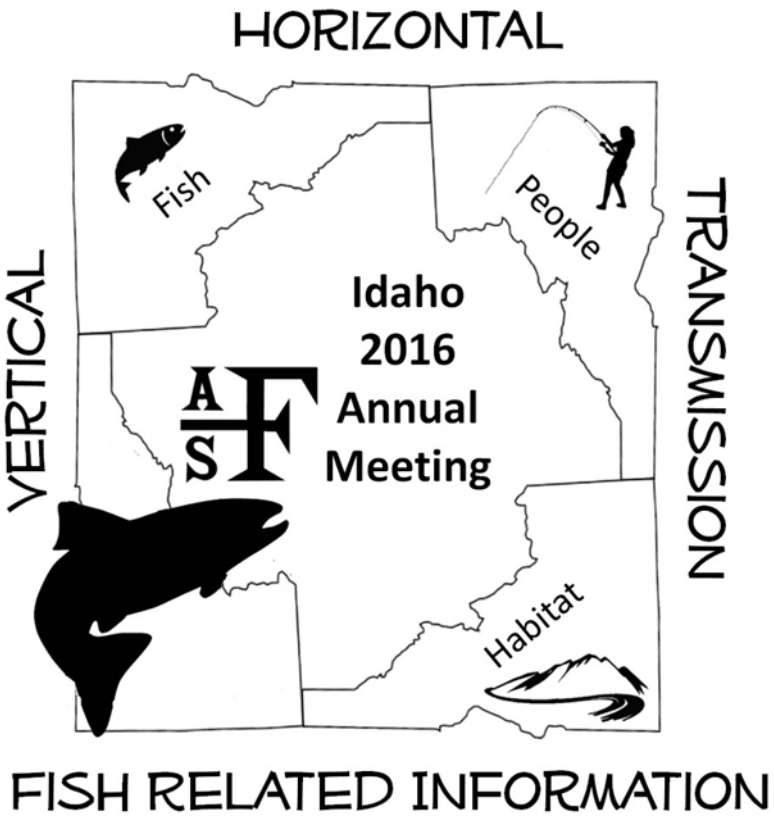
Horizontal and Vertical Transmission of Fish Related Information



Abstracts

IDAHO CHAPTER
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American Fisheries Society

Idaho Chapter

OUR MISSION

IMPROVE THE CONSERVATION AND SUSTAINABILITY OF FISHERY RESOURCES AND AQUATIC ECOSYSTEMS BY:

1) ADVANCING FISHERIES AND AQUATIC SCIENCE

2) PROMOTING THE DEVELOPMENT OF FISHERIES PROFESSIONALS

ORAL PRESENTATION ABSTRACTS

A developmental template to characterize recruitment failure of endangered Kootenai River White Sturgeon, with application to other sturgeon populations

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Sturgeons represent one of the most imperiled groups of fishes worldwide. Many sturgeon populations suffer from recruitment failure (RF), which can result from habitat loss and degradation, altered ecosystem functions, reduced food availability, overharvest, resulting small population sizes, and other causes. We developed and applied a diagnostic developmental template with a seven-step evaluation process to characterize recruitment failure of the endangered Kootenai River white sturgeon population (Acipenser transmontanus). As a collaborative effort involving the Kootenai River White Sturgeon Recovery Team and additional sturgeon researchers and managers in the US and Canada, this process was used to: 1) summarize and evaluate empirical data, 2) address temporal and spatial RF scoping questions, 3) identify proximal and distal mortality factors, 4) evaluate roles of mortality factors in RF, 5) update the template as needed, 6) develop RF hypotheses, and 7) test hypotheses. Despite annual spawning and production of viable embryos over the past 20 years, RF currently occurs annually due to a spatial mismatch between spawning/incubation habitat requirements and the availability of suitable habitat for eggs, embryos, and free embryos at current spawning locations. Spawning occurs annually in a low velocity reach dominated by sand and fine substrates (some clay) generally lacking clean, hard surfaces for egg attachment, interstitial space for concealment of incubating embryos from predation, and gas exchange for embryonic metabolism. Although this developmental template approach was specifically designed to diagnose and characterize mortality and RF for Kootenai River white sturgeon, it can also be used to assess limitations and restore natural recruitment for other imperiled sturgeon populations.

Habitat Use of Juvenile Burbot and Other Fishes in a Tributary of the Kootenai River,

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Burbot Lota lota in the lower Kootenai River have been the focus of extensive conservation efforts, particularly conservation aquaculture. Since 2009, approximately 316,000 juvenile Burbot have been released throughout the Kootenai River system. One of the primary strategies has been small tributary releases. Since 2012, approximately 12,000 juvenile Burbot have been released into Deep Creek, a small tributary of the Kootenai River. Understanding habitat use and species associations of Burbot and other species can provide insight into the life history strategies and a better understanding of ecosystem function. Insight into life history strategies and a better understanding of the system increases the chances of successful restoration, conservation, and management. The objectives of this study were to evaluate habitat associations and species associations of Burbot in Deep Creek. Multiple logistic regression was used to evaluate fish species occurrences. Nonmetric multidimensional scaling was used to examine patterns in fish assemblage structure in Deep Creek. Results from this study will help to ensure efficient and effective stocking efforts, as well as provide insight on the ecology of burbot and other members of the fish assemblage in Deep Creek.

Stepping right in the middle of it – mid-stream changes in ISS coordination, implementation, and design

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I had the pleasure of being the Nez Perce Tribe project leader for the ISS study from 2002-2003. During this period, the ISS project was required to respond to a technical review by the Independent Scientific Review Panel as it transitioned from Phase II to Phase III. I'll describe the technical basis of that review as well as the technical outcomes with regard to data collection and statistical design. Perhaps more importantly, I'll describe changes in project coordination spawned by the review.

The First Year of Burbot Production at a New Kootenai Tribe of Idaho Fish Hatchery

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Burbot Lota lota maculosa populations in the Kootenai River below Kootenai Falls, which includes a 106 km stretch in Idaho, and Kootenay Lake British Columbia declined approximately 40 years ago. Since 2001, the Kootenai Tribe of Idaho; University of Idaho; British Columbia Ministry of Forests, Lands and Natural Resource Operations; and Idaho Department of Fish and Game have been collaborating to develop methods for raising burbot in captivity. Their efforts included significant advances describing methods for wild brood-stock capture, adult spawning, egg incubation, and grow-out of juvenile, sub-adult and adult burbot. Initial work primarily demonstrated small-scale burbot aquaculture was feasible. Empirical studies at the Kootenai Tribe of Idaho's tribal fish hatchery in Bonners Ferry, Idaho, and the Aquaculture Research Institute in Moscow, Idaho, demonstrated successful culture methods for raising burbot to sizes large enough to spawn F2 generation progeny and to be implanted with transmitters. These fish were subsequently released in the Kootenai River to monitor fish movements and survival and to begin to develop protocols for logistical constraints needed to begin population re-building efforts. Following more than a decade of empirical advancements it was determined that large-scale aquaculture of burbot could be feasible. Construction of a new large-scale conservation aquaculture facility (approximately 750 m2 burbot-specific hatchery; located in Moyie Springs, Idaho) was completed in 2014. Hatchery staff successfully raised and released its first year class of burbot in 2015; beginning with three distinct larval fish releases in May 2015 and an all-inclusive first juvenile burbot release in October 2015. A general overview of the new burbot facility components, general production methods, and results from the first year of production will be presented. The goal of the future program is to continue production of juvenile and/or age-1 burbot for population rebuilding while balancing genetic and population structure considerations. The main objective of this presentation is to convey some of the key components to successfully raise burbot in captivity.

ISS: Genesis of a remarkable commitment to research, or, Whose crazy idea was that anyway?

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The role of hatcheries in conserving and recovering imperiled populations of wild native anadromous salmonids remains a contentious scientific and policy debate. Informing this debate with robust information is a challenge, requiring at least some commitments to experimental management at population and generational scales. Idaho Supplementation Studies reflects this unprecedented commitment and is a tribute to the solidarity and vision of the collaborating partners funding and implementing this ambitious research. As lead author of the founding experimental design and one of many original collaborators, I am humbled to be part of this commemoration, grateful to share some reflections on its genesis and development, and excited to hear the results of this decadal effort. This project has been a collaborative effort from the outset, which helped secure its durability and adaptability. The original experimental design was perhaps a somewhat naïve leap of faith in its temporal and spatial scales, its assumptions of stasis, and its assumed policy, management and funding commitments. Yet this boldness of scale was, and is, necessary to address many of the conservation and management questions surrounding hatchery supplementation. Obviously, strict adherence to the original design was not possible due to environmental setbacks and a multitude of other issues, but the overall integrity to the research and resilience to setbacks of the Idaho Supplementation Studies is remarkable. Experimental management at this scale is rare, but certainly needed to address other constraints to anadromous fish conservation in the Columbia Basin, such as hydropower operations (e.g., spill) and estuarine and tributary habitat restoration.

ORAL PRESENTATION ABSTRACTS

Microhabitat Associations of Native Fishes in Rehabilitated Reaches of the Kootenai River, Idaho

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The Kootenai River is one of Idaho's most unique and important resources. Like many other large rivers of North America, the Kootenai River and its catchment have been subject to a variety of water and land use alterations that have had deleterious effects on ecosystem function. The Kootenai Tribe of Idaho has been active in the past and is moving forward with a multi-year habitat rehabilitation program to restore self-sustaining, native wildlife populations. However, additional information is needed to further guide the design of habitat rehabilitation efforts in the Kootenai River. Our objectives were to describe microhabitat use by fishes, describe patterns in fish assemblage structure, and develop and test predictive models of resource use. Prepositioned areal electrofishing devices (0.80 m2) were used to sample fishes. Current was applied for 20 seconds following a 30 minute set time. Microhabitat conditions were measured within a 4 m2 area centered on the electrofishing anode. Across two field seasons and 542 sites, 1,573 fishes were collected representing four families and eight species. Logistic regression was used to determine habitat associations among fish populations. Results from this study provide information relating to specific habitat conditions selected by fishes in an attempt to maximize the benefit of the habitat rehabilitation program.

RESTORING FISH HABITAT in NEWSOME CREEK USING AN ADAPTIVE MANAGEMENT STRATEGY

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Newsome Creek, a major tributary to the South Fork Clearwater River, has suffered a damaging legacy of dredge mining that has left the stream system over-simplified and disconnected from its floodplain. After being locked in a straight, shallow channel for 70+ years, restoration efforts began in 2011 to re-connect the floodplain as well as the addition of large wood and side channels. Adjustments were made to the implementation strategy through the use of simple measurements, monitoring, and observations. LWD orientation and arrangement as well as excavated floodplain elevation and extent were re-evaluated and adjusted. Making these changes has led to an immediate benefit to stream processes, such as sediment sorting, gravel bar formation, side channel formation, and floodplain vegetation recruitment. A comparison between the phases and methods of implementation will be the focus as well as showing the links to the biological benefits using simple observations and feeding those back into the adaptive management loop for both habitat restoration and fisheries resource management decisions.

Tucannon River Steelhead Supplementation: How effective will it be?

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De facto supplementation of steelhead in the Tucannon River began as early as 1985, with returns of an out-of-basin hatchery steelhead stock from the LSRCP harvest mitigation program allowed to spawn naturally in the river. Following the ESA listing of Snake River steelhead in 1997, WDFW explored the potential to develop a local broodstock from natural-origin steelhead returns to the Tucannon River to replace the existing out-of-basin stock. In addition, due to the concern about the natural origin status, managers envisioned a conservation component to the hatchery plan if the local stock could be developed. If successful, the conservation component of the hatchery program would be given the highest priority. The first natural origin brood collections occurred in 2000, and the program was "tested" for ten years (50,000 smolt production), while we gathered information for performance in the hatchery, adult returns, smolt-to-adult survivals, and examined the genetic relationship to the previous hatchery stock used in the Tucannon River. The Tucannon steelhead supplementation program was officially implemented in 2010, after survivals were determine high enough to meet adult return goals, and that the out-of-basin stock releases were not going to be allowed anymore. Within hatchery performance has generally met expectations, though high IHNV titers in broodstock females and bacterial cold-water disease, has limited overall smolt production in a few years. The program faces many challenges which need to be addressed: 1) lack of rearing space is limiting full program production levels (50,000 conservation, 100,000 harvest mitigation), 2) run timing of harvestable fish is very similar to natural origin returns, which could lead to some fishery management changes, 3) nearly ½ of the returning hatchery and natural origin fish never make it back to the Tucannon River, but overshoot and remain above Lower Granite Dam, and 4) large number of strays (both hatchery and natural origin) from other basins are using the Tucannon River for spawning, potentially compromising fitness and genetic integrity.

