2017 AFS/TWS Joint Conference

ABSTRACTS

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INVESTIGATING PATTERNS OF VULNERABILITY AND ADAPTIVE CAPACITY TO GLOBAL CHANGE – INSIGHTS FROM THE CLIMATE-SENSITIVE AMERICAN PIKA AND BEYOND. The paleorecord suggests that numerous species have persisted through several mass-extinction events associated with glacial-interglacial cycles. Sharp increases in predicted rate of temperature change through 2100 have been suggested to be 10,000-100,000 times faster than the rate of niche evolution observed in the paleorecord; however, both paleo- and contemporary species responses to climatic variability have been very diverse. Results of 23 years of recent and ongoing research on a climate-sensitive montane mammal (the American pika) illustrate numerous take-home messages of how species are responding to contemporary global change – both in terms of local distributional losses and of surprising exceptions to the 'rules'. I will use examples from across Idaho, the hydrographic Great Basin, and the western USA to illustrate weather-stress and refugial dynamics at multiple scales. Fundamental to all this work – because it is the key to informing climate-adaptation management and conservation actions – is research into how and why species and communities are responding. Without such understanding of mechanisms, management and conservation of natural resources in an era of global change may be relegated to trial and error. I will end with a brief synopsis of the taxonomic, climatic, geographic, and life-history contexts in which species have exhibited behavioral ability to accommodate acute and chronic weather stresses.

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HOW DO WE PREPARE? CLIMATE PLANNING AND ADAPTATION STRATEGIES IN IDAHO'S STATE WILDLIFE ACTION PLAN. Climate change is expected to have widespread global and regional effects on temperature and precipitation regimes by the end of the century. Conditions in the Pacific Northwest are expected to trend toward hotter drier summers and warmer wetter winters, increasing the vulnerability of Idaho's forests to insect and disease outbreaks, exacerbating wildfire scope and severity, and creating conditions that lead to larger and more intense rangeland fires in sagebrush steppe systems. In addition, the predicted decrease in snowpack depth and persistence has implications for species and ecosystems dependent on more predictable snowpack and mesic conditions. Considering the potential impacts to Idaho's wildlife and the habitats they depend on, climate adaptation strategies to address these impacts will be discussed. In this presentation, we will describe some of the challenges that climate change presents to conservation in Idaho, how we incorporated climate change into the recently completed 10-year revision of the Idaho State Wildlife Action Plan, and discuss ways to adaptively manage wildlife in a changing climate.

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HOW CAN WE BEST USE CLIMATE AND CONSERVATION SCIENCE TO GUIDE MANAGEMENT DECISIONS THAT BENEFIT WILDLIFE POPULATIONS AND HABITATS? In 2009, Secretarial Order 3289 (Interior) established 8 regional Climate Science Centers (CSC) and 22 Landscape Conservation Cooperatives (LCC) to, "work with other federal, state, tribal, and local governments and private landowner partners to develop landscape level strategies for understanding and responding to climate change impacts." The Order recognized that climate-driven changes would likely affect ecosystem function, structure and composition – including wildlife populations and biodiversity – in ways that no single management entity could effectively counter by themselves. We have collectively become well-aware that confounding ecological changes like invasive species spread, fire-regime change, and shifting and expanding land uses are also occurring at spatial and temporal scales that demand a coordinated, inter-jurisdictional approach if we are to mitigate for and adapt to these pervasive stressors. LCCs and CSCs embarked on approaches to convene and coordinate with partners, strategize around needed science and capacity, and find and leverage resources to fund applied research and seek coordinated implementation. Now, eight years and three Secretaries later, the need continues to be recognized and a suite of cross jurisdictional programs and partnerships are effectively working to address the need across Idaho and the region. The Great Northern and Great Basin LCCs and the Northwest Climate Science Center have committed significant resources to their partners to help move us forward as a community of natural resource managers and conservation practitioners. This presentation will review the approach these partnerships have taken, present a few case examples of effective research-informed decision-making relevant to Idaho wildlife, and highlight continuing and emerging needs for application of landscape conservation and climate adaptation science and action.

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USING BIG INTERAGENCY DATASETS TO IDENTIFY CLIMATE REFUGIA FOR IDAHO'S AQUATIC SPECIES. Ongoing climate change this century will cause species distributions to shift and may sometimes result in the local extirpation of populations. Spatially precise forecasts regarding which habitats may continue to host populations and serve as longterm climate refugia are critical for effective conservation planning and investment strategies. Huge temperature and biological survey datasets have been collected in previous decades by dozens of natural resource agencies and small research teams can integrate these data to develop synthetic databases that may be used to predict high-resolution climate scenarios and species distributions across broad areas. Provision of these model predictions as geospatial databases and user-friendly digital maps through custom websites enables wide distribution of the information so that conservation community members are empowered to coordinate their actions, protect key habitat areas, and establish robust monitoring networks. Success stories will be shared from the Climate Shield project (website: http://www.fs.fed.us/rm/boise/AWAE/projects/ClimateShield.html), which has implemented this basic approach for native Cutthroat Trout and Bull Trout in all streams across Idaho and their native ranges throughout the American West. The Climate Shield approach could be applied to many climatically sensitive species and geographic areas because it mines existing temperature and biological datasets, creates a framework to integrate data contributed by many individuals and

resource agencies, and a process that strengthens the collaborative and social networks needed to preserve many populations and species through the 21st century.

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SUSTAINING AMERICA'S DIVERSE FISH AND WILDLIFE – A CALL TO ACTION. The Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources has recommended that Congress dedicate up to $1.3 billion annually in existing revenue from the development of energy and mineral resources on federal lands and waters to the Wildlife Conservation Restoration Program. These funds would provide states with the resources needed to implement State Wildlife Action Plans which are designed to conserve 12,000 species in greatest conservation need. The funds should be dedicated to the existing, but unfunded, Wildlife Conservation Restoration Program. The Wildlife Conservation Restoration Program provides financial assistance to the States under the Federal Aid in Wildlife Restoration Act (PR) for the benefit of all wildlife including species that are not hunted or fished. The program would allocates funds using a formula, requires nonfederal match and provides states with the flexibility to also implement programs that help people learn about and access fish and wildlife for wildlife viewing, photography and other passive forms of recreation. Idaho's share of this funding is estimated at $13,000,000 annually. Action is needed by all professionals to help with this most important fish and wildlife conservation funding expansion in this century.

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GEOLOGICAL PERSPECTIVE OF CLIMATE IN IDAHO. Temperatures on earth are increasing. In order to understand the drivers, extent, and impacts of recent anthropogenic climate change, we examine the natural drivers of climate change on geologic timescales. Over millions of years, our climate has changed in response to movements in the Earth's tectonic plates, changes in the shape of the Earth's orbit, and other natural drivers. Over long timescales, these natural drivers change the storage of carbon within the Earth's carbon cycle, drive glacial and interglacial cycles, and alter natural feedbacks within the Earth's system. Understanding these natural controls on the Earth's climate is essential to understanding how in recent times, people have altered carbon storage, and contributed to changes in the Earth's climate. How has past and ongoing climate change influenced Idaho's forests, rangelands, and aquatic ecosystems? We take a closer look at a primary mechanism of disturbance in Idaho and the western USA: wildfire. Fire is a primary mechanism of disturbance, and examining past records of fire within Idaho's ecosystems provides a direct example of interactions among climate, fire, vegetation, and geomorphic response over recent to millennial timescales.

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IDAHO'S CHANGING CLIMATE - A SUMMIT. A Summit on Idaho's Changing Climate will be held in December 2017. The goal of the Summit is to facilitate the most inclusive discussion around

changing climate in the history of the Gem State. The Summit will bring together Idaho leaders in business, science, conservation and communities to shine a light on what actions are being taken now to address Idaho's changing climate and build solutions and collaborations that help address the impacts of a changing climate on the lives of Idahoans. The summit will address major topics including increased wildfire, decreased snowpack, changing growing seasons and other changes that affect Idaho businesses, natural resources, economies, values, and way of life. The primary purposes of the Summit are to 1) increase understanding of how changing climate is affecting Idaho resources, business, economies, communities, and people; 2) learn about changing climate solutions and actions already being taken in Idaho by Idahoans; and 3) build collaborative climate solutions and adaptations that are Idaho-based, Idaho-driven, and Idaho-focused. The Idaho's Changing Climate Summit will produce the following outcomes: 1) interviews with leaders working on climate change, 2) interviews with Idahoans about climate change and their perspective on it, 3) a compilation of climate science and climate change effects on Idaho's resources, 4) incorporate climate change challenges and solutions into school discussions before and during the Summit, and 5) a Summit Report with short, medium, and long term actions for Idaho to better adapt to the effects of climate change consistent with Idaho values and needs. The public will be invited to attend any portion or all of the entire Summit. The Summit will be streamed live on the internet and will be held simultaneously in different locations across the state to engage discussions and people statewide.

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PERSONAL OBSERVATIONS ON THE EVOLUTION OF THE COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM. From the inception of the Columbia River Basin Fish and Wildlife Program (Program) in the early 1980's to the present, it's funding, implementation, review and oversight of program areas and projects has changed greatly. When I joined Bonneville Power Administration's (BPA) Fish and Wildlife Group in 1987, the Program expense budget was approaching $30M, lacked a formal project solicitation and review process and was devoted mainly to anadromous fish, including hatcheries, and mainstem Columbia hydro research projects with a few resident fish substitution and mitigation projects funded. The Wildlife Rule was initiated in the Program by the NW Power Planning Council at that time, giving clarity to BPA for implementation of wildlife mitigation on a 1:1 basis implemented primarily through land purchases or leases. Endangered Species Act listings of anadromous fish in the early 1990's shifted Program mitigation efforts more closely to those populations. Today the Program incorporates an independent scientific review process for projects, transparent decision-making, incorporates settlement agreements between BPA and project sponsors (mostly States) for wildlife mitigation, and with a greater focus on results. The Program today has provided immense benefits for fish and wildlife across the region, now funded at roughly ten times its 1987 level, almost $300M, including an additional and variable amount of capital funding for qualified hatchery, large irrigation screens, and land acquisition projects, is facing intense pressure from climate change and other stressors, great scrutiny from utility ratepayers, and tough funding challenges for its future. The regional fish and wildlife managers, including the Columbia Basin Tribes, continue to contribute their recommendations, expertise and judgment, towards the success of this critical natural resource Program.

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TANGLED WEBS: SCIENCE AND STEWARDSHIP OF FISH AND WILDLIFE IN THE CONTEXT OF LINKED AQUATIC-TERRESTRIAL FOOD WEBS. In keeping with the overall theme of the joint AFS-TWS meeting, this special session is focused on the science and stewardship of fish and wildlife in the context of aquatic-terrestrial connections. Here, I introduce the session and present research that demonstrates how: a) terrestrial and aquatic food webs are linked, b) these linkages connect the ecology of fish and wildlife populations (often in surprising, indirect ways), and c) tangled webs of aquatic-terrestrial interactions couple fish and wildlife in their responses to natural disturbances and anthropogenic changes like habitat degradation, species additions or losses, and changing climate. For example, land and water are connected by reciprocal fluxes of invertebrates. Inputs of terrestrial invertebrate prey are often important to fish populations, emergence of adult aquatic insects serve as prey for terrestrial predators, and the seasonal asynchrony of these fluxes may mean that more diverse and productive assemblages of fish and wildlife can be sustained by prey from both of these habitats than could be fueled by either alone. Thus, anything that alters these fluxes can have impacts that reverberate between land and water. In Idaho, our studies have shown such "tangled web" responses to natural processes like wildfire and returns of adult salmon, leading, for instance, to responses by fishes and bats that are indirectly coupled. We have also shown how degradation of

aquatic habitat or the introduction of nonnative salmonid fishes can reduce aquatic insect emergence, with negative consequences for terrestrial wildlife. Reciprocally, changes in terrestrial food web dynamics, such as those attributed to the restored presence of wolves in our region, appear to alter stream-riparian habitat, with potential indirect implications for fish populations. An increasing array of evidence from our region points to the dynamics of fish and wildlife being entangled by a web of relationships spanning the aquatic-terrestrial divide.

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EFFECTS OF FIRE AND CLIMATE CHANGE ON CHANNEL MORPHOLOGY AND SALMONID HABITAT IN MOUNTAIN BASINS. Mountain basins of western North America provide a diverse array of physical habitats for aquatic organisms and are influenced by natural and anthropogenic disturbances. Here, we present several vignettes, illustrating dynamic biophysical responses to wildfire and climate change in watersheds of central Idaho. We focus on potential impacts to salmonids due to their threatened and endangered status and the resources expended on restoring and managing salmonid habitat. Results indicate that (1) basin sediment yields will increase over the next few decades in response to wildfire, (2) steep, confined rivers are directly impacted by fire (reduced shading) and post-fire debris flows (altered morphology and loss of riparian vegetation), with uncertain response trajectories, (3) headwater rivers in unconfined valleys are aquatic refuges that are buffered from post-fire debris flows, exhibiting roughly constant channel morphology and wood loading with time after fire despite riparian burning, (4) mainstem rivers receive post-fire pulses of sediment and wood from tributaries, producing debris fans (immediate spawning habitat) and waves of downstream gravel transport (spatially and temporally variable habitat), and (5) climate-related increases in streamflow increase the risk of scour and mortality of incubating salmonid embryos, with risk muted by overbank flows in lower-gradient unconfined valleys (Chinook and steelhead habitat) and amplified in steeper, confined valleys (bull trout habitat). Results emphasize that location matters (affecting disturbance style and potential ecological impacts) and that effects of a given disturbance are species-specific, depending on habitat preferences and phenotypic expression. Consequently, managing for disturbance requires case-by-case analyses for given species and physiographic regions. While disturbance can cause damage to plants, animals, and human infrastructure, it has important ecological benefits; salmonids have evolved with landscape disturbances and show adaptation to them. A critical unknown is whether adaptation can keep pace with future rates of disturbance, particularly for diminished, fragmented, or less-mobile populations.

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KODIAK BROWN BEARS USE SALMON LIFE HISTORY DIVERSITY TO INCREASE SALMON CONSUMPTION: DIRECT EVIDENCE FROM GPS COLLARED BEARS. Over the last decade, Ecosystems Based Fisheries Management (EBFM) has emerged as an alternative to single species fisheries management. One of the goals of EBFM is recognizing and mitigating indirect effects of fisheries management on trophic interactions. Most research on indirect effects has considered how the abundance of managed fishes influences trophic interactions with other species. However, recent work has shown that attributes besides abundance, such as life history diversity, can strongly mediate species interactions. For example, phenological variation within prey species may enhance foraging opportunities for mobile predators by increasing the duration over which predators can target vulnerable life stages of prey. Here, we present direct evidence of individual brown bears exploiting variation in sockeye salmon spawning phenology by tracking salmon runs at two scales: along a single spawning stream and across a 2,800 km2 region of Kodiak Island. At the local scale, data from time lapse cameras show bears tracking salmon spawning from the upper to lower sections of a tributary. At the regional scale, data from 40 GPS collared brown bears show bears visited multiple spawning sites in synchrony with the order of spawning phenology. The average time spent feeding on salmon was 67 days, while the average duration of spawning for one population was only 40 days. The number of sites used was correlated with the number of days a bear exploited salmon, suggesting phenological variation in the study area, rather than salmon abundance per se, constrained bear access to salmon. These results suggest fisheries and land managers attempting to maintain aquatic-terrestrial linkages should focus on maintaining habitat complexity, population diversity, and life history diversity rather than focusing solely on the abundance of interacting species.

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NEW SCIENCE SINCE FEMAT IN 1993: IMPLICATIONS FOR AQUATIC CONSERVATION ON FEDERAL FOREST LANDS OF THE PACIFIC NORTHWEST. Twenty-three years have elapsed since a major science synthesis and planning effort (FEMAT 1993) led to adoption of the Aquatic Conservation Strategy (ACS) of the Northwest Forest Plan in 1993. The plan adopted a precautionary framework to protect and restore riparian and aquatic ecosystems on Pacific Northwest federal forests and ensure that forest management plans achieved legally required and socially desired multiple use objectives, including protection of water quality and aquatic biota. We reviewed relevant science emerging since 1993 to assess the scientific adequacy of existing and proposed aquatic protections. We found that observed and anticipated effects of climate change and cumulative anthropogenic stressors on both federal and adjoining nonfederal forests indicate a need to strengthen and expand several key ACS protections. Soil and slope disturbance from mechanized thinning and fuels reduction, especially within Riparian Reserves, are likely to cause adverse watershed impacts that generally

negate or exceed presumed restorative benefits. Headwater streams warrant wider riparian forest buffers to reduce near-channel erosion, protect stream temperatures and ensure effective retention of sediment and nutrients derived from upslope logging, fire, landslides, and anticipated effects of climate change. Widespread and sustained ecological harm caused by roads necessitate stronger measures to arrest and reduce road impacts in all catchments. Research increasingly shows how roads, grazing, mining, post-fire salvage logging, thinning, water withdrawal, and aerial application of toxic chemicals can cause acute and chronic, often sustained harm to aquatic ecosystems in ways not fully considered by FEMAT. Moreover, a complex, regional web of conservation agreements for nonfederal lands and waters explicitly depends on successful implementation of the NFP and ACS on federal lands sustained over many decades. To ensure conservation success for aquatic resources, we conclude standards, guidelines and land allocations will need to be strengthened to more effectively control adverse impacts of forest management.

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IDAHO DEPARTMENT OF FISH AND GAME PERSPECTIVES ON THE NORTHWEST POWER ACT AND THE COLUMBIA BASIN FISH AND WILDLIFE PROGRAM. The 1980 Northwest Power Act addresses the impact on fish and wildlife of hydroelectric dams on the Columbia River. The Act established the Northwest Power and Conservation Council and directed the Council to adopt a program to protect, mitigate and enhance fish and wildlife on the Columbia River and its tributaries while assuring the Pacific Northwest an adequate, efficient, economical and reliable power supply. The Act directed the Council, in developing its Fish and Wildlife Program, to take into consideration the views of state agencies, tribes and energy customers in the region. The Act also directed the Bonneville Power Administration to provide funding for the Council's Fish and Wildlife Program. The Idaho Department of Fish and Game (Department) has participated in the development and implementation of the Council's Fish and Wildlife Program since the mid-1980s. Currently, the Department puts approximately $12M of Fish and Wildlife Program mitigation dollars on the ground annually. In my presentation, I will 1) describe the nature of the working relationship between the Department and the Northwest Power and Conservation Council; 2) review the suite of mitigation programs implemented by the Department to benefit State fish and wildlife resources; and 3) review additional mitigation measures implemented by the Department associated with the 2008 signing of the Columbia Basin Fish Accords – agreements between the sovereigns and Bonneville designed to supplement biological opinions for listed salmon and steelhead and the Northwest Power and Conservation Council's Fish and Wildlife Program.

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UPPER COLUMBIA UNITED TRIBES PERSPECTIVE – WILDLIFE MITIGATION AND THE NORTHWEST POWER ACT. The UCUT describes the five tribes that are unified to protect, preserve, and enhance Treaty and Executive Order Rights, Sovereignty, Culture, Fish, Wildlife, Habitat and other Interests of common concern in their respective territories through a structured process of cooperation for the benefit of all people. The UCUT perspective is that there are no "wildlife settlement agreements", that the losses contemplated and specified by the Northwest Power Act are losses into perpetuity - so long as the impacts of those losses exist. And, that the tribes desire to mitigate Construction and

Inundation Losses; along with the impacts from continual operations of the Columbia River Power System, for the benefit of all.

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PERSPECTIVES FROM THE REGIONAL AGENCY ESTABLISHED BY THE NORTHWEST POWER ACT ON THE HISTORY AND IMPLEMENTATION OF THE ACT, THE COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM, TND THE NORTHWEST POWER PLAN. The Northwest Power Act of 1980 established the Pacific Northwest Electric Power and Conservation Council. The Act directs the Council to develop the Columbia River Basin Fish and Wildlife Program, based largely on the recommendations of the state and federal fish and wildlife agencies and the region's Indian tribes. The Act also directs the Council to develop a regional conservation and electrical generation plan, with a priority on cost-effective investments in energy efficiency. The federal agencies that manage, operate and regulate the hydroelectric facilities on the Columbia and its tributaries have legal obligations toward the Council's fish and wildlife program and power plan, with the Bonneville Power Administration having a particular obligation to use its funds and authorities to take actions consistent with both. I will provide a perspective from his work with the Council on the history and impact of the Northwest Power Act, the Columbia River Basin Fish and Wildlife Program, and the Council's Power Plan in Idaho and the Pacific Northwest. The talk will touch on the history, premises and relevant provisions of the Act; the history and current status of the Fish and Wildlife Program and its implementation over the 37 years the Act has been in place, concluding with comments about current issues and challenges.

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FISH AND WILDLIFE CONSERVATION IN IDAHO'S CANAL-IRRIGATED LANDSCAPES: OPPORTUNITIES AND CHALLENGES. Idaho's canal-irrigated landscapes provide fish and wildlife habitat through a variety of mechanisms. Riparian habitats along canals, groundwater recharge from canal and irrigation seepage, increased aquifer storage resulting from this recharge, and re-emergence of groundwater in springs and wetlands are some of the ecological functions provided by canal irrigation. Over the past several decades, increases in irrigation efficiency have reduced aquifer recharge at the same time as groundwater pumping has increased, resulting in declines in groundwater and associated resources. Conversion of canal-irrigated lands to suburban, exurban, and resort developments not only results in loss of open space but also decreases aquifer recharge and increases groundwater withdrawals. Fish and wildlife conservation interests now acknowledge that although the ecosystems and species supported by irrigated landscapes are not necessarily native or "natural," they are sociologically, economically, and ecologically valuable. At the same time, Idaho water policy has set objectives for aquifer restoration through managed recharge, maintenance and restoration of traditional flood irrigation, and reductions in groundwater pumping. Achieving these objectives will generally benefit fish and wildlife but can also create conflict among different fish and wildlife management objectives. An example of such conflict occurred in the summer of 2016, when privately leased storage water was delivered to aquifer recharge sites, at least one of which was chosen specifically to benefit waterfowl habitat. The resulting demand on the reservoir storage system had negative consequences for some of Idaho's most important trout fisheries. To avoid these types of conflicts, fish and wildlife managers must understand the consequences of new and rapidly evolving water policies and communicate across fin-fur-feather divisions. Furthermore, conservation advocates must proactively seek market-based incentives to

help farmers cut consumptive use of water, preserve open space, and conduct managed recharge and flood irrigation when and where it has the greatest benefit.

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THE NW POWER ACT AND ITS INFLUENCE ON BONNEVILLE POWER ADMINISTRATION'S FISH AND WILDLIFE PROGRAM. The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (The NW Power Act) called for Bonneville Power Administration (BPA) to "protect, mitigate, and enhance" fish and wildlife affected by the Columbia River basin dams while providing an "adequate, efficient, economical and reliable power supply". Today, BPA continues to provide low cost, reliable power to the Northwest while managing one of the nation's largest fish and wildlife mitigation programs. In 2015, BPA directly invested more than $258 million across the Columbia River Basin to address the impacts of the federal dams. Through partnerships with federal agencies, Northwest Tribes, states, local governments, land conservancies, and other partners, BPA has improved the survival of salmon and steelhead through the eight federal dams on the Columbia and Lower Snake rivers and worked to protect and restore the habitat on which fish and wildlife rely throughout the Columbia River Basin.

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SAGE GROUSE CONSERVATION IN SOUTHERN IDAHO - LESSONS LEARNED ON THE LANDSCAPE. The Sage Grouse Initiative (SGI) is a program backed by the Farm bill aimed at improving sage grouse habitat on private lands across 11 western states. The program implements a host of practices selected by the Natural Resource Conservation Service & the US Fish and Wildlife Service. Since its inception, the SGI has grown to include a team of partner biologists strategically located across the west to further the implementation of the program. The program has expanded outside of the landowner to Natural Resource Conservation Service (NRCS) partnership to include a host of federal, state and NGO partners. Connor White and Ed Contreras will share their insight on successes with the SGI in Idaho. Including, implementing conservation practices on the landscape, and collaborating with landowners and partners to target and deliver conservation projects at a landscape scale.

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SHOOT AN ELEPHANT TO SAVE A FISH AND OTHER TALES FROM THE DARK CONTINENT. As fish and wildlife managers in Idaho we are fortunate to operate with the North American Model of Wildlife Management where the animals belong to the citizens of our state and we have vast public lands on which to access them. Across the ocean, our partners in fish and wildlife management operate under a different model where the wildlife belongs to the landowner. In recent travels my eyes were opened to how policies stemming largely from North America are influencing their ability to manage and ultimately conserve wildlife and wild places. In the volatile times of outrage about Cecil the Lion and misguided NGOs the people and wildlife of Africa deserve a better educated public. Let's take a quick trip through an African experience to learn how we can help communicate a different model of wildlife management to those stateside.

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KEEPING TRACK: A DIGITAL DATABASE TO EVALUATE CRP AND SAFE RESTORATION PRACTICES. Fields enrolled in Idaho's State Acres For Wildlife Enhancement (SAFE) and the USDA Conservation Reserve (CRP) programs are required to meet certain vegetation targets based on providing suitable wildlife habitat. SAFE explicitly targets habitat for Columbian sharp-tailed grouse, a species classified as Critically Imperiled in the Idaho Comprehensive Wildlife Conservation Strategy. Many thousands of dollars and hours of effort are put into planning and restoring SAFE and CRP fields every year, and mid-program performance monitoring is a requirement. Restoration plans are documented from the outset, but is the right information collected, and where does that data go? Diverse stands of forb-rich native vegetation are slow to develop and program terms are usually 10 years with some projects continuing even longer depending on field conditions. These timelines can make evaluating success a real challenge, and based on preliminary data from southeast Idaho, habitat delivery is variable, and often with dubious results. Despite considerable and sustained investments, we

currently have no easy way to determine the most effective restoration techniques. We propose the need for a CRP/SAFE database similar to the USGS Land Effects Digital Database, which tracks restoration of BLM lands following wildfire. Such a database would document key, up front parameters (e.g. time of seeding, equipment used, seeding rates etc.) and could allow us to evaluate future projects to tease out practices that are effective in delivering positive outcomes. Armed with this information we can begin to focus investments on practices that yield the greatest results.

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ASSESSING CHANNEL MORPHOLOGY AND POST-FIRE CHANNEL DISTURBANCE USING HIGH-RESOLUTION STRUCTURE FROM MOTION. Fire is a natural disturbance mechanism for aquatic ecosystems. Post-fire erosional processes (e.g., rilling, floods, and debris flows) transport sediment and carbon from hillslopes to streams and increase large woody debris recruitment. These terrestrial inputs to the aquatic ecosystem increase habitat heterogeneity. In the Pacific Northwest and northern Rocky Mountains, fire-related disturbances impact the headwater stream habitats of salmonids. Sediment and carbon inputs are difficult to quantify over space and time. Measuring changes to channel morphology in small mountainous streams is time-consuming and limited in resolution and scale using existing methods. Similarly, channel surveys of salmonid habitat and redd locations are logistically difficult or expensive. As a rapidly emerging tool in the study of landscapes, Structure from Motion (SfM) photogrammetry may provide a flexible new method for studying terrestrial-aquatic ecosystem interaction. More specifically, SfM can be used to assess post-fire changes to habitat structure and channel form, and quantify sediment volumes and carbon storage. SfM uses feature recognition algorithms and overlapping digital photographs to reconstruct 3D landscapes. Software converts the image sets to point cloud datasets. Previous work has demonstrated sub-cm resolution in lab settings. When combined with rigorous ground control, absolute accuracies of ~6cm are possible. Using an unmanned aerial vehicle (UAV) mounted-camera allows rapid, reach-scale surveys with SfM. SfM provides survey accuracy similar to that of terrestrial LiDAR scanners (TLS) at a fraction of the cost, and with increased flexibility in data collection. Here we apply Structure from Motion to quantify fire-related debris flow sediment inputs to the South Fork Payette drainage of Idaho. The 2016 Pioneer severely burned parts of the S.F. Payette, including habitat for the threatened Bull Trout (*Salvelinus confluentus*). Future work will investigate the impact of large woody debris and hillslope sediment on channel morphology.

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THE CAREER LANDSCAPE IS DIVERSE – ARE YOU? Federal, state, nongovernmental organizations, private-sector, and academic employers need a diverse and innovative workforce who can solve current and emerging local, regional, national, and global problems. University faculty are the front line for preparing this workforce and often the primary source of career advice for students. Yet, few faculty have experience outside the academic setting and may not be prepared to help students navigate through diverse career options. To overcome this barrier and allow graduate education to be responsive to the changing needs of diverse employers, Boise State University is creating the Expanding Pathways for Innovative Careers (EPIC) program. A core feature of the EPIC program is the formation of an advisory commission comprised of non-academic employers who provide a

broad network of career advice and training opportunities for graduate students. Outcomes of the EPIC program are as follows: Students receive insight on the current job market as well as internships to gain hands-on training from potential employers to increase their competitiveness across diverse career paths. Faculty develop meaningful connections with non-academic institutions to guide the transformation of research and educational programs that better prepare students for diverse career options. Employers gain access to a prepared workforce who can help their organizations solve current and emerging problems. This program allows employers and educators to share the responsibility of creating and preparing young professionals for innovative career paths.

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COEUR D' ALENE BASIN NATURAL RESOURCES RESTORATION: PAST, PRESENT, AND PROSPECTS. For more than 100 years, the Coeur d'Alene Basin was one of the most productive silver, lead, and zinc mining areas in the United States, producing 7.3 million metric tons of lead and 2.9 million metric tons of zinc between 1883 and 1997. The wastes generated by these operations contain hazardous metals, including lead, zinc, cadmium, and arsenic. A significant portion of these wastes were discharged into the Coeur d'Alene River and tributaries. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides a means for addressing releases of hazardous substances that may endanger public health and the environment. State, Tribal, and the Federal governments may take legal action and seek monetary damages from responsible parties for the cleanup and restoration of sites affected by mining waste. The Act provides for the designation of "Natural Resource Trustees"—Federal, State, or Tribal authorities who represent the public interest in protecting and conserving natural resources. Through a series of legal actions the named corporate defendants have settled with the Coeur d'Alene Basin Natural Resources Trustees, either separately or together, resulting in more than $140 million in restoration funds received by the Trustees from 1986 to 2011. The Coeur d'Alene Basin Natural Resource Trustees established the Restoration Partnership which includes both a Trustee Council and a Restoration Team. The Trustee Council provides administrative and policy oversight and guidance while the Restoration Team provides technical expertise. It is the intent of the restoration Partnership to work collaboratively and inclusively with both private and public stakeholders to effectively implement restoration. Our primary mission is to return our natural resources to a healthy condition by developing and implementing a restoration plan for the Coeur d'Alene Basin.

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PIMP IT: A NEW APPROACH TO HABITAT IMPROVEMENT ON PRIVATE LANDS. We aimed to incentivize landowners within a focused area of the Palouse to enroll into Farm Bill Programs in order to meet the habitat requirements of upland gamebird populations. We focused on multiple adjacent landowners, comprising >5,000 acres of prime farm ground and enhanced incentives if they enrolled into high value conservation practices such as SAFE and CCRP buffers. This was accomplished by providing a one-time payment along with an establishment and maintenance agreement to encourage five contiguous landowners to enroll 33 acres of riparian forest buffers, 15 acres of filter strips and 188 acres of SAFE within the focus area. In total, over 6 miles of stream will be buffered to provide upland game habitat, slow stream flows, cool water and decrease water

turbidity. We also collaborated with USFWS Partners Program to enhance existing associated habitat such as shruby eyebrows and existing CRP, while also working closely with NRCS to improve existing EQIP and CSP practices being implemented by the landowners. To measure our success we will conduct avian point count surveys, vegetation surveys and photo points over the next five years on this watershed and a similar adjacent untreated watershed. In collaboration with the Palouse Soil Water Conservation District in WA, a paired monitoring program is planned to be installed to measure water quality such as turbidity and nutrient/herbicide runoff by using edge of field and in stream devices on this treated drainage and an untreated drainage.

