POSTER ABSTRACTS

Angler Science: Engaging Our Grassroots

Matt Barney[1], Dan Dauwalter[1], Jake Lemon[1], Shawn Rummel[1]
Trout Unlimited[1]
Presenter: Matt Barney, mbarney@tu.org

"Trout Unlimited (TU) is a national non-profit organization with about 300,000 members and supporters dedicated to conserving, protecting and restoring North America's coldwater fisheries and their watersheds. Our staff and volunteers work from coast to coast to restore degraded habitat and reconnect fish populations to ensure robust populations of native and wild coldwater fish. With limited resources for this important work, it is essential that we use the best science to drive our conservation priorities. Given the limited public resources for this work, TU's on-the-ground network of anglers and stream stewards is ideally positioned as an enthusiastic resource to help prioritize which projects will provide the best return on investment and to track the success of completed projects. TU's approach to citizen science, dubbed "Angler Science"? is part of our organization's 5-year strategic plan, and we have created resources and facilitated projects to enhance the capacity of our volunteers and staff to collect useful data. Through continuous stream temperature monitoring, surveys of trout reproduction, fish passage assessments, water quality monitoring, eDNA sampling, and other methods, angler scientists are making contributions that help inform the conservation priorities of our staff, chapters and partners. By working with state and federal agencies, we increase our analytical capacity and facilitate the use of citizen-generated data to inform resource management decisions.

Movement Patterns and Habitat Use of Walleye in Lake Pend Oreille

Gavin Aguilar[1], Pete Rust[1], Matthew Corsi[1], Bill Harryman[1], Nicky Graham[1]
Idaho Fish and Game[1]
Presenter: Gavin Aguilar, agui0117@umn.edu

Walleye *Sander vitreus* recently became established in Lake Pend Oreille (LPO). To understand their spatial and habitat distribution in LPO, we implemented a pilot telemetry study in spring of 2018. Twenty-one Lotek CART (Combined Acoustic Radio Tag) were implanted into walleye (435-740 mm TL) from October 8- October 31, 2017 and tags were activated in March 2018. We actively tracked by boat or from vehicles between April 15-September 15 2018. Of the twenty-one tags deployed, seventeen (81%) were detected during the study. The Lotek acoustic tags had a pressure sensor and actual fish depth (m), measured depth (m), temperature (°C), and geographical position was recorded each time an individual was detected. From April 15 to June 30, 7 out of the 21 (33%) walleye were near the mouth of the Clark Fork river delta (CF), while 4 out of 21 (19%) were detected by Sandpoint, near the head of the Pend Oreille River (POR). From July 1- September 15, 5 out of 21 (24%) were detected near the CF, while 4 out of 21 (19%) were detected by Sandpoint. There was a total of 68 detections during the study, with 48 (71%) occurring north of Garfield bay and showing a preference for the north end of LPO. Out of the 21 walleye tagged, 16 (76%) were detected greater than 8km away from their tagging location, with one individual moving 71km in less than two months, suggesting walleye in LPO have the potential for wide distribution. Walleye occupied an average depth of 4.9m and 13.4°C, with 44% occupying a depth of 1-5m. This pilot study has provided a useful starting point for walleye movement patterns and habitat use in LPO and more robust telemetry datasets need to be established to make informed management decisions in the future.

Genetic Sex Marker Discovery in Three Non-Native Fish Species

Katharine Coykendall[1], Thomas Delomas[1], Dan Eardley[1], Elizabeth Mamer[2], Dan Schill[2], Matthew Campbell[3]
Pacific States Marine Fisheries Commission[1], Fisheries Management Solutions, Inc.[2], Idaho Fish and Game[3]
Presenter: Katharine Coykendall, katharine.coykendall@idfg.idaho.gov

Invasive species introductions are considered to be the second greatest threat to biodiversity loss in North America. Exotic introductions were a factor in 68% of the extinctions of fish species in North America with rates of introductions increasing dramatically in the past 50 years. Managers are increasingly tasked with devising effective ways for mitigating the damage done by introductions of non-native species that either outcompete, prey upon, or hybridize with native species. One such effort is the use of 'YY' (aka Trojan male) technology. To develop YY males, genotypic male fish are exposed to estradiol causing them to produce eggs. These feminized males are spawned with normal males (XY x XY) yielding ~25% of offspring with YY genotypes. These YY males are released into the wild to spawn (XX x YY), where they yield all male offspring. Over time, the non-native population could be greatly reduced or extirpated with continued addition of Trojan males. To track the efficacy of this method, it is important to identify a genetic marker that can distinguish between females, males, and Trojan males (XX/XY/YY). However, little is known about genetic sex determining factors in most fish species. Therefore, building upon previous work by biologists at Eagle Fish Genetics Laboratory, we utilized Rad-seq technology to sequence segments of the genomes of male and female individuals. We used the bioinformatics pipeline STACKS and custom Python scripts to identify sex-linked single nucleotide polymorphisms (SNPs), that were consistently identical within sexes and different between sexes,

then developed qPCR assays to differentiate all three genotype classes (XX/XY/YY). Our current focus is on three species of non-native fish: Walleye *Sander vitreus*, Lake Trout *Salvelinus namaycush*, and Brown trout *Salmo trutta*, each having been identified by state agencies as priorities for YY broodstock development.

