish is often not summarized or brought into a larger scientific or management context, which leads to uncertainty in terms of their status.

So little was known about coastal cutthroat trout they were termed "the problem children" in 1946 by the Oregon State Fish and Game Commission (Fish Commission of Oregon and Oregon State Game Commission, 1946). In 1999, when the status of the sub-species was being reviewed by the National Marine Fisheries Service (NMFS), it appeared the situation had not changed:

"The BRT (Biological Review Team) wrestled with a fundamental dilemma stemming from the lack of data, which can result in two alternative conclusions:

> There is insufficient evidence to demonstrate that coastal cutthroat trout are at significant risk of extinction
>
> There is insufficient evidence to demonstrate that coastal cutthroat trout are *not* at significant risk of extinction"

Johnson et al. 1999.

Thus, there is a need to identify the issues that are hindering collection of scientific information that will help assess the status of coastal cutthroat trout and move our understanding of this complex sub-species forward.

Currently, in some regions, biologists report population declines for some life history forms of the sub-species (Connolly et al. 2002, Slaney and Roberts 2005). In other regions biologists report that populations are stable (Goodson 2006) or increasing (Johnson et al. 2005). However, throughout the range of coastal cutthroat trout, representatives from state, federal, and provincial agencies have long agreed that information regarding the biology and status of coastal cutthroat trout is too limited to make good decisions about how to prioritize conservation, management and research.

There are a limited number of long-term data sets available to evaluate population trends in coastal cutthroat trout, and those data sets that do exist are primarily related to adult anadromous or fluvial fish. The longest known time-series data set for coastal cutthroat trout is from the Winchester Dam on the Umpqua River in Oregon, where adult trout passing the dam have been counted since 1946 (Loomis 1997). Annual counts averaged approximately 1,000 from 1946-1956. From 1957 to 1960 fish counts averaged below 100, representing an order of magnitude decline in numbers. In 1961, hatchery supplementation from the Alsea Hatchery led to an increase in fish counts (wild plus hatchery) but, when supplementation ended in 1976, estimates of fish counts dropped again. Fish counts from the past decade, 1997-2005, are stable and range from 34-159 individuals and average less than 100 individuals. In California and Washington creel census data and anecdotal information from fisheries biologists suggests that catches of anadromous trout underwent declines in the 1950's and possibly again in the 1970's (Gerstung 1997, Deshazo 1980). It appears that current abundance of populations, while stable in some locations, may represent fragments of historic populations, or that the abundance of life history forms targeted by anglers has undergone a decline.

To address these complex problems, a collaborative effort among state and federal partners was initiated following the 2005 Coastal Cutthroat Trout Symposium held in Port Townsend, Washington. In the spring of 2006, this group identified a goal of "developing a consistent framework to help guide and prioritize conservation, management, research, and restoration of coastal cutthroat trout throughout their native range". To address this goal, the group proposed hosting a series of science and management cutthroat trout workshops that would identify the impediments to gathering and sharing data. This group was formalized (November 2006) and is referred to as the "Coastal Cutthroat Trout Executive Committee".

The first workshop, The Coastal Cutthroat Trout Science Workshop, was sponsored by Pacific States Marine Fisheries Commission (PSMFC), and was held in Portland, Oregon, June 6 and 7, 2006. There, representatives from state and federal agencies representing each jurisdiction throughout the range of coastal cutthroat trout shared information and prioritized the information needs for the sub-species (a representative from California could not attend, but provided information prior to and subsequent to the meeting). This document is a report of the outcome of that meeting. The remainder of this document consists of four sections: 1) introduction, 2) scope and process of the coastal cutthroat trout science workshop, 3) report on the status, current research, and monitoring of coastal cutthroat trout, and 4) recommendations for future work.

The Science Workshop covered a wide range of topics relevant to the biology and management of coastal cutthroat trout. There was clear consensus among the participants that two issues were of primary concern and were ultimately identified as the highest priority among all participants. First, the complexity of life history of coastal cutthroat trout creates challenges for understanding all other aspects of the sub-species biology (Table 1). Second, the sub-species status cannot be evaluated without some new or modified approaches to monitoring distribution and abundance.

In this document I attempt to present the details of how these issues were tackled by the group. When appropriate I use published literature to frame the topic, but by no means provide a complete review of the literature.

Table 1. Data gaps for coastal cutthroat trout and their habitats ranked by priority of need to increase information (5 = high, 3 = moderate, and 1= low) by participants in the Coastal Cutthroat Trout Science Workshop. Responses from California were provided following the workshop.

Data Gap	Alaska	British Columbia	Washington	Oregon	California	Average
Incidence anadromous vs. other forms	4	4	5	5	5	4.6
Life history and ecology	3	2	5	5	5	4.0
Age specific survival	4	5	4	3	4	4.0
Smolt yields	4	5	4	2	4	3.8
Spawning and fecundity	5	2	3	4	5	3.8
Juvenile rearing habitat	3	4	4	3	3	3.4
Migratory patterns and adult habitats	3	3	3	4	4	3.4
Stream and habitat type	4	4	2	3	2	3.0
Isolated resident populations	3	3	3	2	3	2.8

SCIENCE WORKSHOP SCOPE AND PROCESS

One dozen participants representing the states of Oregon, Washington, Alaska, the Province of British Columbia, as well as representatives from USFWS, US Geological Survey (USGS), and the US Forest Service (USFS) attended the Science Workshop. A representative from California participated in our pre-meeting survey but was not able to attend. A representative from tribal agencies (Northwest Indian Fisheries Commission) was invited but was unable to attend. The meeting was facilitated. Invitees were considered experts with specific interest and expertise in native trout and their habitat, and coastal cutthroat trout in particular. The objectives of the meeting were to 1) identify status, ongoing research, threats, and monitoring in each jurisdiction; 2) define current knowledge; 3) identify data gaps and rank those gaps in terms of priorities for addressing, and 4) establish a framework document to guide and prioritize future management, research, and restoration activities.

Prior to the Science Workshop, participants prepared summarized information relating to the ecology, population dynamics, and population characteristics of coastal cutthroat trout within each represented jurisdiction. The topics reflected those reviewed by Slaney and Roberts (2005). In addition, participants were asked to summarize potential impacts to coastal cutthroat trout populations and information on the status of the sub-species. Participants presented this information, followed by a facilitated group discussion. Following the presentations an overall list of data needs (data gaps) based on the agenda items was developed. These topics have been summarized under one heading "Report on the status, current research, and monitoring of coastal cutthroat trout" of this report. Some items that were not main topics in the agenda, but were of clear importance to the participants, have been presented as stand alone topics in this document.

