Poster Abstracts: Western Division American Fisheries Society, Boise ID

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Seven millennia of change: Comparisons of modern and ancient DNA from chinook salmon

Chinook salmon were historically abundant in the Columbia Basin. However, following the arrival of Europeans salmon experienced broad declines. Of all the factors affecting salmon, hydropower development (specifically the Grand Coulee Dam) had the greatest impact on their distribution; completely abolishing salmon passage above the point of construction. The Grand Coulee Fish Maintenance Project (GCFMP) of 1939 aimed to redirect spawning efforts of fish that would naturally pass Grand Coulee into lower tributaries. Adult fish were captured and released in tributaries below the dam or propagated for broodstock. As a result, all the Chinook in the region became a mix of the relocated stocks. The genetic makeup of current chinook populations in the Columbia is well understood; however, the genetic makeup prior to hydroelectric development is unknown. Here we offer an evaluation of genetic implications resulting from changes to the Columbia River Basin with a specific focus on Grand Coulee Dam and the GCFMP. Salmon DNA from the pre-European development period has been extracted from vertebrate collected at sites near the dam and compared to that extracted from contemporary stocks collected in the tributaries where salmon were transplanted during the GCFMP. Haplotype comparisons of mitochondrial DNA indicate that the most abundant haplotypes are similar to the original but auxiliary haplotypes may have gone extinct in this time. Also, it appears that significant losses in overall haplotype diversity have occurred in the region. This research provides a novel opportunity to examine genetic structure of salmon before the Columbia was harnessed.

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Development and Evaluation of Powerful DNA Tests for Early Detection of Invasive Zebra Mussels

Dreissenid mussels (*Dreissena polymorpha* and *D. rostriformis*) are two of the world's most problematic biological invaders, and have spread rapidly in several major N. American drainages since the 1990's. Dreissenid's are biofouling pests with the potential to cause rapid declines in native mussels. Besides being a costly nuisance to control, their prolific growth on all substrates can severely alter food webs by shifting resources from planktonic to benthic systems. We are developing real-time PCR tests for early detection of Dreissenid larvae (veligers) and potentially sloughed cells in plankton tow net samples. We spiked 2-4 microscopic veligers into plankton tow net samples from each of six Montana lakes and also spiked tow net extractions with low quantities of Dreissenid DNA. Preliminary data showed detection of Dreissenids in all samples, with sensitivity down to less than 1 veliger. To protect against false positive tests, all tow net DNA extractions are conducted in a separate lab with no PCR product or mussel tissue, using multiple negative controls and PCR amplifications per lake. Furthermore, real-time PCR tests greatly limit the possibility of cross-contamination by directly reading the PCR product in a closed tube. Finally, a portion of each original field sample is securely archived to allow independent verification by microscopy and PCR in independent laboratories. With additional funding we will quantify the sensitivity of the test compared to other newly developed PCR tests on 100s of spiked samples from multiple lakes.

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Development and testing of new variable SNPs, sex id, and species-diagnostic loci for bull trout from RAD sequence data

Bull trout from across the species range and from 8 focal populations in MT were used for SNP discovery in a RAD sequencing panel. Genotypes from a subset of 18 individuals (9 from across the range and 9 from MT) were used to identify a set of candidate polymorphic loci. The number of potential RAD loci were limited using several filtering criteria, including an observed heterozygosity greater than or equal to 0.2 and less than or equal to 0.6 across all samples. Loci were also required to have at least two polymorphic individuals from MT populations and one polymorphic individual from OR or WA populations. A second screening panel, just consisting of fish from MT populations, was used to identify 71 additional high heterozygosity loci in these populations. In addition, 24 individuals (12 males & 12 females) were used to try to identify a sex specific locus in the RAD sequence data. Three loci with an FST (between sexes) greater than 0.5 were identified as candidate sex ID loci. Sequences for species diagnostic loci and an additional sex id locus were provided by USFWS and the literature. KASPar SNP genotyping assays were designed for 115 variable loci, 71 additional variable loci for MT populations, 3 sex-specific loci, and 24 species-diagnostic loci. Assays were tested on 95 individual bull trout samples, including a subset of the same individuals used for RAD sequencing. Hardy-Weinberg proportions and concordant genotypes with sequence data or field sex id were used to validate the loci. These loci will provide additional resources for rapid assessment of bull trout population structure, gender, abundance (e.g. number of spawners), and hybridization across the species range.

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Advancements in Aquaculture and Supplementation of Imperiled Burbot in the Kootenai River

A conservation program developed by regional stakeholders incorporates aquaculture as one of several approaches to restore an imperiled burbot (*Lota lota*) population native to Idaho and British Columbia. Burbot are the only freshwater member of the cod family and populations are declining across the Northern Hemisphere. Research at the University of Idaho has focused on advancements in egg incubation, larviculture, juvenile propagation, and tagging that demonstrate the feasibility of large-scale production and stocking of burbot. Through collaborative efforts with tribal, state, federal, and provincial agencies, the production and experimental release of hatchery burbot has increased tenfold each year between 2009 and 2012. Over 16,000 burbot fingerlings were propagated, PIT tagged, and released into the lower Kootenai River last year. The use of genetic markers for parentage-based tagging of burbot recently enabled the release of 340,000 larvae and 28,000 juveniles without the need to physically mark individual fish. The Kootenai Tribe of Idaho is planning construction of a new hatchery facility for native fish conservation—burbot aquaculture could expand from an experimental research phase to population-level production necessary to rehabilitate the lower Kootenai stock. Aquaculture of burbot is also developing in other regions of the world in response to population declines, extirpations, and commercial interests. An opportunity exists for the NW region to establish a lead role in restoring the ecological and cultural significance of this unique species.

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Bull Trout age structure estimation based on mark-recapture history in the East Fork Salmon River, Idaho

The East Fork Salmon River (EFSR) trapping facility is operated annually to capture wild adult Chinook salmon. However, Bull trout (*Salvelinus confluentus*) are also incidentally captured at the trap. Since 2007, all Bull trout captured have been tagged with Passive Integrated Transponder (PIT) tags. From these fish, 455 recaptures occurred at least 1 year after the previous capture. Thus, with minimal additional resources, a powerful mark-recapture data set was acquired. Fabens' and Wang's modifications to the Von Bertalanaffy model were applied to this data to construct growth models for males, females, and all combined. Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and R2 values were used to determine which model was the best representation of the data. It was found that the Fabens' model with combined sexes was the best fit. This model was then used to estimate the age, based on length at the time of capture, for all individuals (n=1,358). The age at time of capture varied from 3-13 years old with most individuals being 5 years old (n=417). When compared with previous studies that aged similar populations of Bull trout using fin rays, the Fabens mark-recapture age structure appears similar. However, validation is needed to confirm or refute the accuracy of this estimation.

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The Boulder Creek Study: Increasing outreach through adventure learning

Donnelly Elementary School 5th graders have been involved for the past five years in a riparian restoration and water quality study of Boulder Creek. Their work has engaged additional landowners in the watershed in restoration efforts. Each year the students expand the study by adding another dimension to the project. With funding from AFS and the US Forest Service, a fish cam is used in the trout in the classroom aquarium for winter time behavior studies and during the rest of the year is installed in Boulder Creek for stream observation. Additional funding is being used to create videos of our study to share with our community and other 5th grade classrooms. Our 5th graders want to inspire more people to tackle stream improvement projects in their communities.

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Assessing Fish-Habitat Relationships at Multiple Spatial Scales

Geomorphic processes that shape fish habitat operate at varying spatial scales ranging, from large catchments and landscapes to smaller reaches and geomorphic units (i.e. pools, riffles, bars). These processes create a heterogeneous pattern of habitat assemblages along a riverscape. Fish, in turn, utilize a variety of aspects of this environment to complete their lifecycle, which can range great distances within a system. Research into fish-habitat relationships are most commonly conducted over relatively short distances, ranging 50 to 500m, and therefore may not reflect broader scale patterns and associations. Continuous surveys, via remote sensing or rapid assessments, have changed our perceptions of spatial frameworks that have been used to describe ecological and geomorphic processes. We are combining high resolution, site specific habitat and fish abundance data in conjunction with rapid assessment techniques, including fluvial audits, and snorkel population assessments, to expand our understanding of fish-habitat relationships at multiple scales throughout a watershed. We are using the River Styles geomorphic framework to identify process and form within a spatial nested- hierarchy. Fish abundance, growth, survival, and movement have been determined through watershed-wide PIT tag mark-recap and depletion surveys using electrofishing, along with rapid assessment single pass electrofishing, snorkeling, and mobile antennas surveys. The use of multiple methods, conducted at multiple scales is leading to a more comprehensive understanding of how geomorphic processes and patterns influence on fish assemblages.

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Lower Snake River Dams and the Conservation of Salmon, Steelhead, Pacific Lamprey and White Sturgeon

Wild populations of Snake River spring/summer chinook and summer steelhead are the most important spring migrating salmon remaining in the Columbia River basin. They once numbered in the millions but now are relegated to tens of thousands despite large expanses of quality habitat found in wilderness and roadless tracts in central Idaho and eastern Oregon and Washington. Historically some populations were extirpated from impassable dams and diminished by habitat destruction and harvest. The Snake River basin supports 30 major populations of wild spring/summer chinook and 25 major populations of wild summer steelhead. The biological diversity and genetic integrity of the 55 populations are remarkably intact but they are not viable - too many dams in their path to the Pacific. The cumulative harm attributable to eight mainstem dams and reservoirs in the Columbia and Snake Rivers has taken its toll. Recovery will require four fewer dams - Ice Harbor, Lower Monumental, Little Goose and Lower Granite – found in the lower Snake. Reservoirs and dams slow juvenile salmon migration rates subjecting them to direct and indirect mortality. Surface passage via spill results in the highest survival of smolts compared to turbine and bypass routes. Mitigation with dams in place is only interim – removal will be required for recovery. Global climate change is accelerating at an alarming rate as the earth's temperature rises, mirroring atmospheric carbon dioxide. Water temperature at Bonneville Dam has risen about 1.5 C since 1950. As temperatures continue to increase lower elevation salmon stocks will be pushed toward extinction. Higher elevation habitat found in Idaho's Salmon River drainage will offer valuable cold-water refugia to wild salmon stocks. Pacific lamprey - the forgotten species – passing Lower Granite Dam numbered 48 in 2012. Removing the lower Snake dams will allow lamprey the best chance for re-establishment. An additional 140 miles of free flowing lower Snake River will enhance habitat for white sturgeon that range another 100 miles upstream to Hells Canyon Dam.