Examining Standard Environmental DNA Sample Extraction and Archival Methods

Kelly Mazur[1, 2], Matthew Laramie[1], David Pilliod[1]
U.S. Geological Survey[1], Boise State University[2]
Presenter: Kelly Mazur*, kellymazur@u.boisestate.edu

Use of environmental DNA (eDNA) methods for detecting rare and secretive species has become an important tool for biological research and monitoring. However, given the recent development of the field and the novelty of the methods employed, empirical testing of methods is needed. The goal of our research was to evaluate the handling of filters (used to concentrate DNA during field filtration) prior to and during the DNA extraction process. A common DNA extraction procedure involves splitting a filter sample into equal halves, with one half processed and the other half archived by freezing (at -20C or -80C) in 200-proof molecular grade ethanol. Our first objective was to assess the assumption that eDNA is evenly distributed across both halves of a sample filter. This could have important implications for studies involving quantitative eDNA data. Our second objective assessed the effects freezing and storing the unextracted half of the filter on DNA yield. We tested both objectives using samples collected annually as part of another study dating back to 2012. Preliminary results of this study will be presented, including quantitative, statistical differences in DNA yield from the two halves of each filter within a year, as well as rates of degradation of DNA on stored filters across time (from 0 to 6 years). Results of this study could help improve eDNA laboratory methods and provide insight into proper sample archival procedures, helping to safeguard eDNA archives for future use.

Juvenile Life Stages and Hosts of the Trematode *Euryhelmis cotti*

Ian Holmes[1], Drew Suchomel[1], Eric Billman[1]
BYU Idaho[1]
Presenter: Ian Holmes*, ianwilliamholmes@gmail.com

Euryhelmis cotti is a trematode parasite that requires three hosts to complete its lifecycle including a metacercarial stage that infects freshwater sculpins. However, other hosts have not been identified for this parasite. Our objective was to determine hosts and morphological characteristics of juvenile stages of *E. cotti*. We collected snails and Shorthead Sculpin from Birch Creek, Idaho where *E. cotti* has recently been documented. Cercariae were collected from snails in the genus Stagnicola, but infected snails were only found in the most upstream sample sites where prevalence of the parasite in Shorthead Sculpin is high. Cercariae were lophocercous with a mean body length of 953 µm (SE = 48.0) and mean tail length of 375 µm (SE = 12.6). Metacercarial cysts were oval in shape with the long axis averaging 357 µm (SE = 6.6) and with the short axis averaging 254 µm (SE = 5.0). Distribution of infected snails mirrors the distribution of infected Shorthead Sculpin. We hypothesize that the adult host has a similar distribution (i.e. only found in upstream portions of the stream) thus limiting *E. cotti* distribution in snail and fish hosts in Birch Creek. Future studies should focus on identifying the adult host of *E. cotti* and the adult host's distribution along Birch Creek.

Estimating Distribution of Sensitive Species in the Salt River and Blackfoot River Drainages Using Environmental DNA

Jordan Norman[1], Landon Tolman[1], Dave Kikkert[2], Lee Mabey[3], Cody Diehl[1], Eric Billman[1]
Brigham Young University – Idaho[1], Stantec, Inc.[2], U.S. Forest Service[3]
Presenter: Jordan Norman*, normanj2011@gmail.com

Western Pearlshell mussel *Margaritifera falcata* and Northern Leatherside Chub *Lepidomeda copei* are species of greatest conservation need Tier 2 in Idaho. Our objective was to determine the distribution of these two species in the Salt River and Blackfoot River drainages using environmental DNA (eDNA) samples. We collected eDNA samples from 84 locations primarily on the Caribou-Targhee National Forest and determined presence of Western Pearlshell and Northern Leatherside Chub using quantitative PCR techniques. Western Pearlshell were detected in four sites in the Salt River drainage (Tincup Creek, Stump Creek, Crow Creek, and Salt River) and one site in the Blackfoot River drainage (Lanes Creek). Northern Leatherside Chub were detected in six sites in the Salt River drainage: Squaw Creek (n = 2 sites), Stump Creek (n = 3 sites), and Crow Creek. Northern Leatherside Chub were not detected in Tincup Creek, but the species is present downstream of the site surveyed in this study. Distributions of Western Pearlshell and Northern Leatherside Chub are limited in the Salt River and Blackfoot River drainages in Idaho. Streams with both species present (i.e. Stump Creek, Crow Creek, and Tincup Creek) should be managed to conserve populations of these and other native species (e.g. Yellowstone Cutthroat Trout, Pilose Crayfish, Western Toad). Additional surveys, including both eDNA and physical collection techniques, will help to further delineate the distribution of Western Pearlshell and Northern Leatherside Chub to assist in the conservation of these species of concern.

Salvage and Relocation of Western Pearlshell Mussel in Tincup Creek, Idaho

Emma Brandon[1], Cosette De Ferrari[1], Eric Billman, Lee Mabey[2]
Brigham Young University - Idaho[1], U.S. Forest Service[2]
Presenter: Emma Brandon*, gingeremma0815@gmail.com

The objective of this project was to salvage and relocate Western Pearlshell *Margaritifera falcata* from two sections of Tincup Creek, Idaho, prior to the initiation of a stream restoration project carried out by the US Forest Service. Salvage and relocation of mussels in the restoration reaches will decrease unintended negative effects of the restoration process on Western Pearlshell. We used plexiglass bottom buckets to survey for Western Pearlshell in an upstream reach (843 m) and a downstream reach (928 m) that were in the restoration project area. When mussels were found during surveys, they were double-tagged with vinyl tags, measured, and relocated to a previously restored reach. We salvaged and relocated 408 Western Pearlshell from two reaches in Tincup Creek. Mussels were three times more abundant in the upstream reach (311 mussels) compared to the downstream reach (97 mussels). Western Pearlshell in each reach had an aggregated distribution with the majority of mussels being found in less than 20% of the surveyed habitat. Salvaged Western Pearlshells ranged from 22-78 mm, however 80% of the mussels were ≥ 50 mm. Western Pearlshell were generally found in runs and pools, with fewer than 20% found in riffles. Surveys in subsequent years will determine survival rates and movement patterns of relocated mussels.