After data gaps were identified, each topic was concluded with a prioritization exercise designed to identify the highest priority information needs for each state or province. These priorities were summarized to identify priorities throughout the native range of coastal cutthroat trout (Table 1). After this exercise, representatives from each jurisdiction ranked the topics in order of priority with "5" being of high biological importance to "1" being important yet lower relative to the other topics. The scores were then summarized. It was recognized that an element that was a high priority for one jurisdiction may not be a high priority for other jurisdictions because of the particular issues facing a region or jurisdiction, or resulting from the fact that in some cases a particular element that was a high priority it might be well-researched in a given jurisdiction. For example, in Alaska, long-term monitoring of anadromous populations has been conducted for decades. Thus, gathering more information on this element may not be identified as a data gap for Alaska at this point in time as significant efforts already have been made in this area. To capture this we documented the priority ranked for each jurisdiction as well as a summarized a range wide priority. This process was based on the expert opinion of the representatives. We used a similar prioritization process for threats and opportunities.

REPORT ON THE STATUS, CURRENT RESEARCH, AND MONITORING OF COASTAL CUTTHROAT TROUT

Introduction

There are several overarching issues that encompass the biology, the management history, and the utilization of coastal cutthroat trout that figure into any effort devoted to their conservation. A brief introduction to these issues is necessary to frame the process and outcome of the Science Workshop held in 2006, because these issues complicate basic information gathering that can inform agencies and the public about the status of coastal cutthroat trout. These themes have been identified by previous authors (Hall et al. 1997 and references therein, Johnson et al. 1999), and the participants in the Science Workshop returned to these issues repeatedly as we worked through the agenda. These issues include:

1) Complex life history of coastal cutthroat trout. Coastal cutthroat trout have one of the more complicated life histories of the genus *Oncorhynchus* spp. (see Trotter 1989, Northcote 1997, Johnson et al. 1999 for review). Research and monitoring has been confounded by the difficulty of identifying life history types and understanding their migratory patterns.

2) Lack of baseline data. There are few baseline data to examine spatial and temporal trends in distribution and abundance. This situation has been perpetuated for decades and, as a result, coastal cutthroat trout are the only sub-species of the genus *Oncorhynchus*, including interior forms of trout, without a management plan in place. What data do exist have yet to be examined in a meta-analysis for spatial distribution.

3) Lack of tools to identify life history and basic biology. Because of their similar appearance, it is often difficult to distinguish juvenile coastal cutthroat from steelhead/rainbow trout (*O. mykiss*), which is further complicated by hybridization (Campton and Utter 1987, Hawkins and Quinn 1996, Baumsteiger et al. 2005). It is also difficult to distinguish among life history forms of coastal cutthroat trout (Voight and Hayden 1997). This is especially true for juveniles. In addition, there are few models available to describe the life history and population dynamics of coastal cutthroat trout.

4) Coastal cutthroat trout are a non-commercial sub-species, yet are important for anglers. In some instances, angling groups or individuals have led the effort to gather and disseminate information regarding coastal cutthroat trout (Hall 1997). Thus, conserving populations of coastal cutthroat trout will most likely include an array of partners including those organizations dedicated to serving the interest of angling groups. For, example, gross changes in the locations and quality of fisheries has provided valuable insights on population status in certain geographic regions.

5) Local conditions appear to be driving local adaptation. Populations are highly variable throughout their distributional range. Range-wide efforts to examine trends or develop monitoring programs should include establishing standardized data sets that can indicate trends in distribution and abundance in a highly variable sub-species.

Coastal Cutthroat Trout Ecology and Population Characteristics

Life history and ecology

Coastal cutthroat trout are well known for their diverse array of life history forms. Participants reported that a wide range of life history forms appear to be present in each jurisdiction. These forms are often characterized into four types. Resident fish do not undergo extensive migrations and have a small home range; commonly remaining in headwater reaches. "Sea-run" or anadromous fish become smolts, often at age 2-4, and migrate to marine environments for short feeding forays. Riverine and lacustrine trout are river and lake migrants, respectively. All forms can occur within a single basin or a single form may dominate (Trotter 1989, Johnson et al. 1999).

Limited data and profession experience indicate that when there is open access to the ocean an anadromous form is often present. However, variation in local conditions may have a significant influence on the presence of anadromous individuals (Slaney and Roberts 2005). For example, in British Columbia, not all "cutthroat-bearing" watersheds that link directly to saltwater support anadromous forms. Also, in British Columbia there appears to be an absence of anadromous forms in some rivers in which targeted ocean fisheries (sport fishing) for "searuns" result in no catches (Ron Ptolemy, Province of British Columbia, Victoria, B.C. personal communication). This suggests that caution should be used when extrapolating population estimates from a few locations. River migrant populations tend to occur in closed systems such as those that occur above barrier falls in the Willamette River of Oregon. River migrant forms have also been documented in the Umpqua, Smith, and Rogue Rivers, watersheds with access to the ocean. Documenting the presence of sympatric life history forms has been difficult because of the range of variation in the behavior of individual fish. For example, anadromous fish may undergo extended periods of residency before smolting (Gieger 1972). Riverine fish may reach large sizes, a size which may be sometimes interpreted as marine growth when visual observations (Voight and Hayden 1997), and/or scale analysis are employed (Tomasson 1978). Thus, exceptions to life history categories can sometimes appear to be the rule for coastal cutthroat trout. Some participants expressed the view that many life history forms of coastal cutthroat trout had yet to be described, and that categorizing trout into four life history forms most likely reflects the fishery convention of using migration characteristics to classify life history strategies over biological function.

Northcote (1997) suggested that the life history of coastal cutthroat trout represents a spectrum of behavior ranging from freshwater residency to anadromy based on feeding and refuge migrations. In this model the migratory juvenile fish move to feeding areas, which may include lakes, rivers, or the marine environment. This is followed by a refuge migration for overwintering in a freshwater habitat which could include lakes, rivers, or headwater tributary. This cycle may be repeated yearly until maturation when a spawning migration to headwater tributaries is undertaken in the spring. Similar to other fishes in the salmonid family, the life history pathway is most likely a complex interaction between the genetic capacity of the individual and the environment (Thorpe 1987).