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BIOLOGY, BAYES, AND "BAD" DATA; INCORPORATING RECURRING LIFE-HISTORY CHARACTERISTICS INTO MODELS TO ADDRESS SPARSE AND MISSING MARK-RECAPTURE DATA. To understand population dynamics, it is often necessary to know the abundance of individuals. Obtaining a census of a population in a natural environment can be difficult so abundances are often estimated by counting individuals and expanding these counts by a sampling or detection efficiency. This approach is widely used to estimate abundances of juvenile anadromous salmonids in the Pacific Northwest. Rotary screw traps are passively operating sampling equipment that capture juvenile salmonids as they migrate from natal rearing habitat to the marine environment. Captured individuals are marked and a portion of marked individuals are released upstream to be recaptured during proceeding sampling days providing a trap efficiency that can be used to expand the number of unmarked individuals. Many of these salmonid populations are severely depleted and low species abundances, low trap efficiencies, and fluctuating environmental conditions can lead to sparse and missing data. To address these issues, we explain how two hierarchical Bayesian models utilize within year and between-year data to obtain more accurate estimates with sparse and missing data and how these models could be applied to various mark-recapture studies for other populations of fish and wildlife.

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CULTIVATING FUTURE NATURAL RESOURCES PROFESSIONALS AND AN ENGAGED COMMUNITY: UNDERGRADUATE RESEARCH AND CITIZEN SCIENCE-BASED COLLABORATIVES. In an era of rapid population growth and land conversion at the natural/urban interface, the need for environmentally aware citizenry within Idaho's Treasure Valley has never been greater. Climate variability and population pressures increasingly challenge natural resource professionals to adapt new approaches to monitor and manage ecological systems to remain functional under a wide-range of environmental conditions and human desires. Experiential learning at the undergraduate and citizen science level facilitates the co-identification of issues, and the co-production of knowledge. This process produces strong buy-in from participants and is transformational to the development of appropriate interventions that are supported by an engaged public. Merging undergraduate research activities with citizen science-based biological assessments produces powerful conservation and management tools by 1) providing a cost effective means to monitor biological

communities that are distributed across large areas, 2) creating opportunities to engage citizens in targeted environmental education, data collection, and in developing social networks to participate in stewardship activities, and 3) encouraging undergraduate student retention and workforce development in resilient ecosystem management. The College of Western Idaho (CWI), with the support of the Idaho EPSCoR MILES program, has developed of an undergraduate research program that utilizes undergraduate research as a vehicle to accomplish citizen science-based ecological studies. Projects within our program utilize a diversity of approaches that range from organismal indicators to biogeochemical models. Here we present the program's contributions to developing broad-based and multi-generational public involvement in local and regional conservation and environmental collaboratives. We further highlight program's successes in incorporating underrepresented and marginalized populations among undergraduate natural resources pre-professionals.

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DO SCALES PROTECT FISH FROM ELECTROSHOCK? Some biologists hold the opinion that scales protect fish from electroshock by increasing resistance to penetration of the electrical field during electrofishing. However, comparison of lightly-scaled species and heavily-scaled species is invalid because any differences in response are confounded by other species characteristics. At a fish farm along the Snake River in September 2016, I conducted a preliminary test on four Koi *Cyprinus carpio*, two with common-variant scale pattern (complete coverage) and two with mirror-variant pattern (partial coverage). Fish were exposed, one at a time, to a uniform field of 60-Hz pulsed DC in a test tank to determine electrical field intensity at immobilization threshold. One pair of koi (42-43 cm) was immobilized at 0.55 V/cm (mirror) and 0.69 V/cm (common). The other pair (48-49 cm) was immobilized at 0.39 V/cm (mirror) and 0.51 V/cm (common). Because common variants were immobilized at higher thresholds than mirror variants, preliminary results indicated that scales seem to provide electroshock protection. A rigorous experiment is planned for 2017.

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FISHY THINGS GOING ON AT UI'S HAGERMAN FACILITY. The University of Idaho's Hagerman Fish Culture Experiment Station is part of the Aquaculture Research Institute, but it's much more than a trout hatchery. As the new Director, I'm honored to oversee a top-notch hatchery, state-of-the-art genomics and physiology labs, and an internationally renowned fish nutrition program. On the University side, we've got over 11 scientists and staff focused on all things fish culture. A large part of our efforts support a collaborative research program with the USDA's Trout/Grains Selective Breeding program, which has 4 scientists and 6 technicians associated with our facility. We're also partnered with the Columbia River Intertribal Fish Commission, which has their salmon genetics program at our facility and includes 7 scientists and 9 technicians. The Hagerman Fish Culture Experiment Station has a constant throughput of students and visiting scholars which are able to take advantage of onsite dormitory housing and the diversity of expertise to address many aspects of fish culture, biology and management. The University of Idaho has a new strategic plan, new leadership, and fresh ideas. With all these changes, come opportunities for increased research, teaching, and outreach in critical fisheries areas and a deeper relationship with our state and regional partners.

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CYBERTRACKER APP DEVELOPMENT: LESSONS LEARNED AND THE ROAD FORWARD. The world of digital data capture continues to grow and many tools are available for researchers and managers. Cybertracker is one tool available that allows the custom development of an application for Android and Windows mobile or computer-based data entry in the field. Data can be linked to a central server, but data entry does not require direct connectivity improving the usability in remote areas. While many features are available, the program is fully customizable and is limited only by a user's imagination. Hopefully the development of digital data entry will spark larger conversations on the subject with developers and administrators.

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ANNA'S HUMMINGBIRDS IN IDAHO: A NEW PHENOMENON. How can a 4-gram bird survive single-digit temperatures and double-digit snowfall? Anna's Hummingbirds first began colonizing Idaho about 10 years ago, and there's no sign of them stopping. With the help of reports from citizen scientists, the Intermountain Bird Observatory has been banding Anna's since 2015 to document their overwintering patterns in the Treasure Valley. Hear an update about this project and the patterns that have emerged so far.

Abstracts are in alphabetical order by presenter's last name by category (i.e. oral, poster, etc). Student presenters are denoted by an * after their last name.

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GREATER SAGE-GROUSE NEST SUCCESS IN HIGH ELEVATION SAGEBRUSH HABITATS OF SOUTHEASTERN IDAHO. Greater sage-grouse inhabiting higher-elevation, mountain valley sagebrush habitats dominated by mountain big sagebrush (*Artemisia tridentata vaseyana*) and/or low sagebrush (*A. arbuscula*) may or may not interact with their habitat similarly to sage-grouse inhabiting the more-studied, lower-elevation sagebrush habitats dominated by Wyoming big sagebrush (*A. t. wyomingensis*), in which the current sage-grouse habitat management recommendations were primarily formed. This study used sage-grouse monitored with GPS-PTT transmitters during 2015-2016 to document nest location and success at three eastern Idaho study sites: Sand Creek desert, Lemhi Valley, and Pahsimeroi Valley. We measured vegetation composition and structure at nests and random sites using the Habitat Assessment Framework (HAF) protocol. We are utilizing these data to model nest site selection and success across and within study sites (if differences between study sites are evident) to further inform the identification and management of productive sage-grouse breeding habitat in high-elevation landscapes. Analyses for all study sites are ongoing as of the writing of this abstract, but results from the Sand Creek study area suggest high overall nest success (72%), successful nests had higher total shrub cover (50%) and forb height (13 cm) than unsuccessful nests (42% and 9 cm, respectively), successful and unsuccessful nests had similar sagebrush cover (27%), and nests occurring in >30% sagebrush cover had similar nest success to other nests. Complete results from all study sites, and their relevance to habitat management, will be presented.

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POPULATION GENETICS AND PATHOGEN TRANSMISSION FOR IDAHO BIGHORN SHEEP. Bighorn sheep (*Ovis canadensis*) have experienced severe population depletions across the western US resulting from the spread of pneumonia caused by the bacterium *Mycoplasma ovipneumoniae*. The development of effective management strategies to control this disease requires an understanding

of the mechanisms underlying pathogen transmission, as well as the drivers of individual and population susceptibility. Disease susceptibility may be influenced by population size, with smaller populations experiencing greater vulnerability due to reduced adaptive genetic variation and increased inbreeding. These negative effects of small population size may be alleviated by dispersal, which can increase within-population genetic variation, but dispersal may also increase the probability of disease transmission between herds. To investigate the relationships between genetic diversity, genetic connectivity, and disease spread for bighorn sheep, we examined the population genetic structure of this species for samples collected from 18 populations over the last 15 years across Idaho. We used 15 microsatellite loci, eleven of which are adaptively neutral, and four of which occur within or close to genes associated with immune status and therefore may be under adaptive pressures related to disease. We report on genetic distinctiveness and diversity for both neutral and putatively adaptive genetic markers for each population, and compare these results with the distribution and strain types of *M. ovipneumoniae*. We discuss the implications of these results for understanding the factors driving pathogen transmission and disease susceptibility across Idaho for this species.

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GRAY WOLF HARVEST IN IDAHO. Regulated harvest is a relatively new phenomenon for gray wolves (*Canis lupus*) in Idaho. Most studies of wolf harvest have been conducted in northern latitudes where wolf populations are large and human densities are low. Insights from wolf harvest in northern North America may not accurately describe wolf harvest in Idaho. Although wolf harvest is still in its relative infancy, perceptions and beliefs about the efficacy of wolf harvest in Idaho abound. Both public and agency perceptions have led to beliefs that few wolves will be harvested by rifle hunters, pups are curious and naıve and more likely to be trapped than adults, and interest in wolf harvest will decrease over time. I assessed the efficacy of the recently (2009, 2011–2014) reinstated wolf harvest in Idaho to test whether it was selective for certain characteristics of individual wolves. I hypothesized that males and females would be harvested at similar rates, pups would be more common in trap than rifle harvest, most harvest would be from trapping, and harvest effort would not decline over time. Additionally, I hypothesized that black wolves would be selected as trophies and more frequent in rifle than trap harvest. I found that commonly held beliefs related to wolf harvest in Idaho were not supported by harvest data. Further, inferences from wolf harvest studies in northern climes do not accurately depict wolf harvest in Idaho. Specifically, male wolves were more vulnerable to rifle harvest than females, pups were not more vulnerable to trapping, trapping did not comprise most of the harvest, and effort did not appear to change over time. Lastly, black wolves were not effectively targeted as trophies. I recommend continued monitoring of wolf harvest to further test hypotheses that provide insights specific to wolves and ecological systems of the conterminous United States.

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IDAHO POWER COMPANY'S BAYHA ISLAND RESEARCH PROJECT. Idaho Power Company (IPC) has proposed the Snake River Stewardship Program (SRSP) as part of its efforts to receive a new Federal Energy Regulatory Commission (FERC) license to continue operating the Hells Canyon Complex (HCC). The SRSP uses a watershed approach to address downstream water temperatures that are elevated in the fall due to warming that occurs as the Snake River flows through Southern Idaho

during the summer. In 2014, IPC initiated a research project designed to evaluate the feasibility and cost of implementing in-river enhancement projects. The Bayha Island Research Project included excavation of 51,000 cubic yards of material from the Snake River adjacent to Bayha and Wright Islands, which are part of the Snake River Islands Unit of the Deer Flat National Wildlife Refuge. The excavated material and an additional 22,000 cubic yards of fill were used to create approximately 10 acres of floodplain below the ordinary high water mark. The floodplain was planted with 200 wetland sod mats and over 10,000 plugs and one-gallon containers of shrub and riparian trees. The project was designed to reduce thermal loading to the Snake River by narrowing and deepening the river channel and increasing shade from riparian trees. Aquatic and riparian habitat within the project area will also benefit from the project. IPC completed construction of the Bayha Island Research Project in November 2016.

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IMMIGRATION AS A COMPENSATORY MECHANISM TO OFFSET HARVEST MORTALITY IN HARVESTED WOLF POPULATIONS. In less than a decade the U.S. Northern Rocky Mountain gray wolf (*Canis lupus*) population has experienced large shifts in management practices, from federal protection under the Endangered Species Act to increasingly liberal hunting and trapping seasons in many portions of their range after delisting. As a result, there is interest in how current wolf management practices will affect this population over time. Recent research suggests wolf pup recruitment in central Idaho has declined since harvest was initiated, yet wolf densities appear stable in many regions of the state, suggesting other compensatory mechanisms are offsetting the effects of harvest mortality. Our objective was to evaluate immigration as a compensatory mechanism that may offset the effects of harvest mortality and facilitate population persistence in a heavily harvested wolf population. Using noninvasively sampled DNA we identified dispersers into two focal study areas in central Idaho prior to and after harvest was initiated. We measured genetic relatedness within and among wolf packs using three different metrics to assess how immigration has changed with changing management practices. Our results suggest that at current harvest rates immigration is not acting as a compensatory mechanism to offset the effects of harvest mortality. Local dispersal may be unaffected by harvest pressure whereas harvest has negative effects on long-distance dispersal. Our research can help managers consider the effects of immigration on local wolf populations when making harvest management decisions.

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HABITAT AND SPECIES ASSOCIATIONS OF JUVENILE BURBOT AND OTHER FISHES IN A TRIBUTARY OF THE KOOTENAI RIVER. Burbot *Lota lota* in the lower Kootenai River have been the focus of extensive conservation efforts, particularly conservation aquaculture. One of the primary management strategies has been the release of Burbot into small tributaries in the Kootenai River basin. Since 2012, approximately 12,000 juvenile Burbot have been stocked into Deep Creek, a small tributary of the Kootenai River; however, little is known about the habitat use of stocked Burbot. The objectives of this study were to evaluate habitat associations and species associations of juvenile Burbot and other fishes in Deep Creek. Fish and habitat were sampled from 58 reaches in Deep Creek. Species richness decreased with increased channel gradient. Nonmetric multidimensional scaling indicated that patterns in species richness were largely a function of channel gradient and associated habitat characteristics (e.g., current velocity). Both ordination and regression model results suggested that Burbot move little after stocking and were associated with areas with high mean depths and coarse substrate. Species-specific habitat relationships for other fishes in Deep Creek were generally reflective of the ecology of each species. This study provides insight on patterns of fish assemblage structure, as well as important information on the ecology of native and nonnative fishes in a western stream system. Lastly, this study provides additional knowledge on juvenile Burbot and suggests managers should consider selecting deep habitats with coarse substrate for stocking locations.

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SURVIVAL, MOVEMENT, AND DISTRIBUTION OF JUVENILE BURBOT IN A TRIBUTARY OF THE KOOTENAI RIVER. Burbot *Lota lota maculosa* in the lower Kootenai River have been the focus of extensive conservation efforts, particularly the release of hatchery-reared juvenile Burbot into small tributaries. The Idaho Department of Fish and Game installed a fixed passive integrated transponder (PIT) antenna on Deep Creek, a tributary of the Kootenai River, to evaluate movement of juvenile Burbot to the Kootenai River. Since then, approximately 12,000 juvenile Burbot have been PIT tagged and released into Deep Creek, but few Burbot have been detected at the antenna. The lack of detections raised questions about the fate of Burbot in Deep Creek. The objectives of this study were to evaluate survival, movement, and distribution of Burbot released into Deep Creek. In 2014, 3,000 age-0, 200 age-1, 16 age-2, and 16 age-4 Burbot were released at two different locations in

Deep Creek. In 2015, 3,000 age-0 Burbot were released at six different locations (i.e., 500 per site) in Deep Creek. Additional stationary PIT tag antennas were installed on Deep Creek prior to stocking in 2014. Mobile PIT tag antennas were used to survey Deep Creek in 2015 and 2016. A Barker model in program MARK was used to estimate survival from mobile and stationary PIT tag antenna data. Few Burbot were detected at stationary PIT tag antennas. Mobile PIT tag antenna surveys relocated 758 tags, 88% of which were within 1 km of a release location. Mobile PIT tag antenna surveys of release locations in Deep Creek suggest poor dispersal from stocking locations. Survival estimates were low (0.10 – 0.29) and did not significantly differ between year or release location. Results of this study suggest that managers might consider releasing Burbot at multiple locations and low densities.

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ESTIMATING THE SEASONAL SPATIAL DISTRIBUTION OF UNGULATES ACROSS IDAHO. There has been a recent interest by natural resource managers for information on the seasonal ranges of Northern Rocky Mountain ungulates species. When and where possible, GPS location data can be used to document and estimate seasonal ranges at a population (i.e. 2nd order resource selection) but this has limitations to extrapolating this information to novel areas where not such data occur. In general, when location data is plentiful (>50,000 locations) traditional resource selection techniques are hampered by covariate selection methodology in which Information Criteria indices lead to numerous covariates and interactions beyond the means of biological relevance, e.g. over-fitting. Ultimately, these models lead to results which although they perform well statistically but are hard to convey biological meaning, management relevance, and do not extrapolate well to novel areas. After learning the limitations of traditional techniques, we successfully deployed maximum entropy modeling techniques (Maxent) for the purposes of estimating seasonal ranges for elk and mule deer across Idaho in regions where we had 'adequate' location data. We separate modeling to broad ecological zones that were adapted to each species and selected covariates that were seen as relevant to the species during the particular season with the advice of biologist with experience in the species' ecological zone. Covariates were adapted in a fashion that incorporated daily movement patterns. Maxent's unique machine learning algorithms fit covariate data by segmenting the covariate across the variability that included in the dataset. The segmentation and 'fitting' algorithms inherently minimize over-fitting of the covariate within the study area, thus providing better extrapolation to novel areas. Seasonal species models were validated and threshold values are parameterized for model performance and location omission rates. The resulting models are presented, and evaluated using Receiver Operator Characteristic plots (aka, Roc plots) for both training and validation (testing) location databases.

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LANDSCAPE RESTORATION STRATEGIES IN THE FACE OF CLIMATE CHANGE. The Coeur d'Alene Tribe Fisheries Program has engaged collaboratively with the Tribal Wildlife Program to restore large areas in the Hangman Creek watershed with the intention of revitalizing streams, floodplains, and wetland habitat for native salmonids and wildlife. Management actions are intended to buffer the

ecosystem from projected climate change scenarios and current land use practices which have amplified a historically flashy hydrograph and contribute to extreme variation in stream flow. Specific strategies have been implemented by the Tribal programs in and out of the stream in order to reconnect the stream to the floodplain and improve conditions in adjacent wetlands. Examples of strategies currently being implemented in the Hangman watershed include: installation of engineered log-jams, drainage-tile removal, native plant revegetation, beaver proliferation, and historic stream channel reactivation.

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WHY THE AMERICAN FISHERIES SOCIETY IS THE PROFESSIONAL HOME FOR YOU. What is the American Fisheries Society and why should you be involved? If you were to ask seasoned members or Society staff, they would probably tell you that it's the oldest and largest society for fisheries professionals and a global leader in fisheries that publishes outstanding journals and books and convenes excellent meetings throughout North America. They might also mention various member benefits, including discounts on journal subscriptions, books, or meeting registrations. This is all true, but doesn't really address the true value of AFS membership or why AFS is the professional home for all fisheries professionals. As is often the case, you get out of it what you put into it: realizing the full value of AFS membership only comes with becoming an active, engaged member and seizing the many opportunities professional service in AFS presents. AFS meetings are where we go to share our findings with others and to learn the latest scientific advances that will help us do our jobs better. There is undoubtedly value in this level of participation, but AFS membership really starts to pay dividends when you use AFS to expand your network and make new connections with peers, colleagues, mentors, collaborators, and friends. Invest your time in organizing a meeting, working with a committee, or helping with any other AFS project, and you'll find out just how fulfilling and rewarding professional service can be. AFS is a great place for professionals and students to meet potential employers, develop leadership skills by being involved in Division, Chapter, Section or subunit governance, compete for travel grants and academic scholarships, and be recognized by your peers. The first step—reaching out and getting involved—is often the hardest one, but puts you on the path to making an even greater contribution to the fisheries profession. In this presentation, we will answer that question, "What is AFS and why should I be involved?", by sharing what we think is the real value of membership and offering suggestions for how you can become a more active, engaged, and fulfilled member of the American Fisheries Society.

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MICROHABITAT USE BY NATIVE FISHES IN REHABILITATED REACHES OF THE KOOTENAI RIVER, IDAHO. Fish and microhabitat data were collected from 542 prepositioned electrofishing sites (surface area of each site = 4 m2) in the Kootenai River, Idaho, during 2014 and 2015 to evaluate the effects of habitat rehabilitation on the fish assemblage. Samples were collected from locally-treated and locally-untreated areas of the river to investigate habitat conditions related to the occurrence and relative abundance of fishes from both treatment types. Fishes sampled from backwaters composed 71% of the overall catch and 84% of the catch from locally-untreated areas of the river. Assemblage-level ordinations and population-level regression models suggested that water depth and current velocity were the most important microhabitat variables influencing habitat use by fishes. In particular, shallow habitats with low current velocities were used by native fishes, especially age-0 fish, and are likely serving as important rearing areas. These habitat conditions typically characterize backwater and channel-margin habitats that are vulnerable to anthropogenic perturbation. Conserving or rehabilitating these habitats in large, regulated rivers would enable natural channel forming processes for the benefit of native fishes.

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RESOURCE SELECTION AND SPECIES INTERACTIONS OF SELECT NATIVE AND NONNATIVE FISHES OF THE KOOTENAI RIVER, IDAHO. The Kootenai River is considered among the largest and ecologically important aquatic resources in the Pacific Northwest. Like other large rivers in North America, land use and water development operations have altered aquatic and riparian habitat. Consequently, population declines of several native fish species have been reported. The Kootenai River has received several localized habitat treatments designed to restore self-sustaining, native wildlife populations. However, recent surveys have documented the occurrence of nonnative fishes in rehabilitated areas of the river. Our study investigated the interactions of wild-caught native and nonnative fishes of the Kootenai River in an artificial stream system. Trials were performed using two native species (Mountain Whitefish *Prosopium williamsoni*, Largescale Sucker *Catostomus macrocheilus*) and one nonnative species (Pumpkinseed *Lepomis gibbosus*). The selection of substrate, current velocity, and woody cover was examined for each species in allopatry (n = 72). Additional trials were conducted in sympatry (n = 48) with each native-nonnative pairing to evaluate habitat use in the presence of another species. Four experimental units were outfitted with sand and gravel substrates that were subjected to three different wood treatments: wood on sand, wood on gravel, and no wood. Each experimental unit was marked with an XYZ coordinate system to determine the exact location of the test subject(s). Trials were video recorded to reduce observer bias; four cameras captured the positioning of the fish(es) in each experimental unit and observations were recorded in 15-minute intervals. Mixed-effects logistic regression models were fit for each species tested in allopatry; parameter estimates were then compared to those generated from trials conducted in sympatry. Results from this experiment will be used to further guide the

design of habitat rehabilitation efforts in the Kootenai River and large river systems in general.

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POPULATION CHARACTERISTICS OF INVASIVE BURBOT IN FONTENELLE RESERVOIR, WYOMING. Since their illegal introduction into the Green River in the 1990s, Burbot *Lota lota* have been sampled at increasing frequency in lotic and lentic environments throughout the Green River system of Wyoming. Burbot in the Green River pose a threat to native species and socially, economically, and ecologically important recreational fisheries. In response to this invasion, managers of the Green River have begun to explore the efficacy of a suppression effort targeting Burbot. An age-structured population model developed from previous Burbot research in the Green River showed that high annual mortality rates are required to effectively suppress the population. The model used demographic data from Burbot in the Green River and did not include the dynamic rates (growth, recruitment, mortality) of Burbot in Fontenelle Reservoir. Due to differences that can occur between lotic and lentic Burbot populations, determining differences in dynamic rate functions is crucial to accurately model this population's response to future management efforts. Burbot for this study were collected from Fontenelle Reservoir in October 2016. Mean back-calculated lengths at age of Burbot were estimated using the Fraser-Lee method, and age structure was estimated. Growth was described using a von Bertalanffy model and total annual mortality was estimated using a Chapman-Robson estimator. These rates were then compared to data collected from Burbot in the Green River to determine significant differences in dynamic rates between the two environments. Results from this study will validate the previously developed population model for the Green River and provide baseline data for future management of Burbot in the Green River system.

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EVALUATION OF DIPLOID AND TRIPLOID WESTSLOPE CUTTHROAT STOCKED IN IDAHO HIGH MOUNTAIN LAKES. High mountain lakes are an important component of Idaho's recreation economy, drawing an estimated 40,000 anglers each year. Currently, Westslope Cutthroat Trout (WCT) *Oncorhynchus clarkii lewisi* compose roughly 60% of the requested trout stocked in Idaho high mountain lakes, followed second by all-female triploid (Troutlodge) rainbow trout (25%). Until recently, WCT stocking comprised an even larger proportion of high lakes stocking, but an increased desire for stocking triploid trout led to a reduced number of WCT requested. Since triploid Cutthroat Trout stocks have not been available, all-female triploid Rainbow Trout have become the default choice where sterile trout are desired. The goal of this study was to examine catch per unit effort and length-at-age of both diploid and triploid hatchery WCT in relation to stocking density in an effort to develop stocking recommendations for triploid WCT in alpine lakes. In both the summer of

2011 and 2013, we aerial-stocked groups of Idaho high mountain lakes with either diploid or triploid WCT fry that were marked with an adipose fin clip. Three years post-stocking (2014 and 2016), we returned to sample study fish using floating gillnets. Study fish were recovered from 41 of the 51 lakes sampled across both years. Mean catch per gillnet hour of effort was similar for both diploid and triploid stocking groups (0.198 and 0.186, respectively) as was mean length-at-age (281.2 (±3.8) mm, diploid; 280.8 (±3.4) mm, triploid). Due to similar growth and survival to their diploid counterparts, triploid WCT are a viable alternative to diploid fish that can escape from stocked lakes and compete and breed with native salmonids.

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PRESPAWN MORTALITY IN PACIFIC SALMON: PATTERNS, METHODS, MECHANISMS, AND POTENTIAL CONSEQUENCES. Adult Pacific salmon (*Oncorhynchus* spp.) may reach spawning grounds but perish before reproducing, a phenomenon termed pre-spawn mortality (PSM). We reviewed and synthesized information on PSM rates, survey methods, and common observations to evaluate broad patterns in PSM and facilitate more accurate and consistent study designs. Reported PSM rates from throughout the North American Pacific Region varied among years and locations, and ranged from ~0% to >90% in some regions. Questionnaire responses from 60 fisheries professionals indicated that PSM was routinely monitored for numerous salmonid species, but that variation in methodology could lead to systematic biases in PSM estimates. A comparison of several subsets from a single dataset illustrated how variations in sampling could lead to substantial differences in annual PSM estimates. To improve PSM estimate precision, we recommend frequent carcass surveys beginning when fish arrive at spawning locations, and that study designs should strive to be balanced spatially and temporally, have an adequate sample size, consider males and females separately and carcass recovery probability should be considered. Proximate cause(s) of PSM differ among locations and species, and is broadly associated with higher temperature. On-going work aims to estimate the risk of PSM via energetic depletion for Salmon River Chinook Salmon using an individual-based modeling framework that links the energetic costs of upstream migration, holding and spawning to environmental and passage conditions, including climate projections for stream water temperature. Improved PSM estimates and understanding of underlying mechanisms will aid in identifying management strategies in the face of changing climatic and anthropogenic factors.

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EVOLUTIONARY ADAPTATION OF REDBAND TROUT TO DESERT STREAMS. A heterogeneous and ever-changing thermal environment drives the evolution of populations and species, especially when extreme temperatures threaten fitness. Redband trout (*Oncorhynchus mykiss gairdneri*) typically occupy montane streams but have adapted to desert streams in North America.

Comprehensive approaches were explored to test for evolutionary thermal adaptation of redband trout ecotypes at levels of physiological function, cellular response and genomic variation. A desert population had a significantly higher critical thermal maximum and broader optimum thermal window than cooler montane populations, suggesting superior thermal tolerance. In addition, the desert population had the highest maximum heart rate under thermal stress indicating improved capacity to deliver oxygen to internal tissues compared to montane populations. In response to acute warming, distinct sets of cardiac genes were induced among the ecotypes, which helped explain differences in cardiorespiratory function. Underlying these phenotypic variations, potential adaptive genomic regions and candidate genes were pinpointed, such as hsp40, ldh-b, camkk2 and potassium channel genes. Ecological consequences were modeled for this species under projected scenarios of climate change to help make appropriate conservation decisions. This study demonstrates specific mechanisms and limitations of aquatic species to evolve under changing thermal environments, but illustrates severe ecological consequences and loss of biodiversity across riverscapes due to increasing water temperatures from climate change.

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DOUBLE-CRESTED CORMORANT AND OTHER AVIAN PREDATION ON RAINBOW TROUT STOCKED IN SOUTHEAST IDAHO RESERVOIRS. Idaho Department of Fish and Game (IDFG) stocks approximately 1.8 million catchable-sized Rainbow Trout (*Oncorhynchus mykiss*) into Idaho waters each year to provide anglers opportunities for harvest. Colony nesting fish-eating birds such as double crested cormorants (*Phalacrocorax auritus*) and American white pelicans (*Pelecanus erythorhynchos*) directly compete with anglers for these fish by consuming trout throughout the nesting season. We tagged Rainbow Trout with passive integrated transponder (PIT), T-bar anchors, and radio tags and stocked these fish into seven reservoirs in southeast Idaho. Bird surveys were conducted during the nesting season to estimate proportional abundances of various species. After the nesting season, tags were recovered from bird nesting, loafing, and roosting sites. Predation rates were estimated by recovery rates of PIT and radio tags. Angler exploitation rates were estimated from T-bar anchor tags reported to IDFG's Tag-You're-It existing angler tag reporting program. Bird predation rates on Rainbow Trout in relation to angler exploitation at these sites will be presented.

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SPATIAL DISTRIBUTION AND HABITAT USE PATTERNS OF LONG-BILLED CURLEWS IN CALIFORNIA AND MEXICO. Long-billed curlew populations are experiencing sharp local declines, but range-wide stability or only slight declines. Our research explores issues curlews face at disparate scales in the context of complete annual life cycles. Locally, we are examining the effect of habitat, disturbances, and predators on nesting success, and in a collaborative, range-wide effort, we are using satellite transmitters to further our understanding of migration and wintering ground ecology. For many curlews, flood-irrigated working lands provide important habitat. Some individuals winter extensively or even exclusively in agricultural areas, which may be subject to varied water use scenarios. We used Brownian Bridge Movement Models to create utilization distribution maps for

wintering curlews in the Central and Imperial Valleys of California, and coastal areas of Mexico. Identifying and characterizing high-use areas within patchworks of land-cover types and water regimes will help inform ongoing conservation efforts for curlews and other species utilizing the same habitat.

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EFFECTS OF LIVESTOCK GRAZING INTENSITY ON NESTING SUCCESS AND BROOD MOVEMENTS IN GREATER SAGE-GROUSE. Livestock grazing policies on public land is influenced by the perceived effect of cattle grazing on greater sage-grouse (*Centrocercus urophasianus*), but past studies have not examined the relationship between cattle grazing intensity and sage-grouse demographic traits. Since 2014, we have been conducting a collaborative study to quantify the relationship between cattle grazing and sage-grouse demographic traits. The study includes a landscape-scale BACI experimental design to compare the effects of 4 grazing treatments on sage-grouse vital rates. The results from the manipulative experiments are not yet available, but the data we've collected so far also allow us to examine correlative relationships between grazing intensity and sage-grouse vital rates. We will show the association between grazing intensity (percent of above-ground grass biomass removed by herbivores) and numerous sage-grouse demographic traits based on data collected over the past 3 years from 4 study sites in southern Idaho.