Mussel Behavior and Density in Lolo Creek, Idaho

Michael Murray[1], Doug Nemeth[1], Frank Mullins[1], Chris Giffith[1]
U.S. Fish and Wildlife Service[1]
Presenter: Michael Murray, michael_murray@fws.gov

Freshwater mussels are one of the most imperiled groups of animals in the world and relatively little is known about their behavior. Understanding mussel behavior is necessary for quantification, demographic monitoring, and improving the effectiveness of translocation efforts. The Lolo Creek drainage is part of the Clearwater River basin and supports a large population of western pearlshell mussels *Margaritifera falcata*. We studied mussel behavior and monitoring techniques in the Lolo Creek drainage including: 1) mussel stratification in the substrate by length, 2) detectability of surface and buried mussels, 3) mussel response to physical disturbance of the substrate, and 4) detectability of PIT-tagged mussels. Snorkelers observed or handled mussels from test sites. Mussels were stratified by length in the substrate and responded to substrate disturbance through movement. Recovery of PIT-tagged mussels was inconsistent with some re-captured several times, some never recaptured, and others recaptured during some resampling trips but not others. Detection of PIT-tagged mussels was also highly variable through time and between locations, with only 14% detected during all sampling occasions and many individuals only detected once or not at all. Further research is needed to elucidate the differences between detection probability, survival, and vertical or horizontal emigration.

Describing Freshwater Mussel Species in the Portneuf River

Loni Nelson[1]
Idaho State University[1]
Presenter: Loni Nelson*, nelsloni@isu.edu

Nature provides many benefits crucial for human wellbeing. Freshwater mussels provide benefits in many ways. Over the years, the densities of freshwater mussels in the Pacific Northwest have been declining, primarily due to overexploitation. Previous studies have shown two species *Margaritifera falcata* and *Gonidea angulate* abundant in the Portneuf River Basin in southeastern Idaho. There has not been an official survey of these populations since 1981. The Portneuf River has experienced degradation, and is now deemed highly impaired by the Department of Environmental Quality, so it is of interest to discover what species are present. Five representative sites have been chosen along the river. A presence/absence observational study was done to determine what species still inhabit the Portneuf River. Three distinct species were found: *Margaritifera falcata*, *Gonidea angulata*, and *Anodonta*. *M. falcata* and *G. angulata* were not found in the same reaches of the Portneuf, which differs from previous studies. This may suggest that the impairment of the Portneuf River is having an impact on the distribution of these mussel species.

Pacific Lamprey Distribution and Density in the Clearwater River Basin

Doug Nemeth[1], Frank Mullins[1], Michael Murray[1], Chris Giffith[1], John Erhardt[1], Robert Hand[2], Jason Fortier[3]
U.S. Fish and Wildlife Service[1], Idaho Fish and Game[2], Pacific States Marine Fisheries Commission[3]
Presenter: Doug Nemeth, douglas_nemeth@fws.gov

Pacific lamprey *Entosphenus tridentatus* adult returns to Idaho have declined precipitously. In 2006 the Nez Perce Tribe began collecting adults at Columbia River dams for release into Idaho's waters to ensure some level of lamprey production in the state. In the Clearwater River basin, adult releases were confined to middle and lower river tributary systems. In 2018, U.S. Fish

and Wildlife Service, Idaho Department of Fish and Game (IDFG), and Pacific States Marine Fisheries Commission personnel surveyed lamprey ammocoete abundance in areas expected to be unaffected by adult lamprey releases. Some of these survey locations were also surveyed during 2002-2006 by IDFG. A high frequency of occurrence among all Clearwater River basin sites was observed. With few exceptions, ammocoetes occurred where suitable habitat was present. Sites containing ammocoetes as well as ammocoete density were similar to distribution and density found during 2002-2006 surveys. In contrast, no ammocoetes were found from five sites sampled in the lower Snake River. More than 1,200 fin samples were collected to determine the number of females contributing to ammocoete production and the proportion of ammocoetes produced from translocated lamprey. Future work will include continued distribution and density sampling with collection of fin samples, determination of adult movements and spawning areas, and downstream ammocoete movement.

Pacific Lamprey Abundance and Passage at the Lower Columbia River Dams

David Swank[1]
U.S. Fish and Wildlife Service[1]
Presenter: David Swank, david_swank@fws.gov

The last two years, especially 2017, have seen excellent returns of adult Pacific Lamprey to the lower Columbia and Snake Rivers, even as salmon and steelhead returns have been far below the ten-year averages. There is some evidence that ocean conditions, such as the abundance of Pacific hake, are linked to the returns of Pacific Lamprey. Other factors include the success of Lamprey Passage Structures (LPS's) that have been installed at Bonneville Dam over the last decade. Over the last six years, an average of 45% of total lamprey passage at Bonneville has been though one of these structures. The fish ladders at the dams were designed mainly to pass adult salmon and steelhead, and pose challenges for lamprey, which have a lower swimming speed and have trouble navigating sharp corners. Recent passage improvements at these dams include ways to either increase entrance efficiency, such as reducing the water velocity at the fish ladder entrances, or aim to increase dam passage efficiency by allowing lamprey to circumvent problematic sections of the fish ladders, such as wetted walls. A wetted wall was installed at Bonneville Dam in early 2018, and allowed nearly 3,500 lamprey to exit the fish ladder prior to the serpentine section, which is a known barrier, and pass through the auxiliary water supply to an existing LPS. Despite the high returns to Bonneville, we consistently observe a major drop in run size between Bonneville and the next upstream dam, The Dalles. There are several hypotheses for this drop-off, including holdover, tributary turnoff, predation, and energetics, but studies to date have not been able to provide strong evidence for any of these explanations. A radio telemetry study initiated in 2018 by the University of Idaho is tracking the behavior and fate of adult lamprey tagged at Bonneville.

