

The 2005 Coastal Cutthroat Trout Symposium

Status, Management, Biology, and Conservation

September 29-October 1, 2005
Fort Worden State Park
Port Townsend, Washington

Sponsored By:



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The 2005 Coastal Cutthroat Trout Symposium

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From the Symposium's Early Organizers:

Welcome to the 2005 Coastal Cutthroat Trout Symposium: Status, Management, Biology, and Conservation. The 2005 Symposium follows 10 years after the tremendously successful 1995 Searun Cutthroat Trout Symposium, in Reedsport, Oregon. A wide variety of important new information has been gathered on coastal cutthroat trout since the 1995 Symposium, and the Symposium planners hope that our three days together will prove as useful and rewarding as the 1995 Symposium.

Participants at the 1995 Reedsport meeting made tentative plans for a second Symposium to be held in Washington. A small group of biologists and anglers with interest in coastal cutthroat trout, and knowledge of the 1995 Symposium's tentative plans for a follow-up, began discussing the need for another Symposium in 2003. The early group of three initiated contacts with planners and participants of the 1995 Symposium, and started to develop a strategy for a follow-up Symposium.

In 2004, a Coastal Cutthroat Trout Symposium Steering Committee was formed, composed of original planners from the 1995 Symposium, representatives from each State and Province in the range of coastal cutthroat trout, angling and environmental groups, tribal organizations, and Federal agencies. Sponsorship and support was obtained from each AFS Chapter within the range of coastal cutthroat trout: Alaska, Pacific International, Oregon, and Humboldt. Many potential Symposium locations in Washington were researched and visited, with Port Townsend being selected due to the popular Puget Sound and Hood Canal coastal cutthroat trout fisheries, as well as the excellent conference facilities at Fort Worden State Park.

Significant financial assistance for planning and hosting the Symposium was provided by Pacific States Marine Fisheries Commission, and early Symposium organization, financial assistance, and personnel support was provided by U.S. Fish and Wildlife Service. In addition, several fishing organizations provided financial and personnel assistance towards the 2005 Symposium. All these financial contributions have allowed for a reasonable Symposium Registration Fee, as well as significant travel, food, and lodging subsidies to students. All proceeds from the 2005 Symposium will be equally distributed amongst the four sponsoring AFS Chapters, and will be available through the AFS Chapters for coastal cutthroat trout research scholarships or grants.

The objectives of the 2005 Coastal Cutthroat Trout Symposium are: 1) to update coastal cutthroat trout information presented during the 1995 Coastal Cutthroat Trout symposium, 2) enhance knowledge on all facets of life history and ecology, 3) provide current assessment of the status of populations coast-wide, and 4) encourage development of a coordinated, range-wide conservation plan. Session topics include: Status, Trends, and Management; Biology; and Conservation Planning. These sessions closely mimic the excellent program established for the 1995 Symposium, allowing for new information to be compared to the state of our knowledge 10 years ago. To additionally connect the two Symposia, we invited Bob Gresswell to provide the Symposium's opening and closing comments, as well as Bob Behnke to provide his after-banquet musings on the evolutionary history of coastal cutthroat trout. To top it all off, and in recognition of the angling community's critical participation and leadership in organizing and hosting the 1995 Symposium, we invited a couple of famous angling guides and authors to provide an angling seminar on Thursday night.

The Publications Committee required all technical session and poster presenters to provide a professional paper for the 2005 Symposium Proceedings. Most of these papers were submitted by authors prior to the Symposium, and we hope to publish the Proceedings soon after the Symposium. Your registration fees, along with a donation from Trout Unlimited, will fund printing and mailing of the Proceedings to you in the near future.

In closing, we hope to have organized a technical program that collects and explains new coastal cutthroat trout information, compares and contrasts this information to what was known in 1995, and helps move the management and conservation of these unique fish in a positive direction. It is our desire that all participants leave the 2005 Symposium with more information on these wonderful fish, a renewed sense of dedication to conservation actions, and a heightened resolve to address the many remaining unanswered questions.

Doug Young
Tim Cummings
Joe Jauquet

Program
The 2005 Coastal Cutthroat Trout Symposium
Ft. Worden State Park, Port Townsend, WA

Thursday, September 29

- | | |
|-------------|--|
| 1:00pm | Welcoming and Housekeeping (Young) |
| 1:15pm | Opening Session – Coastal Cutthroat Trout: Past, Present, and Future (Gresswell) |
| 1:45pm | Status, Trends, and Management Session (Chair Roger Harding): |
| 1:50pm | Summary of Coastwide Coastal Cutthroat Trout Status Review (Johnson) |
| 2:10pm | Current Status of Coastal Cutthroat Trout in California (Lentz) |
| 2:30pm | Current Status of Coastal Cutthroat Trout in Oregon (Goodson) |
| 2:50pm | Current Status of Coastal Cutthroat Trout in Washington (Anderson) |
| 2:50-3:20pm | Break |
| 3:25pm | Current Status of Coastal Cutthroat Trout in British Columbia (Costello and Rubidge) |
| 3:45pm | Current Status of Coastal Cutthroat Trout in Alaska (Bangs, Harding, and Lum) |
| 4:05-4:35pm | Group Discussion |
| 6:00-8:00pm | Social |
| 6:00-8:00pm | Poster Session (Chair Eliot Drucker):

Variation in Morphology among Cutthroat Trout of Western North America (Seiler and Keeley) |

Effects of Wildfire on Growth and Demographics of Coastal Cutthroat Trout in Headwater Streams (Heck and Gresswell)

The Puget Sound Acoustic Tracking Array: Is Big Brother Watching Coastal Cutthroat Trout? (Brakensiek and Goetz)

Compared Population Response of Bella Coola/Atnarko River Steelhead and Cutthroat Trout to a Closure of a Long Term Steelhead Fishery (Ramsay)

Unexpected Abundance: Coastal Cutthroat as the Inheritors of Seattle Urban Creeks in the Declining Presence of Other Wild Salmonids (McMillan and Crabb)

Feeding Ecology of Cutthroat Trout in the Salmon River Estuary, Oregon (Jones, Fleming, Krentz, and Cornwell)

Review of Life History of Sea-Run and Resident Cutthroat Trout in Southeast Alaska (Lukey)

Hybridization among Sympatric Anadromous Steelhead and Cutthroat Trout: The Potential Impacts of Captive Brood Smolt Releases at the Keogh River, British Columbia (Troffe, McCubbing and Ward)

Coastal Cutthroat Trout Diet in South Puget Sound, Washington, 1999 – 2002 (Jauquet)

Habitat Use and Movement of Sea-Run Cutthroat Trout in the Salmon River Estuary (Krentz, Li, Fleming, Jones, and Cornwell)

8:00-9:00pm

Coastal Cutthroat Angling Seminar (Kerr and Johnson)

Friday, September 30

8:00am

Biology Session (Chair Ron Ptolemy):

8:10am

The Influence of Spawning Pacific Salmon on the Stable Isotope Composition, Feeding Behavior, and Caloric Intake of Coastal Cutthroat Trout (Ellings, Cedarholm and Chin-Leo)

8:30am

Effects of Landscape Pattern on the Distribution of Coastal Cutthroat Trout in Headwater Catchments in

Western Oregon (Torgersen, Gresswell, Bateman,
and Hockman-Wert)

- 8:50am Role of Barriers in the Distribution, Abundance, and Life History of Coastal Cutthroat Trout in the Columbia River Gorge (Connolly)
- 9:10am Stream Connectivity and Emigration Rates in Headwater Coastal Cutthroat Trout Populations in Western Oregon (Bateman, Gresswell and Hockman-Wert)
- 9:30-10:00am **Break**
- 10:05am Movements of Coastal Cutthroat Trout in Abernathy Creek and Chinook River, two tributaries of the Columbia River (Johnson, Zydlewski and Zydlewski)
- 10:25am Movements of Coastal Cutthroat Trout in the Lower Columbia River (Zydlewski, Johnson, Clements, Karnowski, Schreck, and Zydlewski)
- 10:45am Sea-Run Cutthroat Trout Life History: Should I Stay or Should I Go? (Krentz, Li, Fleming, Jones, Cornwell)
- 11:05am Adult Coastal Cutthroat Trout Movement and Habitat Use in the Lower Columbia River (Hudson, Johnson, Hogle, Brunzell, and Zydlewski)
- 11:25am Seasonal Movements of Radio-tagged Coastal Cutthroat Trout on the Copper River Delta, Alaska (Saiget)
- 11:45am Group Discussion
- 12:00-1:00pm **Lunch**
- 1:05pm Coastal Cutthroat Trout Shoal Spawning in a High Montane Lake of the Cascade Range of Oregon (Saiget)
- 1:25pm Coastal Cutthroat Trout Ecohydrology and Habitat Use in Irely Creek, Washington (Vadas)
- 1:45pm Environmental Factors Influencing the Seasonal Movements and Distribution of Coastal Cutthroat Trout in a Headwater Stream (Novick, Gresswell, and Johnson)

