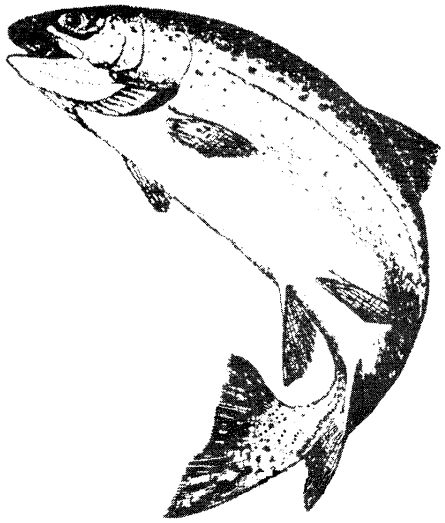
Summary of
the Eighth

Pacific Coast Steelhead Management Meeting



March 5 - 7, 2002
Menucha Retreat and Conference Center
Corbett, Oregon

Sponsored by:
Pacific States Marine Fisheries Commission
and
U.S. Fish and Wildlife Service

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Pacific Coast Steelhead Management Workshop
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Introduction

During March 5-7, 2002, the Pacific States Marine Fisheries Commission, with partial support from the U.S. Fish and Wildlife Service, sponsored the eighth in a series of workshops on steelhead (*Oncorhynchus mykiss*) management. The workshop was attended by approximately 41 Pacific Coast fisheries managers and researchers representing the states of Alaska, Washington, Idaho, and Oregon, the province of British Columbia, and the Russian Republic. Topics for this workshop included:

- an update on the status of steelhead in each management jurisdiction;
- updates on recent activities related to Endangered Species Act (ESA) listings;
- potentials and limitations in the use of wild broodstocks for hatchery steelhead production;
- escapement and harvest management strategies; and
- contributed reports on current steelhead research projects.

Buzz Ramsey, outdoor writer, guide, and Luhr-Jensen sales representative spoke in an evening session on "Steelhead Management Issues from the Public and Industry Perspective", and showed a film on fishing for steelhead in Oregon's Grande Ronde River.

The workshop was structured as a series of panel presentations, followed by discussion and/or questions from the audience. It was intended as a forum to allow steelhead managers and researchers on a coastwide basis to discuss common problems and to share insights into possible solutions. The following abstracts prepared by the speakers summarize their presentations.

Workshop Steering Committee:

Doug Jones, Alaska Department of Fish and Game
Bob Leland, Washington Department of Fish and Wildlife
Art Tautz, Ministry of Environment, British Columbia
Bill Horton, Idaho Department of Fish and Game
Bob Hooton, Oregon Department of Fish and Wildlife
Dennis McEwan, California Department of Fish and Game
Mick Jennings, Confederated Tribes of the Warm Springs
Al Didier, Pacific States Marine Fisheries Commission

Steelhead Stock Status Review by Jurisdiction

Session Chair: Doug Jones, Alaska Department of Fish and Game

Oregon

Mark Chilcote, Oregon Department of Fish and Wildlife

Long-term data sets for 11 populations of steelhead throughout Oregon were analyzed to determine trends in abundance and the proportion of hatchery fish in the natural spawning population. A sharp decline in the late 1980s and an apparent rebound from these low levels in the last 2 years characterized the pattern of abundance for wild fish in nearly all populations. The prediction for 2002 was that spawner escapements will continue this increasing trend. The total abundance of wild steelhead in the Umpqua River basin was estimated to be greater than 40,000 fish in 2001. In Oregon, only the Rogue and John Day basins are capable of matching this level of wild steelhead production. The return of hatchery steelhead to ODFW hatcheries may be highest observed in at least 12 years and is suggestive that marine survival conditions have been favorable for Oregon steelhead populations since 2000. Efforts to rebuild summer steelhead in the Siletz River basin appear to be succeeding. The number of wild fish returning to basin in 2001-2002 is at least ten times larger than the run-sizes observed in the 1990s, which were as low as 50 fish. The impact of hatchery fish on the overall productivity of naturally reproducing populations was measured to be substantial and relatively insensitive to whether the hatchery fish was from a domesticated hatchery broodstock or from a "wild-type" hatchery broodstock.

Washington

Bob Leland, Washington Department of Fish and Wildlife

In 1992, Washington's statewide Salmon and Steelhead Stock Inventory (SASSI) was completed. The review identified the status of each salmon and steelhead stock in the state (i.e., spawning population) as "Healthy", "Depressed", "Critical", or "Unknown". In 2002, Washington's Legislature requested an update of the document using the same stock health definitions and criteria, in addition to new information collected over the past ten years. The 2002 Salmonid Stock Inventory (SaSI) (see tables below) identified fewer healthy stocks, a greater number of depressed stocks, the same number of critical stocks and seven fewer unknown stocks.

Summary of 1992 SASSI and 2002 SaSI

1992: 141 Stocks	
Healthy:	36 = 25.5%
Depressed:	44 = 31.2%
Critical:	1 = 0.7%
Unknown:	60 = 42.6%

2002: 137 Stocks	
Healthy:	31 = 22.6%
Depressed:	52 = 38.0%
Critical:	1= 0.7%
Unknown:	53 = 38.7%

In the Puget Sound geographical area of Washington, several stocks and river systems that were identified as healthy in 1992 are considered depressed in 2002. Notably, a stock status change

has occurred on the Skagit, Snohomish and Stillaguamish river systems. These waters consistently produced adult wild run sizes at or above escapement goals for the past decade and were considered healthy. In recent years escapements have been 40 to 83% of goal and are now considered depressed. A bright spot in Puget Sound is the wild summer steelhead stock on Deer Creek, a tributary of the North Fork Stillaguamish River. Deer Creek steelhead were considered depressed due to a variety of habitat degradation problems that impacted the stream's ability to produce steelhead smolts. Improved age 1+ parr (fish/m^2) survival and several years of adult return counts in the 500 to 1,000 fish range support the stock status change.

The Washington Coast continues to produce harvestable wild steelhead and stocks listed as depressed in 1992 are rebounding to healthy levels. The Quillayute River system continues to produce wild winter-run steelhead in the 15,000 to 24,000 fish range and escapements have been well above the 5,900 fish escapement goal. The Hoh River continues to produce harvestable wild surpluses for both the treaty and non-treaty fisher. The Chehalis River system has substantially exceeded its escapement goal over the past three seasons and is forecasted to have harvestable wild fish. WDFW has proposed an extended catch-and-release sport season to provide additional opportunity for the spring of 2002.

Washington's Columbia and Snake River steelhead stocks continue to be considered depressed. The record 2001 steelhead run (over 635,000 at Bonneville Dam) did contain the largest number of wild steelhead documented in some waters in over a decade.

Idaho

Bill Horton, Idaho Department of Fish and Game

Idaho historically produced about 55% of the total summer steelhead in the Columbia River basin. An average of 70,000 wild adult summer steelhead entered the Snake River during the 1960s, based on Ice Harbor Dam counts. During this period, steelhead were the most numerous anadromous fish returning to the Snake Basin. The documented thirty-year decline of Snake River steelhead led to their listing as threatened in October 1997, pursuant to the federal Endangered Species Act. Development of the Federal Columbia River Power System (FCRPS), particularly the four dams and reservoirs on the Lower Snake River from Pasco, Washington upstream to Lewiston, Idaho, is considered to be the primary factor in Snake River steelhead decline.

The majority of steelhead entering the Snake River return to Idaho. About 60% of the historical steelhead habitat in Idaho is still available, primarily in the Salmon and Clearwater river drainages. About 30% of Idaho's existing steelhead habitat is included within designated wilderness or wild and scenic river corridors. Because approximately 69% of the lower Snake River basin is comprised of lands within the jurisdiction of the federal government, most of the steelhead spawning and rearing habitat in Idaho is federally managed.

Little has changed in the status of Idaho steelhead since this meeting's last review. During the 1990s, the naturally-produced steelhead run, as counted at Lower Granite Dam (uppermost Snake

River dam), averaged only 11,900. This is an 83% decline from the 1962-70 period. The 1995-99 average was even worse at 8,200 steelhead counted at Lower Granite Dam. However, since then the counts have improved sharply, likely because of improved migration and ocean conditions.