ORAL PRESENTATION ABSTRACTS

Variability of Life-History Expression in Oncorhynchus mykiss: Drivers of Partial Migration

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For steelhead (Oncorhynchus mykiss), individual variation in the costs and benefits associated with migration leads to differing migratory strategies for maximization of individual lifetime fitness. While genetics play a role in determining the occurrence of migration, juvenile steelhead migratory behavior is highly plastic in response to conditions experienced in freshwater rearing habitat. In Lapwai Creek, a tributary of the Clearwater River in northern Idaho, we PIT tagged juvenile steelhead during summer from 2011-2013 and estimated summer survival probabilities using a robust design mark-recapture model. We then monitored downstream movements during the subsequent outmigration periods using in-stream PIT arrays. We used multi-strata mark-recapture models to evaluate biotic and abiotic influences on steelhead migration tendencies. Our results illustrate the spatial and temporal variability in outmigration strategies and suggest that individual survival probability predicts life-history expression and operates through a filter of mechanistic drivers of climate and population density. 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.

Evaluation of factors influencing return-to-creel of hatchery catchable-sized trout stocked in Idaho lentic waters

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Idaho Fish and Game
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Catchable-sized hatchery trout are an important component of state fisheries management, as they provide instantaneous fisheries in a wide variety of waters. However, hatchery rearing and transport costs continue to rise precipitously, while funding of hatchery programs has stagnated or declined. As a result, since 2008 the Idaho Department of Fish and Game (IDFG) has reduced the number of catchable-sized (254 mm, average length) Rainbow Trout Oncorhynchus mykiss stocked in Idaho waters from 2.4 to 1.9 million fish, annually. This economizing has emphasized a need to better understand how the hatchery catchable product is being utilized by anglers across the state of Idaho. From 2011 to 2014, IDFG released 50,745 T-bar anchor-tagged hatchery Rainbow Trout into 58 different lakes and reservoirs across 226 individual releases as part of a multi-year, statewide evaluation of exploitation rates. We analyzed the effects of 11 different variables on angler return-to-creel. Anglers reported tags at an average rate of 43% and average first-year catch was 23% across the four years of the study. Factors that influenced return-to-creel were the length of fish at release, size of the water stocked, the season of stocking, the air temperature prior to and following stocking, and the human population within 50 km of the fishery. Fisheries managers are faced with numerous factors to consider when allocating hatchery catchable trout stocking. Managers might consider adjusting stockings to maximize returns based on the above variables, but also need to consider what impacts such adjustments might have on angler perception and use of specific waters.

A mixed-effect model examining the spatial correlation of Chinook salmon abundance estimators for 31 populations in the Interior Columbia Basin

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The migration of adult spring/summer Chinook salmon (Oncorhynchus tshawytscha) returning to spawn in their natal streams once supported vast ceremonial, subsistence, recreational, and commercial fisheries in the Interior Columbia Basin of the western United States. The spawning adults also provided important subsidies of marine-derived nutrients to the ecosystem. The annual return of adult Chinook is a metapopulation of distinct sub-populations – each with spawning characteristics that are important to the long term viability of the aggregation. However, the sub-populations have experienced significant declines in productivity since completion of eight mainstem dams on the Columbia and Snake Rivers leading many of them to be listed as threatened under the Endangered Species Act. Determining the number of spawning adults is one of the primary metrics for measuring progress towards recovery goals. Due to the remote location of the streams and the cryptic nature of the spawners, single pass redd count surveys are the primary metric for determining the number of returning adults. The single pass redd count surveys (RCS) can produce biased and uncertain estimator of abundance because of the variable spawn timing and observer error. For a small number of sub-populations, however, there are mark-recapture surveys (MRS) that more precise, unbiased estimates of the true spawning abundance. We demonstrate how a Bayesian hierarchical model that treats the correlation between RCS and MRS abundance estimators as a function of the temporal, spatial, and stream characteristics can improve our understanding of spawner abundance for streams which only have low precision RCS estimators.

ORAL PRESENTATION ABSTRACTS

Using Field Observations and Remote-Sensing Imagery to Predict Stream Desiccation

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Perennial and intermittent stream classifications are often used for natural resource planning, such as regulating development near streams or developing sampling designs for aquatic assessment. However, classifications in commonly used hydrography datasets, such as the National Hydrography Dataset (NHD), often are not accurate and in the Western U.S. tend to underestimate intermittent streams. We used found fish survey and stream temperature data that described whether stream sites were wet or dry at the time of sampling to explore how remotely-sensed terrain, vegetation, and climate factors influenced the probability of stream desiccation in the Lahontan Basin of the Great Basin. Using a generalized linear mixed model, we found that landscape slope and convexity (characterizing alluvial fans), annual precipitation and lingering summer snowpack, and drought stress in riparian vegetation accurately predicted whether or not stream sites were dry during a given time year across two decades. We discuss how spatial predictions from our model could be helpful in efficiently estimating the inter-annual variability of stream habitat occupied by Lahontan cutthroat trout in desert streams of the northern Great Basin.

Putting it Back Together Again: Reconnecting the headwaters of the Salmon River

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The Salmon River above Stanley, Idaho is home to the furthest inland migration of Chinook salmon (Oncorhynchus tshawytscha), steelhead (Oncorhynchus mykiss), and sockeye salmon (Oncorhynchus nerka) in the lower 48 states. Portions of the historically important spawning and rearing habitat have been degraded or inaccessible to fish for nearly a century due to anthropogenic disturbances that created physical migration barriers or limited in stream flows. For the past several decades work has been on-going to reverse the impacts by restoring flows, passage, and habitat quality. For decades work by a diverse group of agencies and landowners has focused on addressing the main limiting factors from above the Sawtooth Hatchery to the headwaters. Treatments and tools have included improving irrigation diversions, instream flow agreements, fish screens, conservation easements, and physical barrier removal. Using a watershed approach, main stem fish passage and flow improvement was the obvious starting point. After accomplishing the first suite of major projects there was a significant delay in progress due to the complicated nature of next obvious priority. Pole Creek is a major tributary to the Salmon River, but had been seasonally dewatered and had several physical barriers in place for almost a century. Despite the conditions, Chinook salmon were still attempting to utilize the stream for spawning and rearing. For over a decade, the landowners and the team worked on the challenge to find a way to find a positive outcome for the agricultural operation and the fish. In 2015, the reconnection of Pole Creek to the Salmon River represents one of the most complicated projects ever completed by the restoration working group, but has the potential to have some of the largest conservation outcomes.

New Fish Passage Technology: Two Years of Progress

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Over the past two years, Whooshh Innovations has successfully demonstrated that it is possible to move live migratory species safely and gently over/around barriers, to/from rivers, and within a hatchery setting. Whooshh has created a proprietary water-sparing device that gently and safely moves fish through soft flexible tubes using pressure differentials and a light water mist.
Highlights include the Washington Department of Fish & Wildlife completing the second season using the mobile system on the Washougal River, transporting 16,000+ live Chinook over 8 weeks. The agency plans to use the system again in 2016 and is contemplating expanding the use of the system at other installations. Other developments: Safety and efficacy studies were also completed in this two-year time frame. The Yakama Nations compared traditional methods of fish transport to Whooshh. After tracking Chinook from initial arrival through spawning and egg hatch, researchers concluded that the condition of "Whooshhed" fish proved equal to or better than traditional methods. In 2014, under a U.S. Department of Energy grant, the Pacific Northwest National Laboratory (PNNL) compared a traditional trap & haul operation to Whooshh using two separate lengths of tube. Spawning rates and egg survivability were also studied. Presenting at the annual 2015 AFS conference, PNNL concluded that the Whooshh proved equal to or better than trap & haul, and recommended further in-field study. Two volitional entry studies also proved successful. The first, by the City of Newport, OR, involved moving live rainbow trout over an earthen dam. The second, on the White River in Buckley, WA, attracted and transported pink salmon. The Buckley project, a joint effort involving tribes, governmental/private entities, and conservation organizations, showed convincingly that the system could transport live fish "hands-free." Additionally, The Freshwater Institute tested a system on live Atlantic salmon at their recirculating aquaculture facility in West Virginia, during which fish were transported, held, and tested for stress. All fish survived and thrived and the results were published (Nov. 2015).

ORAL PRESENTATION ABSTRACTS

Hedging bets: Dealing with uncertain outcomes by diversifying management approaches

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Physical habitat stressors such as habitat degradation, population fragmentation, and climate change act synergistically with biological stressors such as invasive fish to put unprecedented pressure on some native fish species, such as bull trout. Case in point, the expansion of invasive lake trout within the Flathead Basin has dramatically reduced the ability of protected areas with largely pristine physical habitat, such as Glacier National Park, to serve as refuges for native species like bull trout. We are applying a holistic, multi-pronged strategy of restoration, isolation, monitoring, and population replication to maximize the ability of Glacier's landscape to provide secure habitat for bull trout and other native fish species into the future. This program is unique due to its comprehensive nature and its implementation in a backcountry Wilderness setting. The program requires a close linkage of research and management, while navigating competing/complex policy mandates and public opinion, as well as challenges in implementing field tasks that would be considered straight-forward in a front-country, non-Wilderness setting. We present a variety of approaches we have utilized that may aid others working to address similar resource challenges.

Movement and fate of recycled hatchery-origin summer steelhead in the Willamette River, Oregon

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Annual returns of adult hatchery-origin salmon and steelhead Oncorhynchus spp. to their hatcheries of origin often exceed broodstock quotas and managers are therefore responsible for appropriately allocating this surplus. One option is to recycle fish, a process whereby individuals are collected at a hatchery, transported downstream, and then released back into the river to ongoing fisheries. While the goal of these programs is to increase angling opportunity, recycled fish that avoid harvest can pose ecological and genetic risks to natural-origin populations. We used radiotelemetry to monitor the movements and fates of 423 adult summer steelhead O. mykiss recycled in two tributaries of the Willamette River, Oregon, across three years. Binomial and multinomial logistic regression were used to model fate probabilities and to evaluate whether fate was associated with covariates that included: release site and date, putative sex determinations, fish length, and the number of times a fish was recycled. Overall, approximately 15% of all radio-tagged recycled fish were reported as harvested and most individuals (62%) were last detected in their release tributary. Average annual reported harvest of fish recycled in the Middle Fork Willamette River (22.8) was twice as high as harvest of summer steelhead recycled in the South Santiam River (11.3). Binomial logistic regression models indicated that release date and sex influenced the probability of recycled steelhead being reported as harvested in the Middle Fork Willamette River, while multinomial logistic regression models suggested that release site and sex affected the probability of being reported harvest from the South Santiam River. The low recovery and reported harvest rates indicated that the recycling programs may increase the likelihood that non-harvested summer steelhead interact with natural-origin winter steelhead during winter and spring, including potential spawning periods.

Steelhead seasonal marine growth and variability in age at return

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Two developmental transitions define the life history of anadromous fish: 1) smoltification during migration from a freshwater environment to a marine environment and 2) maturation during the subsequent return to freshwater as an adult. Variation in age during each of these transitions leads to substantial life history diversity within and among populations of anadromous fish. Additionally, variation among individuals in the timing of each transition is thought to reflect trade-offs between growth and survival in variable environments. Prior research on age and timing of smoltification has revealed that a combination of genetic thresholds and individual fish condition (e.g., freshwater growth, lipid content) contribute to plasticity for juvenile steelhead Oncorhynchus mykiss. Fewer studies have examined patterns and potential causes of variability in the age at return of steelhead. Consequently, we used binomial logistic regression models to investigate whether marine growth during a critical period is a proximate factor in controlling the age at return for adult summer- and winter-run steelhead from the interior Columbia, Willamette, Skeena, and Nass River basins. We hypothesized that individuals experiencing periods of rapid marine growth would return earlier. Seasonal marine growth profiles were determined from specific growth increments estimated from scales. Understanding the mechanisms affecting variability in both age at outmigration and age at return is critical, as the resulting life history diversity affects population demographics by influencing the size structure of returning adults, by buffering anadromous populations from stochastic events, and by increasing population stability through time.

ORAL PRESENTATION ABSTRACTS

A Synthesis of Findings from an Integrated Hatchery Program after Three Generations of Spawning in the Natural Environment

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The Cle Elum Supplementation and Research Facility in the Yakima River Basin, Washington is an integrated spring Chinook Salmon Oncorhynchus tshawytscha hatchery program designed to test whether artificial propagation can increase natural production and harvest opportunities while keeping ecological and genetic impacts within acceptable limits. An unsupplemented population in the adjacent Naches watershed provides a reference for evaluating environmental influences. The program has been comprehensively monitored from inception. A synthesis of findings includes: supplementation increased harvest, redd counts, and spatial distribution of spawners; natural-origin returns were maintained; straying to non-target systems was negligible; natural-origin females had slightly higher breeding success (production of surviving fry) in an artificial spawning channel, while behavior and breeding success of natural- and hatchery-origin males were similar; hatchery-origin fish showed differences in morphometric and life history traits; high rates of hatchery age-2 (mini-jack) production were reported but observed proportions of outmigrating juvenile and adult (ages 4 and 5) returning males were comparable for hatchery- and natural-origin fish; hatchery smolts did not affect levels of pathogens in natural smolts; and, ecological interactions attributed to the program were within adopted guidelines. Continued study is required to assess long-term impacts to natural production and productivity.