- 2:05pm Ecoregional Influences Affecting the Abundance of Juvenile Coastal Cutthroat Trout and Other Species Rearing in Coastal Streams of British Columbia (Ptolemy)
- 2:25pm Cutthroat Trout as Successful Urbanites (Seiler, Peterson, Serl, and Tabor)
- 2:45-3:05pm **Break**
- 3:10pm Errors in Visual Identifications of Juvenile Steelhead, Coastal Cutthroat Trout and Their Hybrids (Voight, Hankin, and Loudenslager)
- 3:30pm A Two-Phase Bayes Approach for Estimating Abundance of Juvenile Steelhead in Small Streams where Steelhead, Coastal Cutthroat Trout and Their Hybrids are Present (Hankin, Voight, and Loudenslager)
- 3:50pm Productivity, Trends and Interspecific Associations of Coastal Cutthroat Trout in Two Managed Tributaries to the Smith River, California (Howard)
- 4:10pm Demographics of Coastal Cutthroat Trout in Prairie Creek, California (Duffy)
- 4:30pm Influences of Landscape Variables on Age and Growth of Coastal Cutthroat Trout in Headwater Streams (Rehe and Gresswell)
- 4:50-5:10pm Group Discussion
- 6:00-7:00pm **Social**
- 7:00-10:00pm **Banquet and Raffle**

Special Guest Speaker: Dr. Robert Behnke, Professor Emeritus, Colorado State University **Some Food for Thought Concerning Coastal Cutthroat Trout**

Saturday, October 1

- 8:00am **Biology Session Continued:**
- 8:05am Geographic Variation in Genetic and Meristic Characters of Coastal Cutthroat Trout (Williams and Reeves)

- 8:25am Genetic Variation and Geographic Structure of Coastal Cutthroat Trout in Prince William Sound, Alaska (Griswold, Currens, and Reeves)
- 8:45am Cutthroats above the Rest: Waterfalls, Microsatellites, and Isolated Populations of Coastal Cutthroat Trout (Guy, Gresswell, and Banks)
- 9:05am Drawing the Circles: Nested Analysis of Genetic Variation and the Delineation of Distinct Groups of Coastal Cutthroat Trout in British Columbia (Costello, Down, and Taylor)
- 9:25am Naturally Isolated Coastal Cutthroat Trout Populations Provide Empirical Support for the 50-500 Rule (Hastings, Frissell, and Allendorf)
- 9:45-10:05am Group Discussion
- 10:05-10:25am **Break**
- 10:25am **Conservation Planning Session (Chair Doug Young):**
- 10:30am Review of the 2002 Withdrawal of the Southwestern Washington/Columbia River Distinct Population Segment of Coastal Cutthroat Trout: Implications for Research, Monitoring, and Conservation (Bown, White, and Young)
- 10:50am An Analysis of Information Leading to the Withdrawal of a Proposed Rule to List the Columbia River/Southwestern Washington Distinct Population Segment of the Coastal Cutthroat Trout (Greenwald)
- 11:10am Coastal Cutthroat Trout Conservation: A U.S. Fish and Wildlife Service Vision (Finn, Young, Cummings, and Hudson)
- 11:30am Developing a Consistent Framework for Measuring the Conservation Success of Coastal Cutthroat Trout (Williams and Harig)
- 11:50am Inland Cutthroat Trout Conservation: Lessons Learned and Experience Gained (May)
- 12:10-12:45am **Group discussion and closeout** (Gresswell and Young)

Program and Abstracts
The 2005 Coastal Cutthroat Trout Symposium
Ft. Worden State Park, Port Townsend, WA

Thursday, September 29

- 1:00pm** **Welcoming and Housekeeping (Young)**
- 1:15pm** **Opening Session – Coastal Cutthroat Trout: Past, Present, and Future (Gresswell)**
- 1:45pm** **STATUS, TRENDS, AND MANAGEMENT SESSION (Chair Roger Harding):**
- 1:50pm** **Summary of Coastwide Coastal Cutthroat Trout Status Review**

Orlay Johnson
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Abstract- The National Marine Fisheries Service (NMFS) conducted a coastwide status review of coastal cutthroat trout (*Oncorhynchus clarki clarki*) (CCT) in 1999. A previous review of CCT in the Umpqua River had resulted in listing those CCT under the US Endangered Species Act (ESA) as endangered in 1996. During this review the major concerns of the Biological Review Team (BRT) were whether Umpqua River fish were a evolutionarily significant unit (ESU) or part of a larger ESU, the influence of hatchery fish on native fish, and lack of information on resident fish.

In the coastwide CCT status review, the BRT identified six ESUs from data collected on life history, genetics, and biogeographical variables. The BRT conducted a risk analysis for these ESUs and was unanimous in determining that one (Southwestern Washington/Columbia River) was likely to become endangered in the foreseeable future. Areas of major concern included a steep decline in the anadromous portion of the population, hybridization with *O. mykiss*, habitat loss, ecological interactions, and the paucity of information related to risk. These conclusions resulted in a joint NMFS and U.S. Fish and Wildlife Service (USFWS) proposed listing for this ESU as a threatened species under the ESA. The BRT also determined the Umpqua River ESU was part of a larger ESU (Oregon Coast ESU) and it was delisted and moved to a species of concern until further analysis could be conducted. Soon after the publication of the coastwide review, the USFWS requested sole ESA jurisdiction over CCT and on July 20, 1999 that agency was given jurisdiction.

2:10pm **Current Status of Coastal Cutthroat Trout in California**

David C. Lentz
California Department of Fish and Game, Fisheries Programs Branch, 1812 Ninth Street,
Sacramento, CA 95814

Abstract. - Coastal cutthroat trout in California are found from the Eel River estuary north to the Oregon border. Information on status and occurrence of coastal cutthroat trout is presented. Coastal cutthroat trout information has been gathered from various agencies, tribes, and private interests. Cutthroat data are usually acquired incidental to survey and monitoring efforts for other anadromous salmonids with few studies actually targeted on coastal cutthroat. Notable, however are survey records going back to the 1980's for several streams such as South and Middle Forks of the Smith River and Redwood Creek. The California Department of Fish and Game manages coastal cutthroat trout under the "species of special concern" designation, focusing on habitat protection. In recent years, special angling regulations (reduced bag limits and gear restrictions) have been implemented. A new program featuring angling opportunities for California's native trout, the Heritage Trout Program, will hopefully increase public appreciation for coastal cutthroat trout and for their conservation.

2:30pm

Current Status of Coastal Cutthroat Trout in Oregon

Kevin Goodson

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Abstract.- As part of implementing Oregon's Native Fish Conservation Policy, the Oregon Department of Fish and Wildlife (ODFW) conducted a status assessment of many native fish species around the state in 2004-05, including coastal cutthroat trout. Coastal cutthroat trout in Oregon were grouped into four species management units and each was assessed. The assessment used six interim criteria to determine the level of near-term risk faced by each species management unit. All life history strategies in a geographic area were considered part of a single population. Most of the available data was reviewed to conduct the assessment. The conservation of all of the species management units were found to not be at a near-term risk. The findings of the assessment and the methods used will be discussed.

2:50pm

Current Status of Coastal Cutthroat Trout in Washington

Jon Anderson

Washington Department of Fish and Wildlife

Abstract. – A stock assessment process was completed in 2000 for coastal cutthroat trout (CCT) by the Washington Department of Fish and Wildlife. Activities included preparation of a stock status inventory and an assessment of genetic and life history diversity. Further information on the distribution, life history, abundance and genetic evidence was transmitted to the U.S. Fish and Wildlife Service in reply to their request for information consequent to a status review of the species in 2001-2002. This paper provides an overview and examples of the information available and offers determinations regarding the status of coastal cutthroat trout. Data sources include trap or rack counts, creel surveys (e.g., estimates of total harvest or catch per unit effort), electroshocking surveys, and standardized hook-and-line sampling (e.g., length-frequency and proportion of initial and repeat spawners). Regardless of the source, long-term databases are few, making analyses of stock status and trends difficult. Preliminary analyses suggest that most Washington coastal cutthroat collections are genetically distinct from one another, with a separation between the Strait of Juan de Fuca-Puget Sound groups and the coastal-Columbia River groups. Within these major

divisions, other genetic groupings are evident which generally coincide with geographic regions. The stock assessment inventory identified 40 CCT stock complexes statewide, of which 1 stock was rated healthy, 7 depressed, none critical, and 32 stocks had insufficient information to assess current status. The status of Columbia River stocks appears to have seriously declined in the 1990s, and rebounded in recent years. Fishery regulations for sea-run cutthroat trout are intended to protect out-migrating smolts and to ensure that anadromous adults are able to spawn at least once (two-fish limit, 14" minimum size). Release of wild cutthroat is required in sport fisheries in the Columbia River, its anadromous tributaries, and in all marine waters. Management strategies generally do not incorporate extensive releases of hatchery fish, with the exception of current harvest augmentation programs in the Cowlitz River. Recent hatchery programs for sea-run cutthroat trout in Grays Harbor, the Hood Canal, and south Puget Sound are no longer in operation. In the existing hatchery program, the fish receive fin marks and Wild Cutthroat Release regulations are applied, which allow harvest of hatchery cutthroat trout while protecting their wild counterparts.

