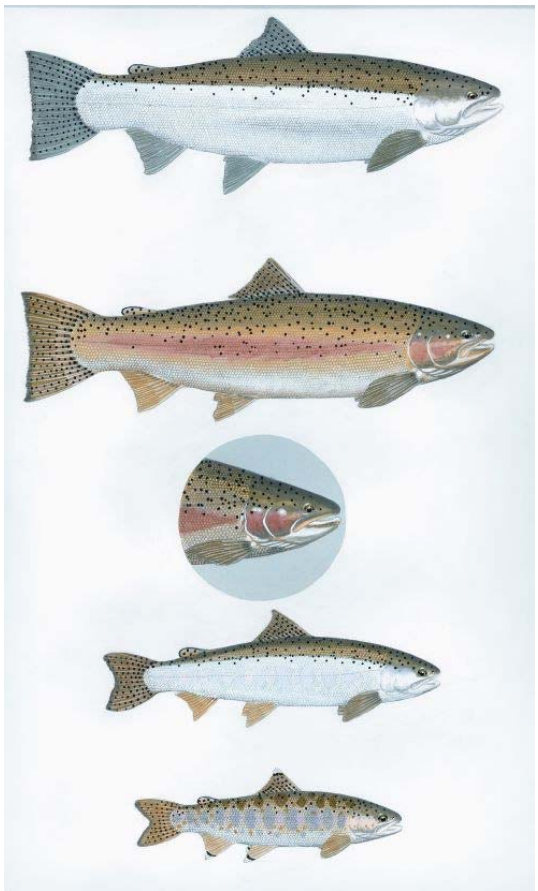
"Comparisons of Steelhead Populations and Management: From the Great Lakes to the West Coast"

A Symposium at the AFS 136th Annual Meeting at Lake Placid, NY September 10-14, 2006



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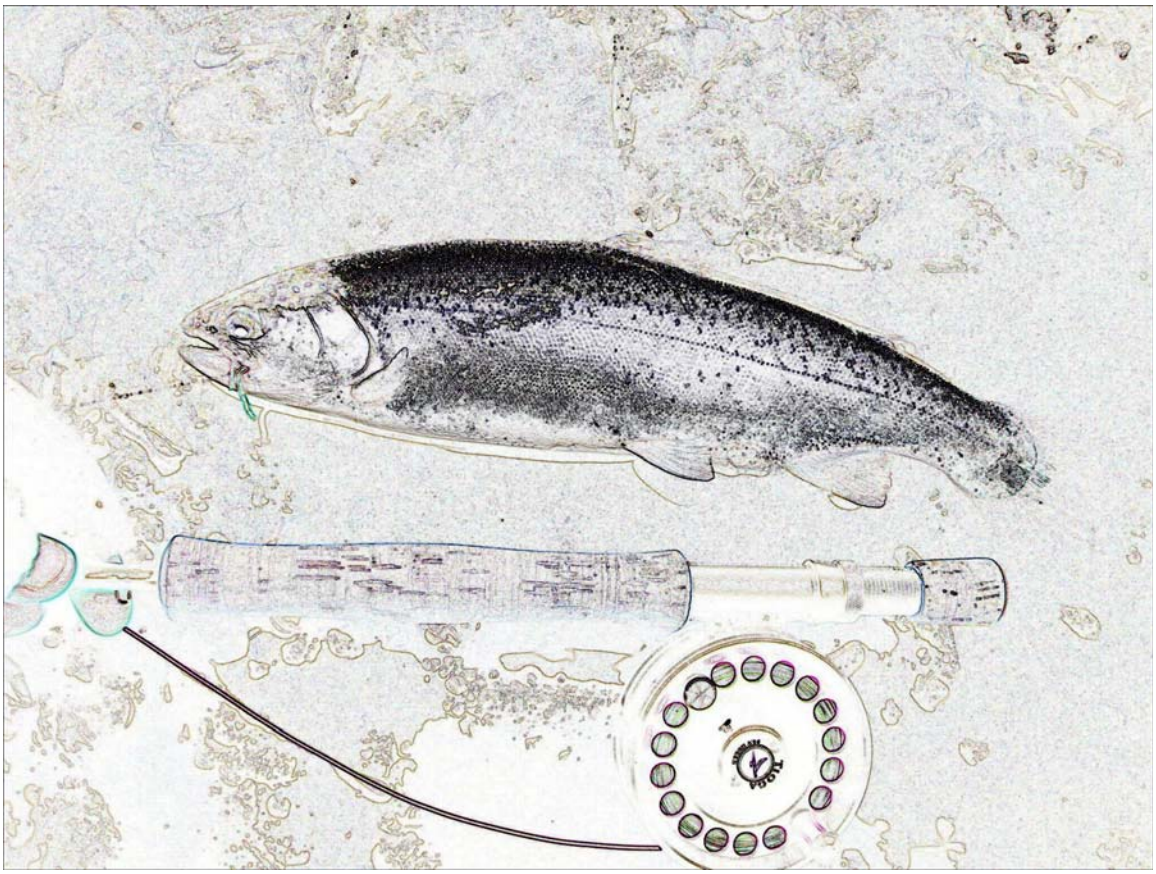
Symposium Organizers:
James L. Markham, NYSDEC
David B. MacNeill, NYSG

