ABSTRACTS OF PAPERS

In alphabetical order by *primary author's* last name

Session number listed after the abstract title

An asterisk "*" indicates presenter when primary author is not presenting the paper

Presenters for "Best Student Paper" competition are listed in bold type

Session: Bull trout

Monitoring Bull Trout Population Trends Using PIT-tags, Passive Instream Antennae, and Pradel Mark-recapture Models

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Bull trout, a threatened species of char native to the Pacific Northwest, have experienced significant declines throughout their range. The conservation and management of remaining bull trout populations requires explicit information about abundance and trend; however, this can be an especially challenging endeavor for populations that are composed of multiple life-history forms. The variability of traditional indices (e.g., redd counts) and high cost of abundance estimates, predicates the need to evaluate alternative techniques to monitor bull trout populations. We used individual mark-recapture data (2002-2005) in combination with passive instream antennae (PIA) to evaluate bull trout population trend estimates using reverse-time Pradel models. We used individual-specific tagging information to evaluate the ability to detect population trends, including different age/stage classes and life-history forms. When compared with trend estimates from annual abundance data, our results suggest that Pradel models may be more effective at detecting population trends. We also found the Pradel model effective for monitoring different components of the population, including the migratory component when in association with PIA. However, our results also illustrate the sensitivity of the Pradel model to violations of assumptions, and in particular, apparent changes in effort in response to environmental variability. Furthermore, we found that PIA detection efficiencies can have profound effects on estimates of emigration, and subsequent trend estimates, and need to be formally evaluated. Ultimately, our results suggest the Pradel model, in combination with PIT-tag technology, may provide an effective approach to monitoring salmonid populations; however, a well-though study design is imperative.

Session: Contributed Papers #3

Documenting *Oncorhynchus mykiss* life histories in Rattlesnake Creek and White Salmon River prior to the reintroduction of anadromous fish above Condit Dam

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From 2001 through 2005, we documented the characteristics of *Oncorhynchus mykiss* populations prior to anadromous fish reintroduction in the White Salmon River with the pending removal of Condit Dam in 2008. The dam has blocked upstream migration of anadromous fish at river kilometer 5.1 since 1913. To document the existing *O. mykiss* life history diversity, we combined radio and passive integrated transponder (PIT) tagging technologies. Radio tagging (n = 64) was performed in the mainstem White Salmon River from the reservoir above Condit Dam through the likely zone of anadromous fish recolonization (rkm 5.1 – 19.7). To document movement and growth patterns in Rattlesnake Creek and the White Salmon River, an instream PIT-tag interrogation system was installed in Rattlesnake Creek at rkm 0.2, and PIT tagging (n = 4,856) was conducted in several reaches. The *O. mykiss* in Rattlesnake Creek and White Salmon River exhibited a wide spectrum of migratory tendencies including resident, fluvial, adfluvial, lacustrine, and anadromous-type life histories. Our radio-tagging and PIT-tagging efforts in Rattlesnake Creek and the White Salmon River show that important linkages exist between the mainstem White Salmon River and tributary populations of *O. mykiss.* The knowledge gained by using a fusion of technologies was substantially greater than the use of a single technology.

Session: Bull trout

Use of an In-stream PIT-tag Detector System to Monitor Movement of Bull Trout between the Snake and Tucannon Rivers

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The ESA listing of the Columbia River Distinct Population Segment of bull trout identified one of the major threats to the species as fragmentation resulting from dams on over-wintering habitats of migratory subpopulations. At the time of listing, it appeared that a migratory subgroup in the Tucannon River may have utilized the mainstem Snake River for adult rearing on a seasonal basis. The occurrence of bull trout in the hydropower system had been verified by a few incidental observations during sampling in Lower Monumental Pool, Snake River and in the adult passage facilities at Lower Monumental and Little Goose dams in the early 1990s. PIT-tag antenna arrays deployed in Tucannon River in fall 2005 enabled monitoring of adult and sub-adult bull trout movement in the lower river. Based on data collected from bull trout implanted with PIT- and radio-tags, we were able to confirm that bull trout from the Tucannon River enter the Snake River. One PIT/RT bull trout was detected in the tailrace of Little Goose Dam, but no bull trout were detected by the PIT-tag systems at either Little Goose or Lower Monumental dams. These data will be used to help fisheries biologists to more precisely monitor population trends, identify recovery and extinction thresholds for conservation and recovery programs, and examine effects of recovery and restoration activities.

Session: Long-Term Monitoring

Status and Trend of Aquatic Habitat Conditions Since the Inception of the Oregon Plan Monitoring Program

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Monitoring programs implemented under the Oregon Plan for Salmon and Watersheds in 1998 were designed to assess the status and trends in fish populations and aquatic habitat in Oregon's coastal basins. Coordinated surveys of aquatic habitat, juvenile salmon rearing, and adult salmon spawning provide a comprehensive view of freshwater habitat, fish distribution, and abundance of salmon at the juvenile and adult life stages. Although land use and management actions have reduced the distribution of historically available high quality aquatic habitats, efforts to reduce the effects of anthropogenic disturbance and improve instream conditions are reflected in widespread restoration projects and additional protection measures. Habitat change is difficult to detect in the short term, however, and may require several years for a readily apparent trend to be discernable. We were challenged to detect an overall improvement in stream habitat across the coastal landscape in response to recent habitat enhancement actions. To meet this goal, sites were randomly selected using a rotating panel sampling design and monitored consistently at varying sampling intervals across the Oregon coast. We describe aquatic habitat conditions within coastal basins, discern trend in habitat conditions since 1998, and determine the relative contribution of the variance components influencing trend detection capabilities. We will also discuss the implications of this preliminary trend assessment on future habitat evaluation and comment on improvements to our current sampling design for sampling at the population scale.

Session: Contributed Papers #1

ODOT Fish Passage Program: "A Highway to Recovery"

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The Oregon Department of Transportation (ODOT) is responsible for the safe and effective state and federal transportation system within Oregon. In addition, ODOT provides good stewardship over the natural resources associated with ODOT rights of way. ODOT is committed to the protection, conservation, and recovery of native migratory fish species in the state; including healthy populations and those listed as threatened and endangered under state and federal statutes. These commitments, memorialized in the 1999 Executive Order No. EO 99-01 (Executive Order no. 99-01: The Oregon Plan for Salmon and Watersheds), defines state agency expectations as they relate to the Oregon Plan for Salmon and Watersheds (Oregon Plan). The purpose of the Oregon Plan, and reaffirmed in Executive Order 99-01, is to restore Oregon's wild salmon and trout populations and fisheries to sustainable and productive levels that will provide substantial environmental, cultural, and economic benefits and to improve water quality. ODOT's Fish Passage Program purpose is to satisfy the Oregon Plan commitments. The Program's primary goal is to replace or retrofit priority culverts for fish passage in the most aggressive, cost effective, and efficient means as practicable. To date, this Program has opened up over 400 miles of stream habitat to a wide variety of fish species. This presentation provides an overview of the ODOT Fish Passage Program.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon

Genetic Analysis of Threatened Foskett Springs Speckled Dace

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Foskett Springs is a small isolated desert spring in the Warner Basin of south-central Oregon containing an undescribed subspecies of speckled dace (*Rhinichthys osculus* spp.) protected under the U.S. Endangered Species Act. Uncertainty regarding the origins of Foskett speckled dace has raised questions about their evolutionary relationship to other, more abundant, populations in the Warner Basin. For example, speckled dace are the only species of fish in Foskett Springs suggesting they may have originated from anthropogenic transfers. To address these questions, we sequenced 1,982 base pairs (bp) of the ND2 and cyt-b genes of mitochondrial DNA (mtDNA) for 86 fish from Foskett Springs, the Warner Basin, and the adjacent Goose Lake Basin. We observed 58 unique mtDNA haplotypes defined by 96 bp substitutions in both genes. MtDNA sequences were highly divergent and reciprocally monophyletic between speckled dace from the Warner and Goose Lake basins with sequence divergences (5% and 3% at ND2 and cyt-b, respectively) in the range usually observed between fish species. In contrast, mean sequence divergence between Foskett speckled dace and other Warner basin populations was less than 1% with no evidence of reciprocal monophyly among mtDNA lineages. These results indicate that Foskett speckled dace and other populations in the Warner Basin are approximately equally diverged from one another evolutionarily, suggesting similar times of divergence since the late Pleistocene.

Session: Contributed Papers #3

Stock Composition of Sub-yearling Chinook Salmon in Four Seasonal Floodplain Wetlands on the Lower Willamette River

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Fish monitoring data at four wetland restoration sites in the Lower Willamette River have revealed extensive use by sub-yearling Chinook during the winter and spring when passage opportunity is available and environmental conditions are favorable. Tissue samples were collected from 140 age-0 Chinook salmon during 2005 and 2006 to

determine stock composition of juvenile Chinook inhabiting seasonal floodplain wetlands. Samples were screened using 13 microsatellite loci. The baseline data set for stock assignments contained 36 populations throughout the Columbia Basin. Not only were upper Willamette River spring Chinook and fall "tule" Chinook that likely originated from the Willamette River confirmed in the samples but also were Lower Columbia River fall and spring Chinook and interior Columbia River summer/fall Chinook stocks. The Columbia River estuary, including lower tributary reaches, may have historically served as a rearing corridor for Chinook with life-history types that used off-channel habitats for over-wintering. While much of the historic floodplain wetlands no longer remain accessible to fish, wetland restoration projects that increase hydrologic connectivity and fish-passage opportunity may provide important rearing habitat to sub-yearling Chinook with life-histories adapted to over-wintering while migrating seaward thus conserving life-history diversity and contributing to salmon recovery.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon

Status and Distribution of the Sand Roller in the Willamette River

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The sand roller, *Percopsis transmontana,* is endemic and considered rare in the lower Columbia River drainage, including the Willamette River and its tributaries. Historical records in the Willamette Basin are scarce. In 2005, we surveyed historical and some recently documented locations to determine the current distribution of sand rollers in the Willamette River basin. Sand rollers were found at 41% of the locations sampled, including most Willamette River subbasins. Sand rollers preferred slow water habitats in low gradient streams and were most frequently associated with roots, other large wood, and undercut banks over sand or gravel substrates. Sand rollers were more common at locations containing only native fishes; larger numbers were collected at locations where nonnative fish were absent. Infrequent reporting of this species is probably related to its secretive daily behavior and inefficient gear, rather than to actual rarity.

Session: Contributed Papers #2

Salmonid Fry Stranding Mortality Associated with Daily Reservoir Fluctuations in Trail Bridge Reservoir, Oregon

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Little information exists on the effects of reservoir fluctuations on stranding risk for early life stages of salmonids. This study focuses on the effects of hydropower-related reservoir fluctuations in Trail Bridge Reservoir, Oregon, where salmonids, including listed bull trout (*Salvelinus confluentus*) and spring Chinook salmon (*Oncorhynchus tschawytscha*), commonly rear. A distance-from-line sampling design was employed with permanently established transects to estimate stranding magnitude of juvenile salmonids during 30 surveys over three months in Spring 2006. All stranded fish observed during field surveys were mapped onto spatially rectified low elevation aerial photographs to assess patterns in stranding. Most fish were stranded in habitats with gradient <6%, typically in interstitial spaces among cobbles, and in "potholes". Fish were stranded in similar numbers following small or large fluctuations, and no relationship was apparent between the range in fluctuation and the number of stranded fish, or between the average rate of water surface decline and the number of stranded fish. Based on the extrapolation, we estimated a total of 470 spring Chinook salmon fry and 326 brook trout (*S. fontinalis*) fry stranded in Trail Bridge Reservoir. No bull trout were observed stranded as a result of project operations. Our findings suggest that stranding in Trail Bridge Reservoir could be reduced, while still retaining the hydropower function of the reservoir, by management actions focused on restricting fluctuations to specific elevations during vulnerable fish migration periods, or increasing the slope of areas identified as having a high stranding risk.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

A Multi-Scale Approach to Trout Survival and Movement in Headwater Streams

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Survival and movement are critical mechanisms that influence the dynamics of fish populations. Although these mechanisms have been studied separately, interactions between survival and movement are not well-documented. Because headwater stream habitat tends to be variable, movement among favorable areas is likely necessary to ensure survival. As a result, the interaction between survival and movement may provide a direct link between habitat conditions and fish persistence. We sought to explore variation in survival of coastal cutthroat trout (*Oncorhyncus clarkii clarki*) throughout a stream network and to evaluate the effects of movement (e.g., extent, timing, and locations) on survival. In order to accomplish these objectives, three headwater streams located in Douglas County, Oregon, were sampled continuously, and data were analyzed at three spatial scales (stream-segment, watershed, and among watershed). A total of 3,649 coastal cutthroat trout were implanted with half-duplex PIT tags and monitored seasonally over a 4-year period using a combination of electro-fishing, mobile antennas, and stationary antennas. Survival and movement were estimated using maximum likelihood models in program MARK, and AIC was used to assist with model selection. By incorporating a range of spatial and temporal scales into our models, we were able to investigate how scale-dependent factors (e.g., winter survival and spatial location) influence these mechanisms, and how synergism between them may help to identify stream characteristics that contribute to persistence of headwater-dwelling trout.

Session: "The Many Faces of Beaver: *Castor canadensis's* Search for Identity in Salmon Recovery (keystone species, furbearer, or pest?)"

Beavers as Agents of Recovery in Eastern Oregon: Fact or Fantasy?

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Across eastern Oregon's stream network and for many other streams in the Western US, beavers (*Castor Canadensis*) were once common. However, EuroAmerican trapping in the 1800s was soon followed by land uses such as grazing and agriculture. As a result, beaver populations were greatly diminished. From a riparian/aquatic perspective, beavers represent a keystone animal in many stream systems. Through the construction of dams, beaver can increase the frequency and amount of overbank flows onto adjacent floodplains, locally maintain high soil moisture levels in summer, increase hyporheic flows, store sediment on floodplains and in channels, and influence water temperatures. The damming and ponding of streamflow typically causes riparian and wetland plant communities to increase in size adjacent floodplains over time. In general, beaver ponds provide excellent rearing habitat for fish. When a beaver dam is breached, previously stored sediments are exposed and typically provide important substrates for species such as willow (*Salix* spp.) and cottonwood (*Populus* spp.). The periodic breaching and construction of dams creates an additional dynamic that increases the physical complexity of channels and the biotic complexity of riparian plant communities. For previously degraded stream/floodplains, beaver play a critical role in the restoration of such systems. However, since many floodplain systems associated with public lands in eastern Oregon are heavily grazed/browsed, the capability of these areas to support a beaver population and accrue important ecological benefits and functions cannot be currently realized.

Session: Redband Trout-Migrations in the Desert

Evaluation of Thalweg Variance to Assess Redband Trout Populations

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This study used successive longitudinal thalweg profiles in 1st to 3rd order streams with channel slope <0.2% in the Upper Klamath Basin, Oregon. At 12 sites from 1994 through 2006, data was collected at base flow on thalweg depths and channel widths at the reach scale, 20 times the wetted width. Bed topography for these sites consists primarily of riffles and pools. Variations in channel bed elevations, range in maximum and minimum depths, and mean wetted channel width was used to quantify morphology diversity. The equation range in thalweg depth squared divided by the mean wetted width provided a Reach Index (R_I). We found a strong relationship between annual precipitation and R_I when the R_I was >0.06. However, when the R_I was <0.06 there was no relationship to precipitation. Fish populations were estimated for each reach using block nets and 3 to 5 pass depletions. While Redband trout (*Oncorhynchus mykiss*) populations fluctuate annually we found a strong relationship specific for each reach, and each year between redband trout biomass (g/m^2) and the R_I. In contrast, the proportion of brook trout (*Salvelinus fontinalis*) decreased as the R_I increased. The implication of reach scale habitat condition influencing salmonid biomass and species composition may offer a means to address limiting factors and potentially by increasing habitat quality reduce competition between native and non-native salmonids. Restoring the mechanics of flow regime as a disturbance mechanism and to sustain ecological diversity and natural selection may be enhanced when the R_I is > 0.06.

Session: "The Many Faces of Beaver: *Castor canadensis's* search for identity in salmon recovery (keystone species, furbearer, or pest?)."

Beavers in Commercial Forests: Benefits, Problems and Current Approach to Management in Oregon and Washington

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The construction of dams, felling of riparian trees and dam construction by beavers alters the hydrology, chemistry, thermal characteristics and productivity of streams both in the area directly influenced by the beavers as well as downstream. The system alterations caused by beavers create conditions favorable to some fishes by creating slow-water habitats, enhancing water storage capacity that can buffer the effects of high flows, and enhancing trophic productivity. Despite their admirable qualities, beavers have not always been viewed favorably by forest managers. Beavers kill trees by cutting and by inundation. Beavers also build dams above culverts, saturating road fills and making the roads susceptible to flooding, surface erosion or catastrophic failure. Beavers were aggressively trapped in commercial forests for many years to reduce damage. In the past decade, use of this option has declined due to fewer trappers and the recognition that the number of trees cut and the area flooded by beavers is limited. Impacts of beavers on roads remains a problem and trapping is still used to address this issue. Engineering solutions also are applied, including the installation of mesh cages or perforated pipes on the culvert opening to discourage dam construction. Engineering solutions do work but often cause secondary problems such as restricted fish passage or rapid sediment accumulation. Therefore, these devices require frequent maintenance. More exotic techniques, such as hanging bear skin in culverts, are considered viable alternatives by some but have not been fully evaluated. In general, beavers and commercial forestry are compatible and beavers may represent an effective and inexpensive method of enhancing fish habitat in managed forests.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Divergent Anti-predator Strategies Affect Foraging Behavior in Three Species of North Pacific Flatfishes

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Juvenile Northern rock sole (*Lepidopsetta polyxystra*), English sole (*Parrophyrs veletus*), and Pacific halibut (*Hippoglossus stenolepis*) cohabit nearshore nurseries off the southern coast of Alaska. Recent work suggests that young-of-the-year exhibit divergent anti-predator strategies: rock sole are risk-averse (remaining cryptic in both presence/absence of predators), English sole are risk-prone (choosing conspicuous behaviors regardless of predator presence) and halibut are risk-sensitive (modifying behavior in response to risk). The aforementioned study examined a brief period during risk and did not explore the potential indirect effects of predation on feeding and growth. We hypothesized that these divergent anti-predator strategies impact foraging behavior and habituation to risk, with implications for longer-term physiological processes. We conducted laboratory experiments with age-0 juveniles exposed to three levels of predation risk: control (no risk), low (risk 2x/day) and high (risk 5x/day). Experimental trials lasted five-days, with indices of posture, burial, activity and feeding recorded during and after risk events on days 1, 3 and 5. As predicted, rock sole remained inactive during low- and high-risk treatments and were the least likely to habituate to predator presence. English sole habituated rapidly and fed during risk events by the end of the five-day experiment, particularly under high risk. Halibut also habituated to predatory exposure, but remained unwilling to feed during predation risk, instead feeding soon after cessation of risk. Our results suggest that these different risk responses are associated with tradeoffs in foraging behavior, which could potentially explain dissimilar growth trajectories observed for the three species.

Session: Long Term Monitoring

Knowles Creek (Siuslaw River, Oregon) Long-Term Monitoring Project. Is there evidence that restoration work can influence production in a "hosed" coastal sandstone stream?

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Streams which run from the Coast Range in to the Pacific Ocean once produced outstanding runs of salmon and steelhead. The Siuslaw River alone produced over 250,000 coho salmon per year. Over the past century these runs have declined to <1,000 coho in the late 1990's or <0.5% of historic runs. Splash dams, landslides, overfishing, ocean conditions, and wood removal all contributed to the decline. Knowles Creek, a Siuslaw tributary, has seen most of these influences. In the 1990's, representatives from an industrial timber organization, an environmental group and the federal government embarked on a mission to see if they could work together to restore some of the function of this tributary and monitor those changes. Since 1992, the USFS, Florence Salmon and Trout Enhancement Program volunteers and Pacific Rivers Council have monitored smolt abundance in Knowles Creek. During this same period juvenile salmonid summer abundance was collected, and adult spawner abundance has been collected for the whole basin since 2002. Within the 1992-2006 timeframe many events have occurred that have influenced the production of the Knowles Creek basin including the flood of record in 1996, three drought periods, numerous instream restoration efforts, and continued timber management on the industrial timber lands. In this presentation, the discussion will focus on the smolt trap and whole basin spawning survey data and how that data provides insight in to the effects of the events mentioned above. A separate presentation by Charley Dewberry that discusses the juvenile monitoring is planned as well.

Session: Evaluation of salmonid production in management decisions for hydroproject relicensing

Modeling Biological Effects on Salmonids Resulting from Hydropower Operations in Oregon

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We developed a life cycle simulation model to assess long-term population response resulting from changes in temperature and flow caused by hydropower operations in Oregon Rivers. The purpose of the model is to predict and quantify the change in salmonid production (from historic to current) over multiple brood years and help to clarify the specific population bottlenecks associated with changes in habitat. The model is a simple excel

spreadsheet designed to model production of Chinook, coho, and steelhead separately. Production of each species is simulated under various thermal and/or flow scenarios to evaluate the effect of changing conditions on model outcomes. Dividing the hydroproject area into reaches provides the model with sufficient spatial resolution to capture differences in thermal and flow regimes experienced by fish in different portions of the project area. The same framework is used to evaluate population response to different restoration strategies targeted to reduce constrictions imposed by population bottlenecks.

Session: Columbia River Basin Issues

Evaluating the Use of Kelt Reconditioning to Rebuild Steelhead Populations in the Yakima River, Washington

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Populations of wild steelhead in the Columbia River Basin have declined dramatically and are listed under the Endangered Species Act. One approach to increase abundance and productivity of steelhead populations is to capitalize on their inherent iteroparity by artificially reconditioning post-spawners (kelts). From 2001-2005, the Yakama Nation and cooperators tested the use of short- and long-term reconditioning as methods for increasing the survival and repeat spawning rates of steelhead kelts in the Yakima River in south central Washington State. Outmigrating kelts were collected at Prosser irrigation diversion dam. Over 90% of the kelts were female. In short-term reconditioning, kelts were held for approximately 3-11 weeks to initiate post-spawning feeding, and were then transported around Columbia River hydroelectric facilities and released, with natural rearing and gonad rematuration occurring in the ocean. In long-term reconditioning, kelts were reared for 6-10 months in a captive environment to reinitiate feeding, growth, and rematuration. This talk will present results from the first five years of this ongoing study.

Session: Marine

Preliminary Findings From a Study of Juvenile Rockfish (genus *Sebastes*) Feeding Habits Off the Coast of Oregon and Washington

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Early life history stages of marine fish suffer high mortality rates making this period a critical determinant of year-class strength. Despite this importance, few studies have looked at the feeding habits of young-of-the-year rockfish (*Sebastes* spp.) off Oregon—information crucial to understanding how these fish may be influenced by bottom-up processes. We undertook a study of the feeding habits of juvenile rockfish collected off the Oregon Coast during GLOBEC Predator Surveys. The predominant species collected in 2006 were darkblotched (*S. crameri*), canary (*S. pinniger*), yellowtail (*S. flavidus*), and widow (*S. entomelas*) rockfishes. Preliminary analysis of gut contents (% number) revealed that darkblotched rockfish had a high degree of variation in diet comprised of all life-history stages of euphausiids, as well as amphipods and copepods. Canary, yellowtail, and widow rockfishes had a high degree of dietary overlap, comprised primarily of copepods and furcilia-stage euphausiids. There was less overlap in diets between species when % wet weight was examined, with only canary and widow rockfish showing significant similarities. Additionally, tissue samples for stable isotope analysis were dissected

from the juvenile rockfishes and those results confirmed that all were feeding at nearly the same trophic level while darkblotched had enriched carbon values relative to the other species. Taken together, the stomach content and stable isotope data will advance our understanding of some of the important environmental factors that effect young-of-the-year rockfish during their pelagic phase.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers
Movement Patterns and Growth of Lahontan Cutthroat Trout; A Whole Stream Whole Population Analysis
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Student

After almost 30 years of conservation effort, Lahontan cutthroat trout (LCT) (Oncorhynchus clarki henshawi) populations remain in peril throughout the Great Basin region of southeastern Oregon and Northern Nevada. This is not surprising because very little research has been done on the ecology of LCT, forcing managers to make uninformed decisions. Our study was conducted on three low order streams in southeastern Oregon and northern Nevada. Streams consisted of headwater, canyon, and valley segments, with fish in all three streams potentially being affected by low discharge and high temperatures during the summer and anchor ice during the winter. The use of half duplex pit tags and multiple, contiguous whole stream surveys allowed us to track the movement, growth, and survival of most adult (>100mm) LCT within the system and thus avoid problems associated with examining only a portion of the population or stream. Although movement was rare especially in headwater sections, it may be important because fish whose movements were greater than the median had higher per day growth rates than fish with movements below the median. Our results will be useful in determining the importance of movement and connectivity in low order streams throughout the Great Basin, and thus allow informed management decisions to facilitate the recovery of the species.

Session: Diamond Lake Mini-session
Mechanical Removal of Biomass for the 2006 Diamond Lake Restoration Project
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Public interest in reducing the nutrient load of Diamond Lake during the Restoration Project was addressed with mechanical removal of tui chubs both before and after the lake was treated with rotenone in September 2006. Estimates of the biomass in the lake prior to treatment year were based on stocking regimes, a statistically based population estimate, and hydro acoustic mapping. Contracts were developed for pre and post treatment periods with an overall goal of removing 50% of the estimated total biomass (200,000 lbs) with as little impact to lake recreation and the sport fishery as possible. In addition to the contracted work, an ODFW crew was hired to monitor and guide the removal activities prior to treatment, sample overall fish composition (size, weight, and species), and distribution. Total numbers will be estimated and pounds will be calculated from the available data.

Session: Coho salmon use in estuaries and tidelands
Alsea Estuary Coho Salmon Smolt Observations During the Late 1990's
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Oregon Coast coho salmon declined to unprecedented levels during a period of poor ocean conditions in the 1990's. Some populations including the Alsea Basin population exhibited more severe declines than others. The life stage responsible for the severe decline in the Alsea appeared to be smolt survival after they left tributary streams (or the hatchery), and prior to being mixed in the open ocean. A negative correlation was also observed

between density of wild spawners in a basin and volume of hatchery releases. An investigation was initiated to examine factors responsible for the poor coho performance in the Alsea and other basins. The Alsea, Yaquina and Siletz lower estuaries were sampled using beach seines from March through June, 1997-99. Wild and hatchery coho smolt were collected to examine diet, disease loads, and observations were made of potential predation. Results indicated competition for food was not likely the problem. Hatchery smolt did not feed extensively in the estuary while wild smolt appeared well fed. Disease loads also did not explain the poor performance in the Alsea. However, predation in the Alsea Estuary associated with hatchery coho smolt releases appeared to be substantial based on visual observations. During predation episodes, wild coho smolt were in the same habitats and may have been schooling with the larger hatchery smolt. Following the last release of hatchery coho from Fall Creek in 1998, the intense predation was no longer observed.

Session: Marine

Reducing Bycatch in U.S. West Coast Recreational Groundfish Fisheries: Evaluation of the Effects of Increased Bait Height Above Bottom on the Catch of Demersal Rockfishes (*Sebastes*)

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This study evaluated whether increasing the elevation of angled artificial baits above the bottom could be useful in reducing the bycatch of demersal rockfishes such as yelloweye rockfish (*Sebasted ruberrimus*) in recreational fisheries. Angling gear equipped with 3.0 and 4.6 m leaders (long leaders) separating the terminal weight from the lowermost bait reduced catch rates of large (>29 cm) yelloweye rockfish by 100% ($P < 0.10$) in nearshore (shoreward of the 73 m isobath) fishing and 79% ($P < 0.05$) in offshore fishing in comparison to the control gear configuration. Long leaders also reduced catch rates of large canary rockfish (*S. pinniger*), lingcod (*Ophiodon elongatus*), and other demersal rockfish. Long leaders reduced or eliminated the catch of many small rockfish likely to be discarded by anglers. Target species catch rates were not significantly reduced for Pacific halibut (*Hippoglossus stenolepis*) or large black rockfish (*S. melanops*) and were increased for yellowtail rockfish (*S. flavidus*), widow rockfish (*S. entomelas*) and blue rockfish (*S. mystinus*). Replicate drifts over the same habitat with and without long leaders showed that gear interactions were not the cause of reductions in yelloweye rockfish bycatch and also suggested that bycatch reduction for canary rockfish may be density-dependent with the greatest reductions in areas with low densities of this species.

Session: Early life history research and monitoring

Estimating Juvenile Lost River and Shortnose Sucker Near-shore Habitat Use in Upper Klamath Lake, Oregon: A Patch-Occupancy Approach

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Habitat use for age-0 endangered Lost River (*Deltistes luxatus)* and shortnose suckers (*Chasmistes brevirostris)* in Upper Klamath Lake, Oregon is not well understood. Previous attempts to describe habitat use for these species may have been confounded by differences in detection probability among habitat types. We used presence-absence data in a patch-occupancy framework to evaluate habitat use and estimate detection probabilities for age-0 suckers over six substrate types and in vegetated and non-vegetated areas in Upper Klamath Lake. Patch occupancy is an extension of capture-recapture theory that allows for estimation of the proportion of sites occupied by a species as well as detection probability. We modeled potential inconsistencies in detection probability among sites and samples, as a result of differences in nets used, length of time nets were set, orientation of nets, vegetation, substrate, temperature, relative abundance of juvenile suckers, and depth. The proportion of sites occupied was inversely related to depth, within the range of depths we sampled (0.4 m to 3.0 m), particularly at end of the summer. Results indicated age-0 suckers were more likely to use habitats with small substrate (fines,

sand, and gravel) than large substrate (mixed substrate sizes, cobble, and boulder), and habitats with vegetation than without vegetation. Detection probability was most affected by abundance of juvenile suckers, which was greatest in the middle of the summer. Our results suggest planned and ongoing restoration of shallow lacustrine habitats will likely increase the quality and quantity of available rearing habitat for juvenile suckers in Upper Klamath Lake.