2:50-3:20pm

Break

3:25pm

Current Status of Coastal Cutthroat Trout in British Columbia

Allan B. Costello

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Emily Rubidge

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Abstract. - Coastal cutthroat trout are a unique and important component of British Columbia's freshwater fauna and have a wide distribution in low lying coastal areas of the province. Few cutthroat systems, however, are routinely monitored in a systematic fashion and the status of many individual populations remains largely unknown. Our recent status review for the federal Committee on the Status of Endangered Wildlife in Canada (COSEWIC) suggests that cumulative development pressures and anthropogenic influence have left many populations susceptible to local extirpation; as in other areas to the south, habitat degradation, overharvesting, and negative interactions with introduced fishes have all contributed to declines. While the majority of cutthroat populations in British Columbia are likely 'secure', those located in the densely populated Georgia Basin appear to be particularly at risk and are deserving of additional conservation measures. Here, we summarize the available trend data, identify information gaps in our current knowledge of BC cutthroat systems, and review the rationale for further protection under Canada's *Species at Risk Act* (SARA).

3:45pm

Current Status of Coastal Cutthroat Trout in Alaska

Peter Bangs^{1*}, Roger Harding², and Judy Lum³

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Abstract. - Cutthroat trout occur as sea-run and resident forms in streams and lakes along the coastal range throughout Southeast Alaska and Prince William Sound and are the most common trout species in the region. Biological characteristics of cutthroat trout, such as their low fecundity and sensitivity to habitat degradation put this species at a high risk to stock declines. Information on the status of cutthroat trout stocks in Alaska is limited. Long-term (over 5 years) information exists for four lake systems and short-term (less than 5 years) information exists for 19 lakes. Estimated annual abundance across resident stocks ranged from 134 (at Helm Bay) to 14,780 (at Florence Lake) cutthroat trout. For the lake systems with sufficient information to assess trends in abundance, these populations appear relatively stable. Information on stock status for sea-run cutthroat trout populations exists for only 10 streams with the majority of information originating from one-year studies. Only one stream, Auke Creek near Juneau, has long-term data on sea-run cutthroat trout, and this population has declined to half the annual average for the period 1980-2004. The northwestern limit of the range of cutthroat trout is Prince William Sound, and many of the sea-run stocks were affected by the Exxon Valdez oil spill in 1989. Studies found slower growth rates in oiled versus unoiled streams, however the recovery status of these cutthroat trout populations remains largely unknown. In the Sport Fishery, the statewide catch of cutthroat trout from 1993 – 2003 has been highly variable, with a range of 30,825 to 75,067. Trends in catch were similar between Prince William Sound and Southeast Alaska until 2001 when the number of anglers in Prince William Sound began to significantly increase with a corresponding increase in catch and harvest of cutthroat trout. Threats posed to cutthroat trout populations in Southeast Alaska include recently liberalized regulations in the Federal Subsistence Fishery as well as potential habitat degradation due to road construction, mines, oil spills, hydroelectric projects, and timber harvest.

4:05-4:35pm

Group Discussion

6:00-10:00pm

Social and Light Buffet Dinner

6:00-8:00pm

POSTER SESSION (Chair Eliot Drucker):

Variation in Morphology among Cutthroat Trout of Western North America

Meredith B. Seiler* and Ernest R. Keeley

Department of Biological Sciences, Idaho State University, Pocatello ID, 83204.208-282-4458; burnmere@isu.edu

Abstract. - The purpose of our study was to compare morphological variation in cutthroat trout species to determine whether ecologically based differences within a species are as great as between known species. In salmonid fishes, populations that occupy flowing water or stream habitats tend to follow distinct morphological patterns in comparison to those occupying standing water or lake habitats. We sampled native populations of cutthroat trout species, including Bonneville, coastal, Colorado River, westslope, Yellowstone cutthroat, to test this hypothesis. Ecotypic variation in morphology is often displayed in features associated with swimming and feeding

ecology. Our research focuses on morphological diversity related to swimming features in cutthroat trout. In order to conserve biodiversity, biologists must accurately document appropriate levels of diversity between and within species. Intraspecific variation can be an important component of biodiversity, but it is often ignored by the 'species' level approach to documenting biodiversity. Given that many cutthroat trout species are of conservation concern, our project provides a better understanding of intraspecific variation existing within these species.

Effects of Wildfire on Growth and Demographics of Coastal Cutthroat Trout in Headwater Streams

Michael Heck

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Robert E. Gresswell

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Abstract. - Wildfire, a largely terrestrial perturbation, is broadly recognized as an agent of disturbance and ecological change in forested biomes, but links to subsequent changes in aquatic systems have been less well-documented. At the basin scale, the influence of wildfire is theoretically most profound in headwater streams because of the tight linkage between aquatic and terrestrial ecosystems. During the late summer of 2002, wildfire burned portions of three headwater streams in the North Umpqua basin. Burn severities ranged from low to severe. We have been evaluating relative abundance, age structure, growth, and mortality of isolated populations of coastal cutthroat trout (*Oncorhynchus clarki clarki*) in these streams for two years following the wildfire. An unburned, fourth stream has also been sampled as a control. Preliminary results suggest that fish are growing at different rates depending on canopy cover and water temperature, both of which are strongly influenced by wildfire severity. Current analyses are exploring relationships among wildfire severity, abiotic stream characteristics, and demographic characteristics of coastal cutthroat trout at the watershed scale.

The Puget Sound Acoustic Tracking Array: Is Big Brother Watching Coastal Cutthroat Trout?

Kyle Brakensiek

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Fred Goetz

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Abstract. - Acoustic tagging and tracking methods are increasingly being used in fisheries research to investigate movement behavior and species life-history traits. Throughout the Puget Sound, Washington, researchers are using this technology to investigate multiple species including Chinook and coho salmon, bull trout, steelhead, sixgill shark, English sole and lingcod. These efforts primarily rely on remote tracking methods where acoustic receivers are submerged and subsequently recovered for data

acquisition. Collectively, there are over 100 acoustic receiver nodes being maintained throughout the region that feasibly allow for individual identification of thousands of tagged individuals. Researchers recognize this opportunity and are collaborating towards development of a large-scale acoustic detection array to track tagged individuals over several months and years. Within this 'acoustic framework', there is certainly research need and unprecedented opportunity to improve our understanding of coastal cutthroat trout.

Compared Population Response of Bella Coola/Atnarko River Steelhead and Cutthroat Trout to a Closure of a Long Term Steelhead Fishery

Mike Ramsay

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Abstract. - The Bella Coola/Atnarko system on British Columbia's Central Coast has provided an exceptional opportunity to investigate and compare life history strategies of co-existing populations of steelhead (*Oncorhynchus mykiss*) and cutthroat trout (*Oncorhynchus clarki clarki*). Habitat partitioning, based on stream size, has limited inter-species competition between rearing steelhead and cutthroat trout. Juvenile assessments have revealed that each species has a different "strategy" in producing adequate number of parr to seed available habitat. Steelhead are more fecund and spawn in larger systems producing higher fry densities. Steelhead fry are more susceptible to density dependant mortality and natural extremes in flow and habitat alteration. Steelhead smolts demonstrate large scale ocean migrations making them more susceptible to "ocean survival" conditions. Cutthroat spawn in smaller, more stable streams and appear to show lower fry production capabilities but higher fry to parr survival. Cutthroat parr and smolts undertake moderate anadromous migrations remaining close to estuaries. They also migrate back and forth into streams during their adult life cycle. In the early 1990's both steelhead and adult cutthroat population numbers on the Bella Coola were severely reduced, at or below conservation levels. A closure in the steelhead fishery has led to increases in both populations. However, eliminating the use of bait, higher fry to parr survivals, and limited ocean rearing requirements have led to a magnitude larger and more balanced recovery of Bella Coola/Atnarko cutthroat trout.

Unexpected Abundance: Coastal Cutthroat as the Inheritors of Seattle Urban Creeks in the Declining Presence of Other Wild Salmonids

Bill McMillan and David Crab

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Abstract. - In response to reports of spring spawning salmonids by residents along Seattle's Thornton Creek, spawning surveys were initiated in March of 2001 on Thornton and Piper's Creeks to determine what salmonid species may be using these urban creeks for spring spawning and to quantify the number of redds, live sightings, spawning distribution, and spawning success of any carcasses found. Subsequent surveys from

2002 through 2005 indicated that a range of 450-650 coastal cutthroat thought to be of primarily adfluvial life history spawned annually in 4.36 miles of Thornton Creek well up into its two main branches. In the 0.5 mile of Piper's Creek surveyed during the same period it is estimated that 25-50 coastal cutthroat of probable sea-run life history spawned. The unexpected abundance of wild spawning cutthroat in these urban streams contrasts with high rates of female coho prespawning mortality on Thornton Creek (80%-90%) and Piper's (18%-70%) which may preclude self-sustaining coho populations. Whereas coho prespawning mortality may be linked to contaminants in urban stormwater runoff, cutthroat appear to be little affected by the mechanism behind coho prespawning mortality, nor by the compromised biological condition (reflected by low B-IBI scores) of Seattle's urban creeks. Despite the adversities, wild cutthroat appear to be the primary inheritors of urban streams whose conditions have proven limiting for coho. How and why are poorly understood.

