Comparing Manned to Unmanned Aerial Surveys for Cetacean Monitoring in the Arctic.
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Manned aerial surveys are routinely used to assess cetacean distribution and density, often over large geographic areas. Unmanned aircraft systems (UAS) have been identified as a technology that could augment or replace manned aerial surveys for cetaceans. To understand what research questions involving cetacean distribution and density can be addressed using manned and UAS technology in the Arctic, we conducted paired aerial surveys for cetaceans near Utqiaġvik (Barrow), Alaska. Abundance estimates of cetaceans were similar using the different methods, but the level of uncertainty in the abundance estimates using imagery from UAS were substantially higher. This work has contributed significantly to our understanding of the operational challenges, analytical complexities, and financial realities of using long-range UAS in a remote environment

Distribution of Porcupines in the Pacific Northwest and Evaluation of a Non-invasive Survey Method.
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Recent evidence suggests that populations of North American porcupines (*Erethizon dorsatum*) may be declining in parts of their range, including the Pacific Northwest. Establishing baseline historical and contemporary distributions of porcupines is necessary for initiating monitoring efforts and, if necessary, informing strategic conservation actions. We compiled 1,293 occurrence records of porcupines in Washington, Oregon, and northern California from 1908 to 2018. Using maximum entropy modeling (Maxent), we created historical and contemporary distribution models based on porcupine records from 1981–2010 and 2012–2018, respectively. Our models suggested a shift in the occupied environmental niche of porcupines in the Pacific Northwest away from forested areas and towards desert scrub and grassland vegetation communities in recent years. In addition, we tested a non-invasive survey method for determining porcupine presence and monitoring their status over time. Our trials suggested that sodium-soaked wood blocks may provide an inexpensive and minimally non-invasive technique to detect porcupines, but further testing is needed to understand its effectiveness and limitations.

Drought Conditions Affect Movement of Stream-living Salamanders (*Dicamptodon tenebrosus*).
Ivan Arismendi*, *Department of Fisheries and Wildlife, Oregon State University, Nash Hall 104, Corvallis, OR, 97331; Ivan.Arismendi@oregonstate.edu*

Understanding the extent to which species' life histories and behavior are shaped by the contraction and expansion of stream networks is a critical step in evaluating the potential impacts of the recent warming climate in headwater streams. The study of how in-stream vertebrates' population demography is affected by specific environmental cues during seasonal low flow will provide insights into answering this question. In particular, the contrast between low and high density of aquatic vertebrates can be used as a surrogate of a natural-low versus extreme-low

streamflow conditions due to climate change respectively. Here, we conducted an experiment in natural stream reaches to examine patterns of movement of Coastal Giant Salamander (*Dicamptodon tenebrosus*). The experiment includes two 25m stream reaches with natural (reference) and high densities of animals (treatment). We used pit-tags and mobile tracking techniques to map daily movement of 54 marked individuals. We estimated home ranges as well as habitat overlap among individuals. Our preliminary findings suggest that under high animal density conditions, such us during periods of drought, competitive interactions lead to a large displacement of individuals. Our experiments provide insights for a mechanistic understanding of links between hydroclimate and biota.

Dwarfing the Aquatic Giants: Shrinking Body Size of Top-Predator in Headwaters Under Climate Change. Ivan Arismendi*, Stan Gregory, Randy Wildman, Linda Ashkenas*; Department of Fisheries and Wildlife, Oregon State University, Nash Hall 104, Corvallis, OR, 97330; Ivan.Arismendi@oregonstate.edu*

Here, we present long-term information from continuous annual surveys of Coastal Giant Salamander (*Dicamptodon tenebrosus*) populations from the HJ Andrews Experimental Forest, OR. We have strong evidence that the size of salamanders have consistently decreased over time due to climate change.

Harbor Porpoise in Washington's Inland Waters: Research Opportunities and Management Issues in a Recovering Population. David Anderson*, *Cascadia Research, 218 1/2 W 4th Ave., Olympia, WA 98501*; *DAnderson@cascadiaresearch.org;* Laurie Shuster, *Cascadia Research, 218 1/2 W 4th Ave., Olympia, WA 98501*; *Laurie.Shuster@gmail.com;* Joseph R Evenson, *Washington Department of Fish and Wildlife; joseph.evenson@dfw.wa.gov* Jessica L Huggins, *Cascadia Research, 218 1/2 W 4th Ave., Olympia, WA 98501*; *JHuggins@cascadiaresearch.org;* John Calambokidis, *Cascadia Research, 218 1/2 W 4th Ave., Olympia, WA 98501*; *calambokidis@cascadiaresearch.org*

Once the most common cetacean in Washington's inland marine waters, Harbor Porpoise (*Phocoena phocoena)* numbers declined drastically in the years following WWII. They were thought to be extirpated from the Puget Sound, and had greatly reduced numbers in the Strait of Juan de Fuca and San Juan Islands. Increases in abundance were first noted in the early 1990s in the northern waters of Washington, with animals reaching southern Puget Sound by 2005. The population has continued to increase throughout the inland waters with a minimum population estimate of over 8,300 animals in 2015. Recovery of the inland Washington harbor porpoise stock raises many interesting management questions and research opportunities. The increasing harbor porpoise population could alter the ecosystem balance by acting as both predators (consuming large quantities of smaller fish and invertebrates) and prey (for Bigg's killer whales and sharks). Collaborations between researchers in Washington and California, where San Francisco Bay has experienced a similar pattern of harbor porpoise disappearance and return, are examining similarities and differences in porpoise behavior including foraging, mating and boat interactions.