Session: Data Management/Sharing

Computers Make Cheap Field Technicians: Automating Data Retrieval and Organization.

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Whether using remotely-sensed tags for small-scale animal movement studies or to assess large-scale behavior and survival, data retrieval and organization are often some of the most time consuming and technically challenging aspects of a research project. Furthermore, the complexity and quantity of telemetry data can make analysis and interpretation difficult. We describe steps one can take to automate much of this process, increasing overall project productivity, accuracy, and reliability. Specifically, we discuss data handling for four telemetry projects with sample sizes (tags used) ranging from 30 to 30,000. For these projects, we collected data via an array of stationary telemetry receivers, and supplemented this with periodic mobile tracking. At regular intervals, the receivers were manually or automatically downloaded. Data were sent to a local server and loaded into an Oracle database, where they were filtered and summarized. The automation scripts sent an email each morning with fish detection summaries and receiver diagnostics. The level of automation varied among projects and depended mostly on budget and time constraints. This timely supply of information can often drive the schedule for tagging additional fish and/or receiver maintenance and repair, reducing the downtime of receivers and increasing efficiency of biologists. Moreover, any or all of these steps can be modified to fit individual research projects, regardless of scope or tagging methodology.

Session: Columbia River Basin Issues

The Influence of Discharge on Recruitment of Age-0 White Sturgeon in the Columbia River between Bonneville and McNary Dams

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Development of the hydroelectric system and the construction of mainstem dams on the Columbia River have relegated white sturgeon *Acipenser transmontanus* populations to a series of impoundments. Systematic sampling for age-0 white sturgeon in lower Columbia River impoundments is conducted annually during the fall to index the relative success of spawning that occurred during the previous spring and summer. Using indices of age-0 abundance dating back to 1989 for Bonneville Reservoir and to 1997 for The Dalles and John Day reservoirs, we found that relative spawning success was positively correlated with average dam discharge during May-July. Years with average May-July dam discharges of approximately 250 kcfs or greater have had the greatest observed levels of spawning success.

Session: Coho salmon use in estuaries and tidelands

Wild Coho Salmon Do Use Estuaries

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The Oregon Coho Salmon Conservation Plan statement "that considerable uncertainty exists regarding the duration and value of estuarine residence by juvenile and adult coho; and the potential to improve estuarine habitat to the benefit of coho and other native species." could imply that estuarine use and estuary conservation for coho is of little value. The hypothesis that coho salmon smolts do not use estuaries was investigated in a comparison of diets of wild and hatchery coho salmon smolts in three adjacent Oregon estuaries between 1997 and 1999. Despite similar ocean and watershed conditions, Alsea River coho salmon production declined dramatically, Yaquina River coho salmon production increased and the Siletz River production remained low, but stable in the 1990s. Wild coho salmon smolts foraged on intertidal invertebrates in all three estuaries while hatchery coho salmon smolts, observed mainly in the Alsea system, consumed nothing or non-food items such as sticks. The different feeding successes of wild and hatchery coho salmon correspond with greater sizes and fat reserves of hatchery-released smolts. However, ability to forage and identify prey items in lower estuaries by wild coho smolts may allow greater success relative to hatchery coho salmon during poor ocean conditions.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon

Genetic Diversity in the Cow Head Tui Chub and Other Tui Chubs From the Northwestern Great Basin

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The Cow Head Tui Chub, *Siphateles bicolor vaccaceps*, is restricted to the small Cow Head Basin in extreme northeastern California and northwestern Nevada. Using 10 microsatellite DNA loci, we found extensive genetic variation among tui chub populations in the Cow Head and surrounding basins of eastern Oregon and northern California. Our data support the distinctiveness of the Cow Head Tui Chub from those in neighboring basins, including the Warner Basin into which Cow Head watershed drains. Tui chubs from the Warner, Goose, and Pit River basins are genetically similar, as are those from the Catlow and Guano basins. Summer and Abert basin tui chubs appear distinct, both from each other and from tui chubs in the other basins. Genetic diversity in the Cow Head population is similar to that of stream-associated populations, but lower than in large lake-associated populations, such as those in Warner and Goose lakes.

Session: Early life history research and monitoring

Variation in Juvenile Coho Salmon Summer Abundance: Hierarchical Analysis of Habitat Effects

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Varying habitat conditions found across a stream network during the summer months may limit the abundance of salmonids such as coho salmon (*Oncorhynchus kisutch*). We examined the abundance of juvenile coho salmon across a stream network in an Oregon coast range basin from 2002 through 2005 to understand the influence of summer habitat and conditions on coho parr abundance. We developed a hierarchical linear mixed effects model to predict habitat unit parr abundance that utilized habitat variables measured during the summer at multiple spatial scales (habitat unit, reach, stream), and an information theoretic approach to select the best approximating model for habitat unit summer parr abundance. The best approximating model fit the data well and contained measures

of habitat unit area, temperature, discharge, and water quality. Habitat unit coho parr abundance was positively associated with habitat unit area within stream reaches; however, the magnitude of this effect was variable across the stream network. There was a strong negative interaction of minimum summer discharge and pool area indicating that larger pools located in the mainstem of the stream network are not utilized to the same degree as smaller pools. Measures of nitrate, phosphorous, and temperature had small positive effects in the in the model. This model will be used to complement an analysis of end of summer coho weight and condition and investigate environmental and restoration scenarios.

Session: Contributed Papers #2

Fish and Amphibian Use of Vegetated and Non-vegetated Intermittent Channels in the Upper Willamette Basin

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Intermittent agricultural drainages found in the lowlands of the upper Willamette Basin provide habitat characteristics that may be preferred by native species of fish and amphibians. Vegetated substrates and lack of vegetation growing in the channels are the most common habitat differences amongst intermittent watercourses. Current grass-seed farming practices involve either seeding intermittent channels with a water-loving grass species or mechanically or chemically removing the vegetation. Neither practice has looked at possible implications for resident fish and amphibian populations. Past results indicate that vegetated substrates provide an order of magnitude more invertebrates than the adjacent hard pan clay substrates as well as provide cover for some fish species. We expect that the cover and increased food availability provided by vegetation would increase the abundance and diversity of fish and amphibian assemblages using this seasonally available habitat. In the fall through spring 2005-2006, we sampled fish and amphibian communities and compared them between twelve seasonally dry channels draining tributaries of the Willamette River in western Oregon. Six channels were selected as vegetated or had a high proportion of rooted vegetation covering the substrate and the remaining six had very little or an absence of vegetation in the channel. Preliminary results showed a high variability in the abundance and diversity of fish and amphibians using the intermittent watercourses. A few non-vegetated channels had very high abundances of fish, but were dominated by only one species. In contrast, a few vegetated channels had relatively low numbers of fish but high species richness.

Session: Implementation of Native Species Reintroductions

Reintroduction of Spring Chinook Salmon into the Umatilla and Walla Walla Rivers

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Spring Chinook were extirpated from the Umatilla and Walla Walla River Basins more than eighty years ago. Restoration efforts have focused on fish passage improvements, flow augmentation, habitat improvements and the reintroduction of hatchery spring Chinook salmon (Carson stock). The Umatilla Tribe's initiatives were coordinated with ODFW and funded by BPA and have produced significant adult returns of hatchery and natural origin adults in both basins. Hatchery smolt releases beginning in the 1980s in the Umatilla River have produced adult returns as high as 5061 (2002), which have been sufficient to provide fisheries, for both sport and tribal interests during 13 of the last 17 years. Restoration efforts began experimentally in the Walla Walla Basin in 2002 when the tribe began out-planting hatchery surplus adult Chinook from the Umatilla River into the Walla Walla River to spawn naturally. Subsequently, a hatchery program was instigated through US v. Oregon negotiations that currently includes an annual release of 250,000 smolts. In both basins, hatchery and natural origin adults spawned and produced viable offspring that emerged, reared, and migrated to the ocean at similar sizes and times as wild populations in adjacent systems. Prespawning mortalities are directly correlated with maximum summer water temperatures and are often less than 5% in reaches with suitable temperature profiles.

Session: "The Many Faces of Beaver: *Castor canadensis's* Search for Identity in Salmon Recovery (keystone species, furbearer, or pest?)"

Understanding the Beaver's Role in Coho Recovery

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Research shows that slow water areas created by beaver dams are important rearing habitat for Oregon coastal coho. As the quantity of beaver dams increase, so does the number of important rearing location for coho. Some speculate that regulated trapping or beaver management to reduce property damage may decrease or limit the number of beaver dams, thus reducing coastal coho rearing habitat. However, surveys show that most coastal beaver are taken from tidewater areas where dam construction does not normally occur. Very few beaver are harvested from important coho rearing areas. Research also shows that beaver numbers and the number of beaver dams are not related. Therefore, beaver population size cannot be used as a surrogate for the number of dams in a specific stream reach. Low numbers of beaver dams does not equate to low beaver populations. A critical aspect of the coho/beaver relationship is the stream characteristics where dams are built. Not all areas with beaver dams are useful to coho recovery. Emphasis should be placed on surveys that build from existing data. The following additional information is needed to successfully increase the number of beaver dams and assist in coho recovery:
Identify the potential of a stream reach to support and maintain beaver dams;
Identify the number of dams that currently exist in that stream reach;
For those sections below potential, survey possible reasons why;
Take appropriate corrective actions to increase dams in high potential areas;
Monitor actions taken to determine response; and
Use adaptive management to adjust future actions.

Session: Evaluation of salmonid production in management decisions for hydroproject relicensing

Use of Stream Habitat Surveys to Predict Rearing Capacity for Juvenile Steelhead (*Oncorhynchus mykiss*) at Different Flow Levels

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The Unit Characteristic Method (UCM) is a model for estimating the capacity of a stream to rear juvenile steelhead (*Onchorhynchus mykiss*). The UCM is a habitat-based model that is driven by habitat features typically measured during stream surveys, including surface area by unit type, depth, substrate, and cover. The model incorporates the influence of a stream's inherent primary productivity as indicated by alkalinity and turbidity. Model estimates provided reasonable predictions of observed juvenile production in well seeded watersheds. Model predictions of capacity have been shown to be highly significantly correlated to observed capacities. Model predictions under-estimated capacity within smaller basins, and over-estimated capacity within larger basins, though capacity estimates were typically within +/- 35% of observed capacities. The UCM provides the ability to understand the production potential of a basin, and to gain insight into factors limiting production. The method can also be used to evaluate potential gains in production from habitat restoration, or losses from degradation as well as to examine the effects of changes in low flow levels on juvenile steelhead production.

Session: Coho salmon use in estuaries and tidelands

Coho Salmon in Southeast Alaska use Estuaries and Marine Waters Prior to Smolthood

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Coho salmon have been commonly thought to rear strictly in freshwater before smolting, with only limited use of estuaries. In many Southeast Alaska systems, however, a fall upstream migration by bright immature fish coincides with the migration of mature adults and jacks. These immature fish presumably over-winter in freshwater and re-enter the sea as smolts in the spring. Coded-wire tag recoveries indicate that some of these immature fish are not returning to their natal stream but have traveled via marine waters to systems up to 100 km or more from their stream of origin. Growth patterns and Sr/Ca ratios, indicative of exposure to marine environments, from smolts recovered in systems distant from their marking location show that some rearing coho salmon spend much of the growing season in marine or estuarine waters. In one surprising instance, a smolt shows marine strontium exposure soon after emergence from gravel and it appears to have reared primarily in marine waters for two summers, re-entering freshwater only to overwinter for two winters before smolting. Before the second re-entry into freshwater for overwintering, it traveled over 65 km via marine waters from the Chilkat River to the Berners River. Estuarine and marine environments likely provide a feed-rich but high-risk option to surplus fry that are unable to obtain sufficient food resources in the highly competitive stream environment. Additionally, estuarine and marine waters provide migration corridors that permit juvenile coho populations to access and exploit isolated freshwater environments that might otherwise remain inaccessible and under populated.

Session: The Pelton Round Butte Story

Design of the New Selective Water Withdrawal and Fish Capture Facility at Round Butte Dam

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Because Round Butte Dam is an earth and rock fill dam approximately 400 feet high, with the present intake 270 feet deep, designing a new intake that will allow surface withdrawal for temperature control and fish guidance presented many challenges. The structure to be built by summer 2009 will consist of three major components; a floating surface withdrawal facility, a bottom water withdrawal facility, and a 40-ft. diameter vertical flow conduit connecting surface and bottom withdrawal facilities. These components will seal together, meeting seismic design standards, while allowing the vertical flow conduit to slip into the surface facility to allow operation over a 20-ft range of forebay elevations. The 150-ft long by 90-ft wide rectangular floating surface withdrawal structure will held in place by a 287-ft. long strut attached to shore. The facility will allow withdrawal of up to 3,000 cfs of surface water through each of two 30-ft wide by 40-ft deep rectangular fish entrances. All but 30 cfs of the flow will pass through V-shaped fish screens within each entrance at "smolt" criteria, down the vertical flow conduit and into the powerhouse. Fish will travel in 30 cfs over a capture weir, with flow dewatered to 12 cfs and passing through a large fish separator, removing fish larger than about 15 inches. Fish smaller than 15 inches will be pumped to the shoreline-associated Fish Transfer Facility. My presentation will illustrate and describe the design and future operation of the new intake structure associated facilities at Round Butte Dam.

Session: Columbia River Session

Predicting Differential Impacts of Climate Change at the Population Level Using Life-cycle Models of Spring Chinook Salmon

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Few studies of the effects of climate change incorporate detailed population dynamic models. Even fewer consider differences between populations in the driving environmental factors that affect population dynamics. Nonetheless, genetic and habitat differences mediate environmental impacts, and often differ between populations. We previously identified such differences in 15 populations of threatened Chinook salmon from central Idaho. We here explore the consequences of different forcing factors for juvenile survival (streamflow vs. temperature) for the population viability of 4 of these populations. We developed a stochastic, density-dependent life-cycle model with independent environmental impacts in juvenile and ocean stages, parameterized for each population, and

compared population viability in the current climate with 3 climate change scenarios. We found that mean abundance decreased and the probability of quasi-extinction increased dramatically for all populations. Differences between populations were greatest in more moderate scenarios. Model results were more sensitive to ocean survival parameters in the current climate, and to freshwater survival parameters after climate change. We conclude that global warming poses a direct threat to freshwater stages in these fish, increasing their risk of extinction. Our results demonstrate that detailed population models can usefully incorporate climate change predictions, and that differences between populations in their responses to warming should inform conservation decisions.

Session: Lamprey Papers

Direct and Indirect Effects of Barriers to Migration-Pacific Lamprey and the Columbia and Snake River Dams

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Barriers in migration, such as dams and roads, have both direct and indirect effects on species. This study specifically focuses on how migrational obstacles can prevent Pacific lamprey from accomplishing distinct life cycle events. During the 2005 and 2006 inland migration of adult Pacific lamprey, 120 lamprey were equipped with a Half-Duplex PIT tag and a coded radio tag, while another 70 received only a Half-Duplex PIT tag. The lamprey's movements were then monitored through McNary and Ice Harbor Dams. During 2006, 29 adult Pacific lamprey were collected from Bonneville and McNary Dams to undergo disease and proximate analysis. Another 50 adult lamprey were captured at Lower Monumental and Little Goose Dams, and released above Lower Granite Dam to establish the spawning distribution and habitat in Idaho. It was determined that 47.5% (38 out of 80) and 55.0% (22 out of 40) of the radio-tagged fish released below McNary and Ice Harbor Dams, respectively, re-ascended to the dam and were recorded via radio telemetry outside a fishway entrance. At McNary Dam, 60.5% (23 out of 38) of the fish that approached an entrance eventually passed the dam. This measurement was 59.1% (13 out of 22) at Ice Harbor Dam. Individual movements of lamprey through fish ladders showed that potential problem areas for adult Pacific lamprey include fishway entrances and exits, the top of the transition pool, and areas associated with diffuser grating. In the disease analysis, *Aeromonas hydrophilia* was the only disease agent found in the 29 lamprey collected.

Session: Lamprey Papers

Adult Lamprey Passage through the Columbia River Hydrosystem: Large-scale Monitoring using Half Duplex PIT-tag Interrogators

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Radiotelemetry and behavioral experiments have revealed that upstream migrating Pacific lamprey (*Lampetra tridentata*) may have difficulty negotiating fishways at hydroelectric facilities. In 2005 and 2006, an array of half-duplex PIT-tag antennas was installed at Bonneville, McNary, and Ice Harbor dams to monitor tagged lamprey released downstream from each dam. We expanded coverage in 2006 to include The Dalles and John Day dams. Of 1,102 fish tagged and released in 2005, 12 fish over-wintered and were redetected in the 2006 migration season. We tagged a total of 2,148 fish in 2006, of which 1,032 (48%) were detected upstream of the release site. Of all fish released below Bonneville Dam (n = 2,050), 6.2% and 1.4% migrated to McNary and Ice Harbor dams, respectively. After release below Bonneville Dam, fish took about 5 weeks (median = 36.7 days) to migrate to the

top of McNary Dam. Overall detection efficiencies at each dam ranged from 69.7% - 98.9% and were affected by fishway configuration, detector design and placement, detector redundancy, and the electrical characteristics of each site.

Session: Long-term Monitoring

The Impacts of a Segregated hatchery Coho Salmon (*Oncorhynchus kisutch*) Program on Natural Smolt Productivity in the North Fork Nehalem River, Oregon

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For the 1996-2004 brood-years, relationships among annual wild and stray hatchery coho salmon (*Oncorhynchus kisutch*) spawner abundance, average return day and peak spawning period, and smolt productivity (smolts per inventoried smolt capacity), in the North Fork Nehalem River upstream of the Nehalem Hatchery demonstrated that hatchery influences, predominantly due to biologically inappropriate goals and broodstock management rather than inherent ill-effects of propagation, severely impacted smolt production. A large majority (87%) of variation in smolts/capacity productivity was explained by two highly significant ($p<0.001$) predictor variables in multiple linear regression: productivity was positively dependent on later average return day (accounting for about 70% of the overall relationship), and negatively dependent on increases in hatchery spawner percentage. Average return day was earlier for hatchery spawners in all but one year, usually by up to a week, but once by 16 days. Maladaptive early emergence of fry resulting in inordinate displacement by late winter/early spring high flows was the primary impact mechanism. However, it appeared that timing and competitive interactions between wild and hatchery spawners and their progeny often resulted in relatively good spawning success of hatchery adults and disproportionately high displacement of wild-parented fry, but that poor longer term survival fitness of remaining hatchery-parented fry (outbreeding depression due to heritable domestication) impacted smolt productivity. Hatchery broodstock management aimed at restoring natural timing through extra inputs of later returning spawners, perhaps including small proportions of wild adults which could also help reduce domestication affects in the hatchery population, should be considered.

Session: Columbia River Basin Session

Optimization of Water Use Through Biological Triggering (or, May we make a reservation for 40 million?)

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One of the major, most contentious, and (arguably) most costly management issues for the Columbia and Snake Rivers has been water management for outmigrant salmon. From the fish resource side we hear that there isn't enough spill at the right times to ensure passage and optimal survival while (primarily) from the hydropower side we hear that millions of dollars of lost energy production occurs because water must be spilled at times that do little or nothing to aid juvenile salmon migration. The reason for this was recently stated, regarding juvenile salmon - "They don't call home and tell us when they're going to migrate". Recent advances and new applications of proven hydroacoustic technology and custom real-time processing applications may now allow them to do just that: If the salmon call ahead, could they make a reservation to be “served” water when they need it, better meeting the needs of all users?

Session: Bull trout

Use of Genetic Markers to Aid in Re-establishing Connectivity in a Fragmented Metapopulation of Bull Trout (*Salvelinus confluentus*)

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Lake Pend Oreille, Idaho and the Clark Fork River, Montana historically supported one of the largest metapopulations of bull trout throughout the species range. The Clark Fork River served as an important migratory corridor for bull trout traveling between their natal Clark Fork tributaries and rearing habitat within Lake Pend Oreille. The construction of three mainstem dams on the Clark Fork River has fragmented these rearing and spawning habitats. Juveniles are able to migrate downstream to Lake Pend Oreille but a lack of upstream passage facilities prevents adults from returning to natal spawning grounds. In order to re-establish connectivity in this metapopulation, we developed a "rapid response" program that utilizes genetic data to determine the most likely region of origin for adult bull trout captured at mainstem dams during spawning migrations. Fish captured at the dams are held in a hatchery while genetic samples are taken and fish are genotyped at a suite of 12 microsatellite loci. Maximum likelihood based assignment methods are then used to determine the most likely region within the Clark Fork River that the captured individuals originated from. These assignments are then given to biologists who use them to make transport decisions for the fish. The amount of time required to process the genetic samples is typically less than 8 hours thus minimizing the stress associated with holding fish. Since this program was implemented in 2004 a total of 127 fish have been captured and transported.

Session: The Pelton Round Butte Story

Management of the Water Temperature in the lower Deschutes River with the New Selective Water Withdrawal Tower at Round Butte Dam

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As part of the federal relicensing process for the Pelton Round Butte Project, 401 water quality certificates were needed from both the State of Oregon and the Confederated Tribes of the Warm Springs Reservation of Oregon. One of the main water quality parameters that needed to be addressed was late summer and fall discharge temperature. Through the entire first license period, the discharge temperature has been artificially high due to the project's storage of heat along with impoundment of water in Lake Billy Chinook. Additionally, the project's deep water outlet results in artificially cooler water discharges during the spring and early summer. Consultants for the licensees used water quality modeling to determine the effects of the hydro project on temperatures in the lower Deschutes River. Numerous model runs were conducted to identify the potential for blending of deep and surface waters from Lake Billy Chinook to offset the project's alteration of the temperature regime in the lower river while also improving water quality conditions within the reservoirs. Modeling indicates that by withdrawing only surface (primarily Crooked River) water from late fall through the winter and spring, colder Metolius River water will accumulate in the reservoir depths. The cold deep water can then be metered out in increasing amounts starting in July to manage downstream temperatures during late summer and fall to meet water temperature standards. This coincides well with surface withdrawal for fish passage during the spring smolt migration period.

Session: Long-term monitoring

Long-Term Snorkel Surveys on Knowles Creek: After Fourteen Years, What's the Point?

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We have conducted whole-basin juvenile salmonid snorkel surveys on Knowles Creek for fourteen successive years. During this period, we have witnessed the drought of record and the flood of record. This paper focuses on the abundance and distribution of coho salmon in Knowles Creek. Previously we have reported that the distribution follows predictably from the abundance. In years when there are fewer coho, they are mostly concentrated in less than 20% of the basin. In years when there are more of them, they are more widely distributed in the basin. In this paper we use the annual abundance and distribution of coho juveniles to develop a new set of spatially explicit diagnostic tools from a landscape process perspective for evaluating the response of biological

organisms to environmental conditions within basins. The two most important measures are the distance from the ridge top to the downstream limit of high density (>1 coho per m^2 of pool area) and distance from the ridge top to the center of the coho distribution. We believe these measures hold promise as an important tool for measuring the impairment or recovery of populations and their associated watersheds.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Effects of Turbidity on Foraging Efficiency and Growth of Salmonids in Natural Settings

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Elevated turbidity and suspended sediment loads have been documented to negatively effect salmonids and their habitats. Laboratory studies have demonstrated the effect of elevated turbidity levels on the physiology and behavior of salmonids. However, the effects of turbidity on fish in a natural setting are largely uncertain. The goal of this study was to extend the understanding of turbidity effects to natural settings where impacts to salmonids may occur both as a result of impaired visual capability and reduced prey availability. We compared foraging efficiency, growth, and movement of steelhead (*Oncorhynchus mykiss*) in reaches immediately above and below a sediment point source in each of two tributaries of the Mad River (Humboldt County, CA) during the winters of 2004-2005 and 2005-2006. Each sampling reach was equipped with a continuous turbidity monitoring station and with RFID fixed-antennas that detected directional movements of PIT-tagged individuals during and between storm events. Recapture of tagged fish during the falling limb of storm hydrographs enabled estimation of specific growth rates and sampling of gut contents. Prey biomass of gut contents was compared with prey biomass from invertebrate drift samples to establish feeding efficiency. Preliminary analysis suggests that fish continued to locate and consume prey under elevated turbidities and that many fish remained in reaches even with increases in turbidities.

Session: Redband Trout-Migrations in the Desert

Multiple Responses of Rainbow Trout to Wildfire and Human Influences

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Wildfire is a major force shaping headwater streams in the Boise River basin, located in central Idaho. The prevalence of wildfire in this basin has increased dramatically in the past 20 years. By looking at different types of biological responses, we were able to identify the potential roles that wildfire may play in the dynamics of rainbow trout populations. We compared spatial distributions, abundance, life history characteristics, and genetic characteristics of local populations in relation to wildfire, channel disturbance, and isolation caused by human-constructed fish passage barriers. Our results showed that common indicators (e.g., distribution, abundance) were not informative. However, changes in the life history of rainbow trout showed marked responses. Patterns of genetic variability within populations provided further indications of the relative effects of wildfire versus human impacts (e.g., barriers and hybridization with nonnative trout). Together, this series of studies provides useful perspectives on potential mechanisms explaining the resilience of native fish to wildfire, and the role of wildfire relative to other threats caused by human influences.

Session: Early Life History Research and Monitoring

Variation in Juvenile Coho Salmon End-of-Summer Size: Hierarchical Analysis of Habitat Effects

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The size of coho salmon juveniles entering the winter has been shown to influence overwinter survival, and hence may be a useful indicator of linkages between summer habitat conditions and subsequent smolt production. We are investigating habitat-specific demographics of juvenile salmonids in the West Fork Smith River, a 6800 ha watershed in coastal Oregon, to evaluate the relationship of habitat conditions to summer abundance and growth. We are using hierarchical linear mixed effects models to evaluate habitat attributes at multiple spatial scales (habitat unit, reach, and stream levels) that are associated with variation in end-of-summer condition of juvenile coho salmon (*Oncorhynchus kisutch*). From 2002 through 2005, end-of-summer size and condition of juvenile coho salmon varied by watershed location, and was associated with juvenile density and degree of infestation by a parasitic *Neascus*-type trematode at the habitat unit level, and with nitrate at the stream level. Year to year variation in size was also evident, likely reflecting annual differences in both overall abundance and habitat conditions. These results complement analyses of patterns of juvenile abundance presented in a companion paper (Colvin et al.; this session). We conclude by discussing the implications of these results for stream management; specifically modifications to physical habitat or trophic/nutrient status (e.g., spawner carcass planting).

Session: Columbia River Basin Issues

Surface Bypass at Lower Granite Dam: Integrating Design with Biology

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Hydroelectric dams present juvenile fish passage challenges for migrating anadromous salmonids on the Snake and Columbia rivers. A variety of surface bypass and behavior structures have been tested at Lower Granite Dam to improve fish passage. A Surface Bypass Collector (SBC) was installed in front of turbine units 4-6 to collect surface oriented fish and guide passage to spill bay 1. In 1997 the SBC passed 7-11% of marked fish with 3% of project discharge. A Behavioral Guidance Structure (BGS) was installed and connected to the SBC to improve fish guidance to the SBC. In 1998, with the BGS in place the SBC passed 14-32% of marked fish with 3.3% of total project discharge. Research on these prototype surface bypass structures at Lower Granite Dam provided a better understanding of the vertical distribution and approach patterns of juvenile salmonids in the water column. As a result the U.S. Army Corps of Engineers installed a Removable Spillway Weir (RSW) in spill bay 1 at Lower Granite Dam in 2001. Research conducted by USGS from 2001-2006 has shown that the RSW passes 27-49% of marked fish with 5% of project discharge. The success of these and other devices in the Columbia River basin was greatest when their design was based on knowledge of fish behavior and distribution in the study area.

Session: The Pelton Round Butte Story

Design of the New Downstream Fish Sorting and Transfer Facility at Round Butte Dam

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Implementation of the Fish Passage Plan portion of the new federal license requirements call for the capture, sorting, and enumeration of all downstream-migrating salmonids at Round Butte Dam. Juvenile salmonids are to be safely transported downstream to the lower Deschutes River and released. Fish smaller than about 15 inches with arrive at the Fish Transfer facility within a 20-inch pipe above reservoir surface level after being elevated by use of the 20-inch Hydrostal fish pump. At the end of the transfer pipe they will travel through a series of PIT-Tag detectors and be discharged into a series of two dewatering screens and automatic fish separators. These will automatically separate the fish by size to reduce predation within the facilities. The fish-holding portion of the facility will consist of four holding raceways with two dedicated to medium sized fish from 8 to 15 inches and two dedicated to smolt-sized fish from 2.5 to 8 inches. Fry (salmonids smaller than 2.5 inches) will be released back

into the reservoir. Two separate systems will be used to handle medium and small fish separately to increase handling efficiency. From February through July, anadromous sockeye, Chinook and Steelhead smolts will be marked, loaded and trucked to the lower Deschutes below the dams and released. My presentation will illustrate and describe the components of the Round Butte Dam, Fish Transfer Facility, and their initial planned operation.