"Comparisons of Steelhead Populations and Management: From the Great Lakes to the West Coast"

The steelhead is one of the most coveted sport fishes in North America. Despite this position of high esteem, many native steelhead stocks along the West Coast and naturalized populations in the Great Lakes continue to decline from a variety of factors. The intent of this AFS symposium was to facilitate bi-coastal information exchange between researchers and managers focusing on steelhead ecology, population dynamics, trophic relationships, fisheries exploitation, and restoration efforts to determine if common problems exist and to identify possible management solutions. The symposium consisted of 21 presentations from grad students and biologists to researchers and statewide managers, covering topics from genetics to recruitment to population models from all of the Great Lakes and the West Coast. The symposium concluded with a one-hour panel session to discuss pertinent issues with representatives from both the West Coast and Great Lakes. Steelhead are indeed a “Fish in the Balance”, the theme of the meeting, caught between expanding human populations creating deteriorating water quality and increased angling pressure due to their beauty and fighting capabilities.



Symposium Presenters

Dr. Sean Hayes (sean.hayes@noaa.gov)
NOAA Fisheries Ecology Division, Santa Cruz

Title: 50 years since Shapovalov and Taft: Steelhead on the central California coast today

Abstract: In 1954, Shapovalov and Taft published a seminal paper that remains one of the most comprehensive studies of steelhead life history. They used adult weirs and smolt traps to monitor population dynamics and life history strategies for 10 years (1933-1942) in Waddell and Scott Creeks, two small streams along California's central coast. Today steelhead in this area are listed as threatened under the Endangered Species Act, although little data exist on current population numbers and health. Using similar techniques of smolt traps and weirs, we began studying steelhead in Scott Creek in 2002. After 70 years of technological advances, we have added population genetics, PIT tagging, Na^+- K^+-ATPase assays, computerized scale analysis, archival data tags, digital-water-chemistry monitors and mark-recapture software to our arsenal of techniques. After four years of study we are rediscovering similar patterns to those observed 70 years ago, in a small but healthy steelhead population. In addition, we are pursuing questions related to instream and ocean movements, growth and habitat use at the individual level, hatchery/wild interactions, reproductive success and resident/anadromous genetics for the purposes of understanding how fish are adapted to their local ecology and how they may differ from northern stocks.

David Gonder (david.gonder@mnr.gov.on.ca)
Ontario Ministry of Natural Resources – Lake Huron Office

Title: Life History Patterns, Status and Management of Lake Huron Steelhead Populations

Abstract: Steelhead were first introduced into Lake Huron in 1876. Since that time, colonization of suitable tributary habitats has occurred. In addition, yearly stocking in Michigan waters began in the 1960s and in the 1970s in Ontario waters. All stocked yearling steelhead in the 1995-2004 year classes were fin clipped. Marked and unmarked, presumed wild, steelhead have represented nearly equal proportions in recent assessment programs on the main basin of Lake Huron. Natural reproduction is more prominent in Ontario waters, both in the main basin and Georgian Bay, due to increased access to spawning habitat. The bulk of wild fish in Lake Huron spend two years in natal streams and then return to tributaries for their first spawning run at three and four years of age. Harvest in Michigan waters has recently declined while stocking rates have remained relatively stable. Numbers of repeat spawning fish, an index that is used as a management tool in Ontario, declined in Georgian Bay populations in the 1990s and have remained depressed in most populations since that time. Fisheries for steelhead are diverse in Lake Huron, with both popular lake and river fisheries. Mortality rates and access to quality spawning habitat represent the most significant challenges for Lake Huron steelhead populations currently.

Kevin Kayle (kevin.kayle@dnr.state.oh.us)
ODNR, Division of Wildlife – Fairport Harbor Fisheries Station

Title: Status of the Lake Erie Steelhead Population: an Overview of Their Biology and Fishery

Abstract: The steelhead population in Lake Erie is thriving. Four states and the province of Ontario annually stock 1.9 million yearling steelhead. Natural reproduction is documented in 24 watersheds; however, annual production is limited due to minimal spawning and juvenile habitat. Steelhead in Lake Erie have a diverse diet consisting of insects, zooplankton and fish, but fish

comprise the bulk of diets by dry weight. Primary prey fish are rainbow smelt and emerald shiners, and to a lesser extent round goby, white perch, yellow perch, drum and alewife. Mean length at age (mm TL) for steelhead entering the fall was: 413, 570, 640, 687, and 732, for ages one though five (summers), respectively, with full maturity achieved by age 3. Mean condition (K) of summer steelhead was 1.14. The length-weight regression for Lake Erie steelhead was: log10(weight, grams)= -4.170788 +2.721708*log10(length, mm TL). Age distribution seen in surveys and fisheries show that steelhead ages 2 and 3 are most prominent, then numbers decline precipitously after age 4. The Lake Erie sport fishery for steelhead is robust with open lake and stream angler efforts, catches, and catch rates increasing in the last decade. Conservative regulations and voluntary catch and release sustain steelhead opportunities.