There is likely a complex composition of steelhead stocks in Idaho for which Idaho Department of Fish and Game (IDFG) is doing a comprehensive genetic survey. For Idaho management purposes, natural and hatchery-produced steelhead are classified as A-run and B-run groups. Naturally-produced steelhead are further defined by production lineage as "wild" (endemic) or "natural" (nonendemic or hatchery-influenced). B-run steelhead return exclusively to Idaho. They are characterized by later freshwater entry and larger adult size at age with a predominantly two-ocean return. For downriver accounting and management purposes, the arrival date at Bonneville Dam has been used to differentiate between the more common A-run and the B-run groups. However, at Lower Granite Dam, IDFG has used length to classify the two groups. Beginning with the 1999-2000 run, steelhead managers agreed to utilize length to classify the runs into "A-run index" (<78 cm) and "B-run index" components.

Naturally-produced A and B index groups at Lower Granite Dam averaged 6,400 and 1,800 adult steelhead during the 1995-99 period, demonstrating the especially critical status of B-run steelhead. Parr density trends generally reflect the poor adult returns counted at Lower Granite Dam. The new decade began with an upswing in the A-run index count at the dam (10,000 and 17,000 steelhead in 99-00 and 00-01), but the B-run index remained anemic at 900 and 2800 for those years.

There is a mix of natural and hatchery steelhead production strategies in Idaho, ranging from wilderness genetic refugia to large-scale hatchery smolt programs. Idaho Department of Fish and Game estimates the statewide accessible habitat could produce at least 4 million steelhead smolts. Areas managed as wild steelhead include expansive contiguous habitat: the Lochsa and the Selway river drainages of the Clearwater River, and the Middle and South fork drainages of the Salmon River. A few smaller tributaries are also included. Much of the wild steelhead refugia habitat is in areas designated as wilderness or wild and scenic.

Since the 1960s, the composition of the steelhead run entering Idaho has changed. The proportion of hatchery origin steelhead has steadily increased due to declining natural spawner return and development of hatcheries. During 1965-69, the Snake River steelhead run was essentially 100% wild. From 1975-79, the steelhead run at Lower Granite Dam averaged 59% naturally-produced fish and from 1985-89, the run averaged 24% naturally-produced fish. From 1995-99, the run slipped further to an average of 11% naturally-produced steelhead. All steelhead hatcheries in Idaho were developed during this period as mitigation for federal and private hydropower production. IDFG has utilized steelhead smolt production almost exclusively to support sport harvest opportunity for hatchery steelhead in selective fisheries. Steelhead harvest declined from near 20,000 wild steelhead annually in the 1950s and 1960s to near 10,000 as wild fish numbers plummeted in the 1970s. Selective fisheries were implemented in the late 1970s. Legal wild fish sport harvest was terminated with the advent of mass marking (adipose fin-clip) in the mid-1980s. Harvest increased to an average of 27,800 hatchery steelhead during

the 1990s. Use of hatchery smolts for steelhead supplementation had been limited to small-scale research but is increasing with 17% of this spring's smolt release allocated to return hatchery adults to production habitat.

The future of steelhead in Idaho and the Snake River Basin will be defined by improvement in smolt-to-adult return rates (SAR). Egg-to-smolt survival, particularly in wild fish areas, has probably not declined significantly from the 1960s. Currently, SARs are not sufficient for consistent replacement. National Marine Fisheries Service (NMFS) has indicated that naturally-produced Snake River steelhead are at significant risk of extinction. For migratory years 1988-98, SARs ranged from 0.10% to 0.96% for naturally-produced juvenile steelhead tagged with Passive Integrated Transponder tags and detected as adults at Lower Granite Dam (based on IDFG unpublished data). The estimated number of naturally-produced steelhead smolts for the Snake River Basin has been less than a million since 1989. So the carrying capacity of Idaho's habitat hasn't been reached in years and the 2% to 6% SARs necessary for consistent replacement are not being attained, either. The surge of good returns in the last couple of years will likely be countered by the very poor outmigration conditions in the Columbia and Snake rivers in 2001.

British Columbia

Bob Hooton, British Columbia Ministry of Environment, Lands and Parks

Wild stock status is evaluated annually at a number of sites throughout the province. Methods include weirs, snorkel observations, aerial observations, test fisheries and fishwheels, each employed according to the logistics at hand. There are about a dozen sites or localized areas where consistently applied methods facilitate inter-annual comparisons of steelhead abundance. In the northern part of the province these include the Skeena and Nass river mainstems where aggregate steelhead stock strength is estimated by test fisheries and fishwheels. Two tributaries of the Skeena are also monitored via weirs. In southern BC emphasis has been placed on the interior Fraser stocks originating in the Thompson and Chilcotin rivers. Methods there include resistivity counters, mark recapture exercises and aerial counts. Coastal drainages in the southwestern part of the province are evaluated primarily via snorkel surveys. One lower Fraser tributary, numerous Vancouver Island streams and five mainland coast streams are monitored. The Keogh River on northern Vancouver Island continues to serve as the primary barometer of steelhead survival trends in the southern half of the province. The data set emanating from that program now spans 27 years. The overall picture for the province continues to exhibit relatively low abundance and poor ocean survival among southern origin stocks, particularly those originating in streams entering the southern Georgia Basin. The west coast of Vancouver Island has fared significantly better. The zone of demarcation appears to be north of Vancouver Island near the central coast or Bella Coola. The Skeena and Nass watersheds to the north have seen consistently higher steelhead abundance and no evidence to suggest anything other than favourable ocean conditions. There is no evidence to suggest the current winter's returns deviate from the pattern evident through the late 1990s.

Alaska

Steven McCurdy, Alaska Department of Fish and Game

Limited data collected on the status of steelhead stocks in Alaska by the Alaska Department of Fish and Game consist of weir counts, sport fishery catch estimates, and index stream surveys. Snorkel surveys conducted on index streams in Southeast Alaska beginning in 1997 show variable escapements with an apparent peak abundance in most streams in 1999. Counts of post-spawning kelts at the Situk River weir peaked in 1999, and were the highest in the history of the weir. Catch estimates on the Situk have been higher than weir counts since 1996 as apparently fish are caught multiple times. Catch estimates may not be an accurate indicator of steelhead abundance, as the catch estimate in 2000 remained high in Southeast Alaska despite apparent lower abundance. Counts of post-spawning kelts at weirs on the Karluk and Ayakulik Rivers on Kodiak Island are used to monitor those stocks. Continued variability in escapement numbers in recent years demonstrates the need for continued restrictive regulations in the fishery that protect Alaska's steelhead stocks.

ESA Update

Session Chair: Bob Hooton, Oregon Department of Fish and Wildlife

Update on Upper Columbia River Steelhead Management and Recovery Plan
Bob Leland, Washington Department of Fish and Wildlife

Hatchery and wild steelhead in the Upper Columbia Evolutionary Significant Unit (ESU) were listed as endangered in August 1997. The Upper Columbia ESU is from the mouth of the Yakima River upstream. In response to the listing the Washington Department of Fish and Wildlife (WDFW) closed harvest trout and steelhead fisheries, modified rules and open areas to allow the harvest of whitefish, and opened a catch-and-release trout fishery under a Section 10 Permit, during summer months on the Methow River.

In April 2001 WDFW completed and sent to the National Marine Fisheries Service (NMFS) the *Upper Columbia Steelhead Management Conservation Plan (The Plan).* The intent of *The Plan* is to:

- Assist with the recovery of wild fish in the ESU.
- Replace the current Section 10 Permit.
- Set production levels and marking strategies for supplementation and hatchery fish.
- Supplementation fish have at least one wild parent (HxW).
- De-list marked Wells stock hatchery steelhead through out the ESU.
- Proposes strategies on the disposition of excess marked hatchery steelhead in the ESU.
    - Would allow a permanent marked hatchery steelhead in the Hanford Reach area of the Columbia River.
    - Would allow marked steelhead fisheries above Priest Rapids Dam, based on in-season run size estimates.
        1. # wild steelhead
        2. # supplementation steelhead
        3. # marked steelhead
    - Fisheries above Priest Rapids Dam would be allowed under a stepwise run size approach.
        1. 7,150 : No fisheries
        2. 7,300 : possible C&R fisheries
        3. 8,300 : 1 fish/day
        4. 8,700 : 2 fish/ day
    - Procedures for the removal of excess fish from dams and hatchery facilities for placement into lakes.
- The 6,000 fish escapement goal above Priest Rapids Dam would not be compromised.

