ABSTRACTS OF PAPERS

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

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Assessing, Preventing and Treating Channel Incision in Oregon and Washington (Session 16)

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Development of watersheds leads to substantial changes in the hydrologic cycle, such as increased runoff discharge rates and durations, which in turn impact the receiving waters. Higher discharge rates and common practices of clearing streams of woody debris can trigger channel incision. Incision not only degrades fish habitat and disconnects adjacent floodplains, but commonly lowers adjacent groundwater elevations. Incision elevates the duration and magnitude in which basal shear stresses exceed critical values, creating a positive feedback that further accelerates incision. To prevent and reverse channel incision requires in-stream grade control structures. We present alternatives to traditional grade control structures that are more sensitive to restoring hydrological and ecological stream functions. Several case studies are presented in this paper describing alternative approaches to controlling channel incision in Oregon and Washington. Each project incorporated engineered logjams (ELJs) and natural channel design to limit or reverse incision, increase channel complexity and floodplain connectivity, and ensure fish passage. ELJs were patterned after natural assemblages of woody debris that dissipate stream energy while maintaining low-flow pathways for fish. High flows cascade over and through the ELJ structures like a riffle. The structures also act to trap bedload sediment and woody debris, and create a complex mosaic of valuable habitat for fish and other aquatic species. Case studies include examples from both rural and urban settings.

Distribution and Behavior of Lost River and Shortnose Suckers in Response to Water Quality in Upper Klamath Lake, Oregon (Session 11)

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In 2002, we initiated a multi-year radio telemetry study investigating endangered adult Lost River sucker (LRS) and shortnose sucker (SNS) behavior with respect to water quality in the northern third of Upper Klamath Lake, Oregon (UKL). In conjunction with this effort, a network of continuous water quality monitors was deployed in this area to determine the spatial and temporal variability of water quality. Our objectives were to determine: 1) the distribution and general movement patterns of adult suckers from June through September, 2) specific sucker locations and their association with water depth and dissolved oxygen (DO), pH and temperature, and 3) adult sucker behavior with respect to water quality. Results from 2002-2005 indicate distributions of tagged suckers differed by species and week, but distribution for both species were similar among years. Movement and movement rates did not differ between LRS and SNS. Mean water depths at sucker locations were 2.9 m for LRS and 2.8 m for SNS. Mean DO concentrations were 7.93 mg/L at LRS locations and 7.62 mg/L at SNS locations. Mean pH at sucker locations was 8.9 for both species. Results from 2002 failed to show any behavioral responses to water quality conditions. Results from 2003 through 2005 showed that suckers avoided areas with extremely low DO (< 2 mg/L) by moving into Pelican Bay, an area with higher DO concentrations and lower temperatures than other areas of UKL.

Nutrient Restoration: A Previously Overlooked Component of Habitat Restoration (Session 7)

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Cultural eutrophication, the artificially excessive supply of nutrients in natural waters, has occupied the main stage of applied limnology for nearly half a century. However, during the past 30 years, the opposite process, cultural oligotrophication (denutrification) has been recognized as an emerging problem in north temperate and boreal aquatic ecosystems. In the first comprehensive, peer-reviewed account of numerous nutrification studies designed to compensate for cultural oligotrophication of lakes and rivers, Stockner (2003) and authors therein reported developments and successes of applied nutrification science from around the world. Nutrient application programs in coastal drainages and inland systems are increasingly common. These programs or adaptive experiments have been referred to as fertilization, nutrient enhancement, nutrient enrichment, and nutrient restoration programs, depending on their objectives. In some cases such programs are restoring nutrient concentrations to historical pre-development levels. In other cases, they intentionally increase nutrient concentrations and productivity above historical levels to compensate for anadromous salmon mortality in the migration corridor and the ocean. Although physical habitat restoration in aquatic systems has been ongoing for many decades in the Pacific Northwest, primary productivity and nutrient availability issues were often overlooked until relatively recently as a central component of habitat restoration.

Restoring Streams and Wetlands in Salem in the Company of Civil Engineers, City Codes, and a City Council (Session 16)

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Five years ago when a small environmental group called Oregon Watersheds began planning stream and wetland restoration projects in Salem, “no” was the common reaction by the city. Back then, the city viewed streams mainly as stormwater ditches and, secondarily, for fish. After a timely acid spill, some changes in personnel, and changes in city code the atmosphere is different. The city now funds stream restoration projects and is a booster of keeping streams for fish. Oregon Watersheds has shifted their view too. Closer attention is paid to keeping log structures intact during floods and the widening of constricted channels for both fish and stormwater conveyance has now become a common prescription. Getting from “no” to “let’s give it a try” was a tortured path at times. But now the city has well-defined policies about streams and wetlands that lead to timely restoration. Projects completed by Oregon Watersheds in Salem include stream widening, log jam creation in streams, streamside plantings, wetland creation, and wetland restoration. Currently, Oregon Watersheds is conducting a survey of all major stormwater outfalls and examining opportunities for the creation of wetlands for the treatment of stormwater before it enters a stream.

Reproductive Success of Conservation Hatchery Salmon in the Wild: Do Supplementation Programs Really Work? (Session 2)

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The use of hatcheries for supplementing threatened salmon populations has become very popular. Yet whether such programs actually increase the size of wild populations remains unclear, and predictions that supplementation fish will drag down the fitness of wild fish remain untested. Here we show that steelhead (*Oncorhynchus mykiss*) that were reared in a supplementation hatchery and then allowed to spawn naturally in the wild had fitness (production of returning adult offspring) indistinguishable from that of wild fish. In contrast, fish from a traditional hatchery (non-local origin, multiple generations in hatcheries) breeding in the same river showed significantly lower fitness than wild fish. We also found that crosses between wild fish and supplementation fish were as successful as those between wild parents. Thus, there is no evidence that supplementation fish drag down the fitness of wild fish by breeding with them. Interestingly, crosses between hatchery fish of either type (traditional or supplementation) were less fit than expected, suggesting a possible interaction effect. Nevertheless, these are the first data to show that a supplementation program with a careful genetic design can provide a single-generation boost to the size of a natural population without obvious short-term fitness costs. The long-term effects of population supplementation remain untested.

Willamette Salmonids At-Risk? A Risk Assessment for the Introduction and Establishment of *Myxobolus cerebralis*, the Cause of Whirling Disease, into the Willamette River. (Session 8)

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Myxobolus cerebralis, the cause of salmonid whirling disease was first detected in Oregon in 1986 in the far Northeast section of the state and the Snake River Tributaries. Since then, it has been detected in stray adult salmon and steelhead in the Deschutes River and in juvenile rainbow trout from a private rearing facility on a tributary of the Clackamas River. This study examines the risk of introduction and establishment of the parasite into the Willamette River. There are numerous potential introduction routes throughout the Columbia River Basin including: movement of fish by humans, dispersal of parasite via birds and predatory fish, angler activities, and dissemination by stray anadromous fish from enzootic areas. Establishment is dependent upon several variables including: tubificid host populations and distributions, and water temperature. This risk assessment will give managers a better understanding of where to allocate resources to help prevent further spread and effects of the pathogen. It will also provide decision-makers with tools to assess management implications and to eliminate non-issues by using logical scientific arguments.

Nutrients and Restoration of Salmonid Ecosystems: Silver Bullet or Placebo? (Session 7)

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The April 2001 Oregon AFS conference "Restoring Nutrients to Salmonid Ecosystems" generated considerable interest among management agencies and organizations responsible for rebuilding depressed stocks of salmonids and other fish species. Since then, several inorganic nutrient, salmon carcass and carcass analogue experiments have been conducted throughout the Pacific Northwest, Alaska and Scandinavia. The results of these experiments have varied, ranging from minimal responses in some situations to significant positive responses in others. As a result, resource managers and fisheries biologists are uncertain about the role of nutrients, carcasses and analogues in restoring depressed stocks of salmonids and other fish species. Federal and State water quality guidelines, and emerging concerns about legacy pollutants in salmon carcasses present additional challenges to conducting whole-lake and river nutrient experiments. Why is nutrient, carcass and analogue supplementation successful in some locations, yet seemingly irrelevant in others? Do streams and rivers respond differently to nutrient, carcass and analogue treatment than lakes and reservoirs, and why? Do anadromous salmonids respond differently from resident stocks? What emerging areas of research could be pursued to examine these questions? This presentation gives an overview of some recent nutrient, carcass and analogue experiments in the Pacific Northwest and northern Europe, provides some answers to these questions, and offers some suggestions for future research on this important topic.

Observations and Anecdotes from Four Years of Monitoring Fish Use of Wetlands in the Portland Area (Session 16)

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Despite extensive habitat alterations (and other anthropogenic assaults) in the Lower Willamette River near Portland, the river still functions as fish habitat, even for ESA-listed juvenile salmon. Modifications to the hydrology and development in the floodplains in the Lower Willamette River have reduced the availability of floodplain wetland habitat for salmon and other fishes. Some salmon life-history types use wetlands for resting, feeding, over-winter rearing, and refuge from high water during their seaward migration. Because floodplain wetlands that are hydrologically connected to the Lower Willamette River during the winter and spring are limited, projects that restore ecological function to wetlands likely benefit native flora and fauna that are adapted to historic patterns of inundation. Results from four years of monitoring fish use of wetlands and passage through structures used in wetland restoration projects in the Portland area will be discussed.

Parentage Analysis Reveals Successful Reproduction of Hatchery-Origin Chinook Salmon Outplanted into Shitike Creek, OR (Session 10)

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The USFWS and Confederated Tribes of the Warm Springs Reservation are supplementing a depressed population of spring Chinook salmon in the Deschutes River basin of Oregon. In 2002 and 2003, surplus hatchery adults from the nearby Warm Springs National Fish Hatchery (NFH) were outplanted into Shitike Creek with the goal that those adults would spawn naturally. Genetic based parentage analysis between 2002 NFH outplants (potential parents) and 799 2002 brood year naturally produced juveniles (potential offspring) indicated 20% of the sampled juveniles had at least one 2002 NFH outplanted parent. We also observed a sex bias in the reproductive success of the 2002 NFH outplants, with 15 of 20 females and 20 of 63 males producing a sampled juvenile. The reproductive

success of the 267 2003 NFH outplants was very high, with 85% of the 826 sampled 2003 brood year juveniles having at least one 2003 NFH outplanted parent. Our results indicate NFH outplants can successfully reproduce in the wild and contribute to the natural production of a depressed population, but the level of contribution can be highly variable. We hope to continue this study to estimate the reproductive success of natural-origin adults spawning in Shitike Creek that were parented by NFH outplants (e.g., the F_1s). Knowing the reproductive success of the F_1s is critical to our evaluation of this supplementation method to aid in the long-term restoration of depressed natural populations.

Estimates of Passage, Survival, and Tailrace Egress of Radio-Tagged Juvenile Chinook Salmon at The Dalles Dam (Session 5)

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Evaluations of survival at The Dalles Dam spillway suggested that survival was significantly lower for juvenile Chinook salmon (*Oncorhynchus tshawytscha*) passing via spillbays on the south vs. north end of the spillway. Other research suggested that fish passing via the south end of the spillway may be entrained in a lateral flow from south to north across the stilling basin. A concurrent engineering study determined that lateral flow in the stilling basin could be blocked by a longitudinal training wall extending from the downstream spillway pier nose between bays 6 and 7 to the end sill. In 2003 a spillway training wall was installed at The Dalles Dam and a new spill pattern was used to improve tailrace egress and survival of juvenile salmonids. Radio telemetry studies evaluating fish passage efficiency and survival of juvenile Chinook salmon were conducted at The Dalles Dam in 2002, 2004, and 2005. Pre- and post-construction estimates of when and where tagged fish passed the dam, their survival through each route, and their egress times and paths through the tailrace will be compared.

A Management Perspective on Modeling Fish Passage in the Columbia River Basin (Session 5)

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The National Marine Fisheries Service has turned to the use of fish passage models to analyze fish passage data and develop and compare management actions in the Federal Columbia Basin Power System (FCRPS). This has allowed fisheries managers to develop a method to analyze and apply existing empirical data on fish survival to develop a picture of "how the river works". As with any model, we have been forced to make assumptions and extrapolations to make up for incomplete knowledge of the system and simplify the simulations of complex processes to produce a working model. NOAA fisheries has relied on the SIMPAS passage model, a relatively simple, spreadsheet-based model to develop the 2000 and 2004 FCRPS Biological opinions. A more comprehensive and complex model (Compass) is being developed by a collaborative effort of Columbia Basin fish management agencies and Tribes. We will review and compare the basic principles and operations of both of these models.

Evaluating the Feasibility of Reestablishing a Coho Salmon Population in the Yakima River, Washington (Session 15)

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Historical returns of coho salmon to the Yakima River Basin were estimated to range from 45,000 to 100,000 fish annually but declined to zero by the 1980s after decades of overexploitation of fishery, water, and habitat resources. In 1996 the Yakama Nation and cooperators initiated a project to determine the feasibility of reestablishing a naturally spawning coho population in the Yakima River. The Yakima coho project explored whether successful recolonization was feasible when multi-generational, hatchery-reared coho were reintroduced to native habitats. After 10-20 years of outplanting, we compared data for adult returns of known natural- and hatchery-origin coho. We found that natural-origin coho returned at a significantly larger size than hatchery-origin coho. Mean egg mass and mean egg size of natural-origin females were greater than those of hatchery-origin females, though the differences were statistically significant for only one of three sample years. Natural-origin adults returned (2 to 9 days) and spawned (5 days) later than their hatchery-origin counterparts. Indices of smolt-to-adult survival for natural-origin coho were 3.5 to 16.9 times survival indices of hatchery-origin coho. The number of coho returning to historical native spawning habitats in upriver areas generally increased. Spawning surveys demonstrated the existence of robust and sustainable spawning aggregates in various locations in the basin. Hatchery releases from reestablished brood source parents had significantly higher smolt-to-smolt survival than releases from out-of-basin hatchery broodstock. We conclude that hatchery-origin coho, with a legacy of as many as 10 to 30 generations of hatchery-influence, demonstrated their ability to reestablish a naturalized population after as few as 3 to 5 generations of outplanting in the wild.

Hedging Our Bets: Can We Manage for Salmon and Ecosystem Resilience? (Session 12)

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Recent scientific assessments have identified the production approach to resource conservation as an underlying cause of Pacific salmon decline and have called for a radical restructuring of recovery programs based on re-establishing natural processes in salmon ecosystems. Despite this awareness and an unprecedented management infrastructure now devoted to salmon recovery, conservation ideas and expenditures still emphasize control of salmon production, particularly during fresh-water life stages. The unpredictable effects of ocean variability on salmon survival, projections of future climate change, and rapid human population and economic growth only increase the likelihood of continued ecological uncertainty in the region. These prospects emphasize the need for an alternative management strategy to maintain population resilience in a highly variable environment. In January, 60 scientists, resource managers, and others met to examine whether the idea of resilience can be applied to restoration of salmon and their ecosystems, with special emphasis on the role of estuaries in salmon recovery. The

workshop reviewed the meaning of resilience, its relationship to life history diversity and habitat connectivity throughout the salmon life cycle, and the social and management implications of incorporating these ideas into salmon, estuary, and watershed conservation. In short, is it possible to manage for resilience under the existing conservation paradigm? If not, what new framework is required, and how might it be implemented?

Habitat Use, Survival and Growth of Fragmented Populations of Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi)* (Session 6)

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After almost 30 years of conservation effort, Lahontan cutthroat trout (LCT) *(Onchorhynchus clarki henshawi)* populations remain in peril throughout the Great Basin region of southeastern Oregon and Northern Nevada. This is not surprising since very little research has been done on the ecology of LCT, forcing managers to make uninformed decisions. Contiguous whole stream surveys were used to look at fish distribution and in-stream habitat. The use of half duplex pit tags in our study allowed us to determine the growth, movement patterns, and survival rates of most adult (>100mm) LCT within the system. We determined how survival, growth, and habitat use patterns changed along a longitudinal gradient. We found greater trout growth, but lower survival, in relatively warmer and more open reaches than in cooler reaches. Additionally, undercut banks (predation shelter) were more important in cooler stream reaches than in warmer ones, where habitat choice responded first to cold water upwelling (= pools in topographic nick-points). Our results will be useful in identifying and describing areas of high quality LCT habitat in low order streams throughout the Great Basin, and thus allow informed management decisions to facilitate the recovery of the species.

Fish Passage on a Spring Creek in the Upper Klamath Basin (Session 13)

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A channel reconstruction project was implemented to restore fish passage on a spring creek tributary to the Sycan River in the Upper Klamath Basin. Earthen berms and vertical standpipes constructed in the 1960s eliminated fish access to a spring network. The springs are believed to have been historically used by two endemic federally listed endangered fish species, the Lost River sucker (*Deltistes luxatus*) and the shortnose sucker (*Chasmistes brevirostris*), and the state sensitive Klamath redband trout (*Oncorhynchus mykiss newberrii*) for spawning. Additionally, the spring system may have provided cold water refugia for native species during the summer months when water temperatures in the Sycan River exceed 20°C. Project goals included providing fish passage from lower Brown Spring Creek to upstream springs, recovering the riparian vegetation community, lowering water temperatures by removing four large ponds, and excluding livestock from the project area. Construction of a step pool structure and over 3,000 ft of channel were completed in 2005. Observations and preliminary sampling indicate fish have already moved through the step pool system and into the pond above the previous fish passage barrier. Future monitoring will evaluate fish use of the constructed channel and spawning in the spring network; channel stability; and riparian vegetation community composition. The Brown Spring Creek fish passage project may serve as a cost-effective means for reconnecting spring creeks impacted by land management practices, to main stem rivers in the Upper Klamath Basin.

Constraints and Opportunities Associated with Stream Rehabilitation in an Urban Environment—Rickreall Creek, Dallas, Oregon (Session 16)

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The Rickreall Creek rehabilitation project at Delbert Hunter Arboretum in Dallas, Oregon was developed to improve public safety by regrading and stabilizing eroding stream banks, halt and potentially reverse progressive channel incision, and improve aquatic and riparian habitat. The project consisted of: setting back unstable stream banks to increase flood conveyance; and construction of two "complex" engineered logjam grade control structures to reduce flow velocities, trap bedload alluvium, and increase the diversity of physical habitat to allow development of a variety of aquatic and riparian habitats. Due to the urban setting of the project reach, there was considerable interest in the project from the Arboretum and neighboring residents. Project construction in 2003 was a community effort, which incorporated volunteer labor and donated materials. The project is a prominent element in the expanded arboretum, and therefore natural appearance of the stream structures was important. The grade control structures each consisted of two cast-in-place concrete logs into which natural logs and large rock was incorporated. Fish passage was insured by creating a sinuous low-flow channel through each grade control structure. Neighborhood concerns about potential backwater flooding were more than compensated by expanding the hydraulic geometry of the high flow channel. Accumulation of flotsam on the upstream structure in the first winter further reduced conveyance and required adaptive management to limit erosion of the right bank and improve debris conveyance through the structure. The project has improved the aesthetic and ecological attributes of the project reach to be a focal point for the City of Dallas.

Annual and Intraseasonal Variability in Pacific Lamprey (*Lampetra tridentata*) Larval Recruitment in the South Fork Coquille River (Session 3)

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Effective Pacific lamprey management requires more thorough evaluation of factors influencing reproductive success. During 2004 and 2005 spawning seasons we monitored Pacific lamprey spawning, emergent ammocoete drift, egg-predator activity, and relevant abiotic variables. Differences in spawning timing, larval production, and egg-predation were detected between and within years. In 2004, spawning activity lasted over 58 days, from April 6-June 3, with 65% of larval production attributable to 24% of adults spawning in the first one-third of the season. Spawning in 2005 occurred from April 25-July 3, taking place over a more prolonged period (69 days). As in 2004, most larvae (60%) were produced during the first one-third of the spawning season, but this corresponded to 53% rather than 24% of spawning observations. Coincident with lower lamprey spawning success, all observations of feeding speckled-dace, an important egg predator, occurred in the final two-thirds of both seasons, with greater incidence of high-density dace predation in 2004. Environmental conditions also differed significantly within and between years, potentially explaining variability in larval recruitment and egg-predation. From April-July 2004, mean water temperature was 16.4ºC, with the hydrograph gradually declining and interrupted by a single, high-flow event. During the same period in 2005, mean water temperature was 14.0ºC, with five substantial high-discharge events. Because water temperature can influence spawning and development and alter ecological interactions experienced by eggs and larvae, it is likely a key variable controlling Pacific lamprey early mortality and subsequent larval recruitment.

Large Scale Changes in Fish Population Dynamics with no Manipulative Management, Crater Lake, Oregon (Session 1)

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Managing fisheries for angler harvest in lakes and reservoirs is exacerbated by many variables, including water level manipulation, competition with other native or introduced fish, timing of stocking, number and size of fish stocked, angler harvest, as well as natural variability in the environment. Managers are challenged to sort out the relative influences of these factors on observed changes in fish populations. Large-scale changes in population dynamics may occur independent, or in the absence, of manipulative management, as is the case at Crater Lake, Oregon. Between 1986 and 2004, kokanee population demographics were highly variable, with a pattern that reoccurred in about 10 years. We believe that the reoccurring pattern resulted from density dependent growth, and associated changes in reproduction and abundance, driven by prey resource limitation that resulted from low lake productivity exacerbated by prey consumption when kokanee were abundant. Kokanee fed primarily on small-bodied prey from the mid-water column; whereas rainbow trout fed on large-bodied prey from the benthos and lake surface. Cladoceran zooplankton abundance may be regulated by kokanee. And kokanee growth and reproductive success may be influenced by the availability of *Daphnia pulicaria*, which was absent periodically during the study. Rainbow trout were less abundant than kokanee and exhibited less variation in population demographics, distribution, and food habits. There is some evidence that the population dynamics of rainbow trout were in part related to the availability of kokanee as prey.

Seasonal Water Quality Patterns Downstream of a Hypereutrophic Lake: Summary of 2002-2005 Monitoring Results in the Lake Ewauna Reach of the Klamath River (Session 11)

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As part of its obligations under the U.S. Fish and Wildlife Service 2002 Biological Opinion on Klamath Project Operations, the Bureau of Reclamation is required to monitor existing water quality conditions in the Upper Klamath Basin. To satisfy part of this monitoring requirement, Reclamation monitors temperature, pH, specific conductance and dissolved oxygen (DO) downstream of hypereutrophic Upper Klamath Lake, between Link Dam (RM 254.4) and Keno Dam (RM 233.4) using multi-probe instrumentation. Parameters are recorded hourly from May through October at several locations and year-round at select locations. In the 21 mile lentic reach upstream of Keno dam, extremely poor water quality is observed each year during summer months (July – September) where water temperatures exceed 25°C and DO concentrations drop to near 0 mg/L. The low DO concentrations are likely caused by an extremely high organic load from Upper Klamath Lake, in the form of the blue-green algae *Aphanizomenon flos-aquae*. The heavy organic load imposes a very high biochemical oxygen demand (BOD) in the Lake Ewauna reach of the Klamath River. The high BOD in combination with the sediment oxygen demand can deplete nearly all oxygen in the water column for several river miles, causing annual fish die-off events.

Genetic Integration vs. Segregation of Hatchery Broodstocks Relative to Natural Populations: Can Gene Flow Overcome Domestication Selection? (Session 2)

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Concerns regarding domestication selection in salmon hatcheries, and the negative genetic impacts of hatchery-origin fish on natural populations, have been raised for over 30 years. To address these concerns, a hatchery broodstock can be managed in one of two fundamentally different ways: (1) as a genetically *segregated* broodstock - or closed population - where natural-origin fish are purposefully excluded from the broodstock, or (2) as a genetically *integrated* broodstock where natural-origin fish are systematically included in the broodstock each year. The *segregated* strategy creates a "hatchery-adapted" population that can facilitate ease of culture and harvest objectives (2 populations, 2 environments). However, simple quantitative genetic models (e.g. Ford 2002) demonstrate that gene flow rates as low as 5% per generation from a *segregated* hatchery population to a natural population can significantly affect the genetic constitution and fitness of a natural population, even in face of natural selection. On the other hand, the *integrated* strategy is intended to increase the demographic abundance of an existing natural population, or gene pool, such that the natural environment drives the genetic constitution and mean fitness of both hatchery and natural-origin fish (1 population, 2 environments). To achieve this latter goal, the proportional genetic contribution of natural-origin fish to a hatchery broodstock must substantially exceed the proportional genetic contribution of hatchery-origin fish to a natural population. For example, if hatchery-origin adults – on average – make a 10% genetic contribution to a natural population each year, then a mean of 50% of the hatchery broodstock must be derived genetically from natural-origin adults in order for the mean genetic breeding values of hatchery and natural-origin fish to be within 20% of the fitness optimum for the natural environment relative to the fitness optimum for the hatchery environment. Conversely, a 10% gene flow rate from a *segregated* hatchery population to a natural population will result, after several generations, in a natural population that is essentially equal genetically to the hatchery population with a mean breeding value equal to the fitness optimum in the hatchery environment. These genetic models illustrate the need to develop genetic broodstock plans for every hatchery program on a case-by-case basis according to the purpose of the program, the viability and long-term genetic goals for natural populations in immediate and adjacent watersheds, and the ability to control or minimize natural spawning by hatchery-origin adults.

Movements and Distribution of Radio-tagged Adult Pacific Lamprey in the Willamette Basin (Session 4)

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Little is known about the freshwater migration of adult Pacific lamprey (*Lampetra tridentata*) in the Willamette Basin. During 2005 we conducted 14 aerial radiotracking surveys to garner information on the movements, distribution, and habitat use of adult Pacific lamprey in the Willamette Basin. All fish were collected and tagged (N = 136) at Willamette Falls Dam as part of a USGS study that examined passage rates and behavior of Pacific lamprey (see Magie et al. abstract). Aerial tracking was conducted between June and November, with emphasis on the Willamette Basin above Willamette Falls. Fifty-one percent of the 57 fish known to have passed above the falls were subsequently detected on upstream flights. Ninety-three percent of these individuals were located in the mainstem Willamette, ranging between Newberg and Eugene, 21% of which were located near the mouths of the Yamhill and Santiam Rivers. The remaining 7% of detected individuals occurred in the North Santiam and McKenzie Rivers. Nearly half (48%) of detected individuals were detected several times in specific locales, suggesting that these locales may be important holding areas for adult Pacific lamprey migrating towards their

spawning grounds. Migratory activity slowly increased over the course of the study, with 73% of all detections occurring between mid-August and mid-November. Our results necessitate the need for follow-up aerial surveys and ground-based tracking to improve understanding of habitat use and spawning locations of this enigmatic and potentially threatened species.