Daniel Bishop (dlbishop@gw.dec.state.ny.us)
New York State Department of Environmental Conservation – Region 7

Title: A New York perspective on steelhead in Lake Ontario: A summary of strains, strategies and allocation issues.

Abstract: New York annually stocks 550,000 yearling steelhead into Lake Ontario; primarily Chamber's Creek strain winter run steelhead that provide both open lake and tributary fisheries. Skamania strain summer run steelhead are also stocked at lower levels, providing a unique, low intensity summer fishery on the Salmon River. Natural reproduction is limited, contributing perhaps 25 percent to the fishable stock. Declines in recruitment since the mid 1980s have resulted in reduced tributary catch rates, particularly on the Salmon River. The Salmon River supports the largest tributary fishery as well New York's only steelhead culture facility. Various improvements in fish culture, experimental stockings in the Salmon River and cooperative pen rearing projects have been used to try to improve steelhead recruitment. Catch and release fishing has become predominant on the tributaries while the lake fishery remains more harvest oriented. Tributary anglers recently requested and received a reduction in the daily tributary creel limit from 3 fish to 1. Further requests for additional restrictions on the lake fishery have been met with opposition from lake anglers.

Dr. Jesse Schwartz (JesseSchwartz@ctuir.com)
Confederated Tribes of the Umatilla Indian Reservation

Title: Umatilla summer steelhead restoration: How far have we come, and where do we go from here?

Abstract: Summer steelhead populations have been in decline in the Umatilla subbasin since the early 1900's. Habitat degradation, agricultural development, and the Columbia River hydrosystem all contributed to these losses. An integrated artificial production program was designed and initiated in 1990. Enumeration of adult returns via a fish ladder at Three Mile Falls Dam began in 1988. The natural fraction of the return has varied between 724 and 3658, and averaged 1695. The hatchery fraction has varied between 165 and 1862, and averaged 774 fish. Adult returns have increased significantly during the monitoring period (Rsq=0.64). Return per spawner has increased as well (Rsq=0.23). Despite these successes the program is under scrutiny due to ESA listing of the Middle Columbia Summer Steelhead ESU. Some have made calls for downsizing Umatilla production, limiting escapement, or modifying hatchery practices. Others continue to argue for reform of the tributary habitats and the Columbia River hydrosystem. We assessed the current potential for natural summer steelhead production using the Ecosystem Diagnosis and Treatment (EDT) model and the All-H-Analyzer to model the steady state benefits of particular management regimes. These models suggest that habitat restoration and mitigation would produce the greatest improvement in adult returns, while hatchery reforms and harvest modifications would be the least effective. To sustain treaty-based fishing opportunities and support natural production it will be necessary to maintain artificial production. However,

improvements in local habitat and passage conditions should remove some of the burden from the production program and provide new opportunities for hatchery reform.

Dr. James McKenna Jr. (jemckenna@usgs.gov)
USGS/BRD – Tunison Laboratory of Aquatic Science

Title: Aquatic Gap Analysis Predictions of Juvenile Steelhead Habitat Throughout New York's Great Lakes Basin

Abstract: The Great Lakes Regional Aquatic Gap Analysis project has gathered georeferenced habitat and fish abundance data for all streams and rivers of the Great Lakes drainage (including New York's), organized them into accessible databases, and developed effective fish-habitat models for common species. Each habitat unit (confluence-to-confluence stream arc) in the basin was described by 325 variables, representing a hierarchy of spatial scale. Fish-habitat models for juvenile salmonids that spawn within the NY drainage explained >90% of variation in their respective data and were used to predict abundances of those species throughout the drainage. Clear spatial patterns of predicted distribution corresponded to the life history of each species. Optimal brook trout (only native salmonid examined) habitat was predicted to occur in 3,862 km of stream (11% of basin). However, competition with brown trout (and other salmonids) may limit this distribution estimate. Predicted optimum juvenile steelhead habitat occurred within 3,142 km of stream (9% of basin), but less than 1/3 of that habitat is available to migratory individuals due to passage barriers. Results provide an indication of the location and extent of potentially suitable salmonid habitats within the basin and should be a helpful tool for management and stream restoration.