Discussions between WDFW and NMFS have determined that *The Plan* will:

- Be incorporated into a new Section 10 Permit and provide five years of guidance for the disposition of excess hatchery fish.
- Not be used as a de-listing plan.
- Assist in the recovery of wild steelhead.

NMFS supports the new Section 10 Permit process.

Negative Association Between the Productivity of Naturally Spawning Steelhead Populations and the Presence of Hatchery-Origin Spawners
Mark Chilcote, Oregon Department of Fish and Wildlife

Based upon a multiple regression analysis, recruitment and productivity in 12 naturally reproducing populations of Oregon steelhead were found to be significantly influenced by four variables, one of which was the level of hatchery fish in the spawning population. It appeared that the presence of hatchery fish depressed overall population productivity, reduced the number of recruits, and lowered the fitness of wild fish. This negative effect was insensitive to the type of hatchery fish. Although hatchery fish represented in five of the study populations were from hatchery broodstocks developed from local wild populations and managed in manner to avoid domestication, the advantages of this strategy were not apparent. The negative effect of hatchery fish on natural production was not trivial. For example, in a mixed population where hatchery fish comprised 30% of the spawning population, the number of recruits produced was 1/3 less than in a population comprised entirely of wild fish. A variety of supplementation simulations, based upon these findings, demonstrated that the recruitment response of natural populations to the addition of naturally spawning hatchery fish was very weak and carried the additional penalty of reducing the genetic fitness of the wild fish. Various genetic and non-genetic explanations for these results were explored, including the consequences of reduced genetic diversity in hatchery populations as a result of having fewer families than would be found for a wild population of similar size. The management implications of these results are that hatchery steelhead, regardless of their broodstock type, are poor substitutes for wild fish in their natural environments. The addition of hatchery spawners to the natural environment does not appear a useful tool for rebuilding depressed populations of wild steelhead. These results support the view that hatchery programs should be managed to minimize the number of hatchery fish that spawn and rear in natural habitats.

KMP Steelhead Update: How the Oregon Department of Fish and Wildlife convinced the National Marine Fisheries Service that KMP Steelhead do not warrant listing under ESA
Russ Stauff, Oregon Department of Fish and Wildlife, Gold Beach

Steelhead in the Klamath Mountains Province (KMP) of Southern Oregon and Northern California were proposed for listing under Federal ESA in 1994. At that time empirical data for both adult and juvenile steelhead were limited to specific projects from the Rogue and Elk rivers. The only data available for all streams were annual estimates of sport harvest. Inventory efforts began in 1994 included spawning ground surveys and smolt production estimates. Because there was serious disagreement between the National Marine Fisheries Service (NMFS) and the Oregon Department of Fish and Wildlife (ODFW) on the status of KMP steelhead, a non-listing agreement was developed in 1998 in which NMFS agreed to delay final determination of the proposed listing for five years. One of the conditions of the agreement was that ODFW develop a monitoring project to evaluate the status and trend of KMP steelhead populations. ODFW adopted a monitoring program to evaluate adult abundance, juvenile distribution, juvenile rearing density, smolt production, life history characteristics and habitat condition. The non-listing agreement was terminated in 2001 because of threat of legal action against NMFS. In March of

2001 co-managers, including the ODFW, met with the NMFS Biological Review Team to present new information on the status of KMP steelhead. The ODFW staff presented data collected from 1994 through April 2001, which included data from the recently adopted monitoring program as well as new additions to escapement data from the Rogue River. These data refuted the five conclusions on the status of the KMP steelhead presented in the NMFS 1994 status review. In April of 2001 the NMFS issued a final determination that KMP steelhead did not warrant listing under the ESA.

Wrestling in the WWF. Who is this Judge Hogan and what does his decision mean to NMFS listing and recovery actions for Pacific salmonids
Rob Jones, National Marine Fisheries Service

On September 10, 2000, Federal District Court Judge Michael Hogan ruled in Alsea Valley Alliance v. Evans that the ESA does not allow NMFS to list a subset of a distinct population segment (Evolutionarily Significant Unit) and invalidated ESA protection for Oregon Coastal coho salmon. On December 14, 2001, the Ninth Circuit Court of Appeals stayed this decision pending appeal. In response to the Alsea decision, NMFS announced it would revisit how it should take into account hatchery fish in determining the viability of an ESU. That process is now underway and NMFS expects to publish a new proposed policy for public comment by this summer. At the same time, it makes sense for NMFS to now take on several other related tasks. Before the end of the year, new information (e.g. population status data) will be coupled with the aforementioned new policy to revisit west coast salmon ESA listing decisions, updated guidelines on artificial propagation and salmon conservation will supersede the April 1993 guidelines published by NMFS and finally, interim ESA delisting criteria will be established for every Pacific salmon listed ESU.

Use of Wild Broodstocks for Hatchery Steelhead Production: Potentials and Limitations
Session Chair: Pat Hulett, Washington Department of Fish and Wildlife

Session Overview (and use of wild broodstocks in Alaska, Idaho, and California)
Pat Hulett, Washington Department of Fish and Wildlife

There has been an increasing trend toward the use of wild steelhead as broodstocks for hatchery production on the West Coast, particularly in Oregon and Washington. My experience in an evaluation of steelhead wild broodstocks on the Kalama River has made evident a number of challenges to successful implementation of wild broodstock programs. This workshop session was initiated with the intent to learn more about both the challenges and the success stories that can be gleaned from a review of the use of wild steelhead broodstocks coast-wide. The perceived need for this effort is embodied by some advice from a project management training seminar: "Every once in a while, get off the merry-go-round and ask yourself these questions:

- What are we doing?
- What should we be doing?
- What should we not be doing?
- What should we be doing next?

Though written from a business project management perspective, this set of questions has applicability to the issues associated with the use of steelhead wild broodstocks in fish management. The original intent was to include in this session reviews of the uses of wild broodstocks coast-wide, from Alaska to California. As it turned out, Alaska and Idaho do not have any steelhead wild broodstock programs, and California was unable to participate in the workshop this year. Thus the session was set to include reviews of wild broodstock programs from British Columbia, Washington, and Oregon (Oregon was ultimately unable to present). Invitations to participate in the session were declined by the Northwest Indian Fisheries Commission and the Columbia Inter-Tribal Fish Commission. Following the jurisdictional reviews, presentations will be given on two examples of steelhead wild broodstock projects that include extensive monitoring and evaluation components: the Hood River steelhead supplementation project, and the Kalama River steelhead wild broodstock evaluations project.

Review of Hatchery Programs Using Wild Steelhead Broodstocks in Washington
Pat Hulett, Washington Department of Fish and Wildlife

District biologists were contacted to identify the steelhead wild broodstock programs. A two page questionnaire was then sent to biologists with programs in their areas, to be filled out by themselves or other appropriate staff. The questionnaire asked for basic information on the main who, what, when, where, why, how issues regarding each program. Information from completed questionnaires were organized in a summary table to be included in the workshop proceedings. This presentation will focus on characterization of the key attributes of the identified programs.

Sixteen programs were initially identified, three of which were not confirmed to currently be in operation and for which no questionnaires were completed. The remainder of this review pertains

to the 13 confirmed programs, five of which use summer-run wild broodstocks and eight of which use winter-run stocks. The programs are scattered across most of the anadromous waters of the state and about half of them involve stocks listed as threatened or endangered under the Endangered Species Act. The vast majority of the programs are very new. Only three programs were initiated prior to 1997: Wells summer-run (1967), Green River winter-run (1982), and Sol Duc winter-run (1986).

Though most programs listed two or three purposes, the primary purposes were identified as: natural production (6), providing harvest (6), and research (1). All but the two upper Columbia programs use 100% wild (naturally produced) fish for broodstock. The Wells summer-run program uses about 10% wild fish, including WxH crosses for smolts stocked in the Methow River and HxH crosses for smolts stocked into the Okanogan River. The Wenatchee summer-run program involves three cross types (WxW, WxH, and HxH), all for smolts stocked into the Wenatchee River basin.

