ORAL AND IGNITE PRESENTATION ABSTRACTS

Using Mark-Resight Surveys to Investigate Sightability during Snorkel Surveys

Matthew Amick[1] and Curtis Roth[2]
Pacific States Marine Fisheries Commission[1], Idaho Department of Fish and Game[2]
Presenter: Matthew Amick, matthew.amick@idfg.idaho.gov

Snorkel surveys are the most broadly used technique by the Idaho Department of Fish and Game to monitor salmonid populations. Snorkel surveys allow managers to monitor salmonid populations when other techniques (e.g., electrofishing) are not feasible. One of the key assumptions of a snorkel survey is that you are able to visibly see all the fish present in the transect during sampling. However, environmental conditions can affect the ability of snorkels to see the fish during surveys. Therefore, in 2007 the Idaho Department of Fish and Game began conducting mark-resight surveys coupled with habitat surveys to investigate how habitat factors influence sightability. Mark-resight surveys were conducted by angling juvenile steelhead Oncorhynchus mykiss and then measuring them for total length, clipping the upper caudal fin, and then returning the fish to the stream in the same area where they were caught. The following day the angled transect was snorkeled to enumerate the number of marked and unmarked fish in the transect. Additionally, snorkel surveys were conducted for 50 m upstream and 50 m downstream of the angled transect to account for fish moving in and out of the transect overnight. In total, 127 surveys were conducted between 2007 and 2014 throughout the Salmon and Clearwater River Basins. Regression analysis was then used to evaluate the relationship between habitat factors and sightability. Results of this study will provide managers with a greater understanding of the influence of habitat factors on the sightability of juvenile steelhead.

Migration and Spawning Potential of Bull Trout Occupying the South Fork Boise River

Joe Benjamin[1], Dmitri Vidergar[2] and Jason Dunham[1]
US Geological Survey Forest and Rangeland Ecosystem Science Center[1], Bureau of Reclamation[2]
Presenter: Joe Benjamin, jbenjamin@usgs.gov

Energetic content of an animal can determine its potential success to reproduce. For fish, energy content is closely linked to environmental conditions such as temperature and food resources, both of which can be influenced in regulated rivers. We used a bioenergetics model to evaluate the migration and spawning potential of female bull trout residing in Arrowrock Reservoir and the SF Boise River. Model simulations suggest up to 65% of the 1000 fish simulated could spawn per year based on available energy. Fish that moved seasonally between the SF Boise River and Arrowrock Reservoir had the highest propensity to spawn and the percentage of potential spawners was relatively consistent among years. Fish that resided solely in the SF Boise River could have a high percentage of potential spawners, but this percentage was variable year to year (range: 20-70%). On average, fish that spawned lost 29% (range: 15-47%) of their energy content relative to their pre-spawn energy. In contrast, fish that skipped spawning accumulated, on average, 13% (-1-27%) energy reserves that could be used towards gamete production for the next spawning season. Bull trout most often skipped spawning when water temperatures were high (annual degree days >4000 C) or low (<3400 C). Similarly, bull trout would skip spawning if upstream migration occurred late (July 19 or later) or early (May 1 or earlier). Overall, our modeling effort suggests thermal and foraging conditions in the SF Boise River appear to promote growth and energy allocation for spawning for bull trout occupying the SF Boise River. However, that skipped spawning may be prevalent.

Using Lake Nutrient Budgets and Stable Isotopes to Reconstruct Historical Sockeye Salmon Abundance in Redfish Lake, Idaho

Rachel Brinkley and Bruce Finney
Idaho State University
Presenter: Rachel Brinkley, brinrach@isu.edu

Idaho's sockeye salmon (Oncorhynchus nerka) have experienced significant reductions in abundance due pressures from a number of factors including commercial harvest, the development of the hydropower system, the introduction of non-native species, and intentional poisoning. Historically, the Salmon River was considered to be one of the most important streams for anadromous salmon in the Columbia River Watershed. Since the Snake River Sockeye were listed as an endangered species in 1991, there have been extensive management efforts aimed at restoring these populations. However, there is a limited understanding regarding the number of sockeye that historically used Idaho lakes for spawning. Anadromous salmon have a high proportion of stable isotope 15N:14N relative to other nitrogen sources, and therefore the analysis of sediment δ15N has proved to be an effective means of constructing historic population estimates of anadromous salmon. We are refining lake nitrogen budgets, informed by stable isotope data, to quantify past sockeye salmon abundance. We applied this framework to a sediment core from Redfish Lake, located in the Sawtooth National Recreation Area, that showed significant temporal changes and a recent decline in δ15N, our proxy for marine derived nutrients from sockeye that historically spawned in Redfish Lake. A range in the abundance of Redfish Lake Sockeye, prior to the dramatic declines following the establishment of the Snake River Dams and Sunbeam Dam, is quantified for a suite of assumptions of past conditions and suggests that the historical abundance of sockeye in Redfish Lake may be higher than previously derived population estimates.

Investigating the Potential for Reverberating Responses to Trophic Cascades Across Ecosystems

Jeremy Brooks[1], Colden Baxter[1], Dana Warren[2] and William Ripple[2]
Idaho State University[1], Oregon State University[2]
Presenter: Jeremy Brooks, broojer2@isu.edu

The loss of apex predators is a worldwide phenomenon, and understanding the extent of direct and indirect effects of these losses or the potential responses to restoration of such predators is a fundamental challenge in ecology. We are addressing this challenge in Yellowstone National Park (YNP) where a large-scale manipulation of gray wolves (Canis lupus) has led to a series of well documented indirect effects, including a terrestrial trophic cascade resulting in the patchy regeneration of riparian woody vegetation (RWV). The presence of RWV is known to influence stream-riparian linkages through changes in allochthonous and autochthonous resources for the stream ecosystem. Moreover, the emergence of stream insects can be mediated by stream basal resources and fish predation, which ultimately can influence the abundance and distribution of riparian insectivores including spiders, songbirds, and bats. We began investigating the potential for these reverberating responses to a terrestrial trophic cascade in the Northern Range of YNP in the summer of 2018. At each site, we measured community assemblage and population of fishes, stream invertebrates, and riparian spiders. Sites with reduced browsing, where top down control was initiated by wolves, tended to have higher stream invertebrate biomass, higher fish biomass, and higher abundances of riparian spiders. These results indicate that the top down control initiated by wolves might result in higher emergence flux and a numerical increase in riparian insectivores. In the summer of 2019, we will conduct more thorough investigations of stream ecosystem processes, fish diets, aquatic insect emergence, and riparian bat and songbird populations in order to better understand stream-riparian food web interactions that may mediate the extent of direct and indirect effects of apex predators.

Effect of Trematode Infection on Growth, Reproduction, and Mortality of Shorthead Sculpin

Darby Byington[1], Jon Flinders[2] and Eric Billman[1]
Brigham Young University-Idaho Biology Department[1], Idaho Department of Fish and Game[2]
Presenter: Darby Byington, rog13004@byui.edu

Shorthead Sculpin, Cottus confusus, in Birch Creek, Idaho, are infected with the trematode Euryhelmis cotti. Our objective was to determine if parasite load has an influence on the fitness (i.e. growth, reproduction, and mortality) of Shorthead Sculpin. We collected sculpin from two sites in Birch Creek that differed in prevalence and parasite load of E. cotti. Prevalence of trematode infection was 100% compared to 32% prevalence. Comparison of von Bertalanffy growth models between sites demonstrated that models only differed in the growth coefficient (K) with a higher growth coefficient in the model for sculpin at the upstream site. Gonadosomatic index for both males and females was significantly higher in the upper site. Females at the upper site also had significantly more eggs per clutch compared to females in the lower site. Annual mortality was significantly higher at the upstream site (A = 57%; 95% CI = 52 – 62%) compared to the lower site (A = 42%; 95% CI = 38 – 46%). As a consequence, density of sculpin was lower at the upstream site (13 fish/m2) compared to the downstream site (54 fish/m2). We did not find evidence to suggest that growth and reproduction of Shorthead Sculpin were influenced by infection of E. cotti. Instead, density dependence appears to be the primary factor causing differences in growth and reproduction between sites. Mortality was higher for Shorthead Sculpin at the site with high prevalence and parasite load. However, we do not know if higher mortality was a direct consequence of trematode infection or merely correlated with trematode infection.

Kokanee Salmon Management at Deadwood Reservoir: Supporting an Increasingly Popular Statewide Fishery

John Cassinelli, Joe Kozfkay and Andrew Endicott
Idaho Department of Fish and Game
Presenter: John Cassinelli, john.cassinelli@idfg.idaho.gov

Kokanee Salmon Oncorhynchus nerka provide recreational fisheries and a prey base for piscivores in many waters of the western United States. In Idaho, kokanee have become increasingly popular with anglers over the last decade. This popularity is reflected in fishing magazine articles, social media, kokanee tournaments, and online forums dedicated to kokanee fishing. Because of a wide variation of population responses to system productivity, habitat, predation, and harvest, management of kokanee populations is often elusive and complex. In central Idaho, the fishery in Deadwood Reservoir is supported primarily by kokanee and other salmonids that may prey on kokanee to reach large sizes. Additionally, this kokanee population has historically been Idaho's primary egg source to produce hatchery kokanee of early run strain and has been monitoring using a combination of hydroacoustics, trawling, and gillnetting. Because of large amounts of spawning habitat, Deadwood Reservoir kokanee productivity has been historically high resulting in a large population of smaller adult kokanee due to density dependent growth. Since 2010, kokanee escapement has been managed annually to regulate fish densities and meet egg collection goals for hatchery stocking of other kokanee fisheries, while still providing desirable sizes for the sport fishery in Deadwood Reservoir. However, these restrictions were overly effective resulting in an over-restriction of kokanee recruitment that culminated in too few adult kokanee to conduct an egg take in 2017. Additionally, population structure appeared to be further impacted by increased angler interest in the resulting larger kokanee and the accompanying 25 fish daily bag limit. In 2018, we monitored trends in the kokanee population and estimated angler effort and harvest rates to inform the need for potential management changes on the reservoir and rebuild the population to support both an egg take and continued kokanee fishery.