Chad Hanson (chad.hanson@noaa.gov)
University of California – Santa Cruz

Title: Steelhead Life History Adaptation and Early Habitat Use

Abstract: The persistence of steelhead on the central coast of California is due at least in part to over 30 documented life histories that help buffer populations against the unpredictable stream environments found there. While the theoretical advantages that life history variation confers on populations is well understood, the factors that lead steelhead to follow a particular trajectory are unclear. To better understand what drives life history variability in steelhead I assessed habitat influences on smoltification in steelhead. Many coastal watersheds in California have estuaries that become isolated from the ocean by sandbars in the summer and form lagoons. Other systems lack an estuary entirely. Growth rates in estuaries/lagoons can be 6-8 times higher than in upstream habitats. This large difference in growth rate caused me to test a size-threshold model of smolting by comparing the sizes and ages at smoltification between populations occupying watersheds with estuaries/lagoons and those without. The results show that smolts from populations with estuaries/lagoons initially migrate downstream at smaller sizes and depend on the estuary/lagoon to attain a size conducive to ocean survival, while fish in populations lacking estuaries/lagoons grow in upstream habitats and take longer to attain the desired size before emigrating.

Dr. James Johnson (jhjohnson@usgs.gov)
USGS – Great Lakes Science Center, Tunison Laboratory of Aquatic Science

Title: Seasonal habitat use and diel movement and feeding of juvenile steelhead in Lake Ontario tributaries

Abstract: Seasonal habitat use, diel downstream movement, and feeding ecology of juvenile steelhead (Onchorhynchus mykiss) were examined in three tributaries of Lake Ontario. Over-

yearling steelhead occupied habitats with significantly greater depth and cover than subyearling trout. Both age groups of steelhead were found in deeper areas in the autumn than in the summer. Seasonal variation in habitat use was more pronounced for subyearlings as they were associated with significantly more cover and larger sized substrates in the autumn. Downstream drift of recently emerged steelhead was greatest between 2000h and 2400h, with 92% of the fry collected at night. Fry drift rates varied among streams and did not appear to be related to fry densities. Subyearling steelhead were diurnal feeders with peak feeding occurring between 0800h and 1600h. Ephemeropterans and chironomids were the main food of recently emerged fry and trout diets were more closely associated with the composition of drift samples (especially during crepuscular periods) than with the composition of bottom samples. Daily food consumption (based on dry weight) and daily ration (based on body weight) of steelhead fry ranged from 4.9 to 5.7 mg and 10.2 to 14.3%, respectively, in the three streams.

Matthew Ward (Matt.Ward@dnr.state.mn.us)
Minnesota Department of Natural Resources – Duluth

Title: Understanding Factors Influencing Juvenile Steelhead Population Dynamics in a Lake Superior Tributary Stream

Abstract: Steelhead *Oncorhynchus mykiss* were introduced into the Lake Superior basin in 1895. Decreased spring creel catch rates on North Shore streams in conjunction with perceived declines in abundance by anglers, led to a desire for a more comprehensive understanding of the factors that influence juvenile and adult population dynamics. To better understand the juvenile life stage, a fish trap was constructed 0.2 miles upstream of the mouth on the French River. The juvenile trap became operational in 1994, and includes a cement dam that restricts upstream migration of anadromous adults. The trap is able to sample approximately 90% of juvenile emigrants. Thus far, the trap has monitored the emigration of nine year-classes (age-0 through age-3), which were the result of fry stocking. The information collected from the juvenile trap will assist managers in the development of regional fry stocking strategies by estimating the carrying capacity of North Shore streams, assessing how environmental factors influence juvenile year-class strength (e.g., discharge, precipitation, water temperature, air temperature), assessing the validity of using electrofishing data to predict juvenile year-class strength, and eventually determining the relationship between juvenile emigrants and returning adults captured in the French River adult trap (0.1 miles upstream from mouth).

James Bowlby (jim.bowlby@mnr.gov.on.ca)
Ontario Ministry of Natural Resources – Lake Ontario Management Unit

Title: Shifts in recruitment and survival of rainbow trout in the Ganaraska River since 1974.

Abstract: The spawning run of rainbow trout in the Ganaraska River, a tributary of Lake Ontario, has been monitored during spring at a fishway near Port Hope, Ontario since 1974. Rainbow trout were counted, measured, weighed, and sampled for scales. Egg collections for Ontario fish culture stations have taken place at the fishway sporadically, since 1984. A rapid increase in the run of rainbow trout from 527 fish counted in 1974 to a peak of over 18,000 in 1989 was followed by a precipitous decline that continued until 1998. Since then, the run of rainbow trout into the Ganaraska River has remained relatively constant with a mean of 5,352. The Ricker model relationship between deposited egg density (estimated from female fecundity) and resulting age-3 recruits in Lake Ontario suggests four distinct stock-recruitment periods (ranked from highest recruitment or lowest Ricker b): 1981-1988, 1989–1993, 1994 to present, and 1974-1980 (based on spawning year). The descending limb of the Ricker model for each of these time periods suggested that juvenile habitat for rainbow trout has been saturated in the Ganaraska River since 1979. The survival of age-4 and older rainbow trout from the Ganaraska River was not significantly different among these time periods and was 30%. Consequently, the difference in

Ricker models between time periods was likely due to differences in survival between smolting (age-2) and age-4. The lower survival of post-smolt rainbow trout during the 1970s may be related to higher lamprey abundance. Lower survival of post-smolts during the 1990s may be related to increased predation by large salmonids as a result of an offshore re-distribution of alewife during spring.