The majority of the programs are quite small: seven use 16 or fewer females to spawn each brood, four use 20-25 females, and only two programs use 50 or more females each year. About half of the programs (7) have meager to modest monitoring efforts in place to evaluate their effectiveness (e.g., some capability to assess adult returns, but not much else). Six of the programs had fairly extensive monitoring programs in place, and these generally involved local or federal grants or mitigation funding.

Every program listed one or more serious challenges to achieving success. The most commonly listed challenge was getting smolts to appropriate release size in one year. Specific issues included late spawning of the wild fish (relative to domesticated broodstocks), lack of warm water to accelerate incubation and growth, and difficulty getting "spooky" wild broodstock juveniles to feed aggressively. The second most frequently listed challenges pertained to broodstock collection and holding, such as ability to collect adults in sufficient numbers or representatively from the population. Third in the list of challenges was inability to achieve desired rearing survival rates, and fourth was spawning and incubation issues (e.g., having matching pairs of ripe males and females, and achieving desired fertilization and hatching rates).

All but three programs stocked one year smolts. Lake Washington and Green River winter-run programs stocked fry and fingerlings, but they did not produce desirable adult returns. The Hamma Hamma winter-run project employed several unique features: collects embryos by hydraulic pumping of natural redds, rears a portion of collected embryos to smolts in two years, and rears a portion of the embryos to age 4 captive-reared adult spawners to be released to spawn naturally in the Hamma Hamma River.

Steelhead Wild Broodstock Hatchery Production: 15 Programs Ongoing in the State of Washington Compiled by Pat Hulett, WDFW, March 2002					
Stock, Facility, and Program Contacts	**Program Years and Purpose**	**Broodstock Collection and Holding**	**Spawning, Incubation, Rearing, and Release**	**Challenges and Solutions**	**Monitoring and Evaluation**
Touchet River Summer-run Lyons Ferry Hatchery Contacts: Joe Bumgarner (Eval. Bio.) (509) 382-4755 or –1710 Glen Mendel (District Bio.) (509) 382-1005 Mark Schuck (Eval. Bio.) (509) 382-1004	2000 – present Harvest (mitigation) Conservation Natural Production (supplementation plan: upon return all H fish to spawn)	Broodstock: 100% wild for now (may use future H returns) 16 pairs = 25% of run collected in voluntary trap (10-45% effective) at lower reach of spawning from Feb-April (miss May entries) Holding: 11C well water at LFH; ∃ 90% holding survival	Spawning: Mar-April (miss May spawners); Kill spawn, ∃2x2 matrix Survival: 80% to eyed, 84% eyed to smolt Other: Std. hatchery protocols plus use of shading; 50K smolts (6-13fpp) (150K future smolt goal) trucked 5 rkm above trap	Challenges: Getting fish to size (late start and spooky) Brood Collect/Holding Spawning/Incubation Rearing Survival	Adult counts at trap **(H:W ratios, too)** Residual surveys (electrofishing)
Tucannon River Summer-run Lyons Ferry Hatchery Contacts: Joe Bumgarner (Eval. Bio.) (509) 382-4755 or –1710 Glen Mendel (District Bio.) (509) 382-1005 Mark Schuck (Eval. Bio.) (509) 382-1004	2000 – present Natural Production (all H fish to spawn upon return) Conservation Harvest (mitigation) Research	Broodstock: 100% wild for now (may use future H returns) 16 pairs = 10% of run; collected by temporary weir and by angling (weir tends to wash out) in Oct-Nov + Feb-Mar Holding: 11C well water at LFH; 75-90% holding survival	Spawning: Mar-April Kill spawn, ∃2x2 matrix Survival: 89% to eyed, 83% eyed to smolt Other: Std. hatchery protocols plus use of shading; 50K smolts (6fpp) (150K future smolt goal) trucked above Tucan. H	Challenges: Brood Collect/Holding (weir washes out; collection timing issues) Getting fish to size Spawning/Incubation Rearing Survival	Adult counts at trap (H:W ratios, too) Genetic profiles Smolt monitoring
Wells (upper Columbia) Summer-run Wells Hatchery Contacts: Heather Bartlett (Dist. Bio.) (509) 826-7341 Jerry Moore (Complex Mgr.) (509) 923-2728	1967 – present Harvest (mitigation) Natural Production	Broodstock: 10% Wild (90% Wells H.) 15M + 25F = 10% of run collected at Wells Dam ladder (below target tribs) starting July (entire run) Holding: held in cold well water ∃ 95% holding survival	Spawning: Dec-March Pituitary inject. to speed maturation of wild fish Kill spawn; HxW crosses, with matrix mating to increase wild contribution Survival: 85% to eyed, 82% eyed to smolt Other: Std. H, but lg. dirt ponds 290K HxW smolts (6 fpp) trucked to Methow River [+180K HxH to Okanogan]	Challenges: Brood Collect/Holding (endangered status limits collection and operation options) Migration Corridor (survival thru 9 dams)	Informal eval. efforts: (no formal objectives) Adult count, ladder (H:W ratios, too)

Steelhead Wild Broodstock Hatchery Production: 15 Programs Ongoing in the State of Washington Compiled by Pat Hulett, WDFW, March 2002					
Stock, Facility, and Program Contacts	**Program Years and Purpose**	**Broodstock Collection and Holding**	**Spawning, Incubation, Rearing, and Release**	**Challenges and Solutions**	**Monitoring and Evaluation**
Wenatchee River Summer-run Eastbank Hatchery Contacts: Andrew Murdoch (Eval. Bio) (509) 664-3148 Rick Stilwater (Compl. Mgr.) (509) 884-8301 Art Viola (District Bio.) (509) 665-3337	1997 – present Natural Production	Broodstock: 30-50% wild 29M + 73F; <10%? of run collected in mandatory trap in lower mainstem, fished entire run: July-Nov. Holding: Held on well water; ∃ 95% holding survival	Spawning: Dec-March Pituitary inject. to speed maturation of wild fish Kill spawn, in WxW, WxH and HxH crosses; 1M+1F+backup M Chilled incub. to slow hatching of HxH crosses Survival: 50-95% to eyed, 60-85% eyed to smolt Other: std H rearing protocols Smolts (220mm), some rel. from acclim. pond And others trucked to mainstem/tribs	Challenges: Spawning & Incubation (fertilization & hatch) Brood Collect/Holding (wild fish contrib.) Getting smolts to size	Directed eval. efforts: Adult count at dams (Pr Rapids, Tumwater) (H:W ratios, too) smolt monitoring residualism monitoring Developing design to assess reproductive success in the wild
Lake Washington Winter-run Issaquah Hatchery Contacts: Steve Foley (Biologist) (425) 775-1311 x102 Brodie Antipa (Compl. Mgr.) (253) 840-4790	1997 – present (but no egg takes since 1999 due to low escapements) Natural Production (north lake tribs)	Broodstock: 100% wild 5-10 pairs 1997-1999 no program 2000, 2001 (run size <50 in 2000, 2001) collected in mandatory trap at Ballard Locks, fished for 6 hours, 3 days per week in March-April only (peak) Holding: Held in circular ponds on spring water 100% survival	Spawning: Mar-early May(??) 1M+1F, no matrix warm incubation after certified disease free Survival: (contact Brodie Antipa) Other: 7-23K fry trucked to multiple tribs; (10+% of fry became smolt outmigrants in 2 yrs.); 12-14K smolts (6-12fpp) released at Issaquah H.	Challenges: Broodstock collection (getting enough) Getting smolts to size Residualism in lake	Limited eval. efforts Potential adult counts at Ballard Locks Spawn survey in tribs Some smolt trapping
Green River Winter-run Keta Creek Hatchery (Coop project, WDFW and Muckleshoot Tribe) Contacts: Tom Cropp (District Bio.) (253) 840-4563 Dennis Moore (Keta Cr. H.) (253) 735-9098	1982 – present Natural Production Harvest	Broodstock: 99-100% wild 16M + 22F = 1.5% of run collected by angling in late March (vs. Jan-May run) in lower 2/3 of spawn area Holding: Held in covered raceway, with formalin treatments; ∃90% holding survival over a 2 month period	Spawning: April through May; Kill spawn, 1M+1F Survival: 65-75% green-eyed 80-90% eyed to smolt Other: fingerlings (300 fpp), trucked to multiple release sites	Challenges: Spawning & incubation (having ripe males avail. when females ripe)	Generally not evaluated: (some parr, smolt monitoring was done) Adult surveys done