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Survival and migration characteristics in the Lower Columbia River of post-spawn steelhead (*Onchorhynchus mykiss*) kelts transported from the mid-Columbia and Snake rivers and released below Bonneville Dam.

Acoustic and PIT-tags were used to examine the freshwater migration and survival of post-spawn steelhead *Onchorhynchus mykiss* kelts in the lower reach of the Columbia River (RK 233 to 0). Post-spawn steelhead from the Yakima River (mid- Columbia Basin) were collected at the Chandler Juvenile Bypass Facility beginning in 2004 through 2008 and resumed in 2010-2011. Collections of postspawn kelts from the Snake River at Lower Granite Dam were also included in 2010 and 2011. These fish were held for 2-30 days and then transported by either truck or barge to below Bonneville Dam at Hamilton Island (RK 233) or further downriver near Westport, OR area (RK 56). Migration speed was calculated based on detection times between 4 acoustic arrays. Travel times from both Yakima origin release locations averaged 6.9 days from release to the ocean. Snake River origin fish migrated slightly quicker with the Hamilton Island releases averaging 4.7 days while the Westport area releases averaged 5.6 days respectively. We estimated survival based on the presence/absence and longevity of detections. Survival through the lower river varied annually but averaged 44-48% for Yakima River origin kelts and 9% for the Snake River origin kelts released at the Hamilton Island site. Survival to the ocean for the Westport releases averaged 27% for Yakima origin groups and 35% for kelts originating from the Snake River. During 2004-2008 the majority of in-river mortalities 19% occurred in the estuary (RK 48 to 0). In 2010 and 2011 the mortality in this area increased to an average of 42% regardless of release location or river origin. The USGS and NOAA shared acoustic detection data with us to further refine where the mortality was occurring during 2010-2011 and determined that the mortality was between RK 48 to 29. Monitoring of return migration from the ocean was based on acoustic and PIT-tag antenna detections at the Bonneville Dam. Survival in the ocean averaged 1-2% for transported kelts returning to the Columbia River based on acoustic array and Bonneville Dam PIT-tag detections.

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Size- and Density-Dependent Outmigration of Juvenile *O. mykiss*

For salmon populations, many aspects of migration undergo significant natural selection and is generally favored under conditions when fitness of transient individuals is greater than those who utilize only a single habitat. However, resident and migratory individuals can coexist within a population (i.e. partial migration). In steelhead (*Oncorhynchus mykiss*), partial migration is considered an evolutionarily stable strategy as individual variation in the costs and benefits associated with migration leads to differing migratory strategies for maximization of individual lifetime fitness. While genetics likely play a role in determining the occurrence of migration, juvenile O. mykiss migratory behavior is highly plastic in response to conditions experienced in freshwater rearing habitat. As migratory individuals generally have higher fecundity than resident individuals at the hypothesized expense of survival, the proportion of anadromous spawners can significantly impact population dynamics. Understanding which fish migrate and the factors influencing this behavior is important for improving our quantification of life cycle demographics, our understanding of habitat relationships for juvenile salmon, and our conservation strategies for threatened populations. In Lapwai Creek, a hydrologically-altered watershed, we evaluated size- and density-dependent effects on O. mykiss migration. In summer 2012, we PIT tagged age 0 and age 1+ O. mykiss and monitored downstream movements during the subsequent outmigration period using in-stream PIT arrays. Based upon previous modeling efforts in the basin, we predicted that outmigration probability would be positively correlated with both body size and local density. Our results illustrate the variability in emigration strategies across space and suggest that density and size play a role on both the occurrence and timing of outmigration patterns. Our results have implications for our general understanding of life-history pathways of salmonids.

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Determining the effects of road construction on stream macroinvertebrates in the Páramo of Ecuador

Water quality around the globe is threatened by a wide range of factors including increasing anthropogenic changes in headwater areas. These changes include the construction of aqueducts, roads, dams and the establishment of more agricultural lands. Unlike similar ecosystems in the world little research has been undertaken to examine the effects this construction has in Southern Ecuador. Such changes are in part being driven by the expanding world population and the demands for freshwater. The increase in population is driving development into fringe areas, spurring infrastructure development into pristine headwaters and affecting the aquatic communities found there. The construction of roads through the Paramo of southern Ecuador is a highly disruptive activity yet little research has been done to assess the impacts. Road construction elsewhere has been shown to have a generally negative effect on aquatic communities yet my research shows that the construction of a road in this system has a generally positive affect on the aquatic macroinvertebrate communities present. This high elevation system appears to be highly oligotrophic with a very low natural nutrient input. My data shows that the health and diversity (measured through %EPT and Shannon-Wiener Diversity indices) in disturbed sites is higher than the health and diversity in pristine sites above the road, suggesting that the road has a positive impact on the community diversity.

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Musselshell Tunnel Realignment

The Musselshell Tunnel Realignment project is located along the mainstem of Musselshell Creek in the upper Musselshell drainage in Section 5 of T35N, R6E, Boise Meridian, Clearwater County, Idaho. The 7,000 acre project area lies within the Musselshell drainage above Gold Creek. The primary purpose of the Musselshell Tunnel Realignment project was to re-establish fish and other aquatic organism passage into upper Musselshell Creek above the historic Musselshell tunnel site. The tunnel was constructed around 1903 to facilitate mining activities in the area. Musselshell Creek was routed through the tunnel leaving the original stream channel dry. The tunnel acted as a complete barrier to the upstream migration of fish due to the vertical bedrock shelf at the upper end of it as well as the high velocities within the tunnel. Forest Road 540 was later constructed in and adjacent to the original channel in 1979. The purpose of the project was to improve access to potential habitat for fish, including steelhead, and westslope cutthroat trout, chinook salmon, and other aquatic organisms. A spawning survey completed by the USFS completed within the month after completion of the restoration, confirmed adult chinook above the tunnel.

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Clearwater Salmon Camp 2012

During August 13-15, 2012, we held a youth educational camp/workshop focusing on Chinook salmon out of Lewiston, Idaho. The session was a cooperative venture among the Idaho Department of Fish and Game, the Nez Perce Tribe, and the Lewiston School District. The venue allowed area youths to learn about Idaho's Chinook salmon and their plight for survival. Twelve kids, ages 11-16, were given three days of Chinook salmon education. All participating youths were recommended by school teachers, resource workers, or other professional workers, who attested to their interest in fish resources and their ability to work within their peer group. School districts represented by the participants included Lewiston, Lapwai, Genesee, and Moscow. The camp began on August 13 with a morning session of classroom presentations on Chinook salmon phylogenetic relationships to other fish species, life history, their habitats, the perils of passage around and through hydroelectric facilities on the Snake and Columbia rivers, the role of hatcheries in Chinook salmon management, and, finally, their role in the ecosystem. Following the classroom presentations, kids spend the afternoon at Lower Granite Dam where they were introduced to problems associated with navigating this and other concrete structures in their way of migrating to and from the ocean. On the second day participants observed the workings of the Clearwater Anadromous Fish Hatchery as well as getting some 'hands-on' experience in spawning Chinook salmon. Later that day and extending into day three the participants toured Chinook salmon adult trapping facilities on Crooked and Red Rivers, observed juvenile out-migrant trap operation on Red River, were educated on physical habitat used by different life history phases of Chinook salmon on Red River, and observed pre-spawning staging of Chinook salmon in Red River. The Idaho Chapter of the American Fisheries Society provided major financial support for this program. Other supporters included the Idaho Department of Fish and Game, the Nez Perce Tribe, Larry Barrett Youth Fishing Fund, Latah Wildlife Association, Joe Hall Ford of Lewiston, and B&C Development of Lapwai.

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An assessment of coastal and anadromous brook trout in New England

Brook trout in their native range are commonly stream resident individuals. However, in New England coastal streams brook trout can exhibit partial anadromy whereby a fraction of a population migrates into estuaries or the ocean. Like many diadromous fishes, anadromous brook trout, often called "salters," have declined in abundance and distribution, and their current status in New England is not well known. We conducted a rangewide assessment of coastal and anadromous brook trout from Maine to Long Island, New York. Across 471 streams, brook trout are thought to be extirpated from 57 streams where they occurred historically, but their status in 201 streams is still unknown. Most coastal brook trout streams were identified in Maine (317 streams) and the fewest were identified in Rhode Island (7 streams) where only two streams are known to occasionally have brook trout present. Only six streams in the region were identified as having anadromous brook trout with a high level of certainty; three streams in Maine and three in Massachusetts. There were 33 other streams from Maine to Long Island, New York where anadromous brook trout are thought to occur with a moderate level of certainty. A cumulative logistic regression model suggested that anadromy is more likely exist when brook trout are abundant, whereas the extent of available habitat connected to the sea had no association with the presence of anadromy. The assessment information will be used to inform a regional anadromous brook trout restoration program focused on habitat reconnection and restoration, watershed protection, and collecting additional information to reduce the uncertainty surrounding coastal and anadromous brook trout in New England.

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The Caldera Symposium: A Scientific and Angling Exploration of the Henry's Fork

The Henry's Fork of the Snake River between Island Park Dam and Mesa Falls, also known as the Caldera, contains some of the most renowned rainbow trout fisheries in the country. But some anglers have said that fishing is not what it used to be with fewer fish, diminished aquatic insect hatches, and degraded habitat in the Harriman State Park reach of the river. To address these concerns, we brought together leading scientific and angling experts for the first Caldera Symposium. The objectives for the symposium included:

1) Exchange scientific findings and develop future collaborations.

2) Gain an understanding of and identify potential research and restoration projects.

3) Gather perspectives from anglers and others about the river and the above objectives.

The full-day symposium was a culmination of the past five years of research by a technical team and other scientific experts. The topics presented included geology and hydrology, aquatic plants, trout ecology, angler surveys, and stream restoration. The symposium also included presentations about fly fishing in the Caldera from five renowned anglers, who have fished the Henry's Fork for several decades.

All angler presenters as well as several scientists participated in a panel discussion titled "Harriman State Park: What do anglers want and where do we go from here?" This discussion highlighted the need in the park for continued research on trout habitat including aquatic plants and macroinvertebrates. The angler presenters noted that the Henry's Fork in Harriman State Park has unique fly fishing qualities that are unmatched on other rivers. Other major themes from the symposium included the importance of winter survival of age-0 juvenile trout and ongoing improvement efforts in the Henry's Fork and its tributary streams. Many symposium attendees commented that the presentations and perspectives of both scientists and anglers worked well together and that they would like to see this event continued in the future. The symposium proceedings and presentation videos can be found at: www.henrysfork.org/caldera-symposium.