Session: Deschutes Summer Steelhead: What have we learned in 30 years of monitoring

A Brief History of Steelhead Management and Monitoring on the Deschutes River

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The Deschutes River has long been recognized as an important and unique steelhead stream in Oregon. Studies to monitor the health and abundance of the Deschutes River steelhead began in earnest in the 1950's prior to the construction of the Pelton and Round Butte hydroelectric complex, and have continued through the present. Abundance and life history data has been collected at the Sherars Falls trap since 1977, Warm Springs National Fish Hatchery weir since 1978, and at the Pelton Dam trap since 1972. The Oregon State Game Commission began a study in 1969, with the primary objectives of obtaining life history information, estimating population abundance, and making steelhead management recommendations for the Deschutes River steelhead. Various incarnations of these original studies remain in place today, providing a long and continuous data set for monitoring adult population and life history trends of wild, Round Butte stock hatchery, and out of basin hatchery steelhead.

Session: Columbia River Basin Issues

Straying Rates and the Genetic Assignment of Radio-tagged Columbia River Basin Chinook Salmon: Beyond the Limits of PIT Tags

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While most migrating adult salmonids return to natal streams, some fish stray to spawning areas other than those of origin. Straying rates are among the metrics important to the conservation of ESA-listed stocks that are dependent on extensive PIT tagging of juveniles. As part of a large radiotelemetry study, PIT-tagged "known-source" fish have been radio tagged at Bonneville Dam and used to assess straying (defined as fish returning to spawning areas other than those of origin). While availability of known-source fish for some runs is relatively high, many populations are not PIT tagged at all, leaving small and potentially biased samples. Recent innovations in genetic technology, and the development of a genetic baseline for West Coast salmonid populations, have made it possible to assign origins to individual fish using microsatellites. We employed individual assignment analysis based on microsatellite loci to assign fish of unknown origin to an evolutionarily significant unit (ESU). For 182 fall and spring/summer Chinook salmon radio tagged in 2004, we isolated fish assigned an ESU of origin with a 90% or greater accuracy, increasing our sample size for straying rates by 45 and 96 fish, for fall and spring Chinook salmon respectively. We compared straying rates of genetically identified fish with those of known source fish that were PIT tagged as juveniles. For both fall and spring/summer Chinook salmon runs, the straying rate was significantly higher for the broader sample assigned by genetic analysis than for the PIT-tagged population.

Session: Stream Restoration: New concepts and strategies

When the Salmon Return: Watershed Management Strategies for Above-Dam Habitat Restoration

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Prioritizing limited funds for restoration projects designed to improve instream habitat conditions is an important step for recovery of endangered salmonid populations. Here, we apply a tool that predicts the outcomes of alternative watershed management strategies (i.e., methods for prioritizing restoration project budgets) in the Lewis River watershed, southwestern Washington State, USA. Using this tool, we developed a hypothetical management strategy specific to enhancing habitat for fish populations introduced above dams and compared the results of this new strategy to those of six strategies that had already been modeled. For all seven strategies, we modeled habitat conditions and fish responses that might be expected under two possible future scenarios: (1) passage above hydropower dams for anadromous fish, and (2) expected future trends in both development (i.e., urban growth and road building) and riparian conservation practices. We found that the choice of which strategy performs best was significantly altered when fish were allowed to migrate above dams: in this case, two strategies that focused restoration actions in upper watershed reaches became viable alternatives. When we incorporated expected future trends in development and conservation, we found that the benefits of riparian conservation practices strongly outweighed degradation from urban development. We discuss how predictions from these seven hypothetical management strategies could be used for developing a real strategy for allocating restoration funds earmarked in the hydropower dam relicensing agreement.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Growth Rates and Species Composition of Juvenile Rockfish *(Sebastes spp.)* in Oregon's Nearshore, Estuarine and Subtidal Habitats

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Despite a clear need for basic biological information on juvenile rockfish life history, there have been very few efforts to describe distribution and habitat of this critical life stage, particularly along the Oregon coast. Identification of nursery habitat for rapidly declining rockfish stocks is a critical step to conserving and rebuilding over-exploited populations. Estuarine environments play a critical role in providing nursery habitats for many fish species throughout the world yet few studies have examined whether or not estuaries along the Oregon coast are providing critical habitat for nearshore groundfish species. This study seeks to investigate the relationship between habitat-type, species diversity, and relative abundance of rockfish species following settlement into nearshore reefs and estuaries. I will determine the timing of settlement events and assess individual growth rates for young-of-the-year *Sebastes* within three separate potential nursery environments: nearshore rocky reefs, subtidal kelp beds, and dock pilings within the Yaquina Bay estuary. This study will provide biologists with information on spatial and temporal patterns of recruitment for Oregon's nearshore *Sebastes* and thereby, contribute unique information for improved management.

Session: Redband Trout – Migrations in the Desert

Accuracy of Abundance Estimates Derived from Electrofishing and Depletion Methods for Redband Trout in Oregon's Great Basin

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Population estimates of stream resident salmonids are commonly calculated using depletion sampling methods. However, a critical assumption, equal capture probability for all individuals in all capture events, is often violated

resulting in biased results. In preparation for a region-wide, multi-year assessment of Great Basin redband trout *Oncorhynchus mykiss* we examined sampling efficiency and bias associated with depletion techniques and investigated methods to improve the accuracy of population estimates derived from these methods. Field crews visited 19 sites across a broad array of habitat conditions in the Chewaucan River basin where both mark-recapture and 2-pass removal methods were implemented to estimate abundance. Habitat characteristics of each site were measured and summarized to determine effect of channel size and complexity on the magnitude of bias. Our results show that 2-pass removal methods overestimated capture efficiencies by an average of 34% (SD 18%) and therefore underestimated abundance by an average of 38% (SD 23%), whereas mark-recapture sampling efficiencies appeared fairly unbiased. The amount of in-stream wood was positively correlated with the degree of negative bias associated with the removal estimates. We produced a simple model to calibrate 2-pass removal estimates to unbiased mark-recapture estimates. Given our findings we recommend conducting mark-recapture methods at a subsample of sites where removal techniques are preformed in order to describe and account for sampling bias.

Session: Law Enforcement

Columbia River Snagging Enforcement Columbia River Snagging Enforcement

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Every fall, salmon and steelhead migrate up the Columbia River throughout the mid-Columbia area and encounter very warm water temperatures. Most tributaries from Bonneville dam to the Deschutes River have lower water temperatures. The salmon and steelhead seek out and congregate at the mouths of these tributaries in the cooler water to rest until the fall rains and cooler weather bring down the temperature of the main stem Columbia. These fish are very vulnerable to snagging due to their high concentration at these locations and their waning feeding habits. Since often times the bite is slow, frustrated and unethical anglers resort to foul-hooking these fish. When these snagged fish are fought for upwards of 45 minutes in 70+ degree water, hooking mortality in these conditions is greatly elevated. This issue has always been a high priority for the north-central state police fish & wildlife division enforcement team. Each year the snagging of anadromous fish is a source of many public complaints, thus making this not only a natural resource issue, but also a serious social concern. Fish & wildlife troopers face enormous challenges in enforcing the laws that help protect our natural resources. Please join us for a discussion on how your Oregon state police are striving to help ensure safe passage and preservation of our Columbia River salmon and steelhead.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

A Phylogeographic Analysis of a Freshwater Streamfish, *Cottus marginatus,* to Address Conservation and Taxonomic Status

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Margined sculpin, *Cottus marginatus*, is a freshwater fish endemic to southeastern Washington and northeastern Oregon. Although presumed locally abundant, its restricted distribution has resulted in its designation as a Species of Special Concern by the Washington and Oregon Departments of Fish and Wildlife. This investigation is the first to address the conservation genetics of *C. marginatus*. Analysis of both the control region and cytochrome *b* indicates monophyly for *C. marginatus* with high haplotype diversity in the former and limited diversity in the latter. Haplotype network analysis is consistent with invasion of the Walla Walla Basin and subsequent localized dispersal and differentiation in separate streams. Despite finding intraspecific genetic diversity we do not recommend relaxing management for the following reasons: 1) sample size used thus far is insufficient for policy change, 2) the species is still restricted to a relatively small area with localized differentiation in different

drainages, and 3) critically endangered fishes can have greater than expected genetic diversity and still be at risk for a rapid loss in fitness. This data is discussed in light of recent ecological surveys in an attempt to better inform conservation efforts.

Session: Marine Topics

Escaping the Surface: The Effect of Depth of Capture on Submergence Success of Surface-Released Pacific Rockfish

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We evaluated the effect of depth of capture and size on the ability of Pacific rockfish to return to depth following hook and line capture and surface release. The frequency distribution of time to submergence showed that most fish that could submerge did so within 60 s. Submergence success was above 80% for rockfish captured in depths less than 30 m. Yellowtail rockfish (N=51, *Sebastes flavidus*) were 100% successful at submerging in less than 49 s at all depths sampled (10-51 m). At deeper capture depths (40-51 m), submergence success declined to 89% for quillback rockfish (N= 9, *S. maliger*), 65% for black rockfish (N=46, *S. melanops*), and 30% for canary rockfish (N=40, *S. pinniger*). At depths of 30-51 m, submergence success was 32% for blue rockfish (N=31, *S. mystinus*). The external signs of barotrauma (e.g. exopthalmia, eversion of the esophagus) increased with depth of capture, and were least prevalent in yellowtail rockfish and quillback rockfish. For several species, the presence of severe esophageal eversion (beyond the buccal cavity) was strongly negatively associated with submergence success ($P<0.01$). Logistic regression showed a negative relationship between depth of capture and submergence success for black rockfish ($P<0.001$), blue rockfish ($P<0.001$) and canary rockfish ($P<0.05$). Depth of capture decreased submergence success most rapidly in blue rockfish and most slowly in black rockfish. Increased length negatively influenced submergence success only in blue rockfish ($P<0.05$). A comparison of data on submergence success with studies of behavioral impairment of rockfish released at depth (Hannah and Matteson in press) suggests that the ability to submerge may be a reasonable proxy for short-term discard survival in yelloweye rockfish and canary rockfish, but not in several other rockfish species, notably blue rockfish.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Using Passive Stream Restoration to Reduce the Impact of Whirling Disease

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Habitat degradation, exotic species, and disease are three factors that commonly impact many of today's fish and wildlife populations. Individually, each of these factors may have predictable effects or even be inconsequential; however when combined there may be unpredictable and highly variable synergistic effects at the population level. We have identified an important population of native Bonneville cutthroat trout (*Oncorhynchus clarkii utah*) in Northern Utah that are potentially impacted by livestock grazing, *Myxobolus cerebralis* the parasite that causes whirling disease, and exotic brown trout (*Salmo trutta*). The relationship between the whirling disease life cycle (e.g., tubifex worms), and the habitat degradation caused by livestock grazing (e.g., sedimentation) represents an interaction between two factors with strong potential for synergistic effects. We are investigating means to mitigate this interaction by implementing a passive stream restoration project on a second order tributary through the exclusion of livestock grazing. We evaluated the effectiveness of this method in 1) improving fish health and viability, and 2) minimizing the impact of whirling disease. Here we report on data collected during two before years, and first after year of an asymmetrical Before After Control Impact study including both aspects of fish health and viability and abiotic and biotic stream factors as response variables potentially related to *M. cerebralis* impact and likely to respond to stream restoration. Currently there are no management methods to eliminate whirling disease from natural systems, though this approach may provide the means by which impacts on native fish may be minimized.

Session: Bull trout

Investigations into Bull Trout (*Salvelinus confluentus)* Distribution, Abundance and Life History in the Hood River Basin

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Bull trout are not widely distributed in the Hood River Basin and are considered to be at high risk of extinction. The only known successful spawning population is located in Clear Branch, a Middle Fork Hood River tributary which is isolated behind a 41-meter high dam. Clear Branch Dam prevents upstream passage and provides limited downstream passage. Our objectives during 2006 were to expand our knowledge of distribution by conducting presence/absence surveys in the basin; gain information of life history patterns using PIT-tag arrays and weir traps; and estimate juvenile, adult, and redd abundance upstream of Clear Branch Dam. In electrofishing and snorkel surveys in six Middle Fork tributaries, juvenile bull trout were present only in Coe Branch (n=4). Of four adult bull trout captured at the Powerdale Dam trap on Hood River (Rkm 6.4), three were detected upstream at a Middle Fork PIT-tag array and one was trapped further upstream below Clear Branch Dam. Using mark-recapture, we estimated 513 ±61% age-1+ bull trout in Clear Branch upstream of the reservoir. Weir traps in Clear Branch captured 138 outmigrating juveniles and 27 upstream-migrant adults. Twenty redds were counted in Clear Branch and Pinnacle Creek. No redds were observed during surveys of 11 potential spawning streams. Given the small spawning population in Clear Branch, the lack of spawning in any other tributaries and the low abundance of fluvial adults, our preliminary results suggest the current abundance of Hood River bull trout is well below the recovery plan goal of 500 adults.

Session: Data management/sharing

Oregon Conservation Strategy Monitoring: Amphibian-Stream Survey Data Collecting Partnership

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The Oregon Conservation Strategy, finalized and USFWS-approved in early 2006, provides a broad and comprehensive vision for conservation of Oregon's native fish and wildlife. The Strategy works by synthesizing the best available data, science, and knowledge at multiple levels – from the statewide to local, landscape and ecoregional scales. Although comprehensive in scope, the Strategy prioritizes species with unmet conservation needs. Collaboration is the cornerstone for measuring the success of the Strategy. For example, the Strategy initiated a new data collecting partnership with the Aquatic Inventories Project at Oregon Department of Fish and Wildlife. In summer of 2006, crews from the Aquatic Inventories Project began to systematically note amphibian occurrences during stream habitat surveys. The data collecting partnership resulted in several economies-of-scale for data collection, data entry, and data management. The observations provide new and valuable information about the distribution of dozens of amphibian species throughout the state, contributing towards a baseline of knowledge. Results will be provided to the Oregon Natural Heritage Information Center, which can use the occurrence data to build distribution models for Oregon's wildlife species. Additional options for data presentation and analysis will be explored. Over time, the observations may contribute toward insights regarding amphibian abundance in Oregon.

Session: Bull Trout

Habitat Use and Timing by Bull Trout in Marine Waters of Northern Puget Sound, Washington State

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Bull trout and their habitats are listed as Threatened under the U.S. Endangered Species Act; however, the scientific literature contains little information about the habitat used by anadromous bull trout during their residence in marine waters. We used stationary receivers located in the lower Skagit River and mobile tracking equipment in marine waters to study the timing and habitat use for bull trout in Skagit Bay during April–August 2006. Acoustic tags were surgically implanted in 30 bull trout that were captured by beach seining or hook and line in Puget Sound during April 2004 to June 2006, and in 20 bull trout that were captured by hook and line in the lower Skagit River during 13 March to 3 April 2006. The fish were 22-56 cm fork length at tagging. We detected fish moving past the stationary receivers toward Skagit Bay from March to May. Fish were detected returning to the river from mid-May to mid-August. While in Skagit Bay, fish typically resided within 300 m of the shoreline and at a depth ≤ 5 m. Each fish tended to remain in a limited nearshore area, generally no more than 1.5 km in length. For four fish monitored over 24 h we found that differences between diurnal and nocturnal habitat selection and behavior seemed to reflect changes in tidal height rather than solar position. We report on other habitat features such as bathymetric topography, geomorphic shoreline forms, distance from shore, and distance from man-made structures or shoreline modifications.

Session: Evaluation of salmonid production in management decisions for hydroproject relicensing

Monte Carlo Simulation to Aid Decision Making in Hydroproject Relicensing

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Quantitative models can be useful for guiding decisions, particularly when evaluating a set of hypothetical alternatives. However, there is often uncertainty in the process being modeled. Making prudent decisions from models requires some understanding of uncertainty in the model results. One method for evaluating the uncertainty in model predictions is to change the input parameters and re-run the model. If one randomly selects the model parameters from a set of values, and completes this step many times, then one has completed a Monte Carlo Simulation (MCS). Monte Carlo Simulation is a powerful tool for evaluating alternative actions in light of uncertain outcomes. We present two examples of MCS to guide decision making in hydroproject relicensing. The first example is the Downstream Migrant Mortality Model (DM3). The DM3 is a juvenile salmonid mortality rate model for evaluating alternative project configurations for three dams on the Clackamas River, Oregon. Monte Carlo simulations of the DM3 incorporated uncertainty in passage route (i.e. turbine, bypass, or spillway) and mortality rates associated with each route. The second example is a life cycle model that was used to evaluate uncertainty in the timing of returning and outmigrating adult sockeye salmon (*Oncorhynchus nerka*) to Baker Lake, Washington. Monte Carlo simulations of the Baker Lake sockeye populations incorporated uncertainty in the run timing, mortality rates of juveniles, and smolt to adult return ratios, which were derived from historical data. In both cases, model results provided an opportunity to evaluate different engineering designs in light of uncertain biological outcomes.

Session: Stream Restoration: New concepts and strategies

Larval Sucker Response to Wetlands Restoration in the Williamson River, Tributary to Upper Klamath Lake, Oregon

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The Williamson River Delta (the Delta) historically provided critical larval rearing habitat for two endangered sucker species that inhabit Upper Klamath Lake (UKL), Oregon. The last ~5 km of the Williamson River was a freshwater delta encompassing ~2,200 hectares of contiguous emergent marsh wetlands that were bisected by the

Williamson River and connected to UKL. Larval suckers historically inhabited the delta wetlands prior to entering UKL. These wetlands provided larval suckers with food resources, warm water, and protection. Beginning in the 1940's, levees were built, and the Delta was drained and converted to cropland such that the Williamson River flowed directly to UKL with no access to floodplain or delta wetlands. The Nature Conservancy is restoring the wetlands at the Delta by removing levees to hydrologically reconnect the Delta to the Williamson River and UKL. Two pilot projects, completed in 2000 and 2003, reconnected approximately 100 HA of prior croplands to the river and lake. This study investigated larval sucker habitat preferences in these restored areas and along existing lake-fringe wetlands. Results suggest restored shallow areas with aquatic vegetation are important rearing areas for larval suckers in UKL.

Session: Redband Trout–Migrations in the Desert

Physiological Indicators of Habitat Quality: Moving Beyond Population Assessment to Evaluate Restoration Strategy Effectiveness

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A substantial amount of effort has been put forth to restore salmonid populations throughout the west. But we are only able to affect population trends in two ways: through habitat restoration or by decreasing targeted or indirect mortality. Population-level response to habitat restoration is in particular a difficult parameter to measure. The time needed to detect a population-level response can be long because of natural variability in recruitment, and separating this natural variability from the effects of a management effort is a challenge. Furthermore, and more insidious, is that we could in fact do everything right with a habitat restoration project and still not see a population-level response. This is because habitat restoration efforts are typically local in nature while total impacts on a salmonid population occur at multiple life stages across substantially larger landscapes. This increases the potential to conclude that habitat restoration is not working, when in fact factors outside the system are responsible for the lack of detectable response. Under these circumstances, alternative response metrics are needed. Physiological markers, including stress proteins, energy stores, and metrics that integrate these such as growth, may allow us to detect management-related change in habitat quality long before any population-level response occurs. Furthermore, physiological measures can potentially be used to determine causative mechanisms for change. Using work in the John Day basin as an example, I will discuss the utility of including physiological metrics as indicators of habitat quality in our suite of tools to assess habitat quality and restoration strategies.

Session: Coastal Cutthroat Trout

Migratory Behavior of Coastal Cutthroat Trout in Big Creek, a Tributary of the Lower Columbia River

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Debate over proposed ESA listing highlighted a general lack of knowledge about coastal cutthroat trout life history and relationships between resident and migratory cutthroat in the lower Columbia River. We monitored the movements of acoustically tagged cutthroat that emigrated from Big Creek, an Oregon tributary joining the Columbia at river kilometer 27. Cutthroat were captured at a smolt trap above a hatchery weir that likely limits the upstream migration of anadromous cutthroat. We estimated that 1162 cutthroat (95%CI 377 to 1947) emigrated from the watershed above this barrier during spring 2006. Migrants ranged in size from 128 to 244 mm fork length and made up roughly 16% of the cutthroat that size or larger in the basin. The simple size/age distribution of migrants supports the hypothesis that few anadromous cutthroat return to the Big Creek watershed above the hatchery barrier. Of 44 cutthroat tagged with acoustic transmitters, 31 entered the Columbia River, and 18 were detected entering the ocean. Median travel time from Big Creek to the mouth of the Columbia was approximately 29 hours, corresponding to a migration rate of 1.2 km/hour. Migration rate was significantly and negatively

related to body length ($p=0.004$, $r^2=0.43$). Six (5%) of 113 PIT tags implanted in cutthroat at the smolt trap were recovered at the Caspian tern colony on East Sand Island. As of November 2006, zero tagged cutthroat were detected returning to Big Creek or the nearby estuary. Preliminary results suggest limited estuarine residence by lower Columbia cutthroat and poor survival (or high straying) of migratory Big Creek cutthroat.

Session: Contributed Papers #1

Lines, Thresholds, and Bars – Oh my! Abundance-based Management in a World of Shared Resources

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Fisheries management benefits from formal establishment, communication, and application of abundance and productivity based fisheries resource expectations/goals. Multiple fisheries management and resource interest groups have unique goals and objectives. Understanding and coordinating those unique goals and objectives promotes trust, accountability, and aids in conflict resolution within highly complex ecosystems such as the Columbia River Basin. Goals and supporting objectives ideally contain quantifiable attributes with accuracy/precision bounds that are directly linked to decisional processes. Managing for high abundance is preferable to managing scarcities. The Nez Perce Tribe Department of Fisheries Resources Management moved toward such an approach during 2006. The intent of this paper is to describe abundance goals and thresholds (and supporting justification) being utilized by the Nez Perce Tribe. Pre-defined thresholds function as decision criteria that trigger specific actions to reverse undesired trends in population performance and/or prevent short-term detrimental impacts. Populations depressed to critically low levels will require more aggressive actions that demand a quicker population response than populations fluctuating at higher levels of abundance. Reference abundances presented for individual populations include; functionally-extinct threshold (a geometric mean annual escapement of 125 adults calculated over a 4 year period), viable thresholds (500 – 2000), ecological escapement goals (highly variable), and sustainable harvest goals (1000 + with sliding scale). The accounting of hatchery-origin adults towards a management goal or threshold is variable.

Session: Deschutes Summer Steelhead: What have we learned in 30 years of monitoring

Straying of Snake River Hatchery Steelhead into the Deschutes River

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Native Deschutes River steelhead abundance declined substantially in the late 1980s and remained depressed throughout the 1990s. Coincidentally, abundance of out-of-basin hatchery-origin steelhead increased dramatically and now comprise a substantial proportion of the escapement above Sherars Falls. These strays are clearly an important component of the recreational fishery but also pose a serious risk to the viability of the native population. Snake River hatchery stocks are known to be a significant source of these strays. We determined the stray rates of steelhead into the Deschutes River from seven Snake River hatcheries and characterized their spatial and temporal distribution within the Deschutes Basin. Wallowa Hatchery had the highest mean stray rate and Dworshak B steelhead had the lowest. For all stocks, the greatest mean annual percentage of steelhead captured was at the Mouth during the Migration Season but a similar proportion of Wallowa Hatchery recoveries came during the Spawning Season and in the Upstream Reach. A similar percentage of Wallowa steelhead were captured in the Deschutes River at the peak months of the Spawn season as were collected in August and September. Wallowa steelhead comprised a mean of 55% of the total fishery captures and 62% of the hatchery trap captures of these stocks. Of the Wallowa steelhead , 53% came from hatchery traps, while the majority (62-81%) of strays recovered for other stocks came from sport and tribal fisheries. ODFW is developing an earlier running Wallowa Hatchery stock in an effort to reduce the strays captured in the Deschutes River.

Session: Redband Trout–Migrations in the Desert

Redband Trout Distribution on the Fremont-Winema National Forest and How it Guides Fish Habitat Management

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Forest management activities on the Fremont-Winema National Forests are guided by a variety of factors including the presence or absence of fish. One of the major components of delineating Riparian Conservation Habitat Areas is fish distribution. On the Forests, a GIS database contains spatial and temporal data related to past fish distribution investigations by a variety of agencies. There are challenges related to determining fish distribution of desert fishes due to the intermittent nature of the streams. This paper investigates the challenges of utilizing a fifty year old data set, and presents some new findings related to upper distribution limits.

Session: Bull Trout

Abundance Estimates of Pacific Northwest Native Trout

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Abundance estimates of Pacific Northwest native trout are necessary to ascertain status of sensitive, threatened and endangered populations. The accuracy of these estimates is of particular importance when considering progress toward recovery and ultimate delisting of a species protected under the Endangered Species Act. Many approaches are available, but multiple pass mark-recapture approaches may provide the most accurate unbiased estimate of abundance. We analyzed data from multiple pass sampling of two Pacific Northwest native trout species, bull trout (*Salvelinus confluentus*) and coastal cutthroat trout (*Salvelinus clarki clarki*). Estimates of abundance were compared in a bull trout population using multiple pass depletion and mark-recapture approaches. The multiple pass mark-recapture approach provided a less biased, more accurate and more precise abundance estimate than multiple pass depletion. Two pass and three pass mark-recapture approaches were compared for preciseness of the bull trout estimate. As expected, the three pass approach was more precise than the two pass mark-recapture, however, the two pass approach may be sufficient. Therefore, two pass mark-recapture abundance estimates were compared between the two species with respect to probability of capture, abundance, precision, density and habitat type. Ultimately, multiple pass mark-recapture is a viable option to providing more accurate abundance estimates of Pacific Northwest native trout.

Session: Contributed Papers #1

Relating Fish Assemblages to Environmental Patterns at Three Multi-state Scales

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Key challenges to studying and managing riverscapes include understanding how factors measured at various spatial-scales influence aquatic biota and developing accurate predictive models where study data are limited. Currently fish zones, physiographic regions, ecoregions, and river basins are commonly used for classifying fish faunas. All these classifications reduce the apparent variability occurring at a large scale, but also include considerable heterogeneity. We analyzed a 780 site data set obtained from the USEPA's EMAP western survey. First, we determined fish clusters at three spatial scales in the western USA (all 12 conterminous states, all western mountains, Pacific Northwest mountains). We next determined that the predictor variables for those clusters

changed with spatial scale. For example, longitude, dams and temperature were the best predictors for all sites, longitude, dams and catchment area were the top predictors for mountain sites, and latitude, turbidity, and canopy density ranked highest for Pacific Northwest mountains. The best three variable models included site, basin, and ecoregion predictor variables. However, basin, ecoregion, state, and abiotic site variables alone only accounted for half of the mean within-group similarity demonstrated by the fish clusters. We conclude that using large quantitative fish assemblage data sets linked with quantitative physical and chemical habitat data and landscape data to predict fish assemblage patterns is preferable to using preexisting landscape classifications.

Session: Redband Trout–Migrations in the Desert

Effects of Impoundments and Hydroelectric Facilities on the Movement and Life History of Redband Trout in the Upper Klamath River: A Synthesis of Past and Recent Studies

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The physical and ecological environment of redband trout in the Upper Klamath River has been altered by hydroelectric dams. Four dams and five distinct river reaches are currently present in the 48-mile section between the outflow of Upper Klamath Lake and the Oregon-California Border. Spencer Creek, which enters the Klamath River just upstream of J.C. Boyle Dam, is an important spawning area and source of juvenile recruitment for redband trout in the upper Klamath River. In 1959, the year after J.C. Boyle Dam was completed, fish ladder trap counts showed adult redband trout migrated upstream in the Klamath River in large numbers to spawn in Spencer Creek. By 1962, trap counts had declined by at least 90%. Despite this decline, studies conducted in the late 1980s showed that a significant spawning run and juvenile outmigration persisted in Spencer Creek. These findings left questions about the adult and juvenile life history of Spencer Creek spawning population. We used radio telemetry and PIT-tag technology to address these questions. Our results suggest that, since the construction of J. C. Boyle Dam, upstream movement of adult redband trout to Spencer Creek has been eliminated and movement of juveniles from Spencer Creek downstream past the dam has been restricted to periods when spill occurs. We also found that the Keno Reach of the Klamath River is the main source of spawning adults in Spencer Creek. In total, these results suggest that diversity of life histories displayed by Spencer Creek spawners has been constricted by the construction of J.C. Boyle Dam This reduction in life history diversity has likely reduced trout abundance downstream of the dam. These results also show that the extant adult life history is composed of a downstream spawning migration in Klamath River to Spencer Creek and a substantial juvenile upstream migration to the Keno Reach.

Session: Contributed Papers #3

Interactions of a Hatchery-origin Chinook Population with a Wild Steelhead Population in the Wind River, Washington

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Historically, Chinook salmon could not access the Wind River above Shipherd Falls at river kilometer (rkm) 4. In 1956, a ladder was built at the falls for spring Chinook to access Carson National Fish Hatchery at rkm 28. Each year, some hatchery-derived adult Chinook spawn in the Wind River. To address concerns about possible interactions between introduced Chinook and native steelhead, a federally threatened species, U.S. Fish and Wildlife Service funded the U.S. Geological Survey to expand ongoing research. Snorkel surveys, electrofishing, and tagging of juvenile Chinook and juvenile steelhead with Passive Integrated Transponder (PIT) tags occurred in the upper Wind River since 2000. Abundance of juvenile Chinook varied between years and sample reaches, but

was generally low. However, densities were high in local areas, at times exceeding those of age-0 steelhead. We found the annual upstream-most distribution of juvenile Chinook to vary from rkm 30 to 42 and that it was significantly related to base-flow conditions the previous summer. Higher flow just prior to spawning appeared to allow adult Chinook increased access to upstream spawning areas. We PIT tagged 543 juvenile Chinook and 1,312 juvenile steelhead within the study area. Additionally, we PIT tagged over 15,000 juvenile steelhead in other areas of the Wind River subbasin where juvenile Chinook were absent, to provide a comparison between allopatric and sympatric conditions. Detections of PIT-tagged fish at Bonneville Dam and other locations provide a potential method to examine Chinook spawning in terms of successful juvenile rearing, smolt emigration, and adult return.