Feeding Ecology of Cutthroat Trout in the Salmon River Estuary, Oregon

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Abstract. - Until recently, coastal cutthroat trout, *Oncorhynchus clarki clarki*, were thought to use estuaries primarily as a migration corridor to and from the ocean, rather than as a rearing environment. However, recent research in Oregon's Salmon River estuary has defined an extensive estuarine life history for a portion of the population. This study was designed to assess the diet of coastal cutthroat trout that reared in the Salmon River estuary during the summer 2003. Fifty-five coastal cutthroat trout, ranging in size from 130 – 400 mm, were collected by beach seine at three locations in the Salmon River estuary from June 18 through August 1. Stomach samples were obtained by gastric lavage and described by taxonomy, total number, and weight. Fish community composition was also recorded at each site. Coastal cutthroat trout fed actively on pelagic and benthic fishes, benthic invertebrates, and some terrestrial insects. Only 4 of 55 cutthroat trout had empty stomachs. Overall, prey availability and diet varied by site. Active selection of various prey items was noted at each location and was site specific. Chinook salmon were not selected for, although they were found in stomach samples.

Review of Life History of Sea-Run and Resident Cutthroat Trout in Southeast Alaska

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Abstract. - I reviewed literature including unpublished reports from state and federal agencies on the life history of cutthroat trout with an emphasis on studies conducted southeast Alaska. The current distribution of cutthroat trout in southeast Alaska originated from the Columbia River drainage. Cutthroat trout may be anadromous or potamodromus (lake and stream), or reside entirely in headwater streams. Anadromous cutthroat in southeast Alaska return to natal spawning streams after only a few months at sea but may use more than one stream for spawning during its lifecycle. Migratory fish tend to grow to larger sizes than resident fish. In southeast Alaska, spawning typically occurs in spring for resident and potamodromus fish and late summer to early fall for anadromous cutthroat trout. Little information on the early life history, including incubation time is available for cutthroat in Alaska; however fry have been observed in shallow lateral habitats in early summer. In southeast Alaska, cutthroat trout are sympatric with juvenile coho salmon, Dolly Varden and rainbow trout. However, morphological characteristics may control habitat selection and interaction. Cutthroat are opportunistic feeders. Diet changes with body size, available prey, season and time of day. Small cutthroat are typically planktivorous while larger cutthroat are piscivorous.

**Hybridization among Sympatric Anadromous Steelhead and
Cutthroat Trout: The Potential Impacts of Captive Brood
Smolt Releases at the Keogh River, British Columbia**

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Bruce Ward
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Abstract. - Anadromous steelhead (*Oncorhynchus mykiss irideus*), and anadromous cutthroat trout (*Oncorhynchus clarki clarki*) are examples of closely related sympatric species that remain distinct despite very similar life history profiles, however, intermediate hybrids are known from almost all sympatric coastal British Columbia populations where hybrids have been the study focus. A recent pilot study investigating the frequency of cutthroat/ steelhead hybridization among seaward migrating smolts on the Keogh River has suggested reciprocal hybridization (F_1 and F_2 evidence of maternal lineage in both species) has occurred in the past, and the potential for increased hybridization exists since wild steelhead populations were augmented with a conservation based captive brood program. During 2002, a total of 67 steelhead and cutthroat seaward smolts were sampled with the aim of identifying the a background steelhead / anadromous cutthroat hybridization rate in the watershed. The results indicated that 6 percent of identified steelhead smolts were hybrids and approximately 27 percent of fish identified as cutthroat had a hybrid lineage. The life history of these hybrid smolts is undocumented, and poorly understood, however all hybrids were back crossed individuals, suggesting that some F_1 hybrids survive to successfully spawn at maturity. It is likely that most F_1 hybrid progeny are male cutthroat spawning with female steelhead, however there is mtDNA evidence suggesting F_2 backcrosses occur in several parentage directions and these results suggest reciprocal hybridization has historically occurred in the Keogh River.

Coastal Cutthroat Trout Diet in South Puget Sound, Washington, 1999 – 2002

Joseph M. Jauquet

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Abstract. - This study explored coastal cutthroat predation of salmon eggs and fry, and the ecological implications of this behavior. From July 1999 to April 2002, 115 coastal cutthroat were captured by catch-and-release angling in South Puget Sound. 94 stomach samples were analyzed. Wet weights of diet items were salmon eggs and chum salmon (*O. keta*) fry (46%), other non-salmon fishes (23%) and polychaetes (12%). Invertebrates (amphipods, isopods, shrimp and clam necks) constituted 17%, and other items 2%. The most important non-salmon fishes in the diet were shiner perch (*Cymatogaster aggregata*), Pacific herring (*Clupea harengus pallasii*), Pacific sand lance (*Ammodytes hexapterus*) and arrow goby (*Clevelandia ios*). Cutthroat length when salmon were present and not present, was not significantly different (Chi-square = 0.11, 2 df). Apparently, coastal cutthroat preferentially select salmon eggs and chum salmon fry when they are present, despite the abundance of alternative food items, and shift to these alternative items at other times. Increased fitness and fecundity of coastal cutthroat is likely the result of successful life history traits, such as interspecies feeding. Setting ecologically-based escapement goals for Pacific salmon could support coastal cutthroat population growth.

Habitat Use and Movement of Sea-Run Cutthroat Trout in the Salmon River Estuary

Lisa Krentz

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Hiram Li

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Ian Fleming

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Kim Jones and Trevan Cornwell

Oregon Department of Fish and Wildlife, Corvallis, OR

Abstract. - “It can be said that Oregon’s estuaries act as a funnel through which all anadromous salmonids must pass through during the course of their lifetime” (R.Giger). While sea-run cutthroat trout often migrate extensively and are thought to be highly dependent on estuaries, their life history and habitat requirements are poorly understood. The goal of this research was to determine the role that the estuarine environment plays in the life history of sea-run cutthroat trout in Oregon’s Salmon River. We used both PIT tag and acoustic tracking techniques to monitor the movement and growth of individuals in the estuary. Over the course of 18 months, approximately 750 fish were PIT tagged and 42 were tagged using acoustic transmitters. Through the duration of the project we identified an “estuarine resident” life history type that does not migrate to the ocean. Instead, they rear extensively in the estuary for many months and

exhibit strong site fidelity while doing so. Coastal cutthroat trout were found in the estuary every month of the year, including the winter months. Habitat use was not closely associated with salinity, temperature, or tide. Mainstem sites were consistently occupied, while marsh channel habitats were used only rarely. Estuarine growth was highly variable, but averaged 0.46mm/day.

8:00-9:00pm Coastal Cutthroat Angling Seminar (Kerr and Johnson)

Friday, September 30

8:00am BIOLOGY SESSION (Chair Ron Ptolemy):

8:10am The Influence of Spawning Pacific Salmon on the Stable Isotope Composition, Feeding Behavior, and Caloric Intake of Coastal Cutthroat Trout

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Abstract. - A growing body of research has established anadromous Pacific salmon (*Oncorhynchus spp.*) as important nutrient vectors between marine and freshwater/terrestrial systems. Research must quantify species-specific utilization of salmon derived nutrients in order to predict their response to decreasing salmon abundance. The focus of this study was to determine the extent to which coastal cutthroat trout (*O. clarki clarki*) utilize salmon derived nutrients at Kennedy and Donkey Creeks in Western Washington. At both study sites, after salmon began to spawn, coastal cutthroat trout shifted their primary prey from invertebrates to salmon eggs. Egg feeding behavior resulted in higher caloric intakes during winter and spring for coastal cutthroat trout sampled from the anadromous reaches of both streams, compared to coastal cutthroat trout sampled above anadromous barriers. Juvenile coastal cutthroat trout from both creeks displayed increased stable isotope ratios ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$) after salmon began to spawn, reflecting their consumption of salmon derived organic matter. The results of this study show that salmon derived material, especially salmon eggs, are an important food source for juvenile and adult coastal cutthroat trout from fall through spring.

8:30am Effects of Landscape Pattern on the Distribution of Coastal Cutthroat Trout in Headwater Catchments in Western Oregon

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Abstract. - Headwater streams are dynamic environments in which landscape characteristics exert strong influences on the distribution of stream fishes. Although geology, topographic factors, and land use have been shown to affect trout population density at a site-specific level, few studies have investigated landscape features associated with the distribution and scale of variation of trout distribution in an entire watershed. To evaluate landscape influences on the distribution and relative abundance of coastal cutthroat trout (*Oncorhynchus clarki clarki*), we conducted spatially continuous surveys of stream habitat and trout abundance in forty randomly selected watersheds (500-1000 ha) in the Cascades, Coast Range, and Klamath Mountains ecoregions of western Oregon. Our investigation of coastal cutthroat trout populations across a broad range of headwater environments revealed that landscape patterns, including topography, geology, stream network structure, annual precipitation, and forest cover type, were associated with the distribution and scale of variation of trout distribution within watersheds. Understanding influences of basin-scale factors on the distribution and relative abundance of coastal cutthroat trout is critical in the Pacific Northwest where resource managers must consider potential effects of forest management on aquatic ecosystems.