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The Pacific Northwest Salmon Habitat Project Database

The Pacific Northwest Salmon Habitat Project Database was created in 2004 after compiling data on restoration projects occurring in Washington, Oregon, Idaho and Montana as part of a project to learn more about the types and locations of restoration actions. Currently, the database contains spatially referenced, project-level data on over 31,000 restoration actions and over 51,000 project locations within the last 15 years from Federal, State, NGO and Tribal contributors. The total cost of restoration projects, with only sixty percent reporting cost information, is almost 2 billion dollars. The database has identified difficulties in regional project tracking and data standardization. The intent of the database is to assist with restoration project planning/design and prioritization. Currently the data is being used to compare restoration projects with data sets of ecological needs and asking if projects are being places to address these ecological needs. The full online database is available at https://www.devwebapps.nwfsc.noaa.gov/pnshp/

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Modeling processes that change the availability, connectivity and diversity of aquatic habitat at landscape scales

Native aquatic species in the Pacific Northwest are adapted to the dynamic disturbance processes that characterize the region and result in a diversity of in-stream and upslope habitats. Aquatic habitat diversity from the headwaters to the mouth is reflected in the diverse life histories of native species. For example, phenotypic plasticity in Pacific salmon allows these species to exploit the range of available freshwater and estuarine habitats. Alterations in disturbance processes associated with land management and climate change pose challenges to species adapted to natural regimes. We present two case studies that contrast different types of landscape alteration and different methods for modeling current and future riverscape condition. The first example is fire management in the western United States. Over the past century, effective fire suppression by land management agencies has altered natural fire regimes thereby modifying landscape processes that naturally enrich streams. For several species of native salmon in the Wenatchee River watershed, WA, we modeled (using Bayesian belief networks) habitat connectivity, quantity, and quality, and proximity of potential re-colonizing subpopulations, in response to predicted fire intensity. The second example is the potential effect of sea-level rise on the complexity, diversity and location of estuarine aquatic habitats. For anadromous aquatic species, the estuary offers a productive juvenile rearing environment and allows for the development of salt-water tolerance, critical for marine survival. We used a geospatial, remote-sensing approach (utilizing LiDAR) that quantified the potential effect of sea-level rise on the quantity, availability, and distribution of estuary and estuary-river ecotone habitats for Pacific salmon in Oregon. Both fire management and sea-level rise are landscape scale issues that require modeling approaches that target the characteristics of the process and the potential effect on aquatic habitat.

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Lower Salmon River Science and Stewardship Learning Strategies:combining science and outdoor adventure

Wild Science Explorers leads 3-5 day science and stewardship whitewater rafting trips for low income teens down Idaho's Lower Salmon River. Blending outdoor adventure, art, writing and scientific investigation, WSE's curriculum engages students in exploring the natural world around them. Using AFS funds, last summer students learned about stream ecology through macroinvertebrate study combined with a fly fishing lesson.

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Experiments in the use of video to monitor outmigrating Columbia River juvenile salmonids at Bonneville and McNary dams in 2011

In 2011, video was recorded of fish passing a viewing window at the Bonneville Dam juvenile bypass and subsequently reviewed. We estimated that only 8.6% of the smolts could be identified by species due to high turbidity, algae growth, the rapid speed of the fish, and the width of the area being monitored.

In 2011 we also used video and PIT tag technology at the McNary Dam juvenile bypass to capture PIT tag code-imprinted video images of selected juvenile fall Chinook tagged upstream in June, 2011 as they passed through a clear 10 cm diameter pipe. We detected 81 of the 86 PIT tagged fish which passed. Of the detected fish that could be positively identified, for 61.5% the presence/absence of an adipose fin could be determined and 47.8% were oriented parallel to the flow. Fish traveled through our system at up to 4.5 m/s resulting in only to two images per fish being captured. The majority of the fish observed (56.4%) appeared to be making contact with the inside of the pipe as they passed.

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Spatial and temporal variation of the fish assemblage in a subtropical estuarine system in the SE Gulf of California

The spatial and temporal variation of the fish assemblage in the estuarine system of Huizache (SE Gulf of California) was analyzed. This estuarine system is composed by channels with mangrove forests, and a lagoon where the mangroves are absent. Also the Presidio River drains into the north part of this system, causing a fresh water habitat in this part. Organisms were collected at monthly intervals from August 2010 to April 2012, using two gears: net cast net and gill net. A total of 2613 individuals from 66 species, 44 genera, 23 families and 7 orders were analyzed. The most abundant species were the snook (*Centropomus robalito*, 13.85%) and the mullet (Mugil curema, 13.39%), in terms of biomass, the highest values were for the Pacific ladyfish (Elops affinis, 17.98%) and the mullet (14.78%). The highest abundance was found during September, and the highest biomass was found during November. The canal area was the most rich and diverse, with 51 species. In the lagoon only 35 species were found. Nineteen species were found in the area most influenced by the river. Species were classified according to their habitat being marine (26) marine / brackish (23), marine / brackish / freshwater (16) and brackish / freshwater (3). The number of species unique to the channel area was 18, 9 for the lagoon area, and for the freshwater zone. Total biomass in the system was estimated to be of 104,111.03 kg.

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Effects of impoundments on brown trout source-sink dynamics in the Logan River, Utah: Conservation implications for endemic Bonneville cutthroat trout

Bonneville cutthroat trout (BCT; *Oncorhynchus clarkii utah*), once found in abundance throughout much of The Great Basin, now occupy less than 40% of their historic range. One of the largest remaining meta-populations of BCT resides in the Logan River in northern Utah. However, high densities of exotic brown trout (BNT*; Salmo trutta*) have displaced BCT from low elevation portions of the Logan River, and may serve as a source of expansion into remaining BCT strongholds. As part of a large collaborative effort to restore BCT, BNT have been experimentally removed annually from the 2.3 km section of free flowing river between two small hydroelectric dams (Second Dam, Third Dam). Preliminary results indicate rapid recolonization by adult BNT (Total Length; TL≥180mm) from source populations limits the effectiveness of removals for BCT conservation. Thus we initiated a mark-recapture study by tagging 382 BNT (TL≥100mm) in Second Dam Reservoir and 362 BNT in Third Dam Reservoir between 16 April and 4 May 2011. We recaptured fish from the Logan River upstream of Second Dam during sampling in August and November 2011. Based on five sampling events conducted in the Second Dam impoundment, we estimate that 1175 (95% CI 955, 1479) BNT ≥ 100mm TL were present prior to summer 2012. Based on recapture data we expect that 4.5% (N=52) of new BNT colonists emigrated upstream from Second Dam. Total Length of recaptures ranged from 179 - 394mm (Mean 296mm), supporting a hypothesis of dispersal of fecund adults. The high rates of BNT dispersal observed from Second and Third Dam over 6 months likely account for the lack of effectiveness of experimental, low intensity, mechanical removal in this reach. Our results highlight the importance of identifying hot spots of invasive species before initiating large, potentially costly suppression efforts.

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Heritability of Male Age at Maturity in Wild and Hatchery Origin Chinook Salmon

Chinook salmon (*Oncorhynchus tshawytscha*) exhibit tremendous life history variation, among which is variation in the age at which they reach sexual maturity. Fish that reach maturation at a later age achieve a greater body size and are more fecund than smaller and younger maturing fish. Furthermore sexual selection favors larger males in the wild, providing them with more breeding opportunities and an overall higher fitness. In a hatchery environment sexual selection may no longer play a role in the fitness of larger older fish. With relaxed selection against early maturation and increased juvenile growth it is purported that hatchery supplementation programs will cause an increase in the frequency of early male maturation within populations. In order to test this hypothesis we assess the heritability of age at sexual maturation in wild and hatchery derived Chinook salmon from Johnson Creek, a tributary to the South Fork Salmon River in central Idaho, U.S.A. We use a suite of microsatellite markers to reconstruct pedigrees in hatchery and wild spawned fish, from which we estimate the additive genetic variance for age at maturation. We also assess the contribution of several factors on shaping the age at sexual maturation in hatchery and wild spawned fish in order to dissect the basis of this trait.

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Using Geology to Determine the Rearing Location of Juvenile Salmon: Application and Limitations of 87Sr/86Sr Prediction From Bedrock Geologic Maps

Recent advances in reconstructing location and movement patterns using isotopic tracers have revolutionized the study of migration across taxa. In salmon in particular, strontium ratio (87Sr/86Sr) has allowed unprecedented temporal and spatial resolution in migration studies. Because the abundance of strontium isotopes is tightly linked to the underlying geology, inviting the possibility that 87Sr/86Sr could be predicted directly from bedrock geology. Accurate predictive models would increase spatial resolution in studies of migration, but previous attempts to predict 87Sr/86Sr in stream water have produced limited success and are not easily generalized across the landscape. Using fall Chinook salmon otoliths and geologic data from the Snake River of Idaho we present a method for accurately predicting stream water 87Sr/86Sr from bedrock, and using these predictions to determine the location of juvenile salmon. We then discuss the importance of understanding the affects of geologic heterogeneity and scale in interpreting and applying these predictions. This method provides a potentially useful way to increase the spatial scale and extent of migration studies that use 87Sr/86Sr as a tracer.

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Nutrient restoration in Dworshak reservoir, Idaho: A bottom up approach enhancing a kokanee fishery

Stream-riparian ecosystems are influenced by multiple invasive species that may interact, influencing one another and generating synergistic effects on food webs and ecosystem processes. We investigated the interaction between two nonnative species widespread in the western USA: common carp and Russian olive (RO), an invasive riparian tree. Deep Creek, Idaho was an International Biological Program site in the early 1970's; at that time carp were rare. Subsequently, RO was introduced and now forms a dense stand that we have previously shown caused substantial increases in allochthonous inputs and benthic organic matter. Since 1971, there has been an approximately 8-fold increase in carp biomass and the dominant native fish, speckled dace, have been drastically reduced. Carp were collected via electrofishing during three sample periods in early, mid, and late spring for gut analysis and a subsample of these fish were used to analyze body tissue nutrient stoichiometry. Additionally, we examined excretion rates of nitrogen and phosphorus by carp, using standard methods. To date analysis of carp diets in Deep Creek shows nearly two-thirds of the gut contents, on average, consisted of RO material. These patterns are consistent with commensal facilitation of carp by RO. Previous study shows that the dinitrogen-fixing RO may increase N-inputs, reduce N-limitation of primary producers, and possibly increase P demand. Carp are P-rich compared to the native speckled dace. We hypothesize carp consumption of N-rich olive material may amplify recycling and export of N from invaded streams. This study investigates the potentially synergistic interaction between these two widespread invasive species, and it extends the investigation of the role of ecological stoichiometry in regulating critical ecosystem processes, such as nutrient cycling.