Dr. Devon Pearse (devon.pearse@noaa.gov)
NMFS Southwest Fisheries Science Center – Santa Cruz

Title: Population genetics of coastal California steelhead, with emphasis on resident and anadromous forms in Scott Creek, CA

Abstract: In central California, variation in life history patterns is a key characteristic of steelhead biology. Anadromous forms inhabit a range of habitats from large river systems to small coastal streams. Yet even within small streams, both anadromous and resident forms can co-exist. Resident populations above barrier falls, whether natural or stocked, can add an additional dimension to the variation present within a single drainage. Genetic data from Scott Creek *O. mykiss* has shown that resident rainbow trout above Big Creek Falls are derived from the anadromous population present in Scott Creek. The data have also demonstrated that fish from this population of trout are moving over Big Creek Falls into the population below, and their descendents maintain a resident life history strategy at the base of the falls. We are using genome-wide data to determine the extent to which fish with above-falls ancestry hybridize with residual and anadromous fish below the falls, conduct parentage analyses, and identify genes under differential selection.

Peter Addison (paddison@zoo.utoronto.ca)
University of Toronto

Title: Life History Variation and Genetic Structure of Naturalized Steelhead Populations in Lake Superior

Abstract: Steelhead were first introduced into Lake Superior in 1883 and by 1920 had colonized tributaries along the entire Ontario shoreline. Naturalized tributary populations have had at least 25 generations since this initial colonization event. This system provides an opportunity to study how this highly plastic species can acclimate and adapt to varying biophysical environments and selective pressures in the absence of the potentially confounding effects of supplemental stocking. Life history data (length and sex data and scale samples) and DNA were collected via non-lethal sampling of individuals during spring spawning runs between 1991 and 2005. Results from eleven microsatellite loci show limited small scale structuring among large genetically variable groups of populations. Also, in comparison to native steelhead populations, Lake Superior's naturalized populations show high variability across most loci suggesting a diverse ancestry. Populations within and among large-scale genetic groups exhibit high variability of important life history traits, inferring local selective pressures may be causing more rapid divergence of life history strategies than is detectable at neutral microsatellite loci. These data have strong implications in the context of rates of local adaptation of steelhead, and may provide insights into the adaptive potential of native steelhead populations of conservation concern.

Morgan Bond (morgan.bond@noaa.gov)
National Marine Fisheries Service – Santa Cruz

Title: Movement patterns of steelhead in a central California stream: using passive integrated transponders to monitor fish behavior

Abstract: We are combining the use of passive integrated transponder (PIT) tags and strategically placed in-stream reading stations to monitor movement patterns of various life stages of steelhead (*Oncorhynchus mykiss*), in Scott Creek, a small central California coastal stream. Reading station antennae have 0.61m high x 2.79m wide apertures mounted vertically on a rigid protective frame that functions in all flow conditions. Adult steelhead are tagged at a weir upon their return from the ocean and their movement into several tributaries is monitored to determine upstream migration rates, spawning habitat use and spawning duration. Juvenile steelhead (>65mm) tagged at upstream tributary locations are monitored for both downstream and upstream migration patterns that coincide with smolting and seasonal habitat use. Smolts are tagged at a downstream migrant trap and in a small estuary. Subsequent tag detections are used to determine time of ocean entry, ocean return and ocean survival rates. This system of monitoring steelhead movement patterns within the watershed has revealed complex movement behavior and habitat utilization within the watershed, improving both our knowledge of population-specific ecology and our ability to manage this threatened population.

James Breck (breckj@michigan.gov)
Michigan Department of Natural Resources – Ann Arbor, University of Michigan

Title: Modeling the influence of stream habitat on steelhead life-history variation in the Great Lakes

Abstract: Steelhead life-histories are known to vary greatly across regions and even among populations within the Great Lakes. In the stream phase, steelhead life-history variation is driven by variation in stream habitat characteristics such as flow stability and gradient, productivity, and temperature. Here we model the influence of diverse habitat characteristics on steelhead life-history traits (juvenile growth, survival, and smolt age) in Great Lakes tributaries. There have been two approaches to modeling salmonid life-history: mathematically tractable models that are too simple to relate to multiple life-history pathways typical of steelhead, and complex, data-driven models that are computationally intractable. Our goal is to build a hybrid of these approaches: mathematical models that relate easily to data. In the process, we will gain insights about the processes that are driving steelhead life-history variation in the Great Lakes, identify needed data, and suggest management implications.