<u>Data Gap</u>

The potential for multiple life history pathways likely exists in many coastal cutthroat trout populations, although specific individual phenotypes are triggered by interactions with the environment acting on unique genotypes. The mechanisms of these potential pathways are unknown and a review of the topic is outside the scope of this document (see Johnson et al. 1999 and Waples et al. 2001 for review) and yet this problem figures centrally in the management and conservation of the sub-species.

Priority

Understanding the life history of coastal cutthroat trout was ranked highly by most participants (60%) especially understanding the incidence of anadromous versus other forms (Table 1).

Status

Distribution

Coastal cutthroat trout are geographically distributed from the Eel River, California, to Prince William Sound, Alaska (Fig. 1). Throughout their distributional range they are found in coastal streams that are influenced by maritime or coastal climate regimes. Populations in the Columbia Gorge and Willamette River are exceptions to this generalization. Status reports for each jurisdiction have been updated for inclusion in the 2005 Coastal Cutthroat Trout Symposium Proceedings therefore general information only is presented here.

At first glance, coastal cutthroat trout appear to be widely distributed. Certainly their geographic range is the largest of any of the cutthroat trout sub-species (Behnke 1992). In Oregon, thousands of surveys have been conducted on headwater populations (Kostow 1995) and, in conjunction with data collection on coho salmon (*O. kisutch*), in mainstem waterways. The state of Oregon reported that at the watershed scale the distribution of coastal cutthroat is well understood. Other participants reported that more precise or fine-scaled distribution (presence/absence at the local level) was generally poorly documented. Thus, it appears that, although the sub-species is widely distributed, they may not be ubiquitous in all jurisdictions.

This data gap may have significant implications as agencies attempt to assess the status of the sub-species or in the development of abundance benchmarks. Approaching these data is complicated by the fact that cutthroat trout rely on different habitat during different life stages. In British Columbia and Washington State, watershed, reach, and local stream characteristics appear to influence the distribution of juvenile coastal cutthroat trout as does the presence of other salmonid species (Latterell et al. 2003, Slaney and Roberts 2005). For example, in British Columbia juvenile coastal cutthroat trout appear to be confined to smaller streams or headwaters or sub-basins of larger watersheds (< 13 km^2 in high runoff watersheds) while steelhead dominate large streams (Hartman and Gill 1968, Slaney and Roberts 2005, Ron Ptolemy,

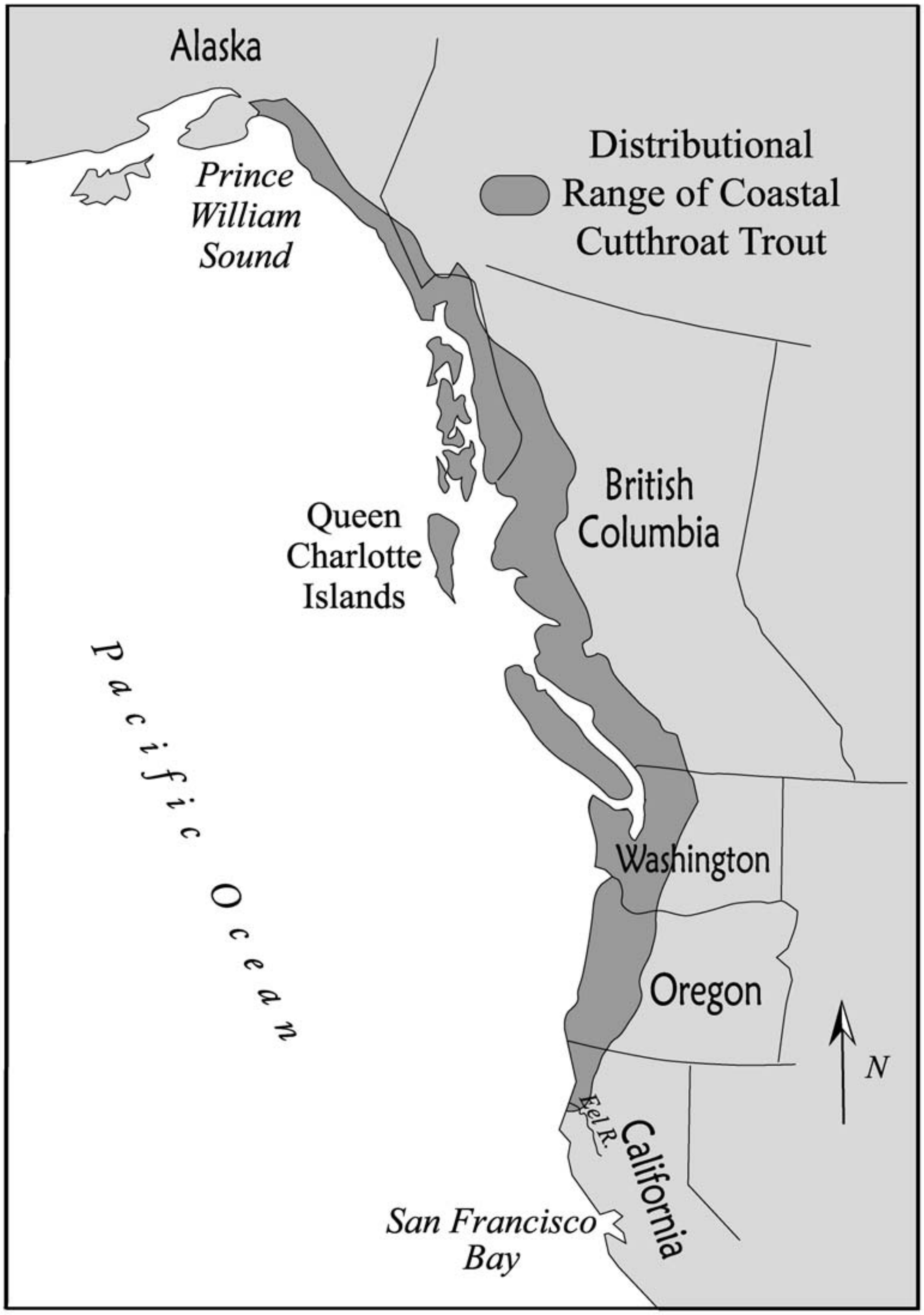

Figure 1. The native range of coastal cutthroat trout (*Oncorhynchus clarkii clarkii*).

Province of British Columbia, Victoria, B.C. personal communication). Sub-adult and adult cutthroat trout often occur in much larger streams that are fed by natal streams.