8:50am **Role of Barriers in the Distribution, Abundance, and Life History of Coastal Cutthroat Trout in the Columbia River Gorge**

Patrick J. Connolly
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Abstract. - Tributaries to the Columbia River above Bonneville Dam and within the Columbia River Gorge support populations of coastal cutthroat trout at the farthest eastern extent of their distribution in the Columbia River Basin. An effort was initiated in 2002 to describe the distribution and population health of coastal cutthroat trout within the Columbia River Gorge. Distribution largely reflected the potential invasion time and the age of barriers. In streams with known coastal cutthroat populations above a barrier, we sampled sections of stream above and below these barriers to compare species assemblages and to estimate abundance and biomass of cutthroat trout and other salmonids. Our findings suggest that the lack of exposure to other species of wild, hatchery, or introduced salmonids is serving to conserve patches of coastal cutthroat

trout. Where cutthroat trout are exposed to other salmonid species, their abundance can be extremely low, which may or may not be able to sustain the population without a sea-run component. The dynamics of isolated coastal cutthroat populations and the decline of the sea-run component in the Columbia River above Bonneville Dam will be discussed in terms of long-term survival within this dynamic portion of their distribution.

9:10am **Stream Connectivity and Emigration Rates in Headwater Coastal Cutthroat Trout Populations in Western Oregon**

Douglas S. Bateman
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Robert E. Gresswell
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David Hockman-Wert
Forest and Rangeland Ecosystem Science Center, U.S. Geological Survey, 3200 S.W. Jefferson Way, Corvallis, OR 97331

Abstract. - Knowledge concerning life-history strategies of headwater coastal cutthroat trout (*Oncorhynchus clarki clarki*) and their potential to influence downstream populations is important for efforts to promote the persistence of the subspecies. Here we will compare the number cutthroat trout emigrating and immigrating within and among three watersheds ranging in size from 858 to 2200 ha. All watersheds have been equipped with a network of channel spanning passive integrated transponder (PIT) tag antennae. An antenna has been placed at the downstream end of each watershed to monitor emigration at the watershed scale. Within each watershed additional pairs of antennae have been placed at each fish bearing tributary junction. At these tributary junction sites, one antenna spans the mainstem channel just upstream from the tributary junction and the second spans the tributary at its mouth. Using 3-4 tributaries per watershed it is possible to compare emigration and immigration rates among subwatersheds across an accessibility gradient ranging from totally accessible to totally inaccessible. Year to year variability in emigration rate, timing, and relation to hydrologic variables is being explored.

9:30-10:00am **Break**

10:05am **Movements of Coastal Cutthroat Trout in Abernathy Creek and Chinook River, two tributaries of the Columbia River**

Jeff Johnson¹, Joseph Zydlewski^{*1}, Gayle Zydlewski²

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²United States and Wildlife Service, Abernathy Fish Technology Center, Longview, WA

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Abstract. - Coastal cutthroat trout movements were studied in Abernathy Creek and the Chinook River, tributaries of the Columbia River. The Chinook River (rkm 6) is a low gradient system that historically witnessed high tidal influences and today is subjected to more moderate tidal intrusions. Abernathy Creek (rkm 76) is a higher gradient system subjected to little tidal influence. In Abernathy Creek, cutthroat trout were PIT tagged in 2001, 2002, and 2003 (n = 462, 498, and 533 respectively) by electrofishing upstream of stationary arrays. Monitoring arrays were constructed at river kilometers 2.9 and 5.0 and interrogate the entire flow volume at one point continuously (year-round at a 50 millisecond resolution) without obstructing the path of the fish. Similarly in the Chinook River, cutthroat trout were tagged in 2002 and 2003 (n =470 and 310 respectively). Monitoring arrays were constructed at rkm 0.1 and 6.0. In both systems, electrofishing in the fall and backpack interrogation (Abernathy only) resulted in recaptures of non-migrant trout. Downstream movements in both systems were greatest in the spring and coincident with steelhead and coho smolt migrations. This behavior in conjunction with increased gill Na⁺,K⁺-ATPase (versus non-migrants captured in the fall) indicates a smolting pattern similar to other salmonids.

10:25am Movements of Coastal Cutthroat Trout in the Lower Columbia River

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Abstract. - Timing and speed of juvenile coastal cutthroat migration was investigated using both active and passive radio and acoustic telemetry in the springs of 2002 and 2003. Actively migrating cutthroat in the Chinook River and Mill, Abernathy and Germany Creeks (tributaries of the lower Columbia River; rkm 6, 87, 88, 91 respectively) were captured by screw trap and implanted with either a radio transmitter or acoustic pinger and monitored. The data suggest that migrant cutthroat trout leave the tributaries and make rapid, directed movements into seawater, often within 5 days of entry into the main-stem environment. In the spring of 2003, the telemetry effort emphasized gathering specific high resolution movement data on cutthroat trout leaving the three Creeks. A similar pattern of rapid downstream migration was observed. Movement data suggests that there is no diel or tidal pattern of non-directed activity. As might be expected, however, directed downstream movement was correlated with outgoing tidal flows. Additionally, downstream movements were greatest just after dawn and dusk. These migratory patterns, together with physiological data (increased gill Na,K-ATPase and increased seawater tolerance during the spring) supports the assertion that the smolting process and migration patterns of cutthroat trout are comparable to other salmonids. Because of these similarities, anthropogenic activities and management actions in the

main-stem Columbia River that influence salmon smolts are likely to affect anadromous coastal cutthroat trout in a parallel fashion.

10:45am Sea-Run Cutthroat Trout Life History: Should I Stay or Should I Go?

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Kim Jones
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Trevan Cornwell
Oregon Department of Fish and Wildlife, Corvallis, OR

Abstract. - Historically, little has been known about the migration patterns of anadromous coastal cutthroat trout in the estuary and ocean. We used both PIT tag and acoustic tracking techniques to monitor the movement of individuals through the estuary. Over the course of 18 months, approximately 750 fish were PIT tagged and 42 were tagged using acoustic transmitters. The combination of methods has allowed us to identify three life history types: an ocean migrant form that migrates through the estuary and out to sea and, upon return, may spend a number of months in the estuary before migrating upstream; a spring and summer estuarine resident form that does not migrate to the ocean but, rather, resides in the estuary for many months and exhibits strong site fidelity while doing so; and a potential estuarine over-wintering life history that remained in the estuary throughout the winter months. Life history types were not associated with size. Over half of the acoustically tagged fish exhibited the estuarine resident life history, suggesting this strategy is not rare. The large number of PIT tag recaptures has enabled us to infer growth rates of estuarine residents versus ocean migrants.

11:05am Adult Coastal Cutthroat Trout Movement and Habitat Use in the Lower Columbia River

J. Michael Hudson ^{1*}, Jeff Johnson ¹, Jeff Hogle ¹, John Brunzell ¹, and Joe Zydlewski ²

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² U.S. Geological Survey, University of Maine, Orono, ME

Abstract. - Coastal cutthroat trout (*Oncorhynchus clarki clarki*) were collected from tributaries to assess adult movement and habitat use in the lower Columbia River basin. Adult coastal cutthroat trout were collected via angling in late winter/early spring in 2004 and 2005. Most individuals were collected from Mill Creek in Washington. However, a few individuals were collected from other tributaries of the lower Columbia River basin. Captured coastal cutthroat trout were implanted with a radio tag that had a guaranteed

life span of 360 days. Tracking was conducted via automobile and boat in 2004 approximately three times a week through September. Tracking continued via automobile and boat in October 2004, but was more concentrated in spring 2005 to occur every day. Most tracking occurred between Longview, WA, and Astoria, OR. Information collected to date indicates that adult coastal cutthroat trout occupy a variety of habitats in the lower Columbia River basin including tributaries, side channels, backwaters and the main channel. It also appears that an individual may utilize more than one tributary within a year. Movement upstream and downstream appears to be influenced by the tidal cycle once an individual is in the main stem lower Columbia River and that movement may occur within the main channel and/or side channels. Further study may be warranted to determine adult coastal cutthroat trout movement and habitat use in the lower Columbia River estuary downstream of Astoria, OR.

**11:25am Seasonal Movements of Radio-tagged Coastal
Cutthroat Trout on the Copper River Delta, Alaska**

David Saiget

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Abstract. - We used radio telemetry to track movements of 27 adult Coastal Cutthroat trout on the North Gulf Coast/Copper River Delta, Alaska. Sixteen upstream-migrating spawners and 4 downstream-migrating spawners were tagged as they passed the Mile 18 stream weir in the spring. In the fall, seven fish were followed to overwintering areas. Tracking of individual fish (FL 272-489 mm) ranged from 6-343 days. Freshwater habitats were utilized in all seasons. Spawning locations varied from low gradient, broad river reaches near the mouth to narrow (<1m width), ephemeral headwater streams 3 miles upstream. Large migratory females (320 mm, 283 mm FL) spawned in headwater streams with 'resident'-sized males 100-130 mm in length.

After spawning, upstream-migrating spawners either remained in the Mile 18 stream for the summer or outmigrated to adjacent drainages or the estuary. Stream residence for kelts leaving the system ranged from 3-28 days. Downstream-migrating spawners outmigrated 1-3.5 mi to adjacent drainages. Fish tracked to the estuary in spring were tracked to freshwater habitats in August, suggesting summer saltwater migration. In late September, fish were tracked to overwintering lakes and ponds where they remained until April. Movements and habitats utilized by these fish suggest the presence of both potomodromous and anadromous behavior.