Steelhead Wild Broodstock Hatchery Production: 15 Programs Ongoing in the State of Washington Compiled by Pat Hulett, WDFW, March 2002					
Stock, Facility, and Program Contacts	**Program Years and Purpose**	**Broodstock Collection and Holding**	**Spawning, Incubation, Rearing, and Release**	**Challenges and Solutions**	**Monitoring and Evaluation**
Kalama River Summer-run Kalama Falls Hatchery Fallert Creek Hatchery Contacts: Pat Hulett (Eval. Bio.) (also Cameron Sharpe, Chris Wagemann) (360) 577-0197 Mark Johnson (Comp. Mgr.) (360) 673-2098	1999 – present Research Harvest Conservation	Broodstock: 100% wild 19-22 pair; <30% of run collected in mandatory trap at KFH (below spawn area) throughout run: May-Nov. Holding: Held in partially covered raceway; formalin drip; 90% survival over a holding period of 3-10 mo.	Spawning: Jan. to May (may try hormonal injection) Air spawn, using 2x2 matrix + backup M; Survival: 76-88% green-eyed 72-90% eyed to smolt Other: std H rearing protocols smolts (190mm): 40-70K 20% from acclim. pond, 80% trucked to multiple sites in the upper basin	Challenges: Rearing survival Getting smolts to size Spawn/incub. survival Adult holding survival	Extensive Evaluation: In-hatchery survival, growth, migration, residualism, adult return to hatchery and creel, H:W ratios Direct evaluation of natural reproductive success using DNA based pedigree analyses
Kalama River Winter-run Kalama Falls Hatchery Fallert Creek Hatchery Contacts: Pat Hulett (Eval. Bio.) (also Cameron Sharpe, Chris Wagemann) (360) 577-0197 Mark Johnson (Comp. Mgr.) (360) 673-2098	1998 – present Harvest Research Conservation	Broodstock: 100% wild 12-15 pair; <5% of run; complete weir trap at KFH (75% spawn above trap), at run peak (mid-late April); Holding: minimal holding; collected ripe or nearly so; some LHRH hormone injections tried, but may discontinue (possible decrease in egg viability; unconfirmed)	Spawning: Last half of April (vs. Feb-May+ in river); Air spawn, using 2x2 matrix + backup M; Survival: 72-84% green-eyed 57-77% eyed-smolt Other: std H rearing protocols smolts (190mm): 19-42K 100% acclimation pond, (less 8K undersized from H)	Challenges: Getting smolts to size Rearing survival Spawn/incub. survival	Extensive Evaluation: In-hatchery survival, growth, migration, residualism, adult return to hatchery and creel, H:W ratios
Elochoman River Winter-run Elochoman Hatchery Contacts: Darren Miller (Eloch. H.) (360) 795-3608 Mark Johnson (Comp. Mgr.) (360) 673-2098	2000 – present Harvest	Broodstock: 100% wild ~15 pair; 10-30% of run collected from fishway trap at partial barrier (spawning is mostly above trap) during April, May Holding: no holding, collected ripe	Spawning: April to early May (vs. Feb-May+ in river) Air spawn: 1M+1F Survival: 62-93% to eyed 34-90% eyed to smolt Other: std H rearing, low density 10-55K smolts (15fpp); 100% release at hatchery	Challenges: Getting smolts to size Rearing survival Spawn/incub. survival Broodstock collection	Evaluation plans unclear; Potential for some evaluation, due to marking of fish

Steelhead Wild Broodstock Hatchery Production: 15 Programs Ongoing in the State of Washington Compiled by Pat Hulett, WDFW, March 2002					
Stock, Facility, and Program Contacts	**Program Years and Purpose**	**Broodstock Collection and Holding**	**Spawning, Incubation, Rearing, and Release**	**Challenges and Solutions**	**Monitoring and Evaluation**
Hamma Hamma River Winter-run Lilliwaup Hatchery [Long Live the Kings] + ponds on Johns Cr. Contacts: Thom Johnson (District Bio.) (360) 765-3979 Barry Berejikian (Eval. Bio.) (360) 871-8301	1997 – present Natural Production Harvest	Broodstock: 100% wild-spawned 1600-4700 eggs pumped from 6-10 redds each in 1998-2000 spawn years Holding: No parental adult holding, but some captured offspring reared to 4-yr. old adult captive broodstock	Spawning: Redds sampled throughout season Survival: 90% eye to release Other: Reared in circular tanks, earthen ponds or Natures raceways; 2 year smolts (8-10 fpp) volitional rel. from ponds and trucked from Lilliwaup to Hamma Hamma; captive brood adults released to spawn in Hamma Hamma	Challenges: Logistics issues with natural ponds (flooding, escapees) Representing all naturally spawned redds in program	Extensive Evaluation: Smolts and captive-reared adults marked; compare parr produced (by anad. vs. captive) assess smolts produced assess redds produced Assess reproductive success of captive-reared vs. anadromous adults from smolt release
Sol Duc River Winter-run Sol Duc Hatchery (Snider Cr.) Contacts: Rich Watson (Sol Duc H.) (360) 327-3246 Don Rapelje (Complex Mgr.) (360) 681-8024	1986 – present Harvest	Broodstock: 100% wild 22-24 pair; 1% of run Angled from early part of run (Nov. thru Jan.) Holding: Held in tanks; given formalin drip treatments	Spawning: mid-Feb. - mid-Mar. Kill spawned; 1M + 1F Heated water incub. tried Survival: 96% to eyed, 78% eyed to smolt Other: Std protocols, except in earthen ponds at 100fpp; smolts released from acclimation pond	Challenges: Getting smolts to size	Basic adult monitoring: Smolts marked (LV), and adults assessed in creel surveys and tribal fisheries
Upper Chehalis River Winter-run Bingham Creek Hatchery Contacts: Richard Ereth (Biologist) (360) 249-4628 x271 Randy Aho (Complex Mgr.) (360) 533-1663	1997 – present Harvest	Broodstock: 100% wild 25M + 15F; <10% of run Angled from upper basin, targets early ½ of run Holding: Temporarily in pond, then raceways 4-6 weeks; Salt & formalin treatments; 95+% holding survival	Spawning: March – April Kill spawned; 1M + 1F Survival: 90% to eyed 50% eyed to smolt Other: Std. hatchery protocols smolt release at 5.5 fpp direct from hatchery	Challenges: Rearing Mortality (up to 250fpp size) Solutions: high protein EWOS diet helps get fish to size	Minimal monitoring: (assess smolts planted and harvest provided) H:W ratio not known

Steelhead Wild Broodstock Hatchery Production: 15 Programs Ongoing in the State of Washington Compiled by Pat Hulett, WDFW, March 2002					
Stock, Facility, and Program Contacts	**Program Years and Purpose**	**Broodstock Collection and Holding**	**Spawning, Incubation, Rearing, and Release**	**Challenges and Solutions**	**Monitoring and Evaluation**
Satsop River Winter-run Bingham Creek Hatchery Contacts: Richard Ereth (Biologist) (360) 249-4628 x271 Randy Aho (Complex Mgr.) (360) 533-1663	1997 – present Natural Production Harvest	Broodstock: 100% wild 55 pair; <10% of run (goal) Angled from all mainstem on 85% of run (miss late) Holding: River sites temporarily, then raceways 4-6 weeks; Salt & formalin treatments; 95+% holding survival	Spawning: March – April Kill spawned; 1M + 1F Survival: 90% green-eyed 50-55% eyed-smolt Other: Std. hatchery protocols; smolt release at 5.5 fpp from acclimation pond	Challenges: Rearing Mortality (until > 250 fpp) Solutions: high protein EWOS diet helps get fish to size	Basic adult monitoring: Smolts marked (AD), and adults assessed by spawner surveys Returning adults trucked to trib sites for natural production (<10% of wild run)
Note: Information for the Programs below was summarized after the steelhead workshop and was therefore not included in the workshop presentation					
Naselle River Winter-run Naselle Hatchery Contacts: Ken Jasma (Naselle H.) (360) 484-7716 Randy Aho (Compl. Mgr.) (360) 553-1663	1999, 2000, 2002 (none in 2001) Natural Production Harvest	Broodstock: 100% wild 13M + 19F in 2000 Angled from lower river from late Feb. through March Holding: 10 x 60 adult pond; no treatments, no losses	Spawning: Late March – April Kill spawned; 1M + 1F Other: Std. hatchery protocols smolt release at 5 fpp direct from hatchery	Challenges: Rearing Mortality Spawn/incub. survival Solutions: high protein EWOS diet helps get fish to size	Minimal Monitoring
Skookumchuck Winter-run Bingham Creek Hatchery Skookumchuck Dam Contacts: Joel Jaquez (Bingham H.) (360) 426-2369 Randy Aho (Compl. Mgr.) (360) 553-1663	1995 – present Harvest (mitigation)	Broodstock: 10% wild (goal) ~100 pair (H+W) spawned Mandatory trap operated at Skookumchuck Dam throughout the run	Spawning: March – April Kill spawned + 40% air spawned some years; 5M + 5F pooled matings Other: Std. hatchery protocols; smolt release direct from hatchery at dam	Challenges: Rearing Mortality	Minimal Monitoring