Developing a Restoration Strategy for a Highly Degraded Valley Bottom, Crooked River, Idaho

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The Crooked River Valley, Idaho, is a highly degraded system due to historic dredge mining. This land use activity has severely altered the physical structure of the valley resulting in a loss of floodplain, riparian and aquatic function. In 2012, the Nez Perce Tribe and US Forest Service contracted River Design Group, Inc. to develop a design to restore the lower 2 miles of Crooked River. The overall goal of the project is to provide spawning, rearing, and overwinter habitat for Chinook salmon and steelhead by restoring a more natural and sustainable hydrologic function in the project area. Factors limiting the site from meeting this goal include: increased stream temperatures, loss of cover and instream complexity, loss of pool quality, loss of suitable spawning habitat, and attenuated spring flows. A design was developed that meets the desired future condition of the site of a connected floodplain that is inundated each year with side channels and wetlands; an appropriate sinuosity for the valley width and slope; off channel habitat including side channels and wetlands; instream complexity with large woody debris and an appropriate pool riffle ratio; and native riparian vegetation. A myriad of hydrologic, vegetative and geomorphic data was collected and analyzed to support and justify the design and environmental compliance efforts. The final design reduces the total stream length and sinuosity of the river, but increases the total functional habitat.

Rapid formation of population genetic structure and life history evolution following the introduction and establishment of a non-native anadromous fish

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The establishment of anadromous fishes outside their native range provides opportunities to examine evolutionary processes in real time and adaptations in novel environments. American shad is an anadromous clupeid native to the Atlantic coast of North America that was introduced to California in 1871. Shad rapidly dispersed and colonized rivers along the Pacific coast¬–several of which may comprise genetically distinguishable populations and may provide insight about the dynamics of dispersal, colonization, and the establishment of philopatry. Non-native shad also exhibit extended freshwater residency in some locations, including a landlocked population that allows examination of life history evolution in novel environments. Using 13 microsatellite loci we genotyped anadromous, freshwater resident and landlocked shad from the US Pacific coast to resolve population genetic structure. Significant ($P<0.05$) allelic heterogeneity was observed among most pairwise comparisons of anadromous collections, and between freshwater resident/landlocked and anadromous collections from the Columbia and Sacramento-San Joaquin Rivers. Standardized genetic differentiation ($F'ST = -0.025–0.248$; global $F'ST = 0.087$) was significant ($P<0.05$) for most pairwise comparisons. Our results suggest that philopatry may have become established shortly after dispersal and colonization, and that some mechanism of reproductive isolation maintains genetic differentiation among shad exhibiting alternative life history strategies within watersheds.

ORAL PRESENTATION ABSTRACTS

History, Evaluation, and Future of the Imnaha River Chinook Salmon Supplementation Program: OK, Now What?

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Abundance, productivity, diversity, and distribution of Imnaha River Chinook Salmon Oncorhynchus tshawytscha have been influenced by a mitigation hatchery program, since 1982. The Imnaha River Chinook Salmon Supplementation Program, co-managed by ODFW and NPT, uses only endemic Imnaha River Chinook Salmon for broodstock, with goals of enhancing natural production and restoring fisheries, while maintaining the natural population's genetic and life history characteristics. The Program uses a sliding scale for managing proportions of natural and hatchery salmon collected for broodstock and released above the weir. However, ~27% of the salmon spawn below the weir and cannot be managed. Annual adult returns reached the goal of 3,210 only once in 28 years, with a mean adult SAR of 0.47%, drastically below recovery goals. Hatchery salmon run and spawn timing and distribution differ from natural salmon, and both origins are returning at increasingly younger ages, as age 5 adults become increasingly rare. Despite increased total spawners due to high abundance of hatchery salmon in nature, neither natural abundance nor productivity have increased, and have decreased relative to unsupplemented streams. The weir was inefficient and sliding scale limits were used as targets and often exceeded, allowing more hatchery spawners, both in nature and the hatchery, than the scale allowed. A new weir, to be used in 2016, will improve weir management and adherence to the sliding scale. Natural Chinook Salmon remain extant in the Imnaha River, salmon culture and management knowledge have increased, and, since 2001, limited tribal and sport fisheries occurred, that would have been absent without supplementation. The Imnaha River Chinook Salmon Supplementation Program has not met its goals of enhancing natural production and maintaining natural life history characteristics or providing the desired level of harvest in the Imnaha, Snake, or Columbia rivers. This Program highlights the challenge of co-managing a program with many competing objectives (harvest, recovery, etc.). Managers will need to consider changes in weir management, broodstock collection, spawning, hatchery rearing, and/or smolt release strategies in order to achieve management goals. Balancing the use of these tools with the objectives of multiple agencies will be the challenge for upcoming years.

Kootenai River Burbot Release Strategy Employed During 2015

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The Kootenai Tribe of Idaho (KTOI); University of Idaho – Aquaculture Research Institute (UI-ARI); Idaho Department of Fish and Game (IDFG); and British Columbia Ministry of Forests, Lands and Natural Resource Operations (BCMFLNRO) have led a collaborative effort developing methods for burbot conservation aquaculture since 2001. Releases of hatchery-reared burbot produced at UI-ARI were for restoring the Lower Kootenai River / Lake population and occurred annually from 2009-2014. These releases support research, monitoring and evaluation (RME) activities, and to increase population abundance. Release strategies and RME activities have been directed by a burbot working group; beginning in 2013, a formal annual program review (APR) was integrated to assist with hatchery-production guidance, RME results dissemination, decision-making, and co-manager agreements. During 2015, the majority of burbot aquaculture production switched from the UI-ARI to KTOI's new conservation aquaculture facility, which was designed to support a significant increase of burbot production. KTOI's aquaculture staff successfully reared and released its first year class of burbot during 2015. KTOI staff released approximately 632,000 larvae during May 2015, and 260,000 juveniles during October 2015. Also, UI-ARI contributed 13,000 juveniles to the 2015 year class. The production and releases in 2015, as in past years, were organized in a manner to mutually support population abundance recovery and RME design needed to evaluate numerous aspects of the Kootenai River restoration efforts. The presentation will provide a summary of 2015 Kootenai River/Kootenay Lake Burbot releases; as well as the rationale and the considerations behind the strategy.

Evaluating the Post-stocking Survival and Reproductive Success of YY Male Brook Trout

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Non-native Brook Trout Salvelinus fontinalis were introduced throughout western North America in the early 1900s, resulting in widespread self-sustaining populations that are difficult to eliminate and that often threaten native salmonid populations. A novel approach to eradicating undesirable Brook Trout populations is using Trojan (YY male) Brook Trout (created in the hatchery by feminizing XY males and crossing them with normal XY males). If Trojan Brook Trout survive after stocking, and reproduce successfully with wild females, in theory this could eventually drive the sex ratio to 100% males, at which point the wild population would become functionally eliminated. We stocked Trojan Brook Trout in four streams in central Idaho in 2014; in two of these streams, the wild Brook Trout population was reduced via electrofishing prior to stocking to determine if diminished competition with wild fish increased survival of Trojan fish. We conducted electrofishing surveys in October 2014 to estimate (1) abundance of wild and Trojan Brook Trout, (2) apparent mortality of Trojan fish, (3) emigration of Trojan fish from stocking reaches, and (4) the baseline sex ratio of wild Brook Trout fry in the four treatment streams and two control streams. Apparent survival of Trojan Brook Trout averaged 11% (range 7-21%), and may have been improved in one stream by removing wild Brook Trout. Trojan emigration was minimal in all treatment streams, and angler exploitation (determined from angler reporting of Floy® tags attached to Trojan fish prior to release) of Trojan fish was either zero (two streams) or about 25% (two streams). Sex ratios of wild Brook Trout fry ranged from 50-75% males and averaged 62% males. In 2015, tissue samples were obtained from 100 Brook Trout fry at each study stream for subsequent genetic testing. Genetic analyses evaluated whether sex ratios were shifted by the stocked Trojan Brook Trout, and determined if any of the fry were progeny of the Trojan Brook Trout. These results might confirm that Trojan Brook Trout spawned successfully with wild fish and this finding would support the theory that Trojan Brook Trout could be used as a tool to eradicate undesirable non-native Brook Trout populations.

Idaho Supplementation Studies: Basin Wide Evaluations of Chinook Salmon Supplementation; Can Managers Use the Tool and at What Cost to Natural Populations?

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Populations of anadromous salmonids in Idaho and most of the Pacific Northwest have declined precipitously since the 1950s. Hatchery programs were developed to mitigate for lost harvest opportunities. As salmon populations continued to decline, supplementation programs were developed to address conservation needs, but often used segregated or non-endemic hatchery stocks. The Idaho Supplementation Studies was designed to measure the population effects of a dedicated supplementation program, using endemic or integrated hatchery stocks where possible, on the abundance and productivity of Chinook Salmon Oncorhynchus tshawytscha during and after treatments. The study was divided into three phases to evaluate supplementation effects using 14 reference and 13 supplemented streams across the Clearwater and Salmon river basins. Phase 1 established a baseline relationship between streams in the pre-supplementation period. In phase 2, abundance and productivity shifts from baseline relationships in treatment streams were measured during supplementation. In phase 3, treatments streams were allowed to return to baseline relationships or indicate an altered state for at least one generation post-supplementation. Basin level analyses of abundance were made at four life-stages: redds (as a surrogate for eggs), emigrants at rotary screw traps, smolts at Lower Granite Dam, and adult progeny returning to study streams. Changes in productivity were estimated for emigrants per redd, smolts per redd, and progeny per parent. Results indicated supplementation treatments provided abundance boosts at varying levels across the spatial (basin) and temporal (life-stage) landscape during the supplementation phase. Abundance boosts in the post-supplementation phase, however, were not maintained and treatment streams returned to baseline relationships with reference streams. Analyses showed productivity changes in treatment streams during and post-supplementation were small across each spatial and temporal scale and generally tracked reference stream patterns. One exception in the Salmon River basin did show a decrease in progeny to parent productivity occurred during supplementation in phase 2. Overall, basin level analyses suggest supplementation is a viable management tool capable of boosting Chinook population abundance while minimizing adverse effects to natural origin productivity.

Adaptive Management and the Nez Perce Tribal Hatchery Spring Chinook Salmon Supplementation Program

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Beginning in 2003, the Nez Perce Tribe implemented a supplementation program in the Clearwater River basin with the goal of restoring spring Chinook salmon populations to self-sustaining levels and provide harvest opportunities for Tribal and non-Tribal anglers. This program utilizes fall releases of pre-smolt life stages, low density rearing and acclimation to best mimic natural production and minimize ecological impacts. Hatchery and natural juveniles and adults were evaluated using abundance, survival and productivity performance measures. Although overwinter survival of hatchery origin pre-smolts was low, surviving smolts demonstrated similar survival to Lower Granite Dam (LGR) and similar smolt-to-adult survival from LGR to LGR compared to natural origin smolts. Finally, adult age structure (including jack proportions) of returning hatchery origin adults was similar to that of natural production. Overall, the results suggest that a pre-smolt release strategy may minimize impacts by producing fish similar to that of the natural population. However, survival from release to the smolt stage was very low and resulted in hatchery abundance levels well below the goals of the program. Through adaptive management a smolt release strategy, in conjunction with the current pre-smolt releases, has been implemented in Lolo Creek to address the low pre-smolt to smolt survival and provide a direct comparison between pre-smolt and smolt releases.

Past, Present and Future Outlook of the Snake River Sockeye Salmon Hatchery Program

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Historically, Sockeye Salmon were abundant throughout the upper Snake and Salmon River watersheds in Idaho. The majority of these populations were extirpated and only a single anadromous population in Redfish Lake supported anadromous Sockeye Salmon in the last part of the century. The Snake River sockeye salmon ESU was listed as endangered under the Endangered Species Act in 1991 and includes all anadromous and residual sockeye salmon from the Snake River Basin, Idaho as well as artificially propagated sockeye salmon. The captive broodstock was initiated, just prior to listing, with the collection and spawning of the four wild adults that returned in 1991. Captive broodstock or gene rescue programs are a form of captive propagation where fish are brought into the hatchery and reared in captivity for their entire life cycle. Upon maturation, adults are spawned and a subset of their progeny are reared in captivity as a safety-net while a subset of their progeny is released into the natural environment. The goal of the program was to utilize captive technology to avoid population extinction and conserve population genetic diversity. Current goals include increasing the number of individuals in the population utilizing the hatchery program, de-listing the ESU and providing sustained sport and treaty harvest opportunity. The hatchery program has played a major role in avoiding extinction of this ESU, which would have been likely if the captive broodstock had not been initiated. The program uses state of the art hatchery facilities and fish husbandry protocols, genetic support, and monitoring and evaluation of both the hatchery and wild components. Here, I describe how the captive broodstock was developed with emphasis on some of the best management practices and spawning protocols to conserve genetic diversity. I also describe the ways in which the program has expanded and changed through time, some of the key findings, and the future direction of the program.