Session: Coastal Cutthroat Trout

Genotypic Analyses of Sympatric Resident and Migratory Coastal Cutthroat Trout in the Lower Columbia River Basin

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The life history of coastal cutthroat trout is arguably one of the most complex of Pacific Northwest salmonids, including migratory and resident life history forms. Both life history forms spawn in the headwaters of small to intermediate size streams and they are known to be sympatric within populations. Recent research with steelhead and rainbow trout (*O. mykiss*) has indicated variable amounts of gene flow between the two life history forms. Genetic and behavioral studies have documented fine spatial scale structuring of coastal cutthroat trout at the population level in individual streams. However, our understanding of the degree of reproductive isolation between sympatric migratory and resident life history forms is poorly understood. Recent PIT tagging studies of coastal cutthroat trout have allowed us to identify migrant and resident individuals. We examined the genetic divergence of sympatric life history forms in Abernathy Creek and the Chinook River. Population genetic structuring indicates differences among populations, but not between life history forms within a population. These findings and work with other salmonids indicate the life history phenotype is most likely determined by a combination of environmental and genetic factors.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Summer Distribution and Habitat Selection of Margined Sculpin (*Cottus marginatus*) in the Walla Walla River System

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Margined sculpin are endemic to the Tucannon, Walla Walla, and Umatilla sub-basins in northeastern Oregon and southeastern Washington. Due to extremely restricted distribution and relatively unknown natural history, the margined sculpin is listed as Species of Special Concern in Oregon and Washington. I present research on margined sculpin distribution and habitat preference in the Walla Walla River system. Habitat factors such as water temperature, substrate type, and stream morphology were considered in relation to margined sculpin presence and availability. Interactions between margined sculpin and other fish species were investigated. Margined sculpin availability showed a strong negative correlation to the availability of Paiute sculpin *(Cottus beldingi)*. The potential impacts of regional logging and agricultural practices on margined sculpin populations are also addressed.

Session: Long Term Monitoring

Two Decades of Monitoring Fish Populations and Habitat Changes in Lobster Creek (Alsea River, Oregon). Is the Gain Worth the Pain?

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Since 1988, the Oregon Department of Fish and Wildlife (ODFW) has monitored juvenile salmonid summer abundance, smolt abundance, adult spawner abundance, and stream habitat parameters in East Fork and Upper Mainstem Lobster Creeks of the Alsea watershed. In 1991, extensive in-stream habitat modification was conducted by the BLM in Upper Mainstem Lobster Creek as part of a before-after-control-impact (BACI) study to determine the effect of habitat modification on survival rate and smolt abundance of juvenile salmonids. East Fork Lobster acted as the control stream during this study, which lasted from 1988 through 1995. A detailed description of this study is in Solazzi et al. (2000). Since that time, the measurements of fish population parameters and habitat parameters have continued. During a February 1996 flood, three large debris torrents entered Upper Mainstem Lobster, significantly altering the habitat and destroying most of the coho salmon eggs that were incubating in the stream that winter. High streamflows in the winter of 1998-99 also caused significant channel changes in East Fork Lobster, while in the summer of 1999, the Bureau of Land Management (BLM) used 65 pieces of large wood to create seven in-channel debris jams in this stream. I will describe the fluctuations in the fish populations in these streams over the past two decades as they respond to changes in habitat, the weather, and basin-wide fisheries management decisions. I will also discuss the advantages and the pitfalls of maintaining long term monitoring sites.

Session: Coho salmon use in estuaries and tidelands

Patterns of Coho Salmon Migration and Residency in Oregon Estuaries

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We compared estuarine habitat use by juvenile coho salmon in Salmon River (1975-77; 1998-2004) and in the Siuslaw, Alsea, and Nestucca River estuaries (2003-04). Age-0 coho were observed consistently in meso- and oligo-haline marsh channel habitats during spring and early summer in all estuaries. In Salmon River, coho used a marsh channel shortly after dike removal restored tidal inundation to the site in 1996. Most of the subyearling coho disappeared from marshes by mid-July as the temperature and salinity increased, however coho were present in Salmon River marshes during late fall and winter. We hypothesize that juvenile coho may express alternative life history patterns in basins where tidal freshwater wetland habitat is present. Two results from the Salmon River basin are consistent with this hypothesis: (1) Few age-0 coho were observed in the estuary during the 1970's when most salt marsh channels were blocked by dikes; and (2) scale analyses indicate that the proportion of adult coho with a subyearling life history was rare in 1974 and 1975 (0 – 0.5%), but ranged from 1 to 18% in 1997-2003, following dike removal from 145 ha of tidal marsh habitat. The life history patterns we observed in Salmon River may be a response to the recovery of estuarine wetlands, but additional analyses are needed to discern whether an estuarine-rearing life history type in Oregon river basins contributes to the population structure of adult coho salmon.

Session: Columbia River Basin Issues

Northern Pikeminnow Management in the 21st Century: Updating Last Millennia's Predation Model

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Northern Pikeminnow (*Ptychocheilus oregonensis*), native to the Columbia River Basin, predate heavily on outmigrating and rearing juvenile salmonids. Early research indicated that a 10 – 20% reduction in the northern pikeminnow population could reduce predation-related juvenile salmonid mortalities 25 – 50%. Targeted northern pikeminnow fisheries were implemented system-wide beginning in 1991. The Oregon Department of Fish and Wildlife developed a model to track reductions in potential predation; this model has indicated that after meeting exploitation goals in 14 of 16 years predation is approximately 75% of pre-program levels. Concerns about gender-specific growth and mortality have been expressed recently, leading to speculation that the current model may not accurately depict actual reductions in predation. We are now updating our predation model. Because of aging uncertainties we will base the updated model on length rather than age. Using length as our base metric will allow us to avoid separately addressing female vs. male differences, and to simplify the model. With the updated model and its' corresponding inputs we will be able to confidently measure not only the success of the program, as it relates to reductions in potential predation, but also to monitor the population status of a native cyprinid.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Response of Juvenile Salmonids to Placement of Large Woody Debris in California Coastal Streams

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Large woody debris (LWD) is frequently placed into streams of the Pacific Northwest in an effort to improve habitat conditions for juvenile salmonids. Unfortunately, many restoration projects do not incorporate monitoring of biotic response to these activities. This project compared stream reaches and individual habitat units with differing quantities of LWD to determine the effects of LWD restoration structures on biomass, size, growth, and survival of juvenile coho salmon and steelhead in two coastal streams in Northern California from July 2004 through June 2005. No significant differences in any response variables were detected between treatment and control reaches with the exception of age-0 trout biomass, which was significantly less in treatment reaches. Biomass of age-1+ steelhead was positively related to the proportion of pool habitat while biomass of age-0 trout was negatively related to the proportion of pool habitat in the summer and positively related to depth of pools in the fall. Growth of steelhead and age-0 trout was positively related to average depth. Fish responses at the habitat unit scale were more variable, but generally indicated preferences for pools and, in some cases, cover. Overall, the proportion of pool habitat and stream depth appeared to be the most important physical habitat features influencing salmonid productivity in these two coastal streams. Although direct effects of habitat restoration were not detected in this study, these results indicate that stream restoration structures that substantially increase the amount of pool habitat and create deeper pools can positively benefit coho salmon and steelhead populations.

Session: Contributed Papers #1

Assessment of Winter Steelhead Spawning, Holding, and Rearing Habitat Upstream and Downstream of USACE Dams in the Willamette Basin

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The U.S. Army Corps of Engineers' (USACE) construction of multi-purpose dams on tributaries in the Willamette Basin blocked access to much of the historic winter steelhead spawning habitat in the North and South Santiam river basins. Efforts to reintroduce Upper Willamette steelhead above the dams are being considered and will be

contingent on the current utility of the habitat to support the holding, spawning and rearing winter steelhead. In order to quantify the available spawning, rearing and holding habitat suitable for winter steelhead in the upper Willamette River, we surveyed more than 95 percent of the mainstem habitat above and below Detroit, Foster, and Green Peter, dams. Survey methods were modified from the Oregon Aquatic Inventory Project using parameters that provided information on habitat suitability for spawning, rearing, and holding. Additional data were collected to further characterize suitable habitat including substrates and velocities in spawning areas, juvenile rearing area in complex habitats and holding habitat with depth. Approximately 81 miles of habitat were surveyed above the dams and 40 miles below. A combination of remote videography and digital aerial photography was used to expand habitat estimates to 3 miles of potential steelhead habitat not surveyed. The results of this effort will include spatial distribution and quantities of steelhead spawning, rearing, and holding habitat georeferenced within GIS coverages in each river basin and will be accessible to the public.

Session: Coastal Cutthroat Trout

Morphological, Physiological, and Genetic Considerations for Improving Field Identification of Steelhead, Cutthroat, and Hybrid Smolts Migrating from a Lower Columbia River Tributary

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In streams with sympatric populations of steelhead and cutthroat trout, life history descriptions and smolt production estimates may be hampered by misclassification of hybrids as steelhead or cutthroat trout. Additionally, important morphological and physiological differences between hybrid and non-hybrid smolts are often unknown. We measured the morphology and physiology of fish migrating out of Abernathy Creek, WA via a screw trap in spring of 2005 and used genetic techniques to classify fish as steelhead, cutthroat trout, or hybrid. Field misclassifications of smolts with steelhead or cutthroat genotypes were low (1% and 2% respectively). However, field misclassification of fish with hybrid genotypes was moderate with 11% of the hybrids being misclassified as steelhead and 32% of the hybrids being misclassified as cutthroat. Hybrid smolts were larger, had lower gill ATPase activities, and lower condition factors than steelhead but were similar to cutthroat smolts in these same measurements. Additionally, statistical classification analyses using morphological traits including subterminal jaw slash intensity, basibranchial teeth presence, and fish body shape (measured from digital pictures) failed to improve classification error rates of hybrids. In conclusion, in systems with suspected hybrids, we recommend a thorough evaluation of field based identification methods with genetic techniques to assess the effectiveness of field based classification in addition to examining important life history differences among steelhead, cutthroat trout and their hybrids.

Session: Reintroduction Using Artificial Propagation: Approaches, Techniques, Management

Restoring Anadromous Salmonids in the Upper Cowlitz River Watershed: A Broad-based Research Approach to Evaluate Adaptive Management Strategies

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Historically, the Cowlitz River watershed supported abundant runs of anadromous salmonids, but construction of Mayfield and Mossyrock dams in the 1960s created barriers to passage of adult and juvenile salmonids. At Cowlitz Falls Dam, the upper-most dam on the system, completion of a surface collection system and fish facility in 1996 presented an opportunity to restore anadromous salmonids to 322 km of stream habitat in the upper Cowlitz River watershed. To restore salmonids to the upper basin, adult fish are transported above the dams and allowed to spawn naturally: juvenile salmonids are collected at Cowlitz Falls Dam and transported and released downstream of the dams. The keys to a successful reintroduction program include: 1) effective collection of migrating juvenile salmonids, and 2) understanding adult migration patterns and spawning distribution. We are using radio telemetry

to evaluate these aspects of the restoration effort. At Cowlitz Falls Dam we have monitored juvenile salmonids for several years and are currently evaluating a prototype screen designed to improve collection of juvenile salmonids. During 2005, we conducted a telemetry study to examine the spawning movements, timing, and distribution of adult salmonids released into the upper Cowlitz River. This combined approach is assisting managers in their restoration efforts.

Session: Evaluation of salmonid production in management decisions for hydroproject relicensing

Population Dynamics of Bull Trout and Spring Chinook Salmon in the upper McKenzie River, Oregon

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A population dynamics modeling approach was used to assess the impacts of a hydroelectric project on bull trout and Chinook salmon in the upper McKenzie River, Oregon, and to provide a tool to guide future management of the project. Conceptual models were developed that provided a theoretical foundation for quantitative models by identifying factors that limit life history stages and the overall production of the populations. This information was used to develop a quantitative stock-production population model. Values from the literature and field studies assessing life-stage-specific population estimates, survival, and suitable habitat were used to parameterize models. Based on the conceptual and quantitative models, the bull trout population in the upper McKenzie River is currently limited by available habitat for subadults and adults; very few juveniles are needed to replace subadults that either emigrate or die. In addition, model results suggested that the adult bull trout population could be increased with reduced angling or poaching pressure (e.g., via increased law enforcement). Results from the Chinook salmon model indicated that the spring Chinook salmon population upstream of Trail Bridge Reservoir is most strongly affected by available spawning habitat, survival of fry, juveniles, and smolts in Trail Bridge Reservoir, and survival while passing downstream past Trail Bridge Dam. These results are being used to inform management decisions associated with relicensing the Carmen-Smith Hydroelectric Project.

Session: Reintroductions and Recovery of Anadromous Fish in the Willamette Basin – Dammed If We Do, Damned If We Don't

Future Management of Hatchery Fish and the Recovery of Wild Spring Chinook Salmon in the Willamette River

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Wild spring Chinook salmon of the Willamette River have experienced a significant decline over the last century. One of the most notable causes for this decline was the construction of dams that eliminated access to headwater habitat in exchange for widespread hatchery mitigation. Managers are now faced with the issue of needing to rebuild sustainable, wild populations while minimizing the risks of hatchery production. The hatchery management strategy currently being pursued in the Willamette River strives to: 1) Minimize hatchery risks on the remaining stronghold wild populations, and 2) use specific hatchery programs to reintroduce Chinook salmon back into their historic habitat above the dams. The short- and long-term goals for each population vary depending upon wild fish status and the specific survival impediments. Hatchery fish may help the re-establishment of wild runs back into historic habitat only if coupled with major improvements in fish survival through the dams and reservoirs.

Session: Contributed Papers #3

Seasonal Variability in the Uppermost Extent of Fish Distribution within Eastern Washington Streams

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The seasonal variability in the uppermost extent of fish distribution in 100 eastern Washington streams was assessed to determine the validity of using previously collected data in constructing a Last Fish Habitat Model. Resurveys of seven watersheds sampled in 2001 and 2002 were performed in the spring, summer, and fall of 2005. Seasonal changes appear to be largely restricted to short-distance movements. The largest average distance moved between sampling periods occurred between summer 2002 terminal points and corresponding spring 2005 points (average absolute distance: 73.7m), while the smallest average distance moved occurred between corresponding summer and fall 2005 terminal points (average absolute distance: 19.1 m). The average absolute distance between spring terminal points and corresponding summer points was 51.4 m. Seasonal changes at lateral points were small relative to those occurring at terminal points, as absolute distances averaged 14.5 m between summer 2002 and spring 2005, 0 m between spring and summer 2005, and 0.2 m between summer and fall 2005. Changes in last-fish locations were related to several physical habitat attributes, notably changes in wetted channel dimensions, stream gradient, and frequency and size of barriers. Collectively, these data suggest that the upper limits of fish distribution are not highly variable among seasons, and that most movements tend to occur over distances that would not have a large bearing on the ability to reliably determine the upper limits of fish distribution in seasons other than spring when seasonal flow conditions are similar to those under which this work was performed.

Session: "Evaluation of salmonid production in management decisions for hydroproject relicensing"

RIPPLE: A Fortified Model that Links Geomorphology, Habitat, and Salmon Population Dynamics

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One of the guiding features of Ripple is the assumption that the physical environment—specifically topography, geology, climate, drainage area, channel gradient, channel longitudinal profile—are essentially time-invariant compared with ecosystems and the salmonid populations supported by these ecosystems. This assumption permits us to construct a model that establishes a physical template composed of topographic information, channel networks, and so forth. The physical template exerts important controls on the distribution and abundance of salmon of various life stages that occupy different parts of the watershed. Ripple uses the physical template to predict reach-specific historical, current, and potential future salmon habitat. Ripple then employees a population sub-model which is spatially explicit—adult salmon choose reaches in proportion to the available spawning habitat or according to known preferences. If the number of fry that emerge in a reach is greater than the carrying capacity the excess fry can migrate downstream in search of available habitat. The same is true for other life stages if habitat is limiting in a reach. One of the uses of the model is to assess the degree to which dams may have changed salmon abundance from historical conditions and how different management options improve or degrade salmon populations.

Session: Contributed Papers #2

Biology Based Approach to Establishing Sediment Criteria

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Excess bottom sediments in streams and rivers may affect the feeding, migration, and reproduction of resident fish. Thus, sediment may be considered a limiting factor when it constrains the distribution and reproduction of fish species. The Environmental Protection Agency has made it a priority to develop sediment criteria that protect the biological health and

beneficial uses of water resources. Setting impairment levels using only reference site physical data may not adequately protect species. We use Environmental Monitoring and Assessment Program-Western Pilot aquatic vertebrate data (fish and amphibians) to develop a framework for setting sediment criteria that relate to the biological response of aquatic vertebrates. We've taken a quantile regression approach at an aggregated ecoregion level to track the rate of change in biological response with increasing percent fines in stream substrates. We also compare sediment criteria with sediment tolerance values for individual sediment sensitive taxa obtained using weighted averaging methodology. Salmonids appear to do best with a criterion of about 10% fines. We generally found that existing documented criteria may not provide adequate protection for salmonid species.

Session: The Pelton Round Butte Story

Using a Dual Frequency Identification Sonar (DIDSON) to Enumerate the Spawning Migration of Kokanee Salmon into the Metolius River.

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Kokanee salmon (*Oncorhynchus nerka*) are among the most numerous fish species in the Lake Billy Chinook/Metolius River System, and support an important sports fishery. Accurate estimates of population size are inherently difficult because of the nature of the system, but attaining a more accurate estimate is important because this kokanee population may be used for reestablishment of anadromous sockeye salmon runs above the Pelton Round Butte hydroelectric complex. In 2006, a long range Dual Frequency Identification Sonar (DIDSON) was deployed at the mouth of the Metolius River in an effort to estimate the number of kokanee salmon migrating into the river to spawn. The DIDSON is a multi-beam underwater acoustic camera, the LR model of which can record digital video files across the entire 30+ m width of the river. The DIDSON was operated between September 5 and November 4, 2006. Aside from some technical issues during September, we were able to record a significant portion of the spawning migration. Early analysis indicates that the majority of kokanee (>90%) migrate in the first 3-5 hours after sunset, and that they tend to move in groups of 10-30 fish, and preferred the shallow side of the river where the current was less strong. Other species of fish (bull trout, rainbow trout, and mountain whitefish) are also present in the system; however, they display different behaviors and are discernable from kokanee salmon. After reading of the DIDSON-LR files is finished, the resulting counts will be expanded to provide an estimate of total escapement.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Temporal Patterns of Larval Ghost Shrimp (*Neotrypaea californiensis*) in Yaquina Bay, Newport, Oregon

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Temporal patterns of larval Ghost shrimp (*Neotrypaea californiensis*) are important ecological components of Pacific estuaries. Recruitment and subsequent returns of ghost shrimp to estuarine tideflats is highly variable among years and their larval life history is poorly understood. The goal of this project is to answer if there were distinct pulses of early life larvae release or are larvae always present in the water column? We collected continuous samples of pelagic ghost shrimp from Yaquina Bay during peak larvae release periods. A continuous centrifugal pump system was used to collect zooplankton samples for estimates of abundance, size, and

development stages. Objectives were, 1) assess the timing and magnitude of larval abundance in Yaquina Bay (larval stages I – V), and 2) assess recruitment from the occurrences of post larvae (i.e. potential recruits). Ninety eight percent of these larvae were stage 1 and were in 3 periods and spanning six total days of peak abundance during study period, and no correlation to physical factors and no evidence for recruitment during the study.

Session: Lamprey Papers

Assessing Electrofishing as a Tool to Detect Presence and Determine Capture Efficiency of Larval Pacific Lamprey

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Understanding the status of Pacific lamprey (*Lampetra tridentata*) has been identified as the most important factor for conserving this anadromous species. The development of standardized sampling protocols is critical for determining the distribution and abundance of adult and juvenile Pacific lamprey. Electrofishing is commonly used for determining distribution and abundance of juvenile fishes including lamprey; however, little work has been done to assess the effectiveness of electrofishing for larval lamprey. We performed controlled electrofishing tests and evaluated the results relative to several factors, such as larval density, size and electrofishing effort (i.e., number of electrofishing passes and electrofisher unit settings). This study provides insights into the utility of electrofishing for predicting the probability of detection and in estimating capture efficiency for larval lamprey. The probability of detection increased as density increased for all sizes of ammocoetes. Smaller ammocoetes are more easily detected than larger ones when distributed at low densities. Cumulative capture efficiency increased as density increased for all sizes. Cumulative capture efficiency was highest for small ammocoetes. The ultimate intent of this work is to evaluate electrofishing and develop approaches to assist in determining larval lamprey presence and abundance for the purpose of understanding Pacific lamprey status. The results of the analyses could also aid in the development of measures of confidence for existing larval lamprey electrofishing data.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Limiting Factors Controlling the Spatial Distribution of Redband Trout (*Oncorhynchus mykiss gairdneri*) and Their Implications Across a Basin

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Monitoring longitudinal summer stream temperatures may be useful to asses the carrying capacity of threatened and endangered salmonids. To understand expressions of habitat heterogeneity in stream systems it is necessary increase research efforts to understand how multi-scale patterns of stream temperature and habitat quality affects fish community distribution. Our objective was to classify habitat quality for Redband trout (*Oncorhynchus mykiss gairdneri*) in the south fork of the John Day River, OR, using a multidisciplinary approach that includes landscape influences, fish community distribution and abundance and physiological responses to temperature. Differences in landscape and land use attributes showed that continuous sampling is more useful than site-specific sampling in order to identify hypothesis about limiting factors and cumulative effects. A cluster and outlier analysis shows that there was not any clustering in fish distributions that was not detectable at the reach scale. Were also found three main "hotspots" for Redband trout distribution that are principally associated with water temperature and stream order. Reach analysis (1 to 5 km) is the most appropriate scale to understand Redband trout distribution patterns in the South Fork Jon Day River, OR. We found that among reaches trout distribution is highly correlated with physiological tolerance to temperature and secondly correlated with distribution patterns of

warm water fishes. Our approach is consistent with the concept of Adaptive Management providing managers with new hypotheses for restoration experiments in specific areas.

Session: Law Enforcement

Protection of Out-Planted Spring Chinook Salmon in the Upper Willamette Basin

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The out-planting of adult Chinook salmon has been an ongoing project for several years in the Upper Middle Fork of the Willamette River drainage. Access by returning salmon to these tributaries has been prevented by flood control and hydroelectric dams with no fish passage facilities. As a result, adult salmon have been outplanted in the North Fork of the Middle Fork of the Willamette River, Fall Creek above Fall Creek Dam and the Middle Fork Willamette above Hills Creek Reservoir. The Oregon Department of Fish and Wildlife and the U.S. Army Corps of Engineers have conducted studies to determine the survival and spawning success of these fish. Survival has been limited due to several factors including water temperature, low water levels, disease, and illegal harvest. The task of preventing the illegal harvest of these fish has fallen upon the Oregon State Police. All three of these Willamette River tributaries which are outplanted with salmon are closed to angling for adult salmon. However, they are popular recreational destinations which attract a large number of campers and trout anglers during the summer season. Most of the salmon angling violations are committed by opportunists that succumb to temptation when they find the large salmon in these small tributaries. Other violators intentionally target the salmon and take them unlawfully by any illegal means. The clear shallow water also makes the fish particularly vulnerable. This presentation will explore the factors that contribute to the illegal taking of these outplanted salmon and will address the enforcement efforts that have been taken by the Oregon State Police Fish and Wildlife Division to protect them.

Session: Evaluation of salmonid production in management decisions for hydroproject relicensing

Interpreting Fish Habitat and Population Model Results in FERC Relicensing: Oracle or Ouija Board?

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FERC reclicensing is typically a protracted process aimed at balancing divergent values attached to aquatic ecosystems. In these debates, computer models are used to characterize strategies and compare their implications in terms of biological, social and economic metrics. Unfortunately, rather than facilitating rational debate, models themselves can become the focus of debate. Parties may support a model largely on the basis of whether the results are "correct", i.e. whether they support preconceived, policy-based notions of reality. In this paper we show how fish habitat and population models are being used to select and implement fish passage systems at large hydroelectric projects. It is evident from our experience in FERC relicensing on the Cowlitz River, Lewis River and Klamath River, that if models are to be used, stakeholders must define upfront how model outputs are to be interpreted. Should outputs be considered accurate forecasts of resulting fish production potential, or as widgets that denote the relative advantages of one system over another? Although models are based on their work, biologists are oddly reluctant to support model predictions and instead focus on variability and scientific uncertainty. Decision-makers and the public, on the other hand, demand accountability and seek answers to questions such as: Which passage alternative produces the most fish? What is the expected benefit of large social and economic investments? In this paper we try to provide some insight as to how models may be used to select fish passage strategies and to bring accountability to the process.

Session: Reintroduction Using Artificial Propagation: Approaches, Techniques, Management

Why the Adult Supplementation Strategy was Selected for Restoring Anadromous Fish Populations in the Cowlitz River

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Chinook, coho and late winter steelhead populations were extirpated from the Upper Cowlitz River (WA) with the construction of Mossyrock and Mayfield Dams in the early 1960's. Although anadromous fish continued to be transported and released to the upper watershed even after dam construction, biologists were unable to collect a sufficient number of juvenile fish to maintain fish runs over time. Eventually, fish stocking efforts into the upper basin were discontinued and anadromous fish production was transferred to hatcheries located in the lower Cowlitz River. In the 1990's, the construction of Cowlitz Falls Dam and the start of FERC relicensing proceedings for the Cowlitz River Hydroelectric Project (FERC 2016) provided local fisheries biologists an opportunity to restore anadromous fish production to the Upper Cowlitz River. Although both juvenile and adult supplementation strategies were implemented to start the anadromous reintroduction program, it became apparent that an adult supplementation strategy would be the more effective strategy given conditions in the Cowlitz River. To illustrate the benefits of adult supplementation, we contrast the benefits and risks of three different strategies that were used for restoring fish production in the Cowlitz River basin.

Session: The Pelton-Round Butte Story

Giving Fish a Boost: Performance of the Hidrostal Pump for Elevating Smolt-Sized *Oncorhynchus mykiss*

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Portland General Electric and the Confederated Tribes of the Warm Springs Reservation of Oregon are attempting to reestablish fish passage for anadromous and resident species at Round Butte Dam. A new surface water withdrawal (SWW) dam intake and associated downstream-migrant fish capture and transfer facility will utilize up to 6,000 cfs of screened surface water to capture fish. A large Hidrostal pump is under consideration for use at the proposed Round Butte SWW fish transfer facility, but few data have been available for assessing this pump's efficacy for passing fish in the larger size range of Deschutes River juvenile steelhead. We used a 20-inch (50.8 cm) Wemco Hidrostal pump, located on an upper Klamath Lake fish facility, to evaluate the potential for physical injury and mortality of juvenile salmonids comparable in size to Deschutes River steelhead smolts. The level of descaling and physical injury to the head, eyes, skin, and fins of hatchery rainbow trout passing through the Hidrostal were the primary factors used to evaluate pump performance. Morbidity of marked rainbow trout passed through the pump and a short bypass pipe was negligible. No significant scale loss (Kruskal-Wallis ANOVA of ranks, P=0.12) or physical injury of fish up to 389 mm (16 inches) FL could be attributed to pump passage. In general, our results are consistent with the fish-friendly performance of the Hidrostal pump for passing smaller-sized fishes reported at other fish passage facilities. Although measurement of latent mortality was not conducted as part of this study, other tests of Hidrostal pumps report that differences between acute and delayed mortality are generally very low. Additionally, certain design elements under consideration for the Round Butte installation appear better in terms of reducing possible fish disorientation and potential for injury during pumped passage compared to that at the test facility.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon

Das Grabenfische

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The minnow genus *Siphateles* is distributed throughout the Great Basin and adjacent drainages in one of the most volcanically and tectonically active regions in the western United States. Relationships of *Siphateles* were investigated through phylogenetic analyses of the complete mitochondrial cytochrome *b* gene. Sequence data supported recognition of *S. boraxobius, S. alvordensis, S. bicolor*, *S. columbianus*, *S. newarkensis*, *S. eurysomas*, *S. isolatus*, *S. mohavensis*, *S. obesus*, *S. thalasinnus,* and an undescribed species, *Siphateles* sp. (Silver Lake). Larval development is being used to corroborate the molecular data and provide morphological characters for species recognition. In Oregon, the northern distribution of *Siphateles* west of the Snake River was bounded by the Brothers Fault Zone, a northwest trending, laterally-moving band of faults that increase in age from west to east. In Oregon, most clades were confined to tectonic depressions, or grabens, with the oldest, Alvord Desert, containing the most divergent taxa. Both the molecular and geological data corroborate an approximate 10 million yr separation of Alvord fish from their closest relatives. Overall distribution patterns were most parsimoniously explained as vicariant events due to Miocene to Pleistocene volcanic and tectonic graben formation. Two exceptions are in Summer Lake and Abert Lake basins where either two or three dispersal events must have occurred. In both basins, human dispersal is suspected and underlines the need to better understand fishes in these basins, some of which are federally listed.