British Columbia's Wild Steelhead Brood Stock Program – Adventures in Enhancement
Bob Hooton, British Columbia Ministry of Environment, Lands and Parks

British Columbia has aggressively pursued steelhead enhancement based on wild brood stock for almost thirty years. Enhancement activity has generally focused on the southwestern corner of the province where water temperatures and logistics are the most accommodating. Two government agencies and the public have been involved in program delivery. Enhancement procedures have been founded on principles and policies developed according to the science of the day. Numerous innovations in equipment and techniques were developed to capture brood stock, keep them alive and healthy through spawning, and rear and release fry and smolts back into their rivers of origin. Reasonable records are available to facilitate estimation of the numbers of adults involved to meet brood stock requirements. Release records indicate clearly which streams were stocked and the size and age at release. Adult returns from stocking activity were best judged by catch estimation data compiled annually for all streams sustaining steelhead angling activity. The records demonstrated that anglers gravitated heavily to streams where harvestable hatchery products were available. Intensive angling pressure on these streams appears to have had a detrimental effect on wild fish, especially in circumstances where wild stocks were small and hatchery:wild ratios were high. Performance measures applied to gauge the effectiveness of the hatchery program revealed that program expectations were commonly not being met. The contribution of adults from fry stocking was negligible. Smolts contributed at a higher rate but frequently still well below the bio-standard used to justify the program. Management concerns at present include the potential negative consequences of hatchery and wild fish interaction in natural spawning situations, the impacts of intensive angling pressure on small and diminishing stocks of sympatric wild fish, and the selective pressures that are exerted by relying on small populations to generate the harvestable product. In the author's opinion it is time to re-visit the terms "augmentation" and "supplementation" and the implicit assumption that wild steelhead can be sustained by such activities. Emerging science and the precautionary principle point strongly in the direction of separating wild and hatchery stocks rather than homogenizing them. A serious consequence of the current downsizing and outsourcing practices of government is that out ability to track and evaluate the influence of hatchery intervention is diminishing rapidly.

Lessons from the Hood; Steehead Supplementation on Hood River, Oregon
Rod French, Oregon Department of Fish and Wildlife

A monitoring and evaluation program was implemented in 1992 to evaluate a newly developed hatchery supplementation program in the Hood River Subbasin. The monitoring and evaluation, hatchery supplementation, and habitat improvement programs implemented in the Hood River Subbasin are collectively called the Hood River Production Program (HRPP). The HRPP is funded by the Bonneville Power Administration (BPA) and is jointly implemented by the Oregon Department of Fish and Wildlife (ODFW) and Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO). The goal of the HRPP, as it pertains to steelhead, is to increase subbasin production of indigenous populations of both summer and winter steelhead

(*Oncorhnchus mykiss*) in the Hood River Subbasin. The monitoring and evaluation component of the HRPP is designed to evaluate both the success of increasing production, and to collect the information needed to minimize the potential genetic and behavioral impacts to the indigenous fish of the subbasin. The combined problems of complex steelhead life history strategies, multiple races of steelhead , and low founding population sizes create many challenges in developing a supplementation program that achieves its goals in a biologically sound manner. This presentation will focus primarily on the challenges faced in implementing this unique program, and several of the hatchery guidelines established as an outgrowth of the monitoring and evaluation program.

Residualism in Wild Broodstock Steelhead: Kalama River Studies

Cameron Sharpe, and Patrick Hulett; Washington Department of Fish and Wildlife/Kalama Research Team
Brian Beckman, National Marine Fisheries Service
Chris Wagemann, Washington Department of Fish and Wildlife/Kalama Research Team

Wild salmonids are increasingly being incorporated into hatchery programs because their offspring may pose fewer genetic and ecological risks to the extant wild population than the naturally spawning offspring of domesticated, non-indigenous broodstock . After two smolt releases (brood years 1998 and 1999), it has become apparent that the rate of residualism of wild broodstock fish is greater than that of the traditional domesticated strain. Preliminary estimates indicate that 8 - 10% of the wild broodstock offspring failed to outmigrate while only 1 - 3% of the traditional stock failed to do so. The residuals were bimodally distributed by size with approximately equal numbers of small (fork length < 160mm) and large (> 200mm) fish remaining in the stream after active migration of the rest of the cohorts had ceased.
The high rate of residualism poses ecological and genetic risks to indigenous fish and has an economic impact on the hatchery program. Ecologically, the residuals will compete directly with native con-specifics and other similar species in the watershed. Two genetic issues arise with residualism. First, residualism is likely an expression of the natural phenotypic diversity of many salmonids and has, in part, a genetic basis. High over-wintering mortality of residuals may result in a loss of genetic diversity within that part of the cohort that does successfully outmigrate and eventually return to spawn. Second, residual fish may spawn directly with native resident rainbow trout or, conceivably, with native coastal cutthroat. Economically, the residuals represent a waste of fish culture effort since there is little evidence that they contribute substantially to adult returns.
We present preliminary results on two projects to evaluate residualism in wild broodstock hatchery steelhead currently underway in the Kalama River, Washington: (1) For winter-run steelhead, we manipulate growth trajectories throughout juvenile rearing to decrease size variance with the expectation that fewer fish will be too small or too large to smolt as yearlings and (2) For summer-run steelhead we apply DNA-based technologies to match residual juveniles to their hatchery-spawned parents and determine the relationship between spawn timing of adults (among other characteristics of the adults and their gametes) and tendency of their offspring to residualize. We expect that the results will be directly applicable to ongoing efforts to develop and implement wild broodstock hatchery programs for steelhead and other salmonids throughout

the Pacific Northwest.

Kalama Wild Broodstock Steelhead Program: Summer and Winter Wild Steelhead Evaluations

C.W. Wagemann, P.L. Hulett, and C.S. Sharpe; Washington Department of Fish and Wildlife/Kalama Research Team

Summer and winter steelhead research projects are underway in the Kalama River to evaluate efficacy and risks (ecological and genetic) associated with the use of local wild broodstocks for hatchery production programs. Findings will address critical uncertainties of programs having stock recovery (supplementation) goals as well as those having fishery enhancement (harvest augmentation) goals. The **winter-run project** (i.e. harvest augmentation) compares survival performance of the progeny of wild broodstock to the traditional hatchery broodstock. The **summer-run project** (i.e. supplementation) compares the natural reproductive performance of the progeny of wild broodstock reared in the hatchery to the performance of their wild-reared counterparts. The fourth brood of age one smolts will be released into the Kalama River this year (2002) from the winter steelhead wild broodstock program. Preliminary smolt-to-adult (STA) return rates for 2-salt winter-run to Kalama Falls Hatchery (KFH) from 1998 BY and 1999 BY indicate considerable higher survival for the progeny of wild broodstock (WB-KFH) compared to the traditional hatchery broodstock (BC-BC & BC-KFH). STA returns for 1998 BY; BC-BC was 0.39%, BC-KFH was 0.90% and WB-KFH was 1.65%. STA returns for 1999 BY; BC-BC was 2.95%, BC-KFH was 3.64% and WB-KFH was 4.60%. The third brood of smolts will be released into the Kalama River this year (2002) from the summer steelhead wild broodstock program. Preliminary smolt-to-adult (STA) returns rates for 1-salt summer-run to KFH from 1999 BY was 0.37%. Importantly, the natural reproductive success component of the summer-run evaluation begins in earnest this year. Hatchery adults returning from smolts released in 2000 and 2001 will be passed upstream of a barrier at KFH and allowed to spawn naturally along with their wild counterparts. Hatchery and wild contributions to natural production will be compared using pedigree analysis of microsatellite DNA profiles resolved from potential parents and their smolt and adult offspring.