In Alaska it is estimated that approximately 2,000-5,000 streams and lakes may contain populations of resident or anadromous coastal cutthroat trout (Roger Harding, ADFG personal communication). Many of these systems are relatively pristine, thus Alaska might serve as a model system for the investigation of the range of life history diversity for coastal cutthroat trout. Populations are reported as stable. However, while it is assumed that cutthroat trout are widespread in Alaska, the distribution of various life history forms is unknown.

In British Columbia, coastal cutthroat trout inhabit low elevation streams, sloughs, ponds, and lakes along its entire coastline (Slaney and Roberts 2005). The status of cutthroat trout in the lower mainland region of British Columbia is largely unknown because of a lack of information on their exact distribution and abundance. However, information on the status of habitats used by cutthroat trout can provide inferences about trout status in some regions. The Lower Fraser Valley supports 55 % of the Province's human population and produces as much as 80% of the Chinook (*O. tshawytchsa*), chum (*O. keta*), pink (*O. gorbuscha*), and sockeye (*O. nerka*) salmon in the Fraser River watershed (Fisheries and Oceans Canada 1998). However, in this region conversion from forest to urbanized landscape has resulted in the extirpation of rivers that supported viable salmonid populations, many of which most likely supported coastal cutthroat trout based on watershed area distribution rule of Harman and Gill (1968) and more recent models (Ron Ptolemy, Province of British Columbia, Victoria, B.C. personal communication). Using mapping tools and published sources, researchers found that of 779 streams in the Lower Fraser 117 have been severely degraded and either no longer exist or have significant portions of their length running underground (Fisheries and Oceans Canada 1998). Of the remaining 662 streams the majority are categorized as "threatened" or "endangered". In what was determined as the "settlement area", locations where most of the urban development has occurred, 20% of the streams were "lost", 62% were "endangered", and 13% were threatened. Five percent of the streams in the settlement area are considered "wild" (Fisheries and Oceans Canada 1998). Thus, in the Lower Fraser Valley a significant loss of habitat is most likely indicative of loss of fish populations. In some instances the documentation of coastal cutthroat trout in the "lost" streams is provided by anglers through historic records or personal accounts (Ron Ptolemy, Province of British Columbia, Victoria, B.C. personal communication).

In Washington, coastal cutthroat trout are found in coastal streams west of the Cascade Mountains including the Straits of Juan de Fuca, Puget Sound, Hood Canal, and the lower tributaries of the Columbia River (Leider 1997, Anderson 2006). With the caveat that little is known about the population abundance levels, populations are reported as stable for management purposes. In the Columbia River Gorge region, the easternmost extent of the sub-species' geographic distribution, Connolly et al. (2002) reported that the distribution of coastal cutthroat trout above Bonneville Dam is poorly documented (see also Gresswell and Connolly 2005).

In Oregon, the distribution of resident coastal cutthroat trout appears to be widespread in coastal watersheds. Coastal cutthroat trout are reported to occupy most headwater tributaries and areas above waterfall barriers. In some regions however, rainbow trout occur above these barriers

(Kostow 1995, Hooton 1997). Anadromous coastal cutthroat trout are thought to be widely distributed in coastal steams in Oregon that have access to ocean environments.

In California, coastal cutthroat trout distributions are relatively limited (Gerstung 1997). They are presently documented in 184 coastal streams (Duffy and Bjorkstedt 2006).

Abundance

Abundance information for coastal cutthroat trout populations is generally limited throughout its native range. In Alaska, one long-term data set (since 1980) for anadromous emigrants is available for Auke Lake, near Juneau Alaska; fall immigrant data are available for the last ten years. Three abundance estimates for coastal cutthroat trout are also available that provide a time-series data set with not only abundance estimates but estimates of basic biological and life history parameters, such as estimates of survival and length and age composition (Lum and Taylor 2006, Harding et al. in press). Auke Lake is an overwintering site for coastal cutthroat trout and represents an important component of the coastal cutthroat trout populations in the Juneau road-system. Several studies (Rosenkranz et al. 1999, Lum and Taylor 2006, Harding et al. in press) conducted by the Alaska Department of Fish and Game (ADFG) suggest that the populations monitored for more than two years appear to be relatively stable. In addition to these studies, estimates from multi-year monitoring efforts of resident populations and populations from anadromous lakes are available for a number of locations in Alaska. One historic comparison is available at Lake Eva where emigrant coastal cutthroat trout counts between 1962 and 1964 ranged from 1,210 to 1,594. A project designed to replicate the 1960's studies counted 2,562 emigrants (Armstrong 1971, Yanusz and Schmidt 1996). Many of these studies are summarized as Fishery Data Series Reports and are available on-line at (http//www.sf.adfg.state.ak.us/statewide/divreports/html/dsp_Simple_Search.cfm)

In British Columbia, it was reported that little information on population trends are available. However, downward trends in smolt and adult numbers in Salmon Creek have been documented (Slaney and Roberts 2005). Recent research has focused on target densities of juvenile coastal cutthroat trout in variable environments. Estimates have been identified that take into account the variation in stream productivity (Slaney and Roberts 2005). The implication for variation in productivity is illustrated by another study evaluating 118 streams in British Columbia. Slaney and Roberts (2005) found that 61% of the cutthroat trout smolt production was attributed to a small number of streams (5). As previously stated, the variation in productivity of coastal streams for cutthroat trout must be considered when evaluating populations.

In Washington State, available abundance data has not been analyzed or summarized. However, it was reported that if resources were made available, existing field survey techniques could be modified to generate abundance estimates.

In Oregon, the Native Fish Status Report (Goodson 2006), prepared by the Oregon Department of Fish and Wildlife (ODFW) to assess the status of cutthroat trout and other native fish, documents that abundance data for coastal cutthroat are limited or absent. To assess the status of coastal cutthroat trout the authors use a method that employs a measure of "critical level" to address the issue of abundance. "Critical level" is defined as when few or no cutthroat are detected in greater than 50% of the sampling sites within a given management unit. Using this measure, the Native Fish Status Report found that coastal cutthroat trout populations are generally characterized by stable or increasing abundance in all management units with the exception of the lower Columbia River coastal cutthroat trout sub-species management unit (SMU). This SMU was assessed as "potentially at risk" because it was determined that the anadromous form was hardly present or missing thus failing the productivity criteria of the assessment. Connolly (1996) provides density and density habitat relationships for numerous allopatric populations of coastal cutthroat trout inhabiting small coastal streams above barriers in the Oregon coast range.

The ODFW Life Cycle Monitoring Project has collected information on coastal cutthroat trout in Cummins Creek and Tenmile Creek over an eight year period (1991-1998) and provides population estimates using Hankin and Reeves (1988) surveys or mark-recapture estimates (Johnson et al. 2005). In this study, smolt numbers increased following a restoration treatment although these results were potentially confounded by a change in harvest regulations (Johnson et al. 2005).