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PATTERNS OF ITEROPARITY IN SNAKE RIVER STEELHEAD TROUT. Steelhead trout have the most diverse life history repertoire of the Pacific salmonids. Unlike most anadromous species of the genus *Oncorhynchus*, steelhead are capable of iteroparity (repeat spawning). Snake River steelhead populations exhibit extremely low rates compared to other populations; therefore, steelhead managers are increasingly interested in managing for iteroparity as a conservation measure with genetic and demographic benefits. However, there is little population-specific information about repeat-spawning steelhead to serve as a baseline to guide and evaluate conservation and management decisions. In this study, we take advantage of two unique data sets from work conducted at Lower Granite Dam to elucidate important patterns and characteristics of repeat-spawning steelhead in the Snake River basin during the last six years: age/genetic sampling and systematic tagging of pre-spawn adults. Repeat spawners were overwhelmingly female (93.3%) and occurred in all genetic stocks. Most repeat-spawning steelhead had spawned first after one or two years post-smolt growth and then either spawned the next year or skipped a year between spawns. There were slight majorities of fish that had first spawned after 1 year in the ocean (51.9%) and fish

that had skipped a year between spawns (59.0%). Three individuals were on their third spawning run. Growth between spawns declined for older, larger steelhead. Estimated abundance of repeat spawners doubled between 2010 and 2013 but then declined. Percentage of repeat spawners ranged from 0.7% to 2.6% for steelhead spawning in 2010-2015. Survival from first spawn to post-spawn emigration increased during the study but survival in the Columbia River estuary and Pacific Ocean got worse such that overall survival to second spawn varied little. These results suggest recent changes to operation of the Columbia River hydrosystem have benefitted post-spawn emigration and survival but poor estuary and ocean conditions overrode positive hydrosystem responses.

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BEAVER DAMS INFLUENCE STREAMFLOW COMPLEXITY AND THE DISTRIBUTION OF A RARE MINNOW SPECIES IN AN IMPAIRED WATERSHED. The northern leatherside chub (*Lepidomeda copei*) is a species of conservation concern that purportedly has been impacted by anthropogenic activities. Microhabitat studies have shown the species to select areas with complex streamflows in addition to other habitat features. While several studies have evaluated the influence of instream habitat on northern leatherside chub at the reach-scale, few have explicitly evaluated associations with habitat complexity at this scale despite field observations suggesting its importance. We studied the effect of reach-scale complexity in streamflow, water depth, substrate, and cover, in addition to other habitat factors, on northern leatherside chub occurrence in the Goose Creek watershed of the Upper Snake River Basin. Of the habitat complexity measures we evaluated, streamflow complexity (SD of velocity) in the reach was the predominant factor associated with the species' occurrence. Multiple regression revealed that streamflow complexity increased in larger streams and in the presence of beaver dams, but was negatively associated with streambank condition and percent fine substrates. Our study suggests that streamflow complexity across multiple spatial scales is important to the distribution of northern leatherside chub and that land and wildlife management will play an important role in future conservation efforts for the species.

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THE SALMONID POPULATION VIABILITY PROJECT: MODELING TROUT VIABILITY IN A DESERT LANDSCAPE. In an ideal world, species conservation planning would be guided by formal population viability analyses (PVA) to determine the probability that each population will persist, and provide an understanding of how persistence is influenced by environmental/biological variables and management actions. Primarily due to a lack of accessible data-driven methods for PVA that can be used across broad spatial scales, most conservation planning instead relies on indirect surrogates of viability (e.g., habitat size or quality). We developed a new statistical Spatio-Temporal Population Viability Model (ST-PVM) that combines fish sampling data with remotely-sensed and other

environmental data to deliver simultaneous estimates of carrying capacity, inter-annual variability, and viability for many populations across large areas. Remotely-sensed spatial covariates describe habitat size and quality, while temporal variability is a function of temperature and flow. The hierarchical approach includes an observation model which calculates site- and pass-specific probabilities of detection and informs a sampling model, the results of which feed into a process (population dynamics) model. ST-PVM can leverage information from well-sampled areas to extrapolate to poorly sampled or even un-sampled populations; it also allows for evaluation of different management scenarios (e.g., barrier or non-native trout removal). We conducted a pilot study of Lahontan cutthroat trout (LCT), a federally threatened cutthroat trout subspecies native to the Great Basin Desert, to generate simultaneous estimates of extinction probability and carrying capacity across the sub-species' range

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ASSESSING THE NATURAL PRODUCTIVITY OF CHINOOK SALMON IN THE SOUTH FORK CLEARWATER RIVER FOR ESCAPEMENT AND HARVEST GOALS. Management goals of Idaho's Chinook Salmon fisheries include both fishery and conservation objectives. Due to extirpation of Chinook Salmon in the Clearwater River basin in the early 1900s, this particular stock is not listed and conservation objectives are different than neighboring Endangered Species Act listed stocks. Although long-term population monitoring has been conducted within the Clearwater River drainage through the Idaho Supplementation Studies project, this data has not been examined in an escapement goal context. We used a long-term dataset of juvenile outmigration and adult returns from the South Fork Clearwater River basin to examine productivity and establish escapement goal objectives within the South Fork Clearwater River population. This evaluation can provide inference on habitat quality and resources for juvenile rearing and adult spawning in the system and can be used to estimate possible surplus for establishing harvest goals and objectives on natural-origin fish. In-basin attributes (e.g., abundance, condition, migration timing) were examined across years for associations to survival of outmigrating smolts. Productivity of natural-origin fish were evaluated using a stock-recruitment curve. Additionally, potential hatchery influences on the survival and productivity of the natural population were evaluated using information on carcasses sampled on the spawning grounds. Indications of density-dependent mechanisms occurring on the natural population can indicate limitations of the habitat and can aid in determining the carrying capacity of the system. Such parameters can develop improved escapement goals and better inform management decisions on hatchery smolt releases, habitat improvement, and harvest goals.

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PREVALENCE AND RISK FACTORS FOR INFECTION OF *TRICHOMONAS GALLINAE* IN WESTERN GOLDEN EAGLE NESTLINGS. Avian trichomonosis, caused by the protozoan *Trichomonas gallinae*, is found

primarily in birds in the family Columbidae but can affect raptors that feed on infected prey. Previous studies have found high rates of trichomonosis in localized raptor populations that experienced habitat loss and changes in historical prey populations yet few have examined prevalence of trichomonosis at a regional scale. We examined the occurrence of *T. gallinae* in western Golden Eagle (*Aquila chrysaetos*) nestlings during the 2015 breeding season. We collected oral swab samples from 124 nestlings, from 77 nests, across 10 western states to estimate regional prevalence of *T. gallinae*. In our intensive study site in southwestern Idaho, we assessed risk factors for *T. gallinae* infection including nestling age, oral pH, and the proportion of Rock Pigeons (*Columba livia*) in nestling diet. We found 6.5% of samples (n = 6) from sites outside Idaho tested positive for *T. gallinae*. In Idaho, 41% (n = 13) tested positive for *T. gallinae*. Age of first detected infection ranged from 9 to 38 days old (mean = 23.5 days) and the probability of infection increased with nestling age. Nestling oral pH significantly decreased as nestlings aged and a higher pH was associated positively with the probability of *T. gallinae* infection. We found the presence of Rock Pigeons in the diet increased the probability of *T. gallinae* infection. Currently, trichomonosis appears to have little demographic impact on western Golden Eagles, however *T. gallinae* does occur across the West and factors related to land cover change and nestling diet may increase risks to local populations.

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MISSING NUTRIENTS FROM PACIFIC LAMPREY: INSIGHTS FROM TRANSLOCATION INTO HISTORIC SPAWNING REACHES. Marine-derived nutrients (MDN) from spawning anadromous fish have been found to increase productivity in oligotrophic watersheds. Most studies have focused on Pacific salmonids with less attention placed on other species expressing differing spawn phenologies. Because streams are variable in space and time, the fate and phenology of resources mediate their importance in food webs. Pacific lamprey (*Entosphenus tridentatus*) spawn in summer when decreasing discharge and increasing temperature and light may allow for larger impacts on productivity per unit biomass in spawning streams, but returns are at a fraction of historic estimates in many places. Few studies have quantified fates of post-spawn carcasses in anadromous fishes and no studies have reported on carcass fate of Pacific lamprey. Mature lampreys were radio-tagged and released into historic spawning reaches in Satus Creek, Yakima River (n=65) and Catherine Creek, Grande Ronde River (n=79) as part of a conservation translocation program. We assessed the movements and post-spawn fate of lampreys using telemetry and mobile surveys and quantified habitat characteristics associated with final detections within the wetted stream channel versus those with final detections in the riparian zone. Approximately 1/3 of tags remaining in the detectable range were found in the riparian zone predominantly within 3 m to the stream and we documented removal of carcasses by vertebrate scavengers using game cameras. Binomial regression and model selection was used to identify the factors influencing instream decomposition. Final detections within stream channels were associated with debris dams, pools, and boulders, revealing carcass resources are unevenly distributed within streams. This work suggests that historic

food web subsidies from anadromous fish were variable in form, fate, and phenology. Restoration and MDN supplementation programs should attempt to mimic historic subsidy diversity and timing to represent the diversity of anadromous species and life histories which fertilized spawning streams.

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CONNECTIONS OR CONTAINERS: USING GENETIC DATA TO UNDERSTAND HOW WATERSHED EVOLUTION AND HUMAN ACTIVITIES MAY INFLUENCE CUTTHROAT TROUT BIOGEOGRAPHY. Species with large geographic distributions often exhibit complex patterns of diversity that may not be captured by their taxonomy. These patterns can be further complicated by human activities that breach natural biogeographic barriers. Cutthroat trout are one of the most widely distributed native freshwater species in western North America that exhibit substantial phenotypic and genetic variability. Through a long history of hatchery propagation and stocking for recreational fisheries, natural boundaries for this polytypic species may have become obscured. In this study, we examine patterns of genetic diversity within and among cutthroat trout populations using microsatellite diversity. Our study focuses on populations representing three distinct haplotypes of cutthroat trout. These lineages are found intermixed within the Bonneville and Yellowstone cutthroat trout ranges; however, no explanation for how this distribution formed has been explored. Genetic data will potentially allow us to identify which populations of cutthroat trout in the contact zone are native and which may have been introduced by stocking activities. If the distribution occurred through natural, historical watershed evolution, we hope to reconstruct those putative connections. Alternatively, if the data suggest stocking, we plan to use genetic data to identify possible source populations. Results of this study will reveal how the interplay between watershed evolution and human activities have shaped the distribution of cutthroat trout.

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DISTRIBUTION AND MOVEMENT OF WILD STEELHEAD, HATCHERY STEELHEAD, AND ANGLERS IN THE CLEARWATER RIVER, IDAHO. Steelhead *Oncorhynchus mykiss* is a species of high economic value and supports popular sport fisheries across the Pacific Northwest. The purpose of this study is to describe movement and distribution patterns of wild and hatchery steelhead in the Clearwater River, Idaho. We are also focused on describing spatial movement patterns of anglers in the system. One hundred and seventy wild (n = 26) and hatchery (n = 144) steelhead were radio tagged at Lower Granite Dam in the fall of 2016. Thus far, tracking of steelhead has focused on the main-stem Clearwater River and Middle Fork Clearwater River and includes twelve fixed stations coupled with mobile tracking (automobile and drift boat). Creel data will provide information on the location and

number of anglers. Motion-sensing cameras (n = 7) at boat ramps will provide additional information on angler use of the river. Expected benefits of this study will identify seasonal movement patterns of steelhead and distribution of anglers that can be used to help manage the fishery.

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EVALUATING THE INFLUENCE OF NON-NATIVE FISHES AND HABITAT CONDITIONS ON THE DISTRIBUTION OF YELLOWSTONE CUTTHROAT TROUT IN THE UPPER SNAKE RIVER. Invasive species contribute to a significant amount of biodiversity loss, habitat alteration and economic drain worldwide. Since the introduction of salmonids cross the world, rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) have had a significant and well documented negative effect on native fish communities. In the Snake River Basin, Yellowstone cutthroat trout (*Onchorhynchus clarkii bouvieri*) have been affected by invasive salmonids. Genetically unaltered populations of Yellowstone cutthroat trout inhabit only a small fraction of their historical range. We used fish sampling records, remote sensing data, and GIS software to identify the current distribution of cutthroat trout in relation to habitat conditions and the presence of non-native fishes. We used Spatial Tools for the Analysis of River Systems (STARS) and the R package Spatial Stream Networks (SSN) to evaluate the effects of non-native salmonids on the distribution of Yellowstone cutthroat trout under different habitat conditions. Our study will provide an estimate of the number of stream miles occupied by native cutthroat trout populations, as well as how frequently they co-occur with non-native fishes under various habitat conditions.

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BUILDING A HABITAT CONNECTIVITY NETWORK WHERE LAND AND WATER MEET. One of the most significant conservation challenges in the 21st century is how to foster species long-term survival in increasingly fragmented and dynamic environments. Going forward, land management actions must consider resilience – the ability of species to survive through peak climatic-related events, habitat fragmentation and/or habitat loss. Habitat connectivity is a key attribute of resilience; yet, re-building connectivity has proven a difficult restoration task, in part due to the lack of coordination between resource and biological conservation organizations. We propose building habitat connectivity through further coordinated efforts to protect and restore riparian ecosystems - for soil and water conservation, for aquatic and terrestrial species, and for fish and wildlife. Increased efforts to protect streamside areas reflect society's acknowledgement that these lands provide key ecosystem services, such as buffering contaminants, hazard mitigation, recreation, and biodiversity. We provide evidence that riparian areas are in a position to connect protected areas, that significant riparian area conservation is already occurring and needs to be further coordinated, and that this solution may be accomplished through existing legal, policy and administrative coordination rather than the initiation of new legislation. Furthermore, the goals of riparian restoration projects may be better served if aligned with conservation efforts focused on '*riparian corridors*', as part of a larger landscape connectivity strategy. While much research on the effectiveness of riparian corridors

remains to be done, the riparian conservation network concept provides a way to guide restoration strategy to improve connectivity among currently protected areas for both aquatic and terrestrial species.

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EVALUTION OF MIGRATION BEHAVIOR, SURVIVAL AND DISTRIBUTION OF ADULT UPPER COLUMBIA SUMMER STEELHEAD USING RADIO TELEMETRY. Understanding migration behaviors of anadromous steelhead is essential for the management of fisheries, especially those that are ESA listed. The goal of this study was to quantify the migration behaviors, overwinter survival, and distribution of steelhead returning to the upper Columbia River basin in 2015. We PIT and radio tagged 400 returning adult summer steelhead at Priest rapids dam between 6-July and 10 November 2015. Hatchery origin steelhead comprised 67% of all tagged adults. Fish movements were monitored using fixed site receivers deployed at mainstem sites and the mouths of tributaries. A substantial proportion of the tagged sample may have 'overshot' downstream tributaries given 69 tagged fish (17%) were detected below Priest rapids dam, or were detected in downstream tributaries or at downstream dams. Of these 43, (62% of fallbacks,~11% of total sample) were detected passing at least one dam on the Snake River. Detection histories indicated that 240 tagged steelhead entered upper Columbia tributaries between August 2015 and May 2016; entry into the Methow (43%) and Wenatchee (25%) was most frequent. A majority (72%) detected in tributaries entered prior to 1-Jan 2016, with the remainder residing in mainstem reservoir habitats during late fall and winter. Kelting behavior was inferred from downstream detections after the peak spawning period. Sixty-six steelhead (28% of those detected in tributaries) were classified as kelts with 16 ultimately detected at or downstream from Bonneville dam (24% of steelhead classified as kelts). Reported kelt rates are likely biased but provide evidence of considerable kelting behavior. We will compare and contrast patterns of behavior, overwinter distribution and survival and kelting in the upper Columbia Basin to those from recent studies in the impounded lower Snake River.

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RESTORING FISH HABITAT IN THE YANKEE FORK BY RETURNING LARGE WOOD TO NATURAL LEVELS. The loss of large wood has adversely impacted fish habitat in the Yankee Fork Salmon River. In 2013, large wood abundance was just 37% of expected natural levels in the 7.4 mile section of the Yankee Fork between Jordan Creek and Eightmile Creek. The loss of large wood in this reach, which was caused by timber harvest and other anthropogenic influences, significantly altered natural processes which resulted in a substantial reduction in fish habitat quality. In 2014 and 2015, the Upper Yankee Fork Large Wood Restoration project was implemented with the purpose of restoring large wood abundance to natural levels within this stream reach. The project involved placing 728 pieces of large wood in the stream channel. The large wood was placed in a manner that mimicked the three

primary natural processes whereby large wood historically entered this stream. These processes were streamside recruitment, avalanches, and debris flows. Additionally, none of the large wood was artificially anchored which allowed it to function in a natural manner after it was placed in the channel. Initial monitoring indicates the project has helped restore natural stream channel processes and is significantly improving fish habitat.

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EFFECTS OF MICROCLIMATE ON NORTHERN IDAHO GROUND SQUIRREL HIBERNATION. The Northern Idaho Ground Squirrel (*Urocitellus brunneus*) is threatened with extinction and habitat degradation is considered the main cause of the species' decline. We attached geolocators to VHF collars to test one alternative hypothesis to explain why northern Idaho ground squirrel populations have declined; the climate sensitivity hypothesis. The climate sensitivity hypothesis suggests that changes in microclimate within hibernacula have resulted in reduced overwinter survival. We are pursuing 2 objectives associated with the climate sensitivity hypothesis: (1) evaluate whether soil depth, forest canopy cover, depth of winter snow pack, or duration of winter snow pack affect selection of hibernacula; and (2) determine which of the hibernacula traits above influence overwinter survival or energy savings. We measured 5 traits that may influence the energetic cost associated with hibernation: date of immergence to hibernation, overwinter body temperature, duration and frequency of winter arousal periods during hibernation, and date of emergence from hibernation. We recovered 5 geolocators in 2016 that were placed on squirrels in 2015. Female squirrels averaged 38.7 (±7.8 SE) arousal periods while male squirrels averaged 21.5 (±1.5 SE) arousal periods during their ~8-month hibernation. Skin temperature during hibernation was negatively correlated between torpor bout length ($r = -0.737$, $P < 0.001$) suggesting that squirrels in hibernacula below 2°C, should save the most energy (and thereby lose less body mass) through the winter.

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LARGE HERBIVORES IN A CHANGING CLIMATE: HOW DOES BODY SIZE INFLUENCE THE RELATIVE IMPORTANCE OF THERMAL REFUGIA? The thermal environment can have important effects on animal energetics and behavior, and those effects are strongly mediated by body size. Specifically, large-bodied animals tend to be more sensitive to warm temperatures than small animals as a result of their smaller surface-to-volume ratios and thicker boundary layers. As global climate change poses a growing threat to many wildlife species, it is especially important to understand the nature and strength of interactions between animals and their thermal environments. We studied the

relative importance of thermal refugia to African antelope in a heterogeneous landscape in central Mozambique, and evaluated how differences in the thermal environment between densely vegetated termite mounds and open savannah matrix habitat influenced rates of metabolism and water loss. To understand the degree to which body size determined the importance of thermal refugia, we chose three congeneric species of antelope that were non-overlapping in body size: bushbuck (*Tragelaphus scriptus*; 50 kg), nyala (*T. angasii*; 110 kg), and kudu (*T. strepsiceros*; 250 kg). We used Niche Mapper, a mechanistic biophysical model that simulates energy and mass transfer between an organism and its environment, to estimate habitat-specific rates of metabolism and water loss for each species under current and future (temperature increased by 3°C) climate scenarios. Niche Mapper integrates information on organismal characteristics such as insulation and behavior, as well as environmental properties such as cloud cover, temperature, and wind speed. Our results demonstrate that termite mounds play an important role in facilitating the conservation of energy and water, but that this role varies considerably with body size. Additionally, our results suggest that although the energetic benefits conferred by termite mounts will be increasingly important to all three species of antelope as global temperatures continue to rise, the benefits of using mounds will increase disproportionately more for larger-bodied species.

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PREY AVAILABILITY FOR SAGE-GROUSE CHICKS: EFFECTS OF CATTLE GRAZING AND VEGETATIVE STRUCTURE. Insects are an essential component in the diet of Greater Sage-grouse (*Centrocercus urophasianus*) chicks. Livestock grazing is common within Sage-grouse breeding habitat and grazing may affect insect abundance and, thereby, affect growth and survival of Sage-grouse chicks. We evaluated the relationship among vegetation characteristics, intensity of cattle grazing, and relative abundance and biomass of insects in southern Idaho. We used pitfall traps and sweep nets to sample insects at each of 60 sampling locations in 2015 and 120 sampling locations in 2016 within four study sites. We also measured a suite of vegetation characteristics (e.g., grass height), estimated herbivore removal of perennial bunchgrasses, and estimated abundance of cow dung at each sampling location. We deployed 4 pitfall traps for three to ten weeks, emptied the traps weekly, and collected approximately 720 pitfall samples in 2015 and 3,540 pitfall samples in 2016. We also used sweep nets along 50-m transects and collected approximately 180 sweep net samples in 2015 and 1,980 sweep net samples in 2016. We identified insects from a subset of our samples at least to taxonomic Order and recorded body length of each individual. We used allometric equations to convert body length into estimates of biomass for insects captured within pitfall traps and sweep nets. We also counted the number of ant mounds along the 50-m transect at each of the sampling locations and used Program Distance to estimate the density of ant mounds at each sampling location. We used general linear models to examine whether any of the following variables explained variation in ant mound density, insect abundance, or insect biomass: vegetation characteristics, grass off-take, and relative abundance of cow dung.

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AMERICAN WHITE PELICAN CONSUMPTION OF SPAWNING WALLEYE AND ITS EFFECT ON THE RED LAKES' FISHERY. We quantified the consumption of fishes, with emphasis on walleye *Sander vitreus*, by American white pelicans *Pelecanus erythrorhynchos* (AWPE) in the Tamarac River, MN during spawning migrations and estimated its effect on the Red Lakes' fishery. AWPE abundance was estimated via aerial surveys (n=7), which peaked at 1,198 birds (95% CI, 1,176-1,219). Foraging bird days occurring on the river was estimated at 15,618. Camera trap data provides evidence to suggest that nearly all foraging occurred between 2028 (95% CI, 2022-2035) and 0621 hours (95% CI, 0608-0635). Walleye comprised 99.4% of voluntary regurgitated fishes (n=166), and 100% of fish retrieved from APWE via stomach pump (n=23). Evidence that the mean length of consumed walleye (μ=464 mm, n=176) was higher than the mean length of walleye in the river, captured via fyke nets (μ=423 mm, n=961), is provided by a Wilcox rank-sum test ($p < 2.2e-16$). A higher proportion of females in consumed walleye (40%) than walleye present in the river (13%) provides evidence to suggest a selection for female walleye by AWPE may exist ($\chi 2 = 21.4$, df = 2, p-value < 0.001). Walleye consumption was estimated using a published bioenergetics model and ground truth consumption data. While some assumptions of the bioenergetics model were violated, consumption estimates from the bioenergetics model were similar to ground truth data. In all cases, AWPE induced walleye mortality represented less than 1.5% of mean walleye natural mortality in the fishery.

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HABITAT IMPROVEMENT IN THE DREDGED PORTION OF THE YANKEE FORK OF THE SALMON RIVER – SOMEBODY SHOULD DO SOMETHING ABOUT THAT. Intermittently from 1940 – 1952, a floating gold dredge turned the lower Yankee Fork into a long narrow gravel pit, and a "river" runs through it. Seventy years later, the dredge excrement continues to preclude formation of fish habitat through natural river processes. Restoration efforts were initially stalled by questions regarding potential toxic contamination in the dredge tailings and historic cultural values. In this presentation, we will discuss overcoming these obstacles and habitat restoration projects implemented by several project which included rebuilding two of the ageing off-channel projects originally completed by the Shoshone-Bannock Tribes in the mid 1980's. The partners also completed a mainstem habitat complexity project which involved adding wood and spawning gravel to a section of the Yankee Fork and a complete flood-plain restoration and stream rebuild project. Projects planned for the near future include another habitat complexity project and another complete flood-plain and stream rebuild. Upon completion of these projects, an entire reach of the dredged section of the Yankee

Fork will contain improved fish habitat and will be able to function naturally.

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STREAM HABITAT INVENTORY PROTOCOL (SHIP): QUANTIFIABLE GEOSPATIAL TOOL FOR STREAM HABITAT SURVEYS. The Stream Habitat Inventory Protocol (SHIP) and associated Geographic Information System data dictionary was developed to combine instream and riparian habitat inventories into a geospatial platform, allowing users to quickly and efficiently quantify and spatially analyze habitat characteristics within and between stream reaches. Using a handheld PC with ArcPad software, main and side channels are mapped with multiple attributes such as bank condition, bank height, streamside vegetation, substrate type, and stream width. Other key habitat features such as large woody debris (LWD), pools and off-channel habitat (i.e., alcoves or ponds) are characterized and spatially linked to the stream reach. SHIP was developed as a tool to answer habitat quality and complexity questions and identify potential restoration opportunities on a reach of Lake Creek, Idaho on private property under a conservation easement (CE) held by the Nez Perce Tribe and Idaho Department of Fish and Game. This CE protects about 0.5 miles of Lake Creek, a tributary to the Secesh River and South Fork Salmon River, which provides spawning and rearing habitat for Chinook salmon, steelhead and bull trout listed under the Endangered Species Act. Differences in distribution of Chinook redds and juvenile fish densities have been observed between the stream reach within the CE and reference reaches outside of the CE. Questions regarding the quality or complexity of habitat and the associated juvenile and adult fish use in the CE were addressed by analyzing SHIP survey results alongside spawning ground survey and juvenile snorkel survey data. This tool proved to be efficient in identifying significant differences in multiple habitat attributes, including LWD, pool size and type, and amount of off-channel habitat between the CE stream reach and reference reaches. Survey results will be used in identifying potential restoration opportunities in the CE where habitat complexity is lacking.

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INSTREAM STRUCTURES INCREASE POOL HABITAT FOR CUTTHROAT TROUT IN SIMPLIFIED HEADWATER STREAMS. Habitat alteration in the riparian zones of streams often results in a decrease and a loss of fish habitat complexity, quality, and abundance. In this study, we tested the effectiveness of an instream restoration effort, designed to increase the availability of suitable habitat for native cutthroat trout populations in headwater streams. We conducted a field experiment in four study streams treated with instream structures designed to increase the availability of pool habitat for cutthroat trout, and compared the effect to control sections of the streams that did not receive any habitat improvement structures. To increase pool area nine wooden instream structures were installed in three 100-meter sections in each of the four streams. The structures were created by driving wooden posts vertically into the substrate across the stream using a gas powered post driver, and then placing woody debris collected locally upstream of the posts and perpendicular to the stream flow. Fish populations in each stream were sampled before and after structure installation. We compare differences in fish growth rates, differences in biomass,

percent change in fish density, percent change in reach area, and percent change in mean depth. This study will provide insight into how cutthroat populations respond to small scale instream habitat improvements in simplified streams in the presence of other stressors such as continued grazing activity.

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COMMON PITFALLS AND MISSED OPPORTUNITIES IN THE USE OF INFORMATION-THEORETIC METHODS (E.G., AIC) IN FISH AND WILDLIFE ECOLOGY. Information-theoretic methods (e.g., AIC, AICc, QAIC) are powerful and widely-used tools in fish and wildlife applied research and management. However, given their ease of use combined with their underlying complexity they are often misused. For example, goodness-of-fit is often ignored, model equivalence is either ignored or addressed when it should not be, and information-theoretic methods are often confused and intertwined with null hypothesis testing. These pitfalls can result in dramatic unexpected consequences of management actions. On the flip side, these tools are often under-utilized. For example, users often do not leverage the inherent hypothesis-testing approach of information-theoretic methods or ignore internal measures of the importance of specific predictor variables. If applied more appropriately these tools could provide more robust results and inference for management. In this talk I describe several common pitfalls and missed opportunities in the application of information-theoretic methods. The target audiences for this talk are beginner-level researchers who apply these methods and fish and wildlife managers who must interpret and rely on results from studies that use these methods. The focus is on application and interpretation of results rather than statistics per se.

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USING OTOLITH MICROCHEMISTRY TO DESCRIBE THE ISOTOPIC LANDSCAPE OF THE COEUR D'ALENE LAKE BASIN. Westslope Cutthroat Trout *Oncorhynchus clarki lewisi* (WCT) are widely distributed throughout the Coeur d'Alene Lake basin and exhibit resident, fluvial, and adfluvial life history strategies. Although the basin supports all of these life history strategies, sources of recruitment and natal origins for adfluvial WCT populations throughout the Coeur d'Alene Lake basin are poorly understood. The objective of this study was to use otolith microchemistry to evaluate natal origins and maternal signatures of adfluvial WCT populations by referencing Sr87/Sr86 stable isotope ratios across otolith growth using laser ablation inductively coupled plasma mass spectrometry. Sagittal otoliths were extracted from 429 fish sampled from 50 different locations throughout the basin and analyzed for Sr87/Sr86 ratios. Water samples were collected from 30 different locations and analyzed for Sr87/Sr86 ratios and other trace elements to characterize the isotopic landscape of the

Coeur d'Alene Lake basin. Least squares regression was used to analyze Sr87/Sr86 ratios between ambient water and sagittal otoliths. Biplots were created to elucidate WCT stocks (i.e., resident, fluvial, or adfluvial) throughout the basin. Results from this study provide a foundational understanding of WCT stock distribution and sources of recruitment throughout the Coeur d'Alene Lake basin, which will help to enhance management of WCT in the basin at large.

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USE OF ISOTOPE TRACERS TO DETERMINE YEARLY VARIATION IN JUVENILE MOVEMENT AND MATERNAL ORIGIN OF SNAKE RIVER FALL CHINOOK SALMON. Advances in techniques to analyze microchemical tracers in animal hard-parts have precipitated understanding of individual origin and movement patterns, at large spatial scales and across taxa, with unprecedented detail. Here we present an application of hard-part microchemistry to study a population of Fall Chinook Salmon in the Snake River of Idaho which expresses putative shifts in juvenile migration timing. Snake River Fall Chinook salmon are heavily impacted by anthropogenic changes to the river system, including significant decreases in available habitat and changes in flow, temperature and productivity throughout their freshwater range. In the last fifteen years, the population has transitioned from a nearly universal sub-yearling (early) outmigration strategy to a mix of early juvenile out migrants and yearling (late) out-migrants. This change has presumably occurred due to a change in the selective pressures exerted on individual out-migrants under these changed conditions. We have previously shown that isotopic and elemental chemistry can be used to determine the timing and sequence of downstream movements in individual fish within this population. This research demonstrates that outmigration strategies are spatially heterogeneous within the basin and correlated with known variation in temperature between spawning areas. Analysis of strontium isotopes and elemental microchemistry from otoliths (ear bones) of juvenile (n=376) and returning adult (n=591) fish have allowed us to determine the origin, downstream movement patterns, and out-migration timing during the freshwater phase of individual fish. The work that I will be presenting summarizes the annual patterns of juvenile migration strategy across the basin over a 10-year period to understand environmental impacts on outmigration timing. The results also inform the utility of otolith chemistry to determine wild vs. hatchery origin, and the potential ability to uncover information related to maternal egg formation at freshwater entry.

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THE HABITAT SUITABILITY INDEX (HSI) MODEL. The habitat suitability index (HSI) model is a mechanistic framework for leveraging CHaMP survey data and post-processing results to characterize the spawning quality and rearing capacity of stream reaches. The HSI model consists of using a suite of hydraulic conditions (depth and velocity, output from 2D flow model), the CHaMP survey generated DEM, and different habitat metrics that are used as input values for different life

stages and species of fish. The resulting high-resolution HSI predictions can then be translated into an estimate of reach-scale fish rearing capacity using fish usage algorithms and a minimum HSI threshold. In this talk, we will (1) characterize what's 'under the hood' of HSI, (2) describe recent efforts at calibrating and validating the model, and (3) provide examples of how and where HSI predictions of reach-scale capacity are being used in broader CHaMP applications.

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SURVIVAL OF YELLOWSTONE CUTTHROAT TROUT EXPOSED TO AIR DURING MID-SUMMER ANGLING EVENTS. Despite the resounding success and popularity of catch-and-release regulations, some concerns have been raised regarding the practice. Exposing fish to air during release is perhaps the most high-profile of these concerns. One of the primary concerns with exposing fish to air is that air exposure causes increased mortality. The purpose of this study was to evaluate the effect of mid-summer air exposure on survival of Yellowstone Cutthroat Trout *Oncorhynchus clarkii bouvieri*. This study was conducted on Palisades Creek, a tributary of the South Fork Snake River, during August 2016. Yellowstone Cutthroat Trout were sampled by angling. Anglers were placed into groups of two to four people. After capture, fish remained in the water while they were measured and tagged with T-bar anchor tags. For each angling group, the first fish captured was randomly assigned to and exposed to air for 0, 30, or 60 s. Air exposure treatments were then systematically cycled in ascending order. In total, 327 fish were sampled (0 s, n = 109; 30 s, n = 110; 60 s, n = 108). Approximately 2 weeks after angling, single-pass backpack electrofishing was used to recapture fish. In total, 204 tagged fish were recaptured via electrofishing. No difference in survival was observed among treatments (0 s, n = 75, 69%; 30 s, n = 63, 57%; 60 s n = 66, 61%). Results of this study suggest that mortality of fish due to air exposure is not a concern in catch-and-release fisheries.