Escapement and Harvest Management Strategies

Session Chair: Bob Leland, Washington Department of Fish and Wildlife

Washington State Escapement & Harvest Management Strategies for Steelhead
Bob Leland, Washington Department of Fish and Wildlife

Prior to the Boldt Decision (*US v Washington*) in the mid-1970's, which mandated a fifty-fifty split of harvestable hatchery and wild steelhead with recognized Indian tribes, steelhead were managed exclusively as a game fish for sport anglers. The Department of Game, prior to the decision, set; seasons, bag limits and gear provisions, and provided sanctuaries for wild fish spawning. Recreational harvest was monitored through catch record cards.

After the Boldt Decision the Department was responsible for:

- Federal Legal Requirements stipulated by the decision.
- Co-management of steelhead with the Tribes.
- Steelhead management by river system.
- Estimation of steelhead run sizes, pre-season.
- The setting of escapement goals.
- Determination of hatchery and wild steelhead harvestable shares.
- Monitoring of fisheries and escapements.
- Implementation of in-season management actions.

Management of steelhead has become increasingly more complicated over the years, but the mandate of the agency toward steelhead management has not changed. Fishery management objectives for Washington's steelhead resource are:

- Maintain healthy wild runs.
    - Default statewide sport rule for wild steelhead is catch-and-release
    - Harvest is allowed only on healthy stocks above escapement goals.
    - No directed harvest of wild steelhead if the run size is below escapement goal.
    - If a run size is <80% of goal, target catch-and-release fisheries are not allowed.
- Provide hatchery fish for harvest.
- Allocate harvestable surpluses between sport and tribal fishers.
- Provide diversity (the appropriate mix) of opportunity for sport anglers.

In response to Washington's management objectives for steelhead stocks.

- Wild steelhead escapement goals have been developed or continue to be developed on most river systems.
- Hatchery steelhead smolts continue to be released to provide sport and tribal steelhead harvest opportunities.
- Pre-season hatchery and wild steelhead run sizes are determined were necessary for allocation purposes between sport and tribal fishers.
- What is the appropriate mix of sport angler fishing opportunity (harvest and catch-and-release) and what information is used in the determination:
    - Status of the runs.

- Public input during the regulation setting process.
- Angler Preference Survey information.
- Local fish biologist recommendations.

Results of 1995 and 2001 Steelhead Angler Preference Survey

- Catch-and-release vs. wild steelhead harvest
  - Harvest - 1995, 58%; 2001, 34%
  - C&R of Wild -1995, 42%; 2001, 61%
  - Other - 1995, N/A; 2001, 5%
- Wild steelhead daily limit
  - Zero -1995, 18%; 2001, 21%
  - One - 1995, 34%; 2001, 40%
  - Two - 1995, 46%; 2001, 33%
  - Other -1995, 2%; 2001, 6%
- Wild steelhead annual limit
  - Zero -1995, N/A; 2001, 25%
  - Ten - 1995, N/A; 2001, 32%
  - Thirty - 1995, N/A; 2001, 15%
  - Other - 1995, N/A; 2001, 28%

The Washington Fish and Wildlife Commission in February 2002 set new daily and annual limits for wild steelhead.

- Daily limit – One wild steelhead/day
- Annual limit – Five wild steelhead/season

Ecosystem escapement goals development and the need to increase other salmon escapements to benefit juvenile steelhead survival

John H. Michael Jr., Washington Department of Fish and Wildlife

The growth of juvenile steelhead rearing in five small independent tributaries of Strait of Juan de Fuca in Washington showed substantial increase in the rate of growth in areas where chum salmon were spawning. In southwest Washington, steelhead juveniles actively sought out areas where coho salmon were spawning. In these locations, they gorged on eggs and carcasses. These observations were corroborated in controlled studies on Vancouver Island where the application of fertilizer resulted in increased growth and survival of juvenile steelhead. Through application of models designed to deliver marine derived nutrients to the ecosystem specific coho and chum spawning escapement goals are proposed.

Discussion Paper: A Draft Policy Framework for the Management of Steelhead

Art Tautz, British Columbia Ministry of Environment, Lands and Parks

This discussion paper outlines a conceptual framework for the management of steelhead in British Columbia and provides a rationale for the elements of the framework. The intent of the

management framework is to conserve the productive capacity of steelhead stocks (i.e., populations or aggregates of populations with similar dynamics) by maintaining spawner abundance at levels that potentially provide sustainable benefits to society. The framework consists of: (1) abundance-based biological reference points that define management zones and (2) associated sets of management actions (decision rules) that adjust either mortality rates or stock productivity to move population abundance towards a desired endpoint within a given time. The framework provides an explicit link between habitat management and harvest management for a stock by defining the reference points in terms of a habitat-based maximum smolt production. The key reference point is the "conservation concern threshold" (CCT) below which the stock is regarded as overfished. For a stock whose recruitment dynamics can be described by a deterministic Beverton-Holt type spawner-recruit relationship, this threshold is at 0.25B, where B is the asymptotic maximum recruitment. The CCT has the useful property of being largely independent of stock productivity. We further define a limit reference point (LRP) as the spawner abundance from which a stock can recover to the CCT within a defined time (e.g., one generation) in the absence of harvest. Although the LRP varies with stock productivity, simulations show that it can be approximated by a fixed value near 0.15B over a wide range of stock productivity if management actions progressively reduce mortality below the CCT. At abundance levels below the LRP, the stock is considered to be an "extreme conservation concern" and extraordinary management actions may be required to eliminate controllable mortality and to increase productivity. Because the LRP and CCT jointly determine the rate at which anthropogenic mortality changes with abundance, it is possible to alter the pair of deterministic values slightly with little impact on the performance of the management system; for steelhead sport fisheries we suggest that the CCT be 0.3 to 0.35B to accommodate environmental stochasticity, and that the LRP can be 0.1 to 0.15B. In conjunction with appropriate management regulations, the system of management zones established by the CCT and LRP will generally maintain stocks at levels well above those at which population viability is a concern. The social cost may be foregone harvest opportunities.

Management of Southeast Alaska's Recreational Steelhead Fisheries

Brian Glynn, Alaska Department of Fish and Game

Increasing levels of sport fishing effort, small populations of steelhead, few streams to distribute effort and sudden declines in escapement have lead to a more conservative management approach toward Southeast Alaska stocks. A public survey of steelhead anglers was utilized to determine angler preferences for protecting steelhead populations and to provide suggestions for future regulations. Alaska's few large steelhead populations are restricted to drainages with either large watersheds or headwater lakes. Typical streams in Southeast Alaska are high-gradient, short-lived and subject to harsh winter conditions. A brief look at two other popular Alaskan steelhead fisheries demonstrates that easier access to Alaskan steelhead streams will result in extremely high levels of sport fishing effort.

Filling in the Blanks: A Synopsis of a NMFS Workshop on the Science, Policy and Management of 4d Rule Fisheries Management and Evaluation Plans (FMEPs)
Herb Pollard, National Marine Fisheries Service

NMFS is aware of the difficulties of developing FMEPs under the 4d rule in the data-poor environments with which many managers must work. However, decisions must be made, and ESA coverage is necessary for fisheries that affect listed species. As with other recovery documents, FMEPs must show substantive conservation benefits for listed species, there must be suretty that the conservation measures will be done, and there must be adequate monitoring and evaluation of the affects of the FMEP. Topics covered include: 1) development of adequate FMEPs that address the 4d criteria and Viable Salmonid Population (VSP) criteria; 2) development of monitoring and evaluation programs including identification of critical information needs and sampling scales; 3) review, processing and approval of FMEP submittals, and 4) implementation and compliance with approved FMEPs. Throughout development of FMEPs, the applicants must demonstrate scientifically sound and logical decision paths. FMEPs should include adaptive management feedback loops and provide for adjustment within sideboards based on sliding scales or biological triggers. It is much preferred to anticipate and provide for management flexibility than to reopen an approved FMEP for amendment, which would reinitiate the public review periods. The FMEP decision pathways should be well documented and able to withstand biological or legal challenge.