In California, abundance estimates of coastal cutthroat trout have been collected intensively in the Prairie Creek watershed, a tributary to Redwood Creek (Duffy and Bjorkstedt 2006). In that study, density varied seasonally with habitat type and stream location. Historic records suggest that coastal cutthroat trout were more abundant historically and, in some locations, supported robust fisheries (Gerstung 1997).

<u>Data Gaps</u>

Participants identified basic information on the distribution and abundance of coastal cutthroat trout as a data gap. In particular, knowledge of the presence or absence of the various life history forms is lacking. This information was identified by most participants as being critical to assessing the status of coastal cutthroat trout. An alternative position was presented by one participant who argued that absence of information regarding life history was not affecting the determination of status. In this case the presence of any life history (i.e. non anadromous) was adequate information to determine overall status.

Obtaining abundance estimates of coastal cutthroat trout has been hindered by several factors. First, long-term data sets are rare and often information on coastal cutthroat trout is collected ancillary to other monitoring programs. Methods used to gather information are often not consistent from year to year or are designed for other target species. For example, trap construction and timing of data collection may focus on species other than coastal cutthroat trout, which may under or overestimate abundance. However, it was noted by several participants that, given adequate resources, existing programs or methods could be modified to improve the enumeration of coastal cutthroat trout. Participants also identified that there was a need to establish data standards and develop tools for identifying life history forms, which would enable agencies to quantify the distribution and abundance of coastal cutthroat trout. Addressing this data gap could improve our understanding of local and range-wide status and population trends.

<u>Priority</u>

The distribution and abundance of coastal cutthroat was identified as a high priority among participants. For some this was one of the highest priorities identified in the workshop. During the workshop several issues were identified that complicate the assessment of these basic ecological features. Thus, it was suggested that in order to understand distribution and abundance, there was a need to establish a basic monitoring framework for coastal cutthroat trout.

Habitat Use

Participants in the Science Workshop identified understanding habitat use as an important component of coastal cutthroat trout ecology. During various stages of their life cycle trout rely on an extensive range of habitat from headwater streams to estuaries and open ocean. Unlike other Pacific salmonids they do not undergo extended ocean migrations and, in general, they overwinter in freshwater habitats (see Bernard et al. 1995 for exception). Because coastal cutthroat trout occupy freshwater habitats for longer periods relative to other salmonid species, they may be more sensitive to habitat alteration (Reeves et al. 1997, Slaney and Roberts 2005). Participants also reported that the use of various freshwater and marine habitats may vary with age, seasonally, and co-occurrence of other salmonids.

While participants recognized the importance of habitat, they acknowledged that little information was being collected on this element in a systematic way. Most habitat data have been collected ancillary to other species and remains in a form that is largely inaccessible for range-wide comparison or analysis. The topics below summarize the discussion of important habitat features in terms of how habitat is used during the various life stages of coastal cutthroat.

Spawning habitat

Information regarding spawning habitat was considered limited by participants yet an important feature of the sub-species life history. The literature reports that coastal cutthroat trout spawn in small head water tributaries in pea to walnut-sized gravel at the tail of pools (Trotter 1989). Like other Pacific salmon, spawning fidelity to natal streams appears to be high and populations appear to be structured at the local level. Wenberg and Bentzen (2001) reported that, although some straying did occur, genetic and behavioral evidence supported tributary level population structure.

Habitat use throughout the life cycle of coastal cutthroat trout may vary depending on the presence of other salmonids such as coho salmon, Dolly Varden (*Salvelinus malma*), and steelhead/rainbow trout, the latter of which may naturally hybridize with coastal cutthroat trout. Spatial partitioning is one isolating mechanism and, commonly when steelhead trout and cutthroat trout occur together, cutthroat trout tend to occupy headwater reaches and small tributaries (Hartman and Gill 1968, Johnson et al. 1999, Slaney and Roberts 2005). When isolating mechanisms break down, hybridization rates can be as high as 60 % (Gordon Reeves, USFS PNW Research Station, Corvallis, Oregon, personal communication) and appear to vary spatially (Campton and Utter 1985, Hawkins and Quinn1996).

Observations of spawning are limited. Nightime surveys in Petersberg Creek, Alaska (ADFG Study No AFS-42) provide rare descriptions of spawning behavior. In the Copper River Delta, observations of large female cutthroat spawning with small "sneaker" males have been observed (Saiget et al. 1994).

Juvenile habitat use

Participants in the Science Workshop identified juvenile habitat as important to cutthroat trout but little information is available. The data that have been collected often focuses on other target species. Research suggests that, after emergence, coastal cutthroat trout may move to lateral habitats such as side channels and backwaters if they are present (Glova and Mason 1976, Moore and Gregory 1988). Age of juvenile migrants ranges from 1-5 years and may vary from year to year in a given location (Lowry 1965). When coastal cutthroat trout young of the year, or "fry", reside with sculpin and coho salmon they tend to occupy more marginal habitats such as riffles (Glova 1987); parr are largely unaffected by coho or sculpin presences and occupy pools.

Adult Habitats and Migratory Patterns

Participants identified small streams, large rivers and river deltas, lakes, and beaver ponds as playing an important role in growth and overwintering.

In Oregon and Washington, telemetry data collected on trout from the lower Columbia River suggests that cutthroat trout utilize a wide range of habitat including the main channel, side channels, tributaries, and sloughs and backwaters. This tagging data suggest that cutthroat trout smolts move downstream rapidly but because of signal loss with radio tags the extent of use of marine habitat is unknown (Mike Hudson, USFWS personal communication). Large rivers and their deltas, such as the Copper River Delta in Alaska, provide thousands of linear kilometers of habitat for coastal cutthroat trout. This delta system provides complex habitat and appears to provide opportunities for complex movement patterns of coastal cutthroat trout, much of which does not fit neatly into the standard life cycle descriptions of the sub-species (Saiget et al. 1994).

Descriptions of movement patterns in and out of lakes, including information on time and length at migration, is available for several locations in Alaska including a significant body of research enumerating immigrants and emigrants from Auke Lake and Lake Eva (Yanusz and Schmidt 1996, Armstrong 1971, Lum and Taylor 2006) and for emigrants only from Sitkoh Creek (Jones and Yanusz 1998, Love et al. 2005).