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FROM LITIGATION TOWARDS RESOLUTION: FLOW RESTORATION FOR LAPWAI CREEK WATERSHED. The Lewiston Orchards Project diverts surface water from the Lapwai Creek watershed to supply irrigation water to the patrons in the Lewiston Orchards Irrigation District. From the early 1900's until the mid-2000's the diversion caused flows in portions of Sweetwater, Webb, and Lapwai Creeks to go subsurface. Endangered Species Act (ESA) consultation began in the early 2000's and the Nez Perce Tribe sued NOAA and Reclamation with regards to minimum flows required for ESA listed Snake River A-run steelhead. A point of contention was the diversion of water from Lake Waha. The outlet for Lake Waha is Sweetwater Springs, which historically produced 3-10 cfs at 50 degrees. The cold water refugia has been identified by NOAA as critical and unique to the lower Clearwater tributaries. Minimum flows were temporarily established and their potential impacts to steelhead have been monitored, while a stay of litigation allowed agencies to find a solution reasonable to the parties involved. A Reclamation funded appraisal study identified three potential solutions: pumping

plant on the Clearwater River, a pumping plant on the Snake River, and a well field in the deep regional aquifer. In the spring of 2014 Reclamation introduced the concept of a Pilot Well. The Pilot Well would build on the well field concept and allow a bucket-for-bucket transfer of water to remain in stream as wells came online. The end goal of the project is to restore cultural and natural resources important to the Nez Perce Tribe, and restore flows for ESA listed A-run steelhead, and create a reliable water source for the patrons of the Lewiston Orchards Irrigation District. This would be accomplished through a water right transfer from Reclamation to the Bureau of Indian Affairs to be held in trust for the Nez Perce Tribe and a title transfer of Reclamation land to Lewiston Orchards Irrigation District and to the Bureau of Indian Affairs, to be held in trust for the NPT.

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WHERE ARE ALL THE WOLVES? AN INTEGRATED POPULATION MODEL FOR ESTIMATING PACK SIZES THROUGH TIME. Monitoring wolf abundance through time is important for determining population viability and evaluating the effects of management actions. It is also critical information for understanding the affect that wolf predation has on elk survival. As part of a larger study seeking to understand ecological drivers of elk survival in Idaho, we needed a spatially and temporally explicit estimate of wolf abundance in areas where we had monitored cause-specific mortality of elk. However, this information proved to be extremely elusive due to sporadic pack counts through time coupled with the challenges of keeping radio-collars on a hunted population of wolves. We developed an integrated population model (IMP) so that we could reconstruct pack abundances through time. Since 2006, we have monitored 208 wolves with GPS collars from 74 wolf packs across the state. Using these individuals we estimated probabilities of dispersal, harvest, and mortality other than harvest. We combined these estimates with observed pack counts to model pack-specific abundance on a monthly basis via the IPM. By leveraging information from both sources (GPS collars and pack counts) we were able to estimate changes in pack abundance through time as well as other important demographic rates for which we have no specific information (e.g., immigration and recruitment). Our results will be used to provide managers a better understanding of changes in the wolf population through time as well as provide a way to measure predation risk and its influence on elk survival

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JUST COUNT 'EM!? A SONAR APPROACH TO ENUMERATING STURGEON. Capture-recapture (C/R) methods have long been a standard for estimating White Sturgeon abundance throughout their range. Highly precise C/R estimates however, often come at the expense of large amounts of effort, resources, and project costs. Side-scan sonar (SSS) is mobile imaging sonar, providing a sonar

equivalent to aerial surveys, and enabling researchers to quickly survey large areas. In February 2016, we obtained replicate count data of White Sturgeon using SSS within the Snake River's 58 km reach between C.J. Strike and Swan Falls dams. We modeled abundance (sturgeon > 1 m total length) within a Bayesian framework using a N-mixture model. Shortly after survey completion, we conducted a closed-population C/R assessment (Huggins 1989 model) to compare traditional assessment methodology with newer SSS technology. Our preliminary abundance estimate for SSS (153, 95% credible interval 142-170) was lower than C/R estimate (219, 95% confidence interval 136-398), but within the 95% confidence interval bounds of C/R. Side-scan survey took 75% less field effort (boat and personnel time) than C/R. While not without its own set of challenges and upfront costs, our SSS survey illustrates potential long-term cost savings to provide relatively precise and reliable sturgeon abundance estimates in a short amount of time.

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HOW MANY FISH LIVE IN THAT STREAM OR RIVER NETWORK? A SCALABLE POPULATION ESTIMATOR USING SPATIAL-STREAM-NETWORK (SSN) MODELS, FISH DENSITY DATASETS, AND NATIONAL GEOSPATIAL DATABASE FRAMEWORKS. Population size estimates for stream fishes are important for conservation and management but sampling costs limit the extent of most estimates to small portions of river networks that encompass 100s–10,000s of linear kilometers. However, the advent of large fish density datasets, spatial-stream-network (SSN) models that benefit from non-independence among samples, and geospatial database frameworks for streams provide the components to create a broadly scalable approach to density mapping and population estimation. The SSN models also accommodate covariates and hypothesis testing to provide insights about the factors that affect patterns of abundance. Here, we demonstrate this novel approach to population estimation with an example dataset composed of trout density surveys from 108 sites in the 735 kilometer Salt River network on the border of Idaho and Wyoming. Universal kriging was used to predict a continuous map of densities among survey locations and block kriging (BK) was used to summarize discrete map areas and make population estimates at stream, river, and network scales. The grand population estimate for the network was 184,030 +/-27,263 trout, of which ~82% were native Yellowstone cutthroat trout. Population sizes for eastern Wyoming tributaries ranged from 612–7,128 trout while western Idaho tributaries ranged from 12,963–27,216 trout. Difference in the lengths of stream networks accounted for most of the variation in population sizes, although many of the Wyoming tributaries were also too cold and unproductive to provide high-quality habitat for cutthroat trout. The SSN-BK population estimator can be applied throughout much of North America using free software and nationally consistent geospatial resources to develop valuable information at low cost from many existing fisheries datasets. For interested users, the dataset and statistical code for the Salt River example can be downloaded from the SSN/STARS website (http://www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml) and run using R software with the SSN package (https://cran.r-project.org/web/packages/SSN/index.html).

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AQUACULTURE METHODS TO RESTORE KOOTENAI RIVER BURBOT. The objective of this presentation is to convey some key components to successfully raise burbot (*Lota lota maculosa*) in captivity at a scale that supports population restoration. Since 2001, the Kootenai Tribe of Idaho; University of Idaho; British Columbia Ministry of Forests, Lands and Natural Resource Operations; and Idaho Department of Fish and Game have been collaborating to develop methods for raising burbot in captivity with the goal to restore the functionally extirpated lower Kootenai River/Lake burbot populations. Following more than a decade of empirical advancements, it was determined that large-scale aquaculture of burbot could be feasible. The Kootenai Tribe of Idaho completed construction of a new large-scale conservation aquaculture facility in 2014. Subsequently, Kootenai Tribe of Idaho hatchery staff successfully raised and released its first two year classes of burbot in 2015 and 2016. The new burbot facility components, general production methods, and results of production for the first two years of production will be presented and compared.

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EVALUATING REINTRODUCTION STRATEGIES FOR ENDANGERED SNAKE RIVER SOCKEYE SALMON. Snake River Sockeye Salmon (*Oncorhynchus nerka*) were listed as endangered in 1991. Prior to listing, a captive broodstock program was initiated by IDFG and NOAA to prevent species extinction and to rebuild the population. Success of the program and the ability to increase the population in natal lakes has been accomplished through adaptive management by exploring a variety of adult and juvenile reintroduction strategies. These reintroduction strategies have included 1) eyed-egg releases to lake incubator boxes, 2) pre-smolt releases direct to the lakes in the summer or fall, 3) smolt releases to outlet streams and to the upper Salmon River, and 4) pre-spawn adult releases directly to the lakes. Evaluations of abundance and survival have identified two strategies that result in the highest number of anadromous returns: 1) captive and anadromous adults released to spawn in natal lakes, and 2) full-term smolts released to migrate to the ocean. Releasing captive and anadromous adults to volitionally spawn produces the greatest benefits in terms of smolt-to-adult return rates (SARs) and there has been a high correlation between the number of females released and estimated natural juvenile outmigrants. Spring-time releases of hatchery reared smolts (particularly Oxbow Fish Hatchery smolts) provided the greatest benefits in terms of recruits per spawner (R/S). This demonstrates the importance of using a two life-stage approach to re-build the population and maximize recovery of this stock.

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USING FISH TO STUDY BIRDS: ASYMMETRIC COMPETITION AND A LANDSCAPE OF FEAR. Species interactions on higher trophic levels can take many forms, and can have profound effects on their utilization of resources. Here, we study a natural experiment where a pair of bald eagles (*Haliaeetus leucocephalus*) usurped the nesting site of a great blue heron (*Ardea herodias*) colony, displacing the colony 4km to another location in the Clearwater River Basin. These species do not compete for food directly, but the eviction from the original nest site caused a shift in the herons' use of juvenile salmonids, an important prey item. We used Passive Integrated Transponder (PIT) data on over 7 million juvenile salmonids to quantify how their taxonomic-, life-history-, and geographic representation in the heron diets changed as a result of the nest site relocation. Tag representation in the heron diets changed significantly following relocation despite the short distance (4.1 km). This was driven by a shift in space use, as herons to a greater extent began utilizing fish from a river basin farther away from the bald eagle nest. As a consequence, the species composition in the diets changed significantly, with the largest increase in coho (*Oncorhynchus kisutch*) and largest decrease in Chinook salmon (*O. tshawytscha*). The representation of Chinook life-history types in the diets also shifted. Fall Chinook was the numerically dominant life-history type, but decreased relative to spring- and summer Chinook following relocation. Finally, herons increased their use of a nearby tributary watershed following the relocation. These results demonstrate that behaviourally mediated space use can shift the pressure on important prey groups.

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EVOLUTION OF RIPARIAN DESIGNS BASED ON SITE CONDITIONS AND WILDLIFE CONFLICTS. The Coeur d'Alene Tribe has undertaken a restoration project in Hangman Creek, a tributary of the Spokane River, which is confronted by a number of challenges. This includes a combination of impacts from land management practices, and inherent natural conditions found in the foothills of the Palouse grasslands. Stream channels are deeply incised and disconnected from the riparian zone. Riparian areas are currently dominated by Reed Canary grass and other noxious weeds resulting in bank sloughing and a lack of canopy. Our goal is to use beaver as a partner to reconnect the stream channel and riparian Zone. Stream channel restoration is being performed to allow beaver to build persistent dams, and to establish vegetation needed for food and dam building materials. This would include a compliment of herbaceous forbs, willows, and hardwoods. A large number of wildlife in the area including elk and beaver has proven to be formidable foes in our efforts to protect plants. Our efforts has evolved over time to provide maximum protection for species preferred by wildlife, and less protective measures for plant species that were shown to have less pressure from wildlife grazing. A variety of methods and materials were used over the last 10 years in the watershed. In addition to the idealistic ecological goals, we found that simple economics will drive future riparian designs. Cultural values also become involved in management decisions regarding fisheries restoration/wildlife interactions when conflicts arise.

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DELIVERY OF FUNCTIONAL HABITAT FOR COLUMBIAN SHARP-TAILED GROUSE- ARE WE SAFE?
Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*, hereafter CSTG) occupy < 5 % of their historic range across five western states and British Columbia. Idaho supports between 60-65% of the remaining population, with most birds occurring in the eastern half of the state on private lands, many of which are enrolled in the Conservation Reserve Program (CRP). Habitat loss has been identified as the primary threat to CSTG survival; however, total acres enrolled in CRP are declining. Idaho incentivizes habitat restoration for CSTG through the State Acres for Wildlife Enhancement (SAFE) program, which helps landowners restore their fields to natural vegetation. Restored habitats are intended to be composed of native bunchgrasses with a high forb composition and in close proximity to native shrub communities. Last summer we partnered with Idaho Fish and Game to evaluate habitat suitability of CRP and SAFE fields planted at least 3 years ago in Southeast Idaho under a USDA Conservation Innovation Grant. Preliminary analysis reveals that most fields are not providing high quality habitat for CSTG because they lack structural and compositional plant diversity and are often dominated by introduced grasses including smooth brome (*Bromus inermis*) and intermediate wheatgrass (*Thinopyrum intermedium*). Despite CRP and SAFE requirements to plant native species with higher seed mix diversity our data suggests projects are still falling short of restoration objectives. From experience we know that with increased effort, the right materials and equipment it is possible to deliver functional habitat for CSTG, however, delivery remains hamstrung by budgets, contractual timeframes and a lack of producer accountability. Increased weed management prior to seeding, higher seed rates, better timing of seeding and using the correct seeding equipment are all factors likely to improve restoration success.

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EVALUATING THE SIZE SELECTIVITY OF MID-WATER TRAWLS FOR SAMPLING KOKANEE. Kokanee *Oncorhynchus nerka* are arguably one of the most important fish in Idaho. Kokanee provide valued recreational fisheries, and also serve as an important prey resource for economically, socially, and ecologically important fishes. As such, kokanee are a major focus of natural resource agencies throughout Idaho. Kokanee are largely monitored using hydroacoustic surveys and mid-water trawls. However, the validity of data collected using mid-water trawls has been questioned due to the potential size selectivity of the gear. Therefore, we sought to assess the length selectivity of mid-water trawls by comparing estimates obtained from gill nets to those obtained using mid-water trawls. Experimental curtain gill nets were used to sample kokanee in six lakes and reservoirs throughout Idaho. Concurrently, kokanee were sampled using standard mid-water trawl techniques. The relative selectivity of gill nets was quantified using the SELECT method and was used to estimate a corrected length distribution. The corrected length distribution was then compared to estimates obtained from mid-water trawls to identify potential size-biases of mid-water trawls. In total, 2,414 kokanee were sampled during 2015 and 2016. Data collected in 2015 and 2016 suggest that mid-water trawls overestimate the number of small fish and underestimate the number of large fish in a

population. The apparent size-selectivity of mid-water trawls could bias population demographic and dynamics data used to manage kokanee populations. As such, managers should clearly identify the goals of a given monitoring program and choose gears that best address questions relating to the management of kokanee in Idaho.

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LIVE FISH, DEAD FISH, FAKE FISH, NO FISH: EFFECTS OF ALTERNATIVE MARINE-DERIVED NUTRIENT SUBSIDIES TO STREAMS IN CENTRAL IDAHO, USA. Ecological productivity in Pacific salmon-bearing watersheds is influenced by annual returns of anadromous fishes that deliver marine-derived carbon and nutrients to inland habitats during migration, spawning, and subsequent carcass deposition. These pulsed subsidies, and associated bioturbation, have been shown to influence the quantity and quality of freshwater and linked riparian habitats. However, extirpated or severely diminished returns of anadromous fishes to upper Columbia River tributaries above the Federal Columbia River Power System have potentially reduced aquatic and terrestrial productivity and associated carrying capacities for resident and anadromous fishes across large spatial scales. We investigated stream ecological responses, at multiple trophic levels (biofilm to fish), to the introduction of: 1) live spawning Chinook salmon (Live Fish), 2) Chinook salmon carcasses (Dead Fish), 3) salmon carcass analogs (Fake Fish), 4) and No Fish (Control). We highlight both similarities and differences in stream food web response measures across trophic levels in streams receiving animate (live salmon) and inanimate (carcass and analog) treatment forms of marine-derived subsidies. Our findings suggest that the ecological role anadromous fishes play in freshwater habitats is not mimicked by mitigation strategies such as carcass or carcass analog additions.

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LINEAR DENSITY OF AGE-0 AND AGE-1 RAINBOW TROUT IN A RENOWNED TAILWATER FISHERY. The South Fork Boise River (SFBR) downstream of Anderson Ranch Dam is a nationally-renowned tailwater trout fishery. Idaho Department of Fish and Game staff has monitored Rainbow Trout *Oncorhynchus mykiss* populations in the SFBR every three years since 1994. These monitoring efforts have only been effectively sample trout longer than 100 mm. Since 2009, IDFG has conducted annual spring and fall surveys along standardized transects to gain a better understanding of the production of Rainbow Trout (i.e. age-0 juveniles prior to fall and less than 100 mm), over-winter survival, and recruitment to age-1. During the spring survey in 2015, catch of age-1 Rainbow Trout ranged from 0 to 40 fish/site, which equated to a mean density was 0.2 fish/m.

Comparing fall and spring fry densities, overwinter survival for 2014-15 was estimated to be 51%. Mean density of age-0 Rainbow Trout during fall 2015 was 1.9 fish/m, which marks a return to near pre-wildfire densities. Fall density estimates in 2013 and 2014 (0.4 fish/m) were approximately 80% lower than the mean 2.3 fish/m estimated for years prior to the wildfire events of 2013. Results from 2015 continue to indicate that overwinter survival or carrying capacity rather than reproduction, determines year class abundance in the South Fork Boise River.

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SEASONAL EFFECTS OF MACROPHYTE GROWTH ON RAINBOW TROUT HABITAT AVAILABILITY AND SELECTION IN A LOW-GRADIENT, GROUNDWATER-DOMINATED RIVER. Rainbow trout habitat use is often described in high-gradient, runoff-driven, heterotrophic streams where geomorphic features and overhanging riparian vegetation provide channel complexity and cover. However, many rainbow trout populations thrive in rivers with contrasting aquatic habitat. We describe rainbow trout habitat use in a low-gradient, groundwater-dominated tailwater river where river flow management and macrophyte growth and senescence largely govern available trout habitat. In the summers of 2013 and 2014, available aquatic habitat (depth, velocity, macrophyte cover, substrate size) was quantified, while individual trout location was determined by radio telemetry and linked to environmental variables. Detailed habitat surveys indicate that macrophyte cover increases throughout the summer and is a strong determinant of in-stream habitat characteristics. Paired logistic regression shows that adult rainbow trout prefer greater depths. Water depth increases with macrophyte abundance at both reach and local scales as plants restrict flow, and available trout habitat is linked to this seasonal pattern. When macrophyte abundance is high, adult trout show secondary preference for localized areas of lower macrophyte cover but otherwise show no selectivity for macrophyte cover, velocity, or substrate size. Results suggest that submerged aquatic plants increased the quantity and quality of rainbow trout habitat as a source of channel complexity and cover. Macrophytes may play a similar role in other low-gradient streams and should not be overlooked by fisheries managers considering habitat suitability.

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ANGLER PERCEPTION OF FISHING EXPERIENCE IN A HIGHLY TECHNICAL CATCH-AND-RELEASE FISHERY: HOW CLOSELY DOES PERCEPTION ALIGN WITH BIOLOGICAL REALITY? Understanding angler expectations and maintaining angler satisfaction are important components of managing recreational fisheries. However, recreational fisheries management, and indeed natural resource management as a whole, faces increasingly complex challenges as human attitudes and

expectations clash with the realities of a changing climate and increasing demands on water resources. This study interviewed anglers in a highly specialized catch-and-release trout fishery in southeastern Idaho in 2008 and 2014, to better understand angler attitudes and assess coherence between perceived angling conditions and observed environmental conditions such as size and quantity of fish, macroinvertebrate abundance, and water quality. Anglers were contacted at fishing access points immediately after their fishing trips and asked about their experience level, trip characteristics, expectations, satisfaction with seven specific attributes of the fishery (e.g., size of fish caught), and satisfaction with overall fishing quality. A separate, informal survey was sent to this same angling community in 2016 after a recurrence of especially powerful criticism of river conditions by anglers. Results indicate that angler satisfaction is more closely tied to perceived aesthetics of a given fishing trip than to measurable biological variables. Furthermore, a higher fraction of 2016 survey respondents cited agricultural water use as a contributor to poor fishing conditions than acknowledged the effect of climatic factors. This poses a great challenge for recreational fisheries managers, but also indicates that both background research into angler perceptions and values, and angler education could be crucial strategies for successful future management of the resource.

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YIN AND YANG OF MIXED FISHERY FOOD WEBS: BALANCING NATURAL PRODUCTION OF KOKANEE, STOCKED RAINBOW TROUT, AND NON-NATIVE LARGEMOUTH BASS IN BUFFALO LAKE, WASHINGTON. Complex food web interactions in mixed warm- and coldwater fisheries can directly impact fish productivity. Buffalo Lake, located on the Colville Confederated Tribes (CCT) Reservation in north-central Washington State, has a mixed fishery primarily managed for a sustainable, naturally reproducing Kokanee population. Secondary management goals are to provide quality Largemouth Bass and stocked Rainbow Trout fisheries. Kokanee and hatchery Rainbow Trout may both exploit a common zooplankton food resource; excess trout stocking may reduce the productivity of both species through competitive interactions. In addition, predation from Largemouth Bass can decrease Kokanee productivity. Food web interactions for all Buffalo Lake fish species, have been studied through quarterly fish collections from 2014 to 2016. We employed stomach content analysis and diet overlap indices to quantify seasonal competitive overlap and interspecific predation. Rainbow Trout and Largemouth Bass appear to feed mostly on crayfish in the summer. Rainbow Trout feeding on crayfish is limited during winter and during warmer summer periods, when they shift to consuming zooplankton. Kokanee tend to occupy shallower waters in spring and fall to feed and spawn, which exposes them to Largemouth Bass predation. Managing these competitive interactions will be a challenge; we are currently employing bioenergetics modeling so that quantitative estimates of the competitive fish interactions can be employed to guide management strategies.

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APPLICATIONS OF ENVIRONMENTAL DNA ANALYSIS TO ASSESS SALMONID DISTRIBUTIONS AND RELATIVE ABUNDANCE IN LARGE LANDSCAPES. To test the utility and effectiveness of environmental DNA (eDNA) analysis as a monitoring method, we combined electro-fishing, snorkel-surveys, and eDNA sampling throughout the Okanogan River Basin in northcentral Washington, USA and southern British Columbia, Canada. Monitoring frameworks were explored to use existing habitat monitoring sites and strata and to take advantage of existing model data. Assessed species consisted of Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) and an ESA-designated Section 10(j) Experimental Population of spring-Chinook Salmon (*O. tshawytscha*). For both species, we explored relationships between eDNA detections (presence/absence) as well as eDNA concentrations (estimated by qPCR) to snorkel surveys, electro-fishing surveys, and habitat data. Preliminary results suggest that there is a correlation between eDNA concentrations and fish abundance (based on electro-fishing surveys) which could be useful to fisheries managers as a relative-abundance model, especially when combined with other survey data. This study demonstrates a strategy for incorporating eDNA sampling and analysis into existing watershed monitoring frameworks as well as highlights the strengths and weaknesses inherent to eDNA methodologies. This study was a collaborative effort between U.S. Geological Survey – Forest and Rangeland Ecosystem Science Center; Confederated Tribes of the Colville Reservation Fish & Wildlife Department - Okanogan Basin Monitoring and Evaluation Program; Confederated Tribes of the Colville Reservation Fish & Wildlife Department - Chief Joseph Hatchery Science Program; and Okanogan Nation Alliance.

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SEASONAL RESOURCE SELECTION BY INTRODUCED MOUNTAIN GOATS IN THE SOUTHWEST GREATER YELLOWSTONE AREA. Introduced mountain goats (*Oreamnos americanus*) and native bighorn sheep (*Ovis canadensis*) inhabit high-elevation, mountainous terrain in the Greater Yellowstone Area (GYA). Mountain goats have been expanding their range in GYA since their initial introductions in the 1940's, prompting concern that competition and disease transfer could negatively impact native bighorn sheep. We constructed summer and winter resource selection models using GPS data collected during 2011-2014 from 18 (14 female, 4 male) allopatric mountain goats in the Snake River Range of the southwest GYA. We used a mixed-model approach and evaluated landscape and environmental covariates at multiple spatial grains within four related suites. Mountain goat resource selection was grain dependent in both seasons. In summer, mountain goats largely selected rugged and steep areas at high elevations and avoided high solar radiation, canopy cover, and time-integrated NDVI. In winter, mountain goats selected lower elevations characterized by steep and rugged slopes on warm aspects and avoided areas with high canopy cover, NDVI amplitude, and snow water equivalent. Slope was the dominant predictor of habitat use in both seasons, although mountain goats selected for steeper slopes in winter than in summer. Regional extrapolations depicted suitable mountain goat habitat in the Snake River, Teton, Gros Ventre,

Wyoming and Salt Ranges centered around steep and rugged areas. Winter range was generally characterized by the steepest slopes within a more broadly distributed and generally less steep summer range. Further research should examine the spatial and temporal overlap of sympatric populations to further our understanding of resource selection dynamics and the potential for introduced mountain goats to alter bighorn sheep behavioral processes.

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THERMAL CONSTRAINTS AFFECT REPRODUCTIVE SUCCESS OF BURROWING OWLS BREEDING ALONG A LATITUDINAL GRADIENT. Burrowing Owl populations are declining both in terms of geographic distribution and abundance. One factor often assumed to contribute to population declines is the eradication of fossorial mammals that the owls depend upon for burrows. However, other processes may be responsible for observed population declines. We are investigating the processes that may drive local and range-wide population dynamics of the Burrowing Owl. Artificial nest burrows are widely used as a management tool for Burrowing Owls. We installed a total of 58 artificial nest burrows at 2 sites in southwestern Idaho (Elmore and Owyhee Counties) in 2015, and at 5 other sites, spanning a latitudinal transect from southeast California to northeastern Oregon. We placed motion-activated infrared video cameras inside artificial owl burrows to quantify geographic variation in numerous demographic parameters and reproductive traits. Burrowing Owls began incubation earlier in the egg-laying sequence, and therefore hatched their eggs more asynchronously, at low latitudes than at high latitudes. Furthermore, eggs often failed to hatch at our lowest latitude site, but hatching failure was rare at our highest latitude site. Finally, eggs that failed to hatch generally showed different levels of embryonic development, suggesting that the cause of hatching failure is embryo death and not egg infertility. These results are consistent with the hypothesis that owls in warmer nests are forced to begin incubation before they are done laying their eggs or risk suffering hatching failure (i.e., the egg viability hypothesis). Because warm conditions predominate at low latitudes, and because early incubation might energetically constrain the ability to lay more eggs, the egg viability hypothesis could also explain the observation that Burrowing Owls lay more eggs at high latitudes. These results could help explain local-scale and latitudinal variation in Burrowing Owl reproductive success and will allow us to refine future nest box designs.

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DISTRIBUTION AND PREVALENCE OF PROLIFERATIVE KIDNEY DISEASE IN SALMONIDS IN THE UPPER SNAKE RIVER DRAINAGE. Tetracapsuloides bryosalmonae (PKX) is an endoparasitic myxozoan, and is the contributing factor of the disease known as proliferative kidney disease (PKD) in salmonid fishes. While much is known about the effects of PKX on cultured fishes, much less is known about the distribution, prevalence, and population-level consequences of PKX on wild fish populations. The objective of this research was to (1) determine the distribution and prevalence of this parasite in the

Upper Snake River basin in Idaho and (2) determine the variation in infection rates among species. To accomplish our first objective, we tested mountain whitefish for PKX at six locations in the Upper Snake River basin. For our second objective, we tested for PKX in mountain whitefish, rainbow trout, and brown trout from Henry's Fork. We detected PKX at all sites that were sampled; mountain whitefish from all sites were infected with PKX with rates of infection ranging from 8 – 76%. Mountain whitefish in the Teton River had the highest rate of infection (76.7%). Infection rates of PKX were not consistent across species. In Henry's Fork, rainbow trout and brown trout (63% and 56% infection, respectively) had significantly higher rates of PKX infection compared to mountain whitefish (38%). Future research is needed to determine if this variation among species is consistent temporally and spatially. Additionally, continued monitoring is necessary to determine how PKX infection rates will change through time and to determine how PKX influences wild fish populations.

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POPULATION DYNAMICS AND MOVEMENT OF SMALLMOUTH BASS IN THE SNAKE RIVER.

Smallmouth Bass *Micropterus dolomieu* are a popular sport fish native to the Midwest and portions of the northeastern United States. They have been stocked outside of their native distribution for more than a century and were reportedly stocked in the Snake River as early as the late 1800s. In addition to past stocking efforts, impoundment of the Snake River and water storage practices have led to habit alterations that more closely resemble the native habitat of Smallmouth Bass. Between 1972 and 2006 Smallmouth Bass abundance increased (2,200%) in the portion of the Snake River near Swan Falls Dam. As a result, the Snake River between Swan Falls Dam and Brownlee Reservoir now supports a popular Smallmouth Bass sport fishery. Other than these long-term trends, little is known about the Smallmouth Bass population(s) in this portion of river or in its major tributaries (Boise, Weiser, and Payette rivers). Forty, 2-km long sites were sampled in the Snake River via boat electrofishing in 2016. Additionally, nine sites (13.5 km) were sampled in the three major tributaries using a combination of boat, canoe, and raft electrofishing. Length and weight of captured fish were recorded and dorsal spines were collected. Fish over 260 mm were tagged with individually marked T-bar anchor tags. Tags displayed a phone number that allowed anglers to report capture. Angler reports were used to identify coarse movement patterns from the initial tagging location to the point of capture and to estimate exploitation and use. Several population indices such as proportional size distribution and relative weight were calculated. Furthermore, growth, recruitment, and mortality will be characterized and used to describe the population and provide guidance to managers.

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MONARCH BUTTERFLY DEMOGRAPHY AND HABITAT SUITABILITY IN WESTERN IDAHO. Monarch butterfly (*Danaus plexippus*) populations have undergone extensive declines since the mid-1990s due to habitat loss and fragmentation in wintering and breeding ranges. Urbanization and intensive agricultural practices in breeding ranges have reduced populations of monarch obligate host milkweeds (Asclepias sp.). Little information exists on western monarch demography and no information exists regarding habitat suitability. In light of increasing conservation concerns and prospective Endangered Species Act listing, we determined the distribution, abundance, and demography of monarchs in Treasure Valley, ID. We employed citizen science efforts and the ArcGIS Collector app to collect milkweed and monarch occurrences and habitat characteristics. We conducted intensive monitoring efforts at known milkweed patch sites and collected monarch egg and larval survivorship data. We conducted habitat suitability analyses using generalized linear mixed models and model selection procedures to evaluate the importance of breeding site characteristics and monarch breeding success. Here, we present data for monarch egg and larval survival, results of our model and discuss their implications for monarch butterfly conservation.

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OSPREY NEST SITE SELECTION. Ospreys (*Pandion haliaetus*) are fish-eating, top predators of aquatic ecosystems that serve as useful sentinel species for monitoring environmental contaminants and ecosystem health. Ospreys are highly adaptable to human-dominated landscapes and readily nest on artificial structures that occur within an array of land use and land cover (LULC) types and human settlement regimes. In Long Valley Idaho, the abundance of breeding Ospreys has declined slightly since the late 1970's while the distribution of nests and nest substrate use has changed dramatically. We evaluated relationships among a suite of nest site characteristics to elucidate relationships among osprey nest site selection and anthropogenic drivers of landscape change. We used multivariate generalized linear models with model selection procedures to evaluate the relative importance of LULC composition and nest site characteristics associated with nest occupancy. Here we present our modeling results and discuss their utility for evaluating human impacts on osprey management.

