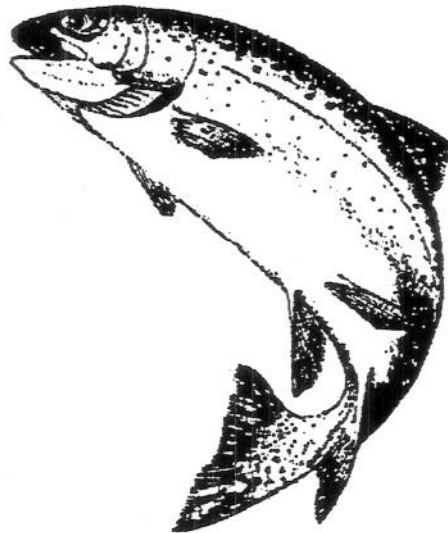


*Summary of
the Third*
***Pacific Coast Steelhead
Management Workshop***



March 9 - 11, 1993
Menucha Conference Center
Portland, Oregon

Sponsored by:
Pacific States Marine Fisheries Commission

Pacific Coast Steelhead Management Workshop
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During March 9-11, 1993, the Pacific States Marine Fisheries Commission sponsored the third in a series of workshops on steelhead (*Oncorhynchus mykiss*).¹ The workshop was attended by approximately 44 West Coast fisheries managers and researchers representing the states of Alaska, Washington, Idaho, Oregon, and California, and the province of British Columbia. Topics for this workshop included:

- oceanographic and marine factors affecting steelhead survival;
- stock monitoring and the Endangered Species Act (ESA); and
- genetic conservation of wild steelhead.

The workshop was structured as a series of panel presentations, followed by discussion and/or questions from the remaining participants. 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 paper prepared from the taped proceedings of the workshop summarizes the presentations and some of the discussion which followed.

Workshop Steering Committee:

Fred Gaffney, Alaska Department of Fish and Game
Art Tautz, Ministry of Environment, British Columbia
Peter Hahn, Washington Department of Wildlife
Dexter Pitman, Idaho Department of Fish and Game
Mick Jennings, Oregon Department of Fish and Wildlife
Forrest Reynolds, California Department of Fish and Game
Al Didier, Pacific States Marine Fisheries Commission

¹ This workshop was partially funded through Agreement No. 14-16-0001-88516 with the U.S. Fish and Wildlife Service.

SESSION I: OCEANOGRAPHIC AND MARINE FACTORS AFFECTING STEELHEAD TROUT SURVIVAL

Session Chair: Dr. Peter Hahn, Washington Department of Wildlife

Trends in steelhead abundance in Washington and along the Pacific coast of North America
- Randy Cooper, Washington Dept. of Wildlife, Port Townsend, Washington.

Harvest of steelhead (*O. mykiss*) in Washington reached a record low during the 1990-91 season. The Washington Department of Wildlife began a study in 1991 to try to explain the factors responsible for the recent decline in steelhead abundance. We examined trends in winter-run, summer-run, hatchery and wild steelhead abundance in several geographic areas in Washington. We also examined and compared trends in steelhead abundance from British Columbia, Washington, and Oregon. Similarities in overall trend and year-to-year trends of steelhead abundance strongly indicate that common factors are responsible for the recent decline in steelhead abundance along the Pacific coast. Potential causes of a coastwide decline in steelhead examined physical and biological oceanic conditions (sea surface temperature, winter air temperatures, ocean currents, wind speed, strength of upwelling, El Niño events, primary and secondary productivity), predation, competition, wild steelhead spawner escapement, number of hatchery steelhead smolts released, and harvest of steelhead in high seas driftnet fisheries. Factors such as freshwater rearing conditions, estuarine and nearshore rearing areas, hydroelectric dams, and incidental harvest in commercial fisheries do not explain the recent decline in steelhead stocks along the Pacific coast but are very important in the survival of regional or individual steelhead populations. A combination of factors contributed to the low steelhead returns during the 1990-91 steelhead season. We hypothesize that low productivity in the Gulf of Alaska during the 1988 and 1989 steelhead smolt years (as evidenced by zooplankton biomass and distribution), competition for food because of increases in the number of salmonid smolts released and large returns of pink and sockeye salmon adults to Alaska during years of low ocean productivity, and catch of steelhead in authorized and unauthorized high seas driftnet fisheries each contributed to the low returns of steelhead in 1990-91.