Participants identified seasonal and annual movement of adult coastal cutthroat trout between habitats as an important but little understood topic (see Sumner 1953, for exceptions). Movement between watersheds (among populations) creating a metapopulation structure was also identified as an important issue with little information available. The information that is available suggests that populations are structured at the local level and the exchange among populations is limited and may be influenced by location (Wenberg and Bentzen 2001) and habitat and disturbance history (Williams 2004). Waples et al. (2001) document that genetic structure for coastal cutthroat in California, Oregon and Washington has less coherence than other Pacific salmonids, meaning there is less apparent geographic structure to the sampled populations. The authors suggest that limited anadromy in coastal cutthroat trout reduces gene flow among near-by populations and leads to this mosaic structure of populations. However, the amount of gene flow among coastal cutthroat trout populations may depend on local conditions. In Prince William Sound, Alaska, populations that are linked through near shore habitat are genetically similar (Griswold 2003). Telemetry studies in Alaska tracked trout moving between watersheds along near-shore intertidal routes and no fish monitored crossed large open bodies of water (Jones and Seifert 1997). In Alaska, this behavior is important as coastal cutthroat trout often overwinter in lakes in non-natal watersheds and migrate into their natal streams to spawn during April-early June (Jones and Yanusz 1998).

A number of recent studies are reviewed below which focus on coastal cutthroat trout and may provide a useful framework for future discussions or activities. These studies examined limiting factors to distribution, habitat preference by trout by different life stages, and the effect of restoration activities on stream habitat.

Coastal cutthroat trout occupy small streams (Johnson et al. 1999, Slaney and Roberts 2005). There are a small number of examples in the literature that suggest habitat can predict the distribution, presence, and abundance of coastal cutthroat trout. For example, the upstream extent of the distribution of cutthroat trout appears to be limited by steep channel gradient and pool habitat (Latterell et al. 2003). In British Columbia, Rosenfeld et al. (2000) examined 119 sites and found that bankfull channel width was the strongest predictor of coastal cutthroat trout presence. A similar and earlier synoptic survey found that stream width was an excellent predictor of cutthroat presence and dominance in mixed salmonid communities (de Leeuw and Stuart 1981). Recently coastal cutthroat trout stream abundance data has been analyzed at the ecoregion scale (Ron Ptolemy, Province of British Columbia, Victoria, B.C., personal communication).

There is also evidence that habitat use is important for growth. Habitat preference experiments in Hudson Creek, British Columbia, researchers found that young of the year cutthroat trout were able to exploit habitat unavailable to larger fish and that pools were necessary for adult growth, as adult cutthroat trout lost weight when confined to riffles (Rosenfeld and Boss 2001). Disturbance associated with historically intensive logging methods can have long-term effects on population abundance of coastal cutthroat trout in small headwater streams (Connolly and Hall 1999). Finally, the effect of restoration activities (additions of large woody debris) in 30 streams in Oregon and Washington were evaluated for a three year period from 1996-1999 and appeared to have a positive effect on overwintering populations of coastal cutthroat trout (Roni and Quinn 2001). In coastal Oregon, coastal cutthroat trout smolt numbers increased following stream restoration in Tenmile Creek and Cummins Creek however, as previously mentioned, these results may have been confounded by more stringent angling regulations that were implemented in the region during the study (Johnson et al. 2005).

<u>Data Gaps</u>

Participants identified several important data gaps in trout habitat use:

- Role of habitat in movement within and among populations (population structure)

- Timing of movement between habitats
- Habitat use of near shore marine environments including estuaries
- The role of connectivity in providing migratory corridors between important habitat types
- The role of habitat complexity in sub-species interactions including hybridization

Priority

Increasing knowledge of habitat use was rated as a moderate priority. Participants identified loss of habitat as an issue of concern for coastal cutthroat trout. For example, in Washington State 42% of its coastal tidal wetlands are lost to agriculture, channelization, and development. Puget Sound has lost 71% of its estuaries (Anderson 2006). The participant from Alaska noted that Alaska, with its millions of acres of pristine habitat, is not immune to habitat loss, and in some regions it is an issue of concern. In British Columbia, loss of habitat has resulted in the extirpation of coastal cutthroat from a number of streams. So, while loss of habitat is considered an important issue, the use of habitat by coastal cutthroat trout was not rated as highly as other information needs.

Population Dynamics of Coastal cutthroat trout

A number of issues that were identified as hindering the understanding of population dynamics of coastal cutthroat trout (Slaney and Roberts 2005) were discussed by the participants. These issues hamper efforts to develop predictive models that could be used to better manage populations of coastal cutthroat trout.

Fecundity

There appears to a strong positive and linear relationship between fecundity and size (Trotter 1989, Slaney and Roberts 2005). As a result, fewer large females may contribute a disproportionate number of offspring to future generations. The range of variation of fecundity throughout the geographic distribution of coastal cutthroat trout is not known. Understanding this relationship is important for management activities such as setting size limits for harvest regulations.

In the state of Alaska, a maturity study was initiated in 1997 to estimate the length at which coastal cutthroat trout are mature. Approximately 1,864 individual trout from five lakes with mixed life history forms of coastal cutthroat trout (resident and anadromous) and 16 lakes with resident trout were sampled to estimate the size of individuals at sexually maturity. Sixty two percent were mature when they attained 11 inches (28 cm) in length (Harding and Jones 2004). This work provided important information for establishing sport fish harvest regulations for coastal cutthroat trout in Alaska where the goal is to allow fish to spawn at least one time before potential harvest.

Data Gaps

Participants reported a number of data gaps under this topic:

- Percentage of mature fish at a given size
- Variability in maturity over environmental gradients
- Iteroparity and fecundity along environmental gradients
- Temporal range of spawning
- Sex ratios

Priority

The issue of fecundity was rated as a moderate priority of participants.

Smolt yields

Participants reported that quantifying smolt yields was difficult largely because of the complex life history and difficulty of identifying trout smolts. There are multiple long-term data sets for the Oregon Coast (Oregon Life Cycle Monitoring Project) and for hatchery populations in Washington State (Cowlitz River). In Alaska, Auke Lake and Sitkoh Lake spring emigrant information is being collected. Participants noted, however, that there is no systematic monitoring of smolt yields that can be compared range wide.