The Pacific Salmon Treaty: Who Cares What the Alaskans and Canadians Do and Why Should We? (Session 9)

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Oregon has been a signatory state of the Pacific Salmon Treaty since its inception in 1985. Since then, the agreement has changed through negotiation and addendum and in complexity up to its latest iteration in the March 2004 agreement. Management schemes have similarly transformed from ceiling-based fisheries to aggregate abundance-based management and individual stock-based management models. The structure, timing and location of fisheries that catch stocks of Oregon-origin salmon, especially Chinook salmon, have changed since the agreement as well. Our ability to determine escapement and exploitation of these stocks has improved, but ever increasing pressures on a limited resource necessitate advancing our assessments. Without precise and accurate population monitoring information, there is no basis within the Pacific Salmon Treaty structure to prevent the over-harvest of Oregon coastal Chinook off the coasts of Alaska and Canada. The Coastal Chinook Research and Monitoring Project of Oregon's Department of Fish & Wildlife has been engaged in studies of how best to measure Chinook escapement and account for both external and internal fisheries exploitation. The future of Oregon's coastal Chinook will depend, in part, upon management adjustments to more precise estimates of both escapement and exploitation. A re-negotiation of the Pacific Salmon Treaty is planned in 2008 and the ramifications of potential changes to fisheries management are yet to be determined.

Optimizing Operations and Configuration at Dams for Passage: Conflicts Between Juveniles and Adults (Session 5)

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The region is struggling to establish the best way to operate dams to increase juvenile salmonid survival. The ultimate purpose of this effort is to reach BIOP survival goals and recovery of listed salmon species. The seriousness of this effort and the uncertainty of what is optimal are reflected in ongoing litigation and remand issues. Interpretations of data on when and how much to spill, when to bypass and transport fish, which turbines and powerhouses to operate, or how to manage water storage have led to conflicting points of view. There can even be competing criteria for adults and juveniles heading in opposite directions, passing the same dams at the same time of year. Evaluations of adult fallback, and passage times at dams throughout the basin have found a significant positive relationship between flow/spill and fallback/passage times. Increases in both passage times and fallback rates have been linked to reductions in adult hydro-system survival. Data on juvenile passage indicate that at certain times of year at certain projects, spillways are the best way to pass fish and that increasing spill can increase project survival. These types of conflicts are not limited to salmon. Adult lamprey are known to have problems with water velocities, gratings, serpentine weir flows, and dead end areas that are part of the designs and modifications made to improve adult salmonid passage. Adult white sturgeon passage is also constrained by dams for both upstream and downstream movement. How can these conflicting passage needs be optimally addressed?

Factors Associated with the Timing of Coho Salmon Smolt Migration at the Stream Level (Session 10)

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The timing of coho salmon smolt emigration has important implications for early ocean survival and population dynamics. Smolt emigration timing may be sensitive to land use changes or climatic shifts. To assess spatial variation in smolt emigration timing within the West Fork Smith River, Oregon, we have PIT (Passive Integrated Transponder) tagged juvenile coho salmon (*Oncorhynchus kisutch*) throughout the stream network annually since 2002. Recaptures of PIT tagged coho salmon at a downstream smolt trap and detections by PIT tag antennas within the stream network have allowed us to examine physiological and environmental factors associated with the timing of smolt migration. We also related smolt timing and condition back to the location where parr were tagged the previous fall. The timing of coho salmon smolt emigration was variable over the sample years and location in the stream network. In general, timing of smolt emigration corresponded to a decreasing hydrograph and increasing temperatures. For all years, length and weight of smolts increased over the duration of migration for all streams. Migration timing of tagged smolts exhibited spatial correlation as fish that were tagged near to the smolt trap were detected earlier. These findings provide new perspectives on within-basin variation in smolt emigration patterns with implications for smolt monitoring designs and population estimates.

Fish and Amphibian Use of Intermittent Streams Within the Upper Willamette Basin (Session 8)

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In the fall through spring of 2002/03 and 2003/04, composition of fish and amphibian communities was examined in intermittent streams of the upper Willamette River basin. We collected 14 species of fish and 5 species of amphibians over two field seasons. Approximately 99% of fish and amphibian species caught were native to the Willamette river basin. The number of fish species decreased as sampling distance from perennial water increased. Species composition and abundance were correlated with regional characteristics of the upper Willamette basin namely: a) the amount of watershed covered in forest and b) upstream slope. Mean maximum water velocity separated communities dominated by fish from those dominated by amphibians. In 2003/04, fish diets were compared between 12 sites on 4 intermittent streams. Two of these streams had incised channels, in contrast to two gently sloping channels, where flood waters had access to the floodplain Two hundred and thirty individual diets of cutthroat trout, northern pikeminnow, redside shiner, sculpin, speckled dace, and threespine stickleback were collected in both winter and spring; the majority of diets were redside shiners. About 60% of the stomach samples contained invertebrates, with approximately 90% aquatic species. Redside shiners, sculpins and speckled dace consumed primarily benthic invertebrates, but each species ate significantly different numbers of invertebrates. These three fish species fed most often on benthic invertebrates, though sculpins and redside shiners ate significantly different numbers of benthic compared to surface/midwater invertebrates.

Spring Chinook Salmon, *Oncorhynchus tshawytscha*, Survival to Spawning Associated with Water Temperatures in the Umatilla River, USA (Session 15)

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Spring Chinook were extirpated from the Umatilla Subbasin more than eighty years ago. Reintroduction efforts have focused on passage, flow, habitat improvements and hatchery of Carson stock spring Chinook. As a result a small but persistent natural population has been established. We assessed the relationship between summer stream temperatures and pre-spawning mortality of spring Chinook using temperature loggers and visual 3-pass spawner/carcass surveys respectively. Pre-spawning mortality increased from about 5% in reaches with maximum summer water temperatures at or below 16ºC, to 45-55% in reaches with maximum water temperatures above 23ºC. Based on fourteen years of data, a significant relationship was observed and can be described by the equation: Pre-spawn mortality = $1.4465\times10^{-5} \times T^{4.7033}$ (R^2 =0.90). Water temperature can be an important factor in spring Chinook pre-spawning mortality, but other factors can also play a role. Disease load, injury rate, non-consumptive harvest effects, cumulative migration stress, and other water quality factors can all contribute to variability in spring Chinook salmon pre-spawning mortalities. However, the correlation between temperature and mortality presents strong inference of a cause-effect relationship. In the Umatilla spring Chinook salmon survive in reaches where the recorded maximum water temperature exceeds the published incipient lethal levels. However, fish appear to be utilizing spring seeps and other thermal refugia to reduce the stress of the ambient river temperatures during the warmest periods of the day.

Defining What Constitutes a Wild Salmon (Session 10)

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In spite of considerable efforts to restore anadromous salmon in the Pacific Northwest, many runs remain at risk. Along with numerous other factors causing the decline, stocking from hatcheries for over a century is often postulated to be a major cause. The listing of over two dozen distinct population segments of salmon under the U.S. Endangered Species Act and two runs under the Canadian Species at Risk Act has catalyzed a reassessment of the efficacy of supplemental stocking in restoring (or even maintaining) naturally spawning salmon. Recent policies have generally tended to place greater emphasis on restoring runs of wild salmon rather than maintaining runs through stocking from hatchery production. Except at the most superficial level, there is little consensus about how to define "wild." There is a continuum of definitions for wild and each definition subtly supports an implicit policy goal. Given that restoring wild salmon runs is the *de facto* public policy goal, the definition of "wild salmon" is important. Ultimately, the choice of definition is itself a policy decision that incorporates science as one of several influencing factors. A suite of options for defining what constitutes a wild salmon are available to policy makers, although the definitions are often poorly articulated.

Do Hatchery Strays Depress Natural Production of Oregon Coast Coho? (Session 10)

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I review data sets from Oregon Coast Coho and find clear evidence that stray hatchery spawners do not depress natural production of Coho, but their inclusion in calculations of stock-recruitment curves leads to gross exaggeration of extinction risk. The hatchery program for coho on the North Umpqua River provided special opportunity to examine the effects of hatchery strays on estimation of stock-recruitment parameters. Hatchery fish were virtually non-existent for the first 24 years of data, 1958-1981, and composed an average 76% of natural spawners after 1982. The Ricker productivity parameter for the pre-hatchery era was comparable to the productivities estimated for the Lower, Middle, and South Umpqua basins, for which ODFW has predicted the probability of extinction to be zero even if survival drops by 50%. The estimated number of natural spawners that would achieve maximum recruitment in the pre-hatchery era was 672, and actual returns of naturally-produced coho have fluctuated near or above the 672 fish level since 1985, while the hatchery program has added 1,000 to 14,000 hatchery fish spawning naturally each year. Since 1985, when substantial returns of hatchery coho began, the trend in natural production of coho from the North Umpqua has consistently out-performed the regional trend in natural production. This finding contrasts sharply with that from a standard stock-recruitment analysis that counted hatchery and wild coho as equivalent natural spawners; that analysis rated North Umpqua coho as one of the populations most at risk of extinction.

Use of Stream Habitat Surveys to Predict Rearing Capacity for Juvenile Steelhead (*Oncorhynchus mykiss*) (Session 12)

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The Unit Characteristic Method (UCM) is a model for estimating the capacity of a stream to rear juvenile steelhead (*Oncorhynchus 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. In this presentation, we present the model, and we test the model by comparing capacity estimates to observed juvenile production in seven watersheds. Model estimates provided reasonable predictions of observed juvenile production in well seeded watersheds. Model predictions of capacity were highly significantly correlated to observed capacities ($p<0.005$, $r = 0.94$). Model predictions underestimated capacity within smaller basins, and overestimated 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 on factors limiting production. The method can also be used to evaluate potential gains in production that may be realized through habitat restoration, or losses from degradation, as well as to examine the effects of changes in low flow levels on juvenile steelhead production.

Evaluation of Adult Pacific Lamprey *Lampetra tridentata* Passage Success at McNary and Ice Harbor Dam (Session 4)

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Through 1997-2002, adult Pacific lamprey *Lampetra tridentata* inland migrations were monitored in the lower Columbia River through radio telemetry indicating that Pacific lamprey do not readily pass Columbia River dams. During summer of 2005, a combination of radio telemetry and Half-Duplex Passive Integrated Transponder (HD PIT) tag antenna arrays were used to characterize adult Pacific lamprey passage and identify potential problem areas for the lamprey at McNary and Ice Harbor dams. We tagged 102 lamprey at McNary Dam between 8 July and 17 September; 60 lamprey were tagged with radio-tags and HD PIT tags, and 42 were tagged with HD PIT tags only. It was determined that 52.5% (21 out of 40) and 45.0% (9 out of 20) of the radio-tagged fish released approximately 1 km below McNary and Ice Harbor dams, respectively, re-ascended to the dam and were recorded on a radio telemetry antenna outside of a fishway entrance. At McNary Dam, 61.9% (13 out of 21) of the fish that approached an entrance eventually passed the dam. This measurement was 33.3% (3 out of 9) at Ice Harbor Dam. By following individual movements through the fish ladder, we were able to ascertain potential problem areas for adult Pacific lamprey at McNary and Ice Harbor dams. At McNary Dam, lamprey appear to have the greatest difficulty at fishway entrances and exits, and areas associated with diffuser grating. Pacific lamprey also have difficulty with the fishway entrances at Ice Harbor Dam and with a section of the south ladder that includes the transition pool.

Assessing Shipping Vectors of Aquatic Non-indigenous Species to the Lower Columbia River (Session 14)

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Introduced species are affecting biological systems around the world causing a wide range of economic and ecological damage. Within aquatic systems, commercial shipping is the primary vector of nonindigenous species (NIS) at a global scale via two sub-vectors; ballast water and hull fouling. Effective strategies to reduce the spread of NIS via ballast water have been developed through research and legislation but similar efforts for the hull-fouling vector are not as prominent. The ABRPI is investigating shipping vectors in the Lower Columbia River (LCR) in a number of projects. Firstly, a ballast water reporting pilot-project is examining rates of compliance between federal and state programs in an effort to improve data quality and quantity as well as monitoring ballast water management in Oregon ports. These data are key components of the information that leads to legislation and successful reduction of ballast-mediated NIS. Secondly, ballast water sampling has been carried out to examine the survivorship, and possibility of introduction, of coastal zooplankton on voyages from other freshwater ports (e.g. Stockton). Data so far suggest that the successful reduction of organism density, and particularly freshwater species, is similar to other analyses of the efficacy of ballast water exchange. Thirdly, the threat of NIS introductions via the hull-fouling vector has been examined through analysis of hulls on dry dock and the colonizable surface areas of vessels arriving to LCR ports. Over 40 million m^2 of wetted surface area arrived to the LCR over a 3-year period (July 2002-June 2005), particularly from bulk carriers and fouling levels on hulls examined on dry-dock ranged between <1% to >90%. Overall, the data show that the threat of ship-mediated introductions to the Columbia River is lower compared to other west coast ports, not because of reduced propagule supply, but because of the system's increased environmental resistance to marine propagules.

Genetic Analyses of Bull and Brook Trout Hybridization in the Malheur River Basin, Oregon (Session 6)

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Non-native brook trout have been introduced and have established naturalized populations throughout the native range of bull trout. Hybridization between bull trout and brook trout has been documented in several instances where the two species coexist and is seen as a significant threat to the persistence of native bull trout populations. Previous genetic studies on hybridization between these two species have documented primarily first generation (F1) hybrids. In this study we identified a group of microsatellite loci that show fixed differences between bull trout and brook trout. We then used these loci to document the presence of hybrids and examine the dynamics of natural hybridization in three creeks in the Malheur River Basin, Oregon. We randomly sampled approximately100 fish from each of three creeks and used genetic methods to identify each fish as a bull trout, brook trout or hybrid. Of the fish we examined, 124 were genetically identified as bull trout, 174 were genetically identified as brook trout and 15 were genetically identified as hybrids. Of the 15 fish that we identified as hybrids, we documented F1, F2 and backcrossed hybrids indicating that hybridization proceeds beyond the F1 generation. Mitochondrial DNA analysis indicated that both female bull and brook trout are involved in hybridization events in the Malheur River Basin. Documentation of post F1 hybrids raises conservation concerns about brook trout genes becoming incorporated into native bull trout populations via backcrossing.

Hatchery Review Procedures Applied by U.S. Fish and Wildlife Service (Session 2)

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In recent years, considerable controversy has centered on whether best science is being applied in the development and operation of fish propagation programs. Attention has also focused on how well propagation programs have been integrated into watershed based fish management strategies. U.S. Fish and Wildlife Service (FWS) was a participant in the Western Washington Hatchery Reform Project, which developed procedures to address these issues. FWS is now applying the scientific principles and review procedures developed during that project to a series of reviews of FWS-operated or owned hatchery facilities within the Columbia Basin. A scientific team formed by FWS is conducting reviews in four phases: a recently completed "pilot review" at the Warm Springs National Fish Hatchery (NFH) followed by three separate regional reviews in the Mid-Columbia, Lower Columbia/Gorge, and Snake River areas, respectively. The reviews will build upon information developed in past evaluations including the Integrated Hatchery Operations Team (IHOT) report, the Artificial Production Review and Evaluation (APRE), Hatchery Genetic Management Plans (HGMPs) and All-H Analyzer (AHA) workshops to develop short-term (10-15 years) and long-term (50 years or more) recommended goals and implementation actions for FWS programs.

A Brief History of New Zealand Mudsnails in Oregon; Impacts, Monitoring and the Future of Prevention Efforts (Session 14)

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The invasive New Zealand mudsnail, *Potamopyrgus antipodarum*, has become well established in the rivers, streams, lakes, and estuaries of 10 western states and it continues to rapidly expand its range. These small (<5mm), live-bearing, parthenogenic snails were first reported in the Snake River in the mid-1980s and found in the Columbia River estuary in the early 1990s. In the past 5 years mudsnails have been discovered up and down the Oregon Coast in lakes, large rivers, and estuaries. In fall 2005, mudsnails were reported from the lower Deschutes River. While this snail continues to spread rapidly throughout the west, there remains much we don't know about its impacts, how it is being transported in Oregon, its current distribution, and how we can effectively limit its spread. The current state of knowledge about the impacts of mudsnails is tenuous at best. Competitive interactions, changes in nutrient cycling and lower quality of available food have all been measured in laboratory studies but information on system-wide impacts is negligible. Current monitoring efforts are limited and the detection of new populations of mudsnails is dependent on existing sampling efforts and the cooperation of anglers and biologists in the field. Future efforts to prevent the further spread of New Zealand mudsnails rely heavily on the participation of anglers, boaters, and biologists.

Swimming Performance and Buoyancy Compensation of Juvenile Sockeye Salmon Implanted with Radio Transmitters (Session 10)

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Most telemetry studies rely on the assumption that the transmitter used has a negligible effect on the performance of the study animal. We measured the buoyancy compensation and critical swimming speeds (U_{crit}) of juvenile sockeye salmon (*Oncorhyncus nerka*) in both field and laboratory studies to test for effects of gastrically implanted radio transmitters. Transmitters were Lotek NTC-2-1 nanotags (14.5 mm x 6.3 mm x 4.5 mm, with antennas trimmed to just 7.5 cm to eliminate interference, making the weight of the transmitter approximately 0.65 g in air. The transmitter weight to body weight ratio of test fish ranged from 1.5 to 6.5%. Swimming performance of tagged fish and untagged controls was measured 1 and 5 d after transmitter implantation using a ramped protocol in Blazka-style respirometers. There were no significant U_{crit} differences between implanted and control fish after 1 d (4.4 BL/s) or 5 d (4.3 BL/s), despite appropriate statistical power. Buoyancy compensation was determined in a pressure chamber by measuring the pressure reduction at which fish are neutrally buoyant before and after tagging. Those measurements were used to calculate the % initial buoyancy regained by the fish. Tagged fish retained an average of 83% of their initial buoyancy immediately after implantation, and untagged controls retained 99% of their initial buoyancy. By 6h, the buoyancy of tagged fish was not significantly different from pooled controls, suggesting that tagged fish could compensate for the additional weight of the transmitter.

Water Quality Responses to Fisheries Management in Odell Lake, Oregon (Session 1)

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Odell Lake is a moderately large, deep lake located near the Willamette Pass in the central Oregon Cascades. Odell Lake was classified as oligotrophic in 1941, but has experienced severe water quality problems in recent years. These problems include major blooms of *Anabaena* (cyanobacteria), with resulting high pH values (> 9.5). Six species of fish have been introduced into Odell Lake, including kokanee, which has developed into a successful sport fishery. The hydroacoustic analysis of the fisheries indicates that there are over 100 metric tons of fish present in the lake, most of it composed of kokanee. The kokanee spend much of the daylight hours below the metaliminion, but ascend into the metalimnion to feed on zooplankton during the night. As a consequence, the kokanee recycle nitrogen and phosphorus in the photic zone, stimulating primary production. Historically, far fewer fish occupied this niche in Odell Lake. The paleolimnological evidence indicates that sediment accumulation rates have increased through the period of record (~1870 to 2004). The sediments deposited since the 1960s have shown substantial increases in carbon, nitrogen, and phosphorus, with the greatest increases associated with phosphorus. Cyanobacteria have been present in the lake during the period of record, but there has been a major increase in their abundance corresponding with the increasing abundance of non-native fish species, especially kokanee. Diatom taxa, another indicator of water quality changes, showed the largest shift in community composition in the 1960s when planktonic diatoms with preferences for high nutrient concentrations increased and low-nutrient taxa declined.

Generation of Continuous Stream Morphometry Data for River Restoration: An Example from the Sprague River, Oregon (Session 9)

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Understanding physical habitat is an important component of restoring the functionality of stream systems. However, these data can be difficult to acquire and most commonly this was accomplished by use of site-specific transects applied to river reaches. We describe the application of hydroacoustic/DGPS technology to collecting stream morphometry in shallow water systems such as the Sprague River. These technologies make it possible to generate continuous surfaces of the stream channel and provide additional information regarding bottom roughness and reflectivity. Furthermore, by integrating the hydroacoustic data with continuous data sets of the terrestrial environment acquired through LiDAR, it is possible to define riparian habitat and paleo-channels that represented historical flowpaths which may have operated prior to alteration of natural hydrologic regimes.

Evaluation of the Passage of Klamath Largescale Sucker, Lost River Sucker, and Shortnose Sucker Spawning Runs Past a Resistance Board Weir on the Williamson River, Oregon (Session 11)

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We evaluated the passage of Klamath largescale suckers (KLS), Lost River suckers (LRS), and shortnose suckers (SNS) past a new resistance board weir installed at rkm 10.5 on the Williamson River. Eighty-five SNS, 69 LRS, and 8 KLS were fitted with radio transmitters and released below the weir prior to the spawning migration. A remote telemetry station located at the weir recorded fish approaching and passing the weir. Sixty-four SNS, 54 LRS, and 4 KLS were detected by the telemetry station at the weir during the spawning migration. Of these, 54 SNS, 51 LRS, and 3 KLS successfully negotiated the weir and continued upstream. An additional 14 SNS, 8 LRS, and 1 KLS were located below the weir following release but were not detected by the telemetry station at the weir. Distinct spawning runs were noted with LRS passing the weir before SNS. Males generally passed the weir before females and remained upstream of the weir for longer periods of time. On average LRS made more approaches on the weir and spent more time at the weir prior to passing than SNS. With most radio-tagged fish successfully crossing the weir it appears that the weir was not an impediment to the upstream migration of spawning fish. Additionally, other data collected at the weir is also proving valuable to improve our ability to model the population dynamics of the endangered suckers in Upper Klamath Lake.

Spawning Distribution of Klamath Largescale Sucker, Lost River Sucker, and Shortnose Sucker in the Williamson and Sprague Rivers, Oregon Prior to the Proposed Removal of Chiloquin Dam (Session 11)

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We conducted a radio telemetry study in 2005 to determine the current spawning distribution of Klamath largescale suckers (KLS), Lost River suckers (LRS), and shortnose suckers (SNS) prior to the proposed removal of Chiloquin Dam. Thirty-four KLS, 94 LRS, and 111 SNS were fitted with radio transmitters and tracked in the Williamson and Sprague rivers during the spawning migration. Tracking efforts included weekly aerial surveys of the Williamson and Sprague rivers, operation of five remote telemetry stations at points between suspected spawning areas, and weekly ground surveys where fish congregated. The KLS released at Chiloquin Dam primarily migrated to Beatty Gap (rkm 117 to 124). The LRS released at Chiloquin Dam were located in the Williamson River (rkm 11 to 18) and the Sprague River near the dam (rkm 0 to 9), the Nine Mile area (rkm 18 to 44), and Beatty Gap. The SNS released at Chiloquin Dam were primarily located in the Williamson River (rkm 11 to 18) and the Sprague River near the dam (rkm 0 to 9). Distinct spawning runs were noted with KLS migrating first, followed by LRS and SNS. Males generally entered spawning areas first and remained longer than females. Upstream and downstream migration rates as high as 34 km/day were recorded. No LRS or SNS tagged below Chiloquin Dam were located above the dam suggesting that it can be a significant impediment for the LRS and SNS migrating in the Sprague River.

The Effect of Dam Operations on Juvenile Salmonids in the Columbia River (Session 5)

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The U.S. Army Corps of Engineers and other action agencies have worked to provide the best operations at its hydroelectric projects in the FCRPS for multiple species of ESA listed juvenile salmonids. Often times however, operations that benefit one species may not be beneficial, or worse, may be harmful to another. In an effort to provide both efficient and safe passage routes for all species, the Corps considers how existing and/or new construction projects or project operations designed to aid fish impact all species of migrating salmonids. For example; spill is commonly used to guide fish away from turbines thereby increasing total dam passage survival. In early March, the Corps provides spill at Bonneville Dam to help guide Chinook salmon fry released from Spring Creek National Fish Hatchery away from operating turbines. Unfortunately, this spill can lead to increases in total dissolved gas levels downstream of the dam. The increased gas levels, typically above 100% saturation, can be harmful to Chum salmon fry emerging from redds below Bonneville Dam.

Bird Predation in the Columbia River Estuary: Terns and Cormorants in a Poor Ocean Year (Session 8)

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The Columbia River estuary supports the largest known breeding colonies of Caspian terns (*Sterna caspia*) and double-crested cormorants (*Phalacrocorax auritus*) in the world. Combined losses of salmonid smolts in the lower estuary to these two avian predators were approximately 10 million in 2004. In 2005, a year of delayed coastal upwelling and poor ocean conditions, we predicted these avian colonies would have poor nesting success and a greater reliance on salmonid smolts relative to marine forage fish. The Caspian tern colony on East Sand Island consisted of 680 fewer breeder pairs in 2005 (n=8,820 breeding pairs) and nesting success averaged 0.37 fledglings per breeding pair, the lowest so far recorded at this colony. The estimate of total smolt consumption by estuary terns in 2005 (3.6 million) was, however, similar to the estimate in 2004 (3.5 million). The double-crested cormorant colony on East Sand Island consisted of 440 fewer breeding pairs in 2005 (n=12,040) and nesting success averaged 1.38 young per breeding pair, a 33% decrease relative to 2004. Despite poor ocean conditions, however, juvenile salmonids represented only ca. 2% of cormorant diets in 2005, compared with 5% in 2004. Although poor ocean conditions resulted in widespread seabird nesting failure along the coast of the Pacific Northwest in 2005, the large tern and cormorant colonies in the Columbia River estuary, although somewhat smaller and less productive than in previous years, did not fail, nor did reliance on juvenile salmonids as a food source increase markedly for either avian predator.

Can We Use Physiological Ecology to Define Habitat Quality for Redband Trout (*Oncorhynchus mykiss*) in the South Fork John Day River? (Session 3)

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Understanding the physiological capacity of juvenile redband steelhead trout (*Oncorhynchus mykiss*) in response to thermal stress is critical for defining suitable summer rearing habitat. During the summers of 2004 and 2005, the physiological condition of juvenile redband steelhead trout was measured in the South Fork John Day River, Oregon by quantifying both whole body lipid levels (body condition) and heat shock proteins (specifically Hsp70). Heat shock proteins are a family of highly conserved cellular proteins that protect cellular function when cells are challenged by a physiological insult such as temperature stress. Hsp70 levels increased with water temperature in liver, white muscle, and fin tissues. The finding that Hsp70 can be quantified in fin tissue is significant because it provides a non-lethal technique for assessing thermal stress in rare or endangered fish. There is evidence that juvenile trout exposed to maximum daily water temperatures greater than 22ºC have elevated Hsp70 levels and begin to experience reduced body condition compared to fish exposed to temperatures less than 22ºC. In summary, a change in water temperature of 1ºC may substantially alter the physiological suitability of summer habitat for juvenile trout in the South Fork John Day River.