Population Dynamics of Longnose Dace in an Eastern Idaho Stream

Taylor Morlan[1], Curtis Roth[1]
Idaho Fish and Game[1]
Presenter: Taylor Morlan, tmorlan11@gmail.com

Increasing interest in ecosystem management has caused fisheries managers to increase their focus on nongame species. Population assessments for nongame fishes are often influenced by the goal of increasing the abundance and distribution of these species. Population dynamics data is often used to conduct population assessments. However, population dynamics data is not readily available for all species. One such species is the Longnose Dace *Rhinichthys cataractae*. Longnose Dace are a small bodied cyprinid that inhabit high gradient riffle habitat and have the largest geographical distribution of any native minnow species in North America. Therefore, Longnose Dace were collected via rotary screw trap in the Lemhi River, Idaho. In total, 113 fish were sampled by rotary screw trap, from May – September, 2018. Once captured, length and weight were recorded for each fish. Age structure, growth, and mortality were then estimated using fin rays (i.e., dorsal, pectoral, pelvic), scales, and otoliths. This study will add to the understanding of the population dynamics of Longnose Dace.

Age and Growth Patterns of Paiute Sculpin *Cottus beldingii* in Antelope Creek, Idaho

Shawnie Geisler[1], Darbie Byington[1], Eric Billman[1], Bart Gammet[2]
Brigham Young University – Idaho[1], U.S. Forest Service[2]
Presenter: Shawnie Geisler*, gei14001@byui.edu

We examined the age and growth patterns of Paiute Sculpin *Cottus beldingii* found in Antelope Creek, Idaho. A total of 123 fish were collected in September 2018. We found a strong, positive correlation between the lengths and weights of Paiute Sculpin for both males and females. Lengths of Paiute Sculpin ranged from 44 mm to 130 mm. Males showed greater lengths, while females showed greater weights. This is due to dominant males being larger to defend their territories or female selection for larger males. Females showed greater weights to increase their energy storage and body mass for reproduction. Age and growth patterns of Paiute Sculpin showed similarities in the age and growth patterns of other Idaho native sculpin. Whole ecosystem dynamics are better understood if we understand Paiute Sculpin dynamics.

Meristic and Morphological Analysis Provides Evidence for Distinctiveness between Populations of Bluehead Suckers *Catostomus discobolus*

Tyson Halbert[1], Brandy Smith[1], Janet Loxterman[1], Ernest Keeley[1]
Idaho State University[1]
Presenter: Tyson Halbert, halltyso@isu.edu

A complete description and understanding of the contemporary distribution and abundance of species is essential for the continued study and conservation of natural populations. For many species, ancient geological processes have altered species' distributions and, in some cases, have removed connections between populations leading to geographic isolation. The isolation of populations due to historical geological events is particularly evident in freshwater fishes from western USA, as shifts in connectivity between paleodrainages has been described as a major contributor to the contemporary distribution of fishes native to this region. Recently, genetic tools have been used to describe the phylogenetic relationships between fishes in previously connected river networks, and it has been proposed that the bluehead sucker *Catostomus discobolus* that was previously thought to be present in both the Columbia and Colorado River drainages may be two separate species separated by watershed boundaries. Populations in the Snake and Bear River drainages have been proposed to be classified as the green sucker *Pantostus virescens* separate from bluehead sucker populations in the Colorado River drainage. The aim of this study was to examine if there is morphological and/or meristic evidence to support this reclassification. To do this, we examined commonly used morphological and meristic characteristics from bluehead/green suckers collected from the Snake, Bear, Green, and Colorado rivers. A principal component analysis and two-factor ANOVA indicate Colorado River fish are distinct from all other bluehead sucker populations we examined. Interestingly, suckers from the Green River were more similar to populations in the Bear and Snake River drainages than to fish from the Colorado River. These results, along with the close geographic proximity of headwater streams in the Green and Snake rivers, may allude to watershed exchange between these two drainages at some point in history.

Principal Components of Thermal Regimes in Central Idaho Rivers and Streams

Dan Isaak[1], Charlie Luce[1], Gwynne Chandler[1], Sherry Wollrab[1], Donna Horan[1]
U.S. Forest Service[1]
Presenter: Dan Isaak, disaak@fs.fed.us

Description of thermal regimes in flowing waters is key to understanding physical processes, enhancing predictive abilities, and improving bioassessments. Spatially and temporally sparse datasets, especially in logistically challenging mountain environments, have limited studies on thermal regimes but inexpensive sensors coupled with crowd-sourced data collection efforts provide efficient means of developing large datasets for robust analyses. Here, thermal regimes are assessed using annual monitoring records compiled from several natural resource agencies in the northwestern United States that spanned a five-year period (2011-2015) at 226 sites across several contiguous montane river networks. Regimes were summarized with 28 metrics and principal components analysis (PCA) was used to determine those metrics which best explained thermal variation on a reduced set of orthogonal axes. Four principal components (PC) accounted for 93.4% of the variation in the temperature metrics, with the first PC (49% of variance) associated with metrics that represented magnitude and variability and the second PC (29% of variance) associated with metrics representing the length and intensity of the winter season. Another variant of PCA, T-mode analysis, was applied to daily temperature values and revealed two distinct phases of spatial variability – homogeneous phase during winter when daily temperatures at all sites were < 3 °C and a heterogeneous phase throughout the year's remainder when variation among sites was more pronounced. Phase transitions occurred in March and November, and coincided with the abatement and onset of subzero air temperatures across the study area. S-mode PCA was conducted on the same matrix of daily temperature values after transposition and indicated that two PCs accounted for 98% of the temporal variation among sites. The first S-mode PC was responsible for 96.7% of that variance and correlated with air temperature variation ($r = 0.92$) whereas the second PC accounted for 1.3% of residual variance and was correlated with discharge ($r = 0.84$). Thermal regimes in these mountain river networks were relatively simple and responded coherently to external forcing factors, so sparse monitoring arrays and small sets of summary metrics may be adequate for their description. PCA provided a computationally efficient means of extracting key information elements from the temperature dataset used here and could be applied broadly to facilitate comparisons among more diverse stream types and develop classification schemes for thermal regimes. This research was published in Hydrology and Earth Systems Science and is available at: https://www.fs.usda.gov/treesearch/pubs/57434