Interannual variation in abundance, migrations and mortality of juvenile salmon in B.C. coastal waters - Dr. Brent Hargreaves, Dept. Fisheries and Oceans, Pacific Biological Station, Nanaimo, British Columbia, Canada

Remarkably little is known about the processes which control the mortality of salmon in the ocean. One hypothesis is that variation in ocean conditions affects survival of juvenile salmon mainly by changing the abundance, distribution, or species composition of predators. Recent multidisciplinary studies in British Columbia coastal waters confirm that large shifts occur in the abundance and species composition of several migratory fish species, associated with both interannual and decadal variations in ocean conditions. Pacific hake migrate into British Columbia waters every year, but their abundance, migration timing, and distribution appears to be strongly affected by interannual variations in ocean conditions. Stronger variations in ocean conditions which occur on longer time scales (e.g. El Niño events) can result in the sudden influx of other fish species, such as Pacific mackerel and Pacific sardine. Pacific hake and Pacific mackerel both preyed heavily on juvenile salmon and herring in near-shore waters. Variability in ocean conditions, and resulting changes in predator-prey interactions, may explain much of the variation in mortality of juvenile salmon, herring, and other pelagic fishes in British Columbia waters.

Ocean productivity and marine survival - Dr. William G. Pearcy, College of Oceanography, Oregon State University, Corvallis, Oregon

Year-class strength for coho salmon in the Oregon Production Index (OPI) may be defined during the critical period for juveniles, which is the first month in the ocean. There is a positive relationship between upwelling and the survival of hatchery coho stocks in the OPI. Nutrient rich upwelled water injected into the euphotic zone usually results in good phytoplankton growth and thus in an increase in coho survival. However, during the 1982/83 El Niño there was strong upwelling and the water was poor in nutrients. The adult coho in 1983 were in poor condition and the adult returns were one-half of the predicted number (based on the 1982 jack returns). Smolt survival in the ocean, coho jack returns in 1983 and 1984, and adult returns in 1984 and 1985 were all extremely low. The center of coho juvenile distribution also shifted northward in response to the warm waters in 1983. Diet for juvenile salmonids consists of larval fish during weak upwelling years and euphausiids during strong upwelling years. During El Niño events there can be a big shift in fish communities which could increase predation and competition. Larger steelhead feed on fish and squid, and there may be competition with salmonids and other species. On a larger scale, long term changes in ocean climate can have a major impact on the production of salmon in the North Pacific Ocean. The interdecadal changes in atmospheric temperature can be related to changes in atmospheric circulation, which in turn affect ocean conditions.

The concept of "scale" in terms of time and space - Dr. Robert C. Francis, Fisheries Research Institute, University of Washington, Seattle, Washington

Fishery oceanographers study exploited populations in the context of a complete physical and biological environment. A multidisciplinary point of view (atmospheric sciences, oceanography, ecology, biology) must be taken to understand the impact the marine environment has on salmonids. The concept of "scale" can be associated with variation in natural systems. Patterns and processes occur on different scales of time and space and the rules that govern these boundaries help define ecosystem boundaries. The initial way to look for a pattern is to pick a scale and look for a correlation. If the biological response occurs at the same scale as the physical variable then there may be a strong relationship. However, this may not always happen and we must look at the processes in terms of a longer time scale and spatial scale (geographic regions) to better understand the patterns that cause shifts. For example, what caused the shift in salmon production between the late 1940's to the late 1970's, and then a shift from the late 1970's to 1990's? If these shifts are occurring, then what are the patterns (less than 10 years or 20 to 30 years)? The time frame also depends upon the species you are studying; therefore, groundfish would not be similar to salmon.