Straying Rates and the Genetic Assignment of Radio-Tagged Fall Chinook Salmon: Beyond the Limits of PIT Tags (Session 9)

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Many metrics important to the conservation of ESA-listed salmonids in the Columbia River drainage depend on extensive tagging of juveniles with passive integrated transponder (PIT) tags. Analysis of metrics such as straying and stock-specific smolt-to-adult return rates are constrained by the number of individuals that are PIT tagged. As part of a large radiotelemetry study, PIT-tagged "known-source" fish have been radio tagged at Bonneville Dam and used to assess straying rates (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. For example, only 166 fall Chinook salmon were available for straying rate analyses from 2000 to 2003. Development of a genetic baseline for Columbia River salmon populations can increase sample sizes for such analyses. Using this baseline, we employed individual assignment analysis based on microsatellite loci to assign fish of unknown origin to an evolutionarily significant unit (ESU). For 173 fall Chinook salmon, we isolated those fish assigned an ESU of origin with a 90% or greater accuracy for which we had a final fate, increasing our sample size for straying rate analyses by 41 fish. We compared straying rates of genetically identified fish with those of known source fish that were PIT-tagged as juveniles. While known source fall Chinook salmon had a stray rate of 4.2%, the rate was significantly higher for fish with final fates in tributaries outside of their natal ESU based on genetic analysis.

The Coming of the Pond Fishes **(100 Years Later): A Review and Update of Smallmouth Bass Concerns in the Columbia River Basin (Session 14)**

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Smallmouth bass *Micropterus dolomieu* were introduced to Oregon and Washington in the late 19th century and have become popular sport fish. Concerns about predation on, and competition with, endangered salmonid stocks have been the focus of a number of recent studies in the Pacific Northwest. We reviewed this work and present findings from our research in the Columbia, Snake, and Willamette rivers. In the lower Columbia River basin, the relative abundance of smallmouth bass generally increases from below Bonneville Dam to Lower Granite Reservoir. The abundance of smallmouth bass appears to have increased in John Day Reservoir since the late 1980s, with a corresponding decrease in another top predator, northern pikeminnow *Ptychocheilus oregonensis*. The age structure of smallmouth bass appears to have shifted towards larger, older fish in some areas. Smallmouth bass consume salmonids in all locations where they co-occur, but the level of predation varies widely. Only 34 of 651 (5.2%) stomach samples we collected from the lower Columbia and Snake rivers contained salmonid remains, though predation appeared to be relatively high in Lower Granite Reservoir. In the Willamette River, diets of juvenile smallmouth bass were similar to those of juvenile Chinook salmon, suggesting the potential for resource competition. Habitat conditions and angler interest will likely continue to favor smallmouth bass, but localized predation on juvenile salmonids remains a concern, especially in areas of very high smallmouth bass density.

Hatchery Release Strategies, Does it Matter? (Session 10)

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One criticism of hatchery programs is that they release juvenile fish before they are developmentally prepared for downstream migration. Volitional release strategies may allow the release of more competent migrants, thus enhancing survival while simultaneously decreasing juvenile residualism. Unfortunately little research has been done to evaluate the efficacy of volitional release. Therefore, we compared physiological and behavioral indicators of smolt development in juvenile steelhead that were either volitionally (VR) or force released (FR) from Winthrop NFH in both 2004 and 2005 release years. In both years body size and condition factor did not differ between VR and FR groups. Gill Na^+, K^+ - ATPase levels were significantly lower in the VR group than the FR group in 2004 but not in 2005. Analysis of travel times suggest that the FR fish migrated slightly faster than VR fish in 2004; however, VR fish were faster than FR fish in 2005. These results indicate no clear benefits of volitional release in terms of smolt development and migratory characteristics.

Northwest Forest Plan—The First 10 Years: Preliminary Assessment of the Condition of Watersheds (Session 9)

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We aggregated road, vegetation, and in-channel data to assess the condition of sixth-field watersheds and describe the distribution of the condition of watersheds in the Northwest Forest Plan (Plan) area. The assessment is based on 250 watersheds selected at random within the Plan area. The distributions of conditions are presented for watersheds and for a few of the attributes that contribute to the condition of watersheds by land use allocation. Under the Plan, management activities were implemented in a way to promote positive changes in the condition of watersheds. The growth rate of trees (2 to 4 percent) exceeded losses (1.6 percent owing to stand-replacing fire and harvest), and nine times more roads were decommissioned than were constructed. Fifty-seven percent of the watersheds had higher condition scores in time 2 (1998-2003) than in time 1 (1990-96) across the entire Plan area. Only 3 percent of the watersheds had lower condition scores in time 2, and the scores did not change in the remainder of the watersheds. More key watersheds, which were given the highest priority for restoration activities, increased in condition than non-key watersheds. The greatest positive change in watershed condition occurred in late-successional reserves.

Benthic Invertebrates in Headwaters: Evaluating the Effect of Fish Presence/Absence (Session 12)

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To examine the effects of fish on benthic invertebrates, we collected invertebrate samples in spring and summer 2004 at sites up- and downstream of fish barriers on six headwater tributaries of Hinkle Creek. We hypothesized that predation by fish would result in lower invertebrate biomass in fish-bearing stream sections and/or that invertebrate assemblage composition would be altered so that larger or more vulnerable taxa would be reduced where fish were present. Contrary to these expectations, in spring samples, total invertebrate biomass was greater in the fish-bearing sections of five of the six streams than in their corresponding sections upstream of fish barriers. Additionally, the median sizes of invertebrates in fish and no-fish sections were not significantly different, indicating that larger, invertebrates were not selectively reduced by fish predation. There was also no consistent shift in invertebrate assemblage composition between fish and no-fish sections. Summer samples are still being evaluated but preliminary analyses indicate a similar pattern. Potential explanations for the lack of clear effects of fish predation on benthic invertebrates could be the low densities of fish in fish-bearing headwaters and/or the presence of another vertebrate predator (the coastal giant salamander, *Dicamptodon tenebrosus*, whose distribution is not limited by fish passage barriers.

A Population Genetic Analysis of *Entospehenus tridentatus* (Petromyzontidae) from British Columbia to Central California (Session 4)

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The North American distribution of *Entosphenus tridentatus* (Pacific lamprey) spans from Alaska south to Baja California, Mexico. Documentation of declining populations, combined with a recent petition to list the under the Endangered Species Act (January 2003), have increased interest in the conservation of the *E. tridentatus*. Currently there is no information available on genetic variability within and between populations of *E. tridentatus*. To assess levels of genetic variability, we used restriction fragment length polymorphism to detect nucleotide variation at 19 sites known to be variable in *E. tridentatus* mtDNA. To date 3,000+ individuals of *E. tridentatus* have been collected from 54 drainages between British Columbia and Southern California. Analyses of 1246 samples reveal the presence of 29 haplotypes with three haplotypes occurring at high frequencies throughout all populations.

The Oregon Native Fish Status Report (Session 10)

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The Oregon Department of Fish and Wildlife is currently finalizing the Oregon Native Fish Status Report. The report describes the current conservation status of native fishes in Oregon based on criteria defined in Oregon's Native Fish Conservation Policy. The Native Fish Conservation Policy (NFCP) provides a basis for managing hatcheries, fisheries, habitat, predators, competitors, and pathogens in balance with sustainable natural fish production. NFCP implementation priorities and actions will, in part, be based on assessments of current conservation risks. The Oregon Native Fish Status Report summarizes risk assessments completed for native salmon, steelhead, trout, and selected sensitive species using the NFCP interim criteria. Risk, as used in this report, refers to the threat to the sustainability of a unique group of populations in the near-term (5-10 years). The interim criteria provide temporary guidance to ensure the conservation of native fish prior to completion of more detailed conservation plans for each species or group of populations. Risks evaluated based on interim criteria refer to the immediate possibility that a unique group of populations may become extinct or fall to low levels where future prospects for recovery are damaged in the interim until an effective conservation plan can be developed and implemented. Interim criteria do not describe long term conservation risks of continuing downward trends, increasing threats or extended intervals of unfavorable environmental conditions. Long-term risks will be considered in conservation plans. The interim risk assessment will help guide priorities for conservation planning.

Spawning Distribution and Habitat Use of Adult Pacific and Western Brook Lamprey in Smith River, Oregon (Session 4)

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Two Oregon coast lamprey species were included in a petition to the U.S. Fish and Wildlife Service for listing under the ESA. Pacific and western brook lamprey are found in many coastal basins, however few data are available to sufficiently describe their distribution, abundance, and life history. To document landscape scale distribution and habitat use of spawning adult lamprey of both species we conducted bi-weekly redd surveys at 67 sites in Smith River (Umpqua basin). Sites were randomly selected from their potential range using EPA's EMAP protocol. Habitat characteristics of lamprey habitat were measured at the redd, habitat unit, and reach scales. Unit level habitat surveys were conducted at each site to quantify available habitat. A description of site occupancy patterns and interspecific comparisons of habitat metrics associated with lamprey presence will be presented.

Where are All These Fish Coming From? An Analysis of Stray Hatchery Steelhead in the Warm Springs River and Implications for the Deschutes River (Session 10)

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The Deschutes River basin in north-central Oregon supports a wild population of threatened summer steelhead (*Oncorhynchus mykiss*). Since the mid-1980s, a large number of out-of-basin stray hatchery steelhead have migrated up the Deschutes River. While the large numbers of stray hatchery steelhead have contributed to making the Deschutes River one of Oregon's premier summer steelhead fishing streams, the impact of hatchery strays on the wild steelhead population is a concern for fishery managers. The U.S. Fish and Wildlife Service and the Confederated Tribes of the Warm Springs Reservation of Oregon, through their cooperative management of Warm Springs National Fish Hatchery, have actively excluded known hatchery strays from the spawning grounds on the Warm Springs River, a tributary of the Deschutes River. Since 1987, hatchery strays accounted for over 50% of the total steelhead population migrating up the Warm Springs River during the steelhead spawning period. An analysis of coded-wire tag recoveries indicates that many of the hatchery strays were released as juveniles from locations in the Snake River basin, particularly the Grande Ronde system, however the lack of comprehensive tagging programs in the Columbia basin means that the origin of over 60% of the strays could not be determined.

Restoring Kootenai River (Idaho) Fisheries Through Nutrient Enhancement (Session 7)

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Libby Dam and Lake Kookanusa (western Montana) are responsible for the depletion of nutrients and the decline of primary productivity in the Idaho portion of the Kootenai River. The Kootenai Tribe of Idaho and the Idaho Dept. of Fish and Game began adding inorganic phosphorous (0.3 L/min) July 13, 2005 to the Idaho portion of the Kootenai River to stimulate productivity and reverse downward trends in resident fish populations such as trout, kokanee, mountain whitefish, burbot, and white sturgeon. Phosphate (P_2O_5) additions (0.31 L/min) began on July 13, 2005. A target concentration of 1.5ug P_2O_5/L (following dilution) was used to stimulate primary productivity. Ambient nitrate (NO_3) concentrations stayed above 85 ug/L during the application season, so nitrate additions were not necessary. Within 21 days, algal growth was visually apparent on near-shore substrates that were within 200 meters of the application pipe (areas previously void of growth). Water samples taken throughout the summer

indicated that soluble reactive phosphate (SRP) levels were still extremely low (below 1 ug/L) within 1 km of the nutrient outlet pipe, indicating uptake by the surrounding biota, and that little or no surplus SRP was available for downriver transport. Phosphate additions were stopped on September 28, 2005. The approximate amount of phosphate used through the growing season was 21,000 L. It is anticipated that through the addition of limiting nutrients (N and P) there will be a measurable restoration of ecosystem functions (including resident fish production) in the Idaho portion of the Kootenai River within a 5-year period.

Oregon's Conservation Strategy: Opportunities for Fish and Wildlife (Session 15)

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In 2004-05, the Oregon Department of Fish and Wildlife prepared a Comprehensive Wildlife Conservation Strategy (Conservation Strategy) to provide a non-regulatory, statewide approach to species and habitat conservation in Oregon. All fifty-six states and territories prepared Comprehensive Strategies that accomplish the following objectives: identify species of greatest conservation need and their habitats; describe the limiting factors facing these species and habitats; describe priority research and survey efforts, identify partnerships and collaborative opportunities, propose monitoring plans, and involve meaningful public participation. Oregon's Conservation Strategy synthesizes reliable, science-based, peer-reviewed information on Oregon's natural resources, with a focus on upland and inland systems. The Strategy provides a proactive framework for conservation at many scales that could reduce the risk of further threatened and endangered species listings. Oregon's Conservation Strategy therefore has many of the same guiding principles as the Oregon Plan. We present some ideas for implementation of Oregon's Strategy, emphasizing opportunities for unmet aquatic and inland fish conservation needs.

Effects of Wildfire on Growth of Coastal Cutthroat Trout in Headwater Streams (Session 3)

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Wildfire, a largely terrestrial perturbation, is broadly recognized as an agent of disturbance and ecological change in forested biomes. Links to subsequent changes in aquatic, biotic systems have been less well documented. Studies focused on the effects of post-fire conditions on ecological characteristics of stream fishes are lacking, although hypothetically the two are strongly connected. In fact, the influence of wildfire may be most profound in headwater streams because of the tight linkage between aquatic and terrestrial ecosystems. By observing growth of coastal cutthroat trout (*Oncorhynchus clarki clarki*), we sought to investigate how post-fire conditions influence fish demographics in headwater streams. During the summer of 2002, wildfire burned portions of three headwater catchments in the North Umpqua basin. Burn severities ranged from moderate to severe. An unburned, fourth catchment was selected as a control. For three years following the wildfire, all fish-bearing streams in these four catchments were sampled and scale samples were collected from a subset of each population for age and growth analysis. Despite considerable changes to the physical stream environment following the wildfire, in-stream ecological responses (as measured by growth of coastal cutthroat trout) appeared to be minimal, and results suggest that the effects of wildfire on stream ecosystems may benefit some members of the aquatic community.

Differential Habitat Use by Juvenile Suckers in Upper Klamath Lake, Oregon. (Session 13)

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Endangered juvenile Lost River and shortnose suckers in Upper Klamath Lake (UKL) have been shown to use shoreline habitats with a variety of substrate and vegetation types. In addition, temporal and spatial variability of habitat use may occur. For example, a north-to-south migration of juvenile suckers has been suggested but never confirmed. We tested the differential use of habitats by juvenile suckers during the summer of 2004 and 2005 to determine if substrate and emergent vegetation play a role in sucker distribution. To determine the importance of various habitats we compared the distribution and abundance of juvenile suckers in nets set in six substrate classes, plus emergent vegetation, in UKL. We set paired fyke nets using a stratified random sampling design based on the geographic area of each substrate type in the north and south end of the lake. Due to low catches of suckers in the majority of our nets, we plan to use a model selection approach based on occupancy of "patches", or substrate type. This procedure will allow us to model the proportion of sites occupied by suckers while taking into account detection probabilities <1. Results will improve understanding of juvenile sucker use of shoreline habitats, whether north-to-south migrations of suckers occur in UKL, and what effects covariates such as water quality or non sucker species co-occurrence may have on juvenile sucker ecology.

Abundance, Growth, and Residence Time of Subyearling Chinook Salmon in Restored and Natural Salt Marsh Channels of the Salmon River Estuary, Oregon (Session 12)

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Natural resource managers have restored tidal inundation to several formerly diked estuarine wetlands in the Pacific Northwest with the aim of improving salmon habitat. Yet, the functional equivalence of restored and natural habitats is seldom assessed. We evaluated one such restoration project by measuring abundance, residence times, and growth of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in a reference salt marsh channel and a formerly diked marsh channel in the Salmon River estuary, Oregon. Sub-yearling Chinook occupied both marsh channels throughout the sampling period from May through October 2004, with peak densities in early June. Chinook densities were lower and Chinook occupied a smaller proportion of available habitat in the restored channel than in the natural channel. Tagged salmon were observed up to 121 and 79 days after initial marking in the restored and reference channels, respectively, and the median time-at-large of recaptured individuals was 10 days in both channels. Average growth rates of individual fish were similar between marshes and increased from 0.84% body weight per day in May to 2.2% per day in July. By allowing tagged salmon to serve as integrative indicators of the quality of restored and natural habitats, this study provides empirical support for restoration assessments based on bioenergetic modeling. Our results demonstrate that degraded estuarine marshes can be restored to provide functional salmon habitat. However, differences in Chinook density between marshes suggest that salmon rearing capacity of the restored site remained less than that of the reference site eight years after dike removal.

The Use of Stationary PIT Detection to Monitor Juvenile Salmon Movement in a Brackish Intertidal Marsh Channel (Session 9)

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Understanding of estuarine habitat use by age-0 salmon is based almost entirely on conventional capture methods, which are not readily adapted to studies of fine-scale movements by individual fish. Although remote interrogation of Passive Integrated Transponder (PIT) tags offers advantages for studying behavior of small (<100mm) fish in freshwater, attenuation of radio frequencies in high-salinity water has largely limited application of the technique in estuarine environments. Recent improvements to tag and transceiver technology have increased the read range of PIT tags, and led us to test the feasibility of remote PIT interrogation in brackish water. We operated a stationary PIT interrogation system within an intertidal salt marsh channel of the Salmon River estuary, Oregon, coincident with the release of over 1500 PIT-tagged Chinook salmon for a mark-recapture study in the estuary. Exciter current of our transceiver decreased on flooding tides as water level and salinity increased, however we found that aluminum-shielded, pass-through antennas (interior dimensions 50cm by 157cm) maintained sufficient current to detect 12mm super tags efficiently in water salinity up to 25-30ppt. Our findings indicate that stationary full-duplex PIT interrogation can be used effectively to monitor tidal marsh channels at salinities typical of Pacific Northwest estuaries. This novel application of PIT technology allowed us to describe for the first time the volitional movements of individual Chinook salmon into and out of tidally flooded salt marsh habitat.

Historical Development and Hydrology of the Upper Klamath River Basin (Session 11)

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The Upper Klamath River basin has undergone significant changes over the past 125 years since European settlers first began establishing homesteads in the area. These changes have occurred in areas located both inside the Klamath Reclamation Project and outside of the project. The Upper Klamath Basin contains approximately 500,000 acres of irrigated land, of which 188,000 acres (about 38%) is located within the Klamath Reclamation Project. Prior to 1885, Upper Klamath Lake consisted of about 65,000 acres of open water and 51,000 acres of natural wetland and emergent marsh areas at elevation 4143, considered full pool today. Between 1885 and 1916 approximately 29,000 acres of wetlands surrounding Upper Klamath Lake were removed from the lake by diking and draining the land. Diking and draining of wetlands continued around the perimeter of the lake until the 1970s. Some of this former wetland has been purchased in the past few years with hopes of returning portions of the land back into wetlands. The Upper Klamath basin historically consisted of two distinct and separate watersheds, the Upper Klamath Lake / Klamath River watershed and the Lost River / Tule Lake watershed. These two watersheds and rivers were joined together in the fall of 1912 by a channel that diverted water from the Lost River into the Klamath River. A recently completed Natural Flow Study of the Upper Klamath River Basin conducted by Bureau of Reclamation depicts what the hydrology of the upper basin would have looked like from the years 1949 to 2000 if no agricultural development had taken place anywhere in the Upper Klamath basin. A comparison of the natural (pre-development) flows and measured historical (post development) flows at Keno shows, that on average, the annual historical flows are 97% of the natural flows, April-September historical flows are about 70% of the natural flows, while October through March historical flows are about 123% of the natural flows.

The Grande Ronde River Basin Spring Chinook Salmon Captive Broodstock Program: Performance in the Hatchery and in Nature (Session 2)

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A captive broodstock gene conservation program was developed for Grande Ronde Basin spring Chinook salmon *Oncorhynchus tshawytscha* due to extremely low adult returns in Catherine Creek, the upper Grande Ronde River and Lostine River. The Captive Broodstock Program began with the first collection of wild parr in 1995 (1994 cohort). We raise the salmon to adulthood and spawn them in captivity. The resulting F_1 generation is reared in captivity to the smolt stage and released into their parents' natal stream for completion of their life cycle - Captive Broodstock offspring are not collected for hatchery broodstock upon their return. Captive rearing is done under one of two pre-smolt (simulated natural vs. accelerated growth) and two post-smolt (freshwater vs. saltwater) rearing protocols. The first spawn of Captive Broodstock salmon was conducted in 1998 and the first smolt release was in 2000. We monitor survival, growth, and spawning in captivity to compare these performance indices among treatments. We monitor performance of the Captive Broodstock offspring in the hatchery and in nature to compare indices such as fertilization rate, egg-to-smolt survival and growth, downstream survival and migration rate, smolt-to-adult survival, age at maturation, and migration and spawn timing in nature. We also collect fin clips from all adults recovered at weirs or on spawning ground surveys for use in evaluating reproductive success of Captive Broodstock and Conventional Broodstock offspring compared with natural Chinook salmon in order to determine if these hatchery programs can aid in rebuilding self-sustaining natural Chinook salmon populations.

Juvenile Chinook Salmon (Oncorhynchus tshawytscha) Utilization of Low Intertidal Estuarine Habitats (Session 12)

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Estuaries function as potential nursery habitats for Pacific salmon populations by providing juvenile outmigrating salmonids with refugia from predators and trophic resources. To assess the relative importance of low-intertidal habitats for juvenile Chinook salmon, we examined the diet and distribution of Chinook among three types of habitats (0-1 m MLLW) commonly found within Pacific Northwest estuaries: seagrass *Zostera marina* ("eelgrass"), oyster on-ground aquaculture (*Crassostrea gigas*), and unvegetated mudflat. We used a modified tow net to compare densities and collect diets of juvenile Chinook salmon (65-115 mm FL) in Willapa Bay, Washington, during their 2002 and 2003 outmigrations. By using laboratory mesocosms, we evaluated which of these intertidal habitats are preferred by juvenile Chinook as refugia from predators. Field results suggested that outmigrating smolts did not exhibit a strong habitat preference, since diet composition was unrelated to habitat type at the point of capture, and densities were significantly related to broad spatial patterns in the estuary but not habitat type within the low-intertidal zone. However, laboratory experiments comparing two age classes of Chinook suggested that older smolts perceive eelgrass as superior habitat for evading an avian predation threat. Chinook in summer experiments (81-115 mm FL) significantly preferred eelgrass to mudflat or oyster in the presence of a mock avian predator, though younger Chinook in spring (42-80 mm FL) demonstrated no significant change in habitat preference. Although Chinook in the field did not exhibit strong habitat specificity, intertidal habitats may provide important resources such as movement corridors on a broad landscape scale.

A Decade of Monitoring Summer Populations of Juvenile Salmonids: What Have We Learned? (Session 9)

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Green Diamond (formerly Simpson) Resource Company has been monitoring summer populations of juvenile coho salmon and steelhead in coastal northern California timberlands for over 10 years. We used a modified Hankin and Reeves approach that emphasized snorkeling counts over electrofishing. The sampling technique worked well to generate reliable estimates on most streams, but it could not be applied in streams with low water clarity (high tannin levels) or if there were too many deep complex pools. Data for all streams and both species indicated a high level of annual variation, but generally coho were more abundant than steelhead most years. The high annual variation made trends difficult to establish, but overall, it appeared that juvenile coho populations have increased over the last 10 years, while steelhead numbers have remained relatively constant. Given that habitat conditions typically do not change dramatically from year-to-year, the high level of annual variation in summer juvenile populations is likely caused by differences in adult escapement or the influence of streamflow on survival of egg-juvenile life history stages. We investigated correlations between indices of adult escapement, discharge and annual juvenile populations to assess the potential drivers of annual variation in juvenile populations. Although not conclusive, our data suggest that ocean conditions influencing adult escapement were the most likely driver on annual variation.

The Little Walla River System: A Historic Perspective, Present Status, and Future Fisheries Potential of a Columbia Plateau Distributary (Session 12)

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The Little Walla Walla River distributaries, located in northeast Oregon and southeast Washington, have been managed primarily for irrigation since the late 1800s. Historically the system was a productive series of natural river channels. Today the system is composed of numerous branches with varying degrees of condition. Significant reduction in available habitat has resulted from straightening, flow manipulation, and land use. The system contains some quality salmonid spawning and rearing areas and provides cool water input to the mainstem Walla Walla River. The Little Walla Walla River has potential to follow successful collaborative restoration templates demonstrated by the Umatilla and Columbia Rivers. The CTUIR Fisheries Program conducted 13 miles of aquatic habitat surveys and electrofished 16 sites in 2004 to assess current conditions and restoration potential. Results indicated 20% of habitat characteristics were categorized as favorable for salmonids but also documented the following detrimental issues; 51 irrigation pumps and 36 ditches (some unscreened), 29 passage concerns, 3 barriers, dewatering, and 600 meters of river piped underground. Density levels of 0-3.6 brook and rainbow trout/m2 were documented. Freshwater mussels and brook lamprey were also observed but not quantified. The Little Walla Walla had the most restoration potential for salmonids, followed by Big Springs, East and West Fork. Several tributaries also had presence of salmonids and moderate restoration potential. Cooperative co-management has potential to increase capacity if sufficient water resources can be developed to improve conditions simultaneously in the dewatered Walla Walla mainstem and its distributaries.

A Comparison of Stream Habitat Quality in Two Coastal Watersheds and its Possible Effects on Freshwater Salmonid Production (Session 12)

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Salmonid monitoring was initiated to determine the overall health and stability of smolt populations utilizing two intensively managed watersheds of the Smith River drainage in Del Norte County, California. Populations of salmonids native to the West Branch and East Fork Mill Creek underwent habitat disturbance through timber harvest activities during different time periods. Differences between harvest histories, harvest methods, and times of entry within the two tributaries reflect the observed variation in both pool frequency and LWD-created habitat types, which we believe are correlated with observed population sizes of salmonids within the two watersheds, and their subsequent cumulative production levels. Riparian logging can alter biological and physical process and features that shape stream ecosystems and determine population densities and community structure of salmonids (Gregory et al. 1987; Reeves et al. 1993). Because these processes and habitat features operate at different time scales, the recovery of fish populations following riparian logging represents an integrated response to multiple habitat attributes that change through time (Gregory et al. 1987). Eleven years of population data collected from these tributaries have shown a difference in overall species abundance. We compared smolt abundance and assemblage within each tributary with several habitat parameters at a coarse scale to determine whether any differences in observed abundance or physical traits could be attributed to remnant anthropogenic factors. Cumulative smolt production is significantly different between West Branch and East Fork Mill Creek.