Contributed Papers

Session Chairs: Art Tautz, British Columbia Ministry of Environment
Bill Horton, Idaho Department of Fish and Game

Geographic Visualization and Analysis - Tools for Fisheries Management (or: Stupid Map Tricks)

David Graves, Mike Banach, and Bruce Schmidt; StreamNet, Pacific States Marine Fisheries Commission

We make a brief presentation of some possible applications of GIS (Geographic Information Systems) as tools for salmonid fisheries research and management. The presentation will include benefits and drawbacks of managing and depicting information spatially, and also some analysis capabilities that are now possible with spatial information, with an emphasis on real-world applications of the latter. Specific examples include: prioritization for removal of migration barriers; correlating land use and fish habitat; assessing migration timing in a reservoir; improved communication of information to constituents; and improved utilization of spatial aspects of fisheries data.

Influence of geology on steelhead production in Oregon coastal streams with application towards the development of population health goals

Steve Jacobs and Gary Susac, Oregon Department of Fish and Wildlife

Geologic features have been hypothesized to influence steelhead production in Oregon coastal streams. The geology underlying stream channels within the Oregon Coastal ESU can be categorized into two major classes: sedimentary and basaltic or volcanic. In looking at the occurrence of these two sediment classes, the substrate underlying coastal streams can be broken into three categories: sandy, pebble/ boulder and mixed. We examined the influence of these factors on steelhead abundance by comparing redd densities in basins that varied across these substrate classes where intensive redd surveys have been conducted. We found that redd densities were higher in watersheds dominated by pebble/boulder and mixed substrate. These results along with stock-recruitment modeling from the North Umpqua River were used to develop interim population health goals for coastal steelhead stocks. Separate goals were developed for four distinct monitoring areas within the coastal ESU that were scaled to reflect differences in productivity among these areas based on differences in stream channel geology. Finally, we developed a monitoring plan to measure steelhead abundance relative to these goals through annual redd surveys.

Steelhead population monitoring In the Oregon Coast ESU as part of the Oregon Plan for Salmon and Watersheds

Gary Susac, Oregon Department of Fish and Wildlife

The Oregon Plan for Salmon and Watersheds Monitoring Program has implemented a broad range of resource monitoring activities ranging from sampling for adult and juvenile salmonid abundance to water quality and biotic condition assessments. The Oregon Department of Fish and Wildlife's Western Oregon Research and Monitoring Program in cooperation with coastal watershed districts has been charged with developing and implementing a monitoring plan to assess steelhead status and trends in Oregon coastal basins. Starting in 1998, we began evaluating the use of spawning survey redd counts as a measure of adult abundance. We comprehensively surveyed the spawning areas above adult counting stations for steelhead redds and developed relationships between adult passage counts and redd counts ($N= 10$, $R2 = 0.99$, $p < 0.0001$). In return years 1999-2000 and 2000-2001, we tested the predictive capability of our methodology in the Smith River Basin. Smith River is a moderate - sized coastal basin with 261 stream miles. We developed two, independent estimates of adult abundance: one using mark-recapture and the other using redd counts. The sampling design for redd surveys followed the U. S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) protocol for site selection. This protocol uses GIS to provide a randomly selected, spatially balanced sample of survey sites across the distribution of spawning habitat. In both years, estimates based on EMAP redd surveys were comparable to estimates derived from mark-recapture. Starting in the 2002-2003 return year, we plan to implement coast-wide EMAP redd surveys as a primary tool for monitoring coastal stocks of winter steelhead.

The use of juvenile steelhead density estimates in establishing population health goals and habitat carrying capacity models

Jeff Rodgers, Oregon Department of Fish and Wildlife

In this presentation I present juvenile steelhead density data collected in Oregon coastal streams. I also discuss problems associated with the use of these data in establishing population health goals and habitat carrying capacity models for naturally produced steelhead populations. The data are highly skewed and non-normally distributed, making parametric data analyzes difficult. Lack of adult escapement information makes it difficult to determine if observed juvenile densities are a function of habitat capacity or are due to patterns of adult escapement influenced by ocean survival rates. Species interactions (e.g. competition with juvenile coho) influence densities but are difficult to assess yet must be factored into carrying capacity models. Response to high-energy food resources (e.g. salmon eggs in the fall and winter) can cause "noise" in seasonal fish density/habitat relationships. Landscape characteristics (e.g. geology, slope, etc.) and its influence on factors such as pool/riffle ratios, availability of off-channel habitat, substrate type, riparian vegetation, water chemistry, and nutrient levels may result in different productive potential for streams in relatively small geographic areas. Only a small proportion of the overall population of juvenile steelhead present in a river basin may reside in the smaller, "wadeable"

stream segments that are typically the source of most juvenile density data, resulting in models that may not pertain to the population as a whole.

Molecular Genetic Variation among rainbow trout *Oncorhynchus mykiss* Walbaum (Salmonidae, Salmoniformes) from the Kamchatka Peninsula

Richard N. Williams[1,2], Madison S. Powell[1], Serge D. Pavlov[3], and Don S. Proebstel[4]

Rainbow and steelhead trout *Oncorhynchus mykiss* from the Kamchatka Peninsula of Russia exhibited low levels of genetic variation in mitochondrial and nuclear DNA, as compared to North American rainbow trout, sharing a common mtDNA haplotype and common nDNA alleles. However, analysis of six microsatellite loci revealed significant differences among populations from different river system, but non-significant differences between anadromous and resident life histories either within or among rivers. Genetic distance among Kamchatkan rainbow trout populations generally increased with increasing geographic separation, supporting a stepping-stone model of population isolation and differentiation following a probable series of Pleistocene founding events by rainbow trout from northwestern North America during the most recent glacial epoch.

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Strategy of Concervation of Kamchatka *Parasalmo (Oncorynchus) mykiss*, the Species of the Russian Red Data Book

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The Strategy of Kamchatkan mykiss conservation was elaborated on the basis of the National Strategy of Russian Federation for the Conservation of Biodiversity. The mission of the Strategy is that it is the document of long-term planning, and it determines the principles and priority directions in the field of conservation of mykiss biodiversity. On the basis of the Strategy the action plan as a system of particular measures for conservation of mykiss must be created. Nowadays destruction and disturbance of habitats, pollution of the environment, overharvest of the natural stocks, high-seas harvest, poaching, predation from seals, diseases and global warming can be considered limiting factors that negatively influence mykiss biodiversity. The next can be recognized as potential results of the negative influence of human activities on the biological characteristics of mykiss: direct decline of populations, deterioration of physiological condition of organisms, disturbance of the reproduction, increased mortality, disturbance in life cycles, disturbance of sexual and age structure in populations, disturbance of genetic structure of populations, loss of genetic diversity, and others. The socioeconomic factors have the most important impact, threatening biodiversity of Kamchatkan mykiss.

For effective conservation of Kamchatkan mykiss the population-species approach should be used. This approach specifies the next basic scientific approaches: 1) conservation of population structure is a necessary condition for its sustainable existence and sustainable use, 2) Local populations are carriers of unique adaptations of the species to the particular environments, and others. According to this principle, conservation and control of abundance and population structure of the species, conservation and restoration of the environment of species and protection of species on specially protected natural territories can be the methods for conservation.

The next prioritive steps of the action plan can be suggested: anti-poaching activity, rationing of legal use for recreational, scientific, cultural etc. purposes; ecological expertise of economic projects, related to mykiss as the species of Red data book, conservation of the local populations on the existing protected natural territories (Utkholok-Kvachina Rivers on Western Kamchatka), creation of the new protected areas and biostations, and elaborate measures for sustainable use of mykiss biodiversity in the scientific goals and as a model for ecotourism.

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