The participant from British Columbia reported smolt yields per unit stream length as a significant data gap (Slaney and Roberts 2005). This measure was identified as a potentially useful measure to predict productivity and population size that could be compared within and among regions. One example of such information is provided by research in Gobar Creek, a Kalama River, Washington tributary (Chilcote et al. 1984). In Gobar Creek the seven year average yield of coastal cutthroat trout smolts was 3.3 per 100 m^2 (Chilcote et al. 1984, Slaney and Roberts 2005). A number of variables, such as presence and absence of steelhead, habitat, variation in age at migration, and harvest may influence the estimates of smolt yields. As reported previously, smolt production may vary spatially (by ecoregion) and temporally, therefore a useful measure would incorporate the range of variation in different habitats throughout the native range of coastal cutthroat trout.

Participants suggested that in some areas where smolt estimates have been collected conversion to an estimate of yield per stream length or habitat area was possible. Ongoing studies could be enhanced if resources were directed towards this work.

Data Gap

- Standard density estimate to describe healthy populations
- Enumerate spawners needed to support population
- Smolt yields per unit stream length

Priority

Identifying smolt yields was given a moderate rating overall. In several regions this topic was given a high rating. In some regions it was rated as a moderate priority because there was significant information already available.

Anadromous and other forms of coastal cutthroat trout

The identification of anadromous forms relative to other forms of coastal cutthroat trout complicates the understanding of population dynamics. As previously stated there is considerable uncertainty in identifying the various life history forms and the underlying mechanisms of life history pathways remain undefined. The incidence of anadromous and non-migratory forms was identified as a data gap that has significant implications for understanding the basic biology and management of coastal cutthroat trout. Participants identified a need to develop new analytical techniques to identify life history forms and/or potentially reanalyze available data. There are a number of opportunities under existing monitoring projects that could be modified to gather this information if sufficient resources were made available.

The spatial and temporal range of variation of anadromy versus other forms is largely unknown. One study used PIT tags to estimate the proportion of migratory trout relative to resident trout in tributaries of the Columbia River. They found a range of 10-35% for anadromous forms relative to non-migratory forms (Michael Hudson, USFWS Vancouver, Washington, personal communication). It is unknown how these relationships vary through time. In Alaska, studies conducted at Auke Lake document that 15% of the trout > 180 mm tagged in the lake eventually emigrate from the system (Lum et al. 2001, Lum and Taylor 2006). Of these, 31% return to Auke Lake following their marine residence. The authors' findings suggest that survival rates for anadromous fish may be higher than lake residents in Auke Lake and other resident lake populations as reported by Harding (1995). This result may be confounded by emigration of resident fish which are accounted for as mortalities, thus deflating the survival estimates of resident fish (Lum and Taylor 2006). Information regarding age at maturity or size at maturity was identified as an important data gap that, if addressed, could help researchers approach the issue of the mixed nature of samples in trout lakes (resident and anadromous) and resulting heterogeneity in capture and survival probabilities.

Finally, there was some stated interest in understanding the population dynamics in trout populations above barriers. In particular, participants identified the persistence of small populations and their potential contribution to below barrier populations as a question of interest (Michael 1983). Research suggests local conditions appear to have an effect on the genetic structure of these populations (Griswold 1996). Genetic drift appears to be an important evolutionary component of above barrier populations that are isolated (Griswold 1996, Wofford et al. 2005)

<u>Data Gaps</u>

- Is there temporal or spatial variability in variation of life history variation?
- Is the proportion of anadromous and other forms influenced by environmental change?
- How does bioenergetics influence the various life history pathways?
- Is there a contribution of isolated resident to other migratory forms?

- Incidence of anadromous and non-migratory forms
- Information regarding age at maturity or size at maturity

Priority

Gaining knowledge of the mechanism and incidence of variation in life history of coastal cutthroat trout throughout their distributional range was ranked as a high priority by almost all participants.

Age-specific survival

Participants reported that, in general, age data for coastal cutthroat trout are lacking and this impairs ability to assess age-specific survival. The importance of developing indices that can be used to estimate fry-to-adult survival or parr-to-adult survival was emphasized by participants as a tool that could be used to estimate productivity when juvenile densities are known. High levels of scale regeneration and difficulty interpreting freshwater and seawater regions have, in general, made it difficult to age with scales (Tomasson 1978). The development of standard aging techniques was identified as an important tool. A scale manual for coastal cutthroat trout in Alaska is available (Erickson 1999), and it was suggested that this tool could be refined to serve as a model for a range-wide standard.

Studies estimating survival have largely focused on overwintering adult survival. Research in Alaska suggests that overwintering survival averages 40-60 % (Harding 1995, Lum et al. 2001, Lum and Taylor 2006: Harding et al. in press). Ocean survival has been estimated to range from 1.56-2.15% (Sumner 1953).

Data Gaps

- Tool to age trout using scale analysis
- Comparison of wild versus hatchery trout survival
- Life history differences and age specific survival
- Bioenergetic analysis and its effects on growth and survival
- Competition and predation effects on survival resulting from fish culture and other salmonids

Priority

This data element was given a moderate to high ranking by participants.

Threats and Restoration Opportunities

As habitats in the Pacific region undergo changes, coastal cutthroat trout populations will inevitably change. The effects of these changes need to be considered within the context of what we know and do not know about the biology of the sub-species. Many of these issues have been addressed in previous sections yet deserve mention under this topic. These issues include: 1) the extended freshwater residency of coastal cutthroat trout suggests that impacts to freshwater habitats would have a strong influence on population health (Reeves et al. 1997, Slaney and Roberts 2005); 2) the relationship between genetic and environmental influences that trigger various life history pathways are unknown, and environmental change potentially presents a risk to the persistence of various life history forms, particularly anadromous forms; 3) because coastal cutthroat trout occupy a large portion of the watershed (headwater to marine), changes in habitat condition may be cumulative, and 4) the loss of estuary environments will have a significant impact on the sub-species, and 5) coastal cutthroat trout populations are genetically structured in a fine scale, generally the watershed or tributary level (Campton and Utter 1987, Wenberg and Bentzen 2001, Griswold 2003, Williams 2004), and the opportunity for recolonization from adjacent populations (or watersheds) is limited.

Participants listed a number of threats to coastal cutthroat trout and their habitats. In general, impacts on flow, water allocation, and loss or fragmentation of habitat were identified as threats to coastal cutthroat trout. Specifically, participants identified fish passage issues from large and small hydropower operations, loss of overwintering habitat, changes in geomorphic processes and channel geometry, channelization and simplification of habitat in estuaries, the loss of large woody debris, climate change, and impacts to small headwater streams as threats to coastal cutthroat trout. Road crossings and culverts that lead to fragmentation of habitat were also identified as having a negative impact on the migratory potential of coastal cutthroat.