Conditions Affecting the Reintroduction of Anadromous Fish to the Upper Klamath Basin (Session 13)

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Hydropower dams constructed on the mainstem Klamath River without effective fish passage facilities have blocked runs of anadromous fish from Oregon's portion of the Klamath Basin since the early 1900s. Prior to completion of the first such dam, Copco, a relatively short distance downstream of the California border, multiple anadromous species returned to streams in Oregon's portion of the basin and unique populations of Chinook salmon supported tribal fisheries above Upper Klamath Lake. Today, with aquatic conditions in large portions of the basin substantially different than those that once supported the historic fish runs, the Klamath Tribes and other parties involved in a relicensing process for the hydropower dams are assessing the potential for reintroducing anadromous fish to historically blocked areas. In this presentation we will review aquatic conditions both in the Upper Klamath Basin and along the mainstem Klamath River between Upper Klamath Lake and the ocean, identify opportunities and constraints affecting a potential fish reintroduction effort, and suggest a meaningful, adaptive approach to restoring at least a portion of the lost runs.

Restoring Odell Bull Trout: What Can be Done? (Session 1)

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Odell Lake supports the only remaining natural adfluvial population of bull trout (*Salvelinus confluentis*) in Oregon. Odell Lake bull trout have been isolated from other populations by a lava flow that impounded Odell Creek and formed Davis Lake about 5,500 years ago. Recent sampling suggests that this population of bull trout is precariously small. Surveys within the Odell watershed have shown spawning to be limited to the lower 1.3 km of Trapper Creek and indicate a spawning population a approximately 20-30 adults. Surveys for juveniles support this indication, with an estimated population of less than 200 in lower Trapper Creek and only a few other isolated individuals observed in other tributaries. Lower Trapper Creek also serves as a major spawning location for a large population of introduced kokanee salmon, which extensively superimpose bull trout redds. In this talk we will describe current restoration and monitoring programs for Odell Lake bull trout and discuss factors suspected to limit the abundance of this population, including the interaction of kokanee and bull trout.

Population Dynamics of Adult Lost River Suckers and Shortnose Suckers in Upper Klamath Lake and its Tributaries, Oregon (Session 11)

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Lost River suckers *Deltistes luxatus* (LRS) and shortnose suckers *Chasmistes brevirostris* (SNS) are both long-lived species endemic to the Upper Klamath Basin of Oregon and California. Both species were listed under the Endangered Species Act in 1988. We analyzed empirical length data, a relative spawning output index, and survival estimates to assess population dynamics and status of adult sucker populations in Upper Klamath Lake, OR. Length data indicate that at the time of listing, both SNS and LRS populations were composed mostly of old individuals with no evidence of recent recruitment. An influx of smaller individuals recruited into both spawning populations during the mid 1990s. Relative reproductive index values for LRS indicate a precipitous decline (98%) in spawning output between 1995 and 1998. A 95% decrease in spawning output was observed for SNS. These declines coincide with consecutive summer fish kill events resulting from poor water quality conditions that occurred in 1995 – 1997. Using a random effects model, we estimated mean annual survival probability for the years 1995 – 2004 to be 0.83 for LRS and 0.79 for SNS. Survival modeling efforts indicate fish kill events during the summers of 1995 – 1997, and 2003 were very important sources of LRS mortality and survival probability during those years was markedly lower than in years without observed fish kill events. Shortnose sucker survival probabilities also varied tremendously with time and estimates indicate very poor survival from 1996 – 1998.

Patterns of Chinook Salmon Migration and Residency in the Salmon River Estuary (Oregon) (Session 12)

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We examined variations in the juvenile life history of fall-spawning Chinook salmon, *Oncorhynchus tshawytscha*, for evidence of change in estuarine residency and migration patterns following the removal of dikes from 145 ha of former salt-marsh habitat in the Salmon River estuary (Oregon). The absence of fry migrants in the estuary during spring and early summer in 1975-77—a period that precedes restoration of any of the diked marshes—and the extensive use of marsh habitats by fry and fingerlings April–July, 2000-02 indicate that wetland restoration has increased estuarine rearing opportunities for juvenile Chinook salmon. Persistent changes in spawner distribution since 1975-77, including the concentration of hatchery strays in the lower river, and the restoration of upper estuary wetlands, may account for the large proportion of fry that now disperse into the estuary soon after emergence in the spring. Although few of these earliest migrants survived to the river mouth, many fry and fingerlings from mid- and upper-basin spawning areas distributed throughout a greater portion of the estuary during the spring and summer and migrated to the ocean over a broader range of sizes and time periods than 30 years ago. Adult spawners and ocean entry juveniles were composed of similar proportions of life history types, dominated by summer migrants entering at 60-95 mm. The findings support the linkage between time and location of spawning adults and juvenile life histories. The results suggest that wetland recovery has expanded life history variation in the Salmon River population by allowing greater expression of estuarine-resident behaviors.

Evaluation of Precision and Accuracy in Scale and Operculum Derived Age Determinations for Northern Pikeminnow (Session 8)

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We collected scale and opercle samples from northern pikeminnow *Ptychocheilus oregonensis* between April and September 2000 – 2005, and ages were assigned by two readers. Between reader, time at-large, and scale and operculum discrepancies were analyzed after final ages were determined. Exact agreement between readers for scale ages ranged between 35% in 2001 and 71% in 2005, and was generally lower for opercula than scales. When final ages assigned to scales collected at both tagging and recapture were compared, the ages accounted exactly for the time at-large 44% of the time within the same year, and decreased substantially each additional year at-large. Corresponding scale and operculum age discrepancies appear dependent on the size of northern pikeminnow, with opercula being assigned ages older than scales as size (fork length) increases. Beginning in 2002, we injected northern pikeminnow with oxytetracycline (OTC) in an effort to determine accuracy of ages assigned to opercula. An evaluation of OTC mark quality has shown mixed results, which have affected validation efforts. When we exclude opercula that exhibit a "poor" mark from the analysis, accuracy of time at-large assessments improve; however, doing so markedly reduces sample sizes, and may select for a particular growth pattern. The precision and accuracy of northern pikeminnow ages obtained from scales are variable, and opercula validation results are confounded by mark quality issues. Until operculum validation issues are resolved, management decisions that rely on this information should consider consequences of aging bias.

Improving Radio Transmitter Signal Strength by Optimizing Antenna Length and Material (Session 9)

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The optimal antenna of transmitters used in small aquatic animals is a compromise between the effects on radio wave propagation and animal behavior. Radio transmission efficiency generally increases with diameter and length of the conductor, but increased antenna length or weight can adversely affect animal behavior. We evaluated the effects of reducing overall transmitter weight through changes in antenna length and material on the subsequent detection of tagged fish. In a laboratory, we compared the relative signal strengths in water of 150 MHz transmitters over a range of antenna lengths (from 6 to 30 cm) and three selected antenna material types. The peak relative signal strengths were at 16, 20, and 22 cm, which are 71-98% of one wavelength underwater at the test frequency. The peak relative signal strengths were approximately 50% greater than those of the 30 cm antennas, a length commonly used in fisheries research. Results of field tests to evaluate detection probabilities at automated detection arrays and detection distances from a boat-mounted receiving system corroborated the laboratory results. Our results indicate careful selection of antenna material and length of small transmitters can be used to 1) reduce weight and possible effects on animal behavior, 2) maximize tag output power and detection, or 3) balance these factors based on the needs of the study.

Natural Reproductive Success and Demographic Effects of Hatchery-Origin Steelhead in Abernathy Creek, Washington (Session 2)

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In order to optimize the use of hatchery produced fish while simultaneously conserving wild stocks it is critical to understand the effects that hatchery rearing practices have on the development and performance of fish as well as the genetic and ecological risks posed to wild populations. Our objective was to examine the performance and natural reproductive success of genetically similar hatchery-origin (HOR) and natural-origin (NOR) steelhead in Abernathy Creek relative to several control streams. We initiated an integrated steelhead broodstock program by captively rearing NOR juveniles to sexual maturity. Juvenile steelhead (N = 30,000 per year) have been released from Abernathy Fish Technology Center (AFTC) yearly beginning in 2003**.** The number of NOR steelhead smolts migrating out of the creeks has been consistent among years. A small number of NOR fish did emigrate earlier than HOR fish; however, the median emigration dates between the HOR and NOR fish were similar and did not vary among years. In addition HOR and NOR fish did not differ in their diel migration pattern. However, HOR and NOR steelhead differed morphologically and physiologically. HOR fish were longer but thinner than NOR fish. Gill Na^+, K^+ ATPase activity was higher in NOR migrants than HOR migrants. HOR migrants had higher plasma osmolality and [Na^+] than NOR migrants following a 24-h seawater challenge. From samples collected from returning adults we have determined that 16% of the NOR juveniles were produced from either a single or pair of individuals passed above the barrier at AFTC.

Linking Smolt Physiology and Migration Timing to Avian Predation Risk in the Columbia River Estuary: A Case Study of Cutthroat Trout and Wild and Hatchery Steelhead of Similar Genetic Origin from a Lower River Tributary (Session 8)

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Steelhead smolts (*Oncorhynchus mykiss*) migrating through the Columbia River Estuary are vulnerable to predation by Caspian terns (*Sterna caspia*) and double-crested cormorants (*Phalacrocorax auritus*). Previous studies have found that over 10% of PIT-tagged steelhead passing Bonneville Dam were eaten and deposited by birds in colonies on estuary islands. Additional information is needed on how physiological and behavioral traits of individual smolts affect the probability of predation. Our objective was to determine if smolt traits relating to seawater tolerance (gill Na+K+ ATPase) and migration behavior were related to the probability of estuary predation of fish PIT-tagged at a screwtrap in Abernathy Creek, WA (river kilometer 87). We found that 12% of wild steelhead, 15% of cutthroat (*O. clarki*) and 20% of hatchery steelhead sampled were presumably consumed by birds (PIT tags were detected on islands). For steelhead, lower Na+K+ ATPase levels (lower seawater tolerance) were related to higher predation risks while no relationship existed for cutthroat trout. Additionally, wild steelhead trout that migrated downstream early were more prone to predation than later migrants. Conversely, cutthroat trout that emigrated later were more prone to predation. Hatchery steelhead had similar predation risks regardless of their migration timing. Our data support the idea that despite similar genetic origin wild steelhead are more prepared for seawater and may have reduced predation mortality compared to hatchery fish, while predation risk for cutthroat trout may be strongly related to migration timing.

Contribution Of Phylogeography of *Catostomus* and *Ptychocheilus* from Cytochrome b Sequence to the Explanatory Theory of the Existence of Primary Freshwater Fishes in Oregon Coastal System (Session 4)

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The Oregon coastal system has a peculiar pattern of species diversity of primary freshwater fishes. It consists of three main high diversity areas: Columbia system, Siuslaw-Umpqua system and Klamath system. The Columbia and Klamath systems are relatively larger than other coastal systems. The high diversity of the two systems is likely due to their past connection with Snake River system; however, the explanation of the high diversity of the Siuslaw-Umpqua system is currently inconclusive. In the past, two theories have been proposed to explain the existence of the primary freshwater fishes in the coastal system: fishes in coastal rivers may be isolates of fishes from the Willamette Basin (Minckley et al.,1986) or ancient lineage that recently invaded back to the Columbia (McPhail and Lindsey, 1986). In this study we analyzed the phylogenetic structure of two groups of primary freshwater fish to address whether the fishes in the coastal system were isolates from the Willamette Basin or from an ancient population that later dispersed back to the Columbia system. We used cytochrome b sequence to infer phylogeny of suckers (*Catostomus* spp.) and pike minnow (*Ptychocheilus* spp.) collected from the coastal system and the Columbia River systems. Results showed that populations from the Willamette/Columbia were basal to coastal populations (Siuslaw-Umpqua systems), indicating that primary freshwater fishes in the coastal system originated from the Willamette/Columbia Basin. This is in general support of the Minckley et al. theory.

The Effect of a Summer Steelhead Hatchery Stock on a Wild Winter Steelhead Population (Session 2)

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We investigated the effect of a summer steelhead hatchery stock on a wild winter steelhead population in the Clackamas River, Oregon. Summer steelhead were introduced into the basin in the 1970s. Returning adults from the hatchery plants were from 31% to 92% (average 70%) of the steelhead adults passed above North Fork Dam (river kilometer 64) between 1975 and 1999. We used a genetic mixture analysis to demonstrate that between 36% and 53% of the unmarked smolts out-migrating from the upper basin in the 1990s were the naturally produced offspring of hatchery summer steelhead. Relative reproductive success of the natural spawning hatchery summer steelhead was poor, about 22% that of the wild winter steelhead to the smolt stage, and 8% to the adult stage. Interbreeding between hatchery and wild steelhead appeared to be negligible. Ecological impacts were substantial. We used a suite of Ricker and Beverton Holt stock-recruitment models that incorporated species interaction variables to demonstrate that when high numbers of hatchery summer steelhead adults passed above the dam, the production of wild winter steelhead smolts and adults was significantly decreased. We saw, averaged over our models, a 50% decline in the number of recruits/spawner produced at low densities and a 22% decline in the maximum number of recruits produced. We estimate that over the 25 years of the hatchery program the large number of hatchery adults passed above the dam regularly pushed the total number of steelhead over the basin's carrying capacity triggering density dependant mechanisms that impacted the wild population.

Status Assessment of Reintroduced Bull Trout in the Upper Middle Fork Willamette River (Session 6)

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The status of the bull trout population in the Middle Fork Willamette was listed by Ratliff and Howell (1992) as at "high risk" of extinction in the early 1990s. Additional sampling failed to identify a viable population and led to a downgrade in status to "probably extinct" (Buchanan et al 1997). In 1998, the U.S. Fish and Wildlife Service designated the entire Columbia River Distinct Population Segment as threatened under the ESA.. Since the listing, the USFS, ODFW, BPA, USACE, and USFWS have joined in a multi–agency, collaborative effort to restore a bull trout population in the Middle Fork Willamette. Beginning in 1997, bull trout fry were collected from the mainstem McKenzie River population and released into several areas on the Middle Fork Willamette above Hills Creek Reservoir. Multiple sampling methods were used to monitor distribution, migration, and growth of fry. In 2005, bull trout were tracked using PIT (Passive Integrated Transponder) tag detection stations along migration paths. This allowed us to more precisely document population dynamics and fish behavior. Results from 2005 indicate an increase in the number of adult bull trout and provide evidence of spawning. To date, bull trout reintroduction in the Middle Fork Willamette appears to be successful. Future efforts will attempt to document natural reproduction, adult distribution within the basin including Hills Creek Reservoir, and effects of thermal barriers on distribution and abundance.

Umpqua Coho Genetic Pedigree Project: CHIP-ping Forward with Assessing Reproductive Success of Supplemental Fish Releases (Session 2)

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This cooperative research project with Oregon State University is part of the Conservation Hatchery Improvement Program (CHIP) created in 1995 to improve and modernize hatchery programs. Its purpose is to develop and evaluate innovative hatchery programs for promoting restoration of wild populations. The first 4 years of this 9-year coho study has been conducted according to the experimental design approved in 2001. Research will evaluate the success and genetic implications of different hatchery supplementation in the Calapooya subbasin (Umpqua) using DNA analysis. The following hatchery scenarios were used: a) hatchery stock released as smolts, b) hatchery stock released as unfed fry, c) first generation wild-type hatchery stock released as smolts, and d) first generation wild type hatchery stock released as unfed fry. All adult fish trapping and hatchery operations have been successful and all scheduled fish releases completed. Over 1.3 million fry and 66,000 smolts, representing three consecutive generation-lines (2001-03), were released into Calapooya Creek and tributaries upstream of NonPareil Dam. The required genetic sampling and data collection have been completed through the 2004 return year. Initial achievements from genetic analysis by OSU included successful parentage simulations using genotype data. These data were used to verify that we can distinguish hatchery and naturally reproducing coho. Relative reproductive success of Hatchery x Hatchery and Wild x Wild matings and the potential genetic differences between hatchery and natural-producing populations are currently being analyzed from the first returns (2004). Results of this study can benefit other ongoing and proposed research in the subbasin.

Diamond Lake Restoration Project: Resetting the Gem of the Cascades, Again! (Session 1)

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Originally fishless, Diamond Lake has been managed as a recreational trout fishery since 1910. Tui chub, a non-native minnow species introduced in the 1940's, overpopulated the lake and caused severe declines in the fishery. In 1954, the Oregon Game Commission treated Diamond Lake with rotenone to eradicate the chub population. The lake was restocked annually with a set number of rainbow fingerlings, providing a well-balanced economically important fishery and healthy lake for decades. In 1992, chub were discovered, and again caused the trout fishery to severely decline. The Oregon Department of Fish and Wildlife immediately began efforts to complete restoration of the lake. Several permit processes and evaluations were ongoing in the 1990's, but not until 2001, when the lake was closed to public use due to algal blooms, did the restoration project move significantly forward. An interagency group was then formed to complete a project with the goal to improve both water quality and fisheries. This group's effort over three years was extensive and costly. The project implementation that began in 2005 will again use a rotenone application in the fall of 2006 to eradicate chub and restock the lake with trout in 2007. This long-awaited restoration of the lake combined with selective fish stocking; water, macroinvertebrate, and fish monitoring; and improved education, will provide the setting (again) for a fishable and swimmable lake.

Sediment Oxygen Demand in Upper Klamath Lake and the Klamath River: Implications for the Survival of Two Endangered Sucker Species (Session 11)

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Lost River and shortnose suckers were listed as endangered by the U.S. Fish and Wildlife Service in 1986. Low dissolved-oxygen concentrations in Upper Klamath Lake (UKL) and the Klamath River downstream of UKL are suspected of causing periodic die-offs of adult suckers and poor survival of larval and juvenile suckers. Over the past 100 years, watershed changes caused by activities such as wetland drainage and lumber production have resulted in the export of large amounts of organic matter and bioavailable phosphorus to these receiving waters. Because UKL is shallow (average depth of 2.5 meters), this phosphorus load fuels summer blooms of *Aphanizomenon flos-aquae* in UKL, which can create large oxygen demands in the water column and bottom sediments when the blooms crash. In contrast, the suspected high sediment oxygen demand (SOD) rate in the Klamath River has been largely attributed to the decomposition of buried woody debris in bottom sediments. The woody debris was derived from sawmills and the storage of logs on and along the river for many decades. A series of SOD measurements made in UKL and the Klamath River over the past 6 years provides insight into (1) the role SOD plays in producing the zones of hypoxia that are lethal to suckers, (2) the source of organic matter producing SOD, (3) how SOD varies spatially and temporally, (4) the potential of various remediation strategies to decrease the magnitude and frequency of hypoxia in both water bodies, and (5) implications for the survival of the endangered sucker populations.

Testing Hypotheses of Limiting Factors that Control Spatial Distribution of Redband (*Oncorhynchus mykiss gairdneri*) from a Riverscape Perspective (Session 6)

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The first step in stream restoration is to identify factors limiting production of target species. We suggest a holistic view of the riverscape provides initial insights concerning limiting factors. This is in strong contrast with site-specific approaches due to processes that are affected by scale. We apply this principle towards increasing the production of redband trout (*Oncorhynchus mykiss gairdneri*) in the South Fork John Day River, where cattle grazing, channelization, logging, and water diversion have been prominent. We use methods to identify potential limiting factors by linking landscape processes with candidate models using an information-theoretic approach based on Akaike's information criteria (AIC), where the relative importance of the predictor variables of each model was ranked using data from different spatial scales. Existing land use - land cover maps, LiDAR (light detection and ranging) geomorphic information, longitudinal temperature profiles from the forward-looking infrared (FLIR) and extensive *in situ* habitat and fish community surveys were used in these models. Our preliminary results confirmed the presence of different strata in the watershed. Differences in landscape and land use attributes showed that continuous sampling is most useful that site-specific sampling in order to detect limiting factors and cumulative effects. More than 1000 models were run and found that Redband distribution in the principal tributaries and in reaches within tributaries have different limiting factors.This approach will provide managers with hypotheses for restoration experiments in specific areas (e.g., wood additions, beaver dams, culvert replacements). This is consistent with the concept of Adaptive Management.

Eulachon Spawning Migration Dynamics and Associated Avian Feeding Aggregation Characteristics on the Copper River Delta, Alaska (Session 8)

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The timing, distribution and number of eulachon (*Thaleichthys pacificus*) spawning runs on the Copper River Delta (CRD) in south-central Alaska appear to vary annually between the end of January and the beginning of July. Spawning eulachon provide a lipid and vitamin-rich food source for avian predators and this is evidenced by the numerical response of avian aggregations that occur near these spawning runs. Adult eulachon presence was determined via dip-net sampling for 13 coastal rivers of the CRD from April 2005-July 2005. Spawning eulachon were found in two rivers during the sampling period. The timing of the three observed spawning runs appeared to be correlated with spring high tides. The number and diversity of avian predators were recorded for all 13 rivers. Avian predators were seen plunge diving, surface diving, pirating and scavenging on live and dead eulachon. Gulls (*Larus glaucescens*, *L. argentatus*, *L. canus*, and *L. philadelphia*) numerically (1000+) dominate these feeding aggregations, which can also contain hundreds of bald eagles (*Haliaeetus leucocephalus*) and corvids (*Corvus corax*, *C. caurinus*, and *Pica hudsonica*). Alaganik Slough exhibited a large number of glaucous-winged gulls and bald eagles in the presence of eulachon and the Copper River exhibited large numbers of glaucous-winged and mew gulls. These preliminary results suggest that seasonal oscillations of eulachon spawning runs on the CRD may influence the composition and dynamics of the avian predator community.

Passage and Behavior of Adult Pacific Lampreys at Willamette Falls Dam, Oregon (Session 4)

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We used radio telemetry to examine passage and behavior of adult Pacific lampreys (*Lampetra tridentata*) as they encountered Willamette Falls and the T. W. Sullivan powerhouse at Willamette Falls dam. During April through October 2005, we collected 136 lampreys—116 from a trap in the fish ladder at the dam and 20 from the falls—radio tagged them, and released them 2 km below the falls. We used an array of fixed telemetry gear and tracking by boat to document the movements, distribution, and passage characteristics of lampreys after release. Since late April, 57 lampreys have passed above the falls. Of these, 44 lampreys passed the dam via the fish ladder, with 36 fish using ladder entrance #1, 8 fish using ladder entrances 3 and 4, and no fish using ladder entrance #2. Thirteen fish moved upstream by ascending the falls. For fish that passed the dam, time from release to passage ranged from 9 h to 42 d. Some lampreys showed directed movements upstream, while others fell back over the dam and either ascended again or moved downstream. So far, 48 fish that had been residing at Willamette falls or near the dam have moved downstream below the release site, and 31 different fish were still between the release site and the falls. Passage and movements of lampreys were correlated with water temperature, flow, date, and time of day. Our results should provide much needed insight into passage and migration characteristics of Pacific lampreys in the Willamette River, will help identify possible impediments to lamprey passage at the dam, and will allow managers to develop modifications to the dam, controlled flow structure, or fish ladder to improve adult lamprey upstream passage.

Bull Trout Movement in the Walla Walla River: Observations from Radio Telemetry (Session 6)

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Decline of anadromous and adfluvial fish in the Walla Walla River has been attributed to agricultural expansion, hydroelectric development, and over harvest. A lack of information on bull trout life history, population connectivity, passage, and distribution was identified as limiting effective conservation in the subbasin. We assessed the fluvial movements of 91 adult bull trout (340-625 mm fork length) using surgically implanted 16.1 and 7.3-g radio tags. Fish were tracked by mobile and fixed station telemetry at least twice per month between June and October and once per month from November through May. Fish were detected from 20 to 1,133 days after tagging, for a total of 3,252 unique detections between 10 May 2001 and 24 June 2005. Movement between observations was typically low during rearing months of December through May (0.3+/-1.2 miles), was significantly higher during up and downstream migratory/spawning months of June through September (0.8+/-1.7 miles), and was statistically highest during downstream return to the rearing habitat in October and November (1.1+/-2.4 miles: $p<0.001$ all ways based on paired Student's-t Tests). We did not observe movement of bull trout below Walla Walla river mile 36.7, connectivity among the three local bull trout sub-populations in the subbasin, or anadromous or adfluvial migrations to the Columbia River. Based on our observations, limiting factors such as physical barriers (e.g. historic stream dewatering, low stream flow and high temperature), hydrosystem modifications, decreased genetic diversity, or other factors appear to have limited life history diversity in the study population.

Performance of the New A-Canal Fish Screen Bypass Facility (Session 13)

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In 2003, the US Bureau of Reclamation completed installation and began operation of a state-of-the-art fish screen and bypass at the A-Canal diversion intake on Upper Klamath Lake. This screening facility includes 266 m^2 of vertical, flat-plate, profile-wire screen set as a single-V configuration in the diversion's intake channel. A fish bypass conveys fish to a bifurcation allowing 1) primary return to the lake via a 20" Hidrostal pump, or 2) secondary gravity passage downstream to the Link River. Descaling and physical injury of fish passing through the primary pumped bypass system was evaluated for three species representing a range of sensitivity to injury including: blue chub, fathead minnow, and Klamath largescale sucker. Scale loss and other injuries varied by species (i.e., blue chubs shed scales very easily); however, there were no significant differences ($P>0.11$, Kruskal-Wallis test statistic) between bypassed fish and control fish for any of the species tested. Similarly, the incidence of other injuries to the head, eyes, and skin after pumped bypass was not significant ($P>0.10$, Chi-square tests) compared to control fish. A slightly higher incidence of injury to the fins (e.g., frayed or split) in bypassed fish was observed for the largescale sucker ($P=0.001$, Chi-square test); however, this result was based on smaller sample sizes for this species compared to the other two species. In general, these results are consistent with the fish-friendly performance of the Hidrostal pump reported for other installations.

Kokanee, Klamath Suckers and the Geography of Genetics (Session 13)

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Each kokanee population is thought to have evolved independently from anadromous sockeye within their drainage through sympatric speciation and assortative mating. Within a drainage, sockeye and kokanee usually share a "drainage genome" reflecting sympatric speciation. The three nominal genera and four species of Klamath Basin suckers also share a "drainage genome" and are more similar to each other than to any species outside the basin. An alternative to sympatric speciation of the four forms from a common ancestor within the basin is allopatric speciation followed by hybridization, but without loss of species integrity, a botanical model called a syngameon. One species, Klamath smallscale sucker (KSS), is also found in Rogue River and is a key to understanding this model. Several nuclear genes are markers for KSS and are fixed in Rogue KSS, while Klamath KSS have additional alleles characteristic of other Klamath species suggesting hybridization. More strikingly, Klamath KSS mitochondrial genes are more closely related to other Klamath species than to its own "species" in the Rogue. These data suggest that ancestral KSS dispersed into the Klamath, that there was introgression of some nuclear genes and complete lateral transfer of Klamath mitochondria. This conclusion raises difficult questions about molecular evolution – whether it always reflects phylogeny; about taxonomy - whether Rogue and Klamath KSS are different species; and about conservation - whether members of a hybridizing complex can be treated as conservation units.