Gayle Zydlewski (gayle.zydlewski@umit.maine.edu)
School of Marine Sciences - University of Maine

Title: Ecology of steelhead trout in a tributary of the Columbia River: From physiology to population level assessments

Abstract: Steelhead trout (*Oncorhynchus mykiss*) survival, age at emigration, emigration timing, migratory physiology, and habitat use were assessed over 5 years in Abernathy Creek, Washington. From 2001–2003 over 5,000 naturally-reared (wild) juvenile steelhead trout were captured and implanted with PIT tags. Starting in 2003 hatchery steelhead trout smolts were released each spring. PIT interrogation arrays (at rkms 3 and 4) monitored movements through spring 2005. A rotary screwtrap was operated at rkm one from April to June each year. PITpacks were used each spring to assess habitat use of hatchery and wild smolts and again in the summer to survey the entire creek. Movement of wild migrants occurred in spring with fewer movements during fall and winter. Emigration peaked at arrays around May 11 and in the screw trap around May 17. Wild fish survival was high and recapture probability depended on season. Hatchery migrants expressed significantly lower levels of gill Na^+, K^+- ATPase activity, did not tolerate seawater as well, used similar habitats as wild migrants but did not displace them. Hatchery smolts were significantly larger than wild smolts. Insights from these studies are being used to manage integrated hatchery programs of steelhead trout.

James Markham (jlmarkha@gw.dec.state.ny.us)
New York Department of Environmental Conservation – Lake Erie Fisheries Unit

Title: "Steelhead Alley": The Steelhead Fishery in New York and Pennsylvania's Lake Erie Tributaries

Abstract: Over a decade of steelhead stocking topping 1.5 million yearlings per year has created a unique angling experience along Lake Erie's famed "Steelhead Alley", the tributaries encompassing Ohio, Pennsylvania (PA), and New York (NY). Tributary creel surveys were conducted in Pennsylvania in 2003-04 and in New York in 2003-04 and 2004-05 to estimate effort, catch, and harvest of the steelhead fishery. Total directed effort was estimated at 847,444 angler-hours in the PA streams and 191,294 – 263,545 angler-hours in the NY streams. Steelhead catch rates were extremely high, equaling 0.63 fish/hour in both PA and NY waters in 2003-04 and 0.55 fish/hour in NY waters in 2004-05. Total catch was estimated at 533,873 steelhead in PA streams and 115,464 – 129,562 steelhead in NY streams. Despite the high catches, harvest remained low with release rates from PA anglers of 78% and 87-94% from NY anglers. The surveys show the tremendous steelhead fishery that has developed in Lake Erie and the economic impact the fishery has had along "Steelhead Alley".

Heather Bartlett (bartlhrb@dfw.wa.gov)
Washington Department of Fish and Wildlife

Title: Hatchery Performance and Implications for Steelhead Management in Washington State

Abstract: Washington's hatchery system represents a tremendous investment by its citizens. Hatchery origin steelhead provide a substantial recreational and economic benefit to Washington State residents and comprise the vast majority of the recreational fishery harvest of steelhead (96% of recreational fishery harvest in 2003-2004). However, the federal Endangered Species Act listings for several of the steelhead populations within the state has identified hatcheries as contributors to the natural population declines. There has been a fundamental paradigm shift in how we view hatcheries. They are no longer a replacement of habitat, but rather an integral part of the watershed in which they operate. Rather than focus on an unproductive debate over whether hatcheries are inherently good or bad, we began with the premise that hatcheries are a tool. The Hatchery Reform Project is a systematic science-driven redesign of our hatchery system to achieve two new goals: • Conserve naturally spawning populations • Support sustainable fisheries. The Hatchery Reform Project, when coupled with the recently completed Steelhead Science paper – Assessment of Washington Populations and Programs – lays the foundation for how we manage steelhead into the future to ensure healthy natural populations and healthy fisheries.

Kevin Goodson (Kevin.W.Goodson@state.or.us)
Oregon Department of Fish and Wildlife

Title: Steelhead management in Oregon: Providing long-term sustainability and ecological, economic and cultural benefits. Part 1.

Rhine Messmer (Rhine.T.Messmer@state.or.us)
Oregon Department of Fish and Wildlife

Title: Steelhead management in Oregon: Providing long-term sustainability and ecological, economic and cultural benefits. Part 2.

Abstract: “Managing Oregon’s steelhead (Oncorhynchus mykiss) populations to provide long-term sustainability, ecological, economic and cultural benefits.” -- This ambitious management objective is the cornerstone of the Oregon Department of Fish and Wildlife’s (ODFW) Native Fish Conservation Policy (NFCP) and is the basis for managing Oregon’s diverse steelhead populations. This presentation will review the scientific, political and social influences that helped shaped this important policy and how it will be used to direct steelhead management in Oregon for years to come. The presentation is broken down into two parts. First we will describe the need that gave rise to development of the new NFCP, how it was developed and the course it sets for steelhead management in Oregon. Included in this discussion is information on a status assessment of Oregon’s steelhead populations and the criteria used to evaluate the populations. Second, we will describe the practical application of ODFW’s fish management policies: how biological investigation, social desires, and political pressures shape management decisions for steelhead fisheries in Oregon. We will conclude with a discussion of actions that will affect ODFW’s ability to provide long-term sustainability of Oregon’s steelhead populations while providing ecological, economic and cultural benefits.