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Scale resorption in migrating and spawning steelhead

Iteroparity (repeat spawning) is an important aspect of steelhead life history. It has been documented but not well described in steelhead of the Snake River basin. Incidence of iteroparity in steelhead is usually based on detection of spawn checks on scales. Spawn checks are formed by loss of scale material occurring during migration, spawning, and overwintering. Variability of resorption leads to differences in the strength of spawn checks, thus complicating the identification of repeat spawners. We quantified resorption seen in scales as fish transition from a pre- to post- spawn state. We obtained 72 paired scale samples from fish collected at Lower Granite Dam during upriver migration and as post-spawn kelts moving downriver. There was a wide range of material loss between individuals. Loss was distributed around the scale in all samples; however, regions showing the most loss varied between fish. Total change in area ranged from 12% to -55%, with a median of -26%. Roughly equivalent losses in anterior and posterior fields were seen in 44% of fish, while 42% had more loss in the posterior field and 14% in the anterior field. The outer annulus was completely lost in 13% of fish, while 39% had partial loss of the outer annulus. Time spent above Lower Granite Dam, genetic stock, sex, and length did not strongly correlate to mean area lost from scales. Season of collection did show strong influence on measured resorption. Fish first collected in the fall showed significantly more loss than fish first collected in the spring. We show that there is much variation in the amount of material loss among individuals, leading to differences in strength and characteristics of spawn checks. This level of variation can lead to mis-identification of repeat spawners and assignment of incorrect ages to steelhead. Results also indicate that resorption is caused by migration and overwintering behavior, rather than mechanical wear from the act of spawning. To our knowledge, this is the first study to quantify the loss of scale material pre- to post-spawn in any salmonid.

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Climate Velocity in Streams: What Does it Mean for Fish?

Climate velocity is the rate at which a temperature isotherm shifts within a stream or river. To ensure persistence this century, species distributions must track the locations of isotherms that delimit thermally suitable habitat as they move upstream with climate warming. Here, we develop the equations for calculating isotherm shift rates (ISRs) in streams that can be used to represent historic or future warming scenarios and be calibrated to individual streams using local measurements of stream temperature and slope. A set of reference equations and formulas are provided for application to most streams. Example calculations for streams with lapse rates of 0.8 °C/100 m and long-term warming rates of 0.1–0.2 °C decade indicate that isotherms shift upstream at 0.13–1.3 km decade in steep streams (2–10% slope) and 1.3–25 km decade in flat streams (0.1–1% slope). Used more generally with global scenarios, the equations predict isotherms shifted 1.5–43 km in many streams during the 20th Century as air temperatures increased by 0.6 °C and would shift another 5–143 km in the first half of the 21st Century if midrange projections of a 2 °C air temperature increase occur. Variability analysis suggests that short-term variation associated with inter-annual stream temperature changes will mask long-term isotherm shifts for several decades in most locations, so extended biological monitoring efforts are required to document anticipated distribution shifts. Resampling of historical sites could yield estimates of biological responses in the short term and should be prioritized to validate bioclimatic models and develop a better understanding about the effects of temperature increases on stream biotas.

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Resolving discrepancies between air and stream temperature warming rates due to climate change in mountain basins using dense sensor arrays and air microclimate models

Air temperature increases from global warming are expected to increase temperatures in the Earth's rivers and streams. Ongoing efforts to downscale climate models are improving the resolution at which air temperatures can be predicted, but outputs from the latest regional climate models remain coarse (e.g., 100s of square kilometers) relative to the scales at which predictions are necessary for natural resource management in complex mountain terrain. Inexpensive digital sensors costing ~$100/site facilitate collection of multi-year temperature data from many locations across a landscape and can be used to develop precise microclimate models with resolutions of 10s of square meters. We illustrate development and application of a microclimate model for the upper Boise River basin (7,000 km2), a mountainous area in central Idaho, to understand spatial and temporal variation in stream temperatures. From 2010 until the present, air temperatures have been recorded hourly at 60 sensor sites across the basin. These data were integrated with 4 km2 gridded climatologies using mixed effects regression models to develop daily air temperature surface maps of 90 m2 resolution. Predicted temperatures from the microclimate model were co-registered to stream temperatures measured at 34 stream sites during the same period. Air and stream temperature patterns were strongly correlated at most sites but important variability in these relationships also occurred relative to geomorphic context, seasonal period, and the time-step over which correlations were estimated. Detailed examination of these patterns promises to provide important insights regarding factors that cause variation in the thermal regimes of mountain streams. These insights could be incorporated to stream temperature models to make more accurate spatial predictions throughout river networks or understand responses to short-term weather patterns and long-term climate change.

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Trophic transfer of Cd and Pb in a subtropical coastal lagoon associated to an agricul-tural basin

Trophic transfer of cadmium (Cd) and lead (Pb) was investigated in Santa Maria la Refor-ma (SMLR) coastal lagoon, SE Gulf of California, which is one of the most important fish-ery grounds in Mexico, and is associated to the largest agriculture districts in the country. The estuarine food web was reconstructed through the use of stable isotopes of the most representative species, from primary producers to tertiary consumers. Cd and Pb concentra-tions were analyzed in the collected organisms (n=85), and in water (n=10) and surficial sediments (n=10) due to their ecological importance as source of metals to the pelagic and benthic food chains. The δ13C and δ15N in ecological niches were: primary producer (-28.23±0.92 to -19.78±1.93 and 6.50±1.76 to 9.08±1.27), primary consumers (-23.55±0.57 to -20.74±2.31 and 8.71±2.94 to 11.06±1.64), secondary consumers (-24.30±0.30 to -14.70±0.10 and 12.08±0.20 to 16.50±0.21) and tertiary consumers (-19.18±0.40 to -13.25±0.10 and 11.36±0.20 to 18.78±0.30). The Cd and Pb concentrations varied widely among ecological niches, but with a significant increase from primary producers to primary consumers, and then decreased to secondary and tertiary consumers. Our findings suggest that organisms in the food web exhibit increasingly efficient excretions index of metal re-sulting in a biodilution phenomenon. Neither Cd nor Pb are being biomagnified trough the food web in SMRL ecosystem, as elevated concentrations were observed only in few spe-cies of ecological and/or commercial relevance (mullet, mojarra, anchovies and Pacific sierra).

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Where are long-toed salamanders found in a game of hide-and-seek with trout?

In many alpine lakes, trout have been introduced for recreational fishing and have replaced native amphibians as top predators. In these systems, trout are associated with reducing the abundance of amphibians and have extirpated populations of long-toed salamanders from many lakes. Although rare, salamander coexistence with trout may occur in some lakes where habitat characteristics such as emergent vegetation and physical barriers are present, as these environments can provide refugia from predation. We sought to identify what key habitat features might allow this co-occurrence. We sampled seven lakes with salamanders and fish and seven with only salamanders in northwestern Montana between July and August 2012. We used minnow traps to capture salamander larvae and we quantified habitat characteristics (e.g., vegetation density, structural complexity) where salamanders were captured. We compared capture rates and habitat characteristics to determine whether lakes with and without fish differed. Preliminary results suggest that salamander capture rates were higher in lakes with fish (33%, 95% CI = 13-84%), but salamanders were smaller, as larvae had 68% shorter tails (51-91%) in lakes with fish. Despite these differences, we did not detect any differences in habitat characteristics. Unless minnow traps were used as refugia, our findings suggest that salamanders utilize similar habitat in these lakes regardless of the presence of fish. Future work will examine factors influencing salamander growth and tail length and determine whether adding habitat complexity is an effective strategy to facilitate coexistence of salamanders and fish.

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Modeling Restoration Trajectories of Oligohaline Tidal Wetland Ecosystem Services in the Pacific Northwest: A Study of Young's Bay Tidal Reconnection Projects

The objective of this study is to identify the rate of wetland ecosystem service recovery in tidally reconnected oligohaline (salinity 0.5-5 ppt) wetlands on historically diked agricultural lands in the Columbia River Estuary. Global tidal wetland loss has resulted in severe declines in ecosystem functions and services including water quality regulation, climate regulation, fish and wildlife habitat, and cultural heritage. In the Pacific Northwest, restoration of these wetland systems is fundamental for restoring critical endangered salmonid habitat. A common tidal wetland restoration approach in this region is hydrologic reconnection through dike removal. Currently, however, the long-term restoration trajectories and rates of ecosystem service recovery in these reconnected wetlands are unclear. Understanding the time required for re-connected wetlands to recover chemical, physical, and biological integrity is important for predicting ecological impacts of these wetland restoration and management activities and for identifying factors impeding ecosystem recovery. To identify rates of ecosystem service recovery, a 53 year chronosequence of tidal wetland restoration sites will be evaluated to create functional restoration trajectory models. Evaluated projects will include sites hydrologically reconnected in 1959, 2002, 2004, 2005, 2006, 2010, 2011, 2012, and 2 sites slated for restoration in early 2014 all within the Young's Bay Watershed. These sites will be monitored in parallel for two years in conjunction with a natural reference wetland. Restoration site monitoring will focus on evaluating plant community, carbon sequestration, soil development, and water quality following standard United States Geologic Survey tidal wetland monitoring protocols. Regression and multivariate analysis of vegetation, soil, sediment accretion, and water quality data will be conducted to evaluate if restoration trajectories toward reference levels can be observed within and among the sites. I expect that older restoration site conditions will be most similar to those found in the reference wetlands, indicating successful restoration over time. This research will provide insight into the major drivers and limiting factors of long-term tidal wetland ecosystem recovery. This information can be used directly by restoration practitioners, land managers, and tribes to identify if restoration outcomes are being achieved and provide insight to how projects can be adaptively managed to improve rates of ecosystem recovery.