Ontogenetic and Spatial Changes in Diet of Juvenile Suckers (Catostomidae) in Upper Klamath Lake, Oregon (Session 11)

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We describe ontogenetic patterns in the diet of shortnose and Lost River suckers, 15.8 – 92.8 mm standard length (SL), from Upper Klamath Lake in the summer of 1999. Both species made a transition from surface and planktonic prey to benthic prey at about 20-30 mm SL. Surface prey was dominated by adult chironomids and undigestable pollen, while benthic prey was dominated by larval chironomids, chydorids and ostracods. In the 15 – 20 mm size class, pollen made up >75% of food particles in 68% of specimens and only two specimens in this size class lacked any pollen grains. A better understanding of the prey-selection process in larval suckers is needed to determine the importance of this potential source of starvation. The planktonic prey eaten during the surface-to-benthic feeding transition were widely distributed, suggesting that larval use of emergent vegetation primarily serves as a predation refuge. On a numerical basis, crustaceans and larval chironomids contributed most to the diet of larger juveniles. In specimens > 40 mm, shortnose suckers ate more Tanytarsini and Lost River suckers ate more chironomid pupae and chydorids. In specimens > 40 mm there was a strong spatial difference in diet in which specimens collected in offshore samples ate more chironomid larvae and pupae, harpacticoid copepods and chydorids while onshore specimens ate more cyclopoid copepods and Daphnia eggs. The transition from onshore to offshore habitat appears to occur over a broad size range of about 40 – 90 mm.

Genetic Distinction of Threatened Summer-Run and Winter-Run Steelhead in the Hood River, Oregon (Session 10)

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Two distinct races of steelhead are native to the Hood River, Oregon. Summer-run steelhead migrate upstream during the summer and fall, overwinter in freshwater, and spawn the following spring in the West Fork of the Hood River. Winter-run steelhead migrate upstream during the winter and early spring immediately before spawning in the East or Middle Forks of the Hood River. Oregon Dept. of Fish & Wildlife hatchery broodstocks have been developed for both races to assist with recovery of these ESA-listed stocks and to support Hood River recreational and Tribal fisheries. Significant temporal overlap exists between the two races when adults are trapped for broodstock. Consequently, the hatchery programs pose significant genetic risk of inadvertently crossbreeding adults from the two races. Using a suite of 22 microsatellite loci, we investigated the genetic structure among SR and WR adult steelhead, and steelhead juveniles from the east, middle, and west forks of Hood River. Neighbor-joining dendrogram topology revealed a cluster of SR adults with west fork juveniles that was distinct from WR adults and both east and middle fork juveniles. A baseline of juvenile steelhead allele frequencies was used to differentiate SR (west fork) from WR (east, middle forks) in ecotype assignment tests. A real time rapid-response (RTRR) protocol was developed and initiated in 2005, which provided hatchery personnel with genetic ecotype assignment results within 24-hours. Of 112 mature fish being held, 39 WR and 32 SR individuals were identified and retained for brood stock based on ecotype assignments (CL $\geq$ 95%).

Successful Natural Production of Hatchery Spring Chinook Salmon: A Lesson from Lookingglass Creek in Eastern Oregon (Session 15)

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Dams, overfishing, loss and degradation of habitat, and hatchery management have contributed to declines in spring Chinook populations in the Grande Ronde Basin. Lookingglass Hatchery, which was completed in 1982 as a mitigation hatchery, attempted to use the Lookingglass Creek endemic stock(LCE) as a broodstock source. Poor returns, switching of stocks, and not allowing spawning above the weir sealed this stock's fate. Lookingglass Creek was used to evaluate reintroduction of a non-endemic hatchery stock (Rapid River(RR)). Fifty to 133 adult RR were released above Lookingglass Hatchery in 1992, 1993, 1994, 1996(RR1), and 1997(RR1). Life history characteristics and production indices of these fish and their naturally-produced progeny were compared with those of the LCE, and other naturally-produced fish from Grande Ronde(GRR) or other Columbia basin tributaries(CSR). The RR redd distribution was lower in the system than the LCE. There was no significant difference in mean adults-per-redd among the RR, LCE, or CSR($P>0.05$). There was no significant difference in mean juveniles-per-redd between RR, RR1, LCE, and GRR($P>0.05$). Monthly mean fork lengths of juvenile salmon from the RR cohorts were 27% longer than LCE cohorts($P>0.001$). Downstream movement of juveniles for the RR cohorts peaked 1 to 2 months later in the fall than the LCE cohorts. Juveniles from RR and LCE moved downstream predominantly as sub-yearlings. The RR that were PIT-tagged exhibited similar arrival timing at and survival indices to Lower Granite Dam compared to GRR. Progeny-per-parent ratios for RR and RR1 were not significantly different than those estimated for GRR ($P>0.05$).

Efficacy of Carcass Analogs for Restoring the Productivity of Salmonid Bearing Watersheds (Session 7)

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We evaluated the effectiveness of carcass analogs for enhancing the nutrient status of streams previously identified as nutrient deficient. Carcass analogs are an emerging technology that convert fish carcasses into small, solid briquettes. The briquettes are pasteurized to kill any pathogens and formulated to mimic a rate of decay similar to actual salmon carcasses. In 2003, we conducted a water chemistry analysis of several streams in the Washougal, Lewis, and Wind River watersheds and showed that several streams had limitations of nitrogen and phosphorus during the growing season. In 2004 and 2005, we documented algal, macroinvertebrate, and fish production in 500-m control and treatment reaches in Martha and Cedar creeks (Wind River watershed) prior to placement of analogs. In September 2005, we placed several hundred Kg of analog material into the treatment reach of Cedar creek (water levels were too low in Martha creek). Following placement of analogs, we monitored water quality, physical chemistry, and stream productivity and compared the responses between treatment and control reaches. For this presentation, we will discuss the baseline aquatic productivity of our test streams and the community responses to a seasonal application of analog material. Our results should provide useful information about the efficacy of carcass analogs to enhance the nutrient status of streams and help restore salmon populations in the Pacific Northwest.

Finding a Place for Expert Opinion in Watershed Assessments for Salmon Recovery (Session 8)

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The biggest fisheries and wildlife issues are complex, messy problems. Most share a set of common characteristics including a lack of information, incomplete understanding, time constraints, and inadequate funding. When pressured to provide policy relevant science to decision makers, fish and wildlife scientists are often left with no choice but to rely on some form of expert opinion. Information based on expert opinion is extremely valuable. But to be most useful for decision making, if it must be perceived as being accurate, transparent, and calibrated by some level of uncertainty. Formal methods of using expert opinion are becoming more common in complex ecological problems. Decision-support models are one such method but are fairly new in their application to fish and wildlife management. Using Oregon coastal coho salmon recovery as a case study, this project examines and tests the usefulness of a decision-support model to assess watershed condition for coho. Preliminary results from this project will be discussed including the difficulties of building expert consensus and the pros and cons of the model.

Effects of Handling Stress on Gene Expression in Rainbow Trout Liver (Session 3)

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In hatchery and management settings, fish handling is unavoidable. The extent to which stressful effects of handling influence the long-term survival of fish is poorly understood. Delayed mortality and reduced fitness are not the direct consequences of stress but result from decreased resistance to disease and altered reproduction. We are interested in understanding how fish respond to and recover from stressors associated with transportation. We conducted stress experiments by exposing rainbow trout, *Onchoryhnchus mykiss,* to a three-hour stressor. Plasma

cortisol levels were measured as an indicator of stress. Gene expression was compared between stressed and non-stressed fish using a microarray. By analyzing the expression of multiple genes at one time we have achieved a better understanding of how the different physiological systems of the body respond to stress. Our results indicate that some immune-related genes increase in expression in response to stress. This paper will discuss the functions of these genes and their implications for fish health.

Aiding Pacific Lamprey Passage in a Salmocentric World (Session 5)

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Fishways at hydropower dams in the Columbia River Basin are designed to aid both downstream and upstream passage of anadromous salmonids. Pacific lamprey (*Lampetra tridentata*), exhibit distinctly non-salmonid behavior and locomotion during their anadromous migrations. Consequently dam structures and operations that aid passage of juvenile and adult salmon can delay lamprey migration, prevent lamprey passage, or kill lamprey. Adult and juvenile lamprey are primarily nocturnal and migrate near the bottom of the water column, while salmonids are usually most active during the day and are more pelagic. Lamprey exhibit reduced swimming capability in high current velocities, while salmonids are attracted and guided by high flows. Screens that protect juvenile salmonids impinge juvenile lamprey and diffuser grates that exclude adult salmon are no barrier to adult lamprey. Since 2002, we have been evaluating the potential to pass lamprey via lamprey-specific structures. In 2004 and 2005 we operated a structure to pass adult lamprey at the Bradford Island fishway at Bonneville Dam. In each year over 8,000 lamprey used this lamprey passage system (LPS); a significant percentage of the total number of lamprey counted at Bonneville Dam in those years. These findings indicate that constructing lamprey-specific fishways may be the best way to reduce conflicting passage requirements of salmonids and lamprey.

American Shad (*Alosa sapidissima*) in the Columbia River: Is this a good thing? (Session 14)

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American shad (*Alosa sapidissima*) are not indigenous to the Columbia River Basin, but have been very successful in this system. American shad were transplanted into the Sacramento River, California, in 1871 and by 1880 they were documented in the Columbia River drainage. Shad abundance has increased since that time from annual adult counts at Bonneville Dam of less than 100,000 in the 1940s and 1950s to yearly averages of over a million fish since 1980. The expansion of shad numbers in the Columbia River drainage has undoubtedly affected native species, both directly and indirectly. We summarize how American shad may have become prey or competitors of native fishes, perhaps influencing feeding behaviors, growth rates, and mortality rates. Some effects of shad may be indirect through trophic interactions that are poorly understood. Moreover, both juvenile and adult shad potentially alter the behavior of native anadromous salmonids at hydropower projects. Such behavioral interactions can reduce the efficacy of structures designed to divert downstream migrants away from turbines. They also may reduce the passage efficiency of adult salmonids during their upstream migration through the many fishways in this system. We review the potential interactions among shad and native fishes in the Columbia River, and use an extensive radiotelemetry database to examine fine-scale behaviors of salmonids in fishways during periods of high and low shad density.

Representing Landscape Scale Stream Channel Attributes with Localized Sample Efforts: An Exploration of the Issue of Sample Size (Session 9)

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I examined the number of segments of stream, referred to as sites, needed to describe the specific characteristics of the stream channel within a single 6th field Hydrologic Unit Code (hereafter referred to as a watershed). I used data from a census of channel habitat classification in the upper Elk River watershed, located on the southern Oregon coast, in which the United States Environmental Protection Agency's Environmental Monitoring and Assessment Program style site surveys would be conducted by field crews. I used Monte Carlo simulations to assess sample sizes of n = 1, 2, 3, 4, 5, 6, 10, 15, 20, 30, and 50 sites to evaluate average residual pool depth (maximum depth – pool tail crest depth), pools per 100 m, deep pools per 100 m (those with = 1 m residual pool depth), and large wood per 100 m against the census value. Average residual pool depth, pool frequency, and deep pool frequency, due to their uniform distribution across the landscape, require two, three, and five sites respectively to be within 20% of the true value. However, wood frequency, due to patchy distribution and "rare occurrences" of log jams, require more than six sites to be within 20% of the true value. I present results of these analyses and general conclusions about using segments of stream to represent conditions of the whole watershed.

Salmonid Habitat, Hydraulics, and Gravel Removal (Session 12)

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Gravel removal from stream and river channels causes hydraulic, geomorphological, and biological changes in salmonid habitat availability and quality. Instream sediment that supports habitat is affected by flows, channelization, and availability of source material. Spawning, incubation, rearing, and migration are all linked to bedload material and forms. Substrate-type and morphological features of gravel deposits provide physical and biological habitat elements. Hyporheic flow through gravel influences water quality, and gravel deposits provide habitat complexity. Bar forms create pool and riffle complexes, and can affect formation of downstream alcoves. Both natural and human-influenced events affect sediment transport and forms. When gravel is permanently removed from the system, the resulting 'sediment-starved' flows erode downstream areas, increasing turbidity and embeddedness. Biological changes consist of reduced habitat availability, potential entrapment depending on the remaining elevations, and shifts in macroinvertebrate prey. As part of instream gravel operations, removing or preventing establishment of vegetation reduces the capacity of the channel to store fine sediment and eliminates local forage sources and potential shade. All of these effects undermine the productivity of salmon populations by reducing the available spawning, incubation, rearing and migration habitat.

The Oregon Hatchery Research Center (Session 2)

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The Oregon Hatchery Research Center is an innovative facility designed to address both practical management issues and fundamental research questions. The OHRC was constructed by the Oregon Department of Fish and Wildlife and is operated jointly by ODFW and the Fisheries and Wildlife Department of Oregon State University. The design and construction of the facility allow for a wide range of research, including tests of conventional hatchery procedures as well as innovative experimental analyses under controlled environmental conditions. Major research features of the OHRC include: controlled environment space, with the availability of either ambient water

or water that can be sterilized and recirculated at controlled temperatures; extensive dry lab research space; a large number of tanks of various sizes for controlled rearing of experimental fish; and four very large simulated stream channels. The OHRC provides residential dormitory space, office space, and research space for research collaborators for varying periods of time. We anticipate continuing research collaborations with colleagues from management agencies, OSU, and other institutions within Oregon, from universities and management agencies in other states, and with colleagues from a number of other countries (we are already negotiating details with colleagues from Canada, Japan, Iceland, China, Argentina and Korea, for example). Another major function of the OHRC is education and outreach. This includes design features to encourage the public to visit and tour facilities, to internship programs with universities and colleges across Oregon, to electronic and conventional print publication of information about the activities of the OHRC.

Anorexia and the Threatened Lahontan Cutthroat Trout: Results and Ecological Implications from a Competitive Interaction Study (Session 3)

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Recent studies suggest that competition from Eastern brook charr (*Salvelinus fontinalis*; EBC) may have negative effects (e.g. displacement) on Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*; LCT). Results from these studies have failed to elucidate the responsible mechanisms, and have not examined if changing environmental conditions result in competitive/subordinate role reversals. The primary objectives of this study were to 1) determine the mechanisms responsible for apparent competition and 2) determine if the results from competitive interactions change under variable environmental conditions. Under laboratory conditions where density, species proportions, and temperature were manipulated, LCT typically lost weight and exhibited elevated blood plasma cortisol levels, an indicator of stress, during the 9-day trials (-8% and ~60 ng/mL, respectively) whereas EBC typically gained weight and exhibited lower cortisol levels (+1% and ~23 ng/mL). When water temperature remained at 13 degrees C, EBC were competitive dominants gaining an average of 5% of their body weight with low cortisol levels (~16 ng/mL) whereas LCT *lost* an average of 6% of their body weight and exhibited elevated cortisol levels (~40 ng/mL). As temperatures increased to 23^{o} C, both species lost weight and exhibited elevated cortisol levels but LCT lost more weight than EBC (11% and 5%, respectively). As the proportion of EBC increased relative to LCT in experimental trials, LCT lost more weight and exhibited higher cortisol levels. These results suggest that EBC are the dominant competitor and that the mechanism may, in part, be physiological in nature.

The Ups and Downs of White Sturgeon Passage at The Dalles Dam (Session 5)

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White sturgeon *Acipenser transmontanus* were monitored via telemetry at The Dalles Dam to describe their distribution, movements, and behavior near the fishways, navigation locks, and the immediate forebay and tailrace areas over time. A total of 148 white sturgeon received surgically implanted transmitters; 90 were released in the tailrace and 58 were released in the forebay. All fish tagged were between 95 and 264 cm total length. Basic information on fish movements and distribution within the immediate vicinity of the dam was obtained. Volitional upstream and downstream passage was noted with 25 transits of the dam by tagged white sturgeon; 17 downstream and 8 upstream. Interestingly, 11 of these transits were made by only 4 individuals. One individual fish that entered and resided within the north fishway during June and July 2004 did so again in 2005, suggesting fidelity to fishways. Seasonal use patterns of areas around the dam are evident, based on the number of individuals detected at each hydrophone over time. As an example, patterns indicate aggregation of white sturgeon in the cul de sac during winter and dispersal into the tailrace during summer. At least two white sturgeon passed Bonneville Dam and have been detected in the lower Columbia River. These findings suggest that a complex behavior is exhibited by white sturgeon that reside in the vicinity of dams.

Direct and Indirect Effects of the Columbia River Hydrosystem and Operations on Adult Salmon and Steelhead Populations (Session 5)

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Migration and survival of adult salmonids in the Columbia River hydrosystem have been evaluated by the University of Idaho, NOAA Fisheries, and USACE over a 10-year period. This multi-year effort provides a unique perspective on the interactions between salmon migration behavior and hydropower dam operations at multiple scales. Results have illustrated specific local behaviors, such as how fish react to fishway passage structures, quantified larger scale behavior such as straying, and revealed general patterns, such as how interannual variation in ocean productivity may affect population success. In general, we have found that most adult salmon readily pass dams but that specific areas, such as transition pools, can be problematic. Dam operations, such as amount of spill or proportion of flow that is passed at powerhouses can decrease passage performance and increase fallback at individual dams. Salmon runs are slowed during high-flow years and during periods of extreme water temperatures. Under most conditions, we found no evidence that high dissolved gas concentrations caused by uncontrolled or forced spill significantly affected adult migrants because of their natural behavior to swim relatively deep in the water column. Fish that were transported downstream on barges from the Snake River as

juveniles show significantly more straying and fallback behavior as returning adults than fish that had migrated downstream in-river as smolts. The cumulative effects of passage delays at fishways, spill, fallback, temperature and transport effects can result in reduced escapement for a portion of at-risk salmon stocks, particularly in years with poor in-river conditions.

100th Meridian Initiative—Stopping the Spread of Zebra Mussels (Session 14)

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The objective of the PSMFC ANS (Aquatic Nuisance Species) Program is to prevent harm from ANS species to important commercial and recreational fisheries and the ecosystems upon which these fish depend. Currently, the PSMFC program funds are directed at four species: zebra mussel (*Dreissena polymorpha*), Atlantic salmon (*Salmo salar*), European green crab (*Carcinus maenas*), and Mitten crab (*Eriocheir spp*). The zebra mussel continues to be primary concern of the program. We are working with numerous state, federal, tribal and private entities to prevent the spread of the zebra mussel into the western United States, including the 100th Meridian Initiative. The 100th Meridian Initiative is a cooperative effort between state, provincial, and federal agencies to prevent the westward spread of zebra mussels and other aquatic nuisance species in North America. The goals of the 100th Meridian Initiative are to 1) prevent the spread of zebra mussels and other aquatic nuisance species in the 100th meridian jurisdictions and west and 2) monitor and control zebra mussels and other aquatic nuisance species if detected in these areas.

Understanding Lost River and Shortnose Suckers in the Upper Klamath Basin: Key Issues and Critical Information Needs (Session 13)

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The Bureau of Reclamation (BOR) operates the 220,000-acre Klamath Irrigation Project located in the Upper Klamath Basin of south-central Oregon and northern California. Established in the early 1900s, the main source of water for the project is Upper Klamath Lake (UKL). UKL is considered primary habitat for two lake-obligate endemic fishes: endangered Lost River (*Deltistes luxatus*) and shortnose suckers (*Chasmistes brevirostris*) (both listed in 1988). Monitoring in UKL over the past decade indicates these fish populations suffer from chronic year-class failure, and unless age-0 survival and subsequently recruitment rates are improved, the aging population could become in serious risk of extinction within decades. To date, there is still considerable uncertainty as to which factors are most important in determining survival rates of endangered suckers, particularly within the first year of life. We will 1) provide some background on key issues impacting sucker populations and their habitat, 2) briefly review monitoring and research programs, and 3) discuss information needed to further understand key issues impacting suckers and their habitat.

Recovery from Barotrauma in Black Rockfish (*Sebastes melanops)* (Session 3)

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Currently all mortality of overfished species of rockfish (*Sebastes* spp.) is 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 been done to follow the physiological recovery of rockfish after recompression and to determine if it is possible for rockfish to survive such a severe physical stress. In this study, I induced barotrauma with subsequent recompression in black rockfish that were acclimated to 3.5 ATM (35 m) using hyperbaric chambers at the Hatfield Marine Science Center. Following recompression, rockfish were slowly acclimated to surface pressure and transported to 2.4 m diameter tanks for recovery. Blood and tissues (brain, eye, gill, pseudobranch, heart, head kidney, liver, rete mirable, and gonad) of rockfish were sampled at 2, 14, and 30 days post-recompression to evaluate the stress and tissue-level response during recovery from barotrauma. This paper will present results from histopathological analyses of affected tissues and levels of cortisol in recovering fish.

Got Stress? Environmental Stressors in a Fish Model Organism (Session 3)

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Environmental stress adversely affects the health, welfare, and fitness of natural and cultured fish species. A better understanding of how fishes respond to stressors will aid in improving environment and fitness. We have demonstrated whole-body cortisol to be a useful indicator of crowding and handling stress for zebrafish, *Danio rerio*, a popular fish model. Crowding fish, for a period of 3 hours or 5 days, resulted in a four-fold increase in whole-body cortisol levels compared to fish that were not crowded. Feeding and tank density were important factors in modulating the cortisol response to crowding. Fish weight was inversely related to the cortisol response to crowding. Severe net stress resulted in a six-fold increase in whole-body cortisol compared to controls (no net stress). Cortisol levels increased linearly, at 3 to 6 minute increments after net stress, peaking at 15 minutes. A similar decrease in cortisol was observed; at 60 minutes the cortisol level of the net stressed group did not differ significantly from control fish. Understanding the zebrafish response to environmental stressors will allow environmental standards to be established for this widely used model species and may provide insight into the stress responses of other fish species.

Evaluation of a Fry Transfer Method for Expanding the Range of Bull Trout in the Upper Willamette Basin (Session 6)

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Prior to ESA listing, ODFW and USFS initiated cooperative efforts to expand the range of bull trout (*Salvelinus confluentus*) in the McKenzie and Middle Fork Willamette basins. In the McKenzie basin, we provided access to two historical spawning and rearing tributaries blocked by impassable culverts and transferred 7,000 fry to repopulate these areas. Bull trout are successfully spawning in the newly accessible areas. In the Middle Fork Willamette above Hills Creek Reservoir, a combination of factors including application of rotenone, land management practices, and angling effectively eliminated bull trout from the basin. Surveys in the 1990s failed to detect bull trout, although suitable rearing habitat was identified, and we concluded that bull trout were either extirpated or present at very low levels. We developed a rehabilitation plan for the Middle Fork Willamette bull trout population that identified Anderson Creek, a tributary to the mainstem McKenzie, as a fry donor source to repopulate the Middle Fork Willamette. Habitat and prey-base restoration, combined with transfers of 10,000 fry over a period of 9 years, were rewarded with at least 11 sexually mature bull trout in the Middle Fork Willamette River in 2005. Changes to fisheries management combined with public education were a common theme to these reintroductions. Success of these fry reintroduction programs is not without economic and potential ecological costs, which we continue to monitor and evaluate.

Larval Transport versus Larval Retention of Two Endangered Lake Sucker Species in Upper Klamath Lake, Oregon (Session 11)

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Early life history theories such as member/vagrant and match/mismatch are an attempt to investigate and constructively explore these crucial early periods in fish population dynamics. Some of the more recent larval literature has a more proactive perception of the ability of larval fishes to remain in or attain appropriate nursery grounds. Most of these insights come from marine settings and less work has been done in fresh water. The present study is an examination of the retention and transport differences between two closely related catostomid species in a highly altered lacustrine/riverine complex. The two species of interest are the endangered Lost River, *Deltistes luxatus* and shortnose suckers, *Chasmistes brevirostris* found in Upper Klamath Lake, Oregon. This study focuses on the patterns of larval retention and transport expressed by these two species while also examining temporal and geographic differences in the spawning patterns of the adults. The results of this study indicate that the two species differ in their tendencies towards retention. The Lost River sucker appears more likely to be transported away from its source or nursery area while the shortnose sucker appears more likely to be retained. Results are presented in a format that attempts to highlight the conservation consequences of these larval patterns.

Index Surveys: Beyond Trend Data (Session 9)

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The 1995 amendment to the Pacific Salmon Treaty has created a shift in Chinook harvest management, from a ceiling-based to an abundance-based management scheme. In order to participate in the management of a mixed stock fishery, an accurate, relatively precise and cost-effective means to assess Chinook abundance must be identified and implemented by all members of the treaty. The state of Oregon is currently researching the applicability of calibrated index surveys to meet these requirements. Index surveys (also known as "standard surveys"), while considered to be trend indicators, are generally thought to have little utility in assessing fish abundance due to their limited number and their non-random selection process. Comparison of abundance estimates from mark-recapture studies to those independently derived from index surveys in the Salmon River basin over the past 15 years suggests that both accurate and precise basin-wide Chinook escapement estimates may be obtained from two index survey stream reaches in this basin. The Coastal Chinook Research and Monitoring Project of Oregon's Department of Fish & Wildlife has been engaged in the analysis of this Salmon River data as well as other studies to determine the advantages and pitfalls of this technique.

Sex Matters: Differential Effects of Steroid Hormones snd Extracellular Glucose on Cardiac Tissue from Male and Female Rainbow Trout (Session 6)

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The rigors of the spawning migration and reproduction may manifest themselves differently between the sexes. We therefore determined whether steroid sex hormones and extracellular glucose modulate cardiac function in rainbow trout. We used isolated, electrically-paced, ventricle strips from 10-12 month-old, sexually immature, hatchery-reared fish tied to isometric force transducers, placed in individual tissue baths containing oxygenated teleost Ringers, and stimulated to contract at 0.5 Hz. Physiologically relevant concentrations of testosterone (T), 11-ketotestosterone (KT) and 17ß-estradiol (E2) promoted cardiac contractility (inotropism), in a sex-dependent manner. Specifically, ventricle strips from male fish responded to T and KT, but not E_2, and females only responded to E2. The inotropic effects of sex steroids on ventricular strips were rapid (10-15 min) at 15°C and appeared to involve binding to specific intracellular receptors, and a metabolic requirement of extracellular glucose. Male ventricle strips had increased inotropic responses to glucose and T compared with female strips exposed to glucose and E2. Preliminary characterization of cytosolic T and E2 receptors has shown their presence, but without obvious sexual dimorphism. Together, these observations 1) highlight the importance of sex for steroid-mediated inotropy and energy metabolism in the teleost myocardium and 2) raise a question as to whether steroids improve cardiac performance *in vivo* during spawning migrations. This research was funded by NSF (IOB-517669) and the Oregon Cooperative Fish Research Unit.