The occurrence, type, and passage and ingestions time of fishing tackle identified in the digestive systems of White Sturgeon using metal detectors and x-ray

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Over the last decade, field reports indicated that many White Sturgeon Acipenser transmontanus have ingested and retained hooks and other fishing tackle in their digestive systems. We scanned 2,077 White Sturgeon using hand-held metal detectors and x-rayed 443 White Sturgeon in the Hells Canyon reach of the Snake River in Idaho to evaluate the percent of fish that contained metal, the number and type of metal, and the retention or passage time of metal in the digestive system. Using x-rays, we confirmed the accuracy of metal detectors (90%) to identify the presence of metal. Across all size classes, 20% of White Sturgeon in Hells Canyon contained metal in their digestive tract, with smaller fish (<100 cm) less likely to contain metal (10%) than larger fish (>100 cm; 28-46%). The majority of the metal identified in the digestive systems of White Sturgeon was fishing tackle, with hooks being the primary type, followed by jigs, swivels, pieces of broken hooks, sinkers, and spinners. We estimate that, of the total fish sampled, 6.7% contained more than 2 pieces of metal. White Sturgeon with metal in their digestive systems, on average, had smaller pectoral and pelvic girths than fish without metal, indicating a reduced body condition. White Sturgeon x-rayed at least twice in consecutive years appeared able to digest or pass metal in approximately 19 months, but some White Sturgeon retained metal for up to 41 months. Several White Sturgeon that passed metal between x-rays also consumed new metal during the same period. Hook ingestion appeared to occur every 19 months, a similar rate as hook passage. Our results suggest that White Sturgeon effectively process the metal they ingest and, considering the stability of White Sturgeon populations in Hells Canyon over the last several decades, it appears that consumption of fishing tackle is not having overly negative effects on the population.

ORAL PRESENTATION ABSTRACTS

Seasonal influences of resource competition and predation on a Kokanee (Oncorhynchus nerka) fishery in an Eastern Washington Lake

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Buffalo Lake, located on the Colville Confederated Tribes Reservation in north-central Washington State, is currently managed with the primary goal of maintaining sustainability of a naturally reproducing Kokanee fishery, and a secondary goal of providing quality Largemouth Bass and stocked Rainbow Trout fisheries. In mixed species systems, complex food web interactions can affect fishery quality. For example, Kokanee and hatchery Rainbow Trout competitive interactions, brought on by excess stocking, may reduce food resource availability and viability of both species. Furthermore, competition and predation pressures with warmwater fish species such as Largemouth Bass and Black Crappie can impact Kokanee. In our study, we employed stomach content analysis to quantify seasonal food web relationships for all Buffalo Lake fish species, identifying competitive overlap and interspecific predation potentials that may impact Kokanee production.

Implementation and the early years of the Idaho Supplementation Studies (1991-2001)

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The Idaho Supplementation studies (ISS) was an ambitious large-scale experiment that began field work in 1991. There were 31 study streams within a rugged landscape 61,000 km2 in area. The learning curve was steep and reality imposed many constraints on the ambitious design. A large budget cut delayed full implementation. Three study streams were too remote and others were substituted. Screw traps and passive integrated transponder tags were used on a large scale for the first time in Idaho. Important juvenile data series were initiated and previously existing peak spawning surveys were enhanced by more intensive multi-pass surveys. Mass marking was initiated to distinguish supplementation fish (ventral fin clips and coded wire tags) and non-treatment hatchery fish (adipose fin clip) from wild fish. Some inconsistencies in data collection occurred as methodologies were developed and researchers became more familiar with study streams. Summer parr surveys yielded wide variances on population estimates and it proved difficult to collect enough parr for tagging, so screw traps were operated through the summer to compensate. Initially, efforts were made to coordinate and communicate among the cooperating agencies (Idaho Department of Fish & Game, Nez Perce Tribe, Shoshone-Bannock Tribes, US Fish & Wildlife Service, University of Idaho) and between ISS personnel, hatchery staff, and fishery managers. However, there were multiple changes of key personnel and the university dropped out of the project after finishing some small-scale studies; consequently, communication and coordination decreased. Worst of all, the already-depressed runs declined even further, creating controversy over the use of study fish, inability to establish a supplementation brood stock for the Clearwater basin, and changes to the experimental treatments. In some cases, treatments were not made or were made at greatly reduced levels; therefore, some streams were changed from treatment to reference. These issues called the integrity of the study into question (see following talk by C. Beasley). Despite many difficulties, a good foundation was established for the study. Communications were gradually re-established, increasing cooperation within and beyond the project, which helped as changes occurred. Such cooperation and quality information proved vital to maintaining ISS through to completion.

Modeling bull trout and brook trout coexistence: a structured decision approach

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Over the last 100 years bull trout (Salvelinus confluentus) have experienced population declines in addition to reductions to their historic range throughout the Pacific Northwest. One factor believed to cause of the decline of bull trout populations has been interactions with invasive fish species, such as the brook trout (Salvelinus fontainalis). The detrimental effects of brook trout on bull trout are well documented and include both resource competition and predation of juvenile bull trout. We developed a decision model to evaluate different management alternatives for populations of fluvial bull trout that coexist with brook trout. Management alternatives we explored include brook trout removal, fish barrier installations, habitat enhancement, as well as bull trout translocations. Our fundamental objective was to identify the management alternative that would maximize the number of adult bull trout in the population. We found that assumptions of how juvenile bull trout interact with brook trout (e.g. resource competition or brook trout predation rates) influenced optimal decision making. In addition, results from our model suggest management alternatives that support the fluvial life history strategy made bull trout populations more resilient to coexistence with brook trout. Future work with this model will include implementing it into an active adaptive management context to facilitate learning through implementing management alternatives.

Impacts of High Discharge from Island Park Reservoir on Downstream Temperature, Turbidity, and Dissolved Oxygen

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Reservoirs increase water residence time and impose stratification, greatly influencing downstream water quality. Island Park Reservoir is an irrigation storage and delivery reservoir on the Henry's Fork and has a capacity equal to one third of mean annual inflow. Recently, anglers and fishing guides have expressed concerns about increased release of sediment during periods of high downstream delivery and potential impacts on trout growth and survival. To address these concerns, we investigated the impact of high summer discharge on water quality, focusing on changes in temperature, turbidity, suspended sediment concentration (SSC), and dissolved oxygen level (DO). We collected data prior to, during, and after the 2015 irrigation season at both reservoir outflow points: the power plant, which discharges a maximum of 960cfs during periods of high delivery, and the dam gate, which is used to deliver any remaining required delivery in excess of 960cfs and which has a 30-foot lower withdrawal depth than the power plant. After accounting for seasonal effects, we found that total discharge greater than 1,100cfs consistently resulted in an average DO increase of 2 mg/L and an average temperature decrease of 1.5˚C. These are beneficial changes in habitat for trout during the summer months because warm temperatures increase their metabolism and oxygen demand, and temperatures at the upper range of their tolerance can stem growth. We found a relatively small increase in turbidity during high-delivery periods (average increase of 2.5 FNU) and found that half of the delivered SSC was organic carbon. We will present a physical explanation for explaining why DO levels were greater in discharge from the lower exit point and we argue that the relatively small increase in turbidity and sediment delivery we saw was a cheap price to pay for lower summertime water temperatures and increased levels of DO.

Improving estimates of steelhead natural production in Idaho: a hierarchical modeling approach

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Steelhead Oncorhynchus mykiss in the Snake River basin, Idaho, were listed as threatened under the Endangered Species Act in 1997. Evaluation and recovery of steelhead populations requires information about abundance, spatial distribution, recruitment rates, and other life-history parameters. However, variability in steelhead ontogeny coupled with challenging environmental conditions during key life-history events makes monitoring populations difficult. One important metric is juvenile steelhead production, which is estimated using screw traps and snorkel surveys. Although screw traps are thought to provide more robust estimates of juvenile abundance, screw trap sampling is spatially restricted. In contrast, snorkel surveys may have lower precision, but can be implemented more broadly, particularly in wilderness areas. Therefore, both methods provide useful data, but combining these two sources of data across spatial and temporal scales has been problematic. The goal of this research was to develop a framework to integrate screw trap and snorkel survey data across space and through time, and in particular, to facilitate comparisons between steelhead subpopulations. Data were collected by the Idaho Department of Fish and Game during routine snorkel- and screw-trap surveys from 2007-2014, which included steelhead density estimates and habitat covariates. A hierarchical model was developed to make joint inference from snorkel and screw trap data. Productivity was compared between basins and across years. The ability to use snorkel and screw trap data simultaneous can improve our understanding of steelhead abundance and population dynamics in the Snake River basin. Beyond the Snake River, these analyses contribute to the broader understanding of the biology of steelhead and will help identify management priorities throughout the distribution of steelhead.

Using what you got: implementing Bayesian models to obtain useful information from poor rotary screw trap data

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Mark-recapture data collected at rotary screw traps are often used to estimate abundances of migrating juvenile salmonids within the Columbia River basin. These abundance estimates are necessary to determine critical population information (e.g. juvenile survival rates, smolt-to-adult returns, juvenile out-migrant production) needed for effective conservation and monitoring efforts. Frequently, environmental conditions and mechanical failures alter rotary screw trap efficiencies, or completely cease rotary screw trap operations, leading to sparse and missing data. Dependent on the statistical approach chosen to analyze sparse and missing data, abundance estimates can vary considerably. We simulated four data sets representative of salmonid data collected at rotary screw traps in Idaho using known parameters to compare the accuracy and precision of abundance estimates produced by three common statistical approaches. The three approaches included in the study were (i) time-stratified Bailey adjusted Lincoln-Petersen estimator (GAUSS), (ii) time-stratified hierarchical Bayesian model with penalized Bayesian splines (BTSPAS), and (iii) multi-year time-stratified hierarchical Bayesian model (MYTSBE). The precision and accuracy of the estimates from the three approaches were comparable when data were abundant and present throughout the data set. When data were reduced and missing time periods were introduced to data sets, GAUSS estimates had the greatest bias (12.5% from the known abundance parameter) with the highest variance (95% confidence interval width of 5,827). The BTSPAS and MYTSBE estimates were relatively unbiased when data were sparse and missing (< 4.3% from the known abundance parameter) with variances comparable to those produced by the GAUSS approach. The hierarchical structures of the Bayesian approaches allowed information to be shared between and within years, ultimately resulting in more accurate abundance estimates.

ORAL PRESENTATION ABSTRACTS

Investigation of factors limiting Yellowstone cutthroat trout in the Snake River floodplain using food web approaches

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The mosaic of habitats referred to as the Fort Hall Bottoms, which includes the Snake River and a suite of floodplain springbrooks located on the Fort Hall Reservation in southeastern Idaho, represents one of the most intact river-floodplain ecosystems remaining in the region. However, regulation of the Snake River's flow for agriculture may be contributing to ecological degradation of the area, and as a result, may be limiting Yellowstone cutthroat trout (Oncorhynchus clarkii bouvieri) residing in the springbrooks. Beginning in the summer of 2015, we started a year-long study in collaboration with the Shoshone-Bannock Tribes that will seasonally examine habitat quality and food web dynamics within a range of aquatic environments utilized by Yellowstone cutthroat trout in order to determine what factors may be limiting the distribution, abundance, and growth of trout residing in the Fort Hall Bottoms. Based on observations and preliminary analyses, it appears that reduced scouring floods originating from the Snake River may be leading to deep accumulations of fine sediment and increased growth of aquatic macrophytes. The trout population in the springbrooks is represented by almost exclusively large adults, possibly suggesting that recruitment is occurring in habitats other than the springbrooks or there is a population bottleneck occurring at the spawning or juvenile life stage. Quantification of benthic invertebrate communities shows that invasive New Zealand mud snails (Potamopyrgus antipodarum) and amphipods are the dominant taxa, a pattern likely related to the stable flow environments of the springbrooks, deep accumulations of fine sediment, and dense beds of aquatic macrophytes. When examining trout diets, we observe that trout in the springbrooks are chiefly relying on non-insect prey items, and the consumption of aquatic insect that does occur is during or after emergence. These findings combined suggest that lack of scour in the floodplain springbrooks may be decreasing the quantity and quality of spawning habitat and the food base available to sustain trout production.

Collette mine restoration and dredge pond removal: reversing the decline of steelhead and the destruction of a local biodiverse hot spot

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The Collette Mine stream restoration project is located along Lolo Creek on the Nez Perce - Clearwater National Forests in Idaho County. The site had been impacted by past dredge mine activity, which caused Lolo Creek to become entrenched due to the legacy tailings piles along the west side of the stream. The tailings piles have reduced the ability of Lolo Creek to access the historic flood plain and prevented the natural channel migration across the valley floor, disconnecting the channel habitat and the associated wetlands. The tailing piles also provide a poor growing medium for riparian plants, decreased stream shading, and large wood recruitment. Lolo Creek contains critical habitat for ESA listed steelhead, potential critical habitat for bull trout, and habitat for Chinook salmon. We hypothesized, restoring the historic channel morphology, geometry, and riparian vegetation will result in a high quality and diverse stream habitat for all ESA fish as well as other resident fish. Construction of the site began in July 2015 and was completed in October 2015. The primary elements of construction included re-grading the floodplain surface including dredge pile excavation and pond back-filling as to gradually tie into the bankfull floodplain, the incorporation of woody debris, and planting of native species back to the site for erosion control, floodplain stability and habitat diversity. Wood structures were also keyed into the streambank to maximize instream habitat. The dredge ponds, which were connected to Lolo Creek, were being used by a large number of native species. Total fish removed and relocated to Lolo Creek from the dredge ponds before construction began, were 35 Steelhead, 187 Chinook salmon, 2,983 lamprey, 58 sculpin, and 190 dace. An unknown number of amphibians, insects, and many other freshwater species were also relocated to Lolo Creek, as well as to other ponds in the area.