High seas steelhead and salmon studies - Katherine W. Myers, High Seas Project Leader, Fisheries Research Institute (FRI), University of Washington, Seattle, Washington

FRI was contracted by the National Marine Fisheries Service (NMFS) to do International North Pacific Fish Commission (INPFC)-related research on salmon and steelhead. The main objective was to determine origin of salmonids caught in the high seas salmon driftnet fishery. An estimated 99.9% of the steelhead caught in the high seas salmon driftnet fishery are of North American origin. A new treaty includes a total ban on directed salmon fishing in the North Pacific Ocean outside the 200-mile zone. In a cooperative project with the Japanese, data are being collected along the dateline to study carrying capacity of salmonids in this area

of the North Pacific. Another study is examining the southern limits of salmonids in relation to temperature and other oceanographic factors. Eighty-eight percent of the time steelhead were found in the surface waters. Steelhead also showed a strong preference for surface waters between 7°C to 9°C and they never went below the thermocline. This preference for surface waters suggests that steelhead could be more susceptible to marine pollution. A recent food habit study has shown that the diet of chum salmon changes during years of low pink salmon abundance. During years of high pink salmon abundance, chum salmon fed on gelatinous zooplankton; they switched to euphausiids during years of low pink salmon abundance.

Summary of Ocean Survival

The panel was asked to address the following questions:

- 1) What information is applicable to understand steelhead ocean survival, and what predictions can be made? Can we predict steelhead returns in advance?
- 2) What information is available, or what information must be gathered? Who can help?

Dr. Francis stated that predicting returns is like forecasting the weather. It is difficult to predict regime changes until five years after it happens. We must understand the physics of what is happening during these regime shifts. The ocean plays an important role but we do not fully understand the processes. You may be able to recognize patterns but not be able to make a prediction. Managers may have more luck predicting salmon/steelhead returns on a short time and local scale. An example would be the recent work done by Dr. Hargreaves looking at the effects of predation on salmonids in Barkley Sound off west Vancouver Island. Dr. Hargreaves also stated that we need to know when and where the fish are from year-to-year during their ocean phase.

Dr. Pearcy suggested looking at steelhead jack return rates as a possible predictor. The Washington Department of Wildlife (WDW) looked at steelhead jack returns as a predictor; it worked fairly well in the 70's and 80's but has not been reliable in recent years. He also suggested looking at year-to-year variations in age composition and growth conditions.

We may be losing the ability to do high seas work on salmonids because of the end of the INPFC and budget constraints. The INPFC focused on the origin of salmon stocks during the high seas salmon driftnet fishery and ignored ecosystem questions. It is important to keep momentum going for high seas salmon research. There seems to be some confusion about where salmon will fit into the new North Pacific Marine Science Organization, or how much, if any, effort this organization will direct towards salmon research. The best method for compiling long term databases by different agencies remains an open question. Key questions also include which stocks to examine and which components to analyze.

SESSION II: STOCK MONITORING AND THE ENDANGERED SPECIES ACT

Session Chair: Dexter Pitman, Idaho Department of Fish and Game

Introduction

The International Symposium on Steelhead Trout Management held January 3-5, 1991 in Portland, Oregon, concluded that West Coast stocks are characterized by increasing angler interest and fishing pressure with some stocks showing significant declines. However, management agencies possess little stock-specific information for management and most are unsure of specific stock's status or trends. Nehlsen *et al.*² provided a list of depleted Pacific Northwest salmonids at risk of extinction or of special concern. The list included 75 stocks of steelhead at risk in Oregon, Washington, Idaho and California. Another 23 stocks were listed as extinct. At about the same time several Pacific salmon species were listed pursuant to the U.S. Endangered Species Act, and in 1992 the Illinois River winter steelhead of Oregon was petitioned for listing.