The Effect of Pulse Frequency on Capture Efficiency and Injury of Trout Sampled with Backpack Electrofishing in Small Streams

Luciano Chiaramonte[1], Kevin Meyer[1], Phil Branigan[1]and Jim Reynolds[2]
Idaho Department of Fish and Game[1], University of Alaska[2]
Presenter: Luciano Chiaramonte, luciano.chiaramonte@idfg.idaho.gov

Electrofishing studies conducted in the 1980s and 1990s established that when using pulsed direct current, higher pulse frequencies (~60 Hz) generally result in more frequent fish injury compared to lower pulse frequencies (~30 Hz). However, these studies were typically conducted on large trout (>250 mm) in artificial settings (lab or hatchery raceways), and did not assess whether capture efficiency was influenced by pulse frequency. Capture efficiency of trout sampled with backpack electrofishing may be reduced if pulse frequencies are minimized out of concern for fish injury. We compared capture efficiencies (measured by the recapture of marked fish) and spinal injury rates of trout in small streams, captured in reaches sampled with either 30 or 60 Hz. Duty cycle (24%) and average power output (~100W) were held constant. Capture efficiency using a four-pass removal averaged 0.84 for 30 Hz reaches and 0.94 for 60 Hz reaches, and declined with successive passes. Bias (the difference between true number and the modeled number of marked fish) averaged 0.16 for the reaches sampled with 30 Hz and 0.06 for reaches sampled with 60 Hz. X-ray images revealed vertebral compressions and/or misalignments for 8% of fish captured with 30Hz (n = 240) compared to 9% of fish captured with 60 Hz (n = 228); no such injuries were observed for fish captured via angling (n = 75). No fractured vertebrae were observed in any of the x-ray fish from any of the treatments. Results suggest that in small streams where trout are generally <300 mm total length, using 60 Hz for sampling purposes appears to have the benefit of greater capture efficiency, resulting in better trout abundance estimates, with little to no increase in spinal injury.

Evaluation of Monitoring Scenarios to Inform Multiple Population Viability Analysis for Lahontan Cutthroat Trout

Daniel Dauwalter[1], Douglas Leasure[2], Seth Wenger[2] and Helen Neville[1]
Trout Unlimited[1], University of Georgia[2]
Presenter: Dan Dauwalter, ddauwalter@tu.org

Prioritizing native trout populations for conservation often requires understanding the status of all populations across a species range. Historically, population status has been inferred by extent of habitat occupied, estimates of population size at one point in time, or trends in abundance at index sites. Population viability analysis integrates information on population size, growth rate, and stochasticity to estimate probability of extinction for a population over a defined time horizon. Multiple Population Viability Analysis (MPVA) integrates spatiotemporal data on habitat conditions with demographic data in a Bayesian hierarchical modelling framework to estimate extinction probability for all populations across a species' range, including those sparsely sampled. We evaluated how different monitoring scenarios influenced the performance of a MPVA developed for Lahontan cutthroat trout. Scenarios included 1-pass versus 3-pass electrofishing, a variable number of sample sites per population, and rotating panel and staggered sampling designs. Preliminary results suggest that employing multiple-pass (versus single-pass) electrofishing is important in reducing the frequency of false extinctions, and that sampling more sites on a population improves estimates of population size and MPVA performance. Results will be used to inform future agency monitoring for Lahontan cutthroat trout, and new monitoring data will be used in future updates of MPVA so that conservation efforts can continually be focused on the populations most at risk to extinction.

Identification of New Diagnostic SNPs for Assessing Hybridization in Salmonids

Thomas Delomas and Matthew Campbell
Idaho Department of Fish and Game Eagle Fish Genetics Laboratory
Presenter: Thomas Delomas, thomas.delomas@idfg.idaho.gov

Interspecies hybridization with an introduced species can threaten the integrity and survival of protected fish populations. If hybrids are fertile and comparable in fitness to the pure species, introgression can eliminate pure populations. In cases where hybrids are sterile, hybridization can lower the average reproductive success of a population and result in increased competition for resources. These potential negative outcomes necessitate monitoring hybridization and introgression in protected fish populations with the potential for interspecies hybridization. Detection of hybrid individuals can rapidly and accurately be performed through genetic analysis if diagnostic markers (genetic markers with species-specific alleles) are known. Single nucleotide polymorphisms (SNPs) are currently the marker of choice for high-throughput genotyping, and are increasingly being assayed through genotyping-by-sequencing of amplicon panels. We developed a bioinformatic pipeline that identifies new SNPs in existing amplicon panels and used it to identify diagnostic SNPs for two pairs of salmonids. From an existing brook trout Salvelinus fontinalis panel containing 242 amplicons; we identified 27 SNPs diagnostic for brook trout and bull trout S. confluentus. From an existing rainbow trout Oncorhynchus mykiss panel containing 379 amplicons; we identified 30 SNPs diagnostic for rainbow trout and Yellowstone cutthroat trout O. clarkii bouvieri. These diagnostic SNPs will allow efficient monitoring of hybridization and introgression in bull trout and Yellowstone cutthroat trout populations in Idaho.

Southeast Idaho Fish Screen Inventory and Database

Jim DeRito[1], Matt Woodard[2] and Matt Mayfield[2]
Henrys Fork Foundation[1], Trout Unlimited[2]
Presenter: Jim DeRito, jderito@tu.org

Fish screens are increasingly being used in inland fisheries to prevent fish entrainment into irrigation canals. This has been the case in Southeast Idaho where numerous fish screens have been installed by several organizations during about the past 20 years. Heretofore, there were no efforts to inventory, summarize, and disseminate information about these projects. In 2017, we began the development of a database and inventory methodology. General information to populate the database was gathered by reviewing data files for fish screen projects and contacting personnel from organizations that had coordinated the installation of fish screens. Detailed information was collected with the development of a fish screen inventory. Site visits were completed in 2017 and 2018. There are over eighty fish screens in the project area. Most of these screens are drum types on small canals (< 5 cubic feet second maximum flow) that have been installed during about the past 10 years. Other types of screens include vertical, horizontal, and cone. Fish screens on five canals are great than a 50 cfs design capacity. Several canals have their second or third generation of fish screens. The Bear River Watershed has the greatest number of fish screens, followed by the Henrys Fork Snake River, South Fork Snake River, Blackfoot, Salt River, and Portneuf watersheds. It is hoped that this effort will facilitate information sharing and improve fish screening efforts in Southeast Idaho and beyond.

Foundations of Relational Values in River Socio-Ecological Systems in the Western US

Adam Eckersell[1], Antonio Castro[2], Colden Baxter[1] and Rob Van Kirk[3]
Idaho State University[1], University of Almeria[2], Henry's Fork Foundation[3]
Presenter: Adam Eckersell, eckeadam@isu.edu

The Ecosystem Services Framework (ESF) proposed by the Millennial Ecosystem Assessment in 2005 has helped demonstrate and quantify the importance of ecosystems and their contributions to human well-being. However, many of the outcomes of ecosystem service research have focused on monetizing such services, a process that is difficult when it comes to the broad category of cultural ecosystem services (CES). Here, we investigated the non-monetary significance of CES associated with a river, its ecology, and its fishery in the Henry's Fork Watershed. To do this, we modified the existing ESF and applied a value system that focused on relational values, as well as intrinsic and instrumental values, linked to fishing. We conducted a survey of over 300 individuals, drew on a previous survey of anglers in the region, and completed a year-round field study of the diets of trout in the Henry's Fork of the Snake River. More specifically, we also investigated how aquatic insect emergence (or "hatches"), and the knowledge and experience of these, contribute to this key CES and associated relational values. Through this combination of methods, we found that 65% of survey respondents reported angling was important to them, anglers tended to value the Henry's Fork because of prolific emergences ("hatches") of aquatic insects, and the adult stage of aquatic insects provided 35% of trout diets. Thus, aquatic insect hatches link ecological processes in the river to value anglers place on the river and its fishery. Last, our use of a values framework enabled us to demonstrate how relational values significantly contribute to the culture of the region by linking fishing to family bonding, recreation, and establishing a sense of place for the residents.

Smallmouth Bass Predation on Juvenile Chinook Salmon in the Snake River

John Erhardt[1] and Ken Tiffan[2]
U.S. Fish and Wildlife Service, Idaho Fish and Wildlife Conservation Office[1], U.S Geological Survey, Western Fisheries Research Center[2]
Presenter: John Erhardt, john_erhardt@fws.gov

Predation by nonnative fishes has been identified as a contributing factor in the decline of juvenile salmonids in the Columbia River basin. Studies conducted in the Snake River during the 1990s found relatively low levels of smallmouth bass predation on Chinook salmon at a time when their populations were at low abundance. In 2012, we began research to re-evaluate smallmouth bass predation on juvenile fall Chinook salmon given their increase in abundance due to recovery measures. From 2012-2018, we examined 22,867 smallmouth bass stomachs within Hells Canyon and Lower Granite Reservoir. Subyearling Chinook salmon were often the first- or second-most consumed fish species during the spring. While bass abundance has not changed appreciably since the mid-1990s, bass consumption rate of subyearlings increased 15-fold in some instances. Total mortality estimates of natural subyearlings in the 115 rkms of Hells Canyon that we studied ranged from ~271,000 to 329,000 per year. Estimates of Chinook salmon mortality (hatchery and natural fish combined) ranged from ~51,000 to 262,000 in 42 rkm of Lower Granite Reservoir. Fall Chinook salmon may be particularly vulnerable to predation due to their small size, extended reservoir rearing, and migrating at times when bass abundance and metabolic rates are high.