11:45am Group Discussion

12:00-1:00pm Lunch

**1:05pm Coastal Cutthroat Trout Shoal Spawning in a High Montane
Lake of the Cascade Range of Oregon**

David Saiget

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Abstract. - We observed shoal spawning in an isolated population of coastal cutthroat trout in Bull Run Lake. Fish utilized shoal areas in the lake for spawning in addition to spawning in lake tributaries. Shoal spawning occurred over a period of one month from May-June, and peaked 2-3 weeks before tributary spawning. Redd construction was most often observed near adjacent boulders or large rocks, presumably for cover. Spawning depths ranged from 1 foot to greater than 12'. Most shoal spawning occurred on an area of roadbed gravels placed for maintenance of water withdrawal facilities. Up to 50 fish at one time were counted in the main shoal area and some fish, identified by unique markings, were observed remaining in the area for several weeks. Shoal spawning on natural lake substrates was also observed but numbers of fish were few and the areas were found to be scarce, widely dispersed, and small in size. Success of shoal spawning on artificial substrates may be limited. A total of 191 fry were counted from 18 redds that had fry caps installed over them. Piscivory of eggs by fish was observed and in some instances, all the eggs were consumed before the female could bury the eggs.

1:25pm

Coastal Cutthroat Trout Ecohydrology and Habitat Use in Irely Creek, Washington

R.L. Vadas, Jr.

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Abstract. - In the Irely Creek watershed (upper Quinault River drainage), which is protected as Olympic National Park, coastal cutthroat trout coexists (as a native-adfluvial run) with anadromous coho salmon (the dominant fish), two resident fishes, and several amphibian species. During 2001-2002, cutthroat redds and fry were abundant in the mainstem, such that we had adequate data to formulate habitat-suitability curves for spawners and assess the incubation period before fry emergence (~2 months). The results for depth, velocity, and substratum preferences were similar to spawning resident-trout species and suggest that cutthroat have lesser instream-flow needs than salmon for reproduction, as supported by the lower flows that cutthroat spawned at as compared to coho. In contrast, cutthroat redds were much rarer (by an order of magnitude) during 2003, reflecting the 2002 summer/fall drought that dried up adult habitat in Irely Lake. Given that another drought again dried out this small lake during the summer/fall of 2003, and that severe mainstem flood scour occurred during the winter of water-year 2004 and a winter drought is now in progress, further depletion of the cutthroat population is expected. But extirpation has not occurred to date, given the consistent presence of cutthroat fry in a headwater tributary that showed less flood scour than in the mainstem, as well as the regular presence of juveniles in the mainstem. Despite possible competition with coho, Irely Creek cutthroat often schooled with coho as fry and likely benefited from coho carcass-derived nutrients. Given that coho rear in the perennially flowing creek and that spawners can access it during winter when flows are relatively high, coho were less susceptible to lake dryout than cutthroat despite the higher spawning-flow needs of the former species.

1:45pm

Environmental Factors Influencing the Seasonal Movements and Distribution of Coastal Cutthroat Trout in a Headwater Stream)

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Abstract. - Previous research in South Fork Hinkle Creek suggested that coastal cutthroat trout exhibit an aggregated spatial pattern across multiple scales. To evaluate the persistence of the observed spatial patterns and identify factors that affect those patterns, half-duplex passive integrated transponders (PIT-tags) were implanted in 690 coastal cutthroat trout (≥ 100 mm, about age 1-plus fish) throughout the watershed. Twenty-three habitat patches of high, medium, or low relative fish abundance were delineated and monitored over a 13-month period. Seasonal habitat surveys quantified channel characteristics in each patch. Immigration and emigration were monitored using stationary and portable PIT-tag antennas along 2 km of stream, including main stem and tributary habitats. Concomitant monitoring throughout the watershed enabled detection of PIT-tagged fish beyond the 2 km study section. Results revealed that fish of downstream origin immigrated more frequently into the study area, and moved longer distances, than fish originating in the upper watershed. In general, habitat patches that supported a high abundance of cutthroat trout experienced less immigration and more demographic stability. Stream gradient, boulder density, and depth of cascade habitats were correlated with fish abundance. Fish movements were strongly correlated with discharge, occurring during low seasonal flows or between storm events. Fish were more active during daytime versus nighttime regardless of season. Identification of the spatial extent of functional habitat and the behavioral processes associated with changes in relative fish abundance may assist managers challenged with monitoring fish population dynamics, setting angling rules, and regulating forest harvest activities in headwater ecosystems.

2:05pm **Ecoregional Influences Affecting the Abundance of Juvenile Coastal Cutthroat Trout and Other Species Rearing in Coastal Streams of British Columbia**

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Abstract. - The empirical abundance and EcoRegion context of juvenile coastal cutthroat trout (*Oncorhynchus clarki*), coho salmon (*Onchorhynchus kitsutch*) and char (*Salvelinus malma*) were evaluated using total removal population surveys at the meso-habitat and reach scale from numerous small streams in coastal British Columbia. Cutthroat trout biomass ($\text{g} \cdot 100\text{m}^{-2}$) varied broadly among and less so within the two primary Ecoprovinces (Georgia Depression; Coast and Mountains) with the highest biomass in streams of high alkalinity or those with high nutrient sources such as salmon carcasses.

Biomass was less variable at the EcoSection or EcoRegion level. A significant, positive curvilinear relationship was observed between alkalinity and biomass of coho salmon as well as aggregate biomass of cutthroat and Dolly Varden. Streams with high conductivity and low annual unit runoff contained higher fish biomass. Streams with sufficient hydraulic diversity in late summer supported higher densities of cutthroat trout in the Georgia Depression EcoProvince and, in particular, the Fraser Lowland EcoSection compared to elsewhere. Various habitat models have been developed to estimate trout carrying capacity, but reliable benchmarks had not been developed for coastal cutthroat trout until now. The primary goal is to establish biostandards for various life-history stages and habitat types to help evaluate population health, stock status and trends during routine monitoring. This meta-analysis is derived from a 30-year career working with cutthroat.

2:25pm

Cutthroat Trout as Successful Urbanites

Dave Seiler and Laurie Peterson
Washington Department of Fish and Wildlife, Olympia, WA

John Serl
Washington Department of Fish and Wildlife, Cowlitz Falls Dam, WA

Roger Tabor
U.S. Fish and Wildlife Service, Lacey, WA

Abstract. - Coastal cutthroat trout *Oncorhynchus clarki clarki* are ubiquitous inhabitants of stream systems throughout the Pacific Northwest. Their abundance is determined by many factors including habitat, water quality, food availability, species interactions and fish harvest management. In anadromous reaches, juvenile cutthroat are usually sympatric with coho salmon *O. kisutch* and steelhead trout *O. mykiss*. Coho spawn in the fall, emerge from the gravel in early spring and rear primarily in pools and slower reaches before emigrating the following spring as yearling smolts. Cutthroat abundance is generally determined by interactions with cohabitants, particularly coho. In productive lowland streams, at the smolt stage, coho usually outnumber cutthroat by factors of at least 50:1 throughout western Washington. As watersheds become developed, expansion of impervious surfaces conveys runoff directly into stream channels altering natural flow patterns and water quality. In such watersheds, fall spawning salmonids are at a disadvantage. Even moderate rainstorms become redd scouring torrents given the magnified stream power. In addition, because winter precipitation is not stored in wetlands and as groundwater for flow maintenance, the resultant extreme low summer flows reduce carrying capacity for rearing juvenile salmonids. Because cutthroat spawn in the spring as flows are generally declining, their eggs survive at apparently much higher rates than those of coho. When cutthroat fry emerge in an urban stream there are few if any coho fry to compete with for food and space. In six small tributaries to Lake Washington sampled in July of 2003, juvenile cutthroat fry densities averaged .67 per m² while coho averaged only .03 per m². These rates are significantly higher and lower than respective cutthroat and coho densities measured with the same methods in the same reaches one decade earlier. These findings are also supported by ongoing downstream migrant trapping that began in the 1970's.

2:45-3:05pm

Break

3:10pm

Errors in Visual Identifications of Juvenile Steelhead, Coastal Cutthroat Trout and Their Hybrids

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Abstract. - Steelhead (*O. mykiss*) are a threatened species in northern California, occurring in sympatry with coastal cutthroat trout (*O. clarki clarki*) north of the Eel River drainage. Juvenile-based population estimates are often used to assess status and establish a quantitative baseline for discerning trends of ESA-listed salmonids, but previous research has shown that field identifications of steelhead, coastal cutthroat trout and their hybrids can be highly inaccurate, even when identifications are made by experienced biologists. We sought to better understand the causes of identification errors by evaluating morphometric and qualitative phenotypic traits of juveniles (n=762 fish) sampled from two coastal streams. We first visually classified fish as a pure species or hybrid, and then determined true fish identities through genetic analyses. For each fish, we also measured head length, maxillary length, and fork length, and assigned qualitative index scores for cutthroat-like "slash" intensity and maxillary extension. Analysis of these field measurements and index scores provided partial explanations for incorrect classifications. We report on the relative performance of discriminant analysis and classification tree methods to improve the accuracy of visual identifications of juvenile steelhead, coastal cutthroat trout and their hybrids.