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INDUCED DEFENSES IN *ARTEMISIA TRIDENTATA WYOMINGENSIS* AND IMPLICATIONS FOR HERBIVORES. Plants and herbivores have been locked in an evolutionary arms race for millions of years. Induced plant defenses, such as production of toxic compounds, can occur as a direct response to damage by herbivores, as well as through "eavesdropping" by neighboring plants that detect volatilized organic compounds released by the damaged plants. Specifically, many studies have documented that induced defenses in sagebrush (genus *Artemisia)* damaged early in the growing season can decrease overall herbivory over the course of an entire summer. Despite evidence that greater sage-grouse (*Centrocercus urophasianus*), pygmy rabbits (*Brachylagus idahoensis*), pronghorn (*Antilocapra americana*), and mule deer (*Odocoileus hemionus*) rely extensively on sagebrush for food during the winter, and that these species avoid plants with the highest concentration of chemical defenses, no study has investigated the timing and short-term effects of induced defenses in sagebrush in the winter. To understand the short-term changes in chemical defenses in sagebrush and predict how induced defenses may influence browsing by wildlife, we simulated browsing on sagebrush (*Artemisia tridentate* spp. *wyomingensis*) in winter by clipping leaves. We sampled "browsed" plants and paired "unbrowsed" control plants one hour, one-, two- and six days after initial "browsing" events and measured the concentration of monoterpenes and total phenolics in those leaves. We predicted an initial and sustained increase in the levels of these compounds in both damaged and control plants. Understanding the temporal dynamics and foraging consequences of induced chemical defenses in response to natural (browsing) and human-caused (i.e., mowing treatments) damage to plants will help predict "foodscapes" as well as foraging patterns of herbivores over varying time scales.

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KOOTENAI RIVER FLOODPLAIN ECOSYSTEM OPERATIONAL LOSS ASSESSMENT. Dams and reservoirs impact the environment through their presence in the landscape and by altering natural hydrologic cycles. To assess the impacts of these alterations, a process-based hierarchy is effective for representing this succession of impacts, and provides a 'roadmap' for exploring and assessing the processes linking successive levels of impact throughout the ecosystem. To assess the ecological impacts experienced in the Kootenai River and on its floodplain communities, a series of multi-metric indices were developed for each order of impacts and combined into an overall Index of Ecological Integrity (IEI) for the US portion of the Kootenai River floodplain and for each of the three unique geomorphic reaches of this river; the canyon, braided, and meander reaches. The current IEI value for the Kootenai River floodplain is 4.9 out of 10, with a 10 representing a pristine condition. When the IEI is calculated at the reach scale, the canyon, braided, and meander reaches scored 5.0, 5.3, and 4.5, respectively. The reach scores indicated that ecological integrity in the braided reach was the least affected, while the meander reach was the most affected of the three reaches. However, whether by reach or as an entire large river-floodplain ecosystem, these values reflect considerable alteration from a natural state (i.e. more than 50% altered).

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AVIAN SPECIES MONITORING ON THE NEZ PERCE – CLEARWATER NATIONAL FOREST. The USDA Forest Service identifies management indicator species (MIS) as indicators of forest health. These species are often chosen to represent specific habitat types within the forest and, to be most effective as indicators, tend to be sensitive to changes within the forest. In 2016, we surveyed for three management indicator species – Northern Goshawk (Accipiter gentilis), Belted Kingfishers (*Megaceryle alcyon*), and Pileated Woodpecker (*Dryocopus pileatus*) – and two other sensitive species – White-headed Woodpecker (*Picoides albolarvatus*) and Mountain Quail (*Oreortyx pictus*), within the Nez Perce – Clearwater National Forest. We engaged a diverse group of citizen scientists to complete surveys of Belted Kingfisher and deployed a team of biologists to complete spatially-balanced surveys for the other four species. We intentionally surveyed within broad strata for Mountain Quail and White-headed Woodpeckers in the hopes of detecting them in previously unknown areas of modeled suitable habitat. We performed multi-scale occupancy modeling to identify the habitat associations and occupancy rates of each species. We successfully established baseline detection and occupancy rates for all species, and identified habitat associations within the Forest for the most plentiful species.

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EXPLORING NORTHERN GOSHAWK POPULATION DYNAMICS USING INDIVIDUAL-BASED MODELS. Population regulation within an area is driven by many intrinsic and extrinsic factors. Understanding the effects and relative importance of these factors is essential to either prioritize management actions or to use population metrics of a given species as an indicator of ecosystem health. As populations become smaller or rarer on the landscape, the resolution of traditional population metrics become less precise and difficult to measure. Individual-based modeling consists of simulating the behavior and life-history traits of individual agents within a system (e.g., Northern Goshawks [*Accipiter gentilis*]). Individuals are then aggregated into populations where population-level dynamics can be calibrated and responses to perturbations can be explored. We will demonstrate how this method has helped inform our research into the population dynamics of the Northern Goshawk within the Minidoka Ranger District of the Sawtooth National Forest.

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EFFECT OF CLIMATE CHANGE ON WATER QUALITY BELOW ISLAND PARK RESERVOIR. Through alteration of nutrient, sediment, and energy budgets and streamflow regimes, reservoirs greatly influence downstream water quality. Island Park Reservoir is an irrigation storage and delivery

reservoir on the Henry's Fork that has capacity equal to one third of mean annual inflow and lies immediately upstream of the most popular reach among trout anglers. In 2016, above-average temperatures and below-average precipitation resulted in earlier springtime runoff, higher early-summer irrigation delivery, and higher early-summer reservoir water temperatures than long-term averages. Amidst these changes, anglers and fishing guides grew concerned about higher perceived turbidity below the reservoir during the historically prime fishing months. To determine ecological impact, we first investigated factors influencing turbidity downstream of the reservoir and then investigated the relationship between turbidity and suspended sediment concentration (SSC). Using time-series modeling and three years of climatic and hydrological data, we found that after accounting for obvious seasonal effects, reservoir volume was the most significant driver of turbidity at the annual scale. Turbidity increased significantly as reservoir volume decreased. During the 2016 irrigation season alone, reservoir volume remained the most significant variable, but there was also statistical evidence for an outflow-elevation factor. Turbidity was slightly lower when at least a portion of outflow was delivered through the power plant, which has a 30-foot higher withdrawal depth than the dam's original outlet works. Additionally, turbidity is more variable below the dam than in unregulated stream reaches and is influenced by factors other than SSC, such as pigments from decay of cyanobacteria blooms in the reservoir. We predict that biochemical reactions that produce cyanobacteria blooms and other in-reservoir productivity will start earlier and last longer under warming climate conditions.

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ADAPTING TO A DRIER FUTURE: EMBRACING CHANGES IN THE FUNCTIONS OF IRRIGATION-SUPPORTED MANAGED WETLANDS. Irrigation water supports numerous restored and created wetlands on the Snake River Plain of Idaho that are managed for wildlife, but which provide many other beneficial functions. Climate change models predict shallower snowpacks, increased irrigation demand, and less water availability. As a result, managed wetlands are likely to have less inflow, shorter hydroperiods with earlier drawdown, extended dry periods, and resultant changes in function. While waterfowl production still drives management of many wetlands, management for migratory bird needs is increasing. How might functions and migratory bird habitat support change in managed wetlands having less inflows and shorter hydroperiods? The potential functions of 13 irrigation-supported wildlife wetlands on the Snake River Plain were rapidly assessed using the Wetland Ecosystem Services Protocol for the United States. Using the same protocol, hypothetical functions under a drier hydrologic regime were calculated for the same wetlands. While changes in functions were not large, trends were toward increased water quality support functions, increased migratory bird habitat, and decreased waterfowl breeding habitat. Wetland management objectives should adapt to hydrologic change and embrace the beneficial functions likely to exist, even in a drier future

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HABITAT USE BY TERRITORIAL MALE PHEASANTS AND CHANGES IN DENSITY DURING 6 YEARS OF LANDSCAPE CHANGE. Census of ring-necked pheasants (*Phasianus colchicus*) were conducted

during the springs of 1994-1999 on 13, one-mile square sections (3.3 km2/section) of agricultural land in Gooding County, Idaho. Average pheasant densities (number/section) were 5.8 ± 1.0 for territorial males, (mean ± 95% CI), 4.6 ± 1.4 for females, 0.8 ± 0.2 for non-territorial males, and 11.2 ± 2.4 for all pheasants combined. The maximum densities observed across all sections and all years were 20 territorial males, 29 females, and 5 non-territorial males. The maximum density for any single year within one section was 16 territorial males, 29 females, and 2 non-territorial males. Territorial male densities declined 39% with an average decline of 6.5%/year for the length of the 6 year study. Crop reports and aerial photos were used to determine cover types within the sections and within male territories. Additional analysis of the habitat within territories compared to available habitat and temporal changes in composition will be presented.

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ENVIRONMENTAL CONSTRAINTS ON PRONGHORN NEONATE SURVIVAL ACROSS IDAHO. Idaho pronghorn (*Antilocapra americana*) populations have failed to rebound to previously high levels found in the late 1980s. Pronghorn population recruitment is driven by nutritional conditions, climate, and predation. We are examining neonate pronghorn survival across Idaho, in three distinct study sites. The habitat of the study sites include: native high elevation shrub-steppe, altered/low quality shrub-steppe, and agricultural based habitat. Neonates were collared and monitored daily to determine survival-ship of the fawns. Morphological measurements of fawns along with fawn bed site cover selection were measured. Predator track plate surveys were completed to estimate predator densities. Alternative prey species were surveyed to estimate densities. Pronghorn fecal samples were collected to assess fecal nitrogen and DAPA indices as a measure of habitat quality across the different populations. We then compared survival rates across the three study sites and survival across the covariates collected throughout the study.

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ECOLOGICAL RESTORATION ALONG THE KOOTENAI RIVER: LINKING FOOD WEB, WILDLIFE HABITAT AND AQUATIC HABITAT. Since 2011, the Kootenai Tribe of Idaho has restored 67 acres of floodplain habitat in the Kootenai River above Bonners Ferry, Idaho. This work supports a whole ecosystem restoration vision to save Kootenai River white sturgeon from extinction and replace habitat lost to Libby Dam operations and a century of land use. Libby Dam, which became operational in 1975, has impacted the nutrient and sediment supply and reduced annual peak flows in Idaho by half. This has affected the foundation of the food web, greatly reduced sediment available to build new floodplains, and disconnected the historical floodplain from current hydrology. In response to these changes, the Kootenai Tribe of Idaho is building new floodplains that are connected to post-Libby Dam hydrology, and restoring riparian forests to support both aquatic and terrestrial habitat. Designing floodplains in this dam-controlled system has required an interdisciplinary approach that incorporates plant ecology, hydrologic and hydraulic analyses, and wildlife management, in addition to aquatic ecology, fish biology and an understanding of food web interactions. Results from land

cover mapping, plant community assessments, 1D and 2D hydraulic modeling, hydrologic analysis, and LiDAR mapping were combined to identify design criteria for constructed floodplains capable of supporting new riparian forests. The revegetation strategy includes strategic planting of native tree and shrub seedlings grown from locally collected seed, combined with natural recruitment of willows and cottonwoods. Low existing supply of riparian forest, combined with high demand from the local deer population, requires an aggressive wildlife management strategy to limit effects from browse. An applied adaptive management program produces annual report cards that guide maintenance actions, and monitoring is targeted to provide information that informs management. The growing data set will continue to support this project, and will also support other projects in the region with similar ecosystem-scale objectives.

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A BIOLOGICAL ASSESSMENT OF FISH POPULATIONS UTILIZING THE LOWER WEISER RIVER, IDAHO. Prior to the fall of 2015, basic information and understanding of fish populations in the lower Weiser River was somewhat limited. Prior surveys in 1974 and 1999 indicated that Smallmouth Bass *Micropterus dolomieu* (SMB) were the most numerous species. To acquire more current information, I sampled nine sites in the lower Weiser River between Cambridge, ID and the confluence with the Snake River, at Weiser, ID, to determine fish distribution, species composition, relative abundance, size structure, and biomass. The survey was completed in early October with a canoe electrofishing unit. Three sites were selected to conduct mark-recapture sampling efficiencies and density estimates. A total of 3,343 fish, comprised of 18 species, were sampled. Native species composed 7% of the fish sampled. SMB were the most abundant species in all survey sites and contributed 76.8% of the catch and 43.1% of the biomass. The total catch-per-unit-effort (CPUE) and weight-per-unit-effort (WPUE) for all species was estimated at 485 fish/h (90% CI, ± 144) and 30.5 kg/h (± 17.4). The mean SMB CPUE and WPUE were 372 f/h (± 152) and 12.1 kg/h (± 5.5), respectively. SMB mean length and weight was 130 mm (± 2) and 51 g (± 4). Proportional stock density (PSD) and relative stock density (RSD) for SMB were calculated at 21 and 13, respectively, indicating an unbalanced size structure skewed towards small fish. Unbalanced size structure may indicate slow growth, high mortality, or movement of larger individuals. Relatively low sampling efficiency for SMB may have skewed size structure and the results from the survey may not fully characterize the fish community within the reach. The survey sites and results serve as baseline data for comparisons with future surveys in the lower Weiser River.

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SAMPLE HETEROGENEITY USING BUCKET SNARES TO CAPTURE AMERICAN BLACK BEARS IN SOUTHEAST OKLAHOMA. While noninvasive methods of population estimation continue to be improved, live capture remains an essential part of wildlife population research. The majority of American black bear (*Ursus americanus*) population studies involving live capture have used Aldrich foot-hold snares and barrel and culvert traps to capture individuals, but new designs including the bucket snare are increasingly being used by

wildlife management agencies and researchers throughout the United States and Canada. Despite their use by several wildlife management agencies, little is known about the capture efficiency, injury rates, and capture biases of bucket snares. To address these gaps in knowledge surrounding the use of bucket snares, we placed remotely triggered cameras at active trap sites from May to August 2015 in southeastern Oklahoma. During 1,285 camera trap-nights, we recorded 712 bear visitation events and 106 successful captures. Of the 403 visitation events in which the trap was active, 26.3% resulted in a successful capture (n = 106). By-catch was limited to 1 species, northern raccoons (*Procyon lotor*). We visually analyzed photographs, grouping captures by visitation type and outcome and modeled the capture process as a series of binary responses using 5 stages. We predicted that (1) unmarked bears would be more likely to approach, handle, spring, be snared, and be captured than marked bears, (2) the likelihood of successful capture would increase with weight, (3) with increasing experience the probability of successful capture would decrease, and (4) males would be more likely to approach and handle a trap than females. Results of the capture models indicated that sex, mark status, and weight characteristics affected the composition of the sample captured using bucket snares, therefore, it is important to keep capture heterogeneity in mind when characterizing population demographics and calculating abundance using this capture method.

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EFFECTS OF DROUGHT AND SEASONAL PRECIPITATION ON COLUMBIA SPOTTED FROG POPULATIONS. Drought is considered one of the greatest threats to amphibian populations inhabiting arid environments and yet few studies have examined how episodic drought affects amphibian population demography and growth rates. Using mark-recapture analysis, we estimated the effect of seasonal precipitation and extreme deviations from normal precipitation on annual survival and recruitment in populations of the Columbia spotted frog (*Rana luteiventris*) at nine locations across the species range. Across all populations, over 15,000 adult frogs were marked between 1997 and 2015, with 33% of frogs recaptured at least once. From 1995-2015, the Great Basin frog populations experienced severe drought 47-58% of the time, with one event lasting 5 years, while northern populations rarely experienced severe drought. Preliminary analyses suggest that capture probability was significantly higher in years with severe drought in 5 of 8 populations, probably because frogs were more congregated near available surface water during these dry years. We found no evidence that severe drought had negative effects on annual survival or recruitment of frogs in the Great Basin, with the exception of the southern-most population that had lower recruitment during drought years. Where drought had negative effects on frog recruitment, simple management actions such as pond building aimed to create more permanent water sources for frogs resulted in rapid increases in recruitment, at least for the first few years after construction. These findings suggest that habitat management actions designed to increase water availability may be a viable solution for reducing threats to arid land amphibian species from frequent drought, which is predicted to become more common in some locations over the next several decades.

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COMBINING INNOVATIVE TECHNOLOGIES FOR MONITORING THE DIVERSITY OF THREATENED WILD STEELHEAD AND CHINOOK SALMON IN THE SNAKE RIVER BASIN. Since 2010, multiple agencies have collaborated to PIT tag and biologically sample adult steelhead and Chinook salmon as they migrate past Lower Granite Dam on the Snake River. The subsequent detection of those adults at Instream PIT Tag Detections Systems (IPTDS) located throughout the Snake River basin, allows estimation of population abundance through mark/recapture methods. By combining known destination adults with biological samples taken during tagging allows the generation of population specific life-history diversity (sex ratios, length distributions, age structure, run-timing) and genetic diversity. In this study, we summarize life-history and genetic diversity for 18 of the 24 extant threatened Snake River Steelhead DPS populations and 26 of the 31 extant threatened Snake River Chinook Salmon DPS populations for spawn years 2010 through 2015. The combination of PIT tag technology, biological sampling, and genetic analyses, provide an innovative monitoring strategy for estimating parameters necessary to assess the viability of these ESA-listed species over time.

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THE INFLUENCE OF WIND ENERGY DEVELOPMENT AND HABITAT COMPOSITION ON COLUMBIAN SHARP-TAILED GROUSE BREEDING SEASON ECOLOGY IN EASTERN IDAHO. Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*, hereafter CSTG) occupy less than 5% of their historic breeding range within the U.S. and have been petitioned twice for Endangered Species Act protection. Habitat loss and degradation are considered the primary threats to CSTG populations throughout their range. Rapid expansion of wind energy development across prairie habitats has raised concerns over impacts to prairie grouse, including CSTG. We initiated a study to address the influence of wind energy development and habitat composition on CSTG breeding season habitat selection and fitness in the vicinity of a 215-turbine wind energy complex in Bonneville County, Idaho. Between 2014 and 2015, we trapped and radio-marked 135 female CSTG from 11 leks, across a mosaic of habitat types, ranging from 0-14 km from wind turbines. We monitored 147 nests and 68 broods and assessed the influence of habitat and wind energy variables on nest site selection, nest survival, brood habitat selection, and brood survival at multiple spatial scales. The best predictor for nest site selection was forb canopy coverage at the core use (60 ha radius) scale. The top multi-scale model for daily nest survival included visual obstruction at the microsite (6 m radius) scale and forb canopy coverage at the core use scale. Wind turbine variables were not strong predictors of either nest site selection or nest survival. Results from ongoing brood habitat selection

and survival analyses will be presented as well.

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USE OF GPS DATALOGGERS TO EXAMINE BEHAVIOR AND RESOURCE SELECTION OF BARN OWLS IN RELATION TO ROADS. Anthropogenic development, including roads, has the potential to affect Barn Owl (*Tyto alba*) populations. Along Interestate-84 in southern Idaho, Barn Owls suffer the world's highest reported rates of roadway mortality. However, little is known about the behavior of Barn Owls in relation to this interstate. Thus, we initiated studies to examine movements and habitat selection of Barn Owls. We instrumented four male Barn Owls during 2015 and obtained location data that spanned two weeks of activity during the nesting season from each. We examined the efficacy of GPS data loggers for tracking Barn Owls and assessed methods for recapturing owls to facilitate retrieval of data from the loggers. We recaptured all instrumented males and found that manual- or laser-break triggered trap doors mounted on the nest box were especially effective for recapturing Barn Owls. Using the location data, we mapped home ranges, evaluated habitat selection, and quantified movements. Owl behavioral results are discussed in relation to population biology and roadway mortality.

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BREEDING POPULATION DYNAMICS AND DISTRIBUTION OF WESTERN AMERICAN WHITE PELICANS, 1981-2014. The western U.S. population of American White Pelicans (*Pelecanus erythrorhynchos*) primarily breeds west of the Continental Divide. Biologists have counted nest and fledgling abundance at western pelican colonies, with varying levels of regularity, since the 1950s. We compiled available count data to assess trends in breeding pelican abundance and productivity and investigate latitudinal changes in breeding distribution. Population-wide, the rate of change in breeding pelican abundance was negatively related to the previous year's abundance and positively related to time, suggesting density dependence and a temporally increasing carrying capacity. The proportion of breeding pelicans that attended new or re-established colonies, versus consistently-occupied historic colonies, increased over time. Population-wide production increased with increasing nest abundance but overall trended down over time. Colony-specific production was not related to colony nest abundance and showed a declining temporal trend across all colonies. Active colonies appear to be expanding northward, with the mean latitude of active colonies in 2010–2014 approximately 260 km north of colonies active prior to 1970. Our results suggest population dynamics of pelicans in the western U.S. are influenced by long-term trends in breeding abundance and production as well as short-term, density-dependent processes that influence annual rates of change in breeding abundance and productivity. Future research should seek to better understand

the mechanisms for these density dependent relationships and for the possible temporal increase in breeding population carrying capacity. Our results also suggest that population-wide monitoring efforts should be modified to accommodate the density dependent dynamics of breeding western American White Pelicans.

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AERIAL POPULATION SURVEYS USING ADVANCED INFRARED SENSORS. Mounted on a fixed wing aircraft, advanced cooled infrared and high definition daylight video integrated systems have the capability to successfully detect, count, and classify a variety of wildlife species. We used this advanced aerial infrared system (AIR) to conduct ungulate surveys over a variety of terrain and habitat types to assess ungulate densities. USGS also recently concluded a four-year study to determine the accuracy of sage grouse (*Centrocercus urophasianus*) lek counts using AIR. Preliminary results of the USGS study indicate AIR is the most accurate method of counting leks, even more accurate than ground counts. Further research is planned to establish AIR survey detection probabilities for both ungulates and prairie grouse leks. A fixed-wing aircraft - mounted advanced AIR system has several advantages over ground based or aerial visual surveys. Increased wildlife detectability, ability to survey remote areas, greater spatial variation, increased survey size, and no disturbance of wildlife all contribute to survey quality and cost effectiveness. AIR surveys are conducted at higher altitudes than aerial visual surveys resulting in increased crewmember safety. Recent technological advancements in AIR accompanied with high definition daylight recording capabilities and integrated GIS functions are increasingly valuable tools for aerial wildlife surveys and enable acquisition of otherwise unavailable data.

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SAGE-GROUSE FORBS: FOOD OR NOT? Sites with greater quantities of forbs have been found to have higher grouse productivity. Why bother eating forbs? Forbs are higher in crude protein, calcium, phosphorus and are more succulent than grasses. However, not all forbs are created equal and yet standard categories for rating forbs have not been well established for sage grouse preference. Sage-grouse (S-G) productivity may be limited by the availability of certain preferred, highly nutritious forb species that have declined due to differential grazing preference and due to the competition from weedy plants. The season of use by livestock can also influence the amount of weeds versus good forbs for SG post fire. 12 forb groups are presented to categorize preference by sage-grouse based on both the wildlife and botanical literature. Some forbs are counted as good for sage-grouse that are really course forbs that they avoid. Coarse forbs are not preferred due to: either of both chemical or physical avoidance.

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BURBOT *LOTA LOTA MACULOSA* RESTORATION IN THE KOOTENAI RIVER, IDAHO: A UNIQUELY COLLABORATIVE SUCCESS STORY. Burbot *Lota lota maculosa* were once abundant in the Kootenai/ay River Basin in Idaho, Montana, and British Columbia, and they provided important commercial, recreational, and cultural fisheries throughout the basin. However, cumulative effects of purported over-exploitation and the completion of Libby Dam in Montana (in 1972) resulted in the entire fishery collapsing to the point of functional extinction. International, multi-agency collaboration since the early 2000s has resulted in increased abundance of Burbot in the river in recent years; however, there is currently little evidence of natural recruitment. Conservation aquaculture efforts by the University of Idaho Aquaculture Research Institute and the Kootenai Tribe of Idaho, in conjunction with largescale mitigation efforts and long-term monitoring and evaluation have revealed key insights into the current status of the species in the Kootenai River basin. Results through 2016 indicate that Burbot numbers are consistently increasing, and the fishery is currently comprised of multiple year classes produced from hatchery efforts, indicative of a healthy and growing population. Apparent survival estimates derived from Cormack-Jolly-Seber models in Program MARK indicate that Burbot are surviving in the river after being released from the hatchery, and there is differential survival based on age-at-release as well as location of release. Derived survival estimates are being used to estimate the number of adult Burbot in the river and also to directly inform hatchery production targets in order to meet previously agreed upon restoration goals. In addition, Burbot are pioneering into tributary habitats during the spawning season, which could potentially provide a mechanism for natural recruitment if the temperature regime in the main-stem river is responsible for the recruitment bottleneck, as purported. Research is ongoing to identify specific causes of recruitment failure, but discussions among managers have begun regarding a potential fishery in the coming years.

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EFFECTS OF AIR EXPOSURE ON SURVIVAL AND FITNESS OF YELLOWSTONE CUTTHROAT TROUT. In recent years, concerns over the negative effects of exposing fish to air during catch-and-release angling have become more prevalent. Current literature has focused on the effects of air exposure on mortality. However, few studies have evaluated the effects of air exposure on fitness. The purpose of this study was to evaluate the effects of air exposure on survival and fitness of Yellowstone Cutthroat Trout *Oncorhynchus clarkii bouvieri*. This study was conducted on Burns Creek, a tributary of the South Fork Snake River (SFSR) from May through October 2016. Pre-spawn adult fish were sampled at an existing Idaho Department of Fish and Game velocity-barrier weir. While the gills remained underwater, each fish was tagged with passive a integrated transponder (PIT) tag, a tissue sample was taken, the fish was measured, and then hooked through the lower jaw with a 1/0 circle hook. Fish were released upstream of the weir and played to simulate angling. After angling, fish were randomly assigned an air exposure treatment of 0, 30, or 60 s. After receiving an

air exposure treatment, fish were unhooked and released upstream. In total, 1,523 adult fish were sampled (0 s, n = 488; 30 s, n = 499; 60 s, n = 536). Two fixed PIT-tag antennas located downstream of the weir were used to detect adult fish as they out-migrated back to the SFSR. Two hundred seventeen tagged fish were detected out-migrating (0 s, n = 58, 12%; 30 s, n = 71, 14%; 60 s, n = 88, 16%). In addition to adult sampling, age-0 fish (n = 2,924) were collected and tissue samples were taken for parentage analysis to evaluate the effects of air exposure on fitness. Results of this study will provide insight on how catch-and-release angling influences survival and fitness of Yellowstone Cutthroat Trout.

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EFFECTS OF YY-MALE STOCKING AND MANUAL SUPPRESSION FOR ERADICATION OF NON-NATIVE BROOK TROUT POPULATIONS. Eradication of non-native Brook Trout *Salvelinus fontinalis* populations is difficult to achieve with standard techniques such as electrofishing removal or piscicides; new approaches are needed. We constructed an age-structured stochastic model to investigate effects of manual suppression and fingerling supermale (MYY) stocking on long-term viability of hypothetical non-native Brook Trout populations. In streams, an annual stocking rate of supermales equivalent to 50% of wild age-0 trout density combined with an annual selective suppression rate equivalent to 50% of wild trout density resulted in a median time to extirpation of only 4 years (LL = 2 years; UL = 4 years) if supermale fitness was equivalent to normal male fitness, but 12 years (LL = 5 years; UL = 15 years) if supermale fitness was 80% lower than normal male fitness. In alpine lakes, increases in fingerling supermale stocking and non-selective gill-netting were required to eradicate Brook Trout populations. However, assuming that supermales are as fit as wild males, any stocking rate greater than 49% in alpine lakes or 60% in streams achieved eradication in 10 years or less, regardless of the suppression rate. Because manual suppression and fingerling supermale stocking can feasibly be conducted at levels assumed in our simulations, use of such an Integrated Pest Management (IPM) approach could extirpate undesirable Brook Trout populations within reasonably short periods of time of interest to managers. Given the recent successful development of a YY Brook Trout broodstock capable of producing large numbers of fingerling MYY fish, and positive results of the present study in both streams and alpine lakes, field testing of YY Male stocking is warranted within an IPM program that includes manual suppression for eradication of undesired Brook Trout populations.

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THE MONITORINGRESOURCES.ORG TOOL TO DESIGN SAMPLING LOCATIONS FOR ECOLOGICAL MONITORING. MonitoringResources.org is a network of online resources and tools, developed by the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), to support many facets of ecological and biological monitoring. These resources include orientation and educational materials, a community forum, a place to document and share your monitoring methods, the ability to describe your monitoring projects, and tools to upload your sample sites and create study designs.

We will present an overview of the resources and tools available for creating, documenting and reporting spatial and temporal designs associated with field data collection. The MonitoringResource.org design tools guide you step-by-step through the process of documenting site selection and spatial and temporal design, resulting in a detailed record. You can use a Master Sample stored in the Site Manager tool to develop a statistically robust generalized randomized tessellation stratification (GRTS) design (Stevens and Olsen, 2004). The tool walks you through the GRTS design process, including stratifying based on attributes associated with the master sample (i.e. eco-region, state, county, elevation), and facilitates building a rotating panel design. Using the MonitoringResources.org design tools you can produce consistent documentation, maps of sampling locations, and shapefiles of sample sites that can be downloaded to implement sample designs. Post-implementation we provide multiple tools to support and guide you through reporting back of actual data collection locations and dates. When you use the full suite of sample design resources, you can display your program's sites on a searchable online mapper view alongside other regional monitoring efforts. This allows you to search and see who is doing what, where, when and how and promotes coordination and collaboration of monitoring efforts.

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COMMON RAVEN USE OF POWER LINES FOR NESTING: IMPLICATIONS FOR SAGE-GROUSE CONSERVATION. The common raven (*Corvus corax*; hereafter raven) has become increasingly prevalent in western sagebrush landscapes due to increased food, water, and nesting subsidies from humans, often associated with habitat fragmentation. The raven is an effective nest predator and can impact reproductive success of sensitive species, including the greater sage-grouse (*Centrocercus urophasianus*). For the past three years, I have monitored all power lines and other infrastructure each spring that could potentially support raven nests on the Idaho National Laboratory Site. My objectives were to quantify the number of raven nests on infrastructure and determine if infrastructure use by raven nesting pairs is increasing. I found clear evidence that ravens have increasingly used power transmission structures as nest substrates. Further, the data provide insight into the size of territories defended by raven breeding pairs. Using this information, I estimate that the current level of raven nesting is likely far below carrying capacity. Although no studies on the INL Site have been conducted that would link raven abundance to sage-grouse reproductive success, a review of the literature suggests that increasing occupancy by ravens will cause negative impacts to sage-grouse that nest on the INL Site.

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DEVELOPMENT AND MORPHOLOGICAL AGING METRICS OF OSPREY NESTLINGS IN WEST CENTRAL IDAHO. Nestling development and morphological metrics provide critical information central to understanding and evaluating raptor breeding ecology. Ospreys (*Pandion haliaetus*) are specialized

piscivorous top predators of aquatic ecosystems. Considerably distinct, ospreys belong to the monotypic family *Pandionidae*. Despite their unique classification, researchers have yet to create a nestling aging guide. We collected morphological and photographic data from six osprey nests in Long Valley, Idaho. We used these data to meet two objectives: 1) Develop a photographic and descriptive osprey nestling aging guide 2) Determine which morphological characteristics are the best predictor of osprey nestling age. Camera traps were installed on each nest before the breeding season and programmed to take one photograph every 5 minutes during daylight hours. Nests were visited weekly to collect morphological measurements and photograph each nestling (n=14). Initial analysis shows a strong correlation in nestling forearm length and age (R2=0.97). Further analysis is being conducted to determine which factors have the greatest effect on osprey nestling development (i.e., hatch order, nest location, preferred prey species, etc.). Here we present photographs, nestling developmental trends, and our initial analysis of age predictors for ospreys in west central Idaho.

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THERAPY FOR THE SHIFTING BASELINE SYNDROME: APPLICATION OF ARCHIVAL AND CONTEMPORARY DATA TO ESTIMATE HISTORICAL CHINOOK SALMON ABUNDANCE IN CENTRAL IDAHO. The paradigm whereby new generations accept recent environmental conditions and species abundances as accurately reflecting historical conditions has been termed the “shifting baseline syndrome”. This syndrome leads to false impressions of past conditions, acceptance of inaccurate population baselines, and establishment of unrealistically low recovery goals. Consequently, the utility of even the highest-quality and longest-term databases may be compromised without historical abundance estimates. The inherent risks of the shifting baseline syndrome challenge biologists to accurately estimate past abundances and distributions of aquatic and terrestrial fauna. Biologists commonly employ redd counts to monitor trends in Chinook salmon. In Central Idaho, salmon redd counts began in 1947 and have been consistently completed since the 1950s. Such long-term datasets represent an invaluable baseline against which current population status may be examined. However, because overexploitation of salmon and disruption of habitats occurred decades before initial quantitative assessments, contemporary managers may misjudge actual population potentials. In response to the need for historical accuracy, our goal was to integrate long-term archival (1952-1964) redd counts with contemporary, continuous redd count (1995-2015) and spawn timing (2001-2005) databases to estimate historical (1950s-1960s) spring/summer Chinook salmon production potential in the Middle Fork Salmon River basin (MFSR). Here we describe our assumptions and analytical approaches for merging the temporal and spatial characteristics of salmon redds with maximum, archival redd counts to estimate historical potential. We also applied historical harvest information to estimate pre-harvest potential in the 1950s-1960s and 1880s. Current salmon populations average 3-5% of 1950s-1960s abundances; which evidence suggests may have been 30% of 1880s populations. Notably, despite high quality MFSR natal habitats, the shifting baseline syndrome has influenced contemporary managers. Summed population goals for MFSR Chinook salmon equal 10.4%, 17.9%, and 20.4%, of estimated 1950s-1960s salmon production potential for minimum viable abundance, sustainable escapement, and

population re-building objectives, respectively.