These events and concerns prompted steelhead management agencies of the Pacific Coast and Idaho to look more closely at the Endangered Species Act and Canadian law as it pertains to steelhead. A session of the 1993 steelhead management meeting was reserved to identify essential and supportive criteria needed to effectively assess the status and trend of steelhead relative to federal law and, more appropriately, for genetic conservation. A panel of experts was invited. Mr. Dale Hall, U.S. Fish and Wildlife Service, and Dr. Robin Waples, National Marine Fisheries Service, provided perspectives of the Endangered Species Act. Dr. Skip McKinnel, Canadian Department of Fisheries and Oceans reviewed the Canadian experience with genetic conservation management and regulation. Dr. Carl Schreck, Oregon State University, summarized the pertinent points of the panel discussions and provided recommendations for steelhead managers.

Endangerment Regulation

Mechanisms for providing protection to critical steelhead stocks exist pursuant to both U.S. and Canadian law. However, while the U.S. Endangered Species Act (ESA) is described as the most powerful single tool to prevent species extinction, the British Columbia Wildlife Act is described as not a rigorous process.

The ESA evolved from efforts to protect the habitat of animal populations on federal land and to preserve the genetic diversity of species. Two major elements of the ESA need to be considered by steelhead managers: population abundance and population distinctness. Population abundance is characterized relative to a stock's threshold level of abundance necessary for sustained production and genetic viability. Abundance is characterized as: eminently facing extinction (endangered); likely to become in danger of extinction in the foreseeable future (threatened); or neither threatened nor endangered. Population distinctness is defined in terms of genetic distinctness from other populations of steelhead (the species definition). Two major elements of species definition are reproductive isolation and

² Nehlsen, W., J. E. Williams and J. A. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(2):4-22.

evolutionary significance. Managers must find answers to the following questions in order to define the species: Does the population represent a unique gene pool? Is the gene pool important to the evolutionary legacy of steelhead, a product of past evolutionary events, and if lost would that represent significant loss to the taxonomic unit and its future evolution?

The B.C. Wildlife Act provides for designation of steelhead as endangered species if the provincial ministry finds that a population is threatened with immediate extinction through all or a significant part of its range. Species protection is emphasized through legislation protecting habitat through no net loss of habitat and avoiding species endangerment. Canadian federal policy for conservation of Pacific salmon is being considered through the Salmon Subcommittee, Pacific Salmon Stock Assessment Committee. While early in development, concepts being considered include maximizing the potential for sustainable benefits (social value) by keeping the greatest number of populations or deems in the largest amount of habitat to guard against the consequences of uncertain species future.

The common message from the panel of experts was prevent population endangerment by habitat (ecosystem) protection. Avoiding species endangerment is far more rational than protecting and attempting recovery of a species after it has become threatened by extinction. Managers were cautioned that threshold abundance is an illusive genetic standard. Also, managers should be resistant to innovative programs such as captive brood stock culture, special harvest regulations and other management applications that remove the burden of responsibility from those responsible for ecosystem problems at the root of species decline and endangerment.

Defining Steelhead Species and Status

Experience in the U.S. with ESA application to Pacific salmon and resident fish and wildlife provides steelhead managers with an opportunity to inventory and begin collecting the information necessary to define species and status pursuant to the standards of the ESA. Valuable information identified by the expert panel as necessary to define a species and characterize its status includes the following:

- a. Threshold - Status
 - Present versus historical abundance
 - Population trends through time
 - Steelhead distribution, both spatial and temporal
 - Genetic consequences
 - Population vulnerability model analysis
 - Other fish species information
 - Short term population projections

- b. Reproductive Isolation
 - Genetic definition and differences
 - protein electrophoresis
 - DNA markers
 - Natural barriers
 - physical
 - adjacent watershed
 - ocean migration route
 - Straying rates

Recolonization rates
Stocking history

- c. Evolutionary Significance
 - Phenotypic characteristics
 - Life history
 - Genetic profiles
 - Habitat uniqueness
 - Behavioral adaptations
 - Influence of fisheries
 - Influence of fish culture and stocking

A good population assessment would include a baseline period that adequately represents the natural abundance and fluctuations of wild populations in response to pre-problem conditions. Information should be specific for the stock of concern, and measure periods of persistence as well as decline. In addition steelhead managers should be able to describe the limiting factors and habitat conditions critical for population recovery and/or stabilization.