Thermal Regimes of Flowing Waters in the Western United States

Dan Isaak[1], Charlie Luce[1], Gwynne Chandler[1], Sherry Wollrab[1], Donna Horan[1]
U.S. Forest Service[1]
Presenter: Dan Isaak, disaak@fs.fed.us

Description and classification of thermal regimes in flowing waters is a fundamentally important step towards understanding the diversity of environmental conditions that aquatic organisms experience. Building on earlier work that described thermal

regimes in mountain river networks (see companion poster), here we address the topic at a broader geographic extent using a dataset of annual monitoring records that spans a consistent five-year period (2011-2015) at 580 sites on free-flowing and regulated streams and rivers across the western U.S. Thermal regimes at the monitoring sites were summarized with 34 metrics that represented some aspect of magnitude, variation, frequency, duration, or timing and principal components analysis (PCA) was used to determine those metrics which best explained thermal variation on a reduced set of orthogonal axes. Similar to our previous findings for mountain river networks, many of the thermal metrics were strongly redundant and most of the variation (81-91%) associated with thermal regimes could be summarized by 3-6 orthogonal PCs. Principal component score coordinates for the PC axes were then used in a hierarchical cluster analysis to identify distinct classes of thermal regimes. Preliminary results suggest at least five classes of thermal regimes exist, which consist of temporally stable regimes associated with spring streams, high elevation mountain stream regimes characterized by strong seasonal cycles and extended winter periods with near zero temperatures, low elevation coastal regimes characterized by seasonal cycles but relatively warm winter temperatures, mid-elevation continental thermal regimes, and regimes associated with flow regulation downstream of dams and reservoirs. After classification of regimes at the 580 sites, linear discriminant analysis was used to predict class assignments based on geospatial covariates that described landscape and network conditions (e.g., elevation, stream size, annual precipitation, etc.) and resultant discriminatory functions were used to map the thermal regime categories throughout the 343,000 km network of perennial streams and rivers in the western U.S. The mountain and continental thermal regime categories were most prevalent across the west; whereas stable thermal regimes were relatively rare and coastal regimes and those associated with flow regulation were intermediate in prevalence. Results of this analysis are useful for understanding patterns of aquatic biodiversity or community structure and predicting thermal characteristics at sites which lack monitoring data. High-resolution digital maps of the thermal regime classes will be developed in association with the future publication of this work and made available as ArcGIS shapefiles at the NorWeST website (https://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html) where the water temperature dataset is also publically available.

Migration Timing of Three Salmonid Species in the Yankee Fork Salmon River

Josh Jackson[1], Jonathan Ebel[1], Riley Ariwite[1]
Shoshone-Bannock Tribes' Fish and Wildlife Department[1]
Presenter: Josh Jackson, jjackson@sbtribes.com

Migration timing is an important aspect of life history and interspecific variation provides insight into species interactions and niche requirements. We investigated the migration timing of adults of three species of salmonids into the Yankee Fork Salmon River: Chinook salmon, steelhead, and fluvial bull trout from 2012-2018 and its interaction with discharge and solar cycle. We used PIT array detections from a dual flat panel PIT array to track the timing of entry into the Yankee Fork. PIT tags were inserted into adult Chinook salmon and steelhead at the trap at Lower Granite Dam and bull trout were tagged at the Redfish Lake trap operated by Idaho Fish and Game from 2010-2012 and at Pole Flat Weir on the Yankee Fork from 2013-2017. The earliest detection of an adult steelhead (n=365) occurred on 16 March 2015 and the latest upstream migrating steelhead on 11 May 2016. River discharge better explains steelhead migrations than day of year, with over 50% of adults entering the Yankee Fork between 250 and 500 cfs and 91% of adults detected when discharge was lower than 500 cfs. Chinook salmon (n=168) enter the Yankee Fork from June - early September, with the earliest detection on 09 June 2015 and the latest on 14 September 2013 and 99% of adult Chinook entered the Yankee Fork when flows were less than 500 cfs. Bull trout (n= 470) enter the Yankee Fork from the mid-June to early-July and leave the Yankee Fork in late August and early September. Stream entry appears better explained by day of year than stream discharge. We further investigate how body size influences entry into the Yankee Fork.

Returning Eggs to Travel: Evaluating the Efficacy of the Shoshone-Bannock Tribes' Egg Supplementation Efforts in Panther Creek, Idaho

Keats Conley[1], Lytle Denny[1], Rebecca Croy[1], Joseph Snapp[1], Ethan Tendore[1]
Shoshone-Bannock Tribes' Fish and Wildlife Department[1]
Presenter: Keats Conley, kconley@sbtribes.com

Panther Creek, a 4th order tributary of the upper Salmon River, is an aboriginal fishing area for the Shoshone and Bannock peoples. A band called the "Agai dika" or 'salmon-eaters' depended upon salmon as a principle food resource. Although historically Panther Creek supported a run of up to 2,000 salmon spawners, its spring/summer Chinook Salmon population was extirpated by the 1970s due heavy metal contamination from mining activities. The precipitous decline of Chinook Salmon populations has severely constrained fishing opportunities for Shoshone-Bannock Tribal members. To contribute to recovery of Chinook Salmon in Panther Creek, the Tribes supplement the system by incubating eyed-eggs in remote site incubators (RSIs). RSIs are a low-cost, low-technology alternative to traditional hatchery production, but remain experimental, with scarce empirical evaluation. Here, we evaluate the efficacy of the Tribes' egg supplementation in Panther Creek using data from two broodyears (2015 and 2016). We estimate the contribution of egg supplementation to juvenile production using parentage-

based tagging to distinguish supplementation progeny from natural-origin juveniles. We examine the dispersal patterns, size and condition, and emigration timing of supplemented juveniles compared to those of natural origin. These are the first results in a long-term, mechanistic evaluation of RSIs as a supplementation method.