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Jump Creek Canyon Field Experience

As part of our 3rd grade curriculum we study community, geography, life cycles, and resources. To meet these objectives we took 4 classes of 3rd graders (110 students) to an area in the foothills by our school, Jump Creek Canyon. Not only is it open land and canyons, but also a creek. The kids crossed the creek and hiked to a waterfall where we did additional observations. We went on this field trip twice, once in early spring and again in the late spring. We observed the riparian area near the river to notice any differences between the two months. In and out of the classrooms we worked on gathering and analyzing data, forming a hypothesis, and comparison/contrast of the data and the area itself. On each trip students worked with a BLM wildlife biologist to obtain a deeper understanding of the riparian and upland wildlife environment that many of our students had never experienced before as well as working side by side with a scientist in his field of study as opposed to just reading about it. The objective for the field trip was to practice our state science standards focusing on the nature of science and biology. We also were able to tie in standards of social studies, looking at and becoming familiar with reading maps of their communities, as well as math standards with interpreting and graphing data, estimation, and math facts of addition/subtraction. Also, writing standards with journals to record data and friendly letters students wrote when sending thank you letters to the biologist. Financial support for field trip was provided by a Target Foundation Field Trip Grant and the Idaho Chapter of the American Fisheries Society. Our students, Parent Teacher Association, the school administrator, and BLM management thought the trip was well worth the two days away from a traditional classroom.

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Reproductive biology of the Panama grunt (Pomadasys panamensis) from SE Gulf of California

The Panama grunt is one of the most important species in the SE Gulf of California and has an economic and ecological importance. This is a common species from the shrimp fisheries bycatch, representing between 15 and 27% of the total captured biomass. However, studies on the biology of this species are scarce or nonexistent, particularly there are no studies related to the reproductive biology of the grunt, which are essential for a proper management of the species. In this sense, reproductive biology of the Panama grunt was described. The fishes were collected from the artisanal fin fishery and industrial shrimp fishery. The total length (TL) varied from 9.2 to 38 cm, with females larger than males. The sex ratio was 1:0.33 (F: M). The spawning occurs from April to July. The partial fecundity ranges from 120,834 to 716,165 with mean of 234,612 (± 143,454), and shows a high correlation to TL (rPearson= 0.85). Mean mature oocyte diameter is 308.95 µm (SE ± 39.33 µm). Size at maturity (Lm) differs between female and male, for females is Lm= 22.3 cm TL, and males Lm=23.4 cm TL. The artisanal fishery lands 46% of organisms below the size at first maturity, indicating that there is a possibility of negative effects on the population of these species caused by the finfish fishery operating in the area. A first management measure would be to establish catch size limits for this species.

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Developing a naturalized Chinook salmon population in the Yankee Fork Salmon River using adult and juvenile releases

The Shoshone-Bannock Tribes (Tribes) are attempting to rebuild the Chinook salmon (*Oncorhynchus tshawytscha*) population in Yankee Fork Salmon River, Idaho using artificial propagation techniques. Various levels of hatchery smolts and adults have been outplanted in Yankee Fork since 2006. Beginning in 2008, the Tribes have annually installed a temporary picket weir adjacent to Pole Flat Campground to capture returning adults and quantify results. A low of 18 adults were trapped in 2010 and high of 228 adults were trapped in 2008. A secondary weir was installed in upper Yankee Fork and pre-spawn hatchery adults were outplanted above this weir for natural spawning. Hatchery adults trapped at Pole Flat Weir were removed and outplanted in upper Yankee Fork. In addition, excess hatchery adults were obtained from a nearby hatchery and outplanted in upper Yankee Fork. There were no adult hatchery outplants in 2010 or 2011, but 1,438, 1,517, and 1,054 were outplanted in 2008, 2009, and 2012, respectively. From 2008 – 2011, Tribal members harvested a total of four salmon. In 2012, Tribal harvest accounted for the mortality of 242 fish, 43 natural-origin and 199 hatchery outplants, which represents the first significant Tribal fishery in Yankee Fork since the mid 1980's. Intensive spawning ground surveys are conducted annually and a high of 660 redds were observed in 2008 and a low of 24 redds observed in 2011. Using mark-recapture techniques, we estimate in an in-river abundance of 1,394 Chinook salmon in 2012, 220 in 2011, 65 in 2010, and 1,640 in 2009. Juvenile monitored commenced in 2009 with a rotary screw trap to estimate brood year specific production. In 2008, we observed the largest spawning aggregate of 660 redds. This resulted in producing 533,974 juvenile Chinook salmon that emigrated from Yankee Fork. Progeny from brood year 2008 spawn year returned as adults in 2011 (1-ocean) and 2012 (2-ocean). The number of natural jacks in 2011 was significantly higher that the counts observed in other years. Furthermore, the number of natural adults (2-ocean) returning in 2012 was also ignificantly higher than any other year. These results suggest that adult outplantings are increasing adult returns to Yankee Fork.

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Effects of stocking history and barriers to movement on the pattern of hybridization in cutthroat trout populations

Introgressive hybridization with non-native species is considered to be a contributing factor to the decline of many native fishes. In western North America, the introduction on non-native species, such as rainbow trout (*Oncorhynchus mykiss*), has had significant negative effects on populations of native cutthroat trout (*O. clarkii*). Understanding the factors that influence the probability and the degree of introgression is important in developing conservation plans for protecting the genetic integrity of species at risk. In this study, we examined populations of westslope cutthroat trout from the Salmon River watershed of central Idaho to determine the levels of introgression and the factors that may influence hybridization. We examined the influence of stocking intensity, distance to nearest stocking event, and the presence of movement barriers to determine whether these factors influence the degree of introgression. Across 34 populations, average levels of introgression was 8.2%, but ranged from 0% to 30% introgressed. Our results indicate that both stocking intensity and distance to stocking location were significant predictors of the degree of hybridization. Populations of cutthroat trout isolated above movement barriers tended to have slightly lower levels of hybridization, but were not significantly different from populations open to the movement of rainbow trout that could hybridize with cutthroat trout. Our results indicate that barriers to movement can have an effect on hybridization, but their use in protecting populations from hybridization will be most beneficial when combined with information on stocking history.

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A genetic estimator of the number of breeders (Nb) per year: Applications to bull trout using SNPs

The effective number of breeders per year (Nb) is a valuable parameter to estimate when monitoring wild populations, because it is a good indicator of the number of successful spawners in one breeding season. However, the reliability of statistical estimators of Nb and its estimate from new genetic markers (SNPs) is poorly understood in age structured populations1. We used computer simulations to quantify the accuracy and precision of the one-sample 'LDNe' estimator of Nb when sampling a single cohort (e.g. of age 0 fish)1,2,4. We simulated genotypes for bull trout populations with realistic age structure and vital rates, using 15 microsatellite loci and 100 SNP loci, and sampled 15 to 100 individuals to estimate Nb. We quantified the effect of nonrandom sampling (i.e. an excess of siblings) on the accuracy and precision of Nb estimates. We predicted that: (1) Nb estimates would be biased high because Ne (the effective size per generation) is larger than Nb in bull trout (unpublished results, see 2 for explanation), (2) precision for resolving between an Nb of 100 and 150 would be sufficient with 100 SNPs and samples of ~25-50 individuals, (3) precision is higher for 100 SNPs than 15 microsatellites because precision increases rapidly with the number of loci screened, and (4) an excess of siblings in a sample can bias low Nb estimates7.

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A multi-trophic level investigation sheds light on long-term responses of stream ecosystems to wildfire

Decades after wildfire, stream ecosystem state may reflect the severity of fire and the recovery of riparian vegetation, which may strongly influence light availability and, in turn, the productivity of stream organisms. We studied three similar wilderness streams that experienced past wildfire but now range from low to high light conditions. During summer, we compared their aquatic primary production, secondary production of invertebrates and fishes, and trophic basis of fish production. Patterns in productivity were mirrored across trophic levels. Gross primary production (via chamber technique) was 2.69X higher, production of dominant insect taxa (via cohort and non-cohort methods) was 41% higher, and trout production (via instantaneous growth rate method) was 2.59X greater in the high versus low light stream, with the third falling intermediate. 73% more trout production was fueled by aquatic vs. terrestrial prey in the high light stream compared to either of the others, whereas the trophic basis of trout production was more diverse in the streams with low and intermediate light. Our results suggest that light regime may mediate post-fire pulses in stream productivity as well as changes in biodiversity.

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BioData: An Aquatic BioAssessment Database for the Nation

The new U.S. Geological Survey (USGS) BioData system stores and serves aquatic bioassessment data (biological community and physical habitat data) collected by USGS scientists from stream ecosystems across the nation. The system has two parts, BioData input and BioData retrieval. BioData input provides tools for project management, stores data collected by USGS using both USGS and EPA national protocols, allows for entry of field sample and habitat data, accepts data uploads from USGS and other taxonomic laboratories, as well as provides internal data checking and review to insure accurate community data for integrated water quality programs. BioData retrieval allows scientists, resource managers, teachers, and the public to retrieve data using an online query. Retrieval criteria can be saved on a desktop for future queries. Users are able to find the data of interest based on criteria (filters) such as data type, location, date, or taxonomy. Currently, over 20,000 fish, invertebrate, and algae community sample data collected as part of the National Water-Quality Assessment (NAWQA) program and other USGS projects are in BioData. BioData architecture has been designed to accommodate more protocols in the future and may soon have the ability to support data exchange standards. Both the internal data storage and external data retrieval systems of BioData are now on-line (URL: http://aquatic.biodata.usgs.gov) and ready to help enhance your scientific investigations. The BioData system will help USGS scientists fulfill their mission of providing high-quality data about the earth's aquatic resources.

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Hybrids lost: fading introgression in two freshwater sculpin populations

Rates of hybridization and introgression are increasing worldwide because of human mediated actions, such as species introductions and habitat degradation, and are having deleterious effects on native populations. The conservation implications of hybridization and introgression varies among species, thus understanding patterns of hybridization is an important step as we explore species interactions and evaluate potential consequences of genetic exchange. Although it is known that species of Cottus (sculpin) can hybridize, few have examined the potential patterns of hybridization among sculpins to explore potential implications on populations in the watersheds in the Rocky Mountain region. Several *C. cf. cognatus* X C. sp. hybrid individuals were previously detected in Trout and Fish Creeks in the lower Clark Fork River, MT. We collected tissues samples across the length of Trout and Fish Creeks in 2012 to discernible patterns in hybridization. Little evidence of introgression was present in 2012 samples. We then analyzed 46 more of the MFWP 2007 samples and compared similar numbers of samples from 2012 samples from overlapping locations in Trout Creek and in Fish Creek. There was substantial loss of in the number of hybrids and proportion of *C. cognatus* alleles in both populations from 2007 to 2012. This reduction could be indicative of reduced fitness of hybrids or the reduction in *C. cognatus* alleles observed could also be due to genetic swamping due to relatively high proportions of the C. sp. parental type.