Steelhead Managers' Assessments

Individual assessments by state and provincial steelhead managers of how well prepared their programs are for assessment of species and status according to ESA criteria indicated several similar points. None felt that existing baseline information was adequate. Most continuous information is recent, and early information does not connect to current conditions. Current ecosystem conditions in Oregon, Washington, California and Idaho are notably changed from pre-problem periods.

Existing information is incomplete. Genetic definition by protein electrophoresis or DNA marker procedures is not comprehensive or current. Life history and behavioral understanding of reproductive isolation and population distinctness is limited.

Management response to the information deficiencies is constrained by lack of personnel trained in genetics, and insufficient funding to undertake the research and monitoring necessary. Most dollars available for endangered species problems are prioritized for reaction to existing salmon issues.

While managers' assessments are somewhat pessimistic, most constraints can be altered. Alaska and British Columbia are in good position to monitor steelhead and develop baseline data prior to major ecosystem disruption. Funding initiatives and legislative mandates for restoring habitat and implementing supportive research are underway in California. Pacific salmon concerns in Oregon, Idaho and Washington are elevating awareness of ecosystem health and restoration, which has potential to benefit steelhead.

SESSION III: GENETIC CONSERVATION OF WILD STEELHEAD

Session Chair: Bob Gibbons, Washington Department of Wildlife

Introduction

Each state and British Columbia was asked to present its approach to addressing the following four questions related to genetic conservation:

- 1) What factor, or factors, should be monitored to determine genetic impacts to wild stocks from hatchery programs? What is the allowable genetic impact to wild stocks from hatchery programs?
- 2) What management strategies can be used to stay within allowable genetic impacts? How can the effectiveness of these management strategies be measured?
- 3) Should a broodstock with similar or dissimilar run and spawn timing to the wild stock be used for hatchery fish that are stocked primarily for harvest?
- 4) Are existing fisheries exerting unacceptable genetic impacts on wild steelhead stocks? (For example, is it detrimental to allow harvest only on the early segment of a run?) If yes, how should fisheries be changed to stay within allowable genetic impacts?

California

California Department of Fish & Game (CDFG) began the session with Dennis McEwan making the presentation. California does not have an active genetics program and thereby does not have an approach for addressing the four questions. They have a policy that does not allow any genetic impacts to wild stocks of steelhead and salmon, however, they have no way to monitor impact.

Implementation of the policy has been inconsistent due to lack of classification of streams, not following established policies and hatchery production practices.

Most of CDFG hatcheries use wild brood stock from the local river although not necessarily native stock since numerous transfers have occurred in the past. Most rivers without hatcheries are not stocked with steelhead.

Alaska

Dr. Jim Seeb represented Alaska. Alaska has a "zero tolerance" policy with regards to impacts to wild stocks from hatchery fish in areas designated as wild only. In other areas native broodstock is used for hatchery production to match wild run and spawn timing. With regards to steelhead, Alaska had only one artificial production program which was on the Kenai Peninsula. This program has been dropped because hatchery fish were straying into a neighboring stream. Alaska has no future plans for hatchery steelhead production.

Idaho

Steve Yundt made the presentation for Idaho. Idaho has a fairly large hatchery program as a result of mitigation for impacts from hydroelectric dams on the Snake River, etc. Their approach has been to sequester certain areas or stocks where no stocking of hatchery fish is allowed. These areas, for the most part, have no roads or are wilderness areas. Hatchery fish are stocked in areas that have good access for anglers to maximize harvest opportunities. Native broodstocks were used to begin the hatchery program and their current hatchery stocks have the same run and spawn timing as wild runs.