Session: Stream Restoration: New concepts and strategies

Evaluation of Fish Movement and Populations in Beaver Creek, a Tributary of the Methow River, After Modification of water Diversions to Improve Fish Passage

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In fall 2004, the last remaining water diversion dam in Beaver Creek, a tributary of the Methow River, at rkm 2 was modified by the U.S. Bureau of Reclamation to improve fish passage for "all fish at all flows". Just previous to the modification, but after other passage modifications upstream, we installed a two-way fish trapping weir below the diversion. In addition, we installed four Passive Integrated transponder (PIT) tag interrogation systems at rkm 1.3, 4.9, 5.0 and 13.0. We calculated annual population estimates at three index sites located between rkm 5 and 17. By the end of 2005, we inserted 3,913 PIT-tags in mostly juvenile steelhead/rainbow trout (79 %), brook trout (9%), and juvenile Chinook (7%), but also adult steelhead, juvenile coho, bull trout, and westslope cutthroat trout. Since modification, we have detected successful upstream passage of adult and juvenile fish over two modified water diversions in lower Beaver Creek. Our PIT-tagged fish have also been detected at several dams in the Columbia River, which has provided valuable information on life history patterns. The use of PIT tags and stationary interrogation systems have proven to be effective tools to track fish movement and assess the effectiveness of habitat restoration efforts.

Session: Columbia River Basin Issues

I Know What Your Fish Did Last Summer – An Overview of Columbia Basin PIT Tag Activities During 2006

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2006 marked the 20th year that Passive Integrated Transponder (PIT) tags have been used to monitor the migratory behavior of salmon (*Oncorhynchus* spp.) and other fish species in the Columbia River Basin (CRB). The Columbia Basin PIT Tag Information System (PTAGIS) manages a publicly-accessible database of all PIT tag mark/recovery records collected since 1987. About 18 million fish in the CRB have been PIT-tagged in the last 20 years; almost two million juvenile salmon were tagged for the 2006 out-migration. Subsequent to marking and release, PIT-tagged fish may be physically recaptured. In 2006, almost 44,000 previously-tagged fish were recaptured, providing researchers with an opportunity to directly measure the growth of thousands of individual fish. In recent years, large numbers of PIT tags have been detected *in situ* on islands in the Columbia River

colonized by breeding terns, cormorants, and other piscivorous avian predators. In 2005, over 90,000 PIT tags were detected on these islands. Similar numbers of tags were likely detected during 2006. Over 815,000 PIT-tagged fish were detected at one or more of over 50 sites in the CRB during 2006. Almost 150,000 fish were detected exiting from a half dozen acclimation ponds. Some 700,000 fish were detected in the juvenile bypass systems at mainstem CRB dams, and over 18,000 adults detected in the fish ladders at these dams. New deployments of PIT tag detectors at these dams significantly increased the numbers of PIT tags reported in 2006, and extended detection opportunities later into the fall than previously possible.

Session: Data Management/Data Sharing

Maintaining Data Access Across Multiple Boundaries – The Success of the Columbia Basin PIT Tag Information System

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PIT-tagged salmon and steelhead (*Oncorhynchus* spp.) in the Columbia River Basin migrate up to 1,000 kilometers from their natal stream or hatchery to the Pacific Ocean as smolts, and repeat the journey in reverse prior to spawning. During these migrations, the tagged fish generally move through multiple geographical, political, and resource management domains. Each year, tagging and subsequent recovery events (including physical recaptures and *in situ* detections) are recorded by hundreds of individuals from dozens of federal, state, tribal, private, and not-for-profit fisheries research and management entities. The Columbia Basin PIT Tag Information System (PTAGIS) is a consistent and comprehensive repository for all of the mark/recapture data reported for almost 18 million salmon and steelhead PIT-tagged since 1987. The software application that records the initial marking and physical recovery events is designed to ensure that the data provided to PTAGIS are validated and verified by the individual data contributors immediately as those data are collected, prior to incorporation into the regional PTAGIS database. Similarly, comprehensive equipment diagnostics are incorporated in the passive detection data reported from the fish facilities at dams and other locations, allowing PTAGIS and other data contributors to quickly detect and resolve issues that might otherwise lead to data loss or corruption. PIT-tag marking and recapture data are automatically loaded into the PTAGIS database upon receipt, and passive detection data are typically loaded within three hours of the detection event. These data are then immediately available to researchers, analysts, and fisheries managers via a publicly-accessible Web Portal.

Session: Reintroduction Using Artificial Propagation: Approaches, Techniques, Management

Natural Productivity of Hatchery-origin Steelhead Identified Through Pedigree Analysis: Evaluating Battle Creek Restoration Strategies at Coleman National Fish Hatchery

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Propagation of steelhead trout (*Oncorhynchus mykiss*) at Coleman National Fish Hatchery (CNFH) on Battle Creek was initiated in 1947 to help mitigate for habitat loss following construction of Shasta Dam on the Sacramento River in California. Broodstock for the hatchery program have been collected from a mixture of hatchery-origin (HAT) and natural-origin (NOR) steelhead returning to CNFH since 1952. From 1995 to 2004 up-stream passage of adult HAT steelhead at the CNFH barrier weir ranged from 200 - 2,000 fish annually with the intent of promoting a demographic boost in natural production. We evaluated relative reproductive success and fitness of HAT and NOR steelhead spawning above the CNFH barrier weir during the 2002-03 and 2003-04 return years using genetic based parentage analysis. Preliminary results, based on returning adult offspring

sampled in 2004-05 and 2005-06, suggests HAT spawners provided a demographic boost in natural production. However, HOR spawners on average produced fewer adult offspring than NOR fish. This study provides valuable information concerning the efficacy of using HAT fish to assist restoration and conservation efforts for steelhead trout in Battle Creek.

Paper
Session: Redband Trout-Migrations in the Desert
Where Did All These Steelhead Come From? A Close Look at a Unique Population of Steelhead Trout
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The goal of this project is to assess the status of anadromous salmonid populations in Asotin Creek. This research, monitoring and evaluation project provides estimates of abundance, productivity, survival rates, and temporal and spatial distribution of ESA-listed summer steelhead (*Oncorhynchus mykiss*) and spring Chinook salmon (*O. tshawytscha*). Adult salmonids entering Asotin Creek to spawn were enumerated using a floating, resistance board weir. The juvenile migrant population was estimated using a rotary screw trap. Five-hundred and thirteen (513) and 474 adult steelhead were captured in 2005 (the first season of adult trapping) and 2006, respectively, resulting in population estimates of 653 and 575 adults, spawning in 46 kilometers of habitat, in stream flows of 25-160 cubic feet per second. Spawning ground surveys were performed over the entire range of available spawning habitat in 2005, resulting in a female per redd estimate of 0.904. The juvenile steelhead population was estimated at 45,744, 27,287, and 38,000 for 2004, 2005 and 2006, respectively. Passive integrated transponder tagging of out-migrating juveniles indicted that 18% of the age 1 fish were detected at a mainstem dam, while 78% and 88% of the age 2 and age 3 fish were detected, respectively. Data suggests that the Asotin Creek summer steelhead – above eight mainstem dams on the Snake and Columbia Rivers – is a productive, naturally-sustaining population of the Snake River steelhead ESU. Monitoring Asotin Creeks' unsupplemented steelhead population provides reference data against which management actions can be assessed for this and other eastside subbasins.

Session: Stream Restoration: New Concepts and Strategies
Salmon and Steelhead Conservation: An Assessment of Anchor Habitat on the Sandy River, Oregon
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Salmon and steelhead populations in the Sandy River Basin have declined over the last century due to degradation of habitat and other factors. To focus habitat restoration activities, non-profit organizations and government agencies have adopted a professional Working Group format to develop a coordinated, anadromous fish restoration strategy for the Sandy River Basin. The identification of anchor habitats for salmon and steelhead populations serves as the starting point for development of a comprehensive, basin-wide habitat restoration strategy. ***Anchor habitat*** is defined as distinct stream reaches that currently harbor specific life history stages of salmon and steelhead to a greater extent than the stream system at large. The Working Group identified anchor habitat by evaluating empirical data, professional judgment data, and Ecosystem Diagnosis and Treatment (EDT) model data. Empirical data were drawn entirely from available spawning survey data. Professional judgment data were collected from independent interviews conducted with fish biologists that have extensive Sandy Basin knowledge and in-the-field experience. EDT model data were derived from previous working group efforts to assess anadromous fish habitat conditions and fish production capability. Results of the anchor habitat evaluation indicate 12 reaches and 35.9 miles of anchor habitat for spring Chinook; 5 reaches and 12.5 miles for fall Chinook;

11 reaches and 17.5 miles for coho; and 22 reaches and 42.1 miles for winter steelhead. The Working Group developed a decision-support model to: 1) create a "living" document, 2) numerically score reaches, and 3) support anchor habitat designations decisions. The decision-support model creates a transparent process and also serves as a relatively simple tool for making anchor habitat adjustments or refinements in the future. Go to www.sandyriverpartners.org to obtain a copy of the anchor habitat assessment document.

Session: Columbia River Basin Issues

Smolt Life History Differences Between Snake River and John Day River Wild Stream-type Chinook Salmon Populations: Confounding Effects or Mechanisms for Differential Mortality?

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Comparisons of performance between Snake River and John Day River stream-type Chinook salmon populations – which produce juveniles passing through a different number of impoundments (8 vs. 3) during their seaward-migrant smolt phase – have yielded considerable insight on the role of hydropower dam construction and operation in salmon decline. Given its reliance on a 'natural-experiment' study design (i.e., uncontrolled spatiotemporal comparisons), however, it has been suggested that an upriver–downriver population comparison approach is confounded and therefore likely to yield spurious results. Specifically, investigators have suggested that the ~350% smolt-to-adult survival discrepancy existing between the Snake and John Day basin populations may be a consequence of between-population differences in fitness-related juvenile life history characteristics. By exploiting a rich (n >100,000), 6-year PIT-tagging database, we tested the plausibility of this hypothesis. While explicitly incorporating year- and population-specific spawner density and environmental conditions, we compared between populations: i) smolt outmigration timing; ii) size at outmigration; iii) migration duration; and iv) estuary arrival timing. We found no evidence for the existence of a systematic difference in either size-at-migration or natal-basin departure timing. In contrast, we observed significantly longer migrations and later estuary arrival dates (~10 days) for Snake- relative to John Day-origin smolts, both results being significantly influenced by hydrology- and impoundment-influenced water velocity patterns. Our analysis suggests that previously documented upriver–downriver performance differentials are likely a result of hydropower dam-related delay (and related effects) rather than hypothesized, innate life history effects.

Session: Redband Trout – Migrations in the Desert

Improving Fish Passage in the Chewaucan River Basin

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Migratory fish passage was blocked in the early 1900's in the Chewaucan River when the area was settled and improved for grass and livestock production. Three weirs were installed on the Chewaucan River to provide irrigation water to the various ranches. In 1990's the "Rivers End Reservoir" was created to improve waterfowl and fish habitat directly upstream from the river's connection with Abert Lake. In 1997 large adfluvial Redband trout were observed directly downstream of the lowest weir (Narrow's weir). This weir at that time when operating blocked all upstream fish passage. A partnership was created between the private landowners, State, Federal and non-governmental organizations to address the fish passage needs. Three fishways have been installed. Currently juvenile fish screens are in place on the upstream weir (Paisley Town Weir). Funds are being pursued to provide juvenile fish protection screening on the remaining two irrigation diversions.

Session: Contributed Papers #1

Elucidating Life History Variation in Pacific Salmonids

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Salmon are an integral and diverse component of Pacific Northwest ecosystems and display broad arrays of naturally-occurring variation in numerous life history traits, i.e., size- and age-at-reproduction, smolt age, fecundity, and egg size. Life history theory predicts that variation in certain traits imparts persistence and resilience to a species and its local populations. Recent studies in evolutionary ecology indicate that local adaptation may occur on relatively short time-scales and, thus, be highly relevant to management and conservation efforts. Certain traits, such as juvenile and adult migratory behavior, also display large amounts of variation and some behaviors appear to have a genetic basis but their effects on fitness are not well understood. Although detailed description of natural variation and its relevance to persistence and resilience of salmon populations are important components of successful management and conservation, there are numerous life history aspects that are poorly understood. A research program designed to provide more detailed information on life history variation to assist management and conservation efforts is being developed. Preliminary results from research focused on migratory variation in Chinook, coho, and steelhead along the Oregon coast will be presented. Efforts include: 1) validation of the use of $^{87}Sr/^{86}Sr$ in otoliths to identify maternal run time in Chinook; 2) characterization of early ocean residence in juvenile steelhead; and 3) determination of the role of the stream-estuary ecotone in coho early life history. The quantification of migratory patterns provides a foundation for further research to determine the ecological and evolutionary significance of variation in migratory behavior.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

A Comparison of Macroinvertebrate Responses to Irrigation Water Withdrawals Across Montane, Foothill, and Lowland River Systems

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Management of river systems for irrigated agriculture in the intermountain west has altered the timing, magnitude, and duration of summer low flow events. Despite documented negative impacts of low flow events on water quality and habitat patches, macroinvertebrate responses to water withdrawals are poorly understood. A preliminary study of 15 sites subjected to a range of water withdrawal intensities revealed highly resistant macroinvertebrate assemblages in a 5th order lowland system. Threshold responses were observed above 90% water withdrawal ($0.7 m^3 s^{-1}$) to the interactive impacts of reduced discharge and altered water quality (i.e., elevated conductivity and temperature values). We hypothesized that observed resistance levels would be unique to lowland rivers, where river fauna typically experience thermal pollution, sedimentation, and low flow conditions. To test this prediction, we sampled above and below diversion points withdrawing 75% or greater of ambient discharge levels in each of four montane, foothill, and lowland river reaches. Benthic macroinvertebrates, physicochemical variables, and chlorophyll-*a* biomass were measured at six sites per river (3 upstream and 3 downstream of the diversion point) during peak irrigation season. We predict the magnitude of macroinvertebrate responses will be greatest for montane reaches and lowest for lowland reaches. Depending on the robustness of macroinvertebrate responses, this study could suggest the need for different management strategies depending on the location of a diversion within a watershed.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Gene Expression During the Stress Response Gives Insight to Recovery and Possible Sex Differences in Rainbow Trout

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Understanding the stress response and subsequent recovery at the level of gene expression can enhance our understanding of fish physiology. In order to better appreciate the mechanisms underlying the physiology of the stress response, we used molecular tools to study gene expression, in rainbow trout (*Oncorhynchus mykiss*). In two different experiments, fish exposed to a three-hour stressor were compared to control (unstressed) fish. In the second experiment, there were additional treatments of fish that were exposed to only a half-hour of stress and of fish sampled 21 hours after experiencing a three-hour stressor. This 21 hour post-stress treatment was a means to study gene expression during recovery from stress. The genes we report as differentially expressed are those that responded similarly in both experiments, suggesting that they are robust indicators of stress. These genes are: *major histocompatibility complex class I* molecule (*MHCI*), an immune related gene; *glucose 6-phosphatase* (*G6Pase*), a metabolic gene; and *JunB* and *nuclear protein 1* (*Nupr1*), which are transcription factors. Patterns of *G6Pase* and *JunB* expression from qPCR data, suggested that by 21 hours post-stress, the fish had recovered from the stressor, however, their patterns in expression seem to be different between sexes. Interestingly, *Nupr1* gene expression was still elevated 21 hours post stress which indicates that recovery was incomplete at that time. The continued elevation of *Nupr1* mRNA nearly a day after a relatively short stressor could make this gene a suitable indicator of the time necessary for full recovery following stress.

Session: Lamprey Papers

A Lamprey Passage Structure at Bonneville Dam: Three Years Old and Growing

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The passage success of upstream migrating adult Pacific lamprey (*Lampetra tridentata*) at Columbia River hydropower dams is poor relative to salmonids. In particular, lamprey are delayed and fall back downstream at the serpentine weirs near the top of the Bonneville Dam fishways. The lamprey also regularly enter auxiliary water supply (AWS) channels which provide no ready outlet to the dam forebay. In 2004-06, we operated a lamprey passage structure (LPS) at the Bradford Island AWS to aid lamprey passage. Lamprey can use this LPS to volitionally move from the AWS, through a series of rest boxes, and into the forebay of the dam. Individual lamprey were counted as they passed through the LPS, and in each year of operation this count increased. In 2006, we added a dual collector system, shortened the lengths of steep ramps, and incorporated a larger resting pool in the LPS. From mid-May to mid-September, 14,975 lamprey used the LPS, and this exceeded the number counted at the count window located in the adjacent Bradford Island fishway (n =14,862). Of the 2,000 lamprey that we tagged with half-duplex passive integrated transponder tags and released below Bonneville Dam, 146 were detected in the LPS while 197 were detected as they passed through the Bradford Island fishway exit. Both of these sources of data suggest that the LPS contributed significantly to overall passage of lamprey in the Bradford Island fishway system.

Session: Lamprey Papers

Identification of Low-elevation Impediments to Adult Pacific Lamprey (*Lampetra tridentata*) Migration in the Umatilla River, Oregon

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Efforts to restore Pacific lamprey (*Lampetra tridentata*) populations in the Umatilla River may be constrained by poor lamprey passage success during their pre-spawning migration. We used radiotelemetry to document passage of both spawning-phase (n = 30) and newly-migrating (n = 51) adult lamprey as they moved upstream from the mouth of the Umatilla River in 2005. The first major obstacle lamprey encounter in the Umatilla River is Three Mile Falls Diversion Dam, which is operated by the Bureau of Reclamation at Rkm 6. Only 50% of the spawning-phase and 11% of the newly-migrating lamprey that approached this low-elevation structure (8 m hydraulic height) were able to successfully pass over. The next obstacle to passage is Boyd's Diversion Dam, a privately-operated hydroelectric diversion at Rkm 14 that is less than 1 m high. Of the lamprey that approached this structure, 40% of the spawning-phase fish and 25% of the newly-migrating fish successfully passed over. At both dams, spawning-phase fish were probably more successful because flows during their migration period (late April-May) were higher than those for newly-migrating fish (late June-July). This resulted in both more potential passage routes and cooler water temperatures. Our pilot study indicated that in the first 50 km of the Umatilla River, the combination of low summer flows, high temperature, and a series of five, low-elevation dams conspire to block passage of adult Pacific lamprey.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

An Assessment of the Chemical, Habitat, and Biological Condition of Wadeable Streams in the Lower Columbia Region of Oregon

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We conducted a two-year study of the biological, chemical, and habitat quality of first through third order, wadeable streams in the Oregon portion of the Lower Columbia basin. We surveyed 54 randomly selected streams and 17 non-random reference streams in 2003 and 2004 during June, July, August, and September using the US EPA Environmental Monitoring and Assessment Program protocol. This region includes the spawning and rearing habitat of several anadromous salmonids that are listed or being considered for listing as threatened under the Endangered Species Act. It also contains Portland, Oregon's largest city. We found that the most extensive stressors were high levels of fine sediment, high turbidity, and warm water temperatures. These stressors impair 30 to 40% of the wadeable stream miles. Water temperature, fine sediment, phosphorus, and turbidity were on average significantly higher across the region relative to reference sites. We found stream habitat simplification and alteration were less extensive (<10%), but when present these stressors were significant risk factors to the biological integrity of the aquatic vertebrate and macroinvertebrate communities. Habitat simplification and alteration were indicated by decreased amounts of large woody debris habitat, increased proportion of glide habitat, and reduced stream shade relative to reference sites.

Session: Data Management/Sharing

The Regional Mark Processing Center's Role in Providing Quality Data for Fisheries Resource Management on the Pacific Coast

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The Regional Mark Processing Center (RMPC) uniquely exists to provide essential services to international, state, federal, tribal and other fisheries organizations. The RMPC provides regional coordination of salmonid tagging and fish marking programs; direction and management of region wide databases of information relating to the marking and coded-wire tagging (CWT) of salmonids; developments and maintenance of online computer applications for querying and reporting from the databases known collectively as the Regional Mark Information System (RMIS); and supporting and facilitating the ongoing needs of the member states of the Pacific States Marine Fisheries Commission, the Regional Committee on Marking and Tagging and the Pacific Salmon

Commission. RMPC places high value on maintaining and reporting objective scientific information suitable for guiding, planning, researching, monitoring, managing, evaluating and policy making related to anadromous salmonids. The project believes that the data should be maintained independently from analysis and interpretation, and the project does not attempt to draw conclusions or make recommendations. The primary goals of RMPC data management are to maintain and improve the integrity of all data elements within the databases; to maintain and upgrade the international database for all CWT releases, recoveries and related data sets; serve as the official United States of America site for Pacific Coast CWT data exchange with Canada; assist agencies in the collection and reporting of fish identification data pertinent to the RMPC mission; embrace and utilize geographic representation of data and maintain and enhance the RMPC system environment by utilizing the best available hardware and software technologies available.

Session: Early life history research and monitoring

Early Life History of Juvenile Summer Steelhead (*Oncorhynchus mykiss*) in the Grande Ronde River Subbasin

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Snake River summer steelhead, including the Grande Ronde River population, were listed as threatened under the Endangered Species Act in 1997, triggering research to document and describe the early life history patterns of juvenile summer steelhead in the Grande Ronde River Subbasin. This research has focused on juvenile summer steelhead migration timing, migrant abundances, age and size of migrants, and survival to Lower Granite Dam. Distinct life history patterns in four study streams have been documented. Early migrants, ranging from age zero to age three, leave spawning and summer rearing areas in the fall and overwinter downstream in larger river habitats. Late migrants, ranging from age one to age four, overwinter upstream in spawning and summer rearing areas and begin their seaward migration in the spring. Some juvenile steelhead leaving upper rearing areas continued to rear within the basin for an extended period of time (6 months to several years). The overall age structure of migrants leaving upper rearing areas differs considerably from the age structure of subsequent dam detections. Of the steelhead tagged at traps and in summer rearing areas, the larger individuals tended to be the ones detected at the dams within the same migration year. The smaller fish where more likely to be detected at the dams one year after tagging.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

A Field and Laboratory Study of Mechanism Conferring Dominance by Brook Trout (*Salvelinus fontinalis*) Over Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi*)

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This talk summarizes field and laboratory research we conducted from 2003-2005, synthesizes previous cutthroat trout/brook trout competition studies, and presents some management recommendations for the recovery of a threatened species. Recent studies suggest that competition from introduced brook trout (*Salvelinus fontinalis*; EBT) may have negative effects on the growth and survival of the native and threatened Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*; LCT). Results from these studies, however, failed to elucidate the mechanism(s) responsible for this negative effect, nor did they examine whether changing environmental conditions might result

in competitive/subordinate role reversals. Our field observations suggested that brook trout colonized more quickly, were more aggressive and might outcompete LCT for food. Follow-up laboratory experiments demonstrated that when EBT are present LCT are substantially less active, do not feed, lose weight, and exhibit elevated cortisol (stress) levels. Collectively, these results suggest that EBT are a dominant competitor and that the mechanisms may, in part, be both physiological and behavioral in nature. We propose that particular attention be paid to performance attributes of sensitive species.

Session: Data Management/Sharing

Finding, Sharing and Using Distributed Data - Northwest Environmental Data-Network Portal Development

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The Northwest Environmental Data-Network (NED) is working to improve the quality, quantity, and availability of regional information on fish, wildlife and their aquatic and terrestrial habitats. The NED Portal is part of a multi-pronged approach to meet this goal. It works with open standards protocols, such as web map and feature services, and houses centralized metadata records provided by data stewards. These records are searchable by keywords, time, geography or full text. Once you find data to answer a question, the Portal's map viewer pulls distributed data sets together into a single, scaleable view. NED's Technology for Data Discovery and Sharing Work Group analyzed data sharing recommendations provided to the NW Power and Conservation Council from SAIC consultants. The suggested approach -to use industry standard protocols - made sense. The NED Steering Committee, comprised of Federal, state, Tribal, and public interest groups, identified existing protocols and recommended using the nation's Geodata.gov Portal software for NED. The look and feel of the ESRI Portal Toolkit has been customized to meet regional needs. We are now focused on filling the Portal with metadata and data by identifying subject matter experts to steward their own data offerings, find related web map services, and help others who have fish, wildlife, and water data to publish in the NED Portal. The NED Portal is the country's first regional Portal. It sits between the national Portal and developing state Portals in a coordinated, federated system. It's ready to help you find, share and use distributed data.

Session: Columbia River Basin Issues

The Ups and Downs of White Sturgeon Passage at The Dalles Dam

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White sturgeon (*Acipenser transmontanus*) $\geq$ 95 cm TL were monitored at The Dalles Dam, Columbia River during March 2004 through November 2005 to determine timing and routes of passage and to characterize general movements. We documented 26 passage events by 19 tagged fish; 8 upstream via fish ladders and 18 downstream, mostly through open spill gates. During the study 17 fish entered the two ladders one or more times. Eleven entered only the east ladder, 3 entered only the north ladder, and 3 entered both ladders at some time. Residence time within the ladders by individual fish was quite variable, ranging from about 1 min to nearly six months (mean=7.1 days; SD=24.8 days). Differences in construction between the north and east fish ladders may account for the greater success of the east fish ladder in passing sturgeon upstream.
Changes to operations at hydroelectric dams to benefit migrating anadromous salmonids may influence upstream or downstream passage by white sturgeon. Altering spill patterns and timing, installation of removable spillway weirs, or adjusting attraction flows to fishway entrances will likely influence passage by sturgeon. A better

understanding of the consequences to the metapopulation of increasing or precluding upstream or downstream passage is needed.

Session: Contributed Papers #2

A Habitat Criteria Mapping Approach to Instream Flow Management

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A habitat criteria mapping approach was used to assess instream flows in regulated reaches of the McKenzie and Smith rivers, Oregon. The approach relies on ground-based field mapping of suitable habitat on digitally rectified low-elevation aerial photographs for a sub-sample of habitat units (e.g., pool, riffle, run). Suitable habitat was delineated in the field using well-defined habitat criteria for the species and life stages of interest in selected habitat units at various flows. The resulting polygons were transferred into a GIS framework to calculate available habitat area for each species and life stage for each measured flow. Available habitat area was then extrapolated to similarly classified habitat units to estimate total habitat availability within the reach with an associated estimate of variance. The approach allows an estimation of total area available at each flow, rather than an index of habitat area (e.g., PHABSIM), is repeatable, and can be applied in hydraulically complex streams where other techniques may be less appropriate. Available habitat areas for specific life stages of bull trout and spring Chinook salmon were ultimately used in stock-production population dynamics models to estimate the response of bull trout and spring Chinook salmon populations to various flow management scenarios.

Session: “The Many Faces of Beaver: Castor canadensis's search for identity in salmon recovery (keystone species, furbearer, or pest?)."

Hydrologic and Geomorphic Effects of Beaver Dams and Their Influence on Fishes

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In this paper we provide both an overview and present current results from our research demonstrating both the physical and biological effects of beaver dams, in particular with regard to their effects on steelhead trout *Oncorhynchus mykiss* and coho salmon *O. kisutch*. Beaver dams alter the hydrology and geomorphology of stream systems and affect habitat for fishes, in particular, salmonids. Beaver dams affect the rates of groundwater recharge and stream discharge, retain enough sediment to cause measurable changes in valley floor morphology, and generally enhance stream habitat quality for many fishes. Historically, beaver dams were frequent in small streams throughout most of the Northern Hemisphere. The cumulative loss of millions of beaver dams has dramatically affected the hydrology and sediment dynamics of stream systems. Assessing the cumulative hydrologic and geomorphic effects of depleting theses millions of wood structures from small and medium-sized streams is urgently needed. This is particularly important in semiarid climates, where the widespread removal of beaver dams may have exacerbated effects of other land use changes to accelerate incision and the subsequent lowering of groundwater levels and ephemeralization of streams.

Session: Coho salmon use in estuaries and tidelands

2004 and 2006 Coho Smolt Movement in the Yaquina River and Estuary

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Migratory fish passage is an important designated use for many Oregon estuaries. Acoustic transmitters were implanted in coho smolts in 2004 and 2006 to evaluate how estuarine habitat, and habitat loss, might affect population health. Acoustic receivers that identified individual fish were deployed along the migration route.

Smolts exhibited the following patterns: 1) In 2004 smolts remained in the freshwater stream for an extended time (average of nine days after tagging) before entering the Yaquina River, while downstream movement into the Yaquina was notably more rapid in 2006. 2) After moving into the Yaquina River, smolts moved quickly downstream in both 2004 and 2006, and then spent the greatest amount of time in the most seaward stretch of the estuary. Smolts moved extensively up- and downstream while in the Yaquina, and occasionally moved to a few hundred meters of open ocean before returning upstream again. Some moved passively with tidal currents, but there were also instances of fish holding position for over 24 hours. 3) Some fish were last detected at receivers closest to the ocean, and presumably entered the ocean, but others were last detected at receivers farther up the estuary. These final detections were well within the transmitter's expected battery life so it is uncertain whether these fish successfully entered the ocean.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Extreme Expansion: Rockfish Who Take it to the Edge

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Overfished species of rockfish (*Sebastes* spp.) from the Northeast Pacific experience high bycatch mortality due to a condition termed "barotrauma," which is induced from the rapid change in pressure during capture. As a result of barotrauma, "catch and release" techniques are not effective for overfished species. Field experiments by the Oregon Department of Fish and Wildlife (Newport) show that it may be possible for rockfish to recover from barotrauma if quickly recompressed prior to release. However, no work has followed the physiological recovery of rockfish after recompression or determined if it is possible for rockfish to survive such a severe physical stress. This summer, I induced barotrauma in adult black rockfish from a simulated depth of 35 m with subsequent recompression. Following recompression, rockfish were slowly acclimated to surface pressure and transported to 2.4 m diameter tanks for recovery. Two control and two treatment fish were sampled for bloods and tissue (eye, gill, heart ventricle, head kidney, liver, rete mirable, and gonad) at days 3, 15, and 31 post-recompression to evaluate the cellular-level response during recovery. This experiment was replicated 4 times, for a total of eight treatment and eight control fish sampled at each time point. Results from histological analyses and blood plasma assays will be presented.