Evidence for Differences in Sex Ratio, Swimming Performance, Morphometrics, and Incidence of Disease in Coho Salmon (*Oncorhynchus kisutch*) from West Fork Smith River, Oregon (Session 6)

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We conducted streamside measurements of swimming performance of wild, pre-smolt coho salmon from a cold tributary and the warmer mainstem of the West Fork Smith River during summers of 2004 and 2005. We also examined morphologic variation, biochemical indices of energy metabolism, health status, and genetic characteristics of these fish. Sex ratio differed between the tributary (27 females:9 males) and mainstem (13 females:25 males) sites. Fork lengths were similar between sites although fish in the tributary were heavier. Regardless of sex, fish in the tributary had larger heads and deeper bodies. At 18°C, critical swimming speed was similar between fish in the tributary or mainstem. However, females swam better than males independent of site. Biochemical analysis revealed that fish from the tributary had higher circulating lipids and citrate synthase activity in white muscle than mainstem coho salmon, suggesting a greater potential for aerobic metabolism. Preliminary analysis also suggests a lack of genetic differences between sites. All mainstem coho salmon were parasitized with metacercaria of a digenetic trematode, whereas only one of 24 fish from the tributary was infected with the parasite. *Myxobolus arcticus* and *Edwardsiella tarda* were also observed at a low prevalence in mainstem coho salmon but not in tributary fish. These results suggest that sex and or site differences exist in morphometrics, biochemistry, and parasite load of juvenile coho salmon in West Fork Smith River. Ultimately, these differences may be related to swimming performance and survival during the freshwater life phase.

Effect of Smallmouth Bass (*Micropterus dolomieu*) on Native Frogs and Fishes in Cow Creek, Oregon (Session 4)

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Foothill yellow-legged frogs (*Rana boylii*) were surveyed over a 36-km stretch of Cow Creek, a tributary of the South Umpqua River. Multiple habitat variables, including presence and abundance of other aquatic vertebrates, were measured in an effort to investigate patterns of frog occurrence. Frog abundance and distribution were inversely related to abundance of smallmouth bass (*Micropterus dolomieu*). Bass abundance was found to be the single best predictor of the presence of frogs. Bass abundance was also inversely related to presence of some native fishes (shiners, *Richardsonius balteatus*; and dace, *Rhinichthys* spp.), across the study reach. These data, along with historical records, suggest that smallmouth bass have extirpated yellow-legged frogs and some native fishes along parts of Cow Creek.

Managing the Impacts of Expanding Colonial Waterbird Populations on Juvenile Salmonids (*Oncorhynchus spp*.) in the Columbia River Basin through a Spatially Explicit & Web-Accessible Database (Session 8)

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The general pattern in science has been for individual researchers to maintain and analyze their own data, allowing access to it only upon special request. However, with large publicly funded projects, data dissemination and long-term maintenance often become of primary importance. An example of such a project is the National Oceanic and Atmospheric Administration *Avian Predation* study in the Columbia River Basin. Since 1987, approximately fourteen million juvenile salmonids (*Oncorhynchus spp*.) have been implanted with passive integrated transponder (PIT) tags throughout the Columbia River Basin in an attempt to track these fish throughout the system. Before they can reach their final destination however, a significant number of these fish are preyed upon by piscivorous waterbirds. Subsequently, the indigestible PIT tags are regurgitated onto the various predators' nesting colonies, serving as a telltale sign of consumption. In 1998, personnel at Pt. Adam's Research station in Hammond, Oregon worked to modify detection equipment so that PIT tags could be read directly from these locations, and to date, over 525,000 tags have been electronically recovered from bird colonies throughout the Columbia Basin. A multitude of research and management questions could be addressed directly if this data were available to decision makers in an easily accessible format. Towards this end, we have been working closely with the Northwest Fisheries Science Center Salmon Data Management Group to develop a spatially explicit (map-based), web-accessible database to facilitate access to this data, and we will present the results of our efforts to date.

Non-Indigenous Species of the Pacific Northwest: An Overlooked Risk? (Session 14)

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Non-indigenous species are recognized as one of the major threats to global diversity and have been cited as a cause of decline in 42% of species listed under the US Endangered Species Act. The Pacific Northwest is home to more than a thousand aquatic and terrestrial non-indigenous species, yet the effects of most of these species on native populations, communities, and ecosystems remain unknown. During their life cycle, salmonids traverse large geographic areas spanning freshwater, estuarine and ocean habitats where they encounter numerous non-native species. To date, the cumulative impact of non-indigenous species on salmonids has not been described or quantified. We examine the extent to which introduced species are a potentially important risk to threatened and endangered salmon, ultimately by contributing to higher levels of life-cycle mortality. We identify and categorize all documented introduced species in the Pacific Northwest, including fish, invertebrates, birds, plants, amphibians, and others. Where data exist, we quantify the impact of non-indigenous and range-expansion species on populations of threatened and endangered salmonids. For example, birds and fish predators are reported to consume 0-40% of juvenile salmon in some habitats. These data indicate that the impact of non-indigenous species on salmon is equal to or greater than commonly addressed impacts (habitat, harvest, hatcheries and hydro-system) and suggest that managing non-indigenous species impacts may be imperative for the recovery of these fish.

Importance of Marine-Derived Nutrients in Idaho Stream Food Webs: Implications for Juvenile Chinook Salmon (Session 7)

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It is increasingly clear that marine-derived nitrogen and phosphorous once delivered to the rivers of the Columbia Basin by spawning salmonids are a critical part of Pacific Northwest ecosystems. Because many streams in which salmon spawn and rear are inherently nutrient poor, the delivery of marine-derived nutrients by returning salmon carcasses may be crucial to survival of juvenile salmon. The Salmon River basin in Idaho is home to several threatened or endangered salmonids. Their recovery is contingent on the existence of fully functioning ecosystems with adequate productivity to support viable populations. We have monitored 17 streams in this basin to examine whether reductions in marine-derived nutrients are limiting stream productivity and subsequently the survival of wild juvenile salmon. We combine data on survival rates of wild Chinook with measurements of water chemistry, nutrient limitation, periphyton and invertebrate biomass, fish species composition and density, and habitat characteristics to examine relationships among nutrient status, juvenile survival, and stream productivity. Results indicate that these streams are nitrogen limited, with near-zero nitrate concentrations in many streams. Across streams, water chemistry is positively correlated with periphyton biomass ($r = 0.37$). In turn, periphyton biomass is positively correlated with invertebrate density, both within and across streams ($0.35< r <0.9$). These data point out a series of positive relationships between nutrient status and biomass of differing trophic levels. Such data are needed to understand how marine nutrients contribute to stream productivity and conditions for growth and survival of juvenile salmonids.

Southeast Oregon's Endemic Non-Salmonid Fishes: Results from 2005 Investigations and Proposed 2006 Investigations (Session 1)

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In the 1980's, threats to fishes in the high desert of southeast Oregon resulted in federal listings of four endemic non-salmonid species: Foskett speckled dace (*Rhinichthys osculus ssp*.), Hutton tui chub (*Gila bicolor ssp.*), Borax Lake chub (*Gila boraxobius*), and Warner suckers (*Catostomus warnerensis*). In 2005, Oregon Department of Fish and Wildlife's Native Fish Investigations Project, with the assistance of state and federal biologists, obtained population abundance estimates and assessed habitat conditions for the three cyprinid species. In addition, ODFW developed proposals for future studies of Warner suckers. Results of these efforts will be discussed.

Reconnecting the Rogue River to the Channel Migration Zone: An In-Channel Bank Stabilization Project (Session 12)

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The 1997 New Year's Day Rogue River flood near Medford, Oregon entered historic channels, eroded a 150-foot-wide buffer, and captured an inactive gravel pond located within the channel migration zone. Channel redirection caused by pit captures threatened adjacent inactive gravel ponds. In response to this capture, a stakeholders group of concerned individuals and organizations was formed in June 2000. Volunteers collected channel and floodplain

data and completed a geomorphic analysis. Landowners and the Oregon Watershed Board funded the group, which ultimately developed a rehabilitation plan that conformed to the Rogue River's geomorphic trends. A two-dimensional model, FLO-2D, was used to evaluate channel splits, flood storage, backwater, and future conditions. Modeling results coupled with trend analysis were used to create a stable design where stream barbs, gravel redistribution, a channel outfall spillway, bendway weirs, bank reshaping, and revegetation were integrated into a single plan for a three-mile reach. The quick action by the stakeholders group averted further damage to the Rogue River system and high value fisheries habitat. The work was completed in 2002 and 2003. The project has preserved three miles of mainstem habitat, one mile of side channel habitat, and protected ten gravel ponds from pit capture.

Umatilla Spring Chinook Restoration: How Far Have We Come, and Where Do We Go From Here?(Session 15)

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Spring Chinook salmon were extirpated in the Umatilla by the early 1900's due to habitat degradation and agricultural development. The Federal Columbia River Power System further hampered their restoration. Carson-stock spring Chinook were used to re-establish a run in 1986, which has since naturalized. Recent returns to the Umatilla have ranged from 96 to 5,884, and averaged 1,926. Redd deposition ranged from 62 to 832 and averaged 309. Spawner and redd abundances have increased throughout the period (Rsq>0.5). Despite these successes scientists have questioned the program, citing limited natural production and genetic consequences of artificial production. Some have made calls for downsizing Umatilla production or limiting escapement. We assessed the current potential for natural CHS production using the Ecosystem Diagnosis and Treatment (EDT) model and the All-H-Analyzer to determine if recent trends in returns were in line with estimates of habitat capacity. The EDT estimate of steady state abundance was 440 adults. The Umatilla All-H-Analyzer estimate of natural abundance was close to 200 returns. Neither the EDT nor the All-H model included genetic information. The actual 10-year average natural return to the Umatilla has been 186 fish. The realization that actual returns are not markedly different from predicted returns, based solely on the evaluation of habitat conditions, suggests that the population is limited by habitat factors rather than by artificial production regimes. Downsizing the artificial production would impact abundance, Nef, allelic diversity, and natural production. We recommend no decrease in the current program, and careful monitoring of natural production trends.

Airborne Contaminants and the Effect on Fish in Western U.S. National Parks. (Session 16)

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Organic contaminants and some metals are known to accumulate in alpine and arctic aquatic ecosytems, precisely the areas characterized by many western U.S. National Parks. In other locations, some of these pollutants have been correlated to endocrine and pathological changes in fishes; however, little information exists for similar occurrence in alpine areas of the U.S. Therefore a multidisciplinary study, the Western Airborne Contaminants Assessment Project, was initiated to assess the levels and potential effects of contaminants in alpine and arctic biota. Fishes were captured in the summers 2003-2005, from 12 total lakes in Sequoia, Rocky Mountain, Gates of the Arctic, Noatak, Glacier, Mount Rainier, and Olympic National Parks or Preserves to be analyzed for contaminants, health, and abnormalities that may be evidence of contaminant exposure. PAHs, PCBs, PDBEs,

mercury and other metals, pesticides, herbicides, and fungicides have been found in the Parks, including fishes. In some fish, whole-body mercury approaches EPA and WHO toxicity guidelines for fillets. Upon capture, each fish was examined macroscopically for gross abnormalities. Otoliths were used to age the fishes, which ranged from 1 to 41 years. Plasma vitellogenin, a biomarker for xenoestrogens, was identified in some male fishes and, histological examination of the gonads indicated the presence of intersex fishes. We are also examining pigment macrophage concentrations in the spleen, liver, and kidney and correlating this with anthropogenic contaminants in these same fish. Our results suggest that anthropogenic activities likely occurring outside National Park boundaries may affect park biota, similar to highly impacted areas.

Restoration of Stream Physical Habitat and Food Resources: Influence on Juvenile Coho Salmon Growth and Salmon Derived Nutrient Incorporation in Coastal Oregon Streams (Session 7)

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Stream restoration in Western Oregon and Washington includes physical habitat improvement and salmon carcass additions. However, few studies examine the effects of carcass placement on juvenile fish in western Oregon, and in particular the interaction with physical habitat. Our goal was to explore how the placement of salmon carcasses and large wood affects juvenile coho salmon (*Oncorhynchus kisutch*) growth and salmon derived nutrient (SDN) incorporation. We studied three streams in the Coos Area with four treatment reaches per stream 1) reference, 2) wood placement, 3) wood placement + salmon carcass addition, and 4) salmon carcass addition. Growth was measured using PIT tagged coho and SDN incorporation determined from $d^{15}N$ and $d^{13}C$. We also conducted a survey of the incorporation of SDN in juvenile Coho across a range of natural and artificial spawner densities. Growth of juvenile coho was greatest in reaches with carcass additions alone. Wood placement had no impact of winter growth or condition. Our results may be limited to low winter flow conditions, since the winter of 2004 had unusually few storms. Along a gradient of spawner densities incorporation of SDN increased as natural spawner densities increased. We saw more incorporation of SDN from natural spawners than from placed carcasses indicating a difference in their function within the stream. Our results suggest that salmon carcass placement can improve juvenile Coho growth and condition under some stream conditions, and emphasizes the need for studies in a variety of stream conditions to assess the effects of stream restoration.

Development of a Maternally Transferred Marker for Salmonids (Session 9)

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This study was undertaken to determine if intraperitoneal cavity injections of strontium can be used to mark the otoliths of progeny of adult *Oncorhynchus mykiss* (anadromous rainbow trout) prior to spawning. Twenty-one adult females from Wallowa River, OR evenly divided between a control group and two treatment groups. Maternal parents received 1cc/500 g of body weight of a physiologically isotonic solution (0.9% saline) containing concentrations of 0 (control), 1000, and 5000 ppm of strontium chloride hexaydrate. A distinct external tag identified each maternal parent within each treatment group. All females were maintained in a single holding tank until spawning. After fertilization, developing embryos were divided according to treatment and family, incubated, hatched, reared, and sampled (length, weight, and otolith extraction). There is convincing evidence the ratio of strontium to calcium in sagittae otoliths among treatment groups was differenct (p-value < .0001; analysis of variance F-test). Artificially inducing strontium signals in otoliths may be used for distinguishing the progeny of

hatchery and naturally produced salmonids by analyzing otolith microchemistry. It is possible to assess the reproductive success of hatchery steelhead that spawn naturally.

Crane Prairie Reservoir: A Case Study of the Management Challenges Presented by Illegal Introductions (Session 1)

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Crane Prairie Reservoir in central Oregon has historically produced a blue-ribbon rainbow trout fishery supported by stocking of hatchery trout. Illegal introduction of largemouth bass in the early 1980s resulted in one of the best trophy largemouth bass fisheries in Eastern Oregon. The collapse of the trout fishery and a number of recent illegal introductions led us to repeat earlier work investigating the food web dynamics in Crane Prairie Reservoir. Hatchery rainbow trout suffered 96% mortality within 3 months of stocking; 19% of the loss could be attributed to predation by largemouth bass. Trout mortality appeared to be size selective as evidenced by examination of bass stomachs and the results of bioenergetic modeling of trout growth. Although trout diet varied seasonally, in August, we saw the highest degree of significant diet overlap between trout and smaller individuals of variety of species. Qualitative analysis of the reservoir fish community suggests that the present complexity of the system has eliminated managers' ability to predict the community's response to press perturbations with any certainty. However, initial management changes as a result of this study appear to be achieving at least partial recovery of the recreational trout fishery. Managing the reservoir largemouth bass population for a targeted level of predation on stocked hatchery trout is also discussed.

Oregon's Warmwater Gamefish: A State Manager's Perspective (Session 14)

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Warmwater gamefish have been part of Oregon's aquatic landscape since their introductions in the early 1900s. Their populations have increased in abundance and in popularity with anglers and now comprise an important component of Oregon's fish fauna with biological, social, and economical implications. As directed by our mission statement to "protect and enhance Oregon's fish and wildlife", ODFW developed the Warmwater Fish Management Plan, which provides a framework for management of warmwater species. Recognizing the importance of warmwater fisheries, ODFW's recently adopted Native Fish Conservation Policy directs the agency to "manage nonnative fish and hatchery based fisheries to optimize user benefits consistent with conservation of naturally produced native fish species. However, the lack of information or biased notions on the mechanisms and levels of interaction between native and introduced warmwater species often leads to simplistic and often inaccurate management strategies to deal with a perceived problem. A better understanding of the complex systems that native species now exist in will allow us to maintain important warmwater fisheries and reduce impacts to native species.

Abundance Trends of Age 0 Endangered Suckers and Other Fishes in Upper Klamath Lake (Session 11)

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Using a multi-gear approach (larval trawl, beach seine, cast net, and otter trawl), Oregon State University has monitored abundance of fishes in Upper Klamath Lake since 1991, with a more refined approach since 1995. The focus of our sampling design is towards monitoring trends in abundance of endangered age-0 larval and juvenile Lost River and shortnose suckers; thus we use gears that target smaller, shoreline-oriented fishes. Multiple indices show declining trends in abundance of age-0 Lost River and shortnose suckers since the late 1990s, while the most common nonnative fish, fathead minnow, has increased in abundance.

Effects of Elevated Water Temperature on the Mortality and Swimming Performance of Radio-Tagged Juvenile Chinook Salmon (Session 10)

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We compared the effects of elevated water temperature on subyearling Chinook salmon (*Oncorhynchus tschawytscha*) gastrically implanted with radio transmitters (tagged) and untagged controls. Our objective was to determine the temperature at which tagged fish show reduced performance relative to controls. We measured 24-h and 96-h post-tagging mortality rates and critical swimming speeds (U_{crit}) of laboratory-held hatchery fish (lab trials) and lower Columbia River active migrants (field trials) between the summers of 2004 and 2005. Test conditions were 19, 21, 23, and 25°C for lab trials and ambient river temperatures (20.7-22.5°C) for field trials. Transmitters averaged 4.0% of the fish's body weight during mortality experiments and 4.2% during swimming performance evaluations. Mortality in lab trials was significantly higher in tagged fish relative to controls at 23 and 25°C. There was high mortality in both tag (100%) and control groups (33%) at 25°C. In field trials, tagged fish had significantly higher mortality than controls in one of eight test groups. The U_{crit} of tagged and control fish at 21°C were not significantly different 24 or 96 h post-tagging. The U_{crit} of tagged fish held at 23°C for 96 h were significantly less than controls. At 25°C few fish were able to swim actively. Subyearling Chinook salmon began to show a significant tag effect, relative to untagged controls, between 21 and 23°C.

Miller Lake Lamprey Restoration Efforts (Session 4)

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Miller Lake lamprey *Lampetra (Entosphenus) minima* is the world's smallest parasitic lamprey. The Miller Lake lamprey along with an introduced tui-chub were believed to be responsible for poor rainbow trout survival in the recreational fishery of the mid -1950s that occurred in Miller Lake. Miller Lake was treated with toxaphene by the Oregon Game Commission to remove both the lamprey and the chub. At the time of treatment the lamprey was only known to exist in Miller Lake. The lamprey was presumed extinct. In 1992, a small lamprey captured by the United States Forest Service fishery staff in the Upper Williamson River was identified as a Miller Lake lamprey. Subsequent investigations have identified six local populations of this lamprey in two small subdrainages (Upper Williamson and Upper Sycan) of the Upper Klamath Basin including Miller Creek (outlet of Miller Lake). Miller Lake lamprey population surveys were conducted in 2004. Monitoring of this important population is scheduled to continue to document progress towards the re-establishment of a viable population in Miller Lake. A conservation plan was adopted by the Oregon Fish and Wildlife Commission in June 2005. This is the first species conservation plan adopted under the Department of Fish and Wildlife new Native Fish Conservation Policy. Goals of the plan are to conserve appropriate habitat, reduce entrainment, and to establish connectivity within and between local

populations. A man-made barrier built in 1959 to prevent the re-colonization of Miller Lake Lamprey from Miller Creek was removed in September 2005.

Pinniped Predation on Samonids and Other Fish at Bonneville Dam (Session 14)

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Pinniped predation on fish in freshwater rivers has been observed in several river systems along the west coast and as far back as the year 1805 on the Columbia River. Pinnipeds were heavily hunted until the enactment of the MMPA of 1972. Populations of California sea lions (*Zalophus californianus*) and Harbor Seals (*Phoca vitulina*) have increased in recent years to numbers higher than previously recorded. With several endangered salmonid species passing Bonneville Dam, the 2000 BiOp for Operation of the LCRPS required an evaluation to determine the impact marine mammals had on salmon populations passing Bonneville Dam. From 2002 through 2005 pinniped predation has been documented at Bonneville Dam, the percentage of the run taken increasing each year (0.4% to 3.4%). The Corps of Engineers, in cooperation with NOAA, WDFW, and ODFW, began to explore options to reduce pinniped presence and predation on salmonids in the tailrace area of Bonneville Dam last year. The agencies continue to struggle with the situation of trying to protect ESA listed species that are being impacted by another protected species. Meanwhile, the abundance, predation, and residence time of California sea lions at Bonneville Dam increases every year, with several animals boldly entering the fishways in 2005. The MMPA regulations limit the management options available to action agencies to non-lethal methods, with the last resort of lethal take permits being very difficult and time consuming to obtain. Non-lethal methods used at Ballard Locks, Washington and Bonneville Dam have had limited effectiveness to date.

Rearing Fall and Spring Chinook Salmon in Michigan and Oregon Raceways: The Umatilla Hatchery Experience (Session 10)

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Umatilla Fish Hatchery was built to raise Chinook salmon for reintroduction into the Umatilla River. It was designed to rear fish in both oxygen supplemented Michigan (MI) and non-oxygen supplemented Oregon (OR) raceways. Michigan raceways have self-cleaning baffles and reuse water three times in a series, whereas standard Oregon raceways reuse water twice in a series. We investigated water quality and cost between MI and OR systems and among MI passes for rearing subyearling fall and yearling spring Chinook salmon at various fish densities. Release size, condition, and health of smolts reared in each system were determined. Juvenile migration from MI and OR raceways was monitored with PIT tags throughout the Columbia basin. Smolt-to-adult survival and straying were compared between systems and among MI passes by marking and recovery of coded wire tags. There was no significant difference in fish size, condition, health, or migration between MI and OR raceways. Smolt-to-adult survival was slightly higher in Oregon than Michigan series, however cost of rearing in Michigan series was lower, and water use efficiency was higher, because fish could be reared at higher densities.

Ecosystem Responses to a Large-Scale Salmon Carcass Supplementation Program in Northwest Oregon (Session 7)

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In order to determine the efficacy of salmon carcass supplementation as a restoration tool, the entire anadromous lengths of several streams in Northwest Oregon were supplemented with 1134 kg, wet weight, of salmon carcasses per mile of stream length for two years. After two years of treatment, carcass loading was increased three to four-fold. Monitored ecosystem responses included water-borne nutrients, biofilm biomass, macroinvertebrate drift biomass, and mean fork lengths and condition factors of emigrating salmonid smolts. Responses were evaluated relative to those in control streams and, where possible, relative to baseline data. Neither carcass loading level resulted in a significant increase in the level of measured nutrients, relative to control streams or upstream control sites. Biofilm biomass did not increase to a significant degree in treatment streams relative to control streams at the lower treatment level. At the higher treatment level, biofilm biomass was significantly higher in treatment streams than control streams for six weeks after carcasses were added. Biofilm biomass in short reaches treated early in the season at the higher loading level, however, revealed no significant increases relative to upstream control sites. Neither mean coho salmon (*O. kisutch*) smolt fork length nor condition factor at time of emigration were higher in treatment streams than control streams at either loading level. Macroinvertebrate drift responses await evaluation. The results suggest that salmon carcass supplementation may not be a measurably effective restoration technique in many forested streams in Oregon, in terms of the ecosystem responses monitored in this study.

Examining Tradeoffs of Movement and Growth by *Oncorhynchus mykiss* of the South Fork John Day River (Session 3)

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Juvenile salmonids emigrating from a rearing area prior to maturation or smoltification have typically been characterized as "losers" of competition for food or space. This status may not hold through subsequent seasons, however, if emigrants gain access to improved conditions. During summer 2004 and summer 2005, we PIT tagged over 6,000 *Oncorhynchus mykiss* in Black Canyon and Murderers creeks, tributaries to the South Fork John Day River. We tracked the movement and growth of these individually marked fish during fall, a period when extensive movement of juvenile salmonids occurs throughout the interior Columbia River basin. An estimated 8.9% of the PIT tagged individuals from Murderers Creek migrated into the lower South Fork John Day, significantly higher ($P < 0.01$) than the 2.3% emigrating from Black Canyon Creek. Individuals that emigrated from the tributaries had significantly higher ($P < 0.01$) growth rates than those that remained in the tributaries during fall. The observed heterogeneity of emigration and growth rates during fall allowed for compensatory growth by emigrants. At summer tagging, the future emigrants from Murderers Creek were significantly shorter ($P = 0.047$) than those that remained in the creek. By the onset of winter, however, there was no significant difference ($P = 0.76$) between length of the initially smaller emigrants from Murderers Creek and the initially larger individuals that remained in the creek during fall.

Evaluating the Success of Outplanting Adult Spring Chinook Salmon (*Oncorhynchus tshawytscha*) in the North Fork of the Middle Fork Willamette and Little North Santiam Rivers, Oregon. (Session 15)

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The U.S. Army Corps of Engineers (USACE) operates and maintains a system of 13 dams and reservoirs within the Willamette River Basin located in northwest Oregon. These dams block access to a majority of the historic spawning habitat for spring Chinook (*Oncorhynchus tshawytscha*) in the basin. Since the 1990s the Oregon Department of Fish and Wildlife has been outplanting hatchery spring Chinook salmon upstream of dams in the Willamette Basin to provide nutrient enhancement, a prey base for native resident fish, and later as a means of supplementing natural production of spring Chinook salmon. To evaluate the success of this outplanting program we established the distribution and pre-spawning mortality rate of radio tagged adult spring Chinook released into the North Fork of the Middle Fork Willamette and Little North Santiam Rivers. In addition, USACE biologists collected mortalities for analysis to determine potential causes of death and conducted spawning surveys to calculate a fish / redd ratio as a metric to compare success between release locations. Date of release influenced distribution and the rate of pre-spawning mortality observed in radio tagged fish. Estimates of pre-spawning mortality ranged from approximately 50 to 100 percent. Analysis of recovered carcasses identified the presence of furunculosis and bacterial kidney disease. Fish / redd ratios for outplanted fish ranged from 6 to 34 and indicated differential success between release locations. Improving survival of outplanted fish will require upgrading existing trapping facilities and modifying protocols for handling fish within the Willamette Basin.