Movements of Yellowstone Cutthroat Trout, Brown Trout, and Rainbow Trout in the South Fork Snake River, Idaho.

Kayden Estep[1] and Brett High[2]
University of Wisconsin-Stevens Point[1], Idaho Department of Fish and Game[2]
Presenter: Kayden Estep, kaydenestep15@gmail.com

Knowledge of the movement of species is considered a pre-requisite for effective management and conservation in well-connected systems. Conservation of native Yellowstone Cutthroat Trout Oncorhynchus clarkii bouvieri is a major concern within the Upper Snake River watershed. The South Fork Snake River (SFSR) supports a world-renowned multi-species trout fishery and is considered a stronghold for fluvial Yellowstone Cutthroat Trout. Radio-telemetry was used to analyze movement and quantify the home range of Yellowstone Cutthroat Trout, Rainbow Trout Oncorhynchus mykiss, and Brown Trout Salmo trutta in the South Fork Snake River. Telemetry data was also used to inform a Bayesian-based multi-state mark-recapture model to quantify the probability of transition between three management zones within the SFSR, as well as monthly apparent survival, and monthly detection probability. Preliminary results suggest that all three species exhibit high variability in home ranges and monthly movement. Yellowstone Cutthroat Trout movement peaked in June, Rainbow Trout movement peaked in July, and Brown Trout movement peaked in October. Yellowstone Cutthroat Trout were found to occupy the largest linear home ranges and had the largest variation in movements. On average, Yellowstone Cutthroat Trout had significantly larger home ranges than Brown Trout but were not statistically different from Rainbow Trout. Monthly transition probabilities were similar between management zones. The probability of tagged trout staying within the zone they were tagged in ranged from 0.87-0.97 across all zones and species. Monthly apparent survival was similar across all management zones. Detection probability was lowest in the upper river zone for all species. Results of this study provide fisheries managers with greater insight into the movement patterns of salmonids in the South Fork Snake River and reinforce current management strategies.

Distribution and Movement of Steelhead and Anglers in the Clearwater River, Idaho

Stacey Feeken[1], Brett Bowersox[2], Marika Dobos[2], Matthew Corsi[2], Michael Quist[1] and Timothy Copeland[2]
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit[1], Idaho Department of Fish and Game[2]
Presenter: Stacey Feeken, feek9833@vandals.uidaho.edu

Steelhead Oncorhynchus mykiss is a species of high economic value and supports popular sport fisheries across the Pacific Northwest. The Clearwater River, Idaho, provides a trophy steelhead fishery and is home to wild- and hatchery-origin steelhead. Given the lack of information on the spatial and temporal overlap of wild and hatchery steelhead, as well as anglers, in the Clearwater River, radiotelemetry was used to describe the distribution of steelhead, and creel surveys were used to describe the distribution of anglers. In total, 289 wild (Potlatch River and Lochsa River) and hatchery (Dworshak and South Fork Clearwater River – local brood and general production) steelhead were radio tagged at Lower Granite Dam, 51 rkm downstream from the mouth of the Clearwater River, from September 2016 – June 2018. Steelhead were tracked upon entry into the Clearwater River using mobile tracking surveys (boat and vehicle) and 12 stationary antennas. The majority of wild and hatchery steelhead arrived in the Clearwater River in the fall with the exception of Lochsa River steelhead which arrived in the fall and following spring. Average daily movement of steelhead was minimal (mean = 0.3-4.7 km/d) and dependent on water temperature and flow. Fates of wild and hatchery steelhead varied with fish either returning to spawning grounds, harvest by anglers (hatchery fish only), or their fate was unknown. Wild and hatchery steelhead returned at high rates to their natal tributaries and release locations. No straying was observed for wild or hatchery steelhead; however, steelhead overshooting their natal tributaries and release locations was documented. Spatial and temporal overlap of wild and hatchery steelhead was minimal. Anglers overlapped with hatchery steelhead in the fall, winter, and spring. Overlap of anglers and wild steelhead was minimal and largely occurred in the early fall in the lower Clearwater River.

Predicting the Distribution of Yellowstone Cutthroat Trout in the Upper Snake River Using Spatial Stream Network Analysis.

Cody Feldman, Charles Peterson and Ernest Keeley
Idaho State University
Presenter: Cody Feldman, feldcody@isu.edu

Evaluating the status of species over large geographic areas can be difficult but recent compilations of fish distribution records may provide a more comprehensive analysis of the remaining range and extent of fish species. Geographic information systems (GIS) can be used to map the extent of a species distribution and identify important associations between habitat characteristics and a species range; however, traditional GIS analyses are primarily designed for terrestrial organisms that can move across a landscape. For fish species that are confined to a network of streams, rivers, or lakes, GIS analyses are needed to map habitat associations within a network of locations. In the Snake River watershed, Yellowstone cutthroat trout (Oncorhynchus clarkii bouvieri) have declined in abundance because of various forms of habitat alteration, fragmentation and by invasion of non-native fish species. In this study, we used fish sampling records, remote sensing data, and GIS software to identify the current distribution of cutthroat trout in relation to habitat conditions. We used Spatial Tools for the Analysis of River Systems (STARS) and an R package, Spatial Stream Networks (SSN), to evaluate how environmental variables affect the distribution of Yellowstone cutthroat trout. Our study will map the extent of streams that have a high probability of containing populations of Yellowstone cutthroat trout based on habitat variables and identify areas that have low probability of supporting native cutthroat trout populations.

Moving Mountains and Making it Rain: Enhancing Riparian Resiliency with Grazing Management and Beaver

Kurt Fesenmyer[1], Dan Dauwalter[1], Carol Evans[1] and Todd Allai[2]
Trout Unlimited[1], Bureau of Land Management[2]
Presenter: Kurt Fesenyer, kfesenmyer@tu.org

To enhance habitat for fish and wildlife and increase the resiliency of riparian and aquatic habitats, land managers in the interior western United States increasingly use alternative grazing strategies, beaver management, or beaver dam surrogates as low-effort, low-expense restoration approaches. To evaluate the effectiveness of these approaches, we used historical archives of satellite and aerial imagery spanning three decades to characterize riparian vegetation productivity and document beaver dam occurrences, then estimated vegetation productivity relative to land management associated with livestock grazing and beaver dam densities while accounting for climate and wildfire. After controlling for stream characteristics such as stream size, elevation, and stream slope, we demonstrate a positive response of riparian area vegetation to conservation-oriented grazing approaches and livestock exclosures, extensive beaver dam development, increased precipitation, and lack of wildfire. We show that livestock management which emphasizes riparian recovery objectives can be an important precursor to beaver activity and describe 11–39% increases in floodplain vegetation productivity where conservation-oriented grazing approaches or livestock exclosures and high beaver activity occur together on low-gradient sites. Land management decisions can therefore potentially confer resiliency to riparian areas under changing and variable climate conditions – the increased vegetation productivity resulting from conservation-oriented grazing or exclosures and high amounts of beaver activity at our sites is the equivalent to moving conventionally-grazed, low-gradient sites without beaver up at least 250 m in elevation or increasing water year precipitation by at least 250 mm. We end with a discussion of the social and management conditions which enabled the restoration.

A Comparison of Three Backpack Electrofishing Configurations for Sampling Juvenile Pacific Lamprey Entosphenus Tridentatus

Robert Hand[1] and Jason Fortier[2]
Idaho Department of Fish and Game[1], Pacific States Marine Fisheries Commission[2]
Presenter: Jason Fortier, jason.fortier@idfg.idaho.gov

Pacific Lamprey Entosphenus tridentatus are a native anadromous species of the north Pacific. Sampling for Pacific Lamprey has occurred over many decades, and changes in technology have resulted in the use of different electrofishing equipment and techniques which could result in difficulty comparing data. This became evident during lamprey sampling we conducted in the Selway River, Idaho. In 2013, we used a Smith-Root LR-24 backpack electrofishing unit (one pole configuration). Our CPUE was much lower than historical surveys, and raised the question of potential differences in efficiency compared to the ETS model ABP-2 unit (two-pole configuration) used in previous lamprey surveys. Therefore, we surveyed in 2015 utilizing the ABP-2 unit, and our CPUE was much higher. Although these samples were conducted in different years, the mean CPUE's were different enough to warrant further investigation. Differences in efficiency would limit our ability to compare data to previous studies if we were to continue using the LR-24. Therefore, we conducted a study in 2018 to compare the ETS (2-pole) and LR24 (1-pole and 2-pole) to determine if there were differences in mean CPUE. We sampled 60 sites on the main-stem Selway River in areas previously known to contain Pacific Lamprey. Statistical analysis indicated that there was no significant difference in mean CPUE among the three methods for either time (fish/minute) or area (fish/m2). The results of this study indicate that any of the three methods tested can be utilized for future lamprey sampling without concern regarding potential differences in efficiency among units or configuration (1-pole vs. 2-pole). We would encourage users to match the configuration of previous sampling whenever possible to maintain consistency.