Session: Law Enforcement

Klamath River – One River, Three Worlds

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The Klamath River, which is divided into three sections, Lake Ewuana to Keno Dam; Keno Dam to Boyle Dam; Boyle Dam to the California/Oregon border. Lake Ewuana to Keno Dam: an area of the Klamath River that is bordered by industrial areas; extensive agricultural lands; extensive wetlands, largely in a private hunt club and Oregon Department of Fish and Wildlife Miller Island Wildlife Area. Keno Dam to Boyle Dam: an area of the Klamath River with limited roadway access. This area of the river is bordered by private timberlands and is bounded on both sides by steep embankments and escarpments. This is the area of trophy fishery, with red band trout observed in excess of 10 pounds. This area includes Spencer Creek, the only spawning stream in Oregon upstream from Copco Reservoir; the only other spawning stream is Shovel Creek in California. The Keno Canyon remains the most popular fishery on the Klamath River. Boyle Dam to Oregon/California state line: this area consists of two major sections, the Cold Water Section, which is from Boyle Dam to the Pacific Power powerhouse. There are warm water springs, which enter the river about ½ of the distance between the two and provides for greater aquatic life. Below the Boyle Dam powerhouse outflow is the start of the River Rafting

Section of the river, which highly regulated. This presentation will explore the challenges of enforcement on a river, which is heavily manipulated and has a wide and historic combination of uses.

Session: The Pelton Round Butte Story

A Plan to Increase Kokanee Survival at Lake Billy Chinook in Anticipation of Fish Passage by Reducing Loss at the Dam, Reducing Angler Harvest, and Reducing Loss to Bull Trout Predation

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Kokanee are a key species in the effort to reestablish fish passage at the Pelton Round Butte Project. Being the resident component of a native sockeye populations, the Fish Passage Plan calls for allowing emigration of yearling kokanee to attempt to reestablish the anadromous sockeye form. Kokanee are also a major prey species for bull trout, and a healthy population will be important as a predation buffer to allow adequate reservoir passage survival for spring Chinook smolts. However, every method of enumerating kokanee indicates that the population is now significantly depressed below historic levels. At the same time, bull trout abundance is at an all time high. A kokanee population model indicates that if a significant percentage of the present population emigrates from the reservoir with surface withdrawal and planned downstream passage starting in 2009, and other mortality rates from the sport fishery and bull trout predation remain at current levels, the kokanee population may collapse. A plan will be discussed which, if cooperatively implemented, will avoid this risk. Components of this plan include: (1) reducing entrainment at the dam prior to 2009, and recycling instead of passing kokanee in 2009 and 2010; (2) Reducing the loss to sport fishing by regulation change for 3 years; (3) A population level study for 3 years that would use sport angling to harvest age-4 and-5 bull trout (~12 to 24 inch) in Lake Billy Chinook, but protect larger, older fish and younger fish. Age 4 and 5 bull trout eat large numbers of age-0 and age-1 kokanee, whereas age-6 and older bull trout feed primarily on age-2+ kokanee. Reducing bull trout numbers in this slot for 3 years would bolster survival for all 3 kokanee cohorts, but only minimally impact the basic population of younger bull trout, or the trophy-sized bull trout.

Session: Implementation of native species reintroductions

Reintroducing Native Fishes to the Desert Southwest: Use of Piscicides, Barrier Construction, and Repatriation to Restore a Native Fish Fauna in Fossil Creek, Arizona

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Fossil Creek is a major tributary to the Verde River in central Arizona. In 1999, after nearly a century of diverting its flow for hydropower, Arizona Public Service committed to decommissioning two powerplants and restoring full flows. Prior to flow restoration, biologists recognized the opportunity to restore the stream's native fish community. Fossil Creek remained an important stronghold for native fish in the Gila River drainage, yet invasion of exotic green sunfish and smallmouth bass had prevented recruitment in native fishes and amphibians. In a major collaborative effort between state and federal agencies—including two national forests, universities, and many volunteers—a native fish fauna was salvaged from over 10 stream miles including remote wilderness. In 2004, piscicides were applied to the stream and native fishes were repatriated after exotic fishes were eliminated. An instream barrier was constructed to prevent future invasions while preserving wilderness values. In 2006, exotic fishes were still absent from Fossil Creek and recruitment had increased dramatically in native fishes. Analysis is on-going to reintroduce imperiled spikedace *Meda fulgida*, loach minnow *Tiaroga cobitis*, razorback sucker

Xyrauchen texanus, and other threatened desert fishes to Fossil Creek. This native fish restoration project received accolades from researchers, politicians, resource managers, and conservationists, and has been hailed as a national case study in river restoration. Symposia, research papers, and television documentaries communicated the project's success. The philosophical outcome of this project revealed what can be accomplished when agency mandates to protect native species are supported and conflicting politics set aside.

Session: Diamond Lake mini-session

Tui Chub Management Without Rotenone—Can it Succeed? An Evaluation of Fisheries and Water Quality in Fish Lake, Southwestern Oregon, and Proposed Restoration Strategies

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Over one million exotic tui chubs *Gila bicolor* have drastically reduced the quality of the Fish Lake recreational rainbow trout *Oncorhynchus mykiss* fishery. Growth in stocked rainbow trout is virtually nonexistent, as the chubs have essentially depleted most of the available food in the lake. Chubs are also associated with degraded water quality including blooms of the toxic cyanobacteria *Anabaena flos-aquae*. Fishing effort is extremely low and catch rates for stocked trout are also generally low. The fishery has shifted from producing trophy sized rainbow and brown trout to trout barely larger than the minimum size limits. Based on case studies elsewhere in Oregon, including Diamond Lake, removal of tui chubs should be a viable strategy to restore the trout fishery and water quality in Fish Lake. Although Fish Lake is a microcosm of Diamond Lake, five prior attempts to eradicate tui chubs in Fish Lake with rotenone have failed, and a new approach to chub management is needed. Modeling suggests mechanical techniques such as netting and electrofishing, if properly implemented, could be sufficient to reduce the chub population size to measurably change trout production and fishery and water quality. Opportunities also exist to change stocking strategies to piscivorous trout that would feed on chubs. Mechanical removal is proposed to begin in 2007, with changes to the stocking program to tentatively follow in subsequent years. For these management techniques to be successful, close coordination between state and federal agencies, concessionaires, permittees, and volunteer groups, and accurate monitoring will be needed.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon

Genetic Interactions Between the Modoc and Sacramento suckers, Two Sympatric Natives

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The Modoc Sucker, *Catostomus microps*, and Sacramento Sucker, *C. occidentalis*, are two naturally sympatric species in the upper Pit River and Goose Lake drainages (N. California and S. Oregon). While the Sacramento Sucker is widespread, the Modoc Sucker is currently known to occupy only three tributary drainages. The two species are phenotypically distinct, and they exhibit ecological, developmental and behavioral characteristics that reduce contact in shared streams. Nevertheless, the results of recent genetic studies (nuclear and mitochondrial) indicate that there is some bidirectional gene flow between them. An understanding of the role that genetic interactions play in the biology of these two species is crucial to their conservation management and to exploring the potential adaptive value of gene sharing in small populations.

Session: Implementation of Native Fish Reintroductions

Modoc Sucker Introductions: Twenty Years Later, the Results of a Low-tech Approach

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The Modoc Sucker, *Catostomus microps*, is known to occupy three relatively small drainages in the upper Pit River and Goose Lake watersheds (N. California and S. Oregon). In the Turner Creek drainage (Modoc Co.) there were two intra-drainage introductions of Modoc Sucker during the 1980's, well before modern genetic or disease assessments were available. In 1983, Turner Creek itself was treated with rotenone to remove "undesirable" fishes (native and exotic) and potentially hybrid suckers. Following treatment, the creek was restocked with about 54 Modoc Suckers from Washington Creek, an untreated tributary, and about 70 redband trout collected from Turner Creek prior to the treatment. In 1986, 20 Modoc suckers (12 adults and eight juveniles) were transplanted to Coffee Mill Creek, a naturally isolated tributary of Washington Creek, which appeared to have suitable habitat but contained only small numbers of redband trout. Over twenty years later, both populations are self-sustaining and have expanded throughout their respective streams. The apparent success of these introductions suggests that there can be practical conservation benefits using relatively small numbers of founder individuals, while limiting impacts of removals from the source population, often a particular concern for endangered species.

Session: Data Management Sharing

The ISEMP Data Management System for Aquatic Resources Monitoring Data

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The Integrated Status and Effectiveness Monitoring Program (ISEMP) is developing a pilot data management system to support research, monitoring, and evaluation programs in the Columbia River Basin. The system includes tools for data processing, storage, analysis, reporting, and distribution to meet crucial data management needs of managers and analysts. These needs include: (a) summarizing how, when, and where monitoring data was collected, (b) supporting a range of analytical methods to assess the status of fish populations and habitat condition and the effect of restoration actions, and (c) the ability to adapt to future requirements. We have developed data management tools to support the workflow process from data collection to long term storage and analysis. Tools include: Protocol Manager, a database that documents data collection protocols and methods; the Aquatic Resources Schema that provides standardized data structures for water quality, fish abundance, and stream habitat data; the Automated Template Modules, data entry templates that are designed to ensure data integrity and compliance with data collection protocols; and, the STEM Databank, a central data repository designed as a flexible container for long-term storage and analysis. Links to an ArcSDE geodatabase allow monitoring data in the STEM Databank to be represented and analyzed in a spatial context. We are currently piloting these tools with state, federal, and tribal agencies in the Wenatchee basin.

Session: Coastal Cutthroat Trout

Juvenile Cutthroat & Coho– How Prey Availability and Co-occurrence is Reflected in Diet

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In many coastal Oregon watersheds, resident cutthroat trout (*Oncorhynchus clarkii*) and juvenile coho salmon (*Oncorhynchus kitsutch*) are the predominant species and must compete for three types of prey – juvenile benthic and adult aquatic insects and terrestrial invertebrates. But to how does the availability change with season, to what extent are the prey represented in the diets and how does it differ by species? To examine availability of aquatic

and terrestrial prey to juvenile cutthroat trout and coho salmon, we collected three types of invertebrate samples. Emergent aquatic adult insects were captured in emergence traps and pan traps; terrestrial invertebrates falling into the stream were collected in pan traps, and benthic insects from Surber samples. These data were compared to the stomach contents of juvenile coho salmon and cutthroat trout obtained using gastric lavage. Sampling was conducted during the summer and fall 2003 and spring 2004. Spring provided the most emergent aquatic and benthic insect biomass and terrestrial invertebrate prey availability was highest in summer and fall. Coho salmon consumed more externally derived prey in summer and spring and favored benthic prey in fall. In all sampling seasons, co-occurring cutthroat trout relied heavily on terrestrial invertebrate prey rather than stream-derived resources. While both species consumed a large amount of terrestrial prey biomass, coho had a higher reliance on benthic prey in all three seasons while this resource was eaten less by larger cutthroat trout who consumed more adult aquatic insect biomass.

Session: Data Management/Sharing

Exploring Oregon's River Basins with a New Digital Library—*The Oregon Explorer*

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Come learn about the State's river basins through an online tour of Oregon State University's evolving natural resources digital library—*the Oregon Explorer*. The Oregon University System Institute for Natural Resources and Oregon State University Libraries joined forces to create a useful statewide natural resource digital library. Users have been involved in all aspects of digital library design, development, testing, and evaluation as we have moved from a prototype at the basin scale to implementation at the statewide level. We are literally building the Oregon Explorer from the ground-up with local user involvement across the state. Since the initial needs assessment in 2001, three basin portals have been developed representing the specific needs of users in three different geographic regions of Oregon (Willamette, North Coast, and Umpqua Basins.) We have learned that in the natural resources arena, user needs change with different geographies, yet the adaptations made at the local level are useful in expanding the content and services delivered at the statewide level. When complete, the Oregon Explorer will include localized information for the fifteen watershed basins in Oregon, as well as statewide information, tools, and services. It is not enough to just provide access to data or documents. Users want access to a wide variety of integrated information resources—digital documents, interactive maps and reports, decision support, high resolution imagery, and access to available expertise. This evolving natural resources digital library will enable users to learn about Oregon's environment, to actively engage in creating and sharing knowledge, and to make informed decisions about our natural resources throughout the State.

Session: Columbia River Session

The Relationship of Snake River Stream-type Chinook Survival Rates to River and Ocean Conditions: Evidence of Hydrosystem Related Delayed Mortality

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Snake River salmon and steelhead have substantially declined since the completion of the Columbia River hydrosystem. A key remaining uncertainty for evaluating recovery options for upper basin salmon populations relates to the source of mortality that fish experience while in the estuary and early ocean. Sources of estuary and early ocean mortality include not only elements of the natural ocean environment, but also delayed effects of earlier life-stage experiences. Multiple analytical approaches are presented addressing this delayed mortality for Snake River spring/summer Chinook and steelhead. The water velocity conditions in the river (water travel time) and ocean/climatic conditions are considered in describing the variation in survival rates. In all results water travel time proved to be a significant factor in explaining the variation in survival. The FCRPS has delayed migration of

in-river fish; with later arriving components of the population exhibiting lower survival rates. The results of these multiple analyses provide compelling evidence that passage through the FCRPS strongly influences levels of delayed mortality of in-river migrants for Snake River populations.

Paper
Session: Implementation of Native Species Reintroductions
Reintroductions of Endangered Oregon Chub in the Willamette Valley
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Oregon chub were listed as endangered under the federal ESA in 1993. A major recovery effort has focused on the introduction of Oregon chub into suitable habitats within its historic range. Nine new populations have been established since 1988 and the three most abundant chub populations in 2006 were the result of these introductions. Oregon chub reintroduction guidelines will be discussed, including identification and evaluation of potential introduction sites, translocation guidelines, and monitoring protocols.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon
Status of the Endangered Borax Lake Chub in Southeastern Oregon
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Borax Lake Chub were listed as endangered under the federal ESA in 1982. Borax chub exist in a single habitat that consists of a 10 acre geothermal lake situated in the Alvord Desert of southeastern Oregon. This species was the focus of intense study from the mid-80's through the mid-90's, when the threats from water diversions, livestock grazing, and potential geothermal development of the aquifer were high. Numerous recovery actions have reduced the threats to this species and recent discussions have considered a change in species listing status. Results of recent monitoring of the status of the chub population and its habitat in 2005 and 2006 will be presented.

Session: Data Management/Sharing
Managing Data v. Data Management (or, Managing your Data Doesn't Make You a Data Manager!)
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Fisheries scientists, by virtue of their training and experience, are adept at managing data. However, as the scale and complexity of analysis increases, the difficulty of managing the data changes from one of managing a single local data set to managing large, complex data sets, often from multiple sources. This greatly magnifies the data management task and requires different skills and tools. This often results in the necessity of moving from using a spreadsheet to manage and maintain the data to using a relational database with complex relationships among data tables and the necessity of performing data normalization and developing a data dictionary and descriptive metadata. These sometimes may involve new technical skills for the scientist. Similar to the need to consult statisticians when study design becomes complex, unless they also have extensive database management skills, we encourage fisheries professionals to involve data management specialists in the design and implementation of any project that will include large, complex data sets. These specialists not only can help design suitable data systems, they can also help in developing data capture and data handling routines or tools that will make the biologist's analysis job much easier and archive the data for future uses.

Session: Deschutes River summer steelhead; What have we learned in thirty years of monitoring?

Trends in Angler Effort and Catch of Summer Steelhead on the Lower Deschutes River, Oregon, 1977 to 2006

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The Deschutes River has long been considered world famous for its summer steelhead sport fishery, which supports over 50,000 angler days each year. Angler surveys have been conducted on the Deschutes River by the Oregon Department of Fish and Wildlife since 1977 to determine angler effort and catch of summer steelhead. Surveys are conducted at two locations, the Max Canyon Access Road at river mile 42 and Heritage Landing at river mile 0. The survey methodology of an expandable collection procedure has been remarkably consistent since 1977. Results from these data allow managers to assess real time and long term trends in the number of anglers, angler hours, catch by origin, and harvest by hatchery mark.

Session: Reintroduction Using Artificial Propagation: Approaches, Techniques, Management

Successes and Challenges During the First Ten Years of the Cowlitz Falls Anadromous Fish Reintroduction Project

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The Cowlitz River historically supported abundant runs of anadromous salmonids. Overfishing, habitat degradation and the construction of dams in the 1960's contributed to the decline of these populations. A majority of salmon and steelhead spawning took place upstream of Mayfield Dam and the construction of Mossyrock Dam in 1968 eliminated volitional adult and juvenile passage to and from these critical spawning areas. The completion of the surface collection system and associated fish facilities at Cowlitz Falls Dam in 1996 provided an opportunity to restore anadromous salmonids to an estimated 380 linear kilometers of historically productive habitat in the upper Cowlitz and Cispus Rivers. The reintroduction program began by seeding the upper watershed with juvenile and adult spring chinook, coho and late winter steelhead from indigenous hatchery stocks. Wild cutthroat populations in the upper watershed also contribute anadromous smolts. The reintroduction is based on the capture of migrating smolts at Cowlitz Falls Dam and the transportation of these smolts to the lower Cowlitz River to continue their ocean-ward migration. Returning adults are collected below Mayfield dam and transported above Cowlitz Falls Dam. Smolt collection efficiency is critical to the success of the reintroduction and research since 1998 has focused on evaluating and improving surface collector performance. In ten full seasons of operation, over 1.8 million smolts have been collected and transported to the lower river. Adults from these smolts have begun to return and have been transported to the upper Cowlitz Basin.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

A New Invader to the Columbia Basin and North America: Confirming the Identification of the Amur Goby, *Rhinogobius brunneus*

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Taxonomic identification of any new exotic is a crucial first step in containment and control of potential invaders, but can prove problematic. International collaborative efforts were required to confirm the identity of a freshwater goby first collected in a restored wetland on the South Fork of the Lewis River near LaCenter, Washington, in Spring 2005. A small breeding population of this goby has become established at the original site, and a single specimen has also been collected on Crims Island on the lower Columbia. Gobies in the genus *Rhinogobius* are Asia's ecological equivalent to North America's darters, and are also a specious group characterized by an array of life history, morphological, meristic and behavioral traits that render specific identification problematic. Based on color photographs of breeding male fish, meristic counts of skeletal elements, and mitochondrial DNA haplotypes, these fish have been assigned to the species *Rhinogobius brunneus* Orange Type (OR), originating from one of several populations on the west slope of Japan. Not only is this species new to the Columbia Basin and North America, but this is the first reported establishment of this species outside of Asia. Ecological and behavioral studies of the established population may enable managers to anticipate ecological impacts of these new invaders on communities of the Columbia Basin.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Micro-shad in the Columbia Basin: A New life History Type of American Shad or a New Exotic Species?

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An unusually small specimen of shad was captured by angling in the Willamette River during the spawning run of American shad (*Alosa sapidissima*) in June, 2005. Superficially, the specimen resembled a juvenile American shad. Additional specimens of this 'small shad' were collected during June 2006 by sampling floodplain wetlands with trap nets, and seven specimens were retained for further studies. Compared to adult American shad sampled at the same time, these fish were significantly smaller (133 mm fork length compared to 385.3 mm), lighter (28.8g compared to 966.8g), and of very different condition (Fulton's Modified Condition Factor of 0.212 compared to 2.45) than 'typical' spawning American shad. Examination of routine sampling records from the Oregon Department of Fish and Wildlife indicate these 'mini shad' have been present in fresh water from February through July in the Willamette since at least 2001. Since juvenile American shad loose the ability to osmoregulate in fresh water by six months of age and do not re-gain the ability until they reach maturity, 'jack' life history types are unknown for this species. Though meristic and morphometric data are equivocal, it is anticipated that genetics will confirm the identity of these fish, which may represent the latest confirmed exotic invader to the Pacific Northwest.

Session: Implementation of Native Species Reintroductions

Assessing the Feasibility of Reintroducing Bull Trout (*Salvelinus confluentus*) into the Clackamas River, Oregon

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A collaborative working group of fisheries biologists and scientists have assessed the feasibility of reintroducing bull trout (*Salvelinus confluentus*) in the Clackamas River, tributary to the Willamette River, Oregon. Bull trout, recorded and documented in the 1870s and once prolific throughout Clackamas River, are locally extinct; being last documented in the upper river during the early 1970s. Using the 1988 American Fisheries Society guidelines for introductions of threatened and endangered species (Williams et al. 1988), the collaborative working group

examined four major components in assessing the feasibility of reintroduction. First, all major factors accounting for the local extirpation of bull trout in the Clackamas River were examined to determine if threats have been remedied. Second, a thorough habitat suitability analysis was completed to determine available habitat patches capable of supporting spawning and rearing life-stages. Third, a genetic and demographic analysis was made to assess potential donor stocks for use. And Fourth, evaluations were conducted to address concerns relating to potential ecological interactions with other species (both native and non-native) and food web dynamics. Sufficient suitable habitat exists and potential donor stocks are available to support a reintroduction effort.

Session: Stream Restoration: New Concepts and Strategies

Sandy River Basin Aquatic Habitat Restoration Strategy: An Anchor Habitat-Based Prioritization of Restoration Opportunities

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Building from the Anchor Habitat Assessment developed for salmon and steelhead conservation in the Sandy River Basin, the Sandy River Basin Working Group completed Phase 2 of its original endeavor – to build a scientifically credible aquatic habitat restoration strategy for the basin. Each participating entity within the working group is active on a year-to-year basis implementing restoration activities to improve watershed conditions and aquatic habitat in various locations throughout the basin; however, all participants endeavored to develop a coordinated, overall basin-wide strategy that best meets the ecological restoration needs for salmon and steelhead. The working group completed a basin-wide strategy that:
Prioritizes watersheds geographically within the basin based on the anchor habitat assessment for salmon and steelhead.
Establishes a hierarchical framework, based on a modification of Roni et al. (2002), for identifying restoration actions that address altered watershed processes revealed through watershed analysis and factors that limit aquatic habitat productivity. This framework provides the top-down sequence of actions recommended in each watershed to ensure the root causes of aquatic habitat degradation are first addressed.
Identifies specific high priority restoration actions, locations, and sequence of implementation to guide future investments.
These high priority restoration actions are quantified and summarized at the watershed-scale within the hierarchical framework to address aquatic habitat restoration needs for recovery and long term persistence of salmon and steelhead populations in the basin. Go to www.sandyriverpartners.org to obtain a copy of the aquatic habitat restoration strategy document.

Session: Reintroductions and Recovery of Anadromous Fish in the Willamette Basin – Dammed If We Do, Damned If We Don't

Is There Enough? Assessment of Spring Chinook Spawning, Holding, and Rearing Habitat Upstream and Downstream of USACE Dams in the Willamette Basin

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The U.S. Army Corps of Engineers' (USACE) construction of multi-purpose dams on tributaries in the Willamette Basin blocked access to the majority of historic spring Chinook spawning habitat in the Upper Willamette Basin. Dam operations, land use, and development have degraded habitat downstream of the projects, and using the habitat upstream of the dams may be a more cost-effective and biologically meaningful way to substantially increase natural production. However, efforts to reintroduce UWR spring Chinook into this habitat will be unsuccessful if the habitat cannot support the holding, spawning and rearing life stages of spring Chinook. Most

of this habitat is under Federal management, and biologists believe it is in relatively good condition, but no comprehensive evaluation had occurred. During fall 2006, we surveyed approximately 89 percent of the habitat within the known distribution of spring Chinook salmon distribution above and below Detroit, Foster, Green Peter, Cougar, Lookout Point, and Hill's Creek dams. Survey methods were modified from the Oregon Aquatic Inventory Project to further characterize habitat suitability by more detailed assessment of substrates and velocities in spawning areas, juvenile rearing area in complex habitats, depth in holding habitat. Approximately 157 miles of habitat were surveyed above the dams and 55 miles below dams in the North Santiam, South Santiam, Middle Fork, and McKenzie basins. We will present the results of the assessment in terms of usable habitat in reaches upstream and downstream of USACE dams and describe how the USACE will use the information in its decision-making processes.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon

Distribution and Abundance of Umpqua Chub in South Umpqua River and Cow Creek, Oregon

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Umpqua chub is small cyprinid endemic to the Umpqua River Basin and considered "sensitive-vulnerable" by the State of Oregon. A 38-site survey throughout the drainage by Oregon State University in 1987 found its distribution to be greater than historical records indicated, but the presence of piscivorous smallmouth bass was noted with concern. A repeat survey in 1998 found the distribution of chub had contracted, with populations restricted primarily to lower order tributaries. Umpqua chub was completely absent from main stem sites. In the 1998 survey, Umpqua chub was captured at only 50% of sites where it was found in 1987 but smallmouth bass distribution and abundance had expanded. In summer 2006 we snorkeled 57 sites in the South Umpqua River and Cow Creek (and tributaries West Fork Cow Creek and Middle Creek) to better understand distribution and abundance of Umpqua chub and smallmouth bass. Umpqua chub was found at 21 sites (37%), smallmouth bass at 35 sites (61%), and both species were found concurrently at 14 sites (25%). Smallmouth bass was found along nearly the entire range of our surveys, but Umpqua chub was primarily restricted to a 25 km reach in South Umpqua River near Tiller and a 22 km reach in the central portion of Cow Creek centered by Union Creek. Umpqua chub was also documented in West Fork Cow Creek and Middle Creek.

Session: Redband Trout - Migrations in the Desert

Miller Lake Lamprey, Ivory Billed Wood Peckers, and Your Favorite Penknife from 5th Grade: Misplaced, Not Really Lost. A Brief Look at Redband Trout in the Summer Lake and Fort Rock Sub-basins

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Field investigations were conducted in the summer of 2006 to try and document native redband trout genetics in the Summer Lake and Chewaucan River sub basins. Past work by Dr. Bob Behnke indicated that hatchery trout had interbred with native redband trout and diluted the genetic make up of the native redband trout. Investigations conducted on Foster Creek, Lake County Oregon in the summer of 2006 by Dr. Benkne and others indicate that the native redband trout genetics still exist in this isolated steam located in the Summer Lake Basin. Cursory investigations into the Fort Rock and Warner basins indicate that native redband trout persist.

Session: Bull trout

Effectiveness of an Expanded Protocol and Greater Training to Reduce Error in Bull Trout Redd Counts of Inexperienced Observers in the John Day River Basin

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Monitoring bull trout populations using redd counts poses several challenges, among them are variability in redd size and the employment of inexperienced observers. These two factors have been identified as sources of error in redd counts and researchers have suggested that using experienced observers or expanded sampling protocols and field training for inexperienced observers may reduce error. This study assessed the effectiveness of an expanded protocol and more intensive training in improving redd counts by inexperienced observers. Redd counts were conducted in five reaches of John Day River tributaries and repeated every two weeks from September to November. Counts by an experienced observer were compared to those of four inexperienced observers who received field and classroom instruction in redd identification before spawning began and field training every two weeks throughout the spawning season. In total, inexperienced observers counted 58% (29/50) of the redds counted by the experienced observer. Inexperienced observers initially committed 4 false identifications and 25 omissions, but 2 false identifications and 4 omissions were corrected during subsequent visits. The median size of counted redds (0.24 m^2) was significantly larger ($p=0.014$) than that of omitted redds (0.13 m^2), which strongly suggests inexperienced observers had more difficulty identifying smaller redds. These preliminary results show that in these study streams, even with an expanded protocol and more intensive training, inexperienced observers underestimated bull trout redd abundance.

Session: The Pelton Round Butte Story

Quest for Success: Using Models and Science to Build Successful Fish Passage at the Pelton Round Butte Project

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When the Pelton Round Butte Hydroelectric Project was constructed between 1956 and 1964, it included upstream and downstream fish facilities. Fish passage was partially successful until Round Butte Dam, which impounds Lake Billy Chinook, was completed in 1964. Historic evaluation studies showed that smolts were lost in the large reservoir, and accumulated away from passage facilities in the upper Metolius River arm of the reservoir. Our interagency Fish Committee has worked to evaluate the potential for renewing fish passage with a new FERC license. Early hydraulic drogues studies indicated that the different temperatures of the three major river tributaries in combination with the deep intake caused surface currents to move down the Crooked and Deschutes river arms, and up the Metolius River arm of the reservoir. The development of a reservoir flow model using 3D hydrodynamic numerical modeling of the reservoir by consulting engineers allowed experimentation with potential withdrawal elevations and management schemes. This model indicates that when water is withdrawn from the surface, currents from the Crooked and Deschutes river arms move directly to the forebay outlet where the new facility will be constructed. The surface currents in the Metolius Arm are more subtle, but at least are not backward and confusing. Prevailing winds during spring tend to move down the Metolius Arm toward the dam. Members of the interagency Fish Committee believe that the combination of surface withdrawal during the smolt migration period, and the relatively narrow reservoir arms will aid future downstream smolt migration through the reservoir.