The Relationship between Flow Management and Oregon Chub Spawning Success in Hospital Pond (Middle Fork Willamette River Drainage) (Session 1)

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The Oregon chub, *Oregonichthys crameri*, is endemic to the Willamette Valley of western Oregon and was listed as endangered in 1993, primarily due to loss of suitable habitats and predation by nonnative fishes. Hospital Pond, located in the Middle Fork Willamette River drainage, supports a large, stable population of Oregon chub that is affected by management of Lookout Point Reservoir. Our studies have established links between reservoir elevations, pond water elevations, pond temperatures and Oregon chub spawning and recruitment. Recent changes in flow management, prompted by the listing of anadromous salmonids in the Willamette Basin, have the potential to affect Oregon chub recruitment and population abundance. We will discuss the results of a study to evaluate recent habitat modifications and their effect on Oregon chub spawning success.

Off-Channel Habitat Restoration in Floodplain Wetlands: A Case Study from the Lower Columbia Slough, Portland, Oregon (Session 16)

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The Lower Columbia Slough Off-channel Habitat Restoration Project, aka Ramsey Refugia Project, was completed in fall 2005 and restored 3 acres of historic tidal floodplain wetland habitat in the Ramsey Wetland Complex, a remant portion of the historic 650-acre Ramsey Lake. Floodplain wetland habitat is significantly less than what was historically present in the Lower Willamette and Lower Columbia rivers. The project principally restores hydrologic connnectivity and ecological function in the Lower Columbia River Estuary to benefit

federally listed Willamette River and Columbia River salmon, and benefit other native fish and wildlife. Project objectives include: 1) Restoring hydrologic connectivity between Ramsey Lake Wetland Complex and the Lower Columbia Slough; 2) Enhancing historic floodplain wetland habitat; 3) Increasing the amount of high quality rearing and refuge habitat for juvenile Chinook, coho, and steelhead, assisting in species recovery; 4) Improving water quality; 5) Engaging the community in restoration and monitoring; and 5) Monitoring fish and wildlife communities and distribution before and after project implementation. Improvement in ecosystem function will be monitored to ensure that the project provides additional habitat to native salmon, restores hydrologic connectivity and improves water quality.

Status of Klamath Basin Bull Trout (Lessons Learned Along the Way) (Session 13)

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In the early 1990s significant concerned was raised by agency biologists and private citizens regarding continued decline of Klamath Basin bull trout. In 1996 The Klamath Basin Bull Trout Conservation Strategy was written by members of the Klamath Basin Bull Trout Working Group. As a result of the Status of Oregon's Bull Trout written by Oregon Department of Fish and Wildlife in 1997, the Oregon Chapter of AFS recommended federal ESA listing of bull trout as endangered. Subsequently, bull trout were listed as threatened under the endangered species act in 1998. The Klamath Basin Bull Trout Working Group originally formed in the early 1990s to protect and conserve bull trout has re-initiated joint field activities after several years of relative inactivity. Several biological and political lessons have been learned after the listing of bull trout as threatened under the Endangered Species Act. Bull trout population status has changed in several streams since the Conservation Strategy was written. Seven populations of bull trout were sampled for status in the years 2001-2005 (Brownsworth, Leonard, Deming, Long, Dixon, Threemile and Sun Creeks). Bull trout populations in Cherry Creek, Upper Sycan River, Coyote Creek, Sheepy Creek, and North Fork Sprague River have been most likely extirpated or occur at very low population levels in recent time. Recent bull trout population status displays the urgency in promoting treatment projects using antimycin or some other action to reduce brook trout and brown trout interaction.

Enhancing Aquatic Habitat along Oregon's Highways through Multi-Agency Collaboration. (Session 12)

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The OTIA III State Bridge Delivery Program is part of the Oregon Department of Transportation's 10-year, $3 billion Oregon Transportation Investment Act (OTIA) program. The package includes $1.3 billion to repair or replace hundreds of aging bridges on major corridors throughout Oregon. Oregon Bridge Delivery Partners (OBDP) is a private-sector firm that has contracted with the Oregon Department of Transportation to manage the program. OBDP, a joint venture formed by HDR Engineering Inc. and Fluor Enterprises Inc., will ensure quality projects at least cost and manage engineering, environmental, and other aspects of the program. OBDP has developed a framework to integrate the myriad tools previously developed by ODOT for the program, including environmental performance standards, a joint batched-programmatic biological opinion, environmental baseline reports, a comprehensive mitigation and conservation strategy, and a web-based GIS. The purpose of this framework is to identify environmental concerns early in the project development process and communicate these concerns to design teams and regulatory agencies to promote environmental stewardship through impact avoidance and minimization. Phased environmental submittals have been developed, which coincide with the stages of project development. The initial submittal identifies critical environmental concerns and permitting constraints. The second submittal outlines the solutions to the earlier concerns. The final submittal includes the project specifications necessary to comply with the permits. OBDP then leads the construction compliance monitoring.

Phasing the submittals in this way allows early and continuous communication between the design teams and the regulatory agencies; thereby promoting environmental stewardship through collaboration and coordination.

Winter Concealment Habitat and the Behavior of Juvenile Spring Chinook Salmon in the Grande Ronde River Basin, Oregon (Session 15)

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Winter concealment habitat (WCH) quality was assessed and its use by juvenile spring Chinook salmon *Oncorhynchus tshawytscha* quantified in three hatching areas of the Grande Ronde River Basin, Oregon. Fish densities were significantly higher in pools with a higher WCH index than pools with a lower index. The mean fork length and mean growth rate of fish did not differ between pools with a higher or lower WCH index. Residual fish were significantly larger than fish that emigrated. Biomass-density (BD), a surrogate of carrying capacity, was significantly higher in pools with a higher WCH index than pools with a lower index in all three hatching areas. BD was positively associated with the amount of cobble substrate (10-24.9 cm/m^2) in all three hatching area, and inversely associated with embeddedness in two of the hatching areas. Results of this study indicate that enhancing WCH could improve habitat quality and increase winter usage by juvenile spring Chinook salmon.

What Do Your PIT Tags Represent? Use of the Separation by Code (SbyC) System for Unbiased Smolt to Adult Return Rates and Adult Run Predictions (Session 5)

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Passive Integrated Transponder (PIT) tags are used to obtain juvenile survival estimates and smolt to adult return rates (SAR's) of a tagged group or a population (based on a known proportion of the population tagged) to the lower Snake River dams. However using PIT tag detections from the returning adults will likely lead to inaccurate and biased estimates of SAR's and run size. Run size and SAR estimates will be influenced by the relatively high collection efficiencies (range of values) and default operation of the juvenile bypass facilities. The current default operation of bypass facilities are to send all PIT tagged fish back into the river and send all non-pit tagged fish to the juvenile transport system. Coupled with high collection efficiencies, the default operations of the bypass facilities result in a disproportional number of PIT tagged fish migrating in the river and non-PIT tagged fish in the transport system. Therefore, returning adults with PIT tags no longer accurately represent the non-tagged population. NPT researchers have implemented a methodology using the Separation by Code (SbyC) system to accurately represent non-PIT tagged fish regardless of management actions relating to collection efficiencies, transportation rates, or migration routes. This approach gives managers a valuable tool to calculate salmon and steelhead SARs at the dam or the stream level (if remote detectors or weirs are installed) and also gives a more accurate means of forecasting the number returning adults.

Resident Fish in the Columbia River Basin: Mitigation for Losses Associated with Hydroelectric Development and Operations (Session 1)

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Development and operation of Columbia River Basin hydroelectric facilities have contributed to the reduction in diversity and abundance of many native resident fish species. To mitigate for effects of hydroelectric development and operations, the Bonneville Power Administration (BPA) annually funds fisheries research and management projects. Recent annual expenditures by BPA for resident fish efforts have averaged about $19 million. Through this resident fish program, managers have begun to better understand and manage impacted resident fish habitats and populations; however, restoration of resident fish populations will require cooperation among resident and anadromous fish managers, hydrosystem operators, and federal regulators. Managers must ensure that power, water management, and land-use decisions consider effects on all fish populations. Only by better understanding the effects of hydroelectric operations on all potentially affected fish populations can fisheries managers develop an integrated program to mitigate and enhance resident fish populations of the Columbia River Basin.

Equipment for Liquid Nutrient Dosing in Small and Large Rivers in the Northwest (Session 7)

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Engineering requirements for liquid nutrient dosing in a small river (Sheep Creek, B.C.) and a large river (Kootenai River, Idaho) are discussed, based on our recent experience. Constraints in liquid nutrient dosing are that very small flows must be maintained with a fair degree of precision, reliably, at remote sites, for a period of several months. Experience with flow released from tanks via very small valves is that it is not possible to maintain steady flows for very long, because of partial or full blockage of the valve openings. Two successful projects that we have been involved with recently, adopted different procedures to achieve steady, reliable dosing flows. At Kootenai River (northern Idaho), the summer flows were relatively large (200 to 680 m^3/s range), and this implied that the dosing flows needed would be small but not very small. For final in-river concentrations of phosphorus of 1.5µg/L, a flow rate of 10-34-0 liquid nutrient in the range 0.08 L/min to 0.28 L/min was needed for the range of river flows expected. A gravity fed system, with the flow released via manually operated needle valves and through an accurate mini conductivity meter was designed and built. The operation during the 2005 summer season went extremely well, and the actual amount dosed to the river during the 2 month period was close (within 7%) to the desired amount of liquid nutrient. At Sheep Creek (British Columbia, Canada) the summer flows were small (0.5 to 5 m^3/s range). The 10-34-0 liquid nutrient was diluted 1:1 with water, and the flow amount needed to achieve an in river concentration of 5µg/L of phosphorus was very low, in the range 1.4 to 14 mL/min. Based on past experience, a decision was made to use a small, solenoid operated, industrial pump, that accurately dispensed this rate of flow. The equipment was installed in July 2004, and has now worked successfully for two summer seasons.

Smile! You're on Candid (Fish) Camera: Does Method of Observation Affect Fish Behavior? (Session 9)

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Snorkeling is a valuable method for enumerating fish and observing fish behavior. However, the presence of an observer can alter the behavior of subjects and affect interpretations of observations or experiments. As part of a research effort describing seasonal and spatial patterns of redband steelhead trout (*Oncorhynchus mykiss*) distribution and behavior, we examined the epistemological issues surrounding our primary sampling method of snorkeling. Diver observations of fish presence and behavior were compared with underwater video recordings in the absence of a diver. In addition, we examined behavior of fishes upon diver retrieval of the video camera, a scenario that represented typical snorkeling conditions and provided insight on candid behavior of fishes when a diver enters a pool. Preliminary results suggest that indeed, diver presence does affect the behavior of fishes. Video recordings of fish behavior will be presented, and a future experiment to determine the nature of interactions in the field between *O. mykiss* and redside shiners (*Richardsonius balteatus*) will be described. This research is being conducted on the South Fork of the John Day River in eastern Oregon in coordination with other Oregon State University researchers, NOAA Fisheries, and the Bureau of Reclamation.

Understanding Upper Klamath Lake Water Quality (Session 11)

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Upper Klamath Lake is a large (140 sq. mile) and shallow (mean depth approx. 8 ft) lake in south-central Oregon. Historical records indicate it has been eutrophic since its discovery by non-Native Americans, however it is now considered to be hyper-eutrophic with annual occurrences of near-monoculture blooms of the blue-green alga *Aphanizomenon flos-aquae* (AFA). Poor water quality conditions associated with the extremely long and productive AFA blooms are believed to be contributing to the decline of the endemic Lost River (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*), listed as endangered in 1988. Mechanisms relating to AFA bloom dynamics and water quality are complex. Recent modeling efforts incorporating water quality, lake bathymetry, wind data and current data have provided insight into the important role that the lake-wide circulation patterns may play in the occurrence of severe water quality events in the lake.

The Potential For Using Inaccessible Areas Above Large Dams For Spring Chinook Salmon and Winter Steelhead Recovery in the Willamette Basin, Oregon. (Session 15)

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During the 1950s and 1960s, large mainstem flood control and hydropower projects blocked fish from migrating into large areas of the upper Willamette Basin. The loss of spring Chinook salmon (*Oncorhynchus tshawytscha*) reduced species diversity and nutrients in these waters. During the 1990s, ODFW released juvenile and adult spring Chinook salmon into waters above these projects in an effort to provide forage for depressed bull trout populations and provide juvenile salmon for anglers utilizing reservoir fisheries. Subsequently, we found evidence of natural reproduction and out migration of Chinook salmon smolts through the projects. Data collected on spring Chinook salmon spawning success and smolt survival indicated differences by project and year. After Willamette

spring Chinook salmon and Willamette winter steelhead *(Oncorhynchus mykiss*) were ESA listed as Threatened in 1999, a multi-agency group initiated efforts to assess the potential for utilizing formerly accessible habitat above the projects as a tool for salmon and steelhead recovery. This ad hoc group has charted the course for the developing adult salmon and steelhead outplant program in the Willamette Basin, assessing and resolving biological issues and social impacts, and establishing priorities for research. Critical uncertainties remain regarding genetics, disease transmission, and passage survival. However, major changes are on the horizon for improving program success and strengthening its potential contribution toward spring Chinook salmon recovery.

Poster Abstracts Begin on Next Page

ABSTRACTS OF POSTERS

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

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

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

Poster Session & Social
Wednesday, March 1, 2006
Great Hall
7:00-11:00pm

(Abstracts of Papers begin on page 29)

Neoplastic Papillomas in English Sole—It's Not A Tumor! (Poster)

Jalal M. Al-Joundi[1], **Aaron C. Chappell**[2]*, Karissa A. Gerretsen[1], **Blake J. Hatteberg**[1]*, **Evan T. Leonetti**[1]*, Kristopher H. Miller[1], and Selina Heppell[1].
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English sole (*Parophrys vetulus*) and other plueronectids on the coasts of Oregon and Washington are subject to a neoplastic skin condition producing papillomas caused by an unknown parasitic protozoan. English sole rearing in Yaquina Bay have extremely high occurrences of this condition, which has not been observed on fish older than two years. We conducted tank studies using English sole from Yaquina Bay in an effort to understand growth and behavioral differences between fish infected with papillomas and those not. Fish were separated into study tanks according to their health condition: those visually infected with papillomas, those visually uninfected, and those visually uninfected which were exposed for two weeks to known-infected fish. All replicates were fed a gel-shrimp diet, and were weighed and measured weekly for a period of ten weeks. We uniquely marked fish in four tanks per treatment with fluorescent elastomer to record individual growth rates and the progress of the disease. We found differences in growth rates in both length and weight between fish infected with papillomas and those uninfected. We also examined the burying behavior of infected and uninfected fish to understand if papillomas affected the ability of fish to submerse in sand, and ultimately, if infected fish were at a higher risk of predation because of this factor. Because infected fish may comprise 50% or more of the juvenile sole population in Yaquina Bay in autumn, our research provides valuable information for management by revealing growth and survival differences which may affect population recruitment.

Abundance and Diversity of Larval Fish in Yaquina Bay, Oregon (Poster)

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Abundance and Shannon-Weaver biodiversities were calculated for ichthyoplankton samples collected from Yaquina Bay, Oregon during the winter and early spring of both 2004 and 2005. Samples were collected over a 24 hour period once per month from the Newport public pier between February and May. The highest larval fish biodiversity was measured in February 2005, and steadily decreased throughout the remainder of the sampling period. In contrast, overall biodiversity was lower in the early months of 2004 than 2005, but remained fairly constant with peak diversity occurring in April. Larval fish abundance was lower in 2005 compared to 2004 although the dominant taxa remained relatively constant between the two years. Groundfish species within the dominant taxa included *Ophiodon elongatus, Hexagrammos decagrammus, Parophrys vetulus*, and *Platichthys stellatus*. *Sebastes* spp. were present but never as a dominant taxon. Changes in biodiversity and abundance may be explained, in part, due to weak El Nino conditions in the northeastern Pacific during 2004-2005.

Modeling Aquatic Habitat in Tributaries of the Lower Columbia (Poster)

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Stream habitat data were used to describe the status of habitat conditions in the Youngs Bay and Big Creek drainages in the Lower Columbia River Basin, Oregon. Approximately 40 % of the watershed within coho salmon (*Oncorhynchus kisutch*) distribution was surveyed in the summers of 1990-2003. In addition, approximately 25 % of the watershed was surveyed in the winters of 1990-1993. We compared stream habitat metrics among the two drainages to reference conditions to understand the status of habitat conditions and quality. We used cumulative distribution frequency (CDF) curves to describe the status and quality of stream habitat attributes important to coho salmon spawning and rearing. Spatial and temporal (seasonal) comparisons were made to assess the features limiting coho salmon smolt status, production potential, and capacity. We estimated the summer and winter habitat capacity of coho salmon based on stream habitat attributes strongly correlated to smolt persistence. The potential for smolt production among streams in both drainages was estimated based on metrics representing high quality habitat. We further estimated total smolt production based on high quality habitat in these drainages as it applies to Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) fry.

Interactions Between Introduced Smallmouth Bass (*Micropterus dolomieui*) and Endemic Umpqua Chub (*Oregonichthys kalawatseti*) and Native Foothills Yellow-legged Frogs (*Rana boylii*) in Cow Creek, Oregon (Poster)

Jonathan Baldwin[1], **Jacob Godfrey***[1], Derric Jacobs[1], Matthew Hamilton[1], Caitlin Madden[1], Thomas Litwin[1], Tyler Reid[1], Kevin Stertz[1], and Alyssa Stutte[1]
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Since the introduction of smallmouth bass into the Umpqua River, Umpqua chub and foothills yellow-legged frogs, both native species, have declined throughout much of the mainstem. We chose six sites within an eight mile section of Cow Creek where all three coexist and examined species specific habitat use and predator-prey interactions. Bass associated with deeper pools and riffles, while chub were found closer to banks in shallower areas with aquatic vegetation. Yellow-legged frogs were observed on banks in rocky areas or on channel bottoms in shallow runs and riffles. Non-lethal stomach content analysis showed smallmouth bass fed on a variety of prey items including crayfish, sculpins, redside shiners, lamprey, frogs, and insect larvae. No chub were recovered from stomachs; however, other research has shown that chub are within the potential prey size range for smallmouth bass. It is unclear whether bass presence affects chub behavior; however, past surveys indicated that chub occupied the entire channel, which suggests that their association with vegetation was a behavioral response to bass presence. Yellow-legged frogs were found in habitats similar to those in previous studies without bass, suggesting that bass presence did not affect frog habitat choice. The impacts of bass on native species in the Umpqua drainage have yet to be fully quantified; however, the coexistence of chub, frogs and bass in our study area may suggest that partial prey refuges exist and are crucial to native species survival.

A Review of Outmigrant Estimators (Poster)

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The accurate and precise estimation of outmigrating juvenile anadromous salmonid abundance is a critical objective for managers. Several analytical methods have been used to estimate outmigrant abundance based on various trapping methods (e.g. rotary screw traps). All use an estimate of trap efficiency from mark and recapture applied to the total number of fish caught. SMOLT was developed in the late 1990's but has seen little use. More recently, DARR 2.0 and GSRUN50 have been developed. DARR 2.0 is a Windows-based program that uses a series of algorithms to combine strata of similar trap efficiencies. Once strata are defined, Darroch's formula is used to produce a total estimate. GSRUN50 is also Windows-based, but uses either maximum likelihood or Bailey formulae to produce point estimates and either profile likelihood or bootstrap formulae to estimate confidence intervals. We calculated the numbers of outmigrating juvenile spring Chinook salmon from Lookingglass Creek during August 2001- June 2002 using SMOLT, DARR 2.0, and GSRUN50. We compare point estimates, confidence limits, documentation, and ease of use of each of the platforms.

Fish Passage Projects on the Chewaucan River (Poster)

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Historically, the Chewaucan River flowed into the Chewaucan Marsh ultimately terminating at Abert Lake. Chewaucan Marsh provided rearing habitat for redband trout, *Oncorhynchus mykiss* ssp., allowing an adfluvial life history to be expressed within the population. The draining of Chewaucan Marsh and the construction of three channel spanning irrigation weirs (Narrows, Redhouse, and Town Weirs moving upstream) in the early 1900's removed the adfluvial component of the redband from the population. Conditions within the basin remained the same until River's End Reservoir was created upstream of Lake Abert in 1994 allowing the adfluvial life history to be reestablished. With adfluvial fish attempting upstream migration; passage around the three irrigation diversions became paramount. Construction on a concrete step-pool fish ladder was completed at the Narrows Weir in the winter of 2004-2005. A second step-pool fish ladder was constructed in the fall of 2005 to provide fish passage around the Redhouse Weir. These projects were a cooperative effort between ODFW and local ranchers with funding provided by the R&E Board and FRIMA. Construction on the Town Weir, the uppermost fish barrier, started in 2005 and is expected to be completed by the fall of 2006. The Bagley Ditch Company has spearheaded efforts on the Town Weir with much of the funding for the project being provided by the Oregon Watershed Enhancement Board. Completion of the three projects will provide barrier free fish passage for adfluvial redband trout within the Chewaucan River.

Barotrauma the Ultimate Death or Not? (Poster)

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Recreational fishing quotas for rockfish (*Sebastes* spp.*)* have been limited to high estimated mortality rates. These mortality rates may be overestimated due to inaccurate assumptions about barotrauma fatality. Barotrauma occurs when fish are brought to the surface from depth, and includes symptoms such as distended swim bladder and gut, extruded eyeballs, and tissue damage. Recompression is difficult so survival rates are expected to be low because of the expansion of the swim bladder. We investigated the effects of barotrauma on recompression of four rockfishes, *S. melanops, S. pinniger*, *S. flavidus,* and *S. mystinus.* We collected 185 specimens with hook and line off the central Oregon Coast between November 2004 and February 2005. Visual symptoms of barotrauma were: a) gut in mouth; b) bulged eyes; c) air in membrane; and d) tight belly. Captured fish were Floy tagged and immediately released either at the surface in a tubular, open-ended net, or lowered in a cage to a depth of 33 feet (1 ATM). Over 90% of *S. melanops, S. pinniger*, *S. flavidus,* and 61% of *S. mystinus* successfully recompressed in both treatments. Surprisingly, most of the fish released in our net appeared to successfully recompress on their own. Our results show overall, recompression and immediate survival rates were much higher than expected. Our results also confirm previous studies that show variance in sensitivity to catch and release fishing by species. Future research will attempt to correlate barotrauma severity with the amount of surface time before self-recompression, and to assess size-specific sensitivity.

Spawning Performance of Catherine Creek Spring Chinook Captive Brood Progeny in Lookingglass Creek, Northeast Oregon: Preliminary Results (Poster)

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Lookingglass Creek once supported a native population of spring Chinook salmon. By the early 1990's, this population was functionally extirpated due to dam construction, habitat degradation, and hatchery practices. From 1992 to 1997, Rapid River stock was used to restore natural production in Lookingglass Creek. In 2000, co-managers decided to only use endemic stocks from within the Grande Ronde basin. The Rapid River fish were phased out and captive brood smolts from Catherine Creek were used to again restore natural production. Catherine Creek captive brood smolts were first released in Lookingglass Creek in September 2001. Returning adults were outplanted above the Lookingglass Hatchery weir to spawn naturally in 2004 (n=100) and 2005 (n=57). There were 49 redds counted above the weir in 2004 and 29 in 2005. Adult spawner-per-redd estimates were 2.0 and 1.6 in 2004 and 2005, respectively. Adult spawner-per-redd estimates from 1964 to 1971 ranged from 1.6 to 2.4 and from 1992 to 1997 were 2.1 to 4.3. We were unable to detect a significant difference in spawner-per-redd estimates between stocks using ANOVA, ($p=0.133$). Spawning distribution was concentrated in the upper reaches of Lookingglass, between rkm 11.0 and 16.25. The peak spawning time of these stocks has remained consistent, typically occurring from August 24 to September 9. Comparisons between the native stock and the reintroduced Catherine Creek stock are problematic. We currently manipulate total numbers released, sex and age composition, accessibility to spawning areas and spawn timing.

Nutrient Enhancement in Oregon Streams: A Summary of Salmonid Carcass Seeding Efforts (Poster)

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Gaining a better understanding of (i) the extent of depleted anadromous fish runs and (ii) the role of salmon carcasses in delivering nutrients to spawning streams has resulted in an increase in nutrient enhancement efforts in Oregon. Here, we present a summary of Oregon's nutrient enrichment program and results of a survey to determine how this program is implemented across the state. Since 1997, Oregon Department of Fish and Wildlife (ODFW) has been distributing surplus hatchery salmonid carcasses and live salmonids in streams in an attempt to restore marine-derived nutrients depleted by reduced spawning populations. Annually, ODFW distributes an average of 107,000 kg. of salmonid biomass (ranging from 16,000 kg. – 200,000 kg.) to an average of 73 streams (ranging from 20 – 105). Based on 1997-2004 data, the combination of nutrient enhancement and current runs in Oregon coastal streams returns only 3-6% of historic nutrients. Among Columbia River streams in Oregon, only 1-2% of basin historic nutrient loading via spawning salmonids are being replenished.

We surveyed the twelve ODFW district biologists to determine specific objectives of enhancement programs, how streams are prioritized for nutrient enhancement, volunteer participation and outreach, approaches used, and monitoring. A summary of these results will be presented. While nutrient enhancement projects have returned only a small fraction of nutrients compared to historic loadings, they have contributed to education of and outreach to diverse community groups about salmon restoration. Careful monitoring of future efforts could reveal if these efforts contribute to stronger runs within local streams and rivers.