Fertilization of Chinook Salmon and Steelhead Eggs Using a Saline Solution for Sperm Activation

Steeve Pomerleau[1], Phil Coonts[1]
Idaho Fish and Game[1]
Presenter: Steeve Pomerleau, steeve.pomerleau@idfg.idaho.gov

The Sawtooth Fish Hatchery has commonly used regular well-water to activate sperm for Chinook salmon *Oncorhynchus tshawytscha* and steelhead *Oncorhynchus mykiss* eggs fertilization. However, literature suggests that the use of a saline solution for sperm activation can improve fertilization rates in numerous salmonid species. The objective of this study was to evaluate a 0.85% saline solution for sperm activation on fertilization rates of Chinook salmon and steelhead eggs. The effect of a 0.85% saline sperm activating solution on eye-up rates was evaluated and compared to common well water during three spawning seasons at the Sawtooth Fish Hatchery (2014 and 2015 Chinook seasons and 2015 steelhead season). On each spawning day, approximately the first half of the egg takes were fertilized in a saline solution and the second half were fertilized in well water. There were no significant differences ($P > 0.05$) in eye-up rates between the saline and no-salt treatments for Chinook salmon on either year tested. However, eye-up rates of steelhead fertilized in a 0.85% saline solution was significantly greater ($P < 0.001$) than eggs fertilized in regular well water. Results suggest that the use of a 0.85% saline solution during steelhead egg fertilization can improve eye-up rates by 3.4 percent. However, despite observing a 0.4% improvements in the average eye-up rates of Chinook salmon fertilized in a saline solution during both spawning seasons, the differences were not statistically significant. However, the power of those t-test analyses were very low (18-27%). The power of the statistical analysis could be improved with a paired-sample experimental design, where each Chinook spawn would be subjected to both treatments.

Evaluating the Relationship between In-Stream Habitat and Salmonid Densities within the Salmon River Basin, Idaho

Amber Young[1], Curtis Roth[1]
Idaho Fish and Game[1]
Presenter: Amber Young, younga9316@gmail.com

Natural Resource agencies spend millions of dollars each year improving habitat in cold-water river basins for salmonids. However, funds for restoration efforts are limited so efforts must be prioritized so that the maximum benefit is achieved with the available funding. Because of these limitations, it is important to understand what habitat factors provide the most benefit to the fishery when designing restoration projects. Therefore, snorkel surveys were conducted in stream reaches throughout the Salmon River Basin, Idaho, during June-August 2018 to estimate salmonid densities. Following snorkel surveys, in-stream habitat data were collected within each stream reach (i.e., temperature, gradient, dominate cover type, substrate composition, and mesohabitat composition). Generalized linear models were then constructed to evaluate the relationship between habitat factors and salmonid densities. Models were then compared using Akaike Information Criterion corrected for small sample size. Additionally, the sum of the Akaike weights for all models in which a given predictor variable was present was used as a measure of relative importance for each habitat factor. This study will provide managers with insight into the relationship between habitat characteristics and salmonid densities and help guide future habitat restoration projects.

Examining Long-Term Trends in Abundance of Juvenile Salmonids in South Fork Clearwater Tributaries

Hunter Distad[1], Brian Knoth[1], Jason Fortier[2], Allison Lebeda[2]
Idaho Fish and Game[1], Pacific States Marine Fisheries Commission[2]
Presenter: Hunter Distad, hmdistad@gmail.com

Understanding long-term trends in the abundance of juvenile salmonids in Idaho streams is important for both resident fish management as well as Endangered Species Act (ESA) recovery. American, Crooked, and Red rivers are tributaries to the upper South Fork Clearwater River, and they support populations of native and non-native juvenile salmonids. Furthermore, these tributaries also contain populations of Steelhead *Oncorhynchus mykiss* and Bull Trout *Salvelinus confluentus* which are listed under the ESA. We examined a long-term (1986 – 2016) snorkel dataset to assess trends in abundance of five juvenile salmonid species within each tributary and examined relationships across the drainages. Sampling effort was not consistent across space and time; therefore we developed criteria to reduce the effects of sampling effort variability. In general, mean juvenile densities were the highest in American River and lowest in Crooked River. Species composition was relatively similar between American and Red rivers and was dominated primarily by Mountain Whitefish *Prosopium williamsoni* and Bull Trout. Whereas, Crooked River was characterized by higher densities of Westslope Cutthroat *Oncorhynchus clarki lewisi*. Abundance trends of juvenile Steelhead were relatively similar across tributaries, most notably a steady decline in abundance since late-1990's and

early-2000's. Similarly, Mountain Whitefish populations declined in abundance across all tributaries over the same timeframe. Trends in the abundance of native Bull Trout and non-native Brook Trout Salvelinus fontinalis (potential competitor) were not consistent across tributaries and warrant further investigation. Correlation analyses will be used to examine the strength of relationships across the tributaries. Data from the project will allow managers to accurately assess the status of these populations. In addition, population trend data could be useful in assessing the future impacts resulting from ongoing habitat restoration efforts in these waters.