Session: Bull Trout

Big Fish in a Small Reservoir: Ecology of Bull Trout *Salvelinus confluentus* Above Trail Bridge Dam, McKenzie River, Oregon

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The McKenzie River supports the only self-sustaining population of bull trout *Salvelinus confluentus* in the Willamette River basin. The population is effectively divided by hydroelectric dams into 3 local-populations: South Fork McKenzie, Mainstem McKenzie, and Trail Bridge. Trail Bridge Dam, which divides the Mainstem and Trail Bridge local-populations, has no upstream passage and no designated downstream passage facility. In support of relicensing for Eugene Water & Electric Board's (EWEB) Carmen-Smith Hydroelectric Project, numerous field studies were used to investigate the ecology of bull trout above Trail Bridge Dam. Two of the three tributaries to Trail Bridge Reservoir are cold (<7°C) streams originating from springs in young (7 – 0 Mya) basalts of the High Cascades. These two streams support bull trout use year-round. The third stream drains predominately older (70 – 40 Mya) Western Cascades terrain and water temperatures exceed 16°C during the summer. Adults were rarely found and no fry or juveniles were identified in this stream. The Trail Bridge population consists of over 100 adults that spend most of the year in Trail Bridge Reservoir with movement out of the reservoir being predominately for spawning. Spawning was documented in the two cold tributaries and occurs from mid-September through October. Fry were found to emerge and migrate downstream from March through July. Bull trout fry were not found in the reservoir. The Trail Bridge Reservoir population of bull trout has persisted for 50 years with only one-way movement downstream over Trail Bridge Dam. Only during the last 5 years have humans intervened to move a few adults a year back upstream over Trail Bridge Dam. Relicensing of the Carmen-Smith Hydroelectric Project presents an opportunity to reconnect the robust Trail Bridge local-population with the Mainstem McKenzie local-population of bull trout.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Growth, Survival, and Distribution of *Oncorhynchus mykiss* Before and After Fall Emigration

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Much of the total annual *O. mykiss* emigration from the South Fork John Day River basin occurs during fall. We examined the origin, yearly proportion of *O. mykiss* emigrating, and growth history before fall emigration of *O. mykiss* in two tributaries of the South Fork. We also investigated the distribution, growth, and long-term survival of these migrants after emigration. Fall emigration was dominated by *O. mykiss* from Murderers Creek, rather than Black Canyon Creek. Of all *O. mykiss* PIT tagged in Murderers Creek, 13.7% emigrated in fall 2004, while 11.6% emigrated in fall 2005. Conversely, 3.1% of the *O. mykiss* PIT tagged in Black Canyon emigrated during fall 2004 and 3.2% during fall 2005. The proportion of emigrants was significantly different ($P < 0.001$) between streams within each year. The proportion of emigrants was not significantly different ($P > 0.10$) between years within each stream, despite increased winter severity in 2005. Fall emigrants were the "winners," as they were longer and had higher growth rates during summer than non-emigrants. The majority of emigrants exited the South Fork and overwintered in a 6 km segment of the Mainstem John Day River downstream of the South Fork. Fall emigration amplified phenotypic differences between emigrant and sedentary individuals, as emigrants shifted into an alternative niche where skeletal growth rates during winter were significantly ($P < 0.001$) higher than for individuals remaining in tributaries. These life history differences can influence migration timing and smolt to adult survival for *O. mykiss* which become anadromous.

Session: "The Many Faces of Beaver: *Castor canadensis's* Search for Identity in Salmon Recovery (keystone species, furbearer, or pest?)"

Beaver Life History, Impacts to Natural Resources, and Methods to Control Damage

Jimmy Taylor

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North American beaver (*Castor canadensis*) were extirpated over much of their range by the beginning of the 20th century. Several factors, including reintroduction of beaver and declining trapping effort, have allowed beaver to thrive in much of their historical range. In areas where humans and beaver coincide, human perception of beaver range from socially acceptable to intolerable. Research has shown that beaver ponds can positively and negatively affect other fauna, depending on environmental variables such as topography, temperature, and sediment load. Conflicts with beaver at the human-wildlife interface are generally associated with damage to roads, bridges, agricultural crops, and timber. In addition to direct economic loss, beaver damage also can risk human health and safety. Trapping is the most common tool used for beaver management, although select non-lethal techniques are effective in reducing beaver damage by preventing the sound of flowing water around dams and culverts. While the total economic impact of beaver on natural resources is unknown, a recent study by Wildlife Services demonstrated that for every $1 spent in managing beaver damage, $6.30 in resources was saved. This resulted in Wildlife Services specialists preventing an estimated $29 million in beaver damage in 2005 across 14 Eastern states. Regardless of geography, beaver will continue to alter landscapes in the presence of human development. There is no "cookbook" for managing beaver because their effects vary throughout their range. However, a proactive approach to beaver management, considering the positive and negative effects of beaver, is essential for ecosystem stability.

Session: Reintroductions and Recovery of Anadromous Fish in the Willamette Basin – Dammed If We Do, Damned If We Don't

Evaluating the Success of Outplanting Adult Spring Chinook Salmon (Oncorhynchus tshawytscha) in the North Fork of the Middle Fork Willamette River, Oregon

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The U.S. Army Corps of Engineers operates a system of 13 dams and reservoirs within the Willamette River Basin. These dams block access to a majority of the historic spawning habitat for spring Chinook in the basin. Since the 1990's the Oregon Department of Fish and Wildlife has been outplanting hatchery spring Chinook salmon upstream of dams to provide nutrient enhancement, a prey base for native resident fish, and later to supplement natural production of spring Chinook salmon. To evaluate the success of this program we monitored the distribution and pre-spawning mortality rate of radio tagged adult spring chinook released into the North Fork of the Middle Fork Willamette River in 2004-2006. In addition, we collected mortalities for analysis to determine potential causes of death and counted redds to calculate a fish / redd ratio as a metric to compare success between years. In 2006, ODFW improved handling protocols and treated outplanted chinook with antibiotics. Date of release influenced distribution and the rate of pre-spawning mortality in radio tagged fish. Estimates of pre-spawning mortality ranged from 2 to 100 percent and were significantly lower in 2006 than in 2004-05. The contribution of improved handling protocols, antibiotic treatment, or environmental conditions to the lower pre-spawning mortality rate observed in 2006 is unclear. Improving survival of adult Chinook outplanted into historic habitat above Corps of Engineers Dams is an important step towards establishing and maintaining viable populations of spring Chinook salmon in the Willamette Basin.

Session: Good Chubs and other Small Fish: Non-game Fisheries Research in Oregon

Age, Growth, and Mortality of Tui Chub (*Gila bicolor bicolor*) from Upper Klamath Lake, Oregon

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The tui chub is a cyprinid that inhabits diverse environments throughout the western United States. The ability of the species to adapt to differing environments has resulted in at least 13 recognized subspecies, one of which is

found in the Klamath Basin of south-central Oregon and northern California. Despite its relative abundance in the Klamath Basin, little is known about the life history of the subspecies. To gain insight on age and growth dynamics, tui chub were captured by trap net from Upper Klamath Lake in 1998, 2003, and 2004, and lapillar otoliths were sectioned in order to age fish. This presentation will focus on results of the age and growth study, data comparisons with the sympatric blue chub (*Gila coerulea*), and mortality estimates for the subspecies.

Session: Columbia River Basin Issues

Status of Chum Salmon in the Mainstem Columbia River Below Bonneville Dam

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Columbia River chum salmon *Oncorhynchus keta* runs once numbered over one million fish, but have declined in the past century due to overexploitation, habitat degradation, and loss of spawning habitat resulting from the development of the federal hydropower system. Persistent low numbers of chum salmon in the Lower Columbia River evolutionarily significant unit prompted the National Oceanic and Atmospheric Administration to list them as threatened under the Endangered Species Act in May 1999. A small but stable population of chum salmon spawns around the Ives and Pierce islands complex in the Columbia River immediately below Bonneville Dam. Spawning and rearing habitats are directly affected by Bonneville Dam flow levels; because this population is vulnerable to changes in tailwater elevation and other environmental factors we have monitored them yearly since 1998. Spawning generally begins in early to mid-November and ends in mid- to late December. We estimated the size of the spawning population annually; it has ranged from 40 in 1999 to over 4200 in 2002. Juvenile emergence began anywhere from late January to late March and continued through late March to early May. Comparisons of median fork lengths from 2003 to 2006 showed significant differences between years; the 2006 beach seine CPUE differed significantly from both the 2004 and 2005 beach seine CPUEs. This population of chum salmon continues to be at risk from many ecological and man-made factors, making continued monitoring imperative.

Session: Data Management

Regional Data Management Capabilities: Progress and Challenges

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The history of information system development in the Pacific Northwest region is, for the most part, ad-hoc. Typically, as different agencies, institutions or projects needed to manage information they mostly went about it independently, creating for example, their own databases, collection methods and reports. While there have been some efforts at consolidation or standardization they have not succeeded or been sustained across the basin as a whole. These individual information systems are called disparate systems because they often don't share the same operating system or language, don't collect data of uniform quality or description and usually cannot "talk" directly to each other. Over the last two decades the Internet, geographical information systems, geographical positioning systems and advances in database technology have created technical ways to knit information from these disparate databases into common systems. The Northwest Environmental Data Network was created to improve the quality, quantity, and availability of regional data and related information on fish, wildlife and their aquatic and terrestrial habitats using a publicly supported approach to information systems management. What progress have we made in this effort and what challenges remain?

Session: Diamond Lake Mini-session

Diamond Lake Restoration Project Rotenone Application

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Diamond Lake was treated with rotenone on September 13-15, 2006 as part of an effort to eradicate the non-native tui chub *Gila bicolor* and restore water quality. The project was planned and completed under an Incident Command System using parties from multiple government agencies. Prior to treatment, the lake was drawn down over a 12 month period to approximately 8 feet below normal full pool to two-thirds (approximately 43,000 acre-feet) of its normal volume, divided up into grids, and sampled for fish distribution in tributaries and along the shoreline. The lake outlet head gates were closed and secured to contain all surface water flows during rotenone application until the lake was rotenone free. 9 custom fitted pontoon boats distributed the majority of the product into the lake, with 2 smaller boats, drip stations, and backpack applicators doing specialized treatment on shore. ODFW crews specifically trained and licensed in pesticide application distributed a total of 107,141 lbs of powdered rotenone and 71,990 lbs of liquid rotenone safely in a time period of 12 hours. The resulting formulation of rotenone after thoroughly mixed in the lake was 2.2 ppm (0.11 ppm active).

Session: Lamprey Papers

Oregon Coastal Riparian Restoration, Stream Temperatures and Larval Lamprey Ecology: An Examination of Responses by Larval Pacific Lamprey, *Entosphenus tridentatus*, to a Range of Experimental Temperature Regimes and Potential Consequences to Lamprey Ecology

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Little is known about the thermal ecology of larval Pacific lamprey, *Entosphenus tridentatus*, with regards to stream temperatures, thermal tolerance, metamorphosis, and outmigration. Along these lines we conducted two laboratory experiments to test 1) the thermal tolerance and 2) the effects of elevated temperature on larval *E. tridentatus* growth. In the first experiment, pre-macrothalmic larvae were acclimated to 10 and 20 °C, followed by a range of 14 day high temperature treatments. The lowest temperature at which mortalities occurred was 28 °C. All larvae treated with an elevated and constant water temperature of ≤ 27 °C survived the 14 day experiment. In the second experiment we treated larvae with a simulated Oregon coast stream temperature pattern during summertime, using the Siletz River as our blueprint. This diurnal pattern involved a daily low of 21 °C and a high of 24 °C. Control larvae experienced a constant mean temperature of 13 °C, similar to that found in lower order, well shaded streams of the Oregon coast. We observed a reduction in mean body size in the 21-24 °C group and an increase in mean body size in the control (13 °C) group. We hypothesize that reduced growth may translate to delayed metamorphosis and seaward migration as an ecological consequence of increased stream temperatures. Using the Oregon Department of Environmental Quality's "Heat Source Model" we will discuss the hypothetical shifts required in the Siletz River Basin riparian habitat to allow for a more "normal" outmigration timing for larval lamprey.

Session: Coho salmon use in estuaries and tidelands

Oregon Tidal Salt Marshes and Juvenile Salmonid Use Patterns - Mining a Chinook Dominant Data Set for Coho Specific Patterns

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Using underwater videography and standard seining techniques we compare juvenile salmonid tidal migration behavior in salt marsh habitats in five Oregon estuaries. We next examine young of the year coho distribution

relative to available to spawning habitat, salt marsh tidal inundation, water temperature and salinity patterns, and marsh channel low tide refugia. From these two data sets we make inferences regarding estuarine habitats available to young of the year coho and their ability to successfully use those same habitats.

Session: Early life history research and monitoring

Ecology of Winter Concealment Behavior in Juvenile Spring Chinook Salmon in the Grande Ronde River Basin, Oregon

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Winter concealment behavior (WCB) was characterized for juvenile spring Chinook salmon *Oncorhynchus tshawytscha* from September through January in three study streams of the Grande Ronde River Basin, Oregon. The Nocturnal Index (NI), an index of the onset of WCB, increased significantly as mean daily water temperature decreased. Significantly more fish were detected using WCB as mean daily water temperatures decreased in the Lostine and upper Grande Ronde rivers, but not in Catherine Creek. WCB was negatively associated with daily mean water temperature in all three streams, and positively associated with fish size in Catherine Creek and the Lostine River. WCB was not significantly associated with fish density in any of the three streams. Both the NI and detections of concealed fish indicated that fish were concealing amid interstitial spaces during the day and emerging at night as early as October-November, yet no population fully exhibited WCB during any month sampled. Results of this study indicated that more ecological factors than low water temperature affected the behavior because not all fish used WCB even when daily mean water temperatures were < 1° C.

Session: Implementation of Native Species Reintroductions

Middle Fork Willamette Bull Trout: Headed in the Right Direction

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The Upper Willamette Bull Trout Working Group has coordinated a multi-year effort among several of the partners to rehabilitate the bull trout population in the Middle Fork Willamette above Hills Creek Reservoir. Much has been achieved since the first fry were released in 1997. This presentation will discuss the considerations that led to the reintroduction strategy. Although significant progress has been made to date, additional work will be necessary before we reach our goal of Middle Fork Willamette bull trout contributing to the viability of populations in the Upper Willamette River Core Area.

Session: Reintroductions and Recovery of Anadromous Fish in the Willamette Basin – Dammed If We Do, Damned If We Don't

No Dam Good!

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Large flood control/hydropower dams operated by the US Army Corps of Engineers block upstream and hinder downstream migrations of anadromous fish to and from much of their historic spawning and rearing habitat in the Willamette Basin. Utilizing high quality habitat above these dams is an important strategy for restoring Chinook salmon and steelhead populations. This presentation explores the challenges of providing safe and effective fish passage at these dams with specific examples from Cougar Dam on the South Fork McKenzie River.

Session: Coho salmon use in estuaries and tidelands

Use of the Tidal Portions of Humboldt Bay Tributaries by Juvenile Salmonids

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Estuaries in California are often overlooked as potential rearing habitat for coho salmon (*Oncorhynchus kisutch*). The California Department of Fish & Game (DFG) is sampling the tidal portion of tributaries in Humboldt Bay, California, to describe their use by juvenile salmonids, especially coho salmon. DFG marked juvenile salmonids with passive integrated transponder (PIT) tags in the tidal portion of the two major Humboldt Bay tributaries, Freshwater Creek and Elk River, to determine estuarine residence times and growth rates for recaptured marked fish. Juvenile salmonids were present in the tidal freshwater portion of the tributaries throughout the year but were absent after late July in the brackish water areas. Subyearling coho salmon arrived in tidal freshwater areas in April and remained there throughout the summer, but most left by October. Their FLs increased from 40-45 mm in April to 80-90 mm by October which was larger than their cohorts rearing upstream. Another group of juvenile coho salmon arrived in tidal freshwater habitat during the fall and winter and reared there until emigrating in the spring. A final group of yearling coho salmon arrived in tidal habitat April to June and passed through the estuary fairly quickly. DFG also captured subyearling coho salmon in the tidal portions of smaller Humboldt Bay tributaries including non-natal areas. Subyearling coho salmon appear to use tidal freshwater habitat where there is year-round cool freshwater flow and appear to avoid saltwater habitat. DFG is acquiring this baseline data to help guide habitat restoration efforts in Humboldt Bay.

Session: Redband Trout –Migrations in the Desert

Lahontan cutthroat trout investigations and collaboration for habitat improvement in the Coyote Lakes Basin, southeast Oregon

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Lahontan cutthroat trout (LCT) historically occupied Lake Lahontan, which encompassed portions of northern Nevada, eastern California, and southeastern Oregon. As climate changed, populations of LCT became isolated in small streams, and the fish adapted from an adfluvial life history to a fluvial or resident life history. Climate change in conjunction with habitat modification resulted in declining populations and concern over long-term viability of many populations. Lahontan cutthroat trout were listed as endangered in 1970, and reclassified in 1975 as threatened. Cutthroat trout in the Coyote Lakes Basin were recognized as LCT and listed in 1991. Conflict over livestock grazing and ecological conditions resulted in strained relationships between the ranching community, state and federal agencies, and environmental groups. To address this conflict, the Trout Creek Mountain Working Group was formed in 1988 to provide guidance and recommendations to enhance ecological health and economic well being for the area. The group consists of representatives from the ranching community, environmental groups, and state and federal agencies. As a result of efforts by the Trout Creek Mountain Working Group, habitat conditions have improved in the Coyote Lakes sub basin. We will present data on changing habitat conditions and changes in LCT populations, and then look at the correlation between climate and LCT population levels. We will then discuss the benefits of collaborative efforts such as those of the Trout Creek Mountain Working Group, and the most likely impacts of habitat improvements on fish populations in desert stream environments.

Session: Data Management/Sharing

Status of the Resources Project: A Collaborative Data Mining, Compilation, and Reporting Effort for Fishes of the Columbia River Basin.

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In 2006, an Independent Scientific Review Panel (ISRP) identified the need for readily accessible data relative to the status of fish populations in the 62 subbasins that comprise the Columbia River Basin. The ISRP recommended that the data, collected through public funds, should be available through publicly accessible websites. Because of the broad authority required to coordinate and implement a basin-wide effort, the Columbia Basin Fish and Wildlife Authority (CBFWA), an organization comprised of state, tribal and Federal fish and wildlife entities, accepted the responsibility. Working collaboratively with data management projects and decision-makers, the CBFWA developed, coordinated, and implemented a comprehensive and uniform basin-wide data inventory and reporting project that mines and compiles abundance data for fish populations throughout the Columbia River Basin. Information is disseminated through a publicly accessible website and annual reports that provide comparisons between abundance values and biological objectives set by fisheries managers during the Northwest Power Planning Council's subbasin planning process.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Bull trout egg-to-fry survival in redds superimposed by Kokanee

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Oregon's only remaining non-reservoir population of adfluvial bull trout (*Salvelinus confluentus*) is found in Odell Lake, in the headwaters of the Deschutes River.
Limited spawning and rearing habitats, combined with the effects of introduced species and other anthropogenic changes to the basin have contributed to a significant population decline. The lower section of Trapper Creek, a tributary of Odell Lake, is the only known spawning area used by this species throughout the system. Large numbers of Kokanee (*Oncorhynchus nerka*) also spawn in the same reach of Trapper Creek, superimposing their redds on those dug earlier by bull trout. After superimposition by Kokanee, bull trout redds are virtually undetectable. The objective of our study is to assess the effect of such overlay on bull trout's egg-to-fry survival rates. Emergent fry traps were used, in combination with egg burial depth measurements, scour chains, and gravel characterization to establish actual physical overlap between both species and degree of bull trout egg pocket disturbance caused by Kokanee. Our results indicate that most bull trout egg pockets are dug deeper than depths reached by spawning Kokanee. Bull trout fry emergence data suggest that redd superimposition does not affect egg-to-fry survival rates.

Session: Coho Salmon Use in Estuaries and Tidelands

Juvenile coho salmon use of estuarine habitats in the Copper River Delta, Alaska

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The Copper River Delta, Alaska, is the largest continuous wetlands on the Pacific Coast of North America, with extensive shallow ponds, intertidal sloughs, braided glacial streams, sedge marshes, willow thickets, and stands of spruce and cottonwood. The US Forest Service constructed a naturally spring-fed spawning channel to enhance

coho salmon production in the Delta in the mid 1980s. I was a member of the fish crew that assessed the distribution of juvenile coho salmon downstream from the spawning channel during its second year of operation. We coded-wire tagged and fin-clipped approximately 13,000 outmigrating fry from the channel in late May and early June, then used minnow traps to determine their distribution in the many sloughs, side channels and beaver ponds downstream of the trap throughout the summer. The intent of this talk is to describe the project and illustrate the types of habitats inhabited by juvenile salmon in the delta, including extensive networks of beaver ponds. For example, we often found juvenile coho salmon above a series of seemingly impassible beaver dams, many of which looked to be decades old. Although the pea-soup thick, silt-laden waters of the glacial Copper River may be inhospitable to juvenile salmon, the Copper River Delta serves as a "coho factory" with its extensive off channel habitats.

Session: The Pursuit of Knowledge in Fisheries Research and Management: Student Papers

Using Context in the Design of Manipulative Field Experiments: A Case Study of Fish Community Influence on Steelhead-Rainbow Trout (*Oncorhynchus mykiss*) Distribution in the South Fork John Day River, Oregon

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In the spirit of this session's title, "The Pursuit of Knowledge in Fisheries Research and Management," this paper discusses how our methods for hypothesis generation influence the type of knowledge we pursue and eventually use for management decisions. The paper outlines a case study of hypothesis generation and testing of fish community interactions in the South Fork John Day River of eastern Oregon. The case study incorporates initial observations, collection of large-scale continuous data, integration of smaller-scale studies, and the context-informed design of a manipulative field experiment. Large-scale continuous sampling of fish distributions hinted that at the reach scale, juvenile steelhead-rainbow trout (*Oncorhynchus mykiss*) and Chinook salmon (*O. tshawytscha*) were associated with different types of habitat, an observation supported by niche differentiation literature. However, integration of smaller-scale observational studies revealed that in local habitats where the two species' distributions overlapped, significant competitive interactions were occurring. To resolve the discrepancies between studies conducted at different scales, a manipulative field experiment was designed and conducted in the summer of 2006. Preliminary results indicate that contrary to the accepted view of niche differentiation, juvenile rainbow trout and Chinook salmon share a common niche and are in direct competition, and therefore their selection of habitat may be affected by their relative distributions. These findings provide contextual knowledge about mechanisms driving observed species distributions and therefore have direct implications for research, monitoring and restoration programs.

Session: Early life history research and monitoring

Development of Bioenergetics Models for Endangered Age-0 Lost River and Shortnose Suckers in Upper Klamath Lake, Oregon

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The endangered Lost River sucker *Deltistes luxatus* and shortnose sucker *Chasmistes brevirostris* have shown poor recruitment into adult populations since their listing in 1988. Recruitment failure may be occurring during the first year of life, and causes may include low survival due to poor summer water quality conditions or poor fish condition in fall leading to winterkill. We are developing bioenergetics models of age-0 juvenile Lost River and

shortnose suckers to better understand growth requirements and to test hypotheses of water quality, poor fall condition or other factors that may affect mortality rates. Model parameters are being developed by constraining Monte Carlo simulations to acceptable ranges as determined by field data. Simulation parameter bounds are being determined by reconciling published parameters for adult fish of two other species with the presumed higher metabolisms of juveniles. The two adult surrogates will be June suckers *Chasmistes liorus*, for their close taxonomic relationship, and fathead minnows *Pimephales promelas*, for their similar gut length, body size, and habitat preferences. Final model parameters will be corroborated by comparison with independent field data. The bioenergetics models that we are developing will provide the first parameter sets for age-0 catostomids. These models will provide a useful platform to test hypotheses about the effects of changing water quality (especially temperature) and food availability to juvenile sucker growth and survival. Bioenergetics models furnish management with tools to work toward species recovery.

Session: Early Life History Research and Monitoring

Using Rotary Screw Traps to Monitor Natural and Hatchery-Produced Spring Chinook Salmon during Hatchery Releases

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Operating rotary screw traps can be difficult during hatchery releases, as high densities of out-migrating fish can overwhelm the holding capacity of the trap and cause stress or mortality. We present a methodology for operating screw traps during hatchery releases while maintaining data collection objectives for on-going research in the Lostine River, OR (Wallowa River watershed). Screw traps are typically operated 24 hours a day during the juvenile out-migration season. When hatchery spring Chinook salmon are released from acclimation ponds the trapping schedule is modified to catch fish during a four-hour subsample. This strategy allows for continued monitoring without risking the safety of fish or overwhelming personnel. Conducting trapping operations during hatchery releases also provides an opportunity to compare the performance of natural and hatchery-produced Chinook salmon emigrating under similar conditions. Three comparative performance measures were assessed; size at emigration, juvenile arrival timing and survival to Lower Granite Dam. Preliminary results indicate that when compared to naturally-produced fish, hatchery fish are larger at emigration, have earlier arrival dates, and generally lower survival rates to Lower Granite Dam. These performance measure comparisons indicate how well hatchery production mimics natural production, with the goal of improving Chinook salmon populations in the Wallowa River watershed.

ABSTRACTS OF POSTERS

In alphabetical order by *primary author's* last name

Session number listed after the abstract title

An asterisk "*" indicates presenter when primary author is not presenting the paper

Presenters for "Best Student Poster" competition are listed in bold type

Poster Session & Social

Wednesday, February 28, 2007
Hellman/Wilder
7:00-11:00 pm

The Importance of Pacific Salmon to Resident Salmonids in a Changing Environment

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Bull trout (*Salvelinus confluentus*) in the Pacific Northwest have experienced significant declines in their abundance and distribution. The conservation and recovery of bull trout populations requires information regarding factors limiting population growth. While the majority of research to date has focused on the importance of abiotic factors as potential limiting factors, there has been little research examining the role of biotic factors. In headwater systems, bull trout are considered a top predator, foraging on juvenile and young-adult salmonids. However, there have been substantial and parallel declines in forage opportunities in the Northwest, as many salmonid stocks have been reduced or extirpated. We used diet data and stable isotope analyses to evaluate the amount of piscivory in bull trout foraging in two eastern Oregon streams. Further, we incorporated bioenergetics modeling to evaluate the effects of declines in salmonid forage on bull trout growth rates and subsequent fecundities under current and future climate scenarios. We found bull trout occupied the highest trophic position across systems and temporal periods. In addition, we found that juvenile salmon represented a large component of bull trout diets. Bioenergetics models suggested that declines in piscivory can substantially reduce bull trout growth, and subsequent fecundity rates. When potential increases in water temperature scenarios were included, the effects were magnified suggesting that increased water temperatures and reduced forage opportunities may have profound effects on bull trout populations. Ultimately, our results imply that reductions in salmon abundance, historically and potentially, can have large effects on bull trout distribution and abundance.

Upper Middle Fork Willamette River Bull Trout Population Developments and Status

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In 1997, bull trout *Salvelinus confluentus* were listed under the ESA as threatened and thought to be extirpated from the Upper Middle Fork Willamette River basin. The demise of bull trout led to the formation of a multi-agency Willamette Bull Trout Recovery Program in 1997. The recovery program initiated a restoration effort for the Middle Fork Willamette River bull trout, upstream of Hills Creek Reservoir. Bull trout fry were transplanted from the McKenzie River watershed population into the Middle Fork Willamette River watershed from 1997 through 2005. In 2005 and 2006, PIT (Passive Integrated Transponder) tags and tag-reading stations were used to track fish movements. During the past two spawning seasons a total of 17 sexual mature bull trout were captured, tagged, and documented as post-spawned. No fry transfers occurred in 2006 therefore, spawning activity was further verified by the presence of young of the year bull trout in the watershed. We continue to conduct a rigorous and ongoing habitat restoration project for all bull trout life stages throughout their historic range. Continued reproduction of the population will validate reintroduction efforts for this threatened species. In the future we will continue to monitor adult migration and spawning frequency with PIT and acoustic radio tags. Juvenile dispersal rates from spawning areas will be documented as well.

Does Dewatering a River Alter the Life Histories of its Emerging Aquatic Invertebrate Adults?

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The adult life stage of many aquatic invertebrates is a critical period that permits propagation of the species and provides a valuable subsidy of energy to the surrounding riparian ecosystem. Intense water use in agricultural areas is capable of removing much of the in-stream flow and has unknown effects on the emergence of adult aquatic invertebrates. To examine the magnitude and nature of water withdrawals on aquatic invertebrate life histories, emergence will be monitored on a pair of rivers during the summers of 2006 and 2007. Data will be used to explore patterns in timing, individual size, and community biomass across gradients of increased duration and proportion of water withdrawal. A controlled in-lab experiment will be conducted to separate the effects of co-occurring factors associated with water withdrawal (i.e. water temperature, flow velocity, and habitat availability). We hypothesize that peak emergence will occur earlier and mean body size will be smaller at sites with a greater proportion of water withdrawal. We expect these effects to become more pronounced later in the season when water demands and summer base flow combine to create extremely low discharges. We also anticipate that increased water temperature is the most influential factor in driving observed effects.

Use of Sturgeon Pectoral Spines and Dentaries from Archaeological Sites to Study Pre-19th Century Fish Population Structure on the Lower Columbia River

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The goal of our research is to track changes in the demographics of the sturgeon populations that were targeted by native fishermen in the Portland Basin, Lower Columbia River. The sturgeon remains found at archaeological sites can afford scientists a window into the past, illuminating the effects of changing levels of human predation on prehistoric sturgeon populations.

Pectoral fin rays recovered from the site of a Chinookan plankhouse (Meier, #35CO5) were sectioned and their annuli counted. This produced an age-at-death for individual fish from the time that the plankhouse was inhabited. Dentaries unearthed at the plankhouse and at an older Chinookan village (Cathlapotle, #45CL1) were measured and used to reconstruct body-sizes for the ancient fish. The skeletal elements examined are associated with radiocarbon dates and temporally sensitive artifact styles, which allows for the evaluation of changes in size and age over time for the period from 1000AD to 1830AD. European contact at ~1775, caused decimation of Native American populations and hence much reduced predation pressure. The working hypothesis is that demographics of sturgeon populations (as monitored by body size and age estimates) before and after European Contact will change. Pre-contact fish will be smaller and younger, owing to predation pressure, and post-contact fish will be larger and older with reduced fishing intensity.

Use of Cryopreserved Sperm from Fall Chinook Salmon O. tshawytscha. — How Much is Enough?