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METHODS COMPARISON: ADULT SALMON AND STEELHEAD ABUNDANCE. Information on adult fish abundance, productivity, diversity and distribution is considered a cornerstone for fish management. The availability and quality of that data is dependent upon the method being used to quantify adult abundance, resulting in nuanced differences in data quality (accuracy and precision), type and scope of attributes (metrics), and cost. While fisheries managers desire accurate and precise information on all populations, fiscal resources and physical habitat influence the spatial coverage of populations be monitored and type of method(s) being applied. Sixty two spring/summer Chinook salmon and steelhead populations exist in the Snake River Basin, spanning the management authorities of three states (Idaho, Oregon and Washington), three tribes (Nez Perce, Shoshone-Bannock, and Confederated Tribes of the Umatilla), and two federal agencies (National Oceanic and Atmospheric Administration and U.S. Fish and Wildlife Service), and with numerous interest groups and funding entities. The methods and spatial coverage of adult fish monitoring actions continues to receive much critique with calls for increased efficiency and reduced cost. It was recommended that concurrent sampling strategies (methods) be implemented/replicated in select Snake Basin tributaries for five years and that a collaborative assessment be prepared. Examined methods include: weir-based mark-recapture, redd counts (five variations), genetic stock identification (GSI), dual identification sonar (DIDSON), and Lower Granite Dam/PIT tag array-based mark-recapture (four variations). In this paper, we present 1) simulation modeling to examine the accuracy and precision of Snake Basin spring /summer Chinook salmon and steelhead abundance estimates at Lower Granite Dam and natal streams, 2) comparisons of abundance estimates (and associated precision) generated by different methods, and 3) description of attributes (metrics) generated by method type and relative cost. We conclude with thoughts on each method's general sufficiency for management use and recommendations for preferred monitoring method(s) in specific populations.

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CREATING A DIVERSE WORK FORCE OF WILDLIFE BIOLOGISTS: HOW ARE WE DOING? Women and minorities are underrepresented in fish and wildlife professions. Creating a diverse workforce for the future is critically dependent on university training programs. This presentation will focus on evaluating current status and trends in gender and ethnic diversity among faculty and students from

2005 to 2015 as well as examine support programs for underrepresented groups. We gathered data on the proportion of women and minorities in the following groups using established databases and online surveys: department heads, faculty, graduate and undergraduate students to evaluate the representation of underrepresented groups in wildlife education and student training. Our final dataset included survey data on faculty from 17 universities and from students at 27 universities. We observed the greatest increases in gender diversity among students and an equal sex ratio in 2015. Ethnic diversity among students also increased but was still considerably below current demographics of the US population. Increases in gender and ethnic diversity were also detected at the faculty level with the greatest increases but lowest percentages observed among the full professor rank. Scholarship programs for underrepresented students were reported at 45% of the institutions and support program were common. Overall, our results show a very positive picture for gender diversity at the student level and the potential for increase in gender diversity among wildlife professionals as these students complete degrees and move into the workforce. Ethnic diversity among students is still 50% lower than observed in the US population and more effort is needed to recruit students from these diverse groups. Retaining a more diverse group of wildlife professionals will likely depend strongly on the work environment and mentoring thus support programs similar to those established at Universities may be beneficial in state and federal agencies.

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REHABILITATION, COLLABORATION, AND EXPERIMENTATION: TEX CREEK WILDLIFE MANAGEMENT AREA FOLLOWING THE HENRY'S CREEK FIRE, AUGUST 2016. The Henry's Creek Fire burned approximately 53,000 acres of mixed-ownership lands east of Idaho Falls in late August 2016. The fire burned 22,000 of the 34,000 acres on the Tex Creek Wildlife Management Area that is managed predominantly for >8,000 wintering mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*). The largest impact of the fire was the substantial loss of the big sagebrush (*Artemisia tridentata*) overstory, particularly important in critical winter range for mule deer, and the long-term rehabilitation goal is the re-establishment of this critical habitat component throughout the burned areas. Initial rehabilitation plans include applying an experimental *Pseudomonas fluorescens* bacterium to inhibit growth of cheatgrass, aerial seeding a sagebrush/forb/grass mix and planting sagebrush seedlings to promote the re-establishment of sagebrush, and controlling noxious weeds throughout the burn footprint. Rehabilitation plans are all based on extensive collaboration with multiple individuals across many organizations. All implemented projects will be monitored for effectiveness, including the effects of the bacteria with and without imazapic herbicide on the control of cheatgrass.

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MOVEMENT OF COLUMBIA RIVER REDBAND TROUT (*ONCORHYNCHUS MYKISS GAIRDNERI*) IN AN INTERMITTENT SOUTHERN IDAHO STREAM. The Columbia River redband trout (*Oncorhynchus*

mykiss gairdneri) is native to the Columbia River Basin east of the Cascades. Throughout the region, redband trout populations have been negatively affected by introgression with hatchery stocks and by isolation due to migration barriers. The objective of our research was to describe trout movement patterns (including an evaluation of culvert passage) in Dry Creek, a small tributary of the Boise River. We used fixed PIT-tag antennae stations and genetic techniques to evaluate fish movement. From 2012-2015, stream reaches throughout the watershed were surveyed for redband trout. Fish were collected via electrofishing, PIT-tagged, and fin clipped. Genetic analyses of 617 individual fin clips were carried out at the Idaho Department of Fish and Game (IDFG), Fish Genetics Laboratory in Eagle, Idaho. Each fish was genotyped at 186 single nucleotide polymorphisms (SNPs). Genetic analyses using the program Colony identified 40 trout families (defined as three or more full-siblings). Mean distance of trout within families was 1545-m, indicating significant dispersal of individual trout. Most families (75%) were located above the culvert while only five families were found entirely below the culvert. While no PIT tagged fish crossed the culvert, full siblings from five families were observed on opposite sides of the culvert. Fish passage models derived from FishXing v3 suggest the culvert (Bogus Basin Road) to be a barrier to upstream movement for fish less than 250-mm total length (TL). A picture has unfolded where fish move downstream across the culvert but then are unable to return upstream. This finding has important implications for the trout population as stream reaches below the culvert often experience complete drying during summer months.

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INVESTIGATING THE STATUS OF THE MONARCH BUTTERFLY IN IDAHO. Monarch butterfly (*Danaus plexippus*) populations in North America have experienced significant declines over the last two decades and are currently being considered for protection under the federal Endangered Species Act. Factors implicated in declines include loss of milkweed (*Asclepias* spp.) host plants, loss of overwintering habitats, severe weather events, and other stressors. In contrast to the monarch population in eastern North America, the smaller western population has been little studied outside of its overwintering sites in coastal California. Basic information on western monarch breeding habitats, nectar resources, and migratory pathways remains poorly understood, particularly across the inland West, including Idaho. These data are crucial to focus monarch habitat conservation and restoration efforts in areas where they will have the greatest impact. As part of a federal grant to address pollinator conservation in the Idaho State Wildlife Action Plan, in 2016 we conducted a statewide survey for milkweeds and breeding monarchs to fill critical knowledge gaps in Idaho. In this presentation, we review our preliminary findings and report on a new western monarch and milkweed data collection and sharing website developed in partnership with the Xerces Society for Invertebrate Conservation.

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COLLECTOR FOR ARCGIS AND SURVEY 123: ELECTRONIC FIELD DATA NAVIGATION, COLLECTION, AND ANALYSIS. Esri has recently released multiple navigation and data collection apps that allow for advanced data collection in the field on different types of portable devices. Here we present a case study and overview of ArcGIS Online, Collector for ArcGIS, and Survey 123 being used to capture monitoring data on over 2,000 points at Soda Wildfire Rehabilitation and Restoration Project. The 2015 wildfire burned over 120,000 ha, including areas of sage-grouse habitat. We review the necessary steps to: (1) set up an ArcGIS Online account, (2) create maps and store data in ArcGIS Online, (3) use those maps in Collector For AcrGIS, (4) create data entry forms using Survey 123, (5) edit and analyze the data in ArcGIS Online, and (6) download the data for local use. These new tools may be particularly useful for fisheries and wildlife biologists where multiple crews are working in remote field locations.

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NEZ PERCE TRIBE FISH MARKING: IMPLEMENTING AND COORDINATING FISH MARKING PROGRAMS. Each year the Nez Perce Tribe rears and releases fish with the cooperation of four agencies at nine different hatcheries and an additional ten acclimation facilities. In order to meet goals set forth in management agreements and to fulfill monitoring and evaluation needs, a large portion of fish must be marked and or tagged in some way prior to release. A comprehensive mass marking strategy relies on the use of multiple tag types or marks to provide critical management information on survival, abundance, distribution, harvest contributions, and enable efficient broodstock management. Although specific tags and marks constantly change as technology evolves, the most commonly used tags and marks in use at this time include coded wire tags (CWTs), passive integrated transponder (PIT) tags, parentage-based tagging (PBT) and adipose fin clips. In keeping with the NPT's guiding management policy on minimizing intrusive marking and handling, marking and tagging regimes are tailored to each release group base on specific management objectives. Central to this is the employment of Automatic Fish Tagging Trailers (autofish trailers), large fish tagging crews and coordinated in- or among-facility fish movements. We describe challenges associated with the operation and coordination of mass marking operations related to fish size, fish health, hatchery space, release transfers, marking schedules and mark group reporting. Finally, we provide recommendations for dealing with these challenges in large, coordinated hatchery programs.

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THE YANKEE FORK SALMON RIVER: A RESTORATION APPROACH INFORMED BY HISTORY, FUELED BY COLLABORATION. The Yankee Fork, a tributary to the Salmon River, was historically home to robust runs of anadromous fish. The discovery of gold in the Yankee Fork watershed in the late 1800's led

to a mining boom followed by decades of mining and timber harvest. These anthropogenic activities negatively altered the riverine landscape and contributed to the decline of Yankee Fork fish stocks. In 2010, a collaborative group of agencies, organizations, and individuals partnered to assess the condition of stream habitat and develop a comprehensive restoration plan. The assessment process led to some unexpected discoveries and informed the restoration approach in unique ways. In this presentation, we will explore how collaboration across a broad range of partners has been the key to success for both understanding history's impact on the Yankee Fork and initiating large-scale restoration through use of a step-by-step plan. The context outlined here also sets the stage for following talks on specific Yankee Fork restoration projects and monitoring results.

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QUANTIFYING NORTHERN GOSHAWK HABITAT IN THE LEWIS AND CLARK NATIONAL FOREST, MONTANA. We used a combination of field habitat analysis and remote sensing to quantify nest site characteristics of northern goshawks in the Lewis and Clark National Forest (LCNF), Montana. Measurements of nest tree and nesting habitat characteristics were taken at active nest sites, and principal component analysis was used to determine important variables. BioMapper, Maxent, and Mahalanobis Typicality were used to construct habitat suitability maps which were then combined into one consensus map identifying areas of optimal, suboptimal, and marginal nesting habitat. This consensus map was used to analyze the projected threat of pine beetle kill and fire risk in these areas, and data from a weather station within the study area was used to predict climate trends for the LCNF through 2050. Around 7% of the study area was modeled as optimal habitat, of which 52% is at risk for mountain pine beetle blight by 2027 and 66% is at risk for increased wildfire damage. Field observations concluded that 49% of nest sites in the LCNF have already been lost to pine beetle kill, suggesting the validity of this model. Forecasting climate trends with three different RCP models also suggested an overall trend of decreased average precipitation and increased temperature in the LCNF during goshawk nesting season which is expected to contribute to habitat loss.

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IMPACTS OF RANGE SEEDINGS ON A KEYSTONE SPECIES: PIUTE GROUND SQUIRREL DIETS IN SOUTHWESTERN IDAHO. Piute ground squirrels (*Urocitellus mollis*) are keystone species in shrub-steppe habitats in southwestern Idaho and are critical prey for one of the world's highest densities of nesting raptors in the Morley Nelson Snake River Birds of Prey National Conservation Area. After wildfires, rangeland seedings are commonly used for rehabilitation, but without data on whether or

not Piute ground squirrels and other native herbivores can subsist on these species. Our objective was to determine if seeded plants (Siberian wheatgrass *[Agropyron fragile*], forage kochia [*Brassia prostrata*], and Anatone bluebunch wheatgrass [*Pseudoregnaria spicatum*]) were included in Piute ground squirrel diets. In March, April, and May 2014, we live-trapped Piute ground squirrels and collected fecal pellets in two seedings. We determined diet composition using a microhistological technique. Both sites were species poor. One site was dominated by exotic grasses and native Sandberg bluegrass (*Poa secunda*). The other was dominated by invasive bur buttercup (*Ranunculus testiculata*), seeded forage kochia, and Sandberg bluegrass. At one site, Sandberg bluegrass, forage kochia, Siberian wheatgrass, and cheatgrass (*Bromus tectorum*) were most important in the diet. At the other site, cheatgrass and Sandberg bluegrass constituted 87% of the diet. The presence of large quantities of cheatgrass in the diet is troubling because ground squirrels typically eat forbs in preference to grasses, and cheatgrass is avoided. Cheatgrass and Sandberg bluegrass were important diet components of the diet but are susceptible to drought. During drought years, Piute ground squirrels may be vulnerable to starvation. The consumption of cheatgrass has management implications which will be discussed.

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THE RANGE-WIDE, EDNA-BASED INVENTORY OF BULL TROUT: EARLY RESULTS AND AN ONGOING INVITATION. We describe the most recent developments in ReDOUBT, the range-wide, eDNA-based observation network for undermature bull trout. The project arose from the need to validate predictions from the Climate Shield model about the likely occupancy of thousands of cold-water habitats by juvenile bull trout in the northwestern U.S. We coupled an efficient, reliable eDNA sampling method (described at http://www.treesearch.fs.fed.us/pubs/52466) with a probabilistic/systematic sampling design that provides reach-specific and range-wide descriptions about the presence of bull trout and sympatric species. The method has better detection efficiency than electrofishing, costs less, and takes less time; a single person can inventory an entire 6th-code watershed in one day. Initial studies were aimed at precisely delineating the distribution of bull trout within select watersheds (described at: http://www.treesearch.fs.fed.us/pubs/50137), as well as confirming their absence from potential habitats and discovering previously unknown populations. We are now targeting the entire U.S. range of bull trout, projecting completion of thousands of inventories by the end of 2018. Early results have confirmed the accuracy of the Climate Shield model predictions along with a few surprises, led to discoveries of new populations, demonstrated seasonal occupancy by bull trout in thermal refugia, and answered long-standing questions about the presence of bull trout in potential natal areas. We invite those interested in participating to learn more at our website:
http://www.fs.fed.us/rm/boise/AWAE/projects/BullTrout_eDNA.html.

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RELEASE STRATEGY FOR KOOTENAI RIVER BURBOT RESTORATION. The presentation will summarize hatchery-reared burbot releases into the Kootenai River/Lake; and, discuss the rationale and considerations behind the production and release strategies. Releases of hatchery-reared burbot (< 20,000 juveniles annually) into the Lower Kootenai River / Lake occurred annually from 2009-2014, primarily to determine post-release success in the wild. During 2015, the majority of burbot aquaculture switched from the University of Idaho -Aquaculture Research Institute (UI-ARI) Lab to the Kootenai Tribe of Idaho's (KTOI) new conservation aquaculture facility, which was designed to increase burbot production (125,000 juveniles annually) to restore a self-sustaining population. KTOI's aquaculture staff successfully reared and released 632,000 larvae, 260,000 juveniles in 2015, and 126,000 juveniles in 2016. Release sites in Idaho and Canada, number of fish released at each site and rational behind the release strategy will be presented. The production and release strategies mutually support population rebuilding and M&E activities needed to evaluate numerous aspects of the Kootenai River Restoration Program.

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SNAKE RIVER HATCHERY FALL CHIHOOK AGE-AT-RELEASE PERFORMANCE: RELATIVE RETURNS TO LOWER GRANITE DAM AND HARVEST CONTRIBUTION. The highly coordinated Snake River fall Chinook Salmon hatchery program includes a diverse set of release strategies meant to promote recovery and provide harvest.The program initially released juveniles only from a single location in the Lower Snake River at Lyons Ferry Hatchery. Since the mid-1990's the program expanded to include releases from multiple locations throughout the Snake and Clearwater River basins through the implementation of the Fall Chinook Acclimation Project and the Nez Perce Tribal Hatchery programs. In addition to releases above and below Lower Granite Dam (LGR), juveniles are reared and released at both subyearling and yearling life history stages to maximize survival and spread the risk. With returns of hatchery and natural fish increasing dramatically over the past ten years, Snake River fish provide significant numbers of fish available for out-of-basin (ocean and Columbia River) and in-basin (Tribal and recreational) harvest. Characterizing the performance of the diverse release strategies is critical for future regional recovery planning, hatchery production and harvest planning and management. Survival calculated as smolt-to-adult return (SAR) rates to LGR demonstrated that in general releases below LGR outperform releases above LGR for both yearling and subyearling release groups. Performance comparisons between yearling and subyearling releases were complex, characterized by similar total SAR rates but different adult and jack SAR rates. Yearling jacks return at a significantly higher rates compared to subyearlings with a reverse pattern for adult returns that demonstrated significantly higher SAR rates for subyearling adults compared to yearling adults. Higher adult returns for subyearlings translated into greater ocean and mainstem Columbia River harvest rates for subyearlings. These results demonstrate that the diverse release strategies of the Snake River fall Chinook Salmon hatchery program provide significant harvest and promote recovery in natural spawning aggregates in the Snake and Clearwater Rivers.

Abstracts are in alphabetical order by presenter's last name by category (i.e. oral, poster, etc). Student presenters are denoted by an * after their last name.

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STOMACH CONTENT ANALYSIS OF WALLEYE INCIDENTALLY CAUGHT DURING LAKE PEND OREILLE LAKE TROUT NETTING IN FALL 2016. Walleye *Sander vitreus* is a nonnative piscivorous species of fish that was first documented in Lake Pend Oreille in the mid-2000s. Though the abundance remains low, walleye have become more widespread throughout the lake in recent years. The introduction of Walleye into Lake Pend Oreille could threaten progress with Kokanee *Oncorhynchus nerka* recovery as well as negatively affect native species and desirable introduced game fish. Presently, little is known about the Walleye population in Lake Pend Oreille including their diet. Therefore, we analyzed the stomach contents of Walleye in Lake Pend Oreille to determine their diet and better understand their role in the ecosystem. All Walleye being analyzed were caught as bycatch in gillnets set during Lake Trout *Salvelinus namaycush* removal project during fall 2016. Because gill nets were set to target Lake Trout, gill nets with stretch mesh sizes of 11.4–12.7 cm were set for five weeks in early fall, and gill nets with stretch mesh sizes of 3.8–7.6 cm were set for five weeks in late fall. The size classes of Walleye collected for this study were restricted by the mesh sizes used. However, for all Walleye sizes (200–550 mm), Kokanee was the most common prey fish found in the stomachs. This study may not completely represent the diet of Walleye in Lake Pend Oreille due to the limited spatial and temporal scope of samples, but data collected during this pilot study will help managers understand potential impacts of a new predatory species in the lake.

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HIGH THROUGHPUT SNP GENOTYPING OF WHITE STURGEON: A POLYPLOID SPECIES IN CONSERVATION AND AQUACULTURE. Genotyping in thousands by sequencing (GT-seq) is a high throughput and cost effective technique for genotyping thousands of individual samples at several hundred loci using Illumina sequencing. This method was originally developed for genotyping diploid organisms but the stability of allele specific signal using this technique make it amenable for genotyping organisms of higher ploidy levels. Specifically, primers are designed such that neither allele is preferentially amplified and a sufficient amount of DNA is interrogated that the relative counts for each allele reflect genomic copy number. Still, accurate determination of nine different genotypic categories for any given SNP locus in the reportedly octoploid White sturgeon genome was a significant obstacle. During initial testing of GT-seq in this organism, SNP loci clustered into five categories rather than nine, simplifying genotyping and suggesting a tetraploid rather than octoploid genome structure. Here we describe the development of a panel of primers suitable for targeted SNP genotyping by GT-seq in White sturgeon (*Acipenser transmontanus*). We also present a

modified GT-seq genotyping pipeline for use with polyploid organisms.

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PREVALENCE OF PARASITIC COPEPODS, OR GIL LICE, ON RAINBOW TROUT IN BIRCH CREEK, IDAHO. Birch Creek is a spring-fed stream in eastern Idaho that is managed as a popular fishery for non-native rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*). Recently, parasitic copepods (*Salmincola californiensis*) were discovered on rainbow trout in the stream. Parasitic copepods, or gill lice, are invertebrate organisms that parasitize fish in both freshwater and saltwater. They attach to the gills, causing damage to gill filaments; in the case of high infection rates, parasitic copepods can cause significant reductions in fish health. The objectives of this research were 1) to determine the distribution of parasitic copepods in Birch Creek, 2) to quantify the rate of infection, and 3) to quantify the parasite load. In October 2015 and May 2016, we collected rainbow trout and brook trout with a backpack electrofisher at five sites in Birch Creek. We examined each fish to identify presence and number of parasitic copepods. Parasitic copepods were only found on rainbow trout with 24.8% of the trout having one or more copepods in the buccal cavity. We found infected rainbow trout at all five sites of which Sites 3 and 5 (sites number downstream to upstream) had the highest rate of infection (32% and 35%, respectively). Mean parasite load of infected rainbow trout was 2.4 copepods (SE = 0.26); approximately half of infected fish had only one copepod while the maximum parasite load was 12 copepods. The probability of infection increased with body size. The smallest rainbow trout infected with copepods was 141 mm TL; the probability of infection increased by 3% for every millimeter increase in TL. At these low infection rates, parasitic copepods likely have little effect on the Birch Creek fishery. Future monitoring will determine how prevalence of this parasite is changing and will predict future effects on the population.

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A HABITAT MODEL FOR SHORT-EARED OWLS IN IDAHO BASED ON BREEDING BIRD SURVEY DATA AND LANDSCAPE CHARACTERISTICS. I developed a habitat model for short-eared owls (*Asio flammeus*; SEOW) in Idaho using 1992-2011 Breeding Bird Survey data, 198 IFWIS records, ReGAP, and topography. SEOWs were detected at 29 of 37 Great Basin BBS routes, but at only 6% of survey points (n = 86; average: 0.40 owls/point/year; range: 0.08-1.50). I computed average distance to vegetation types and topography roughness within 1 km. I then used logistic regression to compare use vs. availability (284 vs. 121 randomly selected points). The best model predicted that flatter areas, closer to shrub-steppe (use: 365.3 m; available: 1118.4 m), nearer to marshes (3261.7 m vs. 6083.2 m), and further from agriculture (169.4 vs. 161.0 m) were more likely to have SEOWs. Riparian habitats and invasive grass were also used more by SEOW but these variables were not significant ($P > 0.05$). My results (i.e. shrub-steppe, marsh, riparian) overlap with ongoing efforts, but may provide some additional insights on SEOW habitat in Idaho.

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HOW IN-STREAM CARBON STORAGE RESPONDS TO AQUATIC HABITAT COMPLEXITY AND POST-FIRE DISTURBANCES. Post-fire debris flows play an important role in shaping terrestrial and aquatic ecosystems by delivering sediment, wood, and nutrients from hillslopes to river channels; thereby altering geomorphic complexity and storage of fine sediment and organic material. Greater complexity (e.g., wood jams and multithread channels) has been correlated with enhanced biodiversity. The details of processes controlling ecosystem response to post-fire debris flows remain unclear. Here, we examine two hypotheses: 1) geomorphic complexity correlates with time since fire such that the greatest complexity corresponds to intermediate recovery, and 2) in-channel carbon storage is positively correlated with time since fire and geomorphic complexity. We examined three sub-basins (Rapid River, Pistol Creek, and Mayfield Creek) with different wildfire histories within the Middle Fork of the Salmon River, ID to determine how complexity responds to wildfire and post-fire debris flows over time. The MFSR has been less influenced by land-use activities and over 40% of the basin has burned providing critical habitat for native species. At each site, we selected a 600-800 m continuous reach with consistent channel type and evidence of post-fire debris flow input. Complexity metrics were computed from geomorphic field data and analyzed for significant differences within sites by using a one-way ANOVA test and Tukey's multiple comparison penalty. Five of the complexity metrics measured were significantly different among the three sites ($p < 0.10$). Pistol Creek, with an intermediate time since fire, shows the highest variability and range in geomorphic complexity. Next steps include analyzing the carbon content (using loss on ignition) of sediment to examine the relative contribution of wood and fine sediment storage and quantifying wood loads using Structure from Motion photogrammetry.

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COMPARISON OF TRACE MINERAL CONCENTRATIONS IN IDAHO'S MULE DEER POPULATIONS. Routine winter captures of mule deer (*Odocoileus hemionus*) throughout the state of Idaho has provided the opportunity for health assessment through biological sampling. The evaluation of trace mineral concentrations from symptomatically healthy mule deer is the first step in determining if deficiencies or toxicity exist chronically or acutely in Idaho. This poster demonstrates a step in providing a known range of trace mineral concentrations for 12 population management units (PMU) in Idaho. Serum and whole blood are most commonly used to assess trace mineral status in live animals and were obtained thru venipuncture on yearling and adult does between December and January of each sampling year (2004-2014). Concentrations of calcium, copper, iron, magnesium, phosphorus, zinc, and selenium are summarized to determine mean, median, and range for each PMU. Population management units were compared to each other using Kruskal-Wallis one-way ANOVA. Post-hoc tests after Nemenyi were conducted when Kruskal-Wallis

indicated significance; all analyses were done in R 3.3.1.

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QUANTIFYING THE RESPONSE OF BENTHIC INVERTEBRATES TO POST-SPAWN PACIFIC LAMPREY CARCASSES IN AN INTERIOR COLUMBIA BASIN STREAM. Many studies have investigated how salmonids link marine and freshwater systems, but little research has examined the role of Pacific lamprey that spawn in many of the same systems. Post-spawn Pacific lamprey provide marine derived nutrients to stream food webs during early summer, a period of increasing metabolic activity and growth. We used experimental additions of lamprey carcasses to evaluate the colonization and use of carcasses and nearby habitats by benthic macroinvertebrates. Macroinvertebrates were collected using Surber samples to assess local density and species richness. Artificial substrate (Hester-Dendy) samplers were placed 0.3 m downstream from carcasses and controls, to assess the role of carcass introduction to the nearby macroinvertebrate community. Preliminary analyses indicate taxon-specific increase in *Ephemeroptera* at or near carcasses. The trophic "hot spots" created by post-spawn carcasses may be an important food web resource for many aquatic organisms, including fishes. Understanding the role of lamprey carcasses in stream food webs will inform fisheries managers in future restoration efforts.

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INVERTEBRATE DRIFT: A TALE OF TWO STREAMS WITH DIFFERING FLOW REGIMES. Invertebrate drift is the process by which aquatic invertebrates release from stream substrate and are transported downstream in the water column. Invertebrate drift is commonly viewed as a primary food source for stream-dwelling salmonid fishes, but despite its importance there is a poor understanding of the main factors that influence its temporal and spatial distribution. As many populations of trout and salmon are in decline, there is a need to more fully understand factors that influence the amount of food available for these species. We conducted a study to compare invertebrate drift density between two spring-fed streams which are characterized by stable discharge and water temperature, and two run-off fed streams which typically have large annual fluctuations in discharge and water temperature. Comparisons will be made to examine how food availability for drift feeding fishes differs between streams under these two differing regimes over the primary growing season. The goal of this project is to benefit our understanding of the factors that influence prey density for drift-feeding fishes.

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MULTI-SCALE ASSESSMENT OF WILDLIFE RESPONSE TO CONIFER REMOVAL: SAGEBRUSH OBLIGATES, WOODLAND SPECIES, AND SAGE-GROUSE NEST PREDATORS. Juniper (*Juniperus* spp.) and pinyon (*Pinus* spp.) woodlands occupy more than 40 million acres of the Intermountain West. These woodlands exhibit structural differences from other forest types and foster a unique assemblage of birds and other wildlife. During the last 150 years, the cover of juniper and pinyon has increased, partially as a result of livestock grazing, altered fire frequency, and changing climate. This increase has resulted in conifer expansion into sagebrush habitat, which itself hosts a variety of obligates and species of concern like the greater sage-grouse (*Centrocercus urophasianus*). Millions of acres of juniper and pinyon have already been or are scheduled to be removed across the west, with the expectation that it will restore sagebrush habitat and benefit sagebrush obligates. This restoration could also result in negative effects on woodland associates. Studies of the effects of conifer removal are often inconclusive because of study designs that lack pre-treatment data. Starting in 2018, the Bureau of Land Management will remove approximately 40 thousand acres of western juniper (*J. occidentalis*) annually from Owyhee County, Idaho, as part of the Bruneau-Owyhee Sage-Grouse Habitat Project. To gauge responses of other wildlife to broad-scale juniper removal, we will use a before-after control-impact study design. In both control and treatment sites, we will assess population density and diversity of birds and small mammals. As nest predation is an important factor in sage-grouse demography, we will also evaluate density and habitat use of important nest predators (e.g. raptors, corvids, and badgers). Additionally, we will document the occurrence of pygmy rabbits (*Brachylagus idahoensis*), a sagebrush obligate species of conservation concern.

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STATUS OF BURBOT *LOTA LOTA MACULOSA* IN THE KOOTENAI RIVER, IDAHO: AN INCREASING TREND IN THE BURBOT POPULATION. The Kootenai River basin historically supported important commercial, recreational and cultural fisheries for Burbot *Lota lota maculosa*. However, purported over-exploitation along with the completion of Libby Dam in Montana in 1972 resulted in a collapse of the fishery throughout the basin. The Idaho Department of Fish and Game has been monitoring the population since the early 1990's via winter hoop netting in the main stem Kootenai River in order to document temporal trends and estimate important population rate functions. Conservation aquaculture efforts by the Kootenai Tribe of Idaho and University of Idaho began in 2009 and have increased Burbot numbers in the river and allowed for evaluation of potential limitations to natural recruitment. Catch rates of Burbot in recent years are higher than they have been since the population collapsed, and fish appear to be using historical spawning areas during the spawning season. Although there is evidence of spawning in the river and tributaries in the basin, there has been little evidence of successful natural recruitment as gauged by genetic analyses and larval sampling efforts. It is speculated that water temperature during egg incubation and early-larval periods may be contributing to recruitment failure, along with a lack of forage availability during early life stages. Answers to these questions are unknown but are currently under investigation. Continued hoop netting efforts and placement of PIT tag arrays in historical spawning tributaries may help further identify sources of recruitment failure. Although, conservation aquaculture is currently providing consistent year classes of Burbot, identifying and addressing specific factors

limiting recruitment are crucial for successful restoration of this native species. With continued success of conservation aquaculture and refinement of potential limiting factors, managers are hopeful the Burbot population in the Kootenai River can once again support a fishery.

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METHODS FOR THE ASSEMBLY OF PARTS AND DEPLOYMENT OF HOBO TIDBIT THERMOGRAPHS IN HIGH ORDER MOUNTAIN RIVER SYSTEMS. Prior to 2015, yearly water temperature data was limited for the upper Salmon River, Idaho. It is difficult to retain small sensors in high order, mountain river systems because of winter ice conditions and spring-time high water events. Here, we will illustrate and describe a technique used to successfully install eight Hobo Tidbit thermographs in the mainstem Salmon River between the Middle Fork Salmon River and Basin Creek (downstream of Stanley). Additionally, tributary thermographs were installed near the mouths of the Pahsimeroi River and the Yankee Fork of the Salmon River. All thermographs were deployed during August 2015 and successfully recovered during August, 2016.