Shared Waters: Utilizing Scales to Distinguish Rainbow Trout from Steelhead in Idaho Streams

Tyler Zumwalt[1], Matt Campbell[2], Jesse McCane[1], Micah Davison[1], Carlos Camacho[2], Karen Gregory[1], Leslie Reinhardt[1]

Pacific States Marine Fisheries Commission[1], Idaho Fish and Game[2]

Presenter: Tyler Zumwalt, tyler.zumwalt@idfg.idaho.gov

In many streams throughout Idaho, steelhead *Oncorhynchus mykiss* (anadromous Rainbow Trout) cohabitate with residential Rainbow Trout before steelhead outmigration. During this phase, the collection and processing of biological samples is an effective tool for gaining accurate ageing information. However, there is possibility for misidentification during collection, due to difficulties in distinguishing resident Rainbow Trout from steelhead. In order to evaluate a potential method of distinguishment, the validity of using growth pattern recognition in scales as a method to differentiate *O. mykiss* life history variances was assessed, using genetic analysis of tissue samples as the validation method. At five different Idaho streams, scale and tissue samples were separately collected from 63 fish initially identified as steelhead. During scale processing, with three experienced agers, these fish were classified as potential resident Rainbow Trout, by identifying distinct scale growth patterns and comparing these patterns to historical steelhead samples. For validation of this method, DNA was extracted from tissue samples of these fish for genetic analysis. After extraction, DNA was genotyped with single nucleotide polymorphism (SNP) marker panels to locate specific DNA sequences. Locating these sequences ultimately allows the *O. mykiss* life history to be determined for each individual fish, confirming it as an identification method. With this genetic analysis for validation, identification assignments between the two methods can be compared to determine the accuracy of using scale growth pattern distinction as a future tool. If high accuracy is shown, this method will be an effective, validated method for differentiating resident Rainbow Trout from steelhead. Having this technique could be very beneficial for limiting misidentification and provide an additional tool for future *O. mykiss* assessments.

Improving Estimates of Abundance for ESA-Listed Wild Adult Chinook Salmon and Steelhead in the Snake River Basin

John Hargrove[1], Carlos Camacho[2], Bill Schrader[2], John Powell[2], Thomas Delomas[1], Jon Hess[3], Shawn Narum[3], Matt Campbell[2]

Pacific States Marine Fisheries Commission[1], Idaho Fish and Game[2], Columbia River Inter-Tribal Fish Commission[3]

Presenter: John Hargrove, john.hargrove@idfg.idaho.gov

Parentage-based tagging (PBT) is a non-lethal tagging method that uses the genetic profiles of a set of parents to genetically tag all resulting offspring. In hatchery supplemented fish populations this technique affords the opportunity to identify the age and stock of origin for hatchery fish sampled at large by assigning them back to PBT baselines. Chinook Salmon *Oncorhynchus tshawytscha* and steelhead *O. mykiss* in the Snake River basin are classified as threatened under the Endangered Species Act (ESA) and are subject to extensive hatchery supplementation efforts. To date, PBT technology has been successfully implemented in the Snake River and Columbia River basins to monitor harvest and straying, and manage associated hatchery broodstock. In the current study, we show that results from PBT can also greatly improve the accuracy of abundance estimates of wild-origin adult Chinook Salmon and steelhead in the Snake River Basin. Whereas historical abundance estimates have relied upon the use of physical marks (e.g., mechanical tags or clipped adipose fin) to quantify returns of hatchery and wild origin individuals, PBT techniques identified that between 2013-2017, an average of 20.4% of Chinook Salmon and 9.4% steelhead identified as wild based on phenotype were actually of hatchery origin. Therefore the incorporation of PBT analysis serves as a valuable tool to improve abundance estimates and to reduce potential bias in run-reconstruction and ESA viability assessment efforts.

Mapping the Foodscape for Drift-Feeding Salmonids Identifies Spatial and Temporal Scales of Resource Exploitation

Hope Owens[1], Ernest Keeley[1]

Idaho State University[1]

Presenter: Hope Owens*, owenhope@isu.edu

The degree to which salmonids acquire energy through different foraging modes are largely unknown. The predominant paradigm of energy intake for stream-dwelling salmonid fishes is to acquire food by maintaining a foraging position in the

stream current and capturing invertebrates drifting past their feeding station. As visual predators, salmonids are also commonly thought to be diurnal foragers, feeding during daylight hours when drift can be observed and targeted in the water column. However, some studies suggest that salmonids may acquire energy using alternative feeding modes, such as benthic, surface, and nighttime feeding, which could comprise a significant component of their energy budget. This research set out to examine the contribution of alternative feeding modes in salmonid energy budgets using a combination of videography and computer software. Research was conducted in three first order streams in the Portneuf River of Southeastern Idaho, USA, that contain genetically pure populations of cutthroat trout. Using a combination of videography and computer software, cameras were programmed to film 10-minute intervals, each hour, over a 24 hour period and throughout two summer-to-fall growing seasons. An infrared light source was used to observe and record nocturnal foraging behavior. Diurnal drift foraging was found to be the predominant behavior used to acquire food source in salmonid energy budget. However, some departures were seen, with benthic and nocturnal foraging occurring at a moderate level at different times of the year. These findings suggest that while cutthroat trout primarily acquire energy during daylight hours, they have an ability to alter their foraging behavior under environmental changes in temperature and drifting invertebrate abundance.