Otolith Analysis Reveals Variable Juvenile Growth and Migration in Chinook Salmon Experiencing Different Environmental Conditions

Katherine Gillies-Rector, Brian Kennedy and Jens Hegg
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit
Presenter: Katherine Gillies, gill5769@vandals.uidaho.edu

Understanding the conditions that produce diverse salmonid life history strategies is challenging in a large river network where life history trajectories arise from the synergistic effects of multiple biotic and abiotic factors. Because early growth is closely linked to migration initiation, identifying the growth conditions and habitat differences experienced by individual fish over a short time scale is crucial. Here, we paired a long-term otolith dataset of life history expression with a detailed bioenergetic assessment of early growth opportunity in a population of Chinook salmon to identify how growth conditions related to life history expression at spatial and temporal scales. In the Snake river population of fall Chinook salmon, juveniles historically migrated before their first winter, but in recent years an overwintering age 1 migration strategy has emerged. Using otolith microchemistry and microstructure analysis, we determined that a significant proportion of fish from both the Clearwater and Snake rivers overwinter and migrate the following spring. Notably, Clearwater origin fish that migrated as yearlings performed a larger proportion of their freshwater growth in their natal tributary than Snake origin fish which only 40% of their freshwater growth in their natal habitat, relative to 48% in Clearwater-origin fish. We also found higher growth and consumption during the early growth period for fish originating in the Snake River and the downstream reservoir compared to the Clearwater River, by comparing relative growth and consumption using a daily time-step bioenergetics model. The combined bioenergetics and life history analysis demonstrates that while both Snake River and Clearwater origin fish express the overwintering life history strategy, their relative growth in natal habitats differ. These findings suggest that the yearling migration strategy may arise from different conditions throughout the population, though the net effect appears to be the increasing prevalence of this strategy under current conditions.

Rainbow Trout Growth is Linked to Kokanee Abundance in Lake Pend Oreille, Idaho

Nicky Graham and Matthew Corsi
Idaho Department of Fish and Game
Presenter: Nicky Graham, nicole.graham@idfg.idaho.gov

Historically, Lake Pend Oreille supported a world record rainbow trout Oncorhynchus mykiss fishery and the largest kokanee O. nerka fishery in Idaho. However, the kokanee fishery saw a significant decline following the 1960s and nearly collapsed in 2007. Subsequent to the decline in kokanee, rainbow trout growth appears to have declined from historic levels. Following multiple measures implemented by Idaho Department of Fish and Game, kokanee abundance trends have increased since 2007. We aim to assess if an increase in kokanee abundance has led to increased growth in rainbow trout in Lake Pend Oreille. The objectives of this study are to examine if rainbow trout growth has increased in the past decade and to determine if rainbow trout growth can be explicitly linked to kokanee abundance. In order to address these objectives, total length and pectoral fin rays were collected from Lake Pend Oreille rainbow trout in 2011 (n=150), 2014 (n=74), 2015 (n=76) and 2017 (n=64). These structures were used to determine age at capture for all individuals in the sample, and data were used to create year-specific von Bertalanffy growth models. The predicted average lengths for age six rainbow trout were 587 mm (95% confidence interval = 570-603 mm), 564 mm (95% confidence interval = 531-598 mm), 626 mm (95% confidence interval = 602-656 mm), and 725 mm (95% confidence interval =694-748 mm) in 2011, 2014, 2015, and 2017 respectively. Predicted lengths for age six rainbow trout were positively correlated (r = 0.733) with a metric representative of the kokanee abundance available for consumption by rainbow trout. This positive correlation may indicate an important link between rainbow trout growth and kokanee abundance. Furthermore, trophy potential for rainbow trout in the lake may be increasing. This highlights the importance of managing for kokanee abundance in Lake Pend Oreille.

A Bioenergetic Analysis of Habitat Suitability for Cutthroat Trout (Oncorhynchus Clarkii) in Headwater Streams Treated with Instream Structures

Tyson Hallbert, Ernest Keeley
Idaho State University
Presenter: Tyson Hallbert, halltyso@isu.edu

Seasonal variation in the amount and availability of suitable habitat is a key factor influencing the productivity of natural populations. In streams and rivers, seasonal changes in water volume affect the amount of space available to stream organisms, and during low-flow periods the lack of space can greatly reduce the availability of suitable habitat. For fish that feed on drifting invertebrates in streams there is a fundamental relationship between space availability and suitable foraging habitat. As a result, drift feeding fish populations in headwater streams may be limited by the availability of suitable foraging habitat during low flow periods. The aim of this study was to examine if increasing the amount of pool habitat improved habitat suitability for native cutthroat trout (Oncorhynchus clarkii) in streams comprised of primarily riffle habitat. To do this, we manipulated the availability of pool habitat by adding instream structures to four headwater streams in southeast Idaho and compared the change of habitat quality to un-manipulated control sections within the same streams. We measured habitat quality at monthly intervals between July and October in 2016 and 2017, and estimated the energetic profitability of the available habitat using a bioenergetic model. The model estimates habitat quality by subtracting the energetic costs accrued from the total energy gained by trout while foraging. This study will provide insight into primary factors that affect habitat suitability and population productivity for drift-feeding fishes.

The Feasibility of In-Situ Gamete Collection, and Early Life Stage Rearing, of Wild Lake Trout (Salvelinus Namaycush): The Path Towards Developing a YY Male Captive Broodstock in the Future.

William Harryman[1], Matthew Corsi[1], Beau Gunter[1], John Rankin[1], Liz Mamer[2] and D.J. Schill[2]
Idaho Department of Fish and Game[1], Fisheries Management Solutions, Inc.[2]
Presenter: bill.harryman@idfg.idaho.gov

There is widespread interest in developing a YY male broodstock for eradication of invasive lake trout populations. However, a 6 to 8 year generation time requires an alternative to the multi-generational approach used to develop Idaho's YY male brook trout. Androgenesis results in the creation of genetically YY male fish in a single generation. In this study, we conduct a preliminary in-situ spawning and early rearing trial to facilitate future attempts to create YY male lake trout via androgenesis. We collected gametes from wild, free-ranging lake trout. Survival and early life stage parameters were compared between two groups of eggs. One group was collected and immediately fertilized from 6 females and 12 males caught in gill nets set as part of IDFG's lake trout suppression program on Lake Pend Oreille. A 2-hour delayed-fertilization group was also collected from these gill nets, but gametes from 6 females and 12 males were kept separate and transported to the rearing facility before fertilization. This treatment was designed to simulate the delay required to conduct androgenisis. Once fertilized, eggs from individual females were placed in separate trays in two "Heath" stacks. They ranged from 2,558 to 10,279 eggs per female in the immediately fertilized group and from 3,702 to 8,229 per female for the delayed group. Our results, in terms of eye-up (87% and 93% green egg to eye) and hatch rates (96% and 87% eyed egg to hatch), suggest that a two hour delay in gamete combination does not present initial survival hurdles. This observation is welcome, as the androgenic process itself often results in heavy mortality. While these results are promising, the efficacy of a YY lake trout program will depend not only on feasibility of components of the androgenesis process, but also on the likelihood of desirable population-level impacts.

Describing Life History Structure of Westslope Cutthroat Trout in the St. Maries Rive Basin Using Otolith Microchemistry

John Heckel[1] Michael Quist[2], Carson Watkins[3], Andrew Dux[3] and Scott Carleton[4]
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit[1], U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit[2], Idaho Department of Fish and Game[3], U.S. Fish and Wildlife Service[4]
Presenter: heck5910@vandals.uidaho.ed

Westslope Cutthroat Trout Oncorhynchus clarkii lewisi are known to inhabit headwater streams, larger rivers, and to seasonally migrate from Coeur d'Alene Lake into drainages throughout the St. Maries River basin. The objectives of this study were to assess spatial variability, evaluate life history structure, and determine natal origins of Westslope Cutthroat Trout by referencing 87Sr/86Sr stable isotope ratios across otolith growth axes. In 2017 and 2018, sampling was conducted in tributaries of the St. Maries River (68 reaches), in the mainstem of the St. Maries River (92 reaches), and Coeur d'Alene Lake (134 sites). We used laser ablation multicollector inductively coupled plasma mass spectrometry (LA-MC-ICPMS) to analyze sagittal otoliths (n = 880), and MC-ICPMS and thermal ionization mass spectrometry (TIMS) to analyze water samples (n = 54) for 87Sr/86Sr ratios. Results from microchemistry analysis indicated that it is possible to discriminate among drainages and evaluate life history structure of Westslope Cutthroat Trout in the St. Maries River basin. Nonparametric analyses were conducted to differentiate among drainages and discriminant function analysis was used to assign fish to natal streams. Results from this study will be used to inform management decisions at multiple spatial scales and to guide Westslope Cutthroat Trout monitoring.

Advances in Hard-Part Chemistry in the Context of Idaho Fish Populations

Jens Hegg and Brian Kennedy
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit
Presenter: Jens Hegg, jhegg@uidaho.edu

The use of fish hard parts to reconstruct the ecology of fish has been a fast evolving area of research over the last decade. The concentric ring structure of many hard parts, otoliths in particular, stores a spatio-temporal record of chemical changes which correlate to important life-history events including developmental stages and movements. Improvements in instrumentation have driven increasing temporal and spatial resolution in reconstructing these important life events. Meanwhile new research and improved statistical techniques have revealed new ways to utilize these chemical records. While in the past many otolith and hard-part studies relied largely on information from the otolith itself, recent hard-part studies are more often integrated with large individual or population-level datasets to answer complex ecological and management questions. Using data from fish populations in the Snake River basin collected over the last decade, we discuss the state-of-the-art in otolith chemistry techniques in the context of fish populations in Idaho. These applications include maternal anadromy, natal origins, high-resolution migration reconstruction, forensic applications, and new time-series analysis techniques.

Where Did You Come From, Where Did You Go? Juvenile White Sturgeon Telemetry.