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Cryopreserved sperm is used in conservation hatcheries when the number of live males available is insufficient. Previous recommendations of one 0.5 ml straw of cryopreserved sperm per 450 eggs have yielded mixed results when used in the Grande Ronde Spring Chinook Salmon Captive Broodstock Program. We examined the relationship between the amount of cryopreserved sperm used and the resulting fertilization rate to further refine and potentially increase fertilization rates when cryopreserved sperm is used. We cryopreserved sperm from eight males and pooled eggs from 14 females. We arrested development at the 4-cell stage, approximately 12 hours after fertilization, and examined a random sub sample of 50 eggs per group for the presence / absence of cell division and estimated percent fertilization. Fertilization rate was significantly related to the individual male ($P < 0.0001$), the number of straws ($P < 0.0001$), and the number of eggs fertilized ($P < 0.0001$), but not the estimated motility of the thawed sperm ($P = 0.1128$). Fertilization rates were low but fertility increased with the number of straws used at a rate of 2.4% per additional straw. There was no difference between 8 vs. 4 straws or 1 vs. 2 straws, however 8 or 4 straws was better than 1 or 2 straws and fertility for 250 eggs was better than 500 eggs, which was better than 1,000 eggs. We conclude that increased fertilization rates can be obtained by increasing the number of straws and suggest using at least 4 straws to fertilize 250 eggs.

Look-Alikes to a New Invader to the Pacific Northwest: An Exotic Asian Goby and Native Sculpins

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The report of a new exotic invasive fish species in the Pacific Northwest reveals the difficulties biologists have in acknowledging and identifying new species in the field. Recent stream surveys of the East Fork Lewis River in Washington reported the presence of a 'mystery' fish, first thought to be a native sculpin, found in a restored seasonal wetland environment. Upon further investigation by Oregon State University researchers, the 'mystery' fish has been identified as a species of goby endemic to Japan, *Rhinogobius brunneus* (the Amur goby). *Rhinogobius brunneus* may be mistakenly identified as similar-looking benthic species, such as native sculpins of the genus, *Cottus*. The purpose of this paper is to examine key morphological differences between *Rhinogobius* and *Cottus* species to aid in the positive identification of both species.

Wild Summer Steelhead Recovery Above Siletz Falls: Is Competition a Factor?

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The Siletz River is the only Coast Range basin in Oregon with a native run of summer steelhead. It is believed that the run developed because anadromous fish could only pass the Siletz Falls during summer flows. A fish ladder was constructed in 1953, which allowed other anadromous fish to pass above the falls. This allowed competition between summer and winter steelhead for habitat. By the early 1990's, a drastic decline in the wild summer steelhead population was evident with returns reaching less than 50 adults. The Oregon Department of Fish and Wildlife Commission approved the Siletz River Basin Management Plan in 1997, which sanctioned changes in fish management in the upper Siletz Basin. Actions included, eliminating passage of winter steelhead and coho salmon above the falls, and closing fishing above the falls. For the first generation, all natural and about 1,000 hatchery summer steelhead were passed above the falls. Starting in 2000 only wild summer steelhead were passed upstream. The number of wild summer steelhead passed above the Siletz Falls has increased greatly since then with an average of 500 adult spawners passed over the last 3 years.

Adult Steelhead Spawner Abundance in Two Small Tributary Streams of the Imnaha River Subbasin, Oregon

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Snake River steelhead (Oncorhynchus mykiss; Hey'ey in Nez Perce), are listed as threatened under the Endangered Species Act. Annual non-biased and precise quantification of adult abundance in component populations is essential to effective management. In this study, we estimated adult A-run steelhead abundance of two non-supplemented tributaries of the Imnaha River via upstream and downstream portable picket weirs. Monitoring in Lightning Creek started in 2000, Cow Creek in 2001 and have continued to date. These streams are relatively small with a drainage area of 103.8 km^2 (Cow Creek) and 152.6 km^2 (Lightning Creek). These extremely flashy systems from spring snowmelt and/or heavy thunderstorm precipitation can render picket weirs unable to function. Tributary specific abundance estimates for Lightning Creek have ranged from 36 (33-39 95% CI) in 2000 to 232 (166-297 CI) adults in 2002. Estimated abundance in Cow Creek have ranged from 26 (16-37 CI) in 2006 and 128 (118-138 CI) adults in 2004. Stray hatchery origin adults have comprised 1.4 to 26.6 percent of the total escapement. Sex compositions have ranged from 61.2 to 84.8 percent female. Scale analysis from 2000 through 2004 have shown natural origin adult one ocean steelhead comprising of 62 percent in Lightning Creek and 71.1 percent in Cow Creek. In 2005 and 2006, we deployed a Logie 2100 resistivity counter with day-time video, to passively calculate an independent population estimate in Lightning Creek with attempt to determine weir impedance.

Ecological Assessment of Stream Restoration in the Willamette Valley

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Stream barbs are designed and installed by the Natural Resources Conservation Service on agricultural lands to reduce lateral meander migration and shift the thalweg away from eroding stream banks. To date, the ecological consequences of stream barbs have not been documented. This study measured the effect of barbs on retention of water and particulate organic matter in streams in the Willamette Valley during winter. Hydraulic retention was measured by releases of Rhodamine WT dye, organic matter retention was measured by gingko leaf releases, and barb function was assessed from photographs at high flow. At seven study sites, a reach with stream barbs and an adjacent agriculturally influenced reach without stream barbs were selected. Average time to peak dye concentration was greater for three, the same for two, and less for four of the barbed reaches. The average fluorescence clearance time was greater for six of the barbed reaches. Dye concentration was greatly diluted in barbed reaches, indicating lateral dispersion and long hydraulic residence time. Maximum velocities were similar for barbed and reference reaches. One gingko leaf release was successfully completed; others releases were prevented by high winter flows. We conclude that properly designed stream barbs dissipate energy away from stream banks, shift the thalweg away from outer bank of the meander, and potentially increase retention of food resources in winter. Factors that reduce the effectiveness of barbs and may cause additional damage include improper spacing, intercepting too much of the flow during high flows, sediment transport into the reach that modifies design criteria, and unanticipated channel migration.

"This Fish is Messed Up!" - A Tale of Conjoined Twin Trout

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An unusual-looking trout was caught by angling in Crane Prairie Reservoir, Deschutes County, OR, on October 9th, 2006. Externally, the fish appeared normal except for a conspicuous pigmented growth on the chest. Subsequent examination revealed the 'growth' on the chest of the fish was actually a 'parasitic' conjoined twin. X-ray revealed no gross abnormalities in the skeletal structure of the 'host' twin, but the rudimentary skeletal structure of the 'parasitic' twin lacked vertebrae. Dissection revealed the 'parasitic' twin lacked a reproductive tract or circulatory

system of its own, and shared a liver with the host fish. However, despite lacking a mouth, the 'parasitic' twin had a spleen and a complete digestive tract, including an esophagus, stomach, pyloric caecae, intestine, and anal opening. Reports of conjoined fish captured in the wild are rare, as survival rates are low for such severely deformed individuals; most reported conjoined fish are of hatchery origin. Analysis of scale growth patterns confirmed this fish was recently planted from Wizard Falls Hatchery rather than recruited from wild stock.

Survival, Fry Deformities and Fluctuating Asymmetry of Rainbow trout (*Onchorhynchus mykiss)* Produced with Fresh and Cryopreserved Sperm

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Although cryopreservation is a widely accepted tool in animal breeding and human reproduction, questions regarding the viability of fish sired by cryopreserved sperm have arisen. We examined viability of rainbow trout families produced using fresh and cryopreserved milt to determine if sperm cryopreservation negatively influenced early development. We used fresh and cryopreserved milt from 3 males to fertilize eggs from 6 females in a 3 x 6 factorial design. Survival to eye and survival to fry were compared between the treatment groups (fresh vs. cryopreserved milt). We estimated developmental viability by comparing the proportion of fry deformities and level of developmental stability between groups. Results revealed a significant reduction in survival to eye (P=0.001) and survival to fry (P=0.001) for families sired using cryopreserved milt. Survival from eye to fry did not differ among the groups (P=0.105), indicating that survival differences occurred prior to the eye stage. Analysis of the proportion of fry deformities per family revealed no significant difference between the groups (P=0.690). Developmental stability was examined using fluctuating asymmetry (FA) of pectoral fin rays. Ten fish from each family were counted by two separate observers. There was no significant difference in mean number of asymmetric individuals/family (P=0.817) or cumulative R – L distribution (P=0.658) between the control and treatment groups. Although survival was significantly lower for families sired by cryopreserved sperm, surviving fry showed no differences in deformity rate or FA, suggesting that sperm cryopreservation is a viable option for conservation and recovery of imperiled salmonid populations.

High-speed Video Analysis of a Unique Pacific Lamprey Climbing Behavior

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Pacific lamprey (*Lampetra tridentata*) populations in the Columbia River Basin have declined, in part due to poor adult passage at main stem hydropower dams. At Bonneville Dam, lamprey passage is aided by inclined ramps that lead around obstacles. The behavior used to climb these ramps and the effectiveness of the ramps are not fully described. We observed the lamprey moving against water at two flow speeds on two ramps, the first at 45˚ and the second at 18˚, relative to horizontal. We documented lamprey climbing movements (jumps) on four nights using high speed video (125Hz), including the individual tendency to jump right or left. We used drawings of body conformations, kinematic analyses, and quantification of behavioral conditions, such as the distance between lamprey and the ramp edge (average distance = 0.08m). The lamprey suction onto the ramp, simultaneously release and propel themselves up the ramp (average distance = 0.052m), and then reattach by suctioning. The number of jumps per second showed no difference across different ramp angles and water flows. The jump distance was affected by ramp angle and water flow. This Pacific lamprey behavior is not described for any other fish species.

Enhancing Recreation, Stormwater Treatment, and Habitat in an Urban Area

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Historically created to drain wetlands in the watershed, Burnt Bridge Creek was not the amenity the City of Vancouver desired in the heart of the city. Water quality in the creek was degraded. Limited riparian cover provided little shade to the creek, and much of the habitat along the creek was dominated by a monoculture of reed canary grass. Future construction in the watershed was likely going to exacerbate water quality problems, further limit habitat value, and lead to flooding along the creek.

In 2002, the City of Vancouver undertook a multi-objective project along the creek to enhance recreational opportunities, enhance stormwater treatment, enhance fish and wildlife habitat, and increase floodwater detention. The project constructed three miles of new trail, connecting isolated segments and extending the trail to the east. The project also constructed or installed two vortexing manholes, two bioswales, an infiltration basin, and two stormwater ponds. These facilities treated stormwater currently flowing to the creek without any treatment.

Work to enhance habitat and increase floodwater detention included enhancement of five acres of existing wetlands and creation of three acres of new wetlands along the creek. Extensive peat deposits suggested that the area was historically inundated or saturated all year long. Grading along the creek was intended to connect the creek to the old floodplain and try to mimic the historical hydrology of the area. Over 20,000 herbs, shrubs, and trees were planted to stabilize soils, shade the creek, and increase habitat diversity.

The Long-Term Effects of the 1980 Eruption of Mount St. Helens on Anadromous Salmonids in the North Fork of the Toutle River: An Evaluation of Adult Salmonid Behavior

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The upper North Fork of the Toutle River, Washington was dramatically altered by the 1980 eruption of Mount St. Helens. Mud, ash, and debris covered 60 square kilometers of the system to a depth of 46 meters. To address sediment transport and fish passage concerns, the U.S. Army Corps of Engineers constructed a sediment retention structure (SRS) and fish collection facility (FCF). A trap and haul program transports adult salmonids into tributaries upstream of the FCF and SRS, which lack upstream fish passage routes. We are using telemetry to investigate movements of adult steelhead and coho salmon above the FCF, the SRS, and in upstream reaches of the system. We released radio tagged fish to evaluate: (1) whether fish could pass upstream via the SRS spillway, (2) whether fish could negotiate the sediment plain above the SRS, and (3) movements from trap and haul program tributary release sites. Few steelhead (18%) and no coho salmon were able to pass upstream via the SRS spillway. More steelhead (52%) were able to negotiate the sediment plain than coho salmon (30%). No fish released into trap and haul tributary sites were detected moving out of those tributaries. Tagging and monitoring efforts continue for the winter of 2006-2007.

Bioassessments to Determine the Status of Native and Introduced Fishes of Large Pacific Northwest Rivers

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The U.S.EPA EMAP large river assessment (RIVMAP) protocol was designed to assess the ecological condition, major stressors, and likely human disturbances of entire main-stem rivers, and includes electrofishing randomly chosen reaches to assess the ecological condition of fish assemblages. Random-systematically chosen RIVMAP study reaches cover the main-stem of Pacific Northwest rivers from where wading becomes impractical to the head of tide. Inflatable rafts are used to ensure access to, and sampling within, reaches inaccessible to other boat types or wading crews. While the main objective of this monitoring method is to produce data to assess fish assemblage condition, a secondary objective is to evaluate fish species distribution over time. Sampling twenty 1-2 km long

reaches covering 23% of a 123 km segment of the Malheur River, OR, during the summer of 2006 revealed: (1) the absence of native mountain whitefish *Prosopium williamsoni*; (2) the first-recorded capture of non-native tadpole madtom *Noturus gyrinus*, black bullhead *Ameiurus melas* and flathead catfish *Pylodictis olivaris* in the drainage basin; and (3) range extensions of five other non-native fish species: largemouth bass *Micropterus salmoides*; smallmouth bass *Micropterus dolomieui*; white crappie *Pomoxis annularis*; pumpkinseed *Lepomis gibbosus*; and yellow perch *Perca flavescens*.Longitudinal, direct and standardized biological assessments of large river fish assemblages can reveal changes that are difficult to obtain by standard point sampling and inform water resource management decisions.

Ecological Considerations for Northern Anchovy (*Engraulis mordax*) Abundance and Distribution in the Northeastern Pacific

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The northern anchovy (*Engraulis mordax*) is a small, schooling coastal pelagic fish found widely distributed along the Pacific west coast from Baja, Mexico to the Queen Charlotte Islands, British Columbia. In the northern California Current, northern anchovy is prey for a number of piscivorous fish, birds, pinnipeds and cetaceans. Since 1998, the National Marine Fisheries Service (NMFS) has been conducting fisheries independent survey cruises off Washington and Oregon to assess the status of marine fishes, with particular emphasis on salmonids. Physical oceanographic data was collected at each fishing station using a conductivity, temperature and depth (CTD) profiler. Annual anchovy densities were compared using a Kruskal-Wallis test and a multiple regression model developed to examine anchovy density as a response variable to key physical oceanographic processes (temperature, salinity, timing of the spring transition, chlorophyll-*a* concentration and the Pacific Decadal Oscillation (PDO) index). Temperature was found to be the central explanatory variable in explaining anchovy abundance, and may be important to ecosystem health considering the strong El Niño/La Niña patterns observed since 1998 in the northeastern Pacific

Temporal Patterns of Larval Ghost Shrimp (*Neotrypaea californiensis*) in Yaquina Bay, Newport, Oregon

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Temporal patterns of larval Ghost shrimp (*Neotrypaea californiensis*) are important ecological components of Pacific estuaries. Recruitment and subsequent returns of ghost shrimp to estuarine tideflats is highly variable among years and their larval life history is poorly understood. The goal of this project is to answer if there were distinct pulses of early life larvae release or are larvae always present in the water column? We collected both continuous samples of pelagic ghost shrimp from Yaquina Bay during peak larvae release periods and post larvae samples in Idaho Flats. Objectives were, 1) assess the timing and magnitude of larval abundance in Yaquina Bay (larval stages I – V), and 2) assess recruitment from the occurrences of post larvae (i.e. potential recruits). Ninety eight percent of these larvae were stage 1 and were in 3 periods and spanning six total days of peak abundance during study period, and no correlation to physical factors also no evidence for recruitment during the study. In the recruitment surveys inferred evidence of post larvae recruitment at stage 0 shrimps.

Growth and Distribution of Juvenile Dungeness Crab, C*ancer magister*, near Juneau, Alaska

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Dungeness crab, *Cancer magister*, is a commercially important species ranging from California to Unalaska Island, and few studies have examined early life history stages in the northern range. In the summers of 2005 and 2006, we examined the density and distribution of juveniles and molts at intertidal beaches accessible by road in Juneau. Molts and/or live juveniles on beaches with suitable habitat were surveyed by visually scanning and/or raking the top 10 cm of substrate in a 50 m by 2 m transect at MLLW. Juvenile or molt carapace width (CW) and carapace length (CL) were measured to the nearest 0.1 mm. Density of molts and juveniles ranged from 0 to 7 per square m. Size frequency distributions indicate that settlement occurs in late summer/fall at approximately 7 mm CW, crabs molt a few times from September through May reaching 14 mm CW in May, 19 mm in June, and 25 mm in July. Growth of first-year Dungeness crab in Juneau resembles that in Puget Sound and is slower than growth in Grays Harbor or San Francisco Bay.

An Assessment of the Chemical, Habitat and Biological Condition of Wadeable Streams in the Lower Columbia Region of Oregon

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We conducted a two-year study of the biological, chemical and habitat quality of first through third order, wadeable streams in the Oregon portion of the Lower Columbia basin. We surveyed 54 randomly selected streams and 17 non-random reference streams in 2003 and 2004 during June, July, August and September using the US EPA Environmental Monitoring and Assessment Program protocol. This region includes the spawning and rearing habitat of several anadromous salmonids that are listed or being considered for listing as threatened under the Endangered Species Act. It also contains Portland, Oregon's largest city.

We found that the most extensive stressors were high levels of fine sediment, high turbidity, and warm water temperatures. These stressors impair 30 to 40% of the wadeable stream miles. Water temperature, fine sediment, phosphorus and turbidity were on average significantly higher across the region relative to reference sites. We found stream habitat simplification and alteration were less extensive (<10%), but when present these stressors were significant risk factors to the biological integrity of the aquatic vertebrate and macroinvertebrate communities. Habitat simplification and alteration were indicated by decreased amounts of large woody debris habitat, increased proportion of glide habitat, and reduced stream shade relative to reference sites.

Changes in Isotopic Signature of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) with Respect to Size and Stream

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Adult salmon transfer nutrients from marine to freshwater and terrestrial habitats upon returning to spawn. These marine-derived nutrients (MDN) play an important role in aquatic ecosystems of the Pacific Northwest and are thought to influence the survival of juvenile salmonids. Stable isotopes of carbon and nitrogen can be used to trace the flow of MDN through inland food webs due to the unique isotopic signature adult salmon acquire in the ocean. Salmon eggs reflect the isotopic signature of their marine heritage. As these eggs develop into alevin and fry, and

begin feeding on terrestrial and freshwater biota, their isotopic signature shifts with dietary changes. Furthermore, differences in growth rate affect tissue turnover times, which subsequently influence isotopic signatures. While initial maternal effects would be expected, previous studies have indicated that these effects are extremely short-lived. We investigated stable isotopic ratios of carbon and nitrogen for 17 populations of juvenile spring/summer Chinook salmon (*Oncorhynchus tshawytscha*) from the Snake River basin in Idaho. Our results indicate that both body size and stream are significant factors influencing stable isotope composition in these juveniles. We observed maternal effects in juvenile salmon up to 75 mm. Furthermore, □15N values for similarly sized Chinook differed as much as 4.4 ppt among streams. Our findings suggest that researchers should pay particular attention to the size and spatial structure of juvenile salmon when stable isotopes are used to characterize dietary habits. Such understandings are imperative for making across-stream comparisons that examine the role of marine nutrients in freshwater stream food-webs.

Low-Elevation Aerial Photography in Riverine Settings

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Environmental studies often require a spatially accurate planform representation as a basis for documenting and quantitatively analyzing physical and biological conditions. Although high elevation orthorectified aerial photography is commonly used for projects covering relatively large areas, techniques for obtaining imagery for small areas are not widely recognized or applied. We present a technique for obtaining high-resolution, spatially accurate planform imagery for meso-scale (10–10,000 m^2) spatial analysis using low elevation aerial photography (LEAP). This technique is especially practical in stream networks where riparian canopy cover may obscure portions of the stream channel from view. In these settings, a linear progression of LEAP images are taken at low elevation (10–100 m) using a digital camera suspended from a ground-controlled helium balloon. The resulting digital photographs are georeferenced in ArcGIS using ground surveyed control points to create an accurate, high-resolution photographic base map suitable for field mapping and spatial analysis. We demonstrate the application of this technique in four riverine case studies: (1) the effects of flow fluctuation on suitable fish habitat area on the South Fork American River, California, (2) a fish habitat criteria mapping approach used to assess instream flows in regulated reaches of the McKenzie River, Oregon, (3) an assessment of the geomorphic effects of boulder placement on spawning gravel capture and retention in a regulated reach of the North Umpqua River, Oregon, and (4) an evaluation of the effects of habitat enhancements on juvenile coho salmon carrying capacity in a tributary to the North Umpqua River, Oregon.

American Shad (*Alosa sapidissima*) in the Pacific Northwest: Contrast with Parent Stocks in the Hudson River

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Since their introduction to the Sacramento River in 1870, the American shad (*Alosa sapidissima*) has undergone range expansion and exponential population growth, becoming the dominant aquatic vertebrate of the Columbia Basin in terms of both numbers and biomass. However, little work has been undertaken to document the biology of this species in their new environment. Ironically, multiple runs of American shad are endangered throughout their native range on the Atlantic Coast. We present preliminary work contrasting the biology and life history of American shad in the Pacific Northwest (Columbia and Willamette Rivers) with their source population in the Hudson River in New York.

Detection of Cured vs. Uncured Visual Implant Elastomer Tags in Larval Pacific Lamprey

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Visual implant elastomer (VIE) tags are frequently used for marking fish and other organisms. They are composed of a silicone-based colored elastomer and a curing agent, which are mixed prior to tagging and injected under an animal's skin. VIE tags are externally visible and can be 'fluoresced' using ultraviolet light. Few studies have specifically addressed the performance of VIE tags in larval Pacific lampreys. Additionally, little is known about the value of the curing agent in retaining VIE tags in larval lampreys. In this study, we compared the detection of cured and uncured VIE tags in Pacific lamprey ammocoetes under ambient and UV light conditions. We administered two 2-3mm VIE tags to each of 40 lamprey ammocoetes, one tag of cured elastomer and one of uncured elastomer. Lamprey were held in a laboratory environment and examined monthly for tags under ambient light, then under UV light. After 251 days, 100% of cured and 100% of uncured VIE tags were visible under both ambient and UV light. Tag color and position had no affect on detection. Zero lamprey mortality resulted from tagging. Our results demonstrate that both cured and uncured VIE tags can be used effectively for tagging larval lamprey. When tagging small batches of fish, using uncured VIE is an effective means of reducing waste and cost incurred by having to discard unused portions of cured VIE. Uncured VIE tagging may be broadly applicable to many fish and wildlife species and warrants further investigation.

Can the John Day River Support a Wild Spring Chinook Fishery?

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The John Day River basin retains one of the few intact, wild runs of spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Columbia River Basin. Over the past 47 years, this run has significantly increased with escapement estimates approaching 6,000 spawners, but there has been no spring Chinook sport fishery since 1978. The escapement target to allow a sport fishery to resume is 7,000 fish to the mouth of the John Day River for 3–4 consecutive years—a target that has not yet been met. Despite significant improvements in Chinook rearing habitat and the region being heralded as a restoration success story, smolt-per-redd ratios indicate that juvenile rearing areas are fully seeded at recent escapement levels and that rearing habitat is limiting freshwater production. The number of smolts per redd declined significantly when recent adult escapements reached record levels. Habitats used by spawners in the fall are vacated by their juvenile offspring during the following summer when water temperatures exceed optimum levels. Greater densities of Chinook parr are frequently found in cold-water tributaries compared to their natal mainstem habitat. Further, redd distribution observed from surveys conducted across recent high and moderate escapement years suggest that spawning habitat is not limiting. Despite significant efforts and improvements in spring Chinook habitat, our evidence suggests that additional habitat improvements are needed to ameliorate sub-optimal summer temperatures that decrease freshwater survival and limit achievement of recovery goals and opportunities for a sport fishery.

Bull Trout in Hot Water, Stream Temperatures from Klamath River Bull Trout DPS

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Klamath River bull trout (*Salvelinus confluentus*) were listed as a distinct population segment (DPS) in 1998 (63 FR 31647) because of physical isolation from other bull trout by the Pacific Ocean and several small mountain ranges in central Oregon. The Klamath River DPS has seven local bull trout populations that are isolated from each other, with low numbers of fish per population. The bull trout occupy streams at elevations between 5000 to 6500 feet. Many of these streams have headwaters within a designated Wilderness Area. Other land uses within

these watersheds vary from Crater Lake National Park to timber harvest and grazing. Oregon Department of Environmental Quality has determined water temperature standards for the life stages of bull trout. The Fremont-Winema National Forests has collected summertime stream temperatures at locations known to be occupied with bull trout, as well as, from streams that are potential migration corridors.

Preventing Beaver Mortality in Rotary Screw Traps

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Beaver (*Castor canadensis)* are an important component of healthy aquatic ecosystems in western North America with suppressed numbers compared to historic levels. The John Day Fish Research project (JDFR) uses rotary screw traps to collect juvenile salmonids in the John Day River basin. Beaver are occasionally captured in these traps. Designed for holding fish, the livebox of a screw trap offers no refuge or resting place for a trapped mammal. None of the three beavers captured during the first two years of our project survived to be released and appeared to have been drowned within the livebox. We subsequently designed and installed a removable angle-iron framed ladder with wooden steps, forty-two inches long and twelve inches wide and placed it on the starboard side of the livebox of all traps. Since the installation of these beaver ladders, all beaver captured in traps have been released unharmed. Recognizing the positive impacts on fish habitat due to beaver activity, we recommend the use of our beaver ladder for all projects operating rotary screw traps where they are present.

An Analysis of Larval Survival Rates and Maternal Parameters for the Deepwater Rockfish Species Pacific Ocean Perch, *Sebastes alutus*, in the Gulf of Alaska

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Older and larger female Pacific Ocean perch may produce more fit and viable larvae due to greater lipid contribution to larvae. Larvae from older and larger females grow more than three times faster, survive starvation more than twice as long, and are able to withstand varying environmental conditions present at birth better than larvae from younger and smaller females. For this study, Pacific Ocean perch larvae were collected in the Gulf of Alaska and reared at the Alaska Department Fish &Game/Alaska Fisheries Science Center Kodiak Laboratory Seawater Facilities. Larval survival rates were measured for 30 days and evaluated against the maternal parameters of age and length at time of parturition. If maternal age and length impact larval survival rates, such findings may prove vital to Pacific Ocean perch maternal effects research. The North Pacific Fisheries Management Council and the National Oceanic and Atmospheric Administration's Fisheries Agency can utilize this information to create management actions to protect a proportion of older age Pacific Ocean perch in the Gulf of Alaska from commercial fishing.

Changes in Floodplain Water Levels Adjacent to a Channel Restoration Site Along the Sprague River in Southern Oregon Measured by Pieziometers and Wells

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Pieziometers and wells were installed in the river and floodplain 1 year prior to the implementation of a channel reconstruction project along a two mile reach of the Sprague River located in Klamath County in southern Oregon. The channel reconstruction project involved the installation of 3 plugs and the reactivation of 800 feet of historic channel that resulted in a single channel in place of multiple channels. The river level increased 1.25 feet in the project reach. The pieziometers and wells recorded water level changes in the floodplain and river that provides useful information on water movement and water elevation at specific distances in the floodplain relative to water levels in the river.

Quagga and Zebra Mussel (*Dreissena spp.*) Invasion Risk in Oregon

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Quagga mussel (*Dreissena bugensis*) was discovered in Lake Mead, Lake Havasu and the Lake Mead fish hatchery in January 2007. These are the first records for this invasive and potentially destructive species west of the 100th meridian, which was previously restricted to the Great Lakes and the St. Lawrence River. An immediate potential pathway into Oregon waters resulted from fish stocking into Wild Horse Reservoir in Nevada, on the Owyhee River, in 2006. Less is known about quagga mussel than about the similar zebra mussel (*D. polymorpha*). Both species require at least 15 to 20 mg/L calcium to complete their life cycles, levels higher than a large majority of Oregon streams and lakes. It appears that rivers are successfully invaded only if an upstream lake or reservoir is invaded, due to larval stage being planktonic for up to a month. There is also evidence that these mussels do not generally invade wadeable streams. Based on these lines of evidence we present an invasion-risk assessment for Oregon.

The Utility of Long-term Spring Chinook Redd Survey Data for Guiding Management and Recovery Efforts in the John Day River Basin

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The John Day River basin remains unique as one of the few intact, wild runs of spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Columbia River Basin. These populations are used as an index stock to assess the effects of management actions taken within and outside the John Day Basin. Objectives of our long-term monitoring include estimates of abundance and distribution of spring Chinook salmon and their redds. Over the past seven years we counted from 902 to 1,962 redds in any given year and added to the 47-year data set of index redd counts. Changes in the distribution of redds through time has also provided a measure of the efficacy of restoration activities. Managers throughout the basin depend on this data to evaluate on-going habitat restoration and barrier removal projects and long-term monitoring should become an increasingly important tool for monitoring passive restoration activities. Our data has brought attention to declines of Chinook in the Granite Creek watershed and population increases related to recovery efforts in the Upper Mainstem watershed. Long-term monitoring is vital for determining how marine and freshwater survival influence population abundance and provides context for individual passage and riparian habitat projects. However, newer technologies must be used in conjunction with redd counts to conduct successful effectiveness monitoring. Long-term trends suggest that the John Day spring Chinook can attain recovery goals as outlined in the subbasin plan only if current restoration projects are allowed to mature and additional projects are implemented.