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Overlapping paired-end RAD sequencing for conservation genomics

Genomic techniques allow for rapid discovery and genotyping of large numbers of single-nucleotide polymorphisms (SNPs) in natural populations of conservation or management concern. One such technique is restriction-site associated DNA (RAD) sequencing, which provides sequence data at tens of thousands of loci across the genome. While RAD sequencing has been used successfully in population genomic studies, it has been limited by the length of sequence reads produced by Illumina next-generation sequencing technology (typically 100-150bp). Here we describe a modification to this technique, called overlapping paired-end RAD sequencing, which provides 300-800bp of continuous sequence at each locus. This approach has several potential benefits: first, it increases the probability of identifying polymorphisms at each RAD locus, even in populations with low overall genetic variation. Second, it allows better discrimination of duplicate paralogous loci, which is a challenge in several taxa with complex genomes such as salmonids. Third, the longer contiguous sequences improve the potential to infer the functional significance of outlier loci showing a signature of selection or local adaptation, because they can be searched against annotated databases. Finally, longer sequences may allow for haplotype-based analysis of demographic processes, such as fine-scale migration rates among populations.

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Modeling the influence of surface-subsurface exchange on periphyton dynamics

Stream food webs are affected by a dynamic array of local and large scale processes. Integrating these processes to explain food web patterns requires interactive, scalable tools. We developed a mechanism-based system dynamics model that links physical and environmental characteristics of stream ecosystems to patterns of basal-level energy production (i.e., primary production). We use this model to explore linkages between the temporal dynamics of in-stream primary production and spatial patterns of surface-subsurface exchange (i.e., upwelling and downwelling), for the Methow River (Washington, USA). The model simulates subsurface hydrologic exchange effects on periphyton dynamics for various channel geomorphologies (i.e. channel size, slope and substrate size). We parameterized the model using available field and literature data. The mechanism-based model helped us formalize the processes affecting periphyton dynamics, information which will be used to inform on-going and planned field experiments, and streamline associated data collection.

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Looking Beyond Marine-Derived Nutrients: Physical and biological drivers of isotopic variation in the aquatic biota of a wilderness watershed

Salmon spawning activity and remnant carcasses have been shown to influence the nutrient dynamics, productivity, and community structure of streams in complex ways. Stable isotope ratios of carbon (δ13C) and nitrogen (δ15N) have been useful to identify material transfers across ecosystems and quantify their effect on ecosystem processes. A lack of research on what drives isotopic variation at the regional scale limits the power of conclusions drawn from past studies that directly link isotopic enrichment to marine-derived nutrient incidence. Many different environmental conditions and processes may influence observed isotopic values in aquatic biota, and their relative effects on isotopic variability are not well resolved. In this study, we used δ15N and δ13C values from 16 sites across a wilderness watershed to quantify regional scale variation in relative nutrient enrichment across trophic levels. We sampled periphyton and three macroinvertebrate taxa before and after spawning events to increase our understanding of marine-derived nutrient contributions in oligotrophic streams in Central Idaho. Using a design that couples longitudinal sampling with paired drainages within the Big Creek watershed, we explored how the isotopic composition of aquatic biota and streamwater nutrients varied as a function of stream size, geology, spawner abundance and wildfire history. Findings suggest that both physical and biological factors influence baseline isotopic variability and that primary drivers may vary by location and environmental conditions. This study provides information useful to future nutrient restoration projects and stable isotope studies, highlighting the utility and limitations of stable isotope analysis as a proxy for nutrient conditions, sources and productivity at the watershed scale.

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Is Bear Valley Creek, Idaho bare naked? Chinook salmon tend to disagree!

Bear Valley Creek is an important spawning and rearing stream for Chinook salmon and is also an important traditional use area for members of the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation. Past counts of Chinook salmon redds indicate Bear Valley Creek was the primary spawning stream in the Salmon River, if not in the entire Columbia River basin. Understanding the limiting factors that are either preventing or facilitating salmon recovery is necessary to make educated resource management decisions. As such, the Tribes developed the Bear Valley Creek Chinook Salmon Abundance Monitoring Project (BRCAMP) to provide critical biological information from one of the last relatively vigorous wild populations in the Columbia River basin. Research program operations include utilizing a rotary screw trap to collect age, size, and timing data for emigrating juvenile Chinook salmon, operating an adult video weir to measure adult escapement, conducting harvest monitoring under the Shoshone-Bannock Tribes' (Tribes) Salmon River Tribal Resources Management Plan, and performing spawning ground surveys to collect pertinent information on the number of redds in the watershed and biological data from carcasses. Approximately 1,212, 1,210, and 1,450 Chinook salmon escaped into Bear Valley Creek in 2010 – 2012, respectively. In 2011 and 2012, a rotary screw trap was installed to enumerate juvenile production. Estimates indicate 1,081,073 (SE 108,357) juvenile Chinook salmon emigrated from the system in 2011 and 781,182 (SE 295,345) in 2012. Tribal harvest in 2012 within the Bear Valley Creek fishery management area yielded 103 adult Chinook salmon and zero jacks. Multi-pass, intensive spawning ground surveys in all years resulted in the observation of 414, 504, and 545 redds in Bear Valley and Elk creeks combined. The results indicate this Middle Fork Chinook salmon population is performing well above the viability threshold recommended for ESA recovery and provides hope that salmon recovery is feasible in Idaho. BRCAMP information is expected to assist co-managers evaluate the status of the Chinook salmon population and provide long-term information to develop trending analyses.

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Reintroduction of Chinook Salmon into the Walla Walla River

Spring Chinook were extirpated from the Walla Walla Basin more than 75 years ago due to over appropriated stream flow, loss of habitat and inadequate fish passage. Today, the Umatilla Tribe and others are working with the local community to restore the subsistence, economic, religious and cultural values of salmon. The Tribes spring Chinook re-introduction program is modeled after its successful Umatilla Fisheries Restoration Program and consists of: 1) habitat and flow restoration, 2) best hatchery management practices, 3) monitoring and evaluation, and 4) adaptive harvest management. The Tribes management goal is to reintroduce natural spawning spring Chinook populations to the Walla Walla Basin in order to provide Tribal and sports tributary harvest. Our early results seem promising, suggesting that reintroduced spring Chinook can successfully rear, return and spawn in the basin. The most significant achievement, in 2010 nearly 1,200 fish returned to the upper basin and the Tribe opened their first spring Chinook fishery on the South Fork Walla Walla River in over 85 years marking an early milestone towards restoration.

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Effects of Three Starter Diets on Bonneville Cutthroat Trout Fry

During the second year of Bonneville cutthroat trout (*Oncorhynchus clarkii utah*) production at Grace Fish Hatchery, mortality was significantly higher during the early rearing stage than it was in the previous production year. Starter feed was identified as the potential cause of the mortality. The purpose of this study was to evaluate whether the choice of starter diet could be responsible for the increased mortality. Treatment groups were fed one of three different starter diets for a twelve week period. During the twelve week period, mortality and multiple growth parameters were recorded. Results of this study indicate that mortality did not vary significantly between starter diets. However, there were differences in certain growth parameters which will influence the starter diet that is used in future production of the species.

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Design, Use, and Applications of a Cost Effective Hydrographic Station

We describe a cost-effective method for collecting water quality data at pre-programmable intervals in lentic systems. Hardware and supplies commonly available from commercial fishing, hardware, and sporting goods vendors were used in conjunction with water chemistry sensors to construct a semi-permanent hydrographic station in Arrowrock Reservoir, Idaho. The hydrographic station was deployed June 2012 and retrieved in November of 2012. A pre-programmed series of dissolved oxygen and temperature data were collected at 10 minute intervals from June 2012 to November 2012. Sensors were deployed at depths from 1 to 25 meters and remained at constant depth as pool elevation fluctuated. Temperature data were collected at 1 meter intervals, from 1 meter to 25 meter depths. Dissolved oxygen data were collected at 4 meter, 8 meter, and 20 meter depths. Depth data were collected at 25 meters, in order to verify consistency of the depths of each sensor throughout the sampling period. We also used a Hydrolab Sonde® DS5 instrument to collect water temperature and dissolved oxygen data at the hydrographic station every 2 weeks, from June to November 2012. Hydrolab data were used to verify the accuracy of hydrograph station data, and to interpolate water quality values for depths greater than 25 meters. The products of our data are Isolux contour charts which display temperature and dissolved oxygen throughout the water column before, during, and after the formation of the seasonal thermocline in Arrowrock Reservoir. Data were used to evaluate reservoir management activities and the temporal distribution of habitat suitable for ESA-listed bull trout (Salvelinus confluentus). Budget-reduction and cost-efficiency imperatives affecting public companies and private entities make our approach an affordable alternative to the purchase and operation of conventional hydrographic stations. The total cost of materials and sensors in our system was less than $8,500, whereas turn-key systems that collect similar data may cost in excess of $100,000.

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fisheriesstandardsampling.org: Comparing standard North American freshwater fish data using a simple online tool.

Recently, the American Fisheries Society developed standard methods to sample freshwater fish populations, publishing them in 2009 in the book Standard Methods for Sampling North American Freshwater Fishes. This project involved 284 scientists from 107 different organizations across Canada, Mexico and the United States. Data collected using standard methods gives biologists the ability to compare data across regions or time. Here we discuss recent progress on an on-line web-accessible tool to compare fish growth, condition, length-frequency, and catch per unit effort data collected using AFS standard methods. Development of this tool is a collaborative effort among AFS, the US Geological Survey, the National Park Service, the U.S. Forest Service, the University of Arizona, and the University of Guadalajara, Mexico. The on-line tool (1) provides on-line summaries of 4,092 data sets of condition, length-frequency, CPUE and growth indices of common freshwater fishes, collected using standard gears from 42 states and provinces across North America, (2) allows entry of new data collected using standardized methods, so averages of commonly-used fishery indices can be updated, and (3) allows queries, graphical, and tabular output of the data summaries so they can be easily accessed and integrated into projects across North America. We invite you to visit the website and compare your data on condition, growth and abundance of fish collected in a particular waterbody with regional and rangewide averages and percentiles, thus increasing resource information in a variety of areas.

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An Overview of the Yuba Accord Monitoring and Evaluation Program: Where did we start, what have we done, and where are we going?