Jacob Hughes
Idaho Power Company
Presenter: Jacob Hughes, jhughes@idahopower.com

White sturgeon below Hells Canyon Dam are believed to represent one of the most robust sturgeon populations in the Snake River. Recent studies however, have documented extremely slow growth, delayed age-at-maturity, and suggest declining recruitment (survival to first fall). Recruitment investigations were initiated in 2014 within Lower Granite Reservoir (LGR), the first such studies since 1990-91. Successful recruitment was documented in 2017 (catch n=13 age-0) and 2018 (catch n=4 age-0), following three years of no detectable recruitment (2014-2016). Year-class strength is poorly understood, however preliminary data suggest age-1 sturgeon are more catchable than age-0 (2018 age-1 catch n= 283). Recaptures of 2017 marked fish (5 of 13 recaptured in 2018) illustrate phenomenal growth capabilities within LGR compared to sturgeon farther upriver. To understand age-0 and age-1 movements and use of LGR, age-0 and age-1 sturgeon were implanted with acoustic transmitters during fall 2017 (n=9) and 2018 (n = 39) and passively tracked over winter with stationary acoustic receivers. To date, data indicate young sturgeon move great distances within a day and across months, utilizing the entire reservoir. Movements will be followed through 2019 to determine if these cohorts leave LGR and to aid future recapture attempts that will provide growth rate data for these known-age wild sturgeon.

Global Warming Rates of Salmon and Trout Rivers in the Pacific Northwest

Dan Isaak, Charlie Luce, Dona Horan, Sherry Wollrab, Gwynne Chandler and Dave Nagel
Forest and Rangeland Ecosystem Science Center, US Forest Service
Presenter: Dan Isaak, disaak@fs.fed.us

Large rivers constitute small portions of drainage networks but provide important migratory habitats and fisheries for salmon and trout when and where temperatures are sufficiently cold. Management and conservation of cold-water fishes in the current era of rapid climate change requires knowing how riverine thermal environments are evolving and the potential for detrimental biological impacts. Robust estimates of warming rates, however, are lacking due to limited long-term temperature monitoring, so here we compile the best available multi-decadal records and estimate trends at 391 sites in the 56,500 km river network of the northwestern U.S. Warming trends were prevalent during summer and early fall months in recent 20-year and 40-year periods (0.18–0.35 °C/decade during 1996–2015 and 0.14–0.27 °C/decade during 1976–2015), paralleled air temperature trends, and were mediated by discharge trends at regional and local levels. To illustrate the biological consequences of warming later this century, trend estimates were used to inform selection of river temperature scenarios and assess changes in thermal exposure of adult sockeye salmon migrating to four population areas as well as thermal habitat shifts for resident brown trout and rainbow trout populations throughout the region. Future warming of 1–3 °C would increase sockeye salmon exposure by 5–16% (3–143 degree-days) and reduce thermally suitable riverine trout habitats by 8–31% while causing their upstream shift. Effects of those changes on population persistence and fisheries are likely to be context dependent and strategic habitat restoration or adaptation strategies could ameliorate some biological impairments but effectiveness will be tempered by the size of rivers, high costs, and pervasiveness of thermal effects. Most salmon and trout rivers will continue to provide suitable habitats for the foreseeable future but it also appears inevitable that some river reaches will gradually become too warm to provide traditional habitats. This research was published in the Transactions of the American Fisheries Society and is available at: https://www.fs.fed.us/rm/pubs_journals/2018/rmrs_2018_isaak_d001.pdf

Understanding the Factors Influencing Population Dynamics of Kokanee in Northern Idaho

Zach Klein[1], Andrew Dux[2] and Matthew Corsi[2]
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit[1], Idaho Department of Fish and Game[2]
Presenter: Zach Klein, Klei7686@vandals.uidaho.edu

Kokanee Oncorhynchus nerka is a recreationally and ecologically important species and is often a focus for natural resource management agencies. One of the primary challenges for managers is understanding the drivers of fluctuations in kokanee populations. This challenge is typified in Lake Pend Oreille, Idaho, where the kokanee population is subject to intraspecific competition and competition with Opossum Shrimp Mysis diluviana (hereafter Mysis). In an effort to better understand how competition may structure kokanee populations, we sought to identify the relative role of both processes in governing kokanee abundance and evaluate how inter- and intraspecific interactions influence spatiotemporal and age-specific patterns in kokanee in Lake Pend Oreille. Historical patterns in kokanee abundance were evaluated using data collected from 1995-2017. The relationship between kokanee, Mysis, and zooplankton was evaluated at a finer-scale using age-specific data on diet and density collected from 2015-2017. Density of Mysis was consistently negatively related to the abundance of age-0 and older kokanee. However, top models also suggested that intraspecific competition may influence younger kokanee age classes. At a finer scale, Mysis and kokanee exhibited high dietary overlap and a preference for seasonally available prey. Our results suggest ontogenetic shifts in diet and behavior in kokanee influence the relative role of intra- and interspecific competition in structuring kokanee populations.

Long-Term Evaluation of Fitness and Demographic Effects of a Chinook Salmon Supplementation Program

Ilana Koch[1], Craig Rabe[2], Ryan Kinzer[2], Doug Nelson[2], Maureen Hess[1] and Shawn Narum[1]
Columbia River Inter-tribal Fish Commission1, Nez Perce Tribe, Department of Fisheries Resources Management[2]
Presenter: Ilana Koch, koci@critfc.org

While the goal of supplementation programs is to provide positive, population-level effects for species of conservation concern, these programs can also present an inherent fitness risk when captive-born individuals are fully integrated into the natural population. In order to evaluate the long-term effects of a supplementation program and estimate the demographic and phenotypic factors influencing the fitness of a threatened population of Chinook salmon (Oncorhynchus tshawytscha), we genotyped tissue samples spanning a 19-year period (1998-2016) to generate pedigrees from adult fish returning to Johnson Creek, Idaho USA. We expanded upon previous estimates of relative reproductive success (RRS) to include two full generations and used generalized linear models to determine if origin (hatchery or natural) or phenotypic traits (timing of arrival to spawning grounds, body length, and age) significantly predicted reproductive success (RS) across multiple years. Our results provide evidence that this supplementation program with 100% natural-origin broodstock provided a long-term demographic boost to the population (mean of 4.56 times in the 1st generation and mean of 2.52 times in the 2nd generation). Overall when spawning in nature, hatchery-origin fish demonstrated a trend towards lower RS compared to natural-origin fish ($p<0.05$). However, when hatchery-origin fish successfully spawned with natural-origin fish, they had similar RS compared to natural by natural crosses (1st generation mean hatchery by natural cross RRS = 1.11 females, 1.13 males; 2nd generation mean hatchery by natural cross RRS = 1.03 females, 1.08 males). While origin, return year, and body length were significant predictors of fitness for both males and females ($p<0.05$), return day was significant for males but not females ($p>0.05$). These results indicate that supplementation programs that reduce the potential for genetic adaptation to captivity can be effective at increasing population abundance while limiting long-term fitness effects on wild populations.

Early Detection and Monitoring of a Reintroduced Spring-Chinook Population in the Okanogan Basin

Matthew B. Laramie
U.S. Fish and Wildlife Service, Idaho Fish and Wildlife Conservation Office
Presenter: Matthew Laramie, mlaramie@usgs.gov

Tributaries of the upper Columbia River used to support abundant populations of spring-Chinook salmon (Oncorhynchus tshawytscha). Today, most populations have been driven to federal listing or even extirpated as result of habitat loss and alterations to natural river systems. In northern Washington, the Colville Confederated Tribes created a reintroduction program for spring-Chinook in the Okanogan Basin. USGS is collaborating with CCT's Chief Joseph Hatchery Program (CJHP) and the Okanogan Basin Monitoring and Evaluation Program (OBMEP) to explore and implement monitoring strategies that include eDNA monitoring to detect changes in Chinook distribution as well as exploratory studies of relative abundance in tributaries. We are using stream habitat metrics to assess the effects of environmental (both physical and biological) covariates on the relationship between quantitative estimates of eDNA and actual fish density. Preliminary results suggest that these eDNA methods are providing basin-wide spatiotemporal distribution information that can help to refine strategies for implementing more intensive monitoring methods.

Effects of Air Exposure on Survival of Yellowstone Cutthroat Trout from a Warm Water Stream

Darcy McCarrick[1], Curtis Roth[2], Daniel Schill[2], Brett High[2] and Michael Quist[3]
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit[1], Idaho Department of Fish and Game[2], U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho[3]
Presenter: Darcy McCarrick, darcy_mccarrick@yahoo.com

With the increasing popularity of catch-and-release angling, understanding the effects of angling on fishes is becoming more important. We evaluated the effects of water temperature and air exposure on Yellowstone Cutthroat Trout Oncorhynchus clarkii bouvieri caught and released in a warm water stream in southeastern Idaho. Fish were caught by angling in a 2.27 km section of Fall Creek, Idaho, during August 2018 using a variety of angling tackle. Sampled fish remained under water while they were measured and then tagged with T-bar anchor tags. Fish were exposed to air for 0, 30, or 60 seconds and then released at the point of capture. Temperature was monitored during the study period and averaged 17.0°C (min = 14.1°C, max = 19.6 °C) during angling hours (1100 to 1700). We caught 161 Yellowstone Cutthroat Trout during the study period (0 seconds: n = 54; 30 seconds: n = 54; 60 seconds: n = 53). Electrofishing was used to recapture tagged fish and estimate relative survival (i.e. percentage of tags recovered by treatment group). Relative survival was highest for the 60 second treatment (0.40 ± 0.14) followed by 0 second (0.35 ± 0.13) and 30 seconds of air exposure (0.3 ± 0.13). Differences were not significant ($P \geq 0.005$) among treatments. Results from this study are consistent with other air exposure studies suggesting that air exposure of 60 seconds or less is not likely a concern for Yellowstone Cutthroat Trout fisheries.