Contrasting Isotopic Niche Size and Overlap of Native and Non-Native Salmonids in a Large River

Nick Birmhingham[1], Jon Flinders[1]
Idaho Fish and Game[1]
Presenter: Nick Birmingham, nickbirmhingham@icloud.com

The largest fluvial population of native Yellowstone Cutthroat Trout *Onchorhynchus clarki bouvieri* in Idaho occurs in the South Fork of the Snake River. Non-native Rainbow Trout *Onchorhynchus mykiss* and Brown Trout *Salmo trutta* may impact Yellowstone Cutthroat Trout population through integration and competitive interactions in the South Fork. We used isotopic niche size and overlap to investigate the potential for resource competition for two size classes (small >250mm and large <250mm) of Brown Trout, Rainbow Trout, and Yellowstone Cutthroat Trout. Rainbow Trout exhibited the broadest niche size (SEAc 1.30 and 1.99), whereas niche size was narrowest for Yellowstone Cutthroat Trout (SEAc 0.04 and 0.56) suggesting a very specialized diet. Brown Trout occupied the highest trophic position, indicating a shift to increased piscivory with size. Stable isotope analysis showed high overlap between Yellowstone Cutthroat Trout with Rainbow Trout and Brown Trout for both size classes. The high degree of niche overlap suggests Yellowstone Cutthroat Trout may be susceptible to competition with other salmonid species in the South Fork, if resources are limited. Future studies aimed at examining resource availability (e.g. invertebrates, sculpin) may increase knowledge regarding resource competition in the system and aid current management focused on reduction efforts of non-native Rainbow Trout.

Measuring Aggressive Foraging Behavior and Competition of Invasive Juvenile Brook Trout with Juvenile Cutthroat Trout

Ryan Whitworth[1], Ernest Keeley[1]
Idaho State University[1]
Presenter: Ryan Whitworth, whitrya2@isu.edu

Understanding the mechanisms behind competition between native and invasive species is imperative because it could be a crucial driver in the decline of the native species. This could be the case between two freshwater fish species; the cutthroat trout and the brook trout. Determining the mechanisms of competition between freshwater fish species like cutthroat trout and brook trout can be difficult to examine because of the medium in which they live. Using videography to examine fish foraging behavior in a laboratory environment provides an efficient way study and quantify fish competition. We used young-of-the-year cutthroat trout and brook trout to conduct pairwise competition trials in a modified aquarium with a glass viewing window. Competitors were size matched and then held in the experimental aquarium for a 24-hour acclimation period. After this period they were then introduced to the arena portion of the tank. Trials were filmed for a period of 5-minutes. We recorded the total number of aggressive acts, total time in the dominant foraging position, and the total number of food items captured by both individuals. Using these methods, we will be able to assess how intense competition is between these two species at very early life stages. This information could help us gain new insights into the possible mechanisms that allow brook trout to out-compete cutthroat trout in headwater streams.

Distribution, Abundance, and Habitat Use of Westslope Cutthroat Trout in the St. Maries River Basin

John Heckel[1], Michael Quist[2], Carson Watkins[3], Andrew Dux[3]
University of Idaho[1], U.S. Geological Survey – Idaho Cooperative Fish and Wildlife Research Unit[2],
Idaho Fish and Game[3]
Presenter: John Heckel*, heck5910@vandals.uidaho.edu

The St. Maries River basin is located in northern Idaho and is a major component of the Coeur d' Alene Lake system. Westslope Cutthroat Trout *Oncorhynchus clarkii lewisi* (WCT) are known to inhabit headwater streams and use the mainstem of the St.

Maries River during spring as a migration corridor to spawn throughout the watershed. Although WCT are known to occupy portions of the St. Maries River basin, assessments of distribution and abundance have not been conducted since the 1980s. Furthermore, habitat characteristics related to their distribution and abundance have not been conducted. Our objectives were to provide a foundational understanding of WCT distribution and abundance in the mainstem and tributaries of the St. Maries River, and to evaluate how the distribution of WCT in tributaries of the St. Maries River was related to habitat characteristics. Boat electrofishing was conducted in 92 reaches of the St. Maries River. Fish and habitat characteristics were sampled from 68 reaches in 35 different tributaries in the St. Maries River basin. Nonparametric analyses were conducted to investigate WCT distribution and abundance in the mainstem of the St. Maries River. Regression modeling was used to predict the occurrence and abundance of WCT related to habitat characteristics in tributaries of the St. Maries River. Results from this study will inform fisheries management decisions, as well as fill critical knowledge gaps pertaining to WCT distribution related habitat associations.

Spawning Migration Timing of Yellowstone Cutthroat Trout and Native Suckers in the South Fork Teton River, Idaho

Drew Suchomel[1], Brett High[2], Eric Billman[1]
Brigham Young University – Idaho[1], Idaho Fish and Game[2]
Presenter: Drew Suchomel*, drew@suchomel.com

The primary objective of this study was to determine characteristics in the spawning run of fluvial Yellowstone Cutthroat Trout in the South Fork Teton River. A secondary objective was to assess spawning runs and upstream movement of other native and nonnative species in South Fork Teton River. We installed and operated a fish trap in the South Fork Teton River's existing fish ladder from 29 March to 14 June 2018. We collected, measured, and sampled for genetics a total of 378 Yellowstone Cutthroat Trout, 52 of which were considered mature (>350mm). Yellowstone Cutthroat Trout were captured across the entire sample period; however, 97% of Yellowstone Cutthroat Trout, including all mature fish, were captured between 7 April and 18 May. We captured 14 Rainbow Trout, with only 6 fish being considered mature (>350 mm). We captured 28 other non-spawning salmonids consisting of Brook Trout, Brown Trout, and Mountain Whitefish. We captured 1,207 mature Utah Sucker with 1,000 Utah Sucker captured between 7 April and 8 May. We captured 35 mature Bluehead Sucker from 22 April to 5 June. The number of mature Yellowstone Cutthroat Trout was similar to total captured in 1995 and 1999 suggesting the population status is similar to its status 20 years ago. Low abundance of Rainbow Trout suggests the concern for hybridization with Yellowstone Cutthroat Trout is low for this population. Run timing of Utah Sucker and Bluehead Sucker appear to be separated temporally with Utah Sucker spawning earlier than Bluehead Sucker. Continued monitoring of fish movements at the fish trap in the South Fork Teton River will provide essential information for managing Yellowstone Cutthroat Trout in the South Fork Teton River as well as for Bluehead Sucker, another species of conservation concern.