Of fire, food, and fish: fish productivity responses to wildfire

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Wildfire is a disturbance by which terrestrial effects translate into consequences for stream ecosystems, food webs, and aquatic productivity. We investigated the consequences of wildfire for food web dynamics and productivity of organisms at multiple trophic levels in wilderness streams of Central Idaho. We combined 24 years of monitoring data and a short term, intensive comparison of food webs and production in a pair of streams with a spatially extensive comparison and multi-factor analysis of fish populations across 12 streams that span gradients in fire history and recovery. Our long term monitoring efforts indicated that the paired streams exhibited similar habitat characteristics, chlorophyll-a (chl-a) biomass, and aquatic invertebrate biomass for 10 years preceding severe wildfire in 2000. After wildfire, one stream retained a relatively open canopy while the other, being of northerly aspect, quickly regrew a dense overstory. Subsequently, trends in chl-a and invertebrate biomass values diverged, and in the 14 years post fire, the open canopy stream averaged ~ 3.2 × higher chl-a biomass (mean = 32.1 vs. 10.1 mg/m2) and ~ 2.4 × higher invertebrate biomass (mean = 2112 vs. 889 mg/m2) than the closed canopy stream. Our short term foodweb comparison of these streams revealed the closed canopy stream exhibited ~ 2.7 × higher primary production (mean = 83.9 vs. 31.2 mg/m2/h), ~ 2.3 × higher invertebrate secondary production (mean = 21.2 vs. 9.4 mg/m2/y), and ~ 2.9 × higher production of steelhead (Oncorhynchus mykiss) and cutthroat trout (Oncorhynchus clarkii) (mean = 0.126 vs. 0.043 g/m2/d), than the open canopy stream. Diet analysis indicated fish in the closed canopy stream consumed ~ 2.0 × the proportion of terrestrial invertebrate biomass than did fish in the open canopy stream (30% vs. 15%). Patterns of fish biomass across 12 streams in the basin were best explained by a model that included: invertebrate biomass, light input, total nitrogen, and watershed area. Our observations suggest that stream productivity is resilient to severe wildfire. Indeed, these findings provide evidence of a pulse of productivity that may persist >10 years post fire, but may also be mediated by trajectories of riparian regrowth.

Development and Simulated Use of a YY Male Brook Trout Broodstock for Potential Eradication of Undesired Brook Trout Populations

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Brook Trout introduced outside their native range often negatively impact native aquatic fauna or provide marginal fisheries and are often targeted for manual or piscicide removal in lakes and streams. Unfortunately, complete eradication of exotic Brook Trout populations via these approaches is rarely achieved; new approaches are needed. A potential alternative is a Trojan Y Chromosome (TYC) program, where hatchery-produced genetically YY male fish would be regularly released into an undesired population over time, skewing the population towards 100% males, theoretically resulting in wild population extirpation. We developed two genetic sex markers for Brook Trout and employed juvenile sex reversal methods commonly used in commercial aquaculture to develop a YY broodstock that can produce offspring for possible future use as biological control agents. Our search for genetic sex markers proved successful with genotypic sex determination for both assays matching the observed phenotype for 90 out of 90 individuals. Estradiol-infused feed readily feminized genetic XY males into neo-females (FXY fish) at a high rate (99.6%, n = 224) in the first phase of the program. In the second program phase we cultured both sperm and egg-producing supermales (YY fish), a vital step towards development of TYC technology on a large aquaculture scale. This study demonstrates that hatchery production of a YY Brook Trout broodstock is feasible, modest in cost (less than US $10,000), and can be completed in less than 4 years. Stochastic population simulations conducted for both typical stream and alpine lake populations predict that, if supermales (MYY) survive and reproduce as effectively as normal wild males, a population could be eradicated in a decade or less using several feasible combinations of supermale stocking and electro-fishing suppression. If supermales survive far less than normal males, brook trout could be eradicated only by using high rates of stocking and electrofishing suppression. Several other potential unknowns, including the possibility of environmental sex reversal, could also complicate population response but the costs to evaluate these possibilities apriori are formidable. We therefore believe that pilot field trials on the use of YY males for Brook Trout eradication are warranted and should be undertaken.

ORAL PRESENTATION ABSTRACTS

Chinook Salmon Captive Rearing: a Novel Conservation Hatchery Strategy for At-Risk Stocks

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The goal of the captive rearing program for Salmon River spring Chinook salmon was to test the efficacy of a small-scale hatchery technique to prevent localized extinctions and ensure a continuum of spawners. Here, we describe the implementation of this program from 1994-2014 and include details regarding the outcomes. Natural Chinook salmon were sourced as parr or eggs from three streams, brought into protective culture and reared to the adult. Upon maturation, adults were released back into the natal streams to spawn volitionally. Parr were collected to source annual captive rearing groups in 1994-1998 (2,094 parr). Collections shifted to eyed-eggs from redds of natural fish in 1999. Egg groups (4,476 eyed eggs, 1999-2005) achieved better overall survival than parr groups, with 61.5% survival from collection to mature adult. From 1998 – 2010, a total of 2,755 captive adults were released to spawn in natal streams. Adults were smaller, and matured at a younger age than natural-origin counterparts, including many age-2 precocial males. Nonetheless, captives exhibited similar habitat selection, male courtship, and female spawn behavior as natural fish. Captives produced 343 redds, which was 0.29 redds per female. Spawn timing of captives was 2-3 weeks later than natural fish, and viability of their eggs averaged 74.5% compared to 90.6% for natural fish. Survival from eyed-egg to fry of naturally spawned captive fish (80.1%) was comparable to natural adults (83.9%). Parentage analyses of East Fork Salmon River (EFSR) adults released to spawn naturally revealed that captives successfully reproduced and produced adult returns. Captives returned fewer adults per female (0.27) than natural females (3.23); however, captive reproductive success was comparable to other Chinook Salmon conservation hatchery programs. Evidence suggests this program, even at modest collection and production levels, would likely have prevented cohort collapse. We found captive fish did experience some domestication and fitness loss but demographic benefits were gained by bringing fish into captivity. Captive fish successfully contributed to the natural production. If a population is small and at risk of extinction, the risks of extinction outweighs potential risks from domestication so this strategy would still be useful and beneficial to implement.

The Mill Creek A to Z Project: An Experimental Approach to Watershed Restoration on Federal Lands

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Since 2003, the Forest Service and Bureau of Land Management have had authority to use stewardship contracting agreements to facilitate watershed restoration by allowing the use of timber receipts to fund service projects in the planning area (e.g., road maintenance, fish passage replacement, and stream habitat restoration). Stewardship contracts have been implemented throughout the US, mostly in the western US, planned and administered by the Federal agencies. With the Mill Creek A to Z Project, the Colville National Forest in northeast Washington has experimented with a new approach to stewardship contracting. As part of the stewardship contract, the successful bidder (Vaagen Brothers Lumber) retained an independent third-party contractor (Cramer Fish Sciences) to conduct the planning and analysis for the project under the Forest Service's direction. Traditionally, the Federal agencies have been solely responsible for identifying the purpose and need for a project and designing proposed timber harvest and restoration activities. In this presentation, we discuss our experiences with this experimental approach, applied on a 50,000 acre planning area near Colville, WA. We will describe the planning process, highlighting key similarities and differences with the "traditional" approach employed by the Federal agencies. We will also highlight key lessons learned, including the efficiency of the experimental approach, its effectiveness in identifying meaningful restoration service projects, the role timber harvest plays in watershed restoration, and challenges we faced in stakeholder collaboration and public perception. These findings have value as the Forest Service considers using this approach to treat lands they administer in the western US.

Effect of High Diel Temperature on Growth, Stress Response, and Immuno-competency of Burbot

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Within the native range of Burbot Lota lota maculosa across the northern United States, habitats from deep, cold lakes to prairie streams are occupied. Controlled laboratory trials were conducted to evaluate the growth, immune response, and thermal stress physiology of Burbot subjected to fluctuating, high diel temperatures. We tested age-0 Burbot from a captive propagation program associated with population restoration of Burbot in the Kootenai River, Idaho in temperature cycles that imitated summer conditions observed in regional stream habitats. The diel temperature cycle for treatments varied from 18°C to 27°C and controls were held at a constant temperature of 14°C. We evaluated survival, growth, feed efficiency, heat-shock protein 70 (hsp70) levels, hsp70 gene expression, serum lysozyme levels, and proximate body composition in samples of fish taken before, during, and at the completion of the trials. Both treatments had high survival, but differences in growth, with the control fish having higher growth rates and better feed conversions than treatment fish. Heat shock protein expression and levels were higher in tissues from treatment fish, but also variable between tissues with liver having higher induction and accumulation of hsp70 than muscle. Serum lysozyme levels were not different between treatments. We conducted an additional short-term trial to evaluate the response of Burbot to upper lethal temperatures where daily maximums approached 32°C. The thermal stress resiliency of Burbot is robust for fish thought to be cold-water stenothermes, with fish from treatment and controls able to withstand temperatures up to and exceeding 31°C.

ORAL PRESENTATION ABSTRACTS

Limiting Factors for Persistence of Plains Topminnow (Fundulus sciadicus) in Nebraska Streams

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The Plains topminnow, Fundulus sciadicus, is an endemic Great Plains stream fish that appears to be experiencing reductions in range and abundance, resulting in regional protection and federal listing considerations. In response, Nebraska Natural Legacy Project, Game and Parks, and the University of Nebraska- Kearney have proactively begun translocation efforts to reestablish and augment populations in 17 sites throughout Nebraska. To take the next step in understand the successful and failed reintroductions and to further species conservation efforts, we identified biotic and abiotic limiting factors of Plains topminnow persistence using standardized sampling protocols and multi-linear regression analysis.

A Summary of Timber Harvest, Conservation Efforts, and Bull Trout Population Structure and Distribution in the Upper Reaches of Hornet Creek Located in Central Idaho

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Hornet Creek is a tributary of the Weiser River located in central Idaho. The upper reaches of Hornet Creek and its tributaries were listed as critical bull trout habitat by the United States Fish and Wildlife Service in 2010. The majority of land within this drainage area is owned by the state of Idaho and managed by the Idaho Department of Lands for timber production. In recent years, a number of water quality monitoring projects were conducted in conjunction with timber harvest activities. Conservation strategies were developed and implemented based on the results of these monitoring efforts. In the summer of 2015, both electrofishing and eDNA sampling methods were used to describe bull trout population structure and distribution. This presentation summarizes recent timber harvest activities, associated water quality monitoring efforts, conservation implementation projects, and bull trout populations in the upper reaches of Hornet Creek.

Idaho Supplementation Studies the Final Years: Crossing the Finish Line and Wrapping it Up

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The final chapter in the ISS story spans the time from the programmatic review through completion of the final report. The review focused collaboration and data collection effort during this time and led to the initiation of joint reporting and integrated statements of work between the cooperators. However, turnover around this time replaced most of those involved in the review, and some of its implications were lost. Reporting became standardized and data needs were so well defined that we entered a period of collecting data with little consideration of the earlier weaknesses. By about 2011, turnover slowed and the final cast of characters became fairly well established. This allowed those involved in finalizing the project to become familiar with the objectives and data available, and to establish individual roles (e.g., analysis, data handling, coordination, vision). Three critical components emerged that facilitated the analyses: 1) individual commitment of the team to completing the task; 2) agency commitment of time to the team to focus; and 3) the ability of the team to communicate, work together, and write effectively. In retrospect, there are things we did well and others that could have been improved. We entered the final analysis with a clear vision of the analytical approach we would take and the questions we could or could not answer. We maintained momentum through weekly, on-line meetings, and assigned individual roles according to their strengths. However, we should have had a better grasp of the “warts” on the data and been better prepared to deal with them. We should have considered alternate data sources and ways to use our own data sooner. Finally, we should have developed the analytical methods earlier and ran data through them periodically to identify stumbling blocks. In summary, several important aspects deserve consideration during the later stages of a program like this. The team should encompass a wide range of core abilities. Turnover is inevitable, but mass turnover should be avoided. Institutional memory must be passed by longer tenured individuals. Finally, analysis should be an ongoing process, where methods are developed and data examined on a regular basis.