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EXPANSION OF PARENTAGE-BASED TAGGING (PBT) BASELINES FOR SALMONID HATCHERY STOCKS THROUGHOUT THE COLUMBIA RIVER BASIN. Parentage-based tagging (PBT) is a large-scale tagging technology for monitoring and evaluating salmonid hatchery stocks. Implementation of PBT involves annual sampling of hatchery broodstock to create a parental genotype baseline. Offspring produced by these parents can be non-lethally sampled either as juveniles or adults, and then genotyped to be assigned back to their parents – thus identifying their age and hatchery of origin. A large-scale demonstration of PBT is currently being applied to Chinook salmon and steelhead hatcheries in the Snake River basin, Idaho (2008-present), and efforts to expand annual tissue collection to Chinook salmon, steelhead, and Coho salmon hatcheries above Bonneville Dam began in 2012. Applications using the PBT baseline have only recently begun as the time it takes for 'tagged' offspring to return to the basin is ~2-5 years after broodstock (i.e., parents) are spawned annually. Thus far, PBT has been applied for: characterization of stock composition in fisheries, estimation of stock-specific abundance and run-timing at dams, identification of physically unmarked hatchery fish, estimation of proportion of hatchery fish on spawning grounds, and identification of stocks using thermal refugia during migration. Adopting PBT more broadly in the Columbia River basin would allow the ability to track millions of hatchery fish and the opportunity to address a variety of parentage-based research and management questions.

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THE USE OF HYDROGEN STABLE ISOTOPES IN CLAWS TO DISTINGUISH BETWEEN MIGRATORY AND RESIDENT BIRDS IN A PARTIAL MIGRANT POPULATION OF AMERICAN KESTRELS (*FALCO SPARVERIUS*). Comparative studies of partial migrants are useful for understanding the consequences of migration strategies but, when migrants and residents are sympatric, it can be difficult to identify whether a bird migrated or not. Ratios of Hydrogen and Deuterium in precipitation (δDp) vary along a latitudinal gradient and birds feeding at different latitudes may incorporate this latitudinal variation in δD into their tissues. We evaluated whether δD of keratin in claw tissue (δDc), which reflects the δD in the diet 3 - 4 mos prior, could be used to distinguish between migratory and resident American Kestrels in southwestern Idaho. From 2013-2015 we captured adult and nestling Kestrels during the breeding (Apr – Jul) and winter (Nov – Feb) seasons, marked each bird with a band, and collected a small claw sample. Claw samples were washed, weighed, and δD was analyzed using a mass spectrometer. If a Kestrel was recaptured in a subsequent season (e.g., breeding and winter) we considered it to be a "known resident", otherwise all adults were assigned an "unknown" migratory status. We found that nestling δDc was significantly depleted compared to adult δDc. For adults, δDc of known residents captured in spring were similar to δDc of known residents captured in winter and did not differ by year, suggesting a consistent local signature in δDc. δDc of unknown Kestrels caught in winter were not significantly different than known residents suggesting that unknown Kestrels wintering in the study area were not migrants from northern breeding areas. However, δDc of unknown Kestrels caught in spring were significantly enriched compared to known resident δDc, suggesting that many unknown Kestrels that were breeding on the study site wintered in more southern latitudes prior to nesting. These results suggest that δDc could be a powerful tool in distinguishing between migrant and resident Kestrels.

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UPPER SNAKE RIVER CLIMATE CHANGE VULNERABILITY ASSESSMENT. The climate around the Upper Snake River Watershed (USRW) of Idaho, Nevada, Oregon, and Wyoming is changing. Upper Snake River Tribes (USRT) Foundation member tribes have noticed shifts in species and habitats driven by increasing temperatures and changing precipitation patterns. Such changes have resulted in: drying sagebrush steppe habitat, extended wildfire seasons, less precipitation falling as snow, earlier spring run-off, low summer river flows, higher water temperatures, reduced flow from springs/seeps, proliferation of invasive weeds, and less productive rangelands. To better understand these changes, USRT and the Burns Paiute Tribe, Fort McDermitt Paiute-Shoshone Tribe, Shoshone-Bannock Tribes, and Shoshone-Paiute Tribes collaborated with Adaptation International, University of Washington (UW), and Oregon State University (OSU) to complete a climate change vulnerability assessment. The collaborative assessment expressly considered the species, habitats, and resources

that are important and valuable to USRT member tribes. Climate change impacts to these resources has the potential to affect tribal members' culture, spirituality, and lifeways. OSU developed temperature and precipitation projections for the USRW using two representative concentration pathway (RCP) trajectories: RCP 4.5 and 8.5. Projections indicate that under RCP 8.5, temperatures will increase throughout the 21st century in the USRW by as much 10.9° F. Precipitation projections are less certain, but it is likely that increases will be seen in the Snake River Plain, with decreases in the mountainous regions of the USRW. Through collaborative workshops, webinars, and site visits to tribal reservations, a set of shared tribal concerns were identified and analyzed by UW to develop a climate change vulnerability index (CCVI). The CCVI results suggest that certain shared tribal concerns, such as North American beaver (*Castor canadensis*) have low vulnerability to climate change, while others, including Chinook salmon (*Oncorhynchus tshawytscha*) and redband trout (*Oncorhynchus mykiss gairdneri*), are extremely vulnerable to climate change.

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KOOTENAI RIVER HABITAT RESTORATION PROGRAM. The Kootenai River Habitat Restoration Program (KRHRP) is a multi-year, ecosystem-based habitat restoration program to restore habitat conditions that will support all life stages of endangered Kootenai River white sturgeon, burbot and other native fish. Under this program, the Kootenai Tribe of Idaho is building multiple habitat restoration projects in a 55-mile-long reach of the Idaho portion of the Kootenai River. In 2009, the Tribe completed the Kootenai River Habitat Restoration Program Master Plan. The Master Plan identified reach-specific habitat conditions that limited the success of Kootenai sturgeon, burbot and other native fish, and provided restoration strategies and treatments to address those limiting factors. From 2011 through 2016 the Kootenai Tribe has constructed nine individual projects under the KRHRP. Additional projects are planned for construction in 2017 and beyond. Project actions include in-river treatments such as construction of a "ladder" of deep pools, construction of pool-forming structures, creation and enhancement of floodplain surfaces, bank restoration, riparian planting and riparian fencing. Projects are identified, prioritized and designed via an iterative process in collaboration with multiple agency partners and a multi-disciplinary team of independent experts. Since most of the land along the Kootenai River is privately owned, the cooperation of private landowners is also critical to the success of the KRHRP. The program includes targeted geomorphology and vegetation monitoring which is used to guide maintenance actions, and to adaptively inform design and construction of future projects. The Kootenai Tribe, Idaho Department of Fish and Game, and graduate students from the University of Idaho, also work together investigate the fish response to the habitat restoration work.

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KOOTENAI RIVER WITH HER FLOODPLAIN ONE ACRE AT A TIME – 2011 THROUGH 2016. The loss of approximately 90% of the historical Kootenai River floodplain has disrupted normal ecosystem functions in the Kootenai watershed. Construction of Libby Dam trapped sediment behind the dam. Dam operations for flood control and power reduced annual peak flows by half and replaced the historical spring flood pulse with diminished managed flows. Diking and agricultural conversion eliminated floodplain, off-channel and side-channel habitat and connectivity. Today, Libby Dam operations further limit hydrologic connection, and seasonal flow ramping regularly scours floodplain surfaces. The loss of floodplains has resulted in lost primary productivity and a depleted food web. Floodplain creation and enhancement is a critical component of the Kootenai Tribe of Idaho's Kootenai River Habitat Restoration Program. From 2011 through 2016, the Tribe restored approximately 65 acres of floodplain habitat in the braided reach of the Kootenai River as part of a suite of broader program objectives. Additional work is planned in the braided and meander reaches of the river. The floodplain restoration strategy includes: 1) identifying ecological flows that can support native vegetative communities under current dam operations; 2) using hydraulic modeling to identify elevations that will provide those targeted ecological flows; 3) constructing surfaces at target elevations, and installing bioengineering structures, large wood, and micro-topography treatments. In the short-term the restoration actions promote sediment and nutrient trapping, storage and retention on mid constructed islands, alcoves, and near bank surfaces. In the mid-term these actions will establish vegetated floodplain surfaces and increase primary production from retention of nutrients and sediment. And in the longer-term, the combined restoration actions will develop ecological nodes of floodplain habitat that support habitat diversity and help to sustain food production.

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KOOTENAI TRIBE OF IDAHO'S INTEGRATED FISH AND WILDLIFE PROGRAM APPROACH. The Kootenai Tribe's Integrated Fish and Wildlife Program includes complimentary programs designed to address the broad range of factors that limit the recovery and self-sustaining success of native fish and wildlife populations. Our Integrated Fish and Wildlife Program is structured around six core guiding principles: 1) the overall framework, individual projects, and decisions are science-based; 2) the Program incorporates a holistic approach to ecosystem restoration that recognizes the highly complex interdependencies inherent in ecosystems; 3) Program actions must be consistent with and support Tribal and cultural values; 4) Program actions should be inclusive of local social and economic values; 5) the Program is implemented in a collaborative manner in cooperation with other managers and stakeholders, and incorporates multiple disciplines; and 6) we recognize that when dealing with ecosystem-based restoration uncertainty is inevitable, therefore we place a strong emphasis on intentional learning through adaptive management processes. The integrated programs includes conservation aquaculture, nutrient addition (to partially mitigate for lost nutrients trapped behind Libby Dam), land acquisition for wildlife mitigation, habitat restoration (river mainstem, tributary, side- and off-channel, floodplain, riparian and upland), and an operational loss assessment to quantify losses associated with construction and operation of Libby Dam and identify and prioritize actions to address those losses. Each of the individual programs draws on the expertise, lessons learned, and technical resources (e.g., monitoring, modeling, analysis tools, etc.) from the other programs to build stronger linkages among the programs and

enhance our understanding of our unique ecosystem.

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BIG BIOLOGY MEETS MICROCLIMATOLOGY: DEFINING THERMAL NICHES OF AQUATIC ECTOTHERMS AT LANDSCAPE SCALES FOR CONSERVATION PLANNING. Temperature profoundly affects ecology, a fact ever more evident as the ability to measure thermalscapes increases and global changes alter these environments. The spatial structure of thermal environments is especially relevant to ectothermic aquatic organisms but the ability to describe biothermal relationships at extents and grains relevant to conservation planning has been limited by small or sparse datasets. We use a large occurrence database of >23,000 species surveys from USFS, IDFG, MTGFP, and the DEQ-BURP program with NorWeST stream microclimate scenarios for a 149,000-km network across Idaho and western Montana to describe thermal niches for 14 fish and amphibian species using correlative species distribution models. Our approach facilitates multivariate assessments, so we also evaluated how inclusion of two other important environmental gradients (i.e., stream size and channel slope) as model predictors could modify the description of thermal relationships. Results indicate that inclusion of the stream size and slope predictors with temperature significantly improved model accuracy for large-bodied, mobile species but not for smaller species. Occurrence probabilities of species peaked across a wide range of mean summer temperatures (7.0–18.8 °C) and distinct warm- or cold-edge distribution boundaries were apparent in thermal response curves. Bull trout, cutthroat trout, brook trout, and Rocky Mountain tailed frogs had especially cold thermal niches and showed warm-edge distribution boundaries; whereas rainbow trout and brown trout had warmer niches and were constrained by cold temperatures in many areas. Remaining species (longnose dace, speckled dace, redside shiner, longnose sucker, mountain whitefish, Chinook salmon, slimy sculpin, and Columbia spotted frog) also had warm niches showing cold temperature constraints. Thermally-mediated boundaries are where populations may be most sensitive to thermal changes and habitat protection or restoration efforts could be targeted to protect local populations. Populations near these boundaries may also be sensitive to climate warming and these locations could be monitored to detect species distribution shifts.

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ASPEN STAND VULNERABILITY AND UNDERSTORY COMPOSITION ALONG ENVIRONMENTAL GRADIANTS. Quaking aspen (*Populus tremuloides*) woodland is an important community type in semi-arid mountains and woodlands of the western US. Although they constitute only a small portion of the landscape in this region, aspen communities provide critical food and cover resources

for wildlife. Aspen is currently undergoing a region-wide decline, and climate predictions show that within 50 years approximately 40% of western aspen stands will no longer have a suitable climate. Drought within the past decade has been reported to cause mortality in western aspen. In Colorado, mature stands on south-facing slopes at low elevations were found to be particularly susceptible to disease and insects as a result of acute drought and high temperatures. Shifts from a snow to a rain dominated precipitation regime and subsequent loss of moisture through the growing season may prevent vegetative regeneration and cause aspen mortality. We are developing a methodology for classifying aspen stands on a drought continuum using gradient analysis of understory species composition and indicator species analysis with the goal of characterizing the hydrology of the aspen clone; vegetation indicator species will serve as a new metric for tracking response to climate change. At a broader scale we are assessing aspen stand vulnerability in relation to environmental data including topographic position, landscape curvature and topographic indicators of wetness.

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SPAWNING TIME AND MATURITY FOR M_{YY} BROOK TROUT AT MACKAY HATCHERY. Nonnative Brook Trout *Salvelinus fontinalis* have been artificially introduced in many lakes and streams and continue to colonize new habitats in western North America. Brook Trout have contributed to declines in native fish abundance through hybridization, competition, and predation. Thus fisheries managers have worked to suppress or eliminate Brook Trout populations outside of their native range. There are several methods fisheries managers can use to control nonnative fish, but one new method utilizes YY male (MYY) Brook Trout that are stocked into wild populations to drive the sex ratio of the wild population to 100% males. The Idaho Department of Fish and Game (IDFG) experimentally produced a YY Brook Trout broodstock which subsequently produced a large number of MYY Brook Trout for stocking into the wild. The MYY broodstock originated from the Story Fish Hatchery in Wyoming and the current brood stock is at IDFG's Hayspur Hatchery then they are transferred to Mackay Hatchery where they are reared until stocking. After stocking, the MYY Brook Trout are intended to spawn with wild Brook Trout, so it was important for IDFG to estimate the spawn timing to understand if the MYY fish were likely to spawn with their wild counterparts in the stream. Also, we wanted to confirm that a high proportion of the hatchery fish were reaching maturity to validate the assumption that the hatchery fish were spawning with wild fish. Mackay Hatchery, staff separated 116 two year old MYY Brook Trout into a separate rearing tank. MYY Brook Trout mature in the fall, and spawning typically peaks in October. Therefore, every fish was P.I.T. tagged and checked each week for ripeness in order to determine the peak of maturity. After the spawn period concluded, each fish was dissected to determine if the fish were in fact immature.

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TEN-YEAR (2006-2016) TREND ANALYSIS OF INTESTINAL PARASITE LOADS FOUND IN DEER AND ELK IN IDAHO. For more than 25 years, the Idaho Department of Fish and Game has collected biological samples for health assessment of free-ranging populations of deer (*Odocoileus hemionus*)

and elk (*Cervus elaphus*) throughout the state of Idaho. These samples include fecal specimens sampled from live animals during planned winter management capture events and opportunistic sampling throughout the year. Intestinal parasites of mule deer and elk are discovered through these samples by microscopic analysis of feces using Sediment and Floatation tests. These tests identified intestinal parasites and the quantity (or load) in each gram of feces tested. These results give biologists another look into the overall health of deer and elk populations within the state to determine if a high internal parasite load negatively affects herd health within a population. This poster demonstrates a ten year trend analysis of intestinal parasite loads on Idaho's free-ranging mule deer and elk populations in years 2006 through 2016.

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THE EFFECT OF SUMMER STREAM DRYING ON WATER QUALITY AND SURVIVAL OF REDBAND TROUT (*ONCORHYCHUS MYKISS GAIRDNERII*) IN DRY CREEK, IDAHO. Redband trout (*Oncorhynchus mykiss gairdneri*) occupy desert streams characterized by high temperatures and variable flows. The purpose of our study was to document the impact of stream drying on water temperature and dissolved oxygen (DO) concentrations and to determine if these changing water quality conditions affected redband trout survival. Dry Creek is a small tributary of the Boise River characterized by summer drying of the watershed's lower reaches. We monitored stream temperature, dissolved oxygen and trout survival across 10 pools (3 lower-reach pools, 4 middle-reach pools, and 3 upper-reach pools). We began to collect stream temperature and DO data on June 7, 2016. Pools were monitored biweekly until dry or until the end of the study (October 21, 2016). Stream temperatures were monitored every hour using HOBO data loggers. At the start of the study, pools were surveyed for redband trout using a backpack electrofisher. Total length (TL) of each fish was recorded and fish were implanted with a 2-mm PIT tag. Survival of fish was monitored via electrofishing every 3-6 weeks until pools became isolated. After which, fish were monitored on a weekly basis via a visual survey. Upper-reach pools flowed continuously while middle-reach pools became isolated in early August. Lower-reach pools became isolated on July 27th and dry a few days later. Over the study period, the lower-reach pools had a mean hourly temperature of 16.1°C (9.6-22.7°C) while mean hourly temperature in middle-reach and upper-reach pools was 14.5 (7.4-28.6°C) and 11.6 °C (3.8-21.6°C), respectively. As flows decreased and pools became isolated, temperatures increased and DO concentrations dropped. Redband trout survived 7-days in a middle-reach pool with DO levels below 1.5 mg/l. This result suggests that redband trout living in arid environments may have unique adaptations to survive extended periods of hypoxia.

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POPULATION CHARACTERISTICS AND THE INFLUENCE OF DISCHARGE ON BLUEHEAD SUCKER, FLANNELMOUTH SUCKER, AND ROUNDTAIL CHUB. Rivers are among the most complex and important ecosystems in the world. Unfortunately, lotic systems have undergone substantial alterations for over 100 years resulting in substantial habitat degradation. Concurrently, many fishes endemic to rivers have suffered declines in abundance and distribution suggesting that alterations to lotic environments have negatively influenced native fish populations. Of the 35 fishes native to the Colorado River basin (CRB), seven are considered either endangered, threatened, or species of special concern. Thus, the conservation of fishes native to the CRB is a primary interest for natural resource management agencies. One of the major factors limiting the conservation and management of fishes endemic to the CRB is the lack of basic information on their ecology and population characteristics. As such, we sought to describe the population dynamics and demographics of three populations of Bluehead Suckers *Catostomus discobolus* and Flannelmouth Suckers *Catostomus latipinnis* in Utah. Additionally, we used mixed-effect models to evaluate the potential influence of altered flow regimes on the recruitment and growth of Bluehead Suckers and Flannelmouth Suckers. Mortality of Bluehead Suckers and Flannelmouth Suckers from the Green, Strawberry, and White rivers was comparable to other populations. Growth of Bluehead Suckers and Flannelmouth Suckers was higher in the Green, Strawberry, and White rivers when compared to other populations in the CRB. Similarly, recruitment indices suggested that Bluehead Suckers and Flannelmouth Suckers in the Green, Strawberry, and White rivers had more stable recruitment than other populations in the CRB. Mixed-effect models relating growth and recruitment to hydrological indices provided little explanatory power. Notwithstanding, our results indicate that Bluehead Suckers and Flannelmouth Suckers in the Green, Strawberry, and White rivers represent fairly stable populations and provide baseline information that will be valuable for the management and conservation of the species.

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KEY FACTORS INFLUENCING REPRODUCTIVE SUCCESS IN CHINOOK SALMON. To mitigate the effects of declining abundance in threatened or endangered Pacific Salmonids, hatchery programs have been developed with the aim of both increasing harvest abundance and bolstering wild population numbers. Recent evidence suggests that integrating wild-origin individuals into broodstock can not only boost natural abundance, but also minimize the effects of domestication selection on the wild population. To determine the effects of supplementation on the fitness of the wild population, we genotyped tissue samples spanning 18 years (1998-2015) from returning adult Chinook Salmon (*Oncorhynchus tshawytscha*) collected at the Johnson Creek weir, the primary spawning location within the East Fork of the South Fork Salmon River basin. Results consistently show that this supplementation program provides a demographic boost to the population and has limited genetic effects on the fitness of the wild population over successive generations. In addition, we evaluate key factors affecting individual reproductive success within years (age, size, origin (hatchery or wild), and return timing) and variation in reproductive success across years (water temperature, spawner

density, and ocean conditions).

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LOCAL STATUS OF A TRADITIONAL FIRST FOOD: PATTERNS OF DISTRIBUTION IN NATIVE FRESHWATER MUSSELS IN THE SALMON AND CLEARWATER RIVER BASINS OF IDAHO. In the Pacific Northwest, mussels are a traditional First Food of Indigenous cultures and current status and trend in populations remain largely unexamined in the Columbia River Basin. Freshwater mussels are long lived (decades) and are known have co-evolved life histories whereby parasitic mussel larvae are dispersed by host fishes. Less is known about the host-parasitic relationship for PNW taxa than eastern taxa. Current distribution and abundance of mussels in much of the Columbia River appears to be reduced based on traditional ecological knowledge. To evaluate current status in the anadromous portion of the Salmon and Clearwater river basins, we present analyses of distribution and relative abundance for mussels collected as ancillary data during IDFG snorkel surveys for juvenile anadromous fish production during 2014-2016. Analyses address three questions: 1) what geographical and site-level variables are associated with mussel presence/absence; 2) what variables are associated with the relative density of mussels, given mussels were observed; and 3) to what degree was presence repeatability observed at sites sampled in multiple years. These results provide the first recent assessment of mussel distribution and abundance in anadromous Idaho streams and generate hypotheses about the mechanisms controlling mussel populations in the Columbia River Basin.

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INVESTIGATING AQUATIC MACROINVERTEBRATE RESPONSE TO POST-FIRE DEBRIS FLOWS AT DIFFERENT SPACIAL SCALES. Wildfires are increasing in occurrence and severity throughout much of the intermountain west. Wildfire disturbances influence aquatic macroinvertebrate population dynamics by introducing large amounts of fine sediments and large woody debris into river systems, which can increase channel complexity. This spatial complexity contributes to habitat diversity and allows pioneer species to recolonize an area where they may have been previously out competed. Therefore, we expect macroinvertebrate populations to differ in streams with different fire histories. Within sites, we expect macroinvertebrate populations to differ upstream and downstream of debris inputs. To test this we investigated the connection between stream complexity, aquatic macroinvertebrate abundance, and time since fire in three different sub basins (Rapid River, Pistol Creek, and Mayfield Creek) of the Middle Fork of the Salmon River, Idaho. These tributaries provide important spawning area for migrating Chinook salmon (*Oncorhyncus tshawytscha*) and steelhead (*Oncorhyncus mykiss*). Organisms were sampled in triplicate at riffles, every 100 meters of our 600-800 meters reaches. Channel geometry metrics (width, depth, slope) were surveyed with a Leica TS09 total station and substrate size determined by using a Wolman pebble count. Initial results showed that macroinvertebrate abundance and stream complexity were

significantly different between sites ($p<0.01$; ANOVA). Current investigations focus on local variability as it relates to debris flows within each reach by comparing the macroinvertebrate abundance above and below the debris flow inputs.

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VARIATION IN INFECTION RATES AND PARASITE LOAD OF A TREMATODE PARASITE IN SHORTHEAD SCULPIN (*COTTUS CONFUSUS*) IN BIRCH CREEK, IDAHO. In Birch Creek, Idaho, shorthead sculpin (*Cottus confusus*) act as an intermediate host for a trematode parasite which is found as encysted metacercariae in the sculpin's epidermis. The effect of the metacercariae on the sculpin is currently unclear, although trematode parasites can cause reduced growth and higher mortality in fishes. The objective of this research was to determine the distribution, probability of infection, and parasite load of the trematode parasite in shorthead sculpin in Birch Creek. We collected shorthead sculpin at five sites along Birch Creek (numbered downstream to upstream) with a backpack electroshocker and determined infection and parasite load on sculpin by counting metacercariae on the fins and body of each fish. We found shorthead sculpin with metacercariae at all sites. Prevalence of the parasite was lowest at the downstream sites (33.9% and 41.0% at Sites 1 and 2 respectively) and was higher at the upstream sites (> 83.2%). Mean parasite load on each fish ranged from 1.2 metacercariae (S.E. = 0.08) at Site 1 to 215.1 metacercariae (S.E. = 19.06) at Site 5. Distribution patterns and parasite load of the trematode parasite suggest that other hosts of the parasite (i.e. snails and fish-eating birds or mammals) occur at higher densities at upstream sites. High infection rates and parasite load in shorthead sculpin at upstream sites may have negative effects on fitness of the fish (e.g. reductions in growth, reproduction, survival, swimming performance, etc.) and warrants further research.

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ENVIRONMENTAL FACTORS DRIVING PATTERNS OF DISPERSAL OF AMERICAN KESTRELS IN NORTH AMERICA. Dispersal is a critical process for animals given its influence on population structure and dynamics. However, few studies have assessed the role of environmental factors in directing dispersal decisions, and our knowledge of how environmental variation associated with climate change may influence dispersal patterns is limited. American Kestrels (*Falco sparverius*) are an excellent species for studying dispersal because they are highly mobile and occupy a wide range of habitats. We used band encounter data from the Bird Banding Laboratory to study patterns of dispersal in American Kestrels throughout North America from 1960-2015. We identified how dispersal distance and direction varied regionally and over time and used circular statistics and statistical models to test relationships between climate factors and dispersal trends. We were particularly interested in the relationship between patterns in dispersal and weather trends associated with climate change over the past thirty years. We also examined how environmental factors interacted with sex and breeding latitude in affecting dispersal of kestrels.

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POPULATION ECOLOGY OF MULE DEER IN NORTHEASTERN OREGON: UNDERSTANDING THE FUNDAMENTAL ROLE OF NUTRITION. Since the 1960's, western North America has experienced a decline in mule deer populations throughout their historic range, and the contributing factors have been a source of substantial debate among both scientists and managers. Quality and quantity of habitat, potential competition with other ungulates, reduced forage biomass, seasonal limitations in nutrition, increased predation, and climatic variation have been considered, but a mechanistic understanding of the relative importance of these factors remains elusive. Habitat loss or degradation may impose nutritional constraints on deer that can lead to malnutrition, starvation, disease, or increased risk of predation. Such effects also may interact with density-dependence, resulting in the manifestation of density dependent feedbacks on body condition, fecundity and survival at smaller population sizes. Both natural and anthropogenic variation in environmental conditions influence the quality and availability of resources, ultimately affecting the amount of energy available to invest in survival and reproduction via effects on body condition, reproductive costs, and rate of reproductive success across years. Additionally, it has been hypothesized that mule deer and elk compete for resources, to mitigate the negative impacts of competition and facilitate coexistence, mule deer may avoid elk in space or time, and/or use alternative resources. This research focuses on three main objectives: 1) asses the degree to which mule deer are nutritionally limited; 2) determine the degree to which nutritional limitation is a direct result of habitat quality, an indirect result of competition and/or predation, or a combination of these; and 3) determine if elk behavior affects performance of mule deer by limiting access to high-quality forage, thereby influencing the degree of nutritional stress experienced by deer. The results of this research will improve our understanding of the underlying factors driving mule deer declines, and will inform management decisions designed to benefit the health of mule deer populations.

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GROWING LIKE A WEED - WHITE STURGEON GROWTH IN THE BLISS TO CJ STRIKE REACH OF THE SNAKE RIVER. White Sturgeon *Acipenser transmontanus* in the Snake River exhibit differing rates of growth and maturity. These rates vary both between river reaches and within reaches as individuals utilize different habitat types (riverine and reservoir). We used tagging data from recaptured White Sturgeon in the Bliss to CJ Strike reach to show differences in sturgeon growth among habitat use. Considering only wild White Sturgeon at-large for 365 days, measured fork lengths and time at-large was used to generate annual growth increments [AGI]. Individual AGI were assigned one of three categories signifying locations of first and second capture: river/river, reservoir/reservoir, and river/reservoir recaptures. Although habitat preferences between capture events are unknown, White Sturgeon AGI and condition factor increased with reservoir presence, whereas White Sturgeon captured in-river displayed higher site fidelity and a lower AGI and condition factor.

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LANDSCAPE GENOMICS OF ANADROMOUS STEELHEAD (*ONCORHYNCHUS MYKISS*) THROUGHOUT THE COLUMBIA RIVER BASIN. Anadromous fish experience environmental conditions along their migration path to the ocean that may not coincide with conditions in freshwater spawning and maturation sites. Consequently, migration-path habitat may pose stronger selective pressures than habitat within tributaries. We used landscape genomic analyses to determine if conditions encountered along migration-paths drive adaptive genomic divergence more so than at-site conditions in 2548 anadromous steelhead trout (*Oncorhynchus mykiss*) collected from 56 sites across the Columbia Basin. We first compiled 21 non-correlated environmental variables that are hypothesized to be associated with adaptive genomic variation and extracted measurements of these environmental variables at freshwater collection sites, as well as along migration paths to the ocean for each population. We then used a multivariate method, redundancy analysis (RDA), to determine which landscape variables contribute the most to adaptive variation in 24,526 single nucleotide polymorphisms (SNPs). Finally, in conjunction with RDA, we implemented a series of outlier analyses and gene-environment association tests to identify SNPs that show the strongest evidence for selection to environments across the landscape. Our results show that the most influential drivers of adaptive divergence were overwhelmingly represented by variables along migration paths rather than at-site conditions. These variables include migration distances to the ocean, the maximum temperature encountered along migration paths, and the mean precipitation encountered along migration paths. Furthermore, we identified 81 evident outlier SNPs that which are primarily associated with temperature and precipitation along migration paths. Gene ontology analyses suggest that these outlier SNPs are largely involved in body development and heart function. Together, our results indicate riverscape features that are strong drivers of adaptive genomic divergence in O. mykiss, and provide a basis to investigate how O. mykiss might respond to predicted scenarios of global climate change.

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TROUT IN THE CLASSROOM - CLOSING THE LOOP. The Idaho Trout in the Classroom is program led by Idaho Fish and Game and enriched through many partnerships throughout the state. Students raise trout, kokanee or steelhead from eggs in a classroom aquarium. Teachers and classroom biologist mentors facilitate hands-on activities that weave aquatic concepts through traditional school subjects. Students learn about biology, ecosystems, animal behavior, water quality, conservation, and much more. Being able to release their young fish into a natural river or lake is the highlight of their experience, closing the loop by connecting students with fish in nature. In spring of 2016, Idaho Chapter of the American Fisheries Society contributed funds to allow ten classrooms to take field trips to experience nature and release their fish into a lake or stream.

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AN INVESTIGATION OF SPATIAL COMPLEXITY IN A RIVER-FLOODPLAIN AND ITS EFFECTS ON INSECT EMERGENCE AND TERRESTRIAL INSECTIVORES. Emergence of adult aquatic insects is a resource flux that can influence a suite of terrestrial insectivores, and in river-floodplains this flux and the movements of consumers link local food webs in a larger, meta-food web. Owing to such connections, spatial complexity of river-floodplain habitats (or, reciprocally, their homogenization) may influence numerous terrestrial organisms, but these relationships are poorly understood. We are conducting a year-long study to investigate the effect of spatial heterogeneity on the emergence of aquatic insects, and subsequent consequences for terrestrial predators (using spiders and bats as indicator species) within the Fort Hall Bottoms river-floodplain mosaic. Using both floating and light traps, we are measuring emergence across 7 sites encompassing the array of river-floodplain habitats, and evaluating how the temporal 'signature' of emergence varies as a function of increasing spatial heterogeneity at 3 different habitat scales (e.g., from pools and riffles within a reach to the characteristics of emergence from the combined mosaic of river-floodplain habitats). To gauge responses by terrestrial insectivores, we are conducting visual spider surveys and acoustic bat surveys monthly throughout the spring and summer. Overall, we expect (and here we present preliminary results) that in spatially complex river-floodplains, a combination of mechanisms leads to "hot spots" and "hot moments" of emergence, insect diversity and life-history asynchrony among local habitats, resulting in greater and more consistent availability of emergent adults across the mosaic of a river-floodplain, and mobility of predators (e.g., bats vs. spiders) mediates responses at different scales.