Estimating Yellowstone Cutthroat Trout Population Dynamics Using an Integrated Population Model

Joshua McCormick and Brett High
Idaho Department of Fish and Game
Presenter: Josh McCormick, josh.mccormick@idfg.idaho.gov

The South Fork Snake River supports one of the most popular trout fisheries in Idaho. Changes in relative abundance of Yellowstone Cutthroat Trout (YCT) O. clarkia bouvierii in recent years has led to increased interest in understanding their population dynamics. The YCT population is monitored using multiple techniques including electrofishing to estimate abundance and passive integrated transponder tagging to estimate survival. Both independent metrics provide information on the dynamics of the population but have traditionally been analyzed separately. Here we used a stage-structured integrated population model (IPM) that allows both datasets to be analyzed jointly. Estimating demographic parameters using IPMs have been shown to be more precise than when estimated independently, and can be used to estimate parameters for which no data are available. Preliminary model results suggest that YCT population growth rate is primarily driven by age-zero survival and density-dependent effects of adult YCT abundance are most prevalent at the subadult stage. Results of this study will be used to guide management of the YCT population on the South Fork Snake River.

Prioritization of Management Actions for a Threatened Trout Using Multiple Population Viability Analysis

Helen Neville[1], Doug Leasure[2] Dan Dauwalter[1], Lee Ann Carranza[3], Jon Sjoberg[4] and Seth Wenger[2]
Trout Unlimited[1], University of Georgia[2], US Fish and Wildlife Service[3], Nevada Department of Fish and Wildlife[4]
Presenter: Helen Neville, hneville@tu.org

Managers of at-risk species frequently need to prioritize actions based on questions such as "Which populations are most at-risk of extirpation?", "Which would benefit most from management?" or "Where could we reintroduce viable populations?", but limitations of traditional modeling approaches and data inadequacies often hamper empirical guidance — especially for species comprising many isolated populations across broad geographies. The federally-listed Lahontan cutthroat trout (LCT) is one such species, for which there has been little quantitative foundation to guide range-wide management and recovery. We employed a recently-developed Multiple Population Viability Analysis model (MPVA), customized for LCT using all count data from backpack electrofishing surveys (1985-2015) and a suite of environmental and biological covariates, to address priority questions identified with management partners. Across 211 streams where LCT populations currently exist or may be reintroduced, we: 1) ranked extinction risk for current populations range-wide, 2) quantified the benefit of removing non-native trout and 3) estimated viability for LCT reintroduced to unoccupied waters using

different protocols. Conservation populations tended to have lower extinction risks than non-conservation populations, but our model identified a suite of these populations being prioritized for recovery with high relative extinction risk (> 70%). Conversely, several non-conservation populations were estimated to have low (<10%) relative extinction risk and might be worthy of targeted management actions to restore genetically intact LCT in these resilient habitats. Our model also suggested substantial benefits to non-native trout removal, but both these benefits and the likelihood of successful LCT reintroduction varied spatially. The Lahontan MPVA, and associated decision support tools, provides a quantitative framework for linking recovery criteria to empirically-demonstrated improvements in extinction risk. Largely due to effective collaboration among academic, non-profit, state and federal entities, data-driven results are being incorporated directly into LCT management prioritization and recovery planning.

Effects of Flow Management on Yellowstone Cutthroat Trout and Rainbow-Hybrid Trout Populations in the South Fork Snake River

Bryce Oldemeyer[1], Rob Van Kirk[1] and Brett High[2]
Henry's Fork Foundation[1], Idaho Department of Fish and Game[2]
Presenter: Bryce Oldenmeyer, Bryce@henrysfork.org

The South Fork Snake River (SFSR) supports one of the largest populations of native fluvial Yellowstone Cutthroat Trout (YCT) in their native range. Competition and hybridization with nonnative Rainbow Trout pose a serious threat to YCT in the SFSR. To preserve genetically pure YCT and reduce Rainbow Trout and Rainbow-YCT hybrids, hereafter jointly referred to as Rainbow and hybrid trout (RHT), Idaho Department of Fish and Game implemented a three-pronged management approach in 2004, consisting of 1) preventing upstream invasion of RHT into the four major spawning tributaries via trapping at weirs, 2) managing springtime flows at Palisades Dam to mimic the river's natural hydrograph, and 3) increasing angler harvest of RHT. The success of the three-prong approach was assessed with a stochastic simulation model of YCT-RHT dynamics calibrated to 1989-2012 conditions. We assessed assumptions on which this model was based by applying it to actual environmental conditions and management actions over 2013-2017. Based on model output, we conducted a series of new statistical analyses to investigate the effects of SFSR flows and tributary conditions on YCT and RHT recruitment. The model predicted YCT numbers to within 20%, suggesting that YCT dynamics are well understood and stable. However, the model performed very poorly at predicting RHT numbers, suggesting that factors affecting RHT numbers are different than when the model was first calibrated. Statistical analysis confirmed earlier results that winter flow downstream of Palisades Dam has a positive effect on recruitment of both species and that late-summer tributary conditions during a cohort's first year affect YCT recruitment. However, the updated analysis showed that late-summer temperature, rather than tributary flow, was a stronger predictor of YCT recruitment.

Fish Community Trends in the Lower Payette River, Idaho, Associated with a 2013 Fish Kill

Mike Peterson, Joe Kozfkay and Martin Koenig
Idaho Department of Fish and Game
Presenter: Mike Peterson, mike.peterson@idfg.idaho.gov

Prior to 2009, very little fish community or creel data had been collected from the lower Payette River between Black Canyon Dam and the Snake River. Boat electrofishing surveys were conducted in 2009 to collect basic fish community data throughout this 62 km reach. Surveys indicated a diverse fish community with moderate abundances of several game fish. In the winter of 2012-13, Black Canyon Reservoir was drafted for a geophysical survey of the dam and dam site, which led to a large, but unquantified volume of sediment being transported downstream. Mobilized sediment and high turbidity led to a fish kill. Post-incident assessments documented mortality of several species, but total mortality remained unknown. This, coupled with substantial angler concern, prompted IDFG to re-survey the reach in 2013. Survey results indicated decreased abundances for most fish species particularly Smallmouth Bass Micropterus dolomieu. Management actions to recover populations were not immediately undertaken due to the possibility of proposed construction at Black Canyon Dam. After the possibility of construction was temporarily suspended in 2018, we again surveyed this reach to determine trends in relative abundance. Methods, sites sampled, water flow, and timing were similar across the surveys. Results indicated that relative abundance was relatively stable for several of the most common species. Smallmouth Bass have decreased the most among surveys. Survey results from 2018 showed that Smallmouth Bass have continued to decline in relative abundance. Mean catch per unit effort for all sites in 2018 represented a decrease of 84% and 53% from 2009 and 2013, respectively. Based on these results, we translocated 1,000 Smallmouth Bass to the lower Payette River from nearby populations during the fall of 2018 to hasten population recovery.

Integration of Environmental DNA-Based Biological Monitoring within the USGS National Streamgage Network

David Pilliod, Matthew Laramie
US Geological Survey Forest and Rangeland Ecosystem Science Center
Presenter: David Pilliod, dpilliod@usgs.gov

The goal of this study was to explore the utility of the USGS National Streamgage Network for biological monitoring using environmental DNA (eDNA) data. We used an existing network of five gages in southwest Idaho to evaluate whether eDNA data collected at the gages provided sufficient information to understand the spatio-temporal distribution of two fish species: bull trout (Salvelinus confluentus) and rainbow trout (Oncorhynchus mykiss). To assess the influence of the spatial distribution of the gages on the biological information obtained, we also collected eDNA samples from locations between the gages three times during the water year. Data were analyzed using a two-stage, multi-season occupancy modeling framework to assess detection (ρ) and occupancy probabilities (ψ) in relation to site and habitat variables. Preliminary results suggest that detection probabilities ranged from 0.641 ± 0.21 to 0.999 ± 0.04 (for bull trout and rainbow trout, respectively), and were influenced by variations in both temperature and discharge. Preliminary results also suggest that the five gages provided meaningful information about the distribution of both species. Sampling between the gages provided some additional information, especially for bull trout whose DNA was detected further downstream than previously known. Timing of sampling also influenced detection, highlighting the importance of matching eDNA sampling with the biology of the animal. We conclude that the amount of additional time required by hydrologic technicians to collect eDNA samples during routine gage visits is easily justified given the value of long-term, standardized biological information obtained throughout a streamgage network. Our case study suggests that the integration of eDNA sampling into a national streamgage network is feasible and could provide a novel and powerful source of biological information for riverine ecosystems in the United States.

The Effect of a Saline Sperm Activating Solution on Fertilization of Chinook Salmon and Steelhead Eggs

Steeve Pomerleau, Doug Engemann, Jacob Rook, Morgan Fife and Phil Coonts
Idaho Department of Fish and Game
Presenter: Steeve Pomerleau, steeve.pomerleau@idfg.idaho.gov

Sperm motility is one of several factors that may affect fertilization of Chinook salmon (Oncorhynchus tshawytscha) and steelhead (Oncorhynchus mykiss) eggs during hatchery spawning events. Literature suggests that sperm may remain active for a longer period when activated with an isotonic salt solution instead of water, consequently resulting in higher fertilization rates. However, the Sawtooth and Pahsimeroi Fish Hatchery have commonly used regular well water to activate sperm for eggs fertilization. A total of four separate studies were conducted to evaluate the effect of a 0.85% saline sperm activating solution on eye-up rates of Chinook salmon and steelhead eggs. The saline sperm activating solution was compared to common well water during one steelhead spawning season (Sawtooth 2014) and three Chinook spawning seasons (Sawtooth 2014, 2015, and Pahsimeroi 2018). The mean eye-up rate of steelhead eggs fertilized in a saline solution (93.9%) was significantly greater ($P<0.001$) than the mean eye-up rate of eggs fertilized in regular well water (90.5%). Conversely, the mean eye-up rate of Chinook salmon eggs fertilized in a saline solution (97.2%, 97.7%, and 97.2%) was not significantly different ($P > 0.05$) than the mean eye-up rate of Chinook eggs fertilized in regular well water (96.8%, 97.3%, and 96.6%) in each of the three years tested (2014, 2015, and 2018, respectively). However, the statistical power estimates from those three Chinook experiments were very low (18-44%).