ORAL PRESENTATION ABSTRACTS

Idaho Supplementation Studies: Results and Recommendations from 20+ Years of Supplementation Research

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The Idaho Supplementation Studies was designed to measure the population effects of dedicated, intentional supplementation on the abundance and productivity of Chinook Salmon during and after supplementation. Basin-level analyses indicated that supplementation provided a boost in abundance during supplementation, relative to reference streams, that was not maintained post-supplementation. Productivity generally declined during the study in supplemented and reference streams and supplementation did not exacerbate this decline (see talk by Kinzer et al.). In this talk, we present our intensive analyses of supplemented streams with weirs investigating the effect of life-stage at release of supplementation juveniles on adult returns and the effect of female origin on abundance throughout the life cycle. This examination allows translation of the full experimental results into guidance for future supplementation programs. We found evidence that releasing more juveniles resulted in more returning adults and this effect was greater for smolt releases. We conclude that releasing smolts is the most efficient way to produce adults for supplementation. The addition of female spawners increased the abundance of natural-origin progeny at all life stages, but the rate of increase varied with female origin and diminished through the life-cycle. Passage of natural-origin females had the greatest effect on abundance followed by supplementation and then non-treatment hatchery females. The effect of supplementation and non-treatment hatchery females was larger in the Salmon basin, where endemic stocks were utilized. The supplementation ratio (supplementation females:natural-origin females passed) had a positive but diminishing relationship with abundance. Abundance increased over a range of supplementation ratios, but as the ratio increased abundance increased at a slower rate. Based on these findings and those from the basin-level analyses, we make four general recommendations: 1) population increases are most effectively generated by increasing the number of natural-origin fish; therefore, supplementation programs should be integrated with other management approaches; 2) supplementation ratios should be tied to risk of population failure; 3) when risk of failure is low, investigate alternative ways to maximize the usefulness of supplementation fish; and 4) whenever possible, supplementation should be implemented using an endemic or localized broodstock integrated with the natural-origin population.

Implementation of Conservation Aquaculture as Part of an Integrated Approach for Restoration of Sturgeon and Burbot Populations in the Kootenai River

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Kootenai River white sturgeon and burbot are keystone species in the Kootenai River and are of immeasurable cultural importance to the Kootenai Tribe of Idaho. These native fish once sustained an important Tribal fishery as well as a valued local recreational fishery. Due to largescale ecosystem changes over the last century, both Kootenai sturgeon and burbot populations have been severely limited to a virtual lack of recruitment. Sturgeon were subsequently listed as endangered in 1994 and Kootenai River burbot were considered functionally extinct. The Kootenai Valley Resource Initiative completed a Burbot Conservation Strategy in 2005 in lieu of an ESA listing and a multilateral conservation agreement was developed to support reintroduction and recovery of burbot. The Tribe has operated a successful sturgeon conservation aquaculture facility since 1990. In 2014 construction of a second hatchery to produce sturgeon and burbot was completed. The conservation aquaculture program is part of a larger integrated ecosystem-based approach that includes habitat and nutrient restoration. The conservation aquaculture program is transboundary in nature with sturgeon and burbot releases occurring in the U.S. and Canada. Science-based adaptive hatchery operations are guided by information gathered through an extensive post-release monitoring and evaluation program conducted by a group of fellow co-managing agencies (Idaho Department of Fish and Game; British Columbia Ministry of Forests, Lands, and Natural Resource Operations; Montana Fish Wildlife and Parks) and a research component assisted by academia and the private sector. Production and release strategies are determined by co-manager consensus through annual program reviews that utilize the research, monitoring and evaluation results. Development and implementation of the sturgeon and burbot conservation aquaculture program will be discussed in this presentation.

Snake River fall Chinook salmon Supplementation Program

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This presentation will provide an overview of the Snake River fall Chinook salmon hatchery supplementation program. The once abundant fall Chinook salmon in the Snake River declined due to habitat loss, excessive harvest and changes to the migration corridor. The current hatchery program developed to mitigation for habitat loss and population decline and involves the coordination of Federal, State, Tribal and Corporate agencies. Current hatchery production totals 5.5 million juveniles including 900,000 yearlings and 4.6 million subyearlings. Broodstock collection occurs primarily at Lower Granite Dam to ensure the incorporation of natural fish in program. Adults are transported to Lyons Ferry Hatchery and Nez Perce Tribal Hatchery for spawning and egg incubation. Juveniles are reared in multiple locations until they are transported to multiple acclimation and release sites throughout the basin. Numbers of adult fall Chinook returning to Lower Granite Dam and redd counts in the Snake and Clearwater Rivers have increased dramatically since 1998 when the first adults began to return from juvenile releases above Lower Granite Dam. Total returns increased from an average of 1,500 prior to 1995 to nearly 40,000 average returns observed from 2005 - present. Natural returns have also increased significantly from a low of 78 in 1990 to an estimated 21,000 in 2013. The ten-year geometric mean of natural adult abundance was 7,359, significantly greater than the delisting goal of 3,000. Natural-origin fish make up an average of 26% of total returns and 32% of adult returns. Age composition was significantly different between natural- and hatchery-origin fish, with a higher proportion of ages 4 and 5 fish in the natural population. There was no significant difference in sex composition between hatchery- and natural-origin fish for total fish and adults. Annual adult stray rates, determined by tag recovery expansions, were below 5%. These results suggested that the supplementation efforts have had a positive effect on abundance of both hatchery- and natural- origin Snake River fall Chinook.

POSTER ABSTRACTS

Population Dynamics of Utah Chub in Henrys Lake, Idaho

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Utah Chub Gila atraria are native to the upper Snake River system in Wyoming and Idaho, and the Lake Bonneville basin in Utah and southeastern Idaho. However, Utah Chub have been introduced into many other waterbodies in Colorado, Idaho, Montana, Nevada, Oregon, Utah, and Wyoming. In systems where they have been introduced, Utah Chub populations often reach high densities and compete with native sport fishes such as Cutthroat Trout Oncorhynchus clarkii. For these reasons, Utah Chub are a concern in systems where they have been introduced, such as Henrys Lake, Idaho. Proper management of fish populations requires estimates of recruitment, growth, and mortality. Our objectives were to estimate recruitment, growth, and mortality for Utah Chub in Henrys Lake, Idaho. Results of this study will provide insight into the Utah Chub population in Henrys Lake and allow fisheries managers to make informed management decisions.

Movement and Distribution of Juvenile Burbot Stocked in a Tributary of the Kootenai River

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Burbot Lota lota in the lower Kootenai River have been the focus of extensive conservation efforts, particularly conservation aquaculture. One of the primary strategies has been to release fish in small tributaries. In October of 2012, the Idaho Department of Fish and Game installed a fixed passive integrated transponder (PIT) antenna on Deep Creek, a third order stream and major tributary to the Kootenai River, to evaluate movement of juvenile Burbot to the Kootenai River. Approximately 12,000 juvenile Burbot have been PIT tagged and released into Deep Creek since 2012, but few Burbot have been detected at the antenna. This raises questions about the survival, movement, and distribution of juvenile Burbot in Deep Creek. The objective of this study was to evaluate survival, movement, and distribution of Burbot in Deep Creek. Additional fixed PIT tag antennas were installed on Deep Creek in October of 2014 prior to stocking. Fixed PIT tag antennas have detected Burbot and are providing data about movement of juvenile Burbot in the Deep Creek system. A mobile PIT tag antenna census of Deep Creek, and mobile PIT tag antenna surveys of stocking locations in Deep Creek have provided additional information. Results of this study will help to ensure efficient and effective stocking methods, and will have broad application to other small tributaries in the Kootenai River basin.

Evaluation of Prepositioned Areal Electrofishing Devices and Fixed Underwater Video for Sampling Riverine Fishes

Philip Branigan[1], Michael Quist[1,2], Brad Shepard[3], Sue Ireland[4],
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Prepositioned areal electrofishing devices (PAEDs) are used to quantify microhabitat use of fishes because they serve to minimize fright biases associated with traditional sampling techniques (e.g., boat electrofishing). Similarly, fixed underwater video (FUV) is used to minimize the effect of observers on fish behavior. As such, we postulated that FUV may be used separately or in conjunction with PAEDs to sample riverine fishes with equal accuracy while minimizing bias due to gear or observers. The specific objectives of this research were to compare estimates of species richness between the PAEDs and FUV and determine an appropriate “set time” for PAEDs. Video cameras were positioned instream at 15 locations on the Kootenai River, Idaho, and collected footage 15 minutes prior to- and 20 minutes following PAED deployment. Electrical current was applied to the PAEDs for 20 seconds and immobilized fishes were collected, identified, and enumerated. Video footage was systematically subsampled in the laboratory, whereby species were identified and enumerated in five-second intervals. Data were summarized and cumulative species richness estimates were compared among gear types and across sites. Fixed underwater video sampled more taxa than PAEDs at any given site and provided a more robust estimate of taxonomic occurrence that came at the expense of laborious video processing. An appropriate set time for PAEDs was unable to be determined due to the discrepancies between long-range movements of riverine fishes and the relatively small sampling space. Both PAEDs and FUV provide acceptable estimates of taxonomic occurrence and could likely be used to estimate relative abundance, but logistical and financial constraints should be considered when selecting between these two gear types. Results from this study provide preliminary information on the effectiveness of each gear type as it relates to the characterization of riverine fish assemblages but further investigation is needed to qualify and increase the precision of these results.

POSTER ABSTRACTS

Adapting Gill Net Mesh Sizes to Maximize Catch in a Collapsing Lake Trout Population

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For more than a decade, kokanee Oncorhynchus nerka recovery in Lake Pend Oreille has been limited by predation, primarily from Lake Trout Salvelinus namaycush. To address this issue, Idaho Department of Fish and Game implemented an aggressive predator removal strategy beginning in 2006 aimed at collapsing the Lake Trout population. We contracted with a commercial fishing company, Hickey Brothers Research, LLC to remove Lake trout from Lake Pend Oreille using gillnets. The majority of netting effort focuses on juvenile fish in Lake Pend Oreille using gill net stretch mesh sizes from 3.8 to 7.6 cm. We compared catch per unit effort (CPUE) of each mesh size during a netting season to assess the effectiveness of different mesh sizes. We then made changes to the proportion of each gill net mesh size fished to adapt to the sizes of Lake Trout available in the population. Additionally, we compared the CPUE of bycatch, specifically Federally Threatened Bull Trout S. confluentus, to minimize incidental capture. The median total length of Lake Trout captured in 3.8 to 7.6 cm mesh decreased from 347 mm in 2008 to 296 mm in 2015. In 2008, 94% of gill net effort was 6.4 cm mesh or larger, and those meshes comprised only 46% of gill net effort in 2015. Additionally, Bull Trout CPUE was 0.96 per net in 2008, and in 2015 it was 0.46 per net. Since the inception of the removal program, roughly 190,000 Lake Trout have been removed from Lake Pend Oreille which resulted in an approximately 80% reduction in Lake Trout abundance. Along with this reduction, the size structure of Lake Trout has shifted toward smaller fish. As a result, the proportion of smaller mesh gill nets has increased to maximize Lake Trout catch while minimizing incidental Bull Trout bycatch. Removal programs such as this one will inherently alter the size structure of a population, and managers need to adapt approaches to continually maximize the program's effectiveness.

Are steelhead seasonal marine growth estimations from scales consistent across multiple readers?

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Change in an organism's growth is widely accepted as a means of evaluating the health of the organism as well as the condition and productivity of the habitat inhabited by the organism. In fish, two methods used to approximate growth are through direct observation techniques, such as measuring changes in length and weight, or through the use of hard structures, such as otoliths and scales. In research involving sensitive species, scales provide a non-lethal opportunity to estimate growth. Repeated growth interpretations of a particular sample provide increased ability to statistically detect patterns. However, reader interpretation of the periodic features, such as when a period of growth begins and ends, could lead to precision errors. Multiple readers used scales to estimate steelhead Oncorhynchus mykiss seasonal marine growth profiles, and we used graphical and statistical methods to determine the consistency of the growth estimations. Through growth estimation comparisons, bias can be uncovered, and we can establish whether growth patterns witnessed are a result of actual biological processes or simply due to a lack of reproducibility.

Clark Fork River Delta Restoration Project

Katherine Cousins[1], Brian Heck[2]
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The Idaho Department of Fish and Game and Ducks Unlimited, along with many partners including Bonneville Power Administration, Avista Corporation, U.S. Bureau of Land Management, the U.S. Army Corps of Engineers, Kalispel Tribe and others, initiated and completed a portion of the restoration activates proposed for the Clark Fork River delta in 2015. Extensive bank erosion has occurred to islands and shorelines in the delta, resulting in losses of soil, native riparian and wetland vegetation, as well as the quantity and quality of fish and wildlife habitat. This erosion is the result of wave action and water level fluctuations of Lake Pend Oreille due to the operation of the Albeni Falls dam. In addition, about 15–25% of all habitat loss in the delta is attributed to the operation of the Cabinet Gorge dam located upstream on the Clark Fork River. The altered hydrology in the Clark Fork River and delta has resulted in changes in the wetland and aquatic vegetation cover, such that many of the delta's wetland functions are severely impaired. Therefore, the goal of the restoration project is to protect areas vulnerable to erosion while improving and diversifying key riparian and wetland habitats behind the protection to restore ecological function in the delta. The 2015 construction effort resulted in over 40 areas of submerged areas being raised (by moving 260,000 cubic yards of fill) so that these areas are now above the lake's summer full pool. These raised areas were seeded and over 70 volunteers and school students planted over 100,000 plants. About 20,490 linear feet of delta island shoreline was stabilized using over 50,000 tons of rock. Fifty thousand soil choked willow poles were embedded in the rock protection. Over 300 large trees with rootwad were also embedded in to the rock and fill areas.