3:30pm

A Two-Phase Bayes Approach for Estimating Abundance of Juvenile Steelhead in Small Streams where Steelhead, Coastal Cutthroat Trout and Their Hybrids are Present

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Abstract.- In northern California, steelhead (*O. mykiss*) are listed as endangered and as juveniles are difficult to visually distinguish from sympatric cutthroat trout (*O. clarki clarki*) and their hybrids. We propose an estimation scheme whereby biased visual identifications of fish can be adjusted by known genetic identifications, thereby producing an unbiased estimate of the abundance of juvenile steelhead. Our scheme consists of two nested two-phase survey designs suitable for small streams. The first survey is a Hankin-Reeves design (diver counts in a large first phase sample; electrofishing removals in a smaller second phase sample) that uses a two-phase ratio estimator to estimate the total number of "trout" present over all habitat units. The second two-phase survey consists of making (biased) visual species identifications of "trout" as steelhead, hybrids or cutthroat in electrofishing catches (first phase). A subsample (second phase) of these same fish are subjected to genetic analyses which allow identifications of true species categories. This second two-phase survey relies upon a novel two-phase application of Bayes Theorem to produce unbiased estimation of the proportion of steelhead. Total abundance of steelhead is then estimated as the product of the estimated total number of "trout" and the estimated proportion of steelhead among all "trout".

3:50pm

Productivity, Trends and Interspecific Associations of Coastal Cutthroat Trout in Two Managed Tributaries to the Smith River, California

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Abstract. - Anthropogenic disturbance resulting from natural resource extraction is a major component of the Pacific Northwest landscape. In 1994, with the potential federal listing of the coho salmon, a long term fisheries monitoring program was initiated to determine the overall health and stability of anadromous species within two intensively managed tributaries to the Smith River, in Del Norte County, California. In addition to coho salmon, several other important anadromous salmonids utilizing the watersheds were also monitored through summer juvenile abundance estimates and smolt trapping (steelhead, Chinook salmon and coastal cutthroat trout). Ten years of population data collected from these tributaries has shown a difference in overall abundance between steelhead and coho salmon, while coastal cutthroat abundance appears to be stable, and similar in size within both tributaries. Steelhead and coho salmon smolt production generally revealed a significant difference between the West Branch and East Fork Mill Creek over ten years. However, coastal cutthroat trout production appeared to be unaffected by those factors (freshwater or marine) affecting the other anadromous salmonids utilizing the drainage. Identifying potential species interactions and habitat associations within Mill Creek as they relate to coastal cutthroat trout production, may offer incite into species status and current trends within the southern portion of their range.

4:10pm Demographics of Coastal Cutthroat Trout in Prairie Creek, California (Duffy-ABSTRACT NOT RECEIVED AT TIME OF PRINTING)

4:30pm Influences of Landscape Variables on Age and Growth of Coastal Cutthroat Trout in Headwater Streams

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Abstract. - Although habitat requirements of anadromous coastal cutthroat trout have been extensively studied, the ecological requirements of other life-history forms are less well understood. In order to investigate the influence of physical habitat on the age and growth characteristics of nonmigratory stream populations in the western Oregon, we examined biological and environmental variables from 38 randomly selected streams. In each stream, scales were removed from coastal cutthroat trout (total = 3,500) ranging in size from 59 to 289mm. Mean age in individual streams ranged from 1.4 to 2.5 years old. Maximum age was 3 years old in five streams, and only eight streams supported fish that reached a maximum age of 5 years old. Relative growth rates declined with increasing age, and in all streams, relative growth was < 0.45 mm/mm/year for fish \geq 2 years old. Data suggest that headwater populations of coastal cutthroat trout are short-lived and grow slowly. Biological variables related to among-watershed variation

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Gordon H. Reeves
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Abstract. - We examined the geographic variation in genetic and meristic characters of coastal cutthroat trout from 54 populations spanning their distributional range from Prince William Sound, Alaska, to northern California. Across their range, population structure was that of many diverse local populations. Populations exhibited extensive variation in meristic characters. Regional clustering of populations from the southern portion of the range contrasted with populations from the central and northern portion of the range, which did not exhibit geographic concordance. Intra-regional differences among populations in the southern region were greater than that observed in the other regional areas. Analysis of genetic population structure based on 30 enzyme encoding loci revealed geographic concordance of populations in the northern and southern regions of the range with little geographic concordance in genetic structure from populations in the central regions of the range. Throughout the range, isolation-by-distance was detected at a regional scale (< 800 km) and was strongest in the northern and southern regions. The primary genetic structure occurred at the individual stream level with genetic affinity among populations at a regional scale. The strong geographic concordance and inter-regional divergence of meristic characters exhibited by southern populations was consistent with other ecological studies that have found that peripheral populations tend to be genetically and morphologically divergent from central populations. Compared to other Pacific salmonids, coastal cutthroat trout are characterized by many smaller, genetically diverse local populations that act in a more independent, isolated nature over short time frames.

**8:25am Genetic Variation and Geographic Structure of Coastal
Cutthroat Trout in Prince William Sound, Alaska**

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Abstract. - In 1995 Northcote suggested that migratory behavior of coastal cutthroat trout represents a spectrum from resident to migrant- a feature which fascinates and confounds those who study and admire this salmonid sub-species. By examining the genetic structure of these populations we gain insight to historical and contemporary patterns of genetic exchange and isolation that may arise on account of these behaviors. Our study examines microsatellite DNA from 13 populations of sea-run and resident trout in Prince William Sound (PWS), Alaska- the northern extent of their distributional range. In some areas of PWS trout populations are highly differentiated from one another, suggesting that they are structured at the watershed scale, results consistent with other studies from other regions. However, in other areas of PWS, we found high

levels of similarity among trout populations including resident and sea-run fish from the same watershed. These results suggest that the genetic structure of trout in PWS is complex. Metapopulation theory predicts that at the edge of a species' distributional range populations fluctuate between extinction and colonization. As a species expands its range, dispersal distance may limit the exchange among neighboring populations and isolation by distance (wherein genetic differences are correlated with geographic distance) may be detected. We found that the stepping stone model of isolation by distance sheds light on the complex genetic structure of trout in PWS. Furthermore, we found that some populations of coastal cutthroat trout within PWS had reduced allelic diversity and heterozygosity a finding consistent with their recent colonization.

8:45am

Cutthroats above the Rest: Waterfalls, Microsatellites, and Isolated Populations of Coastal Cutthroat Trout

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M. A. Banks

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Abstract. - Coastal cutthroat trout, (*Oncorhynchus clarki clarki*) are found throughout the Pacific Northwest in small headwaters streams and are often encountered above waterfalls in small populations isolated from upstream immigration. Although the effects of these extrinsic barriers to dispersal have increasingly been shown to play a significant role in the structuring of contemporary genetic diversity, describing the relationship between landscape structure, stochastic disturbance, and genetic diversity remains a major challenge. Here, environmental features for 27 barrier-isolated populations (2,232 individuals) of coastal cutthroat trout from western Oregon are compared with measures of genetic diversity from seven microsatellite loci (number of alleles, estimates of recent bottlenecks-M, and effective population size- N_e) to examine how watershed-scale environmental factors and estimates of historical population demographics influence genetic structure. Isolated headwater populations of coastal cutthroat trout are strongly differentiated (mean F_{st} = 0.33), but intrapopulation microsatellite genetic diversity (mean number of alleles per locus = 5, mean H_e = 0.60) was only moderate. Differences in genetic diversity of fish from the Coast Range (mean alleles = 47) and Cascade Mountains (mean alleles = 30) coincided with differences in regional landscape features. Furthermore, differences evident from scatterplots of isolation by distance within ecoregions indicated that population structure was primarily mediated by gene flow in the Coast Range, but in the Cascade Mountains, genetic drift is the dominant factor influencing genetic patterns. Thus through comparisons between landscape structure and genetic diversity we demonstrate an example where physical landscape features play a substantial role in the structuring of genetic diversity.

9:05am

Drawing the Circles: Nested Analysis of Genetic Variation and the Delineation of Distinct Groups of Coastal Cutthroat Trout in British Columbia

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Abstract. - As part of a coordinated approach towards native trout conservation in British Columbia, we are using high-resolution genetic markers to describe the scope and partitioning of intraspecific biodiversity in coastal cutthroat trout from the province. The delineation of distinct population segments across the range in BC will be of paramount importance to future conservation measures and is a requirement for any future protection under Canada's Species at Risk Act (SARA). To address the issue, we are employing a nested approach which targets genetic variation distributed across different spatial scales to:

- 1) Describe the distribution of the major evolutionary lineages in the province (i.e. - ESUs) which would act as the major conservation units beneath the subspecific level.
- 2) Achieve a more realistic understanding of a typical cutthroat "population" and the demographic independence between systems by examining patterns of gene flow between 50 populations from Vancouver Island and the Lower Mainland.
- 3) Investigate a typical coastal cutthroat trout breeding unit (Chonak Lk, Quadra Island) using genetic parentage analysis to determine the number and composition of successful spawners in the system and their contribution to yearly fry production.

Here, we discuss preliminary results from the study and the implications for future management and conservation initiatives targeting coastal cutthroat trout.