British Columbia

Art Tautz made the presentation for British Columbia (B.C.). B.C. has a relatively small hatchery program that utilizes only wild broodstock. Returning hatchery fish are not used as a brood stock source. Based on angler demand they have designated twenty out of their three hundred steelhead streams for hatchery stocking. The remaining streams are managed for wild only.

Oregon

Mark Chilcote made the presentation for Oregon. Oregon has a substantial hatchery steelhead program, much of it provided through mitigation. Both native and hatchery broodstocks are used. Oregon has a wild fish management policy that was adopted by their commission that sets limits on impacts to wild stocks from hatchery production. Their approach is to set limits on the number of hatchery fish spawning at the same time and place as wild fish. A sliding scale is used that ranges from allowing fifty percent of the escapement to be hatchery fish for similar stocks to five percent for very domesticated stocks. Various strategies for harvesting hatchery fish and isolating spawning are being used. Assessing the proportion of hatchery spawners (and their impact) has been difficult in some cases but they are continuing to improve assessment techniques.

Washington

Thom Johnson made the presentation for Washington. Washington has a substantial hatchery program also with much of it provided through mitigation. A mixture of native stocks and non-local stocks have been used to develop the current hatchery broodstocks. Washington has no formal policy on impacts to wild steelhead from hatchery production. They have developed a model that predicts the impacts to the long term reproduction potential of wild fish from interbreeding with hatchery stocks. They propose setting of a minimum of ninety percent of the historic wild reproductive potential as the allowable impact from interbreeding with hatchery fish. Stocking levels would be determined based on the number of hatchery fish spawning at the same place and time as wild fish. Like Oregon, Washington will use various management strategies to reduce interbreeding.

Comments by Geneticists

Three non-management agency experts (Dr. Fred Allendorf, University of Montana; Dr. Robin Waples, National Marine Fisheries Service; and Dr. Eric Loudenslayer, Humboldt University) were given twenty minutes to comment on the agencies presentations.

Dr. Waples began by pointing out one potential problem with using wild stock for hatchery production. Because survival is increased in the hatchery environment small numbers of wild broodstock can produce a disproportionate number of spawning adults and thus disrupt the genetic balance of the wild population. This needs to be considered in any hatchery program. He also emphasized that we need to take care of habitat and fishing issues as well as hatchery impacts. Although the Washington Department of Wildlife (WDW) approach did attempt to measure impacts, he questioned whether the model was too simple and how applicable it is. Separating run timing could be beneficial, however, when interbreeding did occur the impacts would be dramatic. He urged caution in using dissimilar stocks and all things being equal, he favored using local brood stocks.

Dr. Allendorf pointed out that it is important to not treat ESU's as management units. Generally, we should be managing for smaller groups representing reproductively isolated units. He questioned why Alaska would even consider hatchery production given its relatively pristine habitat and lack of mitigation. He emphasized that we should be considering long term effects of our action since many impacts may not be expressed in the short term. Finally, we should frame the issues and associated impacts for policy makers and avoid blurring the science with policy.

Dr. Loudenslayer primarily addressed questions one and three. Steelhead habitat is continually changing due to climatic factors (e.g. the drought in California) and increased human population. We don't know what genetic components of steelhead populations will be required to adapt to future habitat changes and thus we need to preserve biological diversity. We should also focus on monitoring of coastwide trends in hatchery and wild stocks to be clear as to what factors are impacting steelhead abundance and health. He found the WDW proposal to be bold and intriguing. He could not say if it is good or bad but he would be hesitant to utilize it in California given their constituent's current concerns. He agreed with Dr. Allendorf that science should proceed policy and the lines between the two remain clear.

Pacific Coast Steelhead Management
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