Red River Meadow Restoration

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The Red River watershed lies within the heart of central Idaho and is a main tributary to the South Fork Clearwater River. This river is home to chinook salmon and steelhead and has been heavily affected by historic mining and grazing, leaving the channel straightened and riparian corridor denuded. In 2016, the Nez Perce Tribe Fisheries Watershed Division will look to implement the Red River Meadow Restoration project. Restoration will focus on re-connecting seven historic meander bends, re-grading and removing existing berms and mine tailings within the floodplain, as well as beginning the establishment of a riparian corridor by planting over 10,000 one gallon plants. Through these actions this section of mainstem Red River will see an increase in the abundance and complexity of fish habitat and overall floodplain and riparian function.

Diatom assemblage responses to wildfire in wilderness streams of Central Idaho

Adam Eckersell, Matt Schenk, Colden Baxter
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Wildfires cause substantial alterations to riparian and stream ecosystems, but the mechanisms behind these responses are often unclear. Specifically, the reduction of canopy cover may have direct and indirect effects on basal food web resources on which stream organisms rely. We conducted a comparative study to investigate the effects of wildfire on benthic algae biomass and diatom community composition in two wilderness streams in Central Idaho. These two streams are similar in size, geology, chemistry, and both were burned similarly by high severity wildfire in 2000. Fourteen years after wildfire, one stream, having a northerly aspect, has regrown a dense closed canopy, while the other retains a relatively open canopy. Moreover, evidence from other studies suggests that the open canopy stream exhibits 2 – 3 × higher invertebrate and fish productivity, but the role of the primary producer community in fueling this sustained pulse of productivity is uncertain. We hypothesized that the stream with the open canopy would receive more photosynthetically active radiation which, in turn, would lead to greater standing crop biomass of chlorophyll-a and higher primary production, but also a more diverse diatom assemblage that might include more taxa that possess endosymbiotic nitrogen fixing cyanobacteria. We found that the open canopy stream received ~ 4.7 × greater photosynthetically active radiation, had ~ 2.4 × greater standing crop biomass of chlorophyll-a than the stream with the dense canopy, and initial estimates suggest ~2-3 × higher primary production (measured via open-channel oxygen technique) in the open canopy stream. Additionally, preliminary observations suggest the open canopy stream has a more diverse diatom assemblage and appears to have a higher proportion of diatoms possessing endosymbiotic nitrogen fixing cyanobacteria (e.g. Epithemia, Rhopalodia). Given primary producers are often limited by nitrogen in streams like these, nitrogen fixation by these organisms may be an important driver of in stream production, particularly where canopies have been opened by wildfire, and this may help explain mid- to long-term responses by higher tropic levels like stream fishes.

Yakima River Steelhead: Habitat Restoration (~20 yrs) + Kelt Reconditioning (~15 yrs) = Population Response?

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Yakama Nation[1], Columbia River Inter-Tribal Fish Commission[2]
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Yakama Nation Fisheries is collaborating with a number of agencies including the Columbia River Inter-Tribal Fish Commission and the Yakima Subbasin Fish and Wildlife Recovery Board to recover ESA-listed steelhead populations in the Yakima River Basin. We are using a combination of habitat actions and steelhead kelt reconditioning to achieve restoration goals. This poster summarizes this work. Current results indicate a possible population response to these efforts.

Tracking White Sturgeon in the Upper Snake River

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White Sturgeon (Acipenser Transmontanus) were recently stocked in the Snake River near the city of Idaho Falls, Idaho, in an effort to create a trophy angling opportunity. White Sturgeon are a sought-after sport fish owing to their size, with some sturgeon reaching up to 4 meters in length, as well as their morphological uniqueness. White Sturgeon were first stocked in the Upper Snake River in 2007. Since stocking, several methods (e.g. set lines, angling) have been employed to collect individuals for population monitoring (e.g. growth), but have been unsuccessful. Determining their home ranges and habitat preferences may provide insight into possible areas to target for collection. On August 5, 2015, Idaho Department of Fish and Game (IDFG) biologists collected nine White Sturgeon (TL range: 83-107 cm) from the Snake River and surgically implanted them with LOTEK CART tags (Combined Acoustic Radio Transmitters) to monitor their movements. White Sturgeon were subsequently released in three river sections separated by a series of hydroelectric dams and tracked weekly. Movement has varied with frequent movements (up to 8.75 km) to limited movement (.74 km) patterns. Downstream movement through hydrological dams has been observed with no associated mortality while making passage through the dams. Determining White Sturgeon home ranges and preferred habitat has provided IDFG insight into future sampling areas for effective population monitoring.

POSTER ABSTRACTS

The Standards and Metrics Committee: Idaho Department of Fish and Game Hatchery and Research Staff Working Towards Common Goals

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In the summer of 2013, Fisheries Bureau leaders with the Idaho Department of Fish and Game requested implementation of the Fish Production Standards and Metrics Committee. Individuals selected to participate on this committee would be tasked with numerous objectives, including: improving and standardizing fish culture data collection, calculation and reporting; establishing a common language amongst fish production staff to recognize trends and share ideas; providing valuable and appropriate tools to enhance efficiency and improve hatchery operations; and promoting a progressive attitude. Members chosen to participate on this committee include not only fish culture professionals, but a fish pathologist and fisheries research supervisor as well. Since its implementation, this committee has worked towards achieving their intended objectives with much success. In addition to establishing a standard reporting format for monthly production data, tools have been provided to statewide hatchery staff that allows them to confidently estimate characteristics for a fish population utilizing sound science and statistical methods. Identifying efficiencies and instilling a progressive mindset is essential if we are to maintain the ability to meet current and future fish production requests. Furthermore, as the work fish culture professionals do continues to be increasingly scrutinized, justification of our methods, techniques and data will be ever more important. The efforts and products provided by this committee establish an avenue for our department to ensure we're on the road to continued success in our fish production programs.

Age estimation of Utah Chub in Henry's Lake, Idaho using otoliths, scales, and pectoral fin rays

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Calcified structures are the most commonly used method for obtaining estimates of fish age. Age estimates are often used to estimate growth and mortality and allow fishery managers to make informed management decisions. Otoliths are generally considered the most accurate structure for estimating fish age for many species. Although lapilli otoliths have been shown to provide accurate age estimates for Utah Chubs Gila atraria other calcified structures have not been evaluated. Pectoral fin rays and scales may provide non-lethal alternatives for estimating the age of Utah Chub. Our objectives were to determine if age estimates from pectoral fin rays, scales, lapilli and asterici otoliths were similar for Utah Chubs collected from Henrys Lake, Idaho. We also sought to determine if among-reader precision differed among structures.

Standard Protocol for In-Hatchery Monitoring of Spontaneous Autopolyploidy in Kootenai River White Sturgeon

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The Kootenai Tribe of Idaho Native Fish Conservation Aquaculture Program (KTOI-NFCAP) has been producing and releasing a White Sturgeon (Acipenser transmontanus) year class annually since 1999 to offset poor natural recruitment. Genetic diversity monitoring and parentage analyses have been an integral part of the White Sturgeon program. More recently, monitoring was expanded to examine families for spontaneous autopolyploidy (SA). The expanded monitoring by Drauch-Schreier et al. (2011; 2012; 2013) revealed that SA White Sturgeon have been unknowingly produced by the KTOI-NFCAP during 2011-2013, and likely during years past. A spontaneous autopolyploid is an individual with larger than normal genome size. A wild-type White Sturgeon is an ancient octoploid (8N) with ~250 chromosomes; whereas, SA individuals are dodecaploid (12N) and may produce decaploid (10N) offspring after a mating with a normal 8N individual (Drauch-Schreier et al. 2011). In-hatchery SA genetic monitoring began with flow cytometry; but due to logistical problems and high costs, a blood smear method has been adapted. This method has proven to be cost effective, applicable to fieldwork, and as accurate as flow cytometry for the Kootenai River White Sturgeon population. The development of an in-hatchery SA monitoring protocol was needed to identify, and estimate the SA prevalence for each hatchery- reared year class. The blood smear method developed for in-hatchery SA monitoring will be outlined.

KOOTENAI RIVER HABITAT RESTORATION PROGRAM

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The Kootenai River Habitat Restoration Program (KRHRP) is a large-scale, ecosystem-based habitat restoration program to restore and maintain habitat conditions that support all life stages of endangered Kootenai River white sturgeon, burbot and other native fish. The Kootenai Tribe of Idaho is implementing the KRHRP within a 55-mile section of the Kootenai River in Idaho. In 2009 the Tribe completed the Kootenai River Habitat Restoration Program Master Plan, which presented a framework for restoring native fish habitats and other ecosystem functions within existing constraints. The goals of the KRHRP are to restore river morphology, aquatic and riparian habitat, and to foster river stewardship. The plan identified reach-specific habitat conditions that limited the success of transboundary Kootenai sturgeon, burbot and other native fish, and restoration strategies and treatments to address those limiting factors. Since completing the Master Plan, the Tribe in collaboration with multiple agency partners (B.C. Ministry of Forests Land Natural Resource Operations, Idaho Department of Fish and Game, Montana Fish Wildlife and Parks, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers and Bonneville Power Administration) and a multi-disciplinary team of independent experts, has identified, prioritized, designed and constructed a suite of KRHRP projects that address multiple objectives.

Restoring Sockeye Salmon to the Yakima River Basin

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Yakama Nation
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Prior to 2008, returns of sockeye salmon to the upper Columbia Basin numbered 50,000 or fewer in 14 of 22 years. The First Nations in Canada worked with local governments across borders to improve habitats and water management in the upper Okanogan Basin. As a result counts at Bonneville Dam dramatically improved in recent years demonstrating the huge potential of sockeye restoration efforts. Four nursery lakes in the Yakima River Basin, which historically produced an estimated annual return of about 200,000 sockeye, were removed from production in the early 1900s when irrigation storage dams were constructed without passage. This poster presents initial results of collaborative efforts led by the Yakama Nation to restore wild sockeye to the Lake Cle Elum watershed.

Some observations on the persistence of stream channel modifications caused by suction dredge placer mining

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Suction dredges are used to by miners to excavate and sort stream channel substrate in their search for placer (i.e., alluvial) gold. The Nez Perce-Clearwater National Forest in north-central Idaho has monitored some of the authorized (and unauthorized) suction dredging operations conducted on Forests streams in 2013, 2014, and 2015. This monitoring has been in the form of site visits, photographs, and, at some sites, elevation and substrate size surveys. I review this monitoring information to evaluate the proposition that stream hydraulics and bedload mobilized during peak flow events will typically "reset" stream channel morphology to pre-dredging conditions.

Prey Selection of Juvenile Burbot

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Burbot Lota lota are the only freshwater member of the family Gadidae and can be found worldwide in northern latitudes. Throughout much of their distribution, Burbot populations are declining. In an effort to mitigate population declines, natural resource management agencies are increasingly employing conservation aquaculture. In Idaho, Burbot are routinely stocked in tributaries of the Kootenai River to restore the native population. Despite years of stocking of Burbot in the Kootenai River, no increase in Burbot numbers have been observed. Managers of the Kootenai River have suggested that low prey availability in the Kootenai River is limiting recruitment of juvenile Burbot. However, relatively little is known about the food habits of juvenile Burbot in lotic systems. We sought to better understand prey use of juvenile Burbot by evaluating the ontogenetic prey use of juvenile Burbot over a four month period. Larval Burbot were stocked into two earthen ponds in the Boundary Creek Wildlife Management Area, Bonners Ferry, Idaho. Burbot and zooplankton were sampled from each pond weekly from May – August in 2012 and 2013. In addition, zooplankton were sampled weekly from the Kootenai River and three of its tributaries (Deep Creek, Boundary Creek, Goat River) to identify potential stocking locations with high prey abundance. Burbot diet was characterized as frequency of occurrence, percent by weight, and overall abundance. Chesson's index of selectivity was used to understand prey use of juvenile Burbot. Zooplankton abundance and species composition of each sampling location were related to Burbot diet to better understand recruitment bottlenecks in the Kootenai River drainage. The results of our study will add to the limited information available regarding the food habits of juvenile Burbot. Furthermore, information on prey availability throughout the Kootenai River drainage will allow managers to identify potential stocking areas most likely to support juvenile Burbot. Overall, our results will aid in the understanding of Burbot ecology and will provide insight towards improving conservation efforts focused on Burbot in the Kootenai River and the rest of the world.