Exploiting Dietary Differences to Develop Species--Specific Control of Common Carp Using Toxic Food Pellets

Josh Poole[1], Blake Sauey[2], Jon Amberg[3] and Przemyslaw Bajer[3]
Idaho Fish and Game[1], University of Minnesota[2], US Geological Survey[3]
Presenter: Josh Poole, josh.poole@idfg.idaho.gov

Species-specific control of common carp (Cyprinus carpio) using a toxin, antimycin-a (ANT-A), was tested in laboratory tanks and outdoor ponds. Experiments were based on the hypothesis that carp eat foods (grains, such as corn) most native species do not, and that a toxin could be incorporated into such food items to selectively target carp populations. To test this hypothesis, corn-based pellets containing ANT-A were developed and tested. Gavage (force-feeding) trials showed ANT-A to be lethal to carp at 8 mg/kg. A leaching study showed that less than 1% of ANT-A leached from pellets causing no unintended mortality. Single-exposure lab tests with mixed species showed >40% mortality among carp and a native cyprinid, but no significant mortality among two common native species, the bluegill (Lepomis macrochirus) and yellow perch (Perca flavescens). Mixed-species tests in outdoor ponds showed 33% mortality of carp and no mortality of bluegills or perch. These results suggest that carp-specific toxin delivery systems might be possible by exploiting carp's gustatory preferences and foraging behavior and that toxin application methods should be further optimized to reduce mortality among native cyprinids.

Two Methods of Estimating Fish Conductivity for Electrofishing

Jim Reynolds
University of Alaska Fairbanks
Presenter: Jim Reynolds, jbreynolds@alaska.edu

Fish conductivity (Cf) has been studied since the 1950s because it has been recognized that both water and fish conductivity affect electrofishing success. Recent work has shown that the cross-section of a fish relative to the cross-section of water in which it resides affects estimates of Cf. That author proposed a direct-measure method to estimate Cf by in situ measure that would circumvent the behavior-threshold method. I compared estimates of Cf for juvenile Rainbow Trout Oncorhynchus mykiss by both methods and evaluated the effect of water:fish cross-section ratio on Cf estimates. Three fish were exposed to pulsed DC at each of seven water conductivities: 15-600 µS/cm. Voltage was increased from zero to the peak voltage required for threshold immobilization. When each fish had been immobilized, it was killed by concussion. Two needle-electrodes attached to an oscilloscope were inserted into the dorsal musculature to give peak voltage gradients (Ef, nearest 0.001 V/cm) in the musculature for comparison with a constant voltage gradient in the tank (Ew, 0.82 V/cm). Both procedures were repeated in three cross-sectional sizes of test tanks: 5 cm x 5 cm, 10 cm x 10 cm and 20 cm x 20 cm. Cf values obtained by the behavior-threshold method were 50-78 µS/cm and declined with increasing tank size. Those values obtained by the direct-measure method had a much wider range, 57-216 µS/cm, and also decreased with increasing tank size. Estimates of Cf by both methods converged as tank size increased. The direct-measure method relies solely on electrical measurements whereas the behavior-threshold method relies on fish response to an electric field. By that comparison, Cf values produced by the behavior-threshold method may be more realistic. These results confirm that electrofishing in very shallow water could produce effective fish conductivity substantially higher than that in deeper water.

Estimating the Abundance of Chinook Salmon Redds with the use of UAVs

Curtis Roth, Greg Schoby and Jordan Messner
Idaho Department of Fish and Game
Presenter: Curtis Roth, curtis.roth@idfg.idaho.gov

Historically two methods have been used to conduct Chinook Salmon Oncorhynchus tshawytscha redd counts (i.e., aerial or ground). Ground counts are considered to be the most accurate, but cannot be conducted in all locations due to logistical restraints. Aerial redd counts have typically been conducted by manned aircraft, (fixed-wing or helicopter), but the use of these aircrafts is expensive and can pose safety risks. The purpose of this study was to evaluate the use of unmanned aerial vehicles (UAVs) to conduct aerial redd counts instead of manned aircraft in the Salmon River Basin, Idaho. Aerial Chinook Salmon redd surveys using UAVs were conducted throughout the Salmon River Basin during the fall of 2018. Results of these surveys suggest that the use of UAVs to conduct redd counts was feasible and that the yearly cost of operating UAVs for aerial surveys ($13,189) was lower than the cost of operating manned aircraft ($19,676). However, aerial redd counts conducted using UAVs consistently underestimated total redd abundance compared to ground counts. Results of this study provide valuable insight into the feasibility and efficacy of using UAVs to conduct redd counts when the use of manned aircraft is limited due to safety or cost concerns.

Monitoring and Adaptive Management: Small Investment, Big Savings

Katie Salsbury and Jason Chircop
Intermountain Aquatics, Inc
Presenter: Katie Salsbury, katie@intermountainaquatics.com

The Snake River in western Wyoming supports native Snake River fine-spotted cutthroat trout (Oncorhynchus clarkii). These fluvial fish rely heavily on spring creek tributaries for spawning and early rearing. Historically, many of these spring creeks had seasonal connectivity with the Snake River during spring run-off. In the 1950's and 1960's, a 42-mile levee system was constructed along the Snake River by the Army Corps of Engineers to reduce flooding. This action degraded both instream and riparian habitat. The reduction of floodplain connectivity altered the hydrologic and sediment regime in crucial spawning tributaries. Active restoration, in the form of riffle augmentation, has proven effective to maintain productive spawning habitat throughout the watershed. In 2008, an extensive fish habitat assessment and monitoring program was established on two spring creeks south of Wilson, Wyoming. Both creeks are utilized by cutthroat trout and are located within the historic Snake River floodplain. As part of the monitoring program, annual cutthroat trout redd surveys were performed to assess spawning utilization. Redd counts along with data pertaining to water depth, location, temperature, discharge, particle size, and overhanging cover were collected. In 2012, this monitoring data was used to inform a restoration project focused on improving cutthroat trout spawning production. Immediately following project implementation, redd counts increased from 16 to 50. Monitoring efforts continued and showed a gradual reduction of spawning activity over time. After five years post-project implementation, adaptive management occurred. Riffle augmentation occurred without the use of heavy equipment and associated high costs. Redd counts the following year increased from 17 to 53. Overall, this project illustrates the importance of project monitoring and adaptive management to maintain project goals. Monitoring has allowed this project to be more functional and cost efficient by influencing design parameters and identifying both the necessity and the timing of adaptive management.

Invasion of Non-Native Crayfish Faxonius Virilis in the Henrys Fork Drainage, Idaho

Peyton Shaw[1], Eric Larson[2] and Eric Billman[1]
BYU-Idaho[1] Sciences University of Illinois[2]
Presenter: Peyton Shaw, sha16003@byui.edu

The virile crayfish Faxonius virilis has recently been documented in the upper Snake River drainage, but its distribution is poorly known. Our objective was to determine the presence and distribution of Faxonius virilis in the Henrys Fork drainage of the Snake River. Sampling was conducted at 30 total sites in Henrys Fork, Teton River, North Fork Teton River, South Fork Teton River and Moody Creek. We used baited minnow traps and kick nets to determine presence of virile crayfish. Absence was only reported if we unsuccessfully captured crayfish using kick nets because this technique is more effective. Virile crayfish were detected in all five streams; we did not collect any native crayfish in this study. Virile crayfish were not present at sites in Henrys Fork from Ashton Dam downstream to Saint Anthony (n = 4 sites), but virile crayfish were present at all sites from Saint Anthony downstream to the confluence of Henrys Fork and South Fork Snake River (n = 11 sites). In the mainstem Teton River, virile crayfish were only present at a site immediately upstream of the bifurcation into North Fork and South Fork Teton River. We captured virile crayfish at the upstream and downstream portions of North Fork Teton River (n = 3 sites), but did not capture any crayfish in the middle section (n = 2 sites). We captured virile crayfish at all sites sampled in South Fork Teton River (n = 5 sites). Virile crayfish were only present at the site in the lower section of Moody Creek. Distribution patterns suggest that virile crayfish are invading the drainage in an upstream direction. Presence of species of conservation concern (e.g. Yellowstone Cutthroat Trout, Bluehead Sucker, Western Pearlshell), as well as native crayfish, warrant additional research to determine the effect of virile crayfish on these species.