Automated Data Collection Technologies in Fisheries Science (Poster)

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Automated data collection (ADC) is the generic term for a number of technologies that bypass manual methods of data collection and data entry, thereby minimizing human error and significantly reducing time and labor. A well-designed ADC system offers both direct and indirect benefits including: increased accuracy and speed, reduced cost, increased data collection and productivity. How can these technologies be integrated into fisheries science? First, evaluate the possible applications. Which tasks are performed on a regular basis that could be simplified with the help of automation? Recording water temperature on an hourly basis and automatically exporting those data into spreadsheets and graphs could be one application of automated technology. Where are the bottlenecks or challenges in the current data gathering process? Challenges could include excessive labor costs, harsh field environments, and undecipherable penmanship on data sheets. With the incorporation of pen-based systems and touch screen technology, data collection could be streamline, legible and accurate. Will implementing ADC actually improve things, and if so, where would it be installed? Most technologies are portable and weatherproof, so it could be installed or toted most anywhere. What other modifications to the existing process might make sense or be required? What is the impact of all these changes on the job or overall process? Implementing ADC technologies into telemetry studies, habitat surveys, and tracking of animals are just a few opportunities to optimize data collection by reducing errors and increasing efficiency. An ADC developed for large-scale telemetry studies will be demonstrated.

The Importance of Beaver (*Castor canadensis*) to Coho Salmon Habitat, and Trend in Beaver Abundance in the Oregon Coast Coho ESU (Poster)

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Beaver have the ability to alter their surrounding environment to better suit their needs through the building of dams. Beaver dams impact the hydrology, channel geomorphology, and water quality of stream and rivers, primarily through the impoundment of water and the addition of woody structure to the stream channel. These alterations to the stream environment and channel processes benefit many fish species, including juvenile coho salmon. Beaver dams can play a crucial role in providing freshwater rearing habitat for juvenile coho, such as off-channel refugia and cover during high winter flows. In the Oregon Coast Range, fish habitat created by beaver dams has been shown to be an important factor in the production of coho smolts. Given the importance of beaver dam habitat to juvenile coho, an understanding of historic and current trend in beaver abundance in the Oregon Coast Range can provide valuable insight into the recent decline of coho salmon populations. This poster reviews information on the impact of beaver on streams and the use of beaver dam habitat by coho, and summarizes historic and current trend in beaver harvest and abundance for the Oregon coastal coho evolutionary significant unit (ESU).

If Presence/Absence is the Question, Hoop Traps Maybe the Answer (Poster)

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Fish biologist from State and Federal Agencies often lack fish inventory data for many creeks and streams in their districts. Regulatory agencies such as the Oregon Department of State Lands rely on fish inventory data to make decisions regarding land use issues. Fish presence/absence data maybe all that is needed to address land use issues involving housing or industrial development, timber harvest, or fish passage. Hoop traps may offer a relatively easy and inexpensive option to gather fish presence/absence data. Assembling the traps can be done by district staff and volunteers using tools and equipment commonly found in maintenance shops. Materials for building the traps, which include rebar and plastic mesh, are readily available and inexpensive. Traps can be built in various sizes to accommodate different creek or river sizes. Suitable trap locations are often available near bridges or roadways for easy access. Once deployed, traps catch a variety of fish species with few injuries or mortalities. Checking hoop traps is relatively safe and easy so volunteers can assist district staff with monitoring traps and collecting inventory data. Although total population estimate are not possible with hoop traps, when simple presence/absence data is needed hoop traps may provide the answer.

Differential Fall Migration of Wild and Hatchery Stocks of Spring Chinook Salmon From a Conservation Hatchery (Poster)

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Timing differences for a volitional fall emigration were apparent among wild and hatchery groups of spring Chinook salmon reared at Warm Springs National Fish Hatchery. Although juvenile performance (e.g. growth, survival) was generally similar among three crosses [hatchery-HH, wild-WW, and hybrid-HW] made to evaluate domestication effects, sampling showed that the migration rate of the WW cross was 2-3 times greater than the HH rate; the HW cross was intermediate. The fall volitional emigration for hatchery fish is both shorter in duration and is initiated later in the season compared to the emigration of naturally-reared fish and may be one pathway to

cause and allow behavioral differences between wild and domesticated fish. Estimates also indicated that 36-43% (11,000-14,000) of the fish from each of two raceways exited the hatchery and entered the Warm Springs River (tributary to the Deschutes River). The numbers of hatchery migrants were greater than expected and suggest that hatchery-reared fish may compete to a greater extent with wild Deschutes River Chinook than was previously considered.

Eagle Creek: Ecological Interactions Between Hatchery and Wild Fish (Poster)

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Eagle Creek National Fish Hatchery spawns and raises juvenile coho salmon (*Oncorhynchus kisutch*) and juvenile steelhead trout (*Oncorhynchus mykiss*) that are released into Eagle Creek within the Clackamas River basin. The purpose of the program is to mitigate fish losses in the Columbia River Basin caused by hydro-power dams, to provide commercial, sport, and tribal harvest, and to support tribal restoration programs upstream of Bonneville Dam. Limited information exists on the ecology and biology of wild fish in Eagle Creek and the impacts of hatchery management practices on wild fish behavior. The Columbia River Fisheries Program Office is undergoing a four year study to evaluate ecological interactions between hatchery and wild coho salmon and steelhead populations in Eagle Creek. The objectives of the study are to determine migration rate and movement of juvenile coho and steelhead following volitional release at the hatchery, track basin distribution and relative abundance of adult hatchery and wild coho and steelhead, and to determine the genetic contribution of hatchery and wild fish to natural reproduction in Eagle Creek.

Preliminary Evaluation of the Spawner Success of Carson-stock Umatilla Run Spring Chinook Salmon Outplanted in the Walla Walla River (Poster)

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Native spring Chinook salmon (*Oncorhynchus tshawytscha*) were extirpated in the Walla Walla Basin in the 1950's. CTUIR has experimentally outplanted Carson stock adult spring Chinook salmon in the South Fork Walla Walla River and Mill Creek since 2000. Due to their extirpation, little background information exists on the migration patterns, smolt production, survival, and habitat utilization for spring Chinook salmon in the Walla Walla Basin. Stock specific life history information is critical for determining success for current tributary restoration efforts. During the study period spring Chinook redds were assessed using three-pass visual surveys, juvenile fish were sampled using electrofishing and snorkeling, abundance of migrants was monitored using rotary screw traps and outmigrant timing and survival were monitored using PIT tags, and adult returns were monitored using visual and video surveys at adult weirs and ladders. Adult outplants utilized 68 rkm of suspected spawning habitat with redd counts ranging from 120 to 392 a year. Adult natural returns from one complete brood year (2000) signify a conservative 1:1.3 adult to adult return estimate of replacement. Densities of sub-yearling Chinook ranged from 0 to 28.3 fish per m^2 with the highest densities occurring in mid-elevation tributaries. Most spring Chinook tagged juveniles passed through the lower Columbia from mid-April to mid-June. An estimated 11,963 (SD 3,921) natural Chinook salmon emigrated from the Walla Walla River from December 2004 to mid-June 2005, primarily from mid-March to mid-May. Preliminary results indicate Carson stock spring Chinook salmon viably spawn, rear, emigrate, and successfully return as adults.

Conservation Strategy for Oregon: Focusing Conservation Efforts (Poster)

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The Conservation Strategy for Oregon, completed in October 2005, provided Oregon Department of Fish and Wildlife an opportunity to realign our conservation priorities, strengthen our partnerships within the conservation community, and create tools to help protect and enhance our natural resources. An important component of the Strategy was the development of Conservation Opportunity Areas (COAs), places Oregonians can focus conservation efforts to meet broad fish and wildlife goals. GIS tools were used analyze information on species and habitats, landscape condition, and existing planning efforts to define areas with the best suitability for conservation actions. Although these are not the only places we encourage conservation, focusing our efforts on priority landscapes will help us promote cooperation across land ownership boundaries, improve funding efficiency, and increase the likelihood of long-term success over larger areas. Along with the rest of the Strategy, Conservation Opportunity Areas will continue to be developed and refined to reflect a changing landscape and updated information.

Non-native Aquatic Vertebrate Assemblage Effects on Assemblage Trophic Structure in the Western USA (Poster)

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Nonnative aquatic vertebrates are widely introduced across the western USA. We analyzed data from the Environmental Monitoring and Assessment Program's (EMAP) Western Pilot to determine the effects of aquatic nonnative vertebrates on the vertebrate trophic structure in streams and rivers of 12 conterminous western states. A total of 1159 sites were sampled from 2000-2003, including 999 probability sites and 160 hand picked sites. Native and nonnative species trophic structure is reported westwide, by ecoregion (Plains, Mountain, Xeric) and by stream order. Westwide, omnivores and invertivores were five times more dominant than herbivores and piscivores, while in the mountain ecoregion invertivore/piscivores were dominant. Reference sites, determined by percentage of native individuals at site, allowed comparison with more disturbed sites. Non-natives generally increase the predator composition of the aquatic vertebrate assemblage and thus directly affect food web dynamics. Alteration of foodweb structure is likely detrimental to many federal and state listed threatened and endangered (T&E) species where they coexist with nonnatives.

Survey for Presence of the Invasive Species, *Potamopygus antipodarum,* in the Umatilla, Walla Walla, John Day and Grand Ronde River Systems (Poster)

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Baseline analysis and procedures for tracking invasion of non-native species within river systems may allow earlier detection and possible prevention and/or alleviation for natural resource managers. The goal of this project was to develop tracking procedures and provide the results for the presence and absence of the exotic New Zealand Mud Snail (NZMS), *Potamopygus antipodarum* a herbivore-detrivore rapidly spreading though out waters in the western USA. To date, there has been little research on the spread of the NZMS, its impacts on native macro-

invertebrates, or potential as a secondary host for vertebrate parasites, and diseases. NZMS consume the algae important to mayflies, caddis flies, and other invertebrates; and has been identified to out competing native species for the same food resources. Its reproduction occurs thought development of unfertilized eggs. It's a livebearer whose physiology and life history are conducive for an invasive style, and potential degradation of whole stream ecosystems over time. Suspected vectors responsible for its spread include: recreational users, fish hatcheries, unsuspecting water resource managers and aquatic birds. We evaluated 24 transect sites, using a Surber sampler/aqua view tube to evaluate physical substrate and composition of invertebrates in four main systems in the Wallow-Whitman, Umatilla and Malheur National Forests. No exotic Hydrobiids were detected at any of the survey sites. With some effort, fishery managers/fishers may now track and avoid the invasion of *Potamopygus antipodarum* into new ecosystems. Routine testing, developing education programs, and cleaning and disinfecting aquatic equipment, prevention could be priority.

Steelhead Movement in the Walla Walla River: Observations from Radio Telemetry (Poster)

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Decline of Middle Columbia River summer steelhead returning to spawn in the Walla Walla Subbasin has been attributed to agricultural expansion, hydroelectric development, hatchery practices, and over harvest. A lack of information on steelhead migration timing, habitat use, passage delay, and distribution was identified as limiting effective conservation in the subbasin. We assessed tag loss, movement, distribution, and passage delay of 181 adult steelhead (105 unmarked and 76 hatchery) using gastric radio tags. Fish were collected and tagged using tangle nets, angling and merwin trap below Walla Walla river mile 36.7. Both mobile (ground, boat, and aerial) and fixed-site telemetry were used. Fish were tracked weekly between September and June 2001-2005. Some 133 (73%) tagged fish (74 unmarked and 59 hatchery) were located upstream or distributed among 11 tributary streams. Mean upstream movement differed significantly (P< .001) between hatchery (37 +/- 16.5 miles) and unmarked fish (51.8 +/- 13.2 miles). Marked and unmarked fish were spatially and temporally mixed below Walla Walla river mile 36.7 (Burlingame Dam) and below Touchet river mile 54.0 (WDFW weir). On average, tagged fish moved from below Burlingame Dam (rm 36.7), past Nursery Bridge Dam (rm 44.7) and Little Walla Walla Diversion (rm 45.9) in 16.2 days (+/- 8.9 days) from January through April. Mean upstream delay at the six monitored diversions ranged from 7:34 to 128:18 (h: min). During March through June, 55 tagged steelhead moved downstream and left the Walla Wall River as Kelts. Study results have led to removal of passage barriers and been applied towards adaptive management within the subbasin.

Fish Passage in the Thompson's Mills Channel Complex (Lower Calapooia River) (Poster)

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Three dams on the lower Calapooia River, all located within the Thompson's Mill channel complex (Sodom, Shear, and the Mill race), have impeded fish passage for decades. In 2002, considerable effort was expended to understand precisely how salmonids, particularly ESA – *Threatened* spring chinook and winter steelhead, interact with the complex's various features (dams, channels) in order to facilitate the development of short and long term remedial strategies. Fish traps were operated in fishways on Sodom Ditch and the Calapooia to document chinook run size, migration timing, and channel route selection. The "Oregon Method" was employed to determine the minimum flow needs for adult salmon passage in the respective channels. Surveys of Sodom Ditch documented spawning by steelhead and Pacific lamprey though juveniles of the former, while initially abundant, had virtually disappeared by the middle of July, presumably due to the presence of excessive water temperatures. It is believed

that this Sodom steelhead "production" may be an anomaly resulting from passage deficiencies (false attraction/delay) at Sodom dam. Acquisition of the Thompson's Mills property by the Oregon State Parks Department in 2004 has greatly improved prospects for resolving remaining passage deficiencies associated with the subject dams. A multi-agency effort is currently engaged in addressing these challenges.

Supplementing Two Ecotypes of Steelhead *Oncorhynchus mkyiss* in the Hood River, Oregon—The Achievements and Challenges (Poster)

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A primary goal of the Hood River Production Program is to increase the production of indigenous populations of summer and winter steelhead *(Oncorhynchus mkyiss)* into the Hood River using supplementation, while minimizing project impacts to fish indigenous to the subbasin. Extensive monitoring has occurred to evaluate the success of the program. Run timing of wild summer and winter steelhead greatly overlaps, creating difficulties in identifying individual ecotypes. To prevent manipulation of run timing, wild broodstock is collected throughout the entirety of each run. Despite these precautions, ongoing monitoring of run timing data indicates the possibility of inadvertent mixing of the ecotypes. Managers have initiated a program utilizing newly developed genetic techniques, using microsatellite genetic markers to further lower this risk. Recent genetic data has shown first generation hatchery progeny from the supplementation program appears to be nearly equal to that of wild fish. Hatchery fish escapement into wild fish spawning areas are strictly controlled, creating unique challenges for fishery managers.

The Benefits and Challenges of Using Volunteers in Fisheries Management Projects (Poster)

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In the wake of funding reductions, natural resource agencies are now looking to make use of the time and expertise of community volunteers to meet a variety of fish management objectives. The use of volunteer service can provide public education, learning opportunities and improve the public's sense of connection to natural resources while reducing program costs. However, recruiting and training qualified volunteers takes considerable staff time and effort. Our staff recruits volunteers by regularly attending meetings of local interest groups, creating announcements of upcoming volunteer opportunities and talking with the public. We maintain a volunteer database that requires regular updating of contact information, volunteer hours and experience. We have developed methods for briefing new volunteers on safety, equipment use and data collection. New volunteers are continually being recruited requiring frequent trainings lead by our staff. The turnover rate for volunteers can be high which requires frequent trainings to provide volunteers with the necessary tools to complete projects safely, effectively and with confidence. Establishing quality assurance and quality control protocols are necessary to make efforts of both staff and our volunteers more productive. We recommend that staff supervise all work carefully while making necessary adjustments to protocols and equipment as necessary. We have found that recognizing and rewarding volunteers for their commitment and unpaid service is a worthwhile investment. We present examples of projects completed by volunteers in the south Willamette Valley.

The Long Way Home: Following the Journey of a Coded Wire Tag Code (Poster)

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Coded Wire Tags (CWTs) are used for data collection and management by biologists throughout the Pacific Northwest as a system for salmonid stock identification. A coordinated sampling effort is carried out by various agencies that gather and compile information in the Regional Mark Information System (RMIS) database managed by the Pacific States Marine Fisheries Commission. To illustrate the path a CWT must take from implantation at a hatchery to RMIS, a tag code was chosen to show harvest and escapement variability among five fall run Chinook salmon. In 1998, a group of 167,038 fish were tagged at Elk River Fish Hatchery, Oregon. The CWT tag code used was 09-24-49 and they were released in October of the same year. 4-5 years later, 3,381 returning fish were collected in different locations by sport and commercial fishery samplers, spawning ground surveyors, and hatchery employees. The presence of the CWT was externally indicated by the absence of the adipose fin. The snout was taken and sent to the CWT laboratory where it was extracted, decoded, verified, and entered into a state database. After the codes were validated, RMIS linked the tagged group's release record with the recovered fish's catch, recovery, and location data. Information from these tag code recoveries could then be queried for research or resource management objectives, such as the estimation of survival rate (3.39%), stock distribution, harvest contribution, stray rates, etc. Through continued cooperation among agencies, CWTs will remain an irreplaceable management tool for years to come.

Development of the Columbia Basin PIT Tag Information System (Poster)

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Within the Columbia River Basin (CRB), anadromous salmonid research often spans multiple geographic and jurisdictional boundaries. In 1987, passive integrated transponder (PIT) tags were first used in the CRB to monitor the migrations of 36 thousand juvenile salmon and steelhead (*Oncorhynchus* spp.) across these boundaries. Early collaborative efforts in the CRB to share standardized PIT tag mark/recapture data led to the development of a regional PIT Tag Information System (PTAGIS). In the early 1990s, PTAGIS assumed responsibility for the operation of most of the automated PIT tag detection (interrogation) systems in the CRB, and for the data collected by those systems. Since 2000, PTAGIS has operated the Separation-by-Code (SbyC) systems at six juvenile and two adult fish passage facilities in the CRB, allowing researchers to collect specific PIT-tagged fish at these locations or affect their passage (*e.g.*, selectively transporting targeted juvenile fish to below Bonneville Dam or bypassing them back to the river). The scope of PTAGIS has expanded in recent years to encompass the detection of adult salmon and steelhead, and the monitoring of adfluvial and resident fishes. In 2005, 1.9 million PIT-tagged fish were released at nearly 600 locations throughout the CRB. These fish were tagged by 19 separate resource management agencies or research organizations. Over 600 thousand individual PIT-tagged fish generated more than 8 million detection records at 51 interrogation sites in 2005, including more than 330 thousand target PIT tags that were diverted by the SbyC systems.

Temperature Monitoring in the Umatilla River (Poster)

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Umatilla River spring Chinook salmon were extirpated more than 70 years ago, but have been reintroduced by The Confederated Tribes of the Umatilla Indian Reservation (CTUIR), in collaboration with numerous state and federal agencies. Despite habitat and flow actions, many reaches of the Umatilla mainstem and its tributaries remain limited for spring Chinook by high summer water temperatures. The purpose of the study is to monitor water temperatures in the Umatilla Subbasin to assess the availability and condition of salmonid habitat. We deployed an average of 30 thermisters throughout the subbasin for the months May through October for 11 years. Vemco mini-logger thermisters were used because of their accuracy (+/- 0.05C) durability, range (0.0C to 39.0C) and data storage capabilities. All thermisters were tested and calibrated before deployment, and at retrieval. After the pre-season calibration was completed**,** the units were set to take a temperature every hour, and were then cabled to a tree with steel cable, and hidden to avoid tampering. Quality Assurance checks were done on each unit monthly during the study season. Mean Temperatures in Spring Chinook Spawning areas range from 5.5° to 10.8° in August . The lower spawning areas mean temperature ranges are 10.5° in May to 19.5° in August. Lower reaches of the main stem Umatilla River are supplemented with releases from McKay Reservoir (RM 50.5) during the irrigation season. These releases appear to have mitigating effects on stream temperature throughout, but are seperated from the mainstem due to significant irrigation withdrawals.

Designing Highway Bridges with Fluvial Considerations (Poster)

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The OTIA III State Bridge Delivery Program is part of the Oregon Department of Transportation's 10-year, $3 billion Oregon Transportation Investment Act (OTIA) program. The package includes $1.3 billion to repair or replace hundreds of aging bridges on major corridors throughout Oregon. Oregon Bridge Delivery Partners (OBDP) is a private-sector firm that has contracted with the Oregon Department of Transportation to manage the program. OBDP, a joint venture formed by HDR Engineering Inc. and Fluor Enterprises Inc., will ensure quality projects at least cost and manage engineering, environmental, and other aspects of the program. Environmental Performance Standards are at the center of an environmental framework developed for the program, including, a joint batched-programmatic biological opinion, environmental baseline reports, a comprehensive mitigation and conservation strategy, and a web-based GIS. The Environmental Performance Standards provide "directions" to the engineers and contractors – outlining how to build "green" bridges. The Fluvial Standard is one of the central Environmental Performance Standards. This standard provides for floodplain functions, including wildlife passage, aquatic habitat development, and flood storage. The Fluvial Standard is an excellent example of Context Sensitive Design—placing the bridge structure so it compliments and works with the landscape.

Influence of Gear Type on Prickly Sculpin (*Cottus asper*) Diet, Especially Predation of Juvenile Coho Salmon (*Oncorhynchus kisutch*) (Poster)

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Freshwater sculpins often inhabit the same waterways as juvenile salmonids and may impact survival through predation on early life-history stages. In this study I examined the stomach contents of 2302 individual *Cottus asper*, a freshwater sculpin, in Auke Lake, Alaska during the summer of 2000 to determine if *C. asper* are important natural predators of juvenile coho salmon (*Oncorhynchus kisutch*), and to explore possible trap bias of gear used in preliminary diet studies. I compared the diet of sculpins collected in confining traps with the diet of sculpins collected in nets. I found significant predation on pre-smolt salmon by trapped sculpins and none by netted sculpins. This result offers strong evidence of trap bias in the observed diet of *C. apser*. The remainder of the diet of trapped sculpins differed significantly from that of netted sculpins as well. Significantly more trapped sculpins had eaten plant material and fish while significantly more netted sculpins contained mollusks. Finally, sculpin diet was correlated with sculpin size, which may influence predation on other salmonid life-stages. These results expand our understanding of prickly sculpin diet and show that they are not important predators of juvenile coho salmon. These findings also demonstrate the importance of assessing the potential bias of collection gear and sampling techniques.

Temporal and Spatial Patterns in Trout (*Oncorhynchus spp.*) Diet in the Hinkle Creek Watershed (Poster)

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On Hinkle Creek, twenty miles east of Sutherlin, Oregon, we are completing an examination of aquatic biota prior to timber harvest of the South Fork headwaters; this poster presents an analysis of trout diet at sites in the lower, fish-bearing portions the watershed. Trout gut contents were collected in spring, summer and fall 2004 at three sites in each fork (North and South forks) of the watershed. At each site, 10 to 20 trout were collected by electro-shocking; fish were anesthetized and diet was collected by gastric lavage. In spring, in the five mainstem sites (3 South Fork, 2 North Fork), aquatic invertebrates were the main component of fish diet. In the sixth site, a tributary of the North Fork, fish consumed more terrestrial invertebrates. In the same season, proportions of insect orders, including terrestrial insects, found in the gut samples differed between the forks of the stream. In North Fork sites, fish ate mostly Diptera (true flies), as well as considerable numbers of Ephemeroptera (mayflies), and Trichoptera (caddisflies). In contrast, fish in South Fork sites ate mostly Ephemeroptera followed by Diptera. Preliminary data from summer and fall suggests large seasonal differences in fish consumption.

Outmigrant Performance of Catherine Creek Captive Brood Second Generation Progeny in Lookingglass Creek in Northeast Oregon (Poster)

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The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) co-sponsors the reintroduction of spring Chinook salmon (*Oncorhynchus tshawytscha*) in Lookingglass Creek under the Lower Snake Compensation Program to achieve recovery and enhancement goals. Co-managers (CTUIR and the Oregon Department of Fish and Wildlife), in 2004, out planted 50 pair of adult Catherine Creek captive brood progeny spring Chinook salmon above the hatchery weir in Lookingglass Creek, a tributary to the Grande Ronde River in Northeast Oregon. These

captive brood progeny were the first outplant of adults intentionally passed above the weir to spawn since 1997. CTUIR will evaluate the performance of these second generation (F_2) juvenile fish. The now extirpated Lookingglass Creek stock, which was studied from 1964-1974, will be used for a baseline comparison. An estimated 198,700 eggs were produced during the 2004 brood year. We captured 577 age 0^+ Chinook at a rotary screw trap July through October 2005. A total estimate of outmigrants was 7,216 with a trap efficiency of 9.7%. We compared growth and condition of fish in 2005 with data collected at standard sites in 1964-1970. Mean forklength of juveniles collected in August 2005 (80mm, n=51) was significantly different from mean forklength of fish collected in August during the years 1964-1970 (t=-8.51, P=.0001). We will continue to monitor the performance of these F_2 progeny during their entire life cycle.

Fish and Amphibian Species Tolerances to Anthropogenic Disturbance in Western Streams and Rivers (Poster)

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Fish and (more recently amphibian) species' tolerances to overall human disturbance are key components of most assessments of biotic integrity of aquatic ecosystems. These tolerance classification are used to develop metrics used in multi-metric indexes, such as the index of biotic integrity (IBI). Usually, species are classified as being tolerant, moderately tolerant, or intolerant (sensitive) to human disturbance. Traditionally, these assignments are based on a combination of professional judgement and information from "Fishes of ..." textbooks. We evaluated field data on chemical, physical, and landscape indicators of human disturbance collected at over 1,000 stream and river sites in 12 western States collected by the Environmental Monitoring and Assessment Program (EMAP). We used weighted averages and weighted upper standard deviations of species relative abundances to define species optimum and upper tolerance limits to the stressor measures. We produced separate tolerance classifications for the species in the Great Plains, and for the Forest Mountains and Xeric Lands ecoregions combined.

Historical Population Structure of Coho Salmon in the Southern Oregon / Northern California Coasts Evolutionarily Significant Unit (Poster)

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Developing an understanding of historical population structure of salmon populations within an ESU is a prerequisite in recovery planning that ultimately results in the development of biological viability criteria. Here we describe the historical population structure of coho salmon in the Southern Oregon/Northern California (SONCC) Evolutionarily Significant Unit (ESU) that includes coastal watersheds from Elk River (Oregon) in the north to Mattole River (California) in the south. Types of information considered included historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. Our analysis was strongly constrained by the lack of data available for consideration; therefore our determination of historical population structure was based primarily on a simple conceptual model of spatially dependent demographics of 59 populations considered to be historically present. Twenty populations that were determined to have minimal demographic influence from adjacent populations and

were viable-in-isolation were classified as Functionally Independent populations. Seven populations that appeared to have been viable-in-isolation but were demographically influenced by adjacent populations were classified as Potentially Independent populations. Small populations with a low likelihood of sustaining themselves over a 100-year time period in isolation and receive sufficient immigration to alter their dynamics and extinction risk were classified as Dependent (32 populations). In addition, the TRT organized the independent and dependent populations of coho salmon in the SONCC ESU into diversity strata largely based on the geographical arrangement of the populations and basin-scale environmental and ecological characteristics.