POSTER ABSTRACTS

McComas Meadows: The Response of an Altered Meadow Habitat to Passive Restoration Techniques

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McComas Meadows is a 468 acre meadow located on Meadow Creek in the South Fork Clearwater River watershed. The meadow was in private ownership since the turn of the century when significant alterations were made including constructing a ditch around the perimeter, removing riparian vegetation, planting grazing crops, fencing, and grazing. The property was acquired in 1992 by the US Forest Service; since 1997, the Nez Perce Tribe Department of Fisheries Resources Management Watershed Division, partnered with the Nez Perce-Clearwater National Forests, has made efforts to restore the meadow to a more natural condition. Passive restoration efforts to date include the construction of livestock fencing exclosures, replanting riparian vegetation, treatment of invasive species, obliteration of abandoned roads, and partial removal of perimeter ditches. The progress of the improvements and restoration was monitored through 2013 with surveys to assess parameters such as stream temperature, flows, riparian vegetation, canopy cover, salmon densities, and macroinvertebrates. The monitoring variables surveyed provide data to facilitate the assessment of current stream conditions, the degree of change that streams have experienced since restoration was implemented, and guide future restoration activities through adaptive management. Data from 1999-2013 shows instantaneous stream temperature exceedances significantly declined, likely due to the increased riparian canopy cover as shown through photo points and canopy cover surveys. Along with the increase in riparian cover, there has been a significant decline in weed populations allowing for native and naturalized species to establish. Further aiding in the revegetation success has been the establishment of a healthy beaver community; dams began appearing in 2010 and quickly grew to 22 observed dams. These dams helped to raise the water level and widen the floodplain of Meadow Creek while further propagating riparian species. Snorkel survey results illustrate an increase in Chinook populations and the first observations of wild, returning adults. Based on these data and observations, natural recovery of the McComas Meadows reach of Meadow Creek is occurring. Passive restoration coupled with natural recovery will continue to enhance habitat diversity, increase fish densities, and rebuild a healthy ecosystem within Meadow Creek.

Trophic Ecology of Burbot and Implications for Sampling

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Burbot Lota lota is an apex piscivore that was illegally introduced in the 1990s to the Green River drainage, Wyoming. The rapid expansion of Burbot in the Green River has increased concern for the conservation and management of fishes throughout the drainage. However, relatively little is known about the trophic ecology of Burbot in systems where they are non-native. If Burbot are highly piscivorous, as we hypothesize, they may influence catch data in hoop nets due to predation on other fish sampled in the gear. Predator avoidance behaviors may also influence catch of non-game fishes in passive gears; thereby, biasing catch data. Our objectives were to 1) characterize diet composition of Burbot, 2) identify differences in diet composition as a function of three sampling gears (i.e., night electrofishing, small mesh hoop net, and large mesh hoop net), and 3) evaluate the influence of Burbot on the catch rate of other fishes using hoop nets. Diet composition was characterized using frequency of occurrence, abundance, and percent by weight to identify the importance of each prey type to Burbot. Diet composition was compared across gears to identify the influence of gear on diet. Catch rates of non-Burbot species using hoop nets were compared to identify how piscivorous fish influence catch of entrainment gear. Fish made up 80% of the diet of Burbot greater than 350 mm during the fall. The greatest number of species was found in diet of Burbot sampled with small mesh hoop nets. Burbot diet was different between small mesh hoop nets and night electrofishing for Redside Shiner Richardsonius balteatus, White Sucker Catostomus commersonii × Flannelmouth Sucker hybrid C. latipinnis, Burbot, and Mottled Sculpin Cottus bairdii. Abundance of non-Burbot species was less for hoop nets containing Burbot. Our results highlight how gear influences diet studies and addresses the influence of piscivorous fish on the catch rate of other fishes.

POSTER ABSTRACTS

Potential habitat for fluvial Yellowstone cutthroat trout in Moody Creek based on fish community assemblage

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Moody Creek is a small tributary to the South Fork of the Teton River and is used as spawning and rearing habitat by fluvial Yellowstone cutthroat trout. Migratory adults are restricted to the lower 37 km of Moody Creek due to Webster's Dam which is an impassable barrier to upstream migration. We quantified fish community assemblage at seven sites in lower Moody Creek to determine the extent of suitable habitat for spawning and rearing for fluvial Yellowstone cutthroat trout. We assumed that the presence/absence and abundance of fish species would reflect habitat conditions at each site thus allowing us to predict the amount of suitable habitat for fluvial Yellowstone cutthroat trout in lower Moody Creek. We quantified fish community assemblage using backpack electrofishing at each site in September and October. Upstream reaches had a cold water assemblage dominated by trout and sculpin. This transitioned into a warm-water assemblage downstream which was dominated by minnows and suckers. The middle site (site 4) did not have any fish despite having high density of fish earlier in the year. We assume this was caused by dewatering for irrigation purposes during summer months by a pump station upstream of this site. Based on these findings, we predict that the 10.2-km section extending downstream from Webster's Dam represents the potential spawning and rearing habitat for fluvial Yellowstone cutthroat trout in lower Moody Creek. Additional habitat may be available if in-stream flows can be maintained. Future research should determine the extent to which fluvial Yellowstone cutthroat trout utilize Moody Creek for spawning and identify potential barriers to migrating fish.

Fish Assemblage of Cartier Slough Wildlife Management Area

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Side channel habitats are valuable to river systems. They have a slower flow rate and generally more vegetation cover, which is favorable habitat for small fish species or juvenile fish of larger species. Cartier Wildlife Management Area provides Henry's Fork of the Snake River with valuable off-channel habitat that has been dramatically reduced throughout the Snake River drainage. We used minnow traps in June and September 2015 to survey small and juvenile fishes in side channel habitat of the Henry's Fork in Cartier Wildlife Management Area. Fourteen sites were chosen using a stratified random design and sampled by baited minnow traps. Thirteen of the sites in June had sufficient water to sample fish. We sampled 2,929 fish representing 10 species; redside shiners, speckled dace, and Utah chub accounted for 99% of all captured fish. Many redside shiners and speckled dace were at or above the size of maturity for these species; body condition of females indicated that redside shiners and speckled dace were using this habitat for spawning. In the Fall, only 4 sites had sufficient water to set traps. At these sites, we captured 679 fish representing 7 species; 79% of the fish were juvenile pumpkinseed (young of year; < 45 mm total length). The side channel with the greatest connectivity to Henry's Fork and the highest water flow had species associated with high flow environments (i.e. mottled sculpin, longnose dace, and bluehead sucker) in addition to other species. Three nonnative species (yellow perch, pumpkinseed, and fathead minnows) were collected in slower moving side channels with silty/muddy substrate. This study demonstrated that habitat availability during a dry year varied substantially between seasons; future monitoring will determine if this seasonal variation is reduced during wet years.

Juvenile steelhead movement in relation to population density, stream habitat, and body size, and their consequences on individual growth rates

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Anadromous salmonids can display considerable movement within their natal streams prior to outmigration, reflecting behavioral responses to biotic and abiotic conditions. In this study we quantify rates of dispersal and site fidelity in juvenile steelhead (Oncorhynchus mykiss), assess their consequences on individual growth rates, and elucidate how proximate factors (habitat, density, and individual size) can explain individual movement decisions. The study took place over a period of four weeks in fall in Lapwai Creek, ID, a tributary to the Clearwater River. The overall retention of individuals ranged from 29% to 66% among the seven, 700m study segments, and was greater among yearlings (61% overall) than subyearlings (31% overall). Site fidelity was best predicted by individual body size (negative relationship) and the amount of pool habitat in the stream sections (positive relationship). We also performed an experimental density manipulation in designated sections of the stream segments. Here, artificially elevated densities caused increased dispersal and depressed growth rates compared to control sections. Within the control sections (i.e. no density manipulation), there were no significant consequences of movement decisions on growth rates in either age class. In summary, these results show that movement within natal streams can be substantial; that movement rates can vary in response to local conditions; and that individual growth rates are affected by local population density.

POSTER ABSTRACTS

Understanding causal factors and implications of life history diversity in a wilderness environment

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Populations of Chinook salmon O. tshawytscha in the Pacific Northwest United States have declined due to anthropogenic and environmental alterations. These declines have spurred collaborative multi-state, multi-agency efforts to try to understand the dynamics of threatened populations in an attempt to manage and restore them. Only recently has research demonstrated the consequences that life history diversity can have on an individual's survival and population viability and resilience. In this study we look at the physical outcomes of the diverse pre-smolt life history expressions for juvenile Chinook salmon in a designated wilderness area in Central Idaho, USA from 2007-2014. We found that juvenile Chinook that move out of natal reach rearing areas prior to their first winter were on average 23 mm larger during spring migration, have nearly double the winter growth rate, and enter the Columbia River Basin an average of 9 days earlier during spring migration than individuals that resided in natal reach rearing areas. We found that density was the best predictor of migration timing over a time period where juvenile abundance varied by an order of magnitude. We report on modeling efforts to quantify the important variables that affect an individual's migration decisions in order to forecast the impacts that climatic and hydrologic shifts may have on populations in this region.

Assessing movement and reproductive success of rainbow trout Oncorhynchus mykiss in the Buffalo River, Idaho and their contribution to the Henry's Fork fishery

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The Buffalo River, a tributary of the Henrys Fork of the upper Snake River basin, is potentially a major contributor of production to the world-renowned Blue Ribbon Henrys Fork rainbow trout fishery. Fish passage was greatly improved at the Buffalo River Hydropower Project in 2006. Since these improvements a significant seasonal migration of rainbow trout between the Buffalo River and the Henrys Fork has been observed. In year one of our study, we demonstrated the utility of a 186 SNP marker panel in assigning parentage for Buffalo River and Henrys Fork rainbow trout. In year two, we assessed the origin and diversity of the Henrys Fork rainbow trout population, and estimated the contribution of Buffalo River rainbow trout to the Henrys Fork fishery. Moreover, we examined whether fluvial adults originating from the Henrys Fork are utilizing the newly available habitat and migrating into the Buffalo River to spawn. Finally, we sampled juveniles at the Buffalo River Hydropower Project to determine whether outmigrating juveniles are the products of fluvial spawning (from Henrys Fork), or a mixture of both fluvial and resident juveniles. If the Buffalo River is confirmed to be a major contributor to the Henrys Fork fishery, management objectives can then be formed to reflect this new information.

Comparing Techniques of Estimating Angler Effort on a Large Reservoir

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Dworshak Reservoir is a large freshwater reservoir located north of Orofino, Idaho on the North Fork of the Clearwater River. Dworshak is accessed predominately by boat and access is limited to seven boat ramps and one marina located on the reservoir. Using this knowledge we conducted creel surveys at each of the eight access sites in order to estimate fishing pressure on the reservoir. We further assessed car counters and game cameras as tools to improve the precision of our estimates. In-person interviews were conducted using an access-access design (Pollock et al 1994). Cameras were placed in the parking lots to count the number of empty boat trailers in the parking lot at 30 minute intervals during hours of daylight to determine the amount of boating hours on the reservoir in a given day. We then applied the ratio of angler hours to boating hours from the in-person interviews to estimate angler hours. In addition, we set up magnetic field disturbance car counters on the boat ramps to determine the number of boats launching daily at each ramp. This was combined with the ratio of angler hours per boat launched from the interview data to estimate fishing effort. To calibrate these car counters we set up motion detecting cameras on the boat ramps to take pictures of trailers loading boats. We then compared the number of boats loaded that day, as seen by the ramp cameras, to the number of hits on the car counter and constructed a regression model to predict the number of completed trips based on hits from the car counter. Finally, we estimated effort by conducting roving boat counts. This was done by traveling the length of the reservoir in a boat to count the number of boats that were angling on the reservoir during the trip. Estimates of angling effort were then compared to determine which one would produce the most efficient way to conduct creel surveys on the reservoir. Implications of this study will be discussed and results will be shown.

Diet of mottled sculpin in Moody Creek in the Teton River drainage

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Sculpin are often overlooked in stream studies because they have a low capture probability using standard capture techniques and therefore are difficult to quantify. However, sculpins play a significant role as both a predator to a variety of organisms (invertebrates, fish, and amphibians) as well as prey to larger fish and other predators. We quantified diets of mottled sculpin at four sites in Moody Creek (tributary to South Fork Teton River) in fall 2015 to determine how prey selectivity varied along a longitudinal gradient. We collected 15 individuals (size range: 58 – 122mm total length) from each site. Prey items in stomach contents were identified to order for invertebrates; fish were not identifiable to species. We found 1 – 5 individuals at each site that had empty stomachs. At all sites, dipterans (primarily chironomids) and trichopterans (both cased and free-living species) were the most common prey items consumed. At each site, 1 – 6 sculpins consumed a fish; based on fish communities, we assume the prey for each sculpin was a minnow species. In one instance, the estimated size of the consumed fish was approximately 73% of the sculpin's length. In Moody Creek, mottled sculpins demonstrated that they are opportunistic feeders consuming a wide variety and size range of prey items depending on prey availability, but showing some preference for dipterans and trichopterans.

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