Dr. David Swank (david.swank@noaa.gov)
Southwest Fisheries Science Center, NMFS – Santa Cruz

Title: A life-history based model for management and analysis of Pacific Coast and Great Lakes steelhead populations.

Abstract: Steelhead populations exhibit a remarkable diversity of life-history patterns across their range that has important consequences for population dynamics and management. For example, variation in stream-phase growth and mortality may influence age at smolting (i.e., one to four years in the stream), ocean growth rate and age at maturity (i.e. number of years in the lake or ocean), and population growth rate. We developed a life-history model to explore the consequences of life-history decisions for steelhead population growth and management. We compiled life-history characteristics of representative steelhead populations in Lake Michigan, Lake Superior, and the Pacific Coast that vary in fecundity, stream and ocean (or Great Lake) phase growth and survival. On average, Great Lakes steelhead populations have lower ocean phase mortality and growth, higher stream phase growth and mortality, and lower fecundity than do Pacific coast populations. We used the model to compute population growth rates and optimal ages of smolting and maturity that produce the largest expected values of population growth rate for each region. We also conducted a sensitivity analysis to quantify effects of habitat-related changes in fecundity, and stream or ocean phase survival and growth on population growth rate.

Andrew Matala (Andrew_Matala@fws.gov)
Abernathy Fish Technology Center - USFWS

Title: Characterization and conservation of threatened summer run and winter run steelhead (*Oncorhynchus mykiss*) ecotypes in the Hood River, Oregon: implementing genetic based broodstock assignments.

Abstract: Conservation efforts to preserve threatened summer-run (SR) and winter-run (WR) steelhead trout (*Oncorhynchus mykiss*) in the Hood River, Oregon are implemented through a long-term hatchery supplementation program. Each year separate broodstocks are established from fish identified as SR or WR based on time of return, reproductive state, and other physical characteristics. However, these criteria become ambiguous during an overlap among the seasonal returns. Misidentification of fish retained for broodstock results in ecotype interbreeding in the hatchery, imposing a serious genetic risk on both populations. We characterized SR and WR life history differences, and used 22 microsatellite loci to investigate genetic structure among the ecotypes. Despite several years of out-of-basin stocking, temporally and spatially based differences persist among Hood River steelhead ecotypes. Neighbor-joining phylogram topology

revealed a grouping of SR adults and west fork juveniles, separate from WR adults, and juveniles of the east and middle forks. Range expansion and allopatric speciation of a single founding population may explain the observed divergence. We evaluated the feasibility of a genetic assignment test and log-of-the-odds ratio (LOD) calculation to differentiate SR (west fork) from WR (east and middle forks) based on a juvenile allele frequency baseline. Among adults of known origin, we observed 91.5% correct assignments for WR fish, and 77.7% correct assignments for SR fish. A rapid-response protocol was developed and initiated in 2005, which provided hatchery managers with genetic ecotype assignment results within 24-hours. Utilizing this protocol, 112 mature fish were evaluated and 39 WR and 32 SR individuals were retained for broodstock.

Symposium Discussion

Following the conclusion of the Symposium, an open forum for discussion was attended by 34 individuals, and topics concerning steelhead life history and management were discussed. The following is a summary of the discussion topics:

The discussion began with impressions of steelhead in the Great Lakes (GL) from West Coast (WC) representatives. The most obvious difference between the two was management; GL strive to optimize steelhead fisheries while WC optimize and maintain wild fish. This leads to different management views to obtain the desired results. Discussion followed that the GL future will change to managing for naturally reproducing stocks within specific streams and habitats that are able to support them. Allow the fish to indicate which systems were the best for pursuing this. Marking hatchery fish will become important in this approach, both to judge natural recruitment but also for management of the fishery (ie. harvest only clipped fish). The importance of refuge areas was mentioned and their importance towards long-term productivity. For GL, dam removal was mentioned as an issue, but sea lampreys must also be considered – this could be an obstacle for improving natural reproduction. Contaminant issues were also discussed, and it was mentioned that the high release rates might due in part to the fear of eating contaminated fish.

Catch and Release – Difference between user groups; stream anglers think of catching fish again while lake anglers think of fish as a meal. The snagging mentality is still hindering populations in many areas. Question was raised if too much catch and release can be harmful? There is dichotomy developing where fly anglers are complaining of egg fishermen catching too many fish. Can probably not have too much C&R on the GL's where natural production is not managed for, but on the West Coast excessive C&R may lead to excessive C&R mortality on wild fish. Washington developed a practical answer – keep a hatchery fish to limit incidental fish mortality when catching too many fish/day.