Change in Species Composition and Abundance of Tropical Fish Fallowing Sudden Temperature Changes in Barney Hot Spring, Idaho

Skyler Smith[1], Eric Billman[1], Bart Gamett[2] and Ryan Beatty[3]
BYU-Idaho1[2], US Forest Service[2], Bureau of Land Management[3]
Presenter: Skyler Smith, skysmith118@gmail.com

Barney Hot Spring, which consists of a spring pond and an outlet stream, is a popular recreation site located in the Little Lost River drainage, Idaho. Over the years people have released aquarium fish in the spring pond, and a few species have established self-sustaining populations. Our objectives were to determine the species composition and abundance of tropical fishes in Barney Hot Spring. In 2017 and 2018, we sampled fish in the spring pond using seine nets, baited minnow traps, and a backpack electrofisher, and estimated abundance of each species using a Peterson estimate. In 2017, we estimated a total of 12,043 fish (95% CI: 9,568 – 15,661) in the spring pond consisting of Green Swordtails (68%), Zebra Mbuna (20%), Amelanic Convict Cichlids (9%), and Mozambique Tilapia (3%). Approximately 10 Goldfish were observed but not included in the abundance estimate. A similar assemblage of tropical fishes was captured in the outlet stream within 300 m of the spring pond. In spring of 2018, a rain on snow event resulted in a sudden temperature decrease and an influx of suspended sediment in the spring pond which resulted in an extensive fish kill in the spring pond and the outlet stream. Our observations showed that after fish kill Goldfish first repopulated the pond, followed by Green Sword tails and, most recently Convict Cichlids. In fall 2018, we estimated a total of 1,793 fish (95% CI: 1,475 – 2,213) in the spring pond consisting of Green Swordtails (49%), Goldfish (49%), and Convict Cichlids (2%). Again, the fish assemblage in the outlet stream was similar to the assemblage in the spring pond. Future species composition and abundance in the Barney Hot Springs will be dependent on species interactions within the current community and with species that may yet be introduced.

A First Look at Genotyping Archived DNA Samples. Can We Do Better?

David Venditti[1], Craig Steele[2], Brian Ayers[2] and John Powell[1]
Idaho Department of Fish and Game[1], Pacific States Marine Fisheries Commission[2]
Presenter: David Venditti, david.venditti@idfg.idaho.gov

Genetic samples are regularly collected from salmon carcasses and other genera during routine activities. These samples are often archived with the intent that they may prove valuable in the future, particularly when they are from species of conservation interest. To evaluate long-term viability of carcass samples we genotyped 656 archived samples collected in 2015–2017. Only 28%–51% of samples from each year successfully genotyped. In 2018, we initiated a study to evaluate carcass tissue type and preservation technique on genotyping success. We collected fin tissue preserved on paper (N = 120) and fin (N = 120) and heart (N = 118) tissue preserved in ethanol from 120 Chinook Salmon carcasses sampled downstream of the Sawtooth Hatchery weir. Two highly decomposed carcasses did not contain heart tissue. We also incorporated standardized measures of carcass condition to determine if there was a relationship between sample method, carcass condition, and genotyping success. Heart tissue genotyped at a higher rate than either fin sample from “excellent”, “good”, and “fair” condition carcasses, but about 20% lower than either fin sample from “poor” condition carcasses. Fin samples from both preservation techniques genotyped at approximately equal rates for “excellent”, “fair”, and “poor” condition carcasses, but fin preserved in ethanol genotyped at an approximately 15% higher rate for fair condition carcasses. Future work will include genotyping archived samples of various ages and preservation methods. Based on these results, we make the following recommendations: For general archiving, fin on paper is sufficient for at least several years, but samples should be maintained separately at all times and kept dry. If carcass samples are to be run immediately to answer specific questions, collect heart tissue and preserve in ethanol for all but poor condition carcasses. For these, select the best remaining fin tissue and preserve in ethanol.

Assessment of Largemouth Bass Growth in Northern Idaho Lakes: Spatiotemporal Patterns and Environmental Associations

Carson Watkins and Andrew Dux
Idaho Department of Fish and Game
Presenter: Carson Watkins, carson.watkins@idfg.idaho.gov

We examined patterns in the somatic growth of Largemouth Bass Micropterus salmoides populations in northern Idaho lakes, and modeled its variation to understand how spatiotemporal differences in climate regulate growth in lentic systems. Age was estimated from 768 Largemouth Bass from 6 distinct populations that were collected during late spring in 2014–2015. Parameter estimates from von Bertalanffy models showed that Largemouth Bass growth and longevity in northern Idaho was substantially slower-than-average compared to other populations throughout North America. Mean relative growth estimates of Largemouth Bass for ages 1–8 rarely exceeded the 25th percentile of the North American average and relative growth was either stable or slightly increasing as a function of age for most study populations. Annual incremental growth was more variable across years than among populations, and patterns in interannual growth were closely associated with lake surface area than proximity to one another. Growth tended to be positively related to precipitation during the growing season or mean minimum annual temperature, but the importance of either covariate was dependent on lake surface area. Approximately 50% of the variation in growth of Largemouth Bass was explained by precipitation during the growing season (April–September) in lakes of ≤ 70 ha surface area. In the largest study lakes (i.e., ≥ 600 ha), over 50% of the variability in incremental growth was attributable to mean minimum annual temperature. Similarity in lake surface area resulted in the most interannual growth synchrony, whereas less synchrony was observed as a function of proximity. We interpret our results to mean that the ecology and conservation of Largemouth Bass may benefit from a more complete understanding of the climate-growth relationships on a region-by-region basis, with particular consideration for ecosystem characteristics.

Effects of Fishery Related Fight Time and Air Exposure on Pre-Spawn Survival and Reproductive Success of Adult Hatchery Steelhead

Don Whitney, Kevin Meyer, Joshua McCormick and Brett Bowersox
Idaho Department of Fish and Game
Presenter: Don Whitney, donald.whitney@idfg.idaho.gov

In recent years, increased scrutiny has been placed on potential negative physiological effects stemming from exhaustive exercise and air exposure of caught-and-released fish. Steelhead broodstock in the South Fork Clearwater River of central Idaho are collected using anglers, which enabled fight and air exposure times to be recorded for individual fish to determine their influence on pre-spawn survival and progeny survival to fry stage in the hatchery. The average fight time was 164 s. Air exposures were measured twice, once when anglers initially landed fish and again during transport from the river to the hatchery vehicle. The longest interval of air exposure averaged 23 s during angler activities and 28 s during transport. Three-year average pre-spawn survival was 97.0% for the 1,148 fish that were fought, exposed to air, and collected for brood and 91.2% for the 3,325 swim-in brood collected at the hatchery trap. Mixed effects logistic regression models were used to evaluate factors that influenced progeny survival in the hatchery. The top model included day of the year of spawning, likely associated with peak spawn time in the hatchery. Odds of progeny survival increased in both models that included the number of days fish were held in the hatchery. Air exposure and fight time did not have a statistically significant effect on progeny survival. Based upon results of this study, fight time and air exposure did not increase pre-spawn mortality or decrease hatchery progeny survival from adult steelhead captured by anglers.

How Many Fish Should We Stock? Using Population Dynamics of Kokanee in Lake Pend Oreille to Inform Stocking Goals.

Sean Wilson and Matthew Corsi
Idaho Department of Fish and Game
Presenter: Sean Wilson, sean.wilson@idfg.idaho.gov

Kokanee support a popular fishery on Lake Pend Oreille in Northern Idaho, both as a target species and a prey source for trophy species. IDFG stocks hatchery fish on an annual basis to provide adequate numbers of kokanee for both anglers and predators. The kokanee population is limited by a combination of predators, intraspecific competition, and interspecific competition from Mysis shrimp. Recent declines in Mysis abundance have coincided with increased survival of kokanee. Increasing densities of kokanee have coincided with decreased growth rates. At high densities, kokanee may take longer to achieve a size at which they fully recruit to angling gear and reach sexual maturity later. We examine the effects of interspecific competition (Mysis density) and intraspecific competition (kokanee density) on growth and maturity and the resulting kokanee population. We attempt to use these relationships to recommend stocking goals that maximize the performance of the fishery.

I Want to Teach You Everything I Have Ever Learned with You in the Next Five Minutes. Reframing How We Approach Educational Outreach in Fisheries.

Natasha Wingerter and Sarah Olsen
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit
Presenter: Natasha Wingerter, nwingerter@uidaho.edu

Often we are asked to spend an afternoon educating the next generation of scientists to ignite their passion for fisheries. Authentic science experiences like these have the potential to have lasting impacts on a student's science identity and his or her persistence within STEM fields. As part of scientist-educator partnership, a process for co-creating science outreach programs was developed to foster a student's science identity. Important elements include: (1) the alignment of goals of the program between the educator and scientist, (2) creating an effective learning space, (3) breaking down existing stereotypes, (4) actively engaging students to see science in their everyday lives, (5) performing science, and (6) students teaching what they learned to others. Combined, these elements reframe science outreach activities to be student-centered and encourage the development of a student's science identity.

Changes in Resource Selection Due to Seasonally Induced Intraspecific Competition in Steelhead *Oncorhynchus Mykiss*

Natasha Wingerter and Brian Kennedy
University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit
Presenter: Natasha Wingerter, nwingerter@uidaho.edu

Within a threatened population of steelhead (Oncorhynchus mykiss), inter-cohort competition has been demonstrated by which subyearling growth rates were negatively associated with densities of yearling fish despite relatively low overall population densities. To maximize energetic gain per unit of effort, fish are expected to select larger prey as they grow; however, seasonally-induced intraspecific competition could hinder optimal foraging behavior. To determine the relative role of inter-cohort competition and seasonality on resource selection within this system, invertebrate food availability and stomach contents of subyearling and yearling fish were sampled in early summer, late summer, and early fall. Taxonomy of samples for availability and diet contents were identified to order. For these samples, prey abundance and dry-mass were measured. Ivlev's electivity index was calculated and resource selection was modelled for yearling and subyearling fish. At greater yearling densities and warmer temperatures, we predict in yearling fish that niche width will expand, greater piscivory will occur, and less energetically efficient prey will be selected due to seasonally induced competition. In subyearling fish, niche width will contract as greater yearling densities reduce drift foraging opportunity, causing greater selection of energetically poor prey and benthic invertebrates. These findings will support that changes in resource selection can occur at low population densities due to seasonally induced inter-cohort competition for resources.