9:25am

Naturally Isolated Coastal Cutthroat Trout Populations Provide Empirical Support for the 50-500 Rule

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F.W. Allendorf

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Abstract. - Natural experiments provide a valuable way to gain insight about the long-term results of processes set in motion by human activities, such as habitat fragmentation and population isolation. We studied populations of stream-resident coastal cutthroat trout (*Oncorhynchus clarki clarki*) and Dolly Varden (*Salvelinus malma*) in southeastern Alaska that have been naturally isolated above waterfalls for many hundreds of generations by post-Pleistocene uplift. We examined 124 sites with suitable fish habitat above waterfalls and compared sites where one or both species persisted in isolation with those where they did not. We found a very strong correlation between the amount of habitat available and the likelihood of population persistence. There was a 90% likelihood that populations of either coastal cutthroat trout or Dolly Varden would be present when more than 5.5 km of stream habitat were available, and a less than 50% likelihood of finding either species in less than about 1.5 km of habitat. When multiplied by the typical adult fish density that we found for these settings, the former number corresponds strikingly well with the theoretical prediction that an effective population size of about 500 is required to support long-term persistence in isolation. Our study was the first in which the long-term persistence of stream-resident, headwater salmonid populations was inferred from empirical data unencumbered by complications due to extensive human alterations of the landscape, and it provides a valuable baseline against which to make conservation recommendations in more anthropogenically altered settings.

9:45-10:05am Group Discussion

10:05-10:25am Break

10:25am CONSERVATION PLANNING SESSION (Chair Doug Young):

10:30am Review of the 2002 Withdrawal of the Southwestern Washington/Columbia River Distinct Population Segment of Coastal Cutthroat Trout: Implications for Research, Monitoring, and Conservation

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Abstract. - In 2002, the U.S. Fish and Wildlife Service withdrew the proposed rule to list the Southwestern Washington/Columbia River Distinct Population Segment of coastal cutthroat trout as a threatened species. We will review the process and rationale for the decision to withdraw the proposed listing, including a discussion of the legal and regulatory requirements of the Endangered Species Act. We will discuss four categories of new information that indicated listing was no longer warranted and an overview of the “five factor threat analysis” that led to the conclusion. We will emphasize that, while the species does not meet the definition of a threatened species, there are remaining threats and uncertainties that should be addressed in the future. Finally, we will describe the

information and conservation needs identified during this process that would allow future managers to better assess, document, and address the condition of this species.

10:50am **An Analysis of Information Leading to the Withdrawal of a Proposed Rule to List the Columbia River/Southwestern Washington Distinct Population Segment of the Coastal Cutthroat Trout**

D. Noah Greenwald

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Steve Mashuda, Save Our Wild Salmon Project Attorney, Earthjustice, 705 Second Ave.,
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Abstract. - We comprehensively reviewed all information cited in a status review of the Coastal Cutthroat Trout conducted by the National Marine Fisheries Service (NMFS), a joint proposal by NMFS and the U.S. Fish and Wildlife Service (FWS) to list the Columbia River/Southwest Washington distinct population segment (DPS) of the Coastal Cutthroat Trout, and a withdrawal of the DPS listing by FWS. Much of the information cited in the withdrawal was also cited in the status review and proposal, indicating the withdrawal was based as much on a reinterpretation of existing data as new information. The withdrawal and proposal differed on the importance of the anadromous portion of the population to the viability of the population as a whole. FWS argued that only the status and management of the entire DPS should be considered when determining whether the Coastal Cutthroat Trout meets the criteria for listing as a threatened species, whereas NMFS argued that the status of the anadromous portion of the population alone was sufficient to warrant protection. We discuss the merits and implications of these different conservation paradigms for the Coastal Cutthroat Trout and other species with varied life-history strategies.

11:10am **Coastal Cutthroat Trout Conservation: A U.S. Fish and Wildlife Service Vision**

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Abstract. - In the 2002 coastal cutthroat trout listing withdrawal decision, the FWS agreed to “continue to work with these [Federal, State, and other] agencies and entities to collect additional biological information, monitor the status of coastal cutthroat trout, and monitor the progress of conservation efforts for the DPS.” FWS has since been litigated over the withdrawal decision. FWS believes that a rangewide conservation strategy and agreement has the potential to greatly benefit the long-term conservation of

coastal cutthroat trout. FWS' Fisheries and Ecological Services programs have developed a simple conservation strategy model, which emphasizes a rangewide research, monitoring, and evaluation (RME) program, specific conservation activities, and actions to evaluate population and habitat response to those RME and conservation actions. The RME program would emphasize internal reviews of each agencies' management activities, to determine programs that could be enhanced or better-focused to address key coastal cutthroat trout management uncertainties. New collaborative, rangewide monitoring and research efforts would be established, to focus attention on development of better population and trend data, and to better address several key uncertainties about coastal cutthroat trout biology and ecology that were identified in the Petition and the 2002 withdrawal. Conservation actions would be identified and initiated, to address threats facing coastal cutthroat trout. This paper will review FWS' efforts to encourage participation in a coastal cutthroat trout conservation strategy, including efforts to outreach to states and other agencies. The FWS is committed to assist any interested and committed entities in development and implementation of local, regional, or rangewide coastal cutthroat trout conservation strategies and plans.

11:30am Developing a Consistent Framework for Measuring the Conservation Success of Coastal Cutthroat Trout

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Abstract. - The status of coastal cutthroat trout can be a good indicator of management of coastal stream systems and fish communities. Application of integrated tools that measure and report range-wide conservation status should be a regular part of our coastal management efforts. These tools should be scientifically comprehensive, easily repeatable, based on the latest status information, and readily understood by the interested public as well as scientists. We describe the Conservation Success Index (CSI), which has been developed by a team of scientists working with Trout Unlimited to measure the conservation status of salmonid fishes in North America. The CSI is comprised of a multi-scale assessment of historic and current status based on 6th level hydrologic units and a quantified analysis of extinction risk. Three sets of criteria should be considered when analyzing extinction risk in salmonid fishes: 1) population integrity, including population size, genetic purity, and life history diversity, 2) habitat integrity, including watershed connectivity and flow regimes, and 3) threats to populations and habitats, including factors influencing water quality, energy input, flows, habitat structure, and biotic interactions. We discuss how the CSI can be applied to coastal cutthroat trout.

11:50am Inland Cutthroat Trout Conservation: Lessons Learned and Experience Gained

Bruce May
Retired, US Forest Service

There are eight (8) subspecies of cutthroat trout (Bonneville, Colorado River, Greenback, Lahontan, Paiute, Rio Grande, westslope and Yellowstone) that fall under the label "Inland Cutthroat Trout." From a historical perspective, early efforts to preserve and protect many of these cutthroat trout were focused on conserving these fish for utilitarian purposes. More recently, conservation efforts have expanded the focus to include consideration of intrinsic as well as utilitarian interests.

Contemporary conservation of cutthroat trout began in the 1970's as concerns for the status of inland cutthroat trout became a topic of discussion. Early conservation efforts were weakly coordinated and largely driven by the personal motivation of a few dedicated individuals. More recently, the coordination component of inland cutthroat trout conservation has become a greater factor as conservation plans and strategies consider a range-wide perspectives that often crosses jurisdictional boundaries. Currently, Bonneville, Colorado River, Rio Grande, westslope and Yellowstone cutthroat are being conserved and protected by an assortment of State and Federal laws and under the direction of various state fish and wildlife agencies working in partnerships with other state and federal agencies and interest groups. Three subspecies (Greenback, Lahontan and Paiute cutthroat trout) are currently listed under the ESA and are being managed under recovery programs led by the USDI-Fish and Wildlife Service.

The primary components of an effective conservation effort include administration and organization, implementation and public outreach and education. Administration and organization considerations should address range-wide and local perspectives, they should be anchored to clearly stated goals and objectives, there should be agreements that foster "buy in", conservation plans and strategies that address range-wide and local population needs and are structured to facilitate action, improve efficiency and make effective use of the potential workforce. Implementation considerations include providing protection and enhancement of current populations, restoration and expansion of populations, and program and project effectiveness evaluations that will allow objective for course corrections as needed. An integral component of conservation implementation is developing an objective appraisal of status that is anchored to a realistic historical point of reference. Public outreach and education are arguably the most important of these conservation components. Support and acceptance of the conservation efforts associated with the inland cutthroat trout are based on trust and a clear understanding of the conditions associated with the individual cutthroat trout subspecies.

The success of contemporary conservation programs can be linked to the degree to which these components have been addressed and incorporated in the respective conservation efforts. For each of the five subspecies being conserved principally under state leadership there are strengths and weaknesses. Most have both range-wide and local goals and objectives anchored to conservation agreements and plans. Some maintain a high level of coordination through annual meetings while others meet less often. Even though significant conservation action has occurred most programs are not organized in a way that optimizes the available workforce in an effective and efficient fashion. None of the conservation programs have active, coordinated public outreach and education programs in place at present.

The quality of inland cutthroat trout conservation is vastly improved over those initiated three decades ago. The early efforts of a few dedicated individuals have been replaced the efforts of many individuals working in a more coordinated and consistent manner.

Inland cutthroat trout conservation has become institutionalized and is an integral component of most fishery management programs. The future of all inland cutthroat trout is more secure than ever before due to the coordinated programs that are in place.

12:10-12:45am

Group discussion and closeout (Gresswell and Young)