Social Issues - Social aspects of harvest were discussed between the WC and GL. Unlike the GL where harvest conflicts are common between lake and tributary user groups, social differences in harvest do not occur on the WC because only harvest is in streams; offshore populations and movement are largely unknown. No non-tribal commercial fishery except in BC where it is a major impact on returning fisheries.

Steelhead Movements - Offshore steelhead movements, albeit in a much smaller system, are largely unknown in the GL's as well. WC steelhead will occasionally turn up off the coast of Japan! Tag and recapture is main method to determine where they go. Anecdotal data suggests steelhead prefer temps of 10-15C if given choice. Some work on thermal preferences being done on Lake Ontario. Archival tags were put in 30 Kamloops strain steelhead in Lake Superior with data from 10 males in so far. In general, steelhead are considered surface pelagic species in oceans, and will move from one end to the other in the GL's.

Juvenile Recruitment – 150mm length seems to be the "magical" length where both wild and hatchery recruits survival. Some systems on WC need fish as large as 180mm to see returns. Disadvantage in that large smolts returned at younger ages, hence smaller sizes. Stocking size depends on goals and whether to mimic natural returns or not. Discussion on whether steelhead should be smolted before stocking or not. Washington stocks smolts at 180-220mm, and fish generally return to stream in which released, though it may not be the watershed in which it was reared (response of fish similar to that seen in Oregon). Oregon pond reared fish to smolting to obtain larger size, but found poor homing; fish stocked in streams homed better. Fish migrate at different sizes, and this may be an advantage and more close to natural populations. But have to balance what you get for returns. Oregon also relies on visual and ATPase cues to stock steelhead, and fish that don't out-migrate are moved to ponds for further growth. Mentioned that ATPase is not a silver bullet to indicate smolting – it is a very much more complicated physiological process. There is an advantage to large systems and hatchery programs in that they have the ability to more closely mimic what happens in natural populations.

Discussed exploring the release of different age classes as well as sizes to see what gets better returns. Might get too costly, but could be a good strategy on severely depleted stocked to re-establish fishery. Comments made that gains are not made by keeping fish in the hatchery longer as fish turn dumb and rely on hatchery feed. Again, fish less than 150mm get few returns. Genetics at work, and holding longer than normal is not optimal for fish. Bottlenecks for recruits are when fish enters GL systems, most likely from fish predation. Cormorants are a potential problem as well. Many smolts stocked upstream in GL never make it back to lake. WC – terns in ocean, and largemouth bass in streams. BC – seals are major problems, and more predation occurs in saltwater.

Fry Stocking Contribution – If object is to acclimate to stream, then why not do it? Oregon does some with limited success, but is this really a wild fish? Lake Superior has had success with fry stocking in some streams. Limited success seen in Credit River on Lake Ontario and in BC. Advantages of larger fish are so much more especially when trying to re-establish populations. Rather than stocking fry, would rather have wild fish spawning and naturally reproducing to repopulate stream.

Fall Migrants – The outward migration of juvenile steelhead in the Fall was mentioned in several talks, and it would appear that this is due to limited available habitat forcing some fish out of the stream. Survival of these fish probably depends upon whether they can find the right habitat and thermal regimes to survive to smolt. Thoughts are that most fish cannot find these conditions for another year and probably do not survive. However, steelhead are very plastic and seem to adapt and adjust to both changing and marginal conditions. L. Huron experienced best steelhead recruitment in 1992, which was the coolest summer on record due to Mt. Pinatubo eruption. Lake Huron returns indicate that small smolts that must migrate early have returned back to natal streams.

Joint Research – At the conclusion of the discussion, at least one joint research project was established exploring steelhead life history traits in the GL and WC. Further meetings between the two groups were also discussed with possibilities at the 2007 AFS Meeting in San Francisco or at the Westcoast Steelhead Workshop (tentatively scheduled for March 2008 in Boise, ID).

Symposium Expenses

Funding was needed to help with travel costs for several symposium presenters. The following table lists the travel expenses that were needed by individual participants. Registration costs ($395) were also covered for Gayle Zydlewski, bringing the total expenditures to $6,004.33. A grant ($3,000) from the Great Lakes Fishery Commission was used to help with these expenses, and New York Sea Grant (NYSG) covered the remainder of the balance. The New York Chapter of Trout Unlimited donated $200 towards a lunch for the symposium presenters, and NYGS covered the remaining cost of this as well. Cabela's donated gift certificates for each presenter. We wish to thank all of these organizations for their sponsorship and generous support of this symposium!

	Airfare	**Hotel**	**Meals**	**Totals**
Sean Hayes	400.50	581.44	151.20	1,133.14
Morgan Bond	306.50	570.00	151.20	1,027.70
Devon Pearse	370.70	Shared	151.20	521.90
Chad Hanson	362.70	Shared	151.20	513.90
Rhine Messmer	471.70	348.87	151.20	971.77
Kevin Goodson	728.21	561.51	151.20	1,440.92
TOTALS	**2,495.31**	**2,061.82**	**907.20**	**5,609.33**