In 2008, the State Water Resources Control Board approved a comprehensive program to protect and enhance 24 miles of aquatic habitat in the lower Yuba River. This program, known as the Lower Yuba River Accord (Yuba Accord) is an innovative settlement agreement designed to resolve one of the longest-running environmental disputes in California, and consists of a Fisheries Agreement and several other elements. The Yuba Accord set up a River Management Team (RMT) to guide the Monitoring and Evaluation Program (M&E Program) to identify and evaluate of the effects of the Yuba Accord flows on fisheries resources on the lower Yuba River. To guide the RMT in implementation of the M&E Program, a broad strategic framework was necessary to serve as a strategic planning guide to integrate the monitoring actions for the Yuba River Accord. The M&E Framework, a living guidance document authored by the RMT, was developed that set up the M&E Program based on the concept of maintaining fish in good condition as prescribed by California Fish and Game Code 5937 and the Viable Salmonid Population concept developed by McElhany et al. (2000). The M&E Framework incorporated limiting factors, both flow-related and non-flow related, and was designed to examine causal relationships between limiting factors and population responses, and habitat management actions using a tiered approach by evaluating specific attributes of the individual, population, and community levels. Because the RMT envisioned a dynamic M&E Program, they embraced a monitoring-based adaptive management approach to increase the effectiveness of, and to address the scientific uncertainty associated with, specific monitoring and study activities. The adaptive management component allowed the RMT to learn from past experiences through experimentation, or by altering specific studies or actions. Within the framework of the M&E Program, the RMT retained the flexibility to revise or develop and implement additional monitoring actions to address specific issues as they arose, or as additional information became available. This flexibility has and continues to facilitate coordination of the M&E Program with other programs on the lower Yuba River and in the Central Valley to achieve maximal benefits to population viability.

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Length-weight relationship and initial biomass of the grunt *Haemulopsis elongatus* in the SE Gulf of California

A population analysis was made using data of the grunt *Haemulopsis elongatus*. The information is from the bycatch in estuarine waters, open-ocean waters, off the coast of Sinaloa and northern Nayarit, NE Mexico, in the SE Gulf of California from March to October 2008. The area of influence is about 14,000 km2. In this work studied the length-weight relationship, size structure and biomass as a first approach of some aspects of its population. The species has an isometric growth. The frequency distributions and the multinomial solution shows two representative modal groups. The simulation of the initial biomass is nearly 60 t, with 600,000 organisms before starting the fishing season or the end of closed season. The results provide new information about this species.

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A morphometric determination of gape limit for six fish predators in three western USA waters

For piscivorous fishes, components of body morphology such as gape size affect the size of prey species that can be eaten, and can determine the ability of predators to effectively utilize and control the prey base. We examined gape sizes of six piscivorous fishes in three western water bodies: five salmonids and one centrarchid. We measured predator and prey morphometrics in the field and later analyzed fish diets to determine prey sizes consumed. In Pyramid Lake, Nevada, endemic Lahontan cutthroat trout (LCT; *Oncorhynchus clarkii henshaw*) became piscivorous as small as 250 mm; however, most LCT switched to piscivory at 380 mm and consumed prey well within their vertical and horizontal gape size. Conversely, exotic Sacramento perch (*Archoplites interruptus*) became piscivorous at 120 mm and consumed native Tui chub (*Gila bicolor*) greater than their vertical gape size, but within their horizontal gape (i.e., mouth width) size. In Scofield Reservoir, Utah, stocked Bear lake cutthroat trout (*Oncorhynchus clarkii utah*) became piscivorous at 320 mm TL, consuming Utah chub (*Gila atraria*) near and well above their horizontal and vertical gape size. Similarly, stocked tiger trout (*Salmo trutta*, female × *Salvelinus fontinalis*, male) switch to piscivory at 340 mm TL and also consumed fish very close to or just exceeding their horizontal and vertical gape sizes, demonstrating that these two stocked predators may be effective chub control agents. In contrast, stocked rainbow trout (*Oncorhynchus mykiss*) fed on prey less than their gape size and exhibited very limited piscivory. In the Logan River, Utah, naturalized brown trout (*Salmo trutta*) become piscivorous at 250 mm, feeding on prey far below both their vertical and horizontal gape size. These gape limit data provide an excellent indicator of the size range of prey being consumed by predatory fish, and thus provide a better understanding of the effectiveness of different piscivores to control aquatic systems from the top and as biological controls agents.

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Smolt behavior in the Sacramento River at a levee repair site

Since 2010 more than 1000 smolts and four species of predators have been implanted with acoustic tags to study their two dimensional movements in relation to a levee repair site located at RM 85.6. Repair work on this levee began in June of 2006 and made use of more than 80,000 tons of materials. The study primarily focused on juvenile late-fall Chinook, however juvenile steelhead trout were also monitored. Only a handful of predators were implanted with acoustic tags, however our objective with these individuals was to characterize a difference in behavior and movement patterns relative to the tracks of smolts. Two-dimensional track data was used to calibrate a Eularian Lagrangian Agent Method model. In 2010/2011 season of study positions of smolts were consistently higher in the river channel with the lowest proportion of overall positions calculated occurring along the levee repair site. Also two-dimensional tracks from smolts were highly directional, 91.4% of smolts with more than 5 bearing calculated were found to have a Rayleigh test $p<0.05$. Average movement rates within the study site were 0.8 m/s. We observed no significant difference in the transit times of smolts near (within 20m) the levee repair site (00:15:25) versus further away individuals(00:14:31)(t-test: $t=0.61$ $df=174$ $p=0.27$). A single smallmouth bass was tagged in 2010/2011, however the behaviors and movements rates of this individual were drastically different than those ofthe observed juvenile salmonids. The movement rates of the observed predator were lower than of the Chinook (t-test:$t=-42.9$ $df=5994$ $P<0.01$) and bearings were bimodal primarily showing lateral movement (Rao's Test: $U=223.9$ $p<0.01$).

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Detection efficiency and habitat use to inform inventory and monitoring efforts: juvenile coho salmon in the Knik River basin, Alaska

Imperfect detection associated with sampling gear presents challenges for wildlife inventory and monitoring efforts. We examined occupancy dynamics and habitat use of juvenile coho salmon, Oncorhynchus kisutch, in shallow lake environments over a summer and early fall season in the Knik River area of south central Alaska using models which control for and estimate sampling gear detection efficiency. In addition, we present statements for the probability that observed absences at a survey site or from a survey area (a collection of sites) are true absences given some amount of sampling effort and analysts' beliefs about site occupancy and sampling gear detection efficiency which can be used to guide inventory and monitoring efforts for juvenile salmon or other wildlife and plant species. Occupancy modeling results demonstrate that minnow traps were effective at sampling juvenile coho in shallow lake environments, with a mean probability of detection across the study period of 0.68 (i.e. probability of detecting the presence of juvenile coho given that they are present at a trap site; s.e. = .03). Juvenile coho salmon migrated into shallow water lakes in late summer and early fall, presumably to seek out overwinter habitat. N-mixture modeling examination of habitat use demonstrated that once in shallow lake environments, juvenile coho were widely distributed across a range of microhabitats, with some evidence for preference for shallower depths and warmer water temperatures.

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Kurt Tardy

As the world turns: Shoshone Bannock Tribes subsistence fishing for the future

In historic times, Shoshone and Bannock speaking peoples lived at the headwaters of four major river systems in the western Unites States and were fishers who relied, in one degree or another, on the anadromous fish species of the Columbia River drainage and who also depended on a wide variety of other species found in the waterways of their vast territorial range. The Shoshone-Bannock peoples maintained lifestyles which were closely and continuously adapted to the pulse of the riverine environment where they lived and traveled. Walker (1993) estimated a potential annual catch of 4,050,000 pounds or about 250,000 fish harvested in the Weiser – Boise, Hagerman – Shoshone, and Lemhi – Salmon River fisheries. Upon the onset of European settlers, game became increasingly scarce and tension grew between the whites and Native Americans. Tribal leaders and the federal government agreed to the Fort Bridger Treaty of 1868 which reserved the "right to hunt on any unoccupied lands of the United States." Under contemporary management and the Endangered Species Act 4(d) rule, the Shoshone Bannock Tribes developed Tribal Resource Management Plans (TRMP) for the conservational take of spring/summer Chinook salmon for subsistence only. Tribal Chinook salmon fisheries are managed on an annual basis consistent with the ESA and need to promote recovery of the ESU. Following the guidance of the Tribal Resource Management Plans, the Tribes manage harvest on each Chinook salmon population or fishery management area (FMA) according to the population's viability threshold and annual fluctuation in abundance. To accomplish population specific management, the Tribes: 1) Develop pre-season forecasts for each FMA, 2) Use the harvest management framework to set impact rates and develop Tribal guidelines, 3) Conduct harvest monitoring, 4) Implement Chinook salmon spawning ground surveys to estimate abundance, and 5) Determine post season harvest impact rates for each population. Recent estimates indicate less than 1,000 Chinook are harvested each year, equating to only 0.18 salmon or 2.7 pounds per Tribal member. Therefore, the Tribes are and will continue to actively pursue restoration of anadromous fish in all historical fishery areas.

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Alternative Downstream Passage Design for the Main Street Fishway

Downstream fish passage technologies for alosines are much less advanced than those concerning upstream fish passage facilities and are the areas that are in the most need of research. This is partly due to the fact that efforts towards re-establishing movement for migrating fish began with the construction of upstream fish passage facilities and that downstream migration problems have only more recently been addressed. The purpose of this research was to determine a plausible alternative to the existing Denil-style baffles in the Main Street fishway on the Saugatucket River in Wakefield, RI that would allow for better downstream passage. A bench-scale model of the existing system was constructed and calibrated by down-scaling known flows of the existing fishway at the USGS Conte Anadromous Fish Research Center in Turners Falls, MA. Alternate designs for the baffles were created and tested including a weir with a corner orifice, a weir with a middle orifice, and a slanted weir. The results were analyzed and used to determine the best possible alternate fishway design. The performance of the designs was evaluated by the depth of water and flow characteristics.

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Coeur d'Alene Basin restoration: Planning restoration of natural resources injured by mine waste contamination

Large-scale restoration of natural resources and associated services is being planned in the Coeur d'Alene Basin through a partnership of state and federal agencies and the Coeur d'Alene Tribe. Restoration will address injuries to natural resources caused by historic releases of mine waste contamination from the Coeur d'Alene Mining District including lead, cadmium, and zinc. Injured natural resources include fish, wildlife, plants, wetlands, surface waters in lakes and streams, and associated services include hunting and fishing, wildlife watching, recreation, and other benefits. A comprehensive Restoration Plan/Environmental Impact Statement is being developed to describe the philosophies, priorities, and strategies for restoration. It will also describe existing conditions and evaluate possible effects of restoration actions. Concurrent with comprehensive planning, several restoration projects are ongoing under a 2007 interim plan. Additionally, restoration will be coordinated with ongoing remediation (clean-up actions) of the Coeur d'Alene Basin Superfund site led by the Environmental Protection Agency. This initiative is being led by natural resource trustees represented by the U.S. Fish and Wildlife Service, Bureau of Land Management, USDA Forest Service, Coeur d'Alene Tribe, Idaho Department of Environmental Quality, and the Idaho Department of Fish and Game. Funds from a series of legal settlements for natural resource damage awards made approximately $140 million available to restore, rehabilitate, replace, or acquire the equivalent of the injured natural resources. Community outreach and involvement are vital components of the work and public scoping is scheduled for early summer 2013. Aquatic resources of interest include westslope cutthroat trout, bull trout, and surface water quality. Assessments will describe the current status of these resources as well as the desired future condition post-restoration. The effects of mine waste contamination on the resources will be identified and other limiting factors will be addressed.