Fisheries management impacts, such as hatchery supplementation of trout or other salmonid species, were identified as having a negative impact on cutthroat trout populations. In many regions hatchery trout stocking has been curtailed (Hooton 1997).

Historically, fishery impacts probably played a significant role in reducing populations. Currently more stringent regulations (catch and release) or reduced bag limits have been enacted. In addition, hatchery supplementation has been curtailed in many regions both for conservation reasons and an apparent reduction in the popularity of the fishery following initial population declines (Hooton 1997).

<u>Data Gaps</u>

- Fragmentation of habitat
- Changes in ecological processes
- Fish management impacts
- Global climate change
- Mining
- Small scale hydropower development

<u>Priority</u>

Urbanization was listed as having the highest impact on coastal cutthroat trout populations (Table 2). Educating the public as to the importance of trout populations was identified as an important component for conserving and restoring populations.

Monitoring and Evaluation

Participants identified a number of technical challenges facing monitoring coastal cutthroat trout populations, and they also acknowledged that gathering biological information through monitoring populations has been perceived as having low priority within agencies. Funding and resources to monitor the sub-species are an additional major challenge to monitoring. The group reported that ongoing efforts to monitor coastal cutthroat trout that could provide information on

Table 2. Summary of ranking of impacts on coastal cutthroat trout and their habitats (5 = high, 3 = moderate, 1= low) by participants in Coastal Cutthroat Trout Science Workshop. Responses from California are from a pre-survey workshop that did not incorporate a rating scale. Averages exclude the responses from California.

Impact	Alaska	British Columbia	Washington	Oregon	California	Average
Urbanization	4	5	5	4	2	4.0
Agriculture	2	4	4	5	3	3.6
Timber	3	3	4	3	3	3.2
Fisheries Management	5	4	2	2	2	3.0
Hydropower Development	4	2	4	3	1	2.8
Mining	4	2	1	2	3	2.4

status are limited. However, there are regions throughout the range of the sub-species where information is being gathered. Several examples have been previously mentioned, including migrant traps that have been monitoring trout populations for extended periods of time in several locations in Alaska Lakes, long-term monitoring of Cowlitz River, Washington, wild and hatchery populations (Tipping 1981), Winchester Dam fish count data in Oregon, and long-term research sites such as Alsea Water study in the Alsea Basin, Oregon, and the Carnation Creek Study in British Columbia. There was discussion of using the information collected from these locations as baseline data to compare long-term trends in distribution and abundance.

There was extended discussion focused on a less tangible but critical issue of identifying the intent of monitoring efforts. In the broadest sense this was articulated as “what are we trying to conserve?” For example, if the goal of a range wide conservation program is to maintain the life history diversity (biodiversity) of the sub-species, then the focus should be on maintaining the capacity for expression of the range of life history forms. Given our lack of understanding of the mechanism of expression of life history diversity, a conservative approach is probably warranted. In other words, the best monitoring efforts for coastal cutthroat trout should include monitoring of all life history forms.

Several more technical challenges related to monitoring cutthroat trout populations were identified. These included identifying the presence of various life history forms, identifying the target life history form (smolt), lack of standardized protocols within jurisdictions, limited tools for aging individuals, limited tools for estimating maturity, and lack of a defined production standard. A list of needed tools was summarized (see below). Additional challenges include institutional barriers, namely limited resources to develop these tools, expanding current monitoring efforts, and making historic data available.

A clear consensus among all participants was reached that the lack of information regarding the status and trends of coastal cutthroat trout populations is a significant problem for agencies charged with their management. It was recommended by the attendees of the Science Workshop that the range of life history diversity of the sub-species, the extent of habitat that they occupy in basins (headwater to marine), and their large distributional range warrant the exploration of new or modified approaches for monitoring populations. A workshop devoted to monitoring coastal cutthroat trout populations throughout their distributional range was proposed as a first step to address this need.

Other identified needs for monitoring

- Define production standards
- Range-wide smolt production evaluation
- Evaluate all life history forms
- Tool to determine maturity
- Tool to estimate stock status in areas where there is no data
- Tool to utilize creel or catch data and angler perceptions of fishery changes
- GIS tool to help store data, prioritize work, and assess range-wide status
- Spatially balanced sampling sites
- Funding to support monitoring efforts
- Tools to identify life history forms

Finally, participants agreed upon a number of elements regarding monitoring coastal cutthroat trout including standardized protocols to identify benchmarks for:

- Productivity
- Density
- Abundance
- Distribution
- Identifying presence of various life history forms
- Genetic population structure

<u>Priority</u>

All participants agreed that the need to develop a strategy to monitor coastal cutthroat trout was high priority. Overall this issue was identified as one of the top two priorities for understanding and managing coastal cutthroat trout throughout their range.

RECOMMENDATIONS FOR FUTURE WORK

Participants recognized that there is a great deal of work that needs to be done if we are to increase our understanding, better manage, and conserve coastal cutthroat trout. They also recognized that collaboration through a range-wide effort could improve the chances of this work getting done.

Participants felt that the two major issues that were identified as priorities, increasing the understanding of the mechanisms of life history pathways and incidence of life history forms and developing a strategy for monitoring coastal cutthroat trout, deserved additional follow-up workshops. All participants strongly voiced that the opportunities to advance knowledge are hindered by a lack of financial resources and the perception that coastal cutthroat are a low priority for agencies. Identifying sources of funding and increasing the general level of interest in coastal cutthroat trout was identified as a high priority.

Given the large geographic range of distribution of coastal cutthroat trout, participants agreed that using spatial tools such as GIS would improve the efficiency of their efforts.

Additional follow-up items were suggested:

- Monitoring workshop
- Life history science and research workshop
- Form a technical working group that meets regularly (annually or biannually)
- Develop a genetics library or catalog of known existing genetics samples
- Develop an aging/maturity tool using scale analysis
- Continue to maintain and expand the coastal cutthroat trout online bibliography (Gresswell and Connolly 2005, http://ocid.nacse.org/nbii/cutbib/index.php)
- Partnership with Western Native Trout Initiative http://www.fishhabitat.org/action.htm
- Continue to inform the public of activities http://www.fws.gov/columbiariver/cctsym.html

In the end, participants felt optimistic regarding the collaborative effort devoted to coastal cutthroat trout; however, they acknowledged that without support from their respective agencies the situation regarding our understanding of coastal cutthroat would not change. The hope of participants is that coastal cutthroat will no longer be the "problem child" and will instead remain part of the legacy of the Pacific Northwest.

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