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THE PHANTOM GAS FIELD PROJECT: HOW DOES NOISE FROM NATURAL-GAS-FIELD OPERATIONS AFFECT ECOSYSTEM FUNCTIONING IN SAGEBRUSH-STEPPE? Changes in soundscapes from human-caused noise have been shown to alter avian and mammalian community assemblages, their foraging behavior, and reproductive success. However, little is known about how noise-induced changes in avian communities can directly, or indirectly, affect herbivorous arthropod communities, and consequently plant physiology and productivity. To isolate the effect of human noise, we used solar-powered speaker systems to continuously broadcast (24-hrs /day) recordings of natural-gas compressor station extraction from April through October 2015 in sagebrush-steppe in Idaho, USA. We hypothesized that altered soundscapes would change existing insect abundances via changes in avian predators, and therefore insect herbivory on plant physiology and productivity in sagebrush shrubs (*Artemisia tridentata* ssp. *wyomingensis*). We predicted that experimental noise would decrease avian abundance, resulting in increases in shrub herbivory because of reductions in avian predation on herbivorous insects. We further predicted that experimental noise would cause decreased productivity in shrubs because of physiological costs associated with increased herbivory damage. We observed statistically significant reductions in bird abundance at Noise-On sites (~25%), and greater numbers (13.5%, n.s.) of insects from sap-sucking families on shrubs in Noise-On sites.

Stem elongation during the growing season was 19.5% greater at Noise-On sites, contrary to our initial hypotheses. Noise significantly increased both respiration and photosynthesis in shrubs. We hypothesize that the increases in respiration and photosynthesis that we observed—which were opposite our hypotheses—were compensatory responses from increased sap-feeding damage in sagebrush, because of reductions in bird foraging activity at Noise-On sites. Boosts in photosynthesis and growth due to modest increases in herbivory have been reported in previous studies, whereas more intense herbivory can lead to declines in photosynthesis. Collectively, our research indicates that chronic human noise has the capacity to affect ecosystem functioning at multiple trophic levels because of altered soundscapes.

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IMPACT OF LOST FLOODS ON FISH AND FOOD WEBS IN A REGULATED RIVER FLOODPLAIN. The mosaic of habitats referred to as the Fort Hall Bottoms, which includes the Snake River and a suite of floodplain springbrooks located on the Fort Hall Reservation in southeastern Idaho, represents one of the few intact river-floodplain ecosystems remaining in the region. However, regulation of the Snake River's flow and overdraft of groundwater for agriculture appears to have reduced scouring floods originating from the Snake River and decreased flows in the floodplain springbrooks themselves. These together have caused accumulations of fine sediment in the springbrooks and a commensurate loss of gravel habitats important to sustaining invertebrate prey for fishes. In 2015-2016, we completed a year-long field study to seasonally examine food web dynamics within a range of floodplain habitats and determine if resident populations of fishes, and in particular Yellowstone cutthroat trout, rainbow trout, and their hybrids, are experiencing food resource limitation linked to reductions in hydrologic scour. We observed that non-insect taxa, such as amphipods, were the primary prey items consumed by salmonids in non-scoured springbrook habitats, which reflected the relative abundance of these invertebrate taxa in benthic communities. In a springbrook habitat that experiences periodic scour, however, aquatic insects were more abundant and salmonids proportionally consumed more of these taxa. Furthermore, the salmonid populations in this habitat were principally composed of juvenile and sub-adult individuals, whereas in other springbrook habitats, adult salmonids dominated and smaller size classes were generally rare. Based on these initial findings, our working hypothesis is that through a combination of factors ultimately related to the loss of scouring floods, including decreased habitat for successful spawning, reduced food availability for juvenile rearing, and increased piscivory by adult fishes, a bottleneck at the juvenile life stage is constraining populations of salmonids on the Fort Hall Bottoms, but we need further analyses to corroborate this hypothesis.

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LEK ACTIVITY AND DISCOVERING NEW LEKS OF COLUMBIAN SHARP-TAILED GROUSE ON THE MOODY BENCH. Historically, the Columbian sharp-tailed grouse (*Tympanuchus phasianellus*

columbianus) was one of the most abundant upland game birds in the northwest, ranging from British Columbia through Colorado. Due to habitat loss, these birds currently occupy only 5% of their historical range. In light of that habitat loss, southeastern Idaho has continued to be a stronghold for sharp-tailed grouse and therefore critical for the management and conservation of these birds. An important management practice for documenting population trends of this game bird is monitoring lek activity. From April 16 to May 18, 2016, we revisited 34 of 39 known leks on the Moody Bench to determine if those leks were active (≥ 1 bird on a previously documented lek) or inactive. On active leks, we also counted the highest number of birds using previously established protocols. We also searched potential habitat in the study area to document new active leks (≥ 2 birds that were flushed at the site). Of those 34 leks surveyed, 12 were active, and during the highest count on those leks the mean number of birds was 6.6 (SD = 6.5, range = 2 to 21). During our lek discovery surveys, we documented 4 new leks. Of those new leks, the mean number of birds counted was 4.4 (SD = 1.3, range = 3 to 6). Our results can be used for the conservation and management of sharp-tailed grouse and their habitat on the Moody Bench and southeastern Idaho. We recommend that biologists continue to conduct annual surveys and then potentially establish lek routes to monitor the sharp-tailed grouse on the Moody Bench.

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ZOOPHARMACOGNOSY: NEW APPROACHES TO DISCOVER BIOACTIVE COMPOUNDS IN NATURE TO CONTROL PESTS. Observing self-medicating behavior or 'zoopharmacognosy' of wild animals provides a natural in vivo screen to direct the discovery of plants with the greatest potential to have bioactive chemicals that can control pests. We propose that observations of birds that use green nesting material can direct us to plants that contain chemicals that reduce ectoparasites. Golden Eagles (*Aquila chrysaetos*) in southwestern Idaho have been observed to include aromatic greenery into their nests that appear to have no structural role. Additionally, these birds are hosts to a haematophagous ectoparasite known as the Mexican chicken bug (*Haematosiphon indorus*), a relative We hypothesized that green nest material selected by golden eagles in southwestern Idaho would have higher concentrations of potentially toxic chemicals than greenery occurring in lower abundance in nests relative to what was available in the landscape. We found that concentrations of phenolics were higher in plants selected for nest material than other species. Furthermore, we hypothesized that the chemicals extracted from plants selected by golden eagles are bioactive against haematophagous ectoparasite. We investigated if plant extracts alter refuge-seeking behavior of cimicids. If plant extracts alter behavior of ectoparasites, this is evidence that zoopharmacognosy may be a dependable source of directed discovery of bioactive compounds against pests. In addition, these compounds could become a useful tool in fighting infestations of ectoparasites in wildlife, domestic animals and humans.

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WATER QUALITY AND REDBAND TROUT HABITAT IN DRY CREEK, ADA COUNTY, IDAHO. Redband trout are considered a subspecies of concern by the AFS and a sensitive species by the BLM. Water quality and redband trout habitat within the Dry Creek watershed are becoming increasingly threatened by anthropogenic forces. We evaluated water quality and anthropogenic impacts on the habitat occupied by the genetically pure redband trout population in Dry Creek to determine habitat suitability and help inform the local habitat management practices. The redband trout population in Dry Creek appear to be threatened by anthropogenic impacts such as pollution and habitat degradation. We found that springtime water quality is typically within the range of tolerance; however, areas adjacent to agricultural land have the poorest water quality. Stream water next to agricultural areas may become poor quality over the course of the summer. Areas upstream of Lower Gauge are likely the only areas hospitable to redband trout during spawning time and dry summers. Upstream refuge from low flow may be inaccessible due to a culvert that runs beneath Bogus Basin Road or nearby waterfalls. Here, we present the results of our water quality and habitat analysis and discuss their implications for redband trout conservation and habitat management.

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THE IDAHO AMPHIBIAN AND REPTILE INATURALIST PROJECT. Data on the occurrence and distribution of amphibians and reptiles are needed to identify and address conservation problems for these species. Observations from citizen science projects can be an important source of data for conservation and management. The goal of this project is to improve available data for Idaho amphibians and reptiles by collecting observations using iNaturalist, a mobile application from the California Academy of Sciences that allows people to contribute observations of organisms using their mobile devices. The application is available for iOS and Android devices from the App Store or Google Play. Observations can also be contributed and viewed via the iNaturalist website (inaturalist.org). Observation records include photographs, time, date, geographic coordinates, and any other comments the observer wishes to make (e.g., life stage, habitat, and behavior). The Idaho Amphibian and Reptile iNaturalist Project was initiated in June of 2016 by the ISU Herpetology Laboratory. As part of the project, we created on-line and downloadable field guides to all of the species of Idaho amphibians and reptiles. Preliminary results indicate considerable, widespread interest in contributing amphibian and reptile observations in Idaho. As of January 2017, the project has over 350 observations of 35 of the 38 species of Idaho amphibians and reptiles from over 84 participants, including students, teachers, agency personnel, and interested citizens. We evaluate and verify each observation which are then shared with the Idaho Fish and Wildlife Information System (IDFG). Contributed observation data sets need to be characterized and analyzed with respect to museum and survey data to understand their strengths and weaknesses. Contributed observations can be applied in a variety of ways, but especially for helping determine changes in the occurrence and distribution of amphibians and reptiles over time.

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LEK AND NEST FIDELITY OF FEMALE GREATER SAGE GROUSE. Recently, greater sage grouse (*Centrocercus urophasianus*) have become a species of concern in sagebrush steppe ecosystems. This species was recently denied for listing under the Endangered Species Act, but research and conservation actions are still ongoing for grouse and its habitat. We attached rump-mounted GPS transmitters to 26 female sage grouse during the 2015 breeding season on the Sand Creek Desert of southeast Idaho. Eight of these females survived to lek and nest in both years. The purpose of our study was to quantify the fidelity of those females to leks and nesting areas. We documented lek fidelity after capture during the lekking season (late March through late April) and nesting fidelity (end of April to early May) across years. We also used minimum convex polygons to calculate breeding season home range size for each grouse. During the 2015 breeding season, female sage grouse visited an average of 3.8 leks (n = 8, SD = 2.6, median = 3.5). During the 2016 breeding season, female grouse visited an average of 5.1 leks (n = 8, SD = 2.3, median = 5.5). Of the 8 female grouse alive during the 2016 breeding season, three did not return to a lek used the previous year, three returned to one lek used the previous year and two returned to two or more leks used the previous year. Female sage grouse generally occupied the same breeding season home range between years, with a mean home range size of 56.7 km2 (n = 8, SD = 44.4, median = 48.5). Nest sites were separated by an average of 444.6 m between years (n = 8, SD = 492.4, median = 332.4). This research has important management implications for state and federal agencies, as well as initiatives aimed at improving private land for sage grouse habitat.

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AIR EXPOSURE TIMES OF CAUGHT AND RELEASED TROUT ON THE SOUTH FORK SNAKE RIVER. Fishing regulations are used by natural resource agencies to accomplish a variety of management objectives, including a focus on improving the quality of a fishery or maintaining the viability of a population. Catch-and-release regulations are one of the most commonly implemented types of fishing regulations. Catch-and-release regulations have largely been successful in reducing exploitation, and increasing density and size structure of fish populations. In recent years, concerns have been raised regarding anglers exposing fish to air during catch-and-release angling. To date, there has only been one study that has explicitly focused on air exposure times of angled fish. The purpose of our study was to evaluate the length of time angled fish were exposed to air by anglers in

a typical catch-and-release fishery. Anglers were observed on the South Fork Snake River from May through August 2016. Observations were conducted discreetly as to not alter angler behavior. We recorded a number of angler characteristic including air exposure duration, fight time, approximate age of the angler, sex of the angler, how the angler accessed the river, whether the angler was guided, whether the angler took a picture, and whether the angler used a landing net. Air exposure duration was considered from the time the fish left the water until the fish was returned to the water. In total, we observed 316 individual anglers. We observed an average air exposure duration of 19.3 s (SE = 0.8), and average fight time of 40.5 s (3.5). Results of this study suggest that anglers typically do not expose fish to air long enough during catch-and-release angling to incur the negative effects associated with prolonged air exposure.

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THE BREEDING ECOLOGY AND HABITAT SUITABILITY OF FERRUGINOUS HAWKS (*BUTEO REGALIS*)IN SOUTHERN IDAHO. Ferruginous hawks (*Buteo regalis*) are avian apex predators that display high breeding habitat specificity within pinion juniper shrub grasslands and shrub steppe ecosystems in the western United States. Their sensitivity to a variety of ecological parameters associated with climate change and increasing anthropogenic landscape change makes them a suitable indicator species of ecosystem health. Range-wide, ferruginous hawk populations have become the subject of growing conservation concern, in light of widespread habitat alteration associated with invasive annual grasses, increased fire frequency, growing anthropogenic encroachment and disturbance within historic breeding habitats. In southern Idaho, ferruginous hawks are listed as a "Species of Greatest Conservation Need" by the Idaho Fish and Game and are a Bureau of Land Management "Type II Sensitive Species", with the loss of suitable habitat listed as the primary cause of their decline. Despite this status, there is little published information available on the distribution, demography and reproductive performance of ferruginous hawks in southern Idaho. We initiated efforts to establish a long-term collaborative monitoring program to provide baseline data on the ecology and population demography of ferruginous hawks in southern Idaho. We monitored historic and contemporary breeding territories and documented territory occupancy and productivity. We used a multivariate generalized linear model with model selection procedures to evaluate the relative importance of land use and cover attributes and distance to human disturbance agents on ferruginous hawk nest breeding success. Here, we present the results of our monitoring and preliminary models and discuss their applications for ferruginous hawk management.

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IMPACTS OF WILDFIRE ON FOOD WEBS AND PRODUCTIVITY OF WILDERNESS STREAMS IN CENTRAL IDAHO. Wildfire is a disturbance by which terrestrial effects translate into consequences for stream ecosystems. We investigated these consequences for food-web dynamics and productivity of organisms at multiple trophic levels in wilderness streams of central Idaho. We combined 24 years

of monitoring accompanied by a short-term, paired-stream comparison of food webs and production with a spatially-extensive, multi-factor analysis of fish biomass across 12 streams spanning gradients in fire history and riparian recovery. Long-term monitoring showed paired streams exhibited similar habitat characteristics, chlorophyll-a, and aquatic invertebrate biomass for 10 years pre-wildfire. After both experienced severe wildfire, one stream retained a relatively open-canopy, while the other regrew a dense overstory. Subsequently, trends in chl-a and invertebrate biomass values diverged, and during 14 years post-wildfire, the open-canopy stream averaged ~ 3.2 × higher chlorophyll-a biomass, and ~ 2.4 × higher invertebrate biomass than the closed-canopy stream. Summertime comparisons 14 years post-wildfire showed the open-canopy stream exhibited ~ 3.2 × higher gross primary production, ~ 3.4 × higher aquatic invertebrate production, and ~ 1.6 × higher salmonid production (*Onchorhynchus mykiss* and *O. clarkii*), than the closed-canopy stream. Bioenergetic estimates of salmonid demand for invertebrate prey revealed their production in the open-canopy stream required ~ 90% of the available aquatic invertebrate production, whereas in the closed-canopy stream, their demand was nearly twice that of aquatic invertebrate production, and salmonid diet analysis indicated correspondingly greater reliance on terrestrial invertebrates. Patterns in fish biomass among 12 streams across the basin were best explained by a model that included: watershed area, nitrogen, invertebrate biomass, canopy cover, and proportion of the basin burned. Although severe wildfire is often perceived as catastrophic, our observations point to resistance, resilience, and even positive responses of stream ecosystems and organisms, including salmonid populations, to this disturbance in wilderness streams of this region.

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AN EVALUATION OF PHENOTYPE-GENOTYPE CONCORDANCE IN TWO ISOLATED BROOK TROUT POPULATIONS. Brook Trout have extirpated western native species, thus numerous eradication projects have been implemented. Few have succeeded. Recently, a new technique for eradication of Brook Trout and other non-native species has surfaced. Known as the YY Male or Trojan Y Chromosome approach, the technique seeks to shift the population sex ratio to 100% male by stocking genetically YY male fish. The development of a YY Brook trout broodstock has recently been reported and computer simulations suggest that this technique may be successful in eradicating undesirable Brook Trout populations. One factor that could potentially prevent this tool from succeeding is a form of Environmental Sex Determination (ESD) where a large reduction in female abundance could result in genotypic males becoming phenotypic females. This paper reports on the first of three years' work evaluating such potential ESD in two isolated Brook Trout populations. To determine if Brook Trout can change their phenotypic sex based on sex ratio or female abundance, fish removals took place in Bear Creek and Willow Creek near Mackay, ID. About 75% of Brook Trout were manually removed with electrofishing, and euthanized with MS222. After euthanization, fish were measured for length, had a fin clip taken, and were frozen on dry ice. Fin clip DNA was extracted and amplified with a PCR machine, and then tested using two sex markers to determine genotypic sex. Fish were defrosted and necropsied to determine phenotypic sex, which was then compared to genotype. Average lengths in Willow and Bear Creek were 117 and 159mm,

respectively. Male and female average lengths were virtually identical in both populations. In both streams, no genotype phenotype mismatches were found, (n=1181), suggesting that ESD in Brook Trout was not occurring in these stream prior to the population reduction that occurred in 2016. Additional work in 2017 and 2018 will determine if ESD occurred following the population reduction.

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MONITORINGRESOURCES.ORG: ENTERPRISE WEB TOOLS TO SUPPORT MONITORING. The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) facilitates collaboration and coordination of diverse ecological monitoring programs within the region. To aid partners, PNAMP developed a suite of integrated web tools and resources, MonitoringResources.org, that supports practitioners to document how, when, where, and why data are collected. With standardized documentation of metadata, practitioners can document details once, easily update annually, and share their work many times. MonitoringResources.org uses standardized documentation for data collection and analysis methods, for protocols, and for spatial and temporal study designs. Information is integrated so that users can plan more efficiently. Long term storage of information preserves annual documentation, facilitating discovery of past data collection procedures, and assisting analysts how to best synthesize and analyze data in the future. MonitoringResources.org supports information sharing among monitoring programs, allowing us to leverage funding for data collection and sharing. PNAMP is working with partners and subject matter experts to expand MonitoringResources.org to support continental scale monitoring of subject matters in addition to aquatic monitoring.

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IMPACT OF A CULVERT AS A MIGRATION BARRIER FOR SPAWNING KOKANEE IN BIG ELK CREEK, IDAHO. Spawning kokanee (*Oncorhynchus nerka*) provide a recreational fishery in Big Elk Creek, a tributary to Palisades Reservoir. Kokanee were originally stocked into Palisades Reservoir in 1963 and 1965, and the population has persisted by natural recruitment from adults spawning in Big Elk Creek. Idaho State Highway 26 separates the main reservoir from the Big Elk Creek arm; the two sections of the reservoir are connected by a culvert that is 7 ft in diameter and is approximately 100 ft below the water surface when the reservoir is filled to maximum capacity. During some years, the culvert under Highway 26 can become exposed and even perched, becoming a passage barrier for adult kokanee during the spawning run. To determine the influence of the culvert on kokanee, we radio tagged 15 kokanee to determine if they could navigate through the culvert and spawn in Big Elk Creek. Additionally, we used historic water surface elevation data for Palisades Reservoir to determine how frequently the culvert was a migration barrier. We were unable to capture fish in the reservoir; tagged fish represented fish that had already passed through the culvert. None of the 15 tagged kokanee passed through the culvert a second time; the culvert was < 20 feet below the surface after fish were released and became perched on 10 September (16 d after fish were tagged and released). Since 1965, the culvert has become exposed or perched during 13 of 41 spawning

runs, occurring at a much higher frequency since 2000 (n = 8 years). Considering that Big Elk Creek is the only tributary used by kokanee for spawning habitat, our research suggests that the culvert as a migration barrier can have an adverse effect on the entire population of kokanee in Palisades reservoir.

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DIET OVERLAP OF BROOK TROUT AND RAINBOW TROUT IN BIRCH CREEK. Brook trout and rainbow trout are common sport fish that have been introduced to streams across North America. Both of these species have extensive negative impacts on native salmonids through competitive interactions leading to species declines and changes in ecosystem dynamics. However, much less is known about how these two species influence each other through competition. We studied diet selectivity and overlap between brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) at five sites in Birch Creek, Idaho. The objectives of this research were (i) to determine the availability and abundance of aquatic and terrestrial invertebrates in each reach, (ii) to quantify diet selectivity of each trout species in each reach, and (iii) to determine the extent of diet overlap between the two species. In October 2015 and May 2016, we collected benthic and drift macroinvertebrate samples at each site to determine prey availability for the fish species present. At each site, we collected fish via electroshock sampling and performed gastric lavage to collect the stomach contents of each trout. Insects from the stream and stomach samples were identified down to the order level, and analyses were performed to determine diet selection and overlap at each site as well as for the whole stream. We found that there is significant diet overlap between brook trout and rainbow trout, with both species showing positive selection for annelids and terrestrial insects. These results suggest that these species are competing for prey resources in Birch Creek. Additional research should determine how seasonality of prey availability may lead to variation in competitive interactions and niche partitioning.

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WHOLE OR SECTIONED OTOLITHS? CHOOSING THE BEST METHOD FOR AGING TROUT IN HENRYS LAKE. Whole otoliths have historically been used for age determination for trout in Henrys Lake. However, sectioned otoliths are often assumed to be more reliable method particularly for older fish. Sectioning otoliths is less time-efficient and may not be necessary in order to achieve higher precision in age estimates in Henrys Lake. In an effort to evaluate whether sectioning was essential, we compared the precision of estimated ages between readers and between sectioned and whole otoliths for Brook Trout (*Salvelinus fontinalis*) Hybrid Trout (Rainbow Trout *Oncorhynchus mykiss* x Yellowstone Cutthroat Trout), and Yellowstone Cutthroat Trout (*O. clarkii bouvieri*), collected from gillnets in 2015 and 2016 annual spring surveys in Henrys Lake. The two readers were within 1 year on 98.9% of section and 93.4% of whole otolith estimates for brook trout. Agreement between readers was within 1 year on 92.1% of sectioned and 96.1% of whole otolith estimates for hybrid

trout and 98.4% of section and 100% of whole otolith estimates for Yellowstone Cutthroat Trout. We found no significant bias in estimated ages between paired sectioned and whole otoliths for Brook Trout (McNemar test, $\chi2=0.4$, $P=0.53$), Hybrid Trout (McNemar test, $\chi2=2$, $P=0.37$), and Yellowstone Cutthroat Trout (McNemar test, $\chi2=3$, $P=0.08$) based on chi-square tests of symmetry. Our results suggest that sectioning trout otoliths may not be necessary in order to achieve more precise age estimates used for dynamic rate functions in Henrys Lake.

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REALIZING THE PROMISE OF PARENTAGE-BASED TAGGING FOR ADDRESSING CONSERVATION AND MANAGEMENT OF STEELHEAD IN THE COLUMBIA RIVER BASIN. Since 2008, cooperating state, tribal, and federal agencies have genetically sampled and genotyped steelhead broodstock at all hatcheries in the Snake River Basin in Idaho, Oregon, and Washington. This regional implementation of Parentage-Based Tagging has resulted in the genetic tagging of >95% of the hatchery smolts produced in the Snake River (~12 million smolts per year). This accounts for ~61% of the hatchery steelhead that are released in the entire Columbia River basin each year. The IDFG and CRITFC are committed to using PBT technology to complement existing mechanical tagging evaluations, or in some cases replace mechanical tags for assessments where their use may have limited precision or uncertain accuracy. This poster provides examples of current sampling programs that are in place throughout the Columbia River basin that utilize the Snake River PBT baseline to address conservation and management questions throughout the region. Collaborative efforts are currently underway to extend this technology throughout the Columbia River Basin.

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HIGH DESERT DROUGHT RESILIENT RANCHING, REGIONAL CONSERVATION PARTNERSHIP PROGRAM. The High Desert Drought Resilient Ranching project is a collaborative restoration effort across the Owyhee, Malheur, and Salmon Falls Basins of Oregon, Idaho, and Nevada and focuses on improving wildlife habitat for redband trout, Sage Grouse, and Columbia spotted frog. Fourteen project partners will work closely with Trout Unlimited and the NRCS to implement restoration projects focused on riparian areas in state and private lands across the geographical project area. Example projects may include enhancement and creation of wet meadow systems, stream bank stabilization, off stream livestock watering facilities, riparian pastures, brush management, and grazing management. Another key component to these restoration efforts is outreach and education. The partnership will hold 2 informational workshops for partners and landowners to learn about different restoration techniques and how they can apply them to their operations. This poster presentation will showcase the geographical project area, collaborative partnerships, outreach/education, and potential project types to be implemented on state and private lands.

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EVALUATION OF SAMPLING TECHNIQUES USED TO SAMPLE SMALLMOUTH BASS IN LENTIC SYSTEMS: COMPARISON OF GEAR-SPECIFIC ESTIMATES OF POPULATION CHARACTERISTICS. For decades, electrofishing has been the most widely-used gear to sample Smallmouth *Bass Micropterus Dolomieu* populations in recreational sport fisheries. However, the shortcomings of electrofishing for estimating various population characteristics (i.e., size structure, growth, mortality) are poorly understood. In addition, there are no known studies that have compared estimates of population characteristics of Smallmouth Bass obtained from alternative sampling gears to electrofishing. Fishery managers must understand the shortcoming of commonly-used sampling gears in order to minimize bias in estimates of population-level characteristics that are subsequently used to formulate management decisions. In this study, we sought to quantify the influence of three sampling gears (i.e., electrofishing, gill nets, trammel nets) on estimates of population size structure and dynamics of Smallmouth Bass in Coeur d'Alene Lake, Idaho. We sampled fish during 6–14 June, 2016 from littoral habitats at 14 sites throughout Lake Coeur d'Alene. Each site was sampled with each gear according to standard methods which included three 10-minute long electrofishing passes and three trammel and gill nets being fished overnight. Our results showed that gill nets sampled a broader length distribution (157–498 mm) of fish than electrofishing (56–399 mm). Trammel nets captured fewer individuals (n = 6) and only one mesh size (i.e., 2") successfully captured Smallmouth Bass. The length distribution of fish sampled with gill nets encompassed that of the trammel nets, and required half of the effort to process entangled fishes. Gill nets sampled fewer Smallmouth Bass (n = 65) than electrofishing (n = 279) and the discrepancy was larger created by the lack of small-bodied (i.e., > 130 mm total length) Smallmouth Bass that were not sampled by gill nets. Our study provides important insight for fishery scientists undertaking projects focused on evaluating population characteristics of Smallmouth Bass in lentic environments. Ultimately, our results can be applied to reduce bias in estimates of size structure and improve reliability of total annual mortality estimates.

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A COMPARISON OF FRESHWATER MOLLUSK COMMUNITIES IN TWO IDAHO RIVERS. We conducted a comparison of freshwater mollusk communities in the Boise and Payette rivers to support state-wide efforts to describe and understand the diversity, distribution, and ecological function of freshwater mollusks in Idaho. Our survey sites were located in rivers that are third order streams, with headwaters at approximately 3000 m. Both rivers are influenced by snowmelt hydrograph, have similar lengths, and drain to the Snake River. We performed systematic cobble count surveys and plot square sampling accompanied with non-random surveys. We used viewing buckets and dip-net samples to collect specimen of various taxa. We identified specimens, curated them, and entered into the Idaho Freshwater Mollusk Database. Here, we describe the mollusk community and quantify species richness within each river system. We further present statistical comparisons of

richness within (elevational gradients) and among rivers systems and discuss our results in the context freshwater management and ecosystem services.

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BAT MORTALITIES AT WIND-ENERGY FACILITIES IN SOUTHERN IDAHO. Wind-energy development is expanding across the western USA, and unprecedented mortality rates of bats have occurred at many of these facilities. Southern Idaho provides important seasonal habitat for many species of bats. Little is known, however, about bat mortalities in southern Idaho—as well as the western USA—from wind-energy facilities. We described bat mortalities (gender, species, and age) at three wind-energy facilities in southern Idaho from 2011 to 2014. We analyzed 667 carcasses across those three facilities, and of those carcasses that were identifiable, 46% were hoary bats (*Lasiurus cinereus*), 29% were silver-haired bats (*Lasionycteris noctivagans*), 13% were big brown bats (*Eptesicus fuscus*), and 5% were little brown myotis (*Myotis lucifugus*). Across those species, 25% were males, 25% were females, and for 50% we could not determine gender due to advanced carcass decomposition or other factors. Also, of those species; 59% were adults, 15% were juveniles, and 26% could not be determined. One wind-energy facility accounted for 95% of big brown bat mortalities (26% of all carcasses recovered at that facility), which is one of the highest percentages of big brown bat mortalities at a wind-energy facility compared with other studies conducted in the USA. Our results provide managers with basic information about bat mortalities at wind-energy facilities in southern Idaho, which can be used for mitigation efforts, as well as for land-use planning for bats and their habitat in this area.

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AN ECOLOGICAL, CULTURAL AND LEGAL REVIEW OF PACIFIC LAMPREY IN THE COLUMBIA RIVER BASIN. Pacific lamprey (*Entosphenus tridentatus*) is an anadromous species in an ancient lineage of jawless fishes. The species is native to the North Pacific and marine-accessible freshwater rivers and streams. Pacific lamprey is understudied relative to other anadromous fishes, and has declined in abundance in its conterminous US range. Pacific lamprey rear for three to seven years as filter-feeding larvae in freshwater streams, metamorphose prior to downstream migration, grow during a multi-year ectoparasitic marine phase, and return to freshwaters to spawn and die. Indigenous people of the Snake and Columbia River basins have long recognized the ecological role and value of lamprey through their spiritual and cultural practices. The combined effects of poor passage at dams, historic and continued habitat degradation, and altered marine host conditions have contributed to the observed decline in abundance and distribution. Here we provide a review of legal protections and recovery actions throughout the Columbia River basin, including an analysis of the Fish and Wildlife Service's 2004 denial of a petition to list Pacific lamprey under the Endangered Species Act. The current patchwork of measures fail to provide integrated protections across the life

history of the species because of a life cycle spanning dozens of local, state, tribal, federal and international jurisdictions combined with the uncharismatic traits of the species as viewed by western society. Recent shifts in perceptions about the ecological value of the species and increased co-management of anadromous species within the Columbia River basin has elevated the species as a management priority within the past 15 years. Continued efforts to conserve and recover Pacific lamprey pose a complex and honorable challenge for fisheries managers within the Columbia River basin.

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A MAP AND DATABASE OF WESTSLOPE CUTTHROAT TROUT HYBRIDIZATION THROUGHOUT IDAHO AND MONTANA STREAMS. Among the many threats posed by invasions of nonnative species is introgressive hybridization, which can lead to the genomic extinction of native taxa. This phenomenon is regarded as common and perhaps inevitable among native cutthroat trout and introduced rainbow trout in western North America, despite that these taxa naturally co-occur in some locations. We conducted a synthetic analysis of 13,315 genotyped fish from 558 sites by building logistic regression models using data from geospatial stream databases and from 12 published studies of hybridization to assess whether environmental covariates could explain levels of introgression between westslope cutthroat trout and rainbow trout in Idaho and Montana. A consensus model performed well (AUC, 0.78–0.86; classification success, 72–82%; 10-fold cross validation, 70–82%) and predicted that rainbow trout introgression was significantly associated with warmer water temperatures, larger streams, proximity to warmer habitats and to recent sources of rainbow trout propagules, presence within the historical range of rainbow trout, and locations further east. This poster shows predictions that the probability of hybridization exceeds 10% mapped to stream reaches in a 55,234-km network for current and future scenarios. The database, user-friendly digital maps, and ArcGIS shapefiles showing hybridization probabilities for all westslope cutthroat trout streams in Idaho and Montana for multiple climate change and rainbow trout invasion scenarios are available at this website: http://www.fs.fed.us/rm/boise/AWAE/projects/CutthroatRainbowTrout.html to assist managers in conservation planning. The manuscript describing this research was recently published in PLoS ONE and is available at: http://www.treesearch.fs.fed.us/pubs/53197.