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Genetic monitoring of threatened Chinook salmon populations: Estimating introgression of non-native hatchery stocks and temporal genetic changes

Conservation efforts aimed at Pacific salmon (*Oncorhynchus spp*.) populations have frequently utilized artificial propagation in an attempt to increase fish abundance. However, this approach carries the risk of unwanted changes in genetic characteristics of the target population, and perhaps others that might incidentally be affected. We used genetic monitoring techniques to estimate the amount of introgression that has occurred from non-native hatchery stocks into native populations and to determine the extent of genetic changes that have occurred in association with supplementation efforts over the past 20-50 years in Snake River Chinook salmon (*O. tshawytscha*) populations from northeast Oregon. A total of 4,178 fish from 13 populations were genotyped for 12 microsatellite DNA loci. We found that introgression from the Rapid River Hatchery stock was particularly noticeable in the early 1990s, but it appears to have had a substantial effect on only two of the native populations (Lookingglass Creek and Upper Grande Ronde River), despite the ample opportunities that existed for introgression to occur. All seven of the native populations sampled have maintained their levels of within population genetic diversity throughout the sampling period. Expected heterozygosity values for each sample ranged from 0.707 – 0.868. Estimates of the effective number of breeders per year in the naturally spawning populations ranged from 20.6 - 459.1, whereas in the hatchery populations, they ranged from 33.8 – 1,118.8.

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Jumping the Falls? Interactions Between Resident and Anadromous O. mykiss Populations at a Putative Natural Barrier, Big Bear Falls, Potlatch River, Idaho

Big Bear Creek in Potlatch River, ID contains a strong wild *O. mykiss* population despite significant habitat degradation within the drainage. The population is comprised of both anadromous and resident *O. mykiss* groups. Anadromous populations spawn and rear in lower Big Bear Creek, whereas resident populations occur approximately 20 kilometers upstream in the headwaters. Located between the populations is Big Bear Falls; a putative upstream migration barrier. This experiment was conducted to determine the effect of the falls on steelhead upstream migration to guide potential habitat restoration approaches in Big Bear Creek. We collected tissue samples from 424 anadromous and resident O. mykiss throughout Big Bear Creek; all individuals were genotyped at 191 SNPs. Using multi-locus SNP data we evaluated directional gene flow in the creek, specifically at the waterfall. Our objectives were two-fold: 1) identify whether Big Bear Falls is a complete barrier to upstream migration for adult steelhead, and 2) gauge evidence for downstream migration from resident fish into the anadromous population. Principal correspondence analyses of allele frequency data shows that anadromous and resident populations are highly differentiated and that exchange of genetic material between populations is limited. However, we determined that juvenile *O. mykiss* captured directly above the waterfall were offspring of anadromous steelhead that successfully migrated and reproduced above the waterfall. Further, we identified evidence of downstream gene flow, suggesting that resident fish may contribute genetic material to anadromous populations. The Big Bear Creek drainage is a candidate for habitat restoration efforts that would likely benefit both native resident and anadromous O. mykiss life history forms in the drainage.

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Utilization of Visible Implant Elastomer Tags (VIE) to determine the distribution and abundance of marine catfish species in the SE Gulf of California

Marine catfishes (Ariidae) are abundant species in the Tropical Eastern Pacific, and in the Gulf of California are a common catch in the small scale finfish fisheries, as well as in the shrimp fishery bycatch. These species are an existing resource in quantities that justify their capture. However, information on their biology and distribution is nonexistent for the studied area. This information is essential to develop adequate management programs. In this study the distribution patterns of the four most abundant marine catfish species present in the area is being analyzed through the use of VIE tags. The goal is to determine the movements of different fish stages between habitats (estuarine and open sea), and variation in abundances related to time and abiotic factors. This study aims to determine recruitment zones and seasons, as well as migration patterns.

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Emulating riverine landscape controls of beaver in stream restoration

Stream and floodplain restoration at the reach scale has ranged from expensive, heavy handed modification of the channel and floodplain to relying on simple, longer term revegetation efforts. We have developed and implemented a simple approach that emulates the ecosystem engineering effects of beaver that is less expensive and disruptive than typical large scale engineering efforts, and has the potential to restore both fish habitat and floodplain vegetation more rapidly than simply revegetating and waiting for the riparian zone to mature. The approach involves constructing log flow choke structures that mimic the hydraulic function of a natural beaver dam during flooding. By placing these structures throughout incised or entrenched stream reaches at locations promoting increased frequency of flood engagement of floodplain swales and relict channels, we are able to set the stage for restoring the riparian corridor and floodplain more quickly than could be achieved through revegetation alone. Passive techniques are also an important part of this approach with the aim of improving the structural integrity of active beaver dam complexes. Monitoring shows that within just one to two years of implementation, beaver are building more persistent dams in close proximity to our structures and we are seeing increased hydraulic connectivity with the floodplain. Our technique may therefore provide a cost effective, natural process-based restoration tool with potentially large scale benefits.

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Fish Assemblage Structure in Side Channels of the Kootenai River, Idaho

Since disconnection of the Kootenai River from its historic floodplain, off-channel habitats, though scarce, have been of high importance to the fish assemblage. In particular, side channels are thought to provide important habitat diversity and refugia for many fishes, and act as the last remaining link to the terrestrial floodplain. While the importance of side channel availability and the quality of instream habitat in side channels of the Kootenai River has not been assessed, the functional diversity they offer makes them an important component of the lower Kootenai River ecosystem. As such, the Kootenai Tribe of Idaho has undertaken an aggressive habitat manipulation program focused on restoring ecosystem function to the braided reach of the Kootenai River. To evaluate the response of the fish assemblage to habitat restoration we used boat-mounted electrofishing and a mini-Missouri benthic trawl to sample fish in 118 sites on 12 sampling events from July-September 2012. Assemblage structure between side channels and between main- and side-channel habitats was evaluated. We also assessed differences in catches from the different sampling gears. Lastly, we compared catch rates of fishes among habitats and evaluated the size structure of three ecologically-important species. The results of this study will provide baseline information on fish assemblage structure in side channels of the Kootenai River. Furthermore, results from this study will help guide and prioritize the objectives of future large river restoration projects.

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Fluvial westslope cutthroat trout movements and restoration of habitat in the Nevada Spring Creek complex

Anthropogenic degradation of aquatic habitat has diminished native trout throughout the American West. As a result, the restoration of degraded streams is a significant element of wild trout management. In the Blackfoot river in western Montana, catch-and-release harvest regulations combined with habitat restoration are both important for the recovery native cutthroat trout especially in the mid-to upper basin where cutthroat trout stocks are now increasing in many streams. An example of this expansion has been occurring in the Wasson Creek, Nevada Spring Creek and lower Nevada Creek complex for several years. Here, natural channels and flow and temperature regimes were restored, re-establishing both habitat conditions and migration corridors necessary for native trout. Under these conditions, the abundance and distribution of native trout have been expanding from Wasson Creek downstream into Nevada Creek. To assess the life history tactics of of adult westslope cutthroat trout associated with this expansion, FWP radio-tagged 20 westslope cutthroat in wintering areas in Nevada Creek just downstream of Nevada Spring Creek in 2011-12. We then tracked those fish through their spawning period in May into summer in order to examine movement patterns within the restored reaches. A high percentage (n =10) fish moved from Nevada Creek through Nevada Spring into the headwaters of Wasson Creek through stream reaches where enhanced instream flows, grazing improvements as well as fish ladders on diversions and fish screens on ditches were employed. However, four radioed fish moved out of Nevada Creek into the Blackfoot River and then ascended upper river tributaries. The preliminary results of this telemetry study show that restoration can not only improve environmental conditions necessary for migratory for native trout, but also promote recovery migratory native fish from other reaches of the Blackfoot River.

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Evaluation of Calcified Structures for Estimating Age of Common Carp

Common carp *Cyprinus carpio* are a widely distributed non-native cyprinid in North America. Common carp have the potential to negatively influence the integrity of aquatic ecosystems and fish assemblage structure. Understanding age distributions is critical for effective management of systems influenced by common carp. Scales, vertebrae, opercles, and pectoral fin rays have been previously compared to otolith (i.e., asteriscus) age—a previously validated structure. Age estimates between dorsal fin spines and pectoral fin rays have been compared, but age estimates derived from dorsal spines have not been previously compared with those from otoliths. In Ocotber 2012, common carp were collected using daytime electrofishing and experimental gill nets from Crane Creek Reservoir (n = 121) and Lake Lowell (n = 88) in southwestern Idaho. We will compare dorsal spines, scales, pectoral fin rays, and otoliths to determine the efficacy of different structures for estimating age. This research will provide insight on the relative efficiency of dorsal fin spines, scales, and pectoral fin rays as non-lethal alternatives for obtaining age information from common carp.

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Lamprey passage at migration barriers: Fishway design criteria and biological insights

The Pacific lamprey (*Entosphenus tridentatus*) is a culturally and ecologically significant anadromous fish that is in decline around the Pacific Rim. Low adult lamprey passage success at dam fishways designed for adult salmon and steelhead (*Oncorhynchus spp*) is one of the factors limiting population recovery efforts in many river systems. Over the last decade, fish biologists and engineers have collaborated on the development of Pacific lamprey-specific fishways that are intended to increase adult escapement past dams to spawning areas. This presentation describes some of the unique migration behaviors of Pacific lamprey (i.e., anguilliform swimming, oral disc attachment, climbing) and provides details on how we have exploited these behaviors to design novel passage structures. As a case study, we catalog the features of new lamprey passage structures that will be installed at Bonneville and John Day dams (Columbia River) this spring. We will also summarize recommended design criteria for such structures, including: siting, materials, ascent angles, resting areas, target water velocities, water depths, and other important features. These features will be described in relation to behavioral traits of Pacific lamprey and are intended to guide the design of both fishway retrofits at existing projects (i.e., at dams with salmonid fishways) and at manmade barriers with no passage facilities.