Foothill Yellow-legged Frog Assessment Model (FYFAM). Don Ashton*, *McBain Associates, 980 7th Street, Arcata CA 95521; ashton.don@gmail.com*; Scott McBain, *McBain Associates, 980 7th Street, Arcata CA 95521; Scott@mcbainassociates.com*; Steve Railsback, *Lang, Railsback, and Associates, 250 California Ave, Arcata CA 95521; Steve@langrailsback.com*

The Foothill Yellow-legged Frog (*Rana boylii*, FYF) relies on river edgewaters for reproduction, timing its oviposition with hydrograph cycles to minimize scour and desiccation risks to eggs and tadpoles while maximizing first-year development time for offspring. Individual frogs initiate breeding using a suite of environmental cues. Dams can decouple the hydrology, hydraulics, and thermal regimes from other natural environmental cues, hampering oviposition choices of breeding FYF, increasing scour and desiccation risk, and thus diminishing reproductive success. Managing water resources for biotic benefits downstream requires better insight on how organisms such as FYF will respond to alternative flow release schedules. The Foothill Yellow-legged Frog Assessment Model (FYFAM, developed using support from US Forest Service) uses water temperature, depth, and velocity outputs from hydrologic, hydraulic, and water temperature models to assess potential differences in cohort success under various hydrograph scenarios. FYFAM uses cell-specific environmental inputs and probabilities to simulate decisions by virtual frogs and tadpoles and predicts developmental rate of eggs and tadpoles through metamorphosis on a daily time step. Number of froglets produced per breeder and median date of metamorphosis are the primary output metrics, but many secondary metrics are useful in evaluating results. We will describe the model and explain how to interpret model outputs for two potential management actions: 1) alternative dam release hydrographs, and 2) alternative channel restoration site designs. These examples draw from rivers in California where FYFAM is providing insights on how flow management and channel restoration can influence reproductive success for this imperiled, river-breeding frog.

It's Turtles All the Way Down: Perspectives for the Western Pond Turtle (*Actinemys marmorata*) as a Long-lived Species in a Rapidly Changing Environment. Don Ashton, *McBain Associates, 980 7th Street, Arcata, CA 95521; ashton.don@gmail.com;* R. Bruce Bury, *1410 NW 12th Street, Corvallis, OR 97330; burybr@peak.org*; Gwen W. Bury, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97330; gbury@ oregonstate.edu.*

With the species' status in review at state and federal levels, western pond turtle conservation has gained momentum across its range, but is this attention too little too late? A changing climate is blamed for increasing drought severity and duration, increasing high-intensity wildfires, and a prolonged fire season. The bauplan (body plan) of the Western Pond Turtle has proved resilient over millions of years, but can it help the species persist through the environmental changes predicted to unfold across the west over the next century? Will we witness their extinction at our hand? Drawing on >50 years of research experience with Western Pond Turtles in northern California, as well as reported range wide demographic trends and life history features, we will provide perspectives on its ecology and management and recovery in natural populations. Population estimates are crucial to determine trends and more robust statistically than observational evidence. We need to increase the number of studies using population estimates with mark-recapture techniques, establish long-term sampling in a network range wide, and determine losses of nests and hatchlings. An emphasis on its life history and population trends are crucial for understanding meta-population effects of rapid environmental change on a long-lived semi-aquatic vertebrate.

It'snot What You Think—Collecting DNA from the Spout of a Whale with a 'SnotBot' Drone. C. Scott Baker*, Angie Sremba, Logan Pallin, *Marine Mammal Institute, Oregon State University, 2030 SE Marine Science Drive, Newport OR 97365; scott.baker@oregonstate.edu; srembaa@oregonstate.edu; lpallin@ucsc.edu;* Shannon Atkinson, *University of Alaska*

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Unmanned aerial vehicles (UAVs) or drones are finding a role in an increasing number of wildlife studies. For whales and dolphins, UAVs offer the potential to collect high-definition video and photographs with little or no disturbance. Through photogrammetry, these images can be used for assessment of physiological condition, individual health and scarring from past entanglement. Here we assessed the potential for using a 'SnotBot' drone to collect genetic samples from the spout of blue and humpback whales from southeast Alaska, the Gulf of California, the Gulf of Maine and the coast of Gabon. The primary objective was to link the aerial images to the individual identification and sex of the whale by 'DNA profiling', allowing integration with extensive life history records available from some of these regional populations. A parallel effort attempted to extract hormones for assessing stress and pregnancy. For the trials, a UAV was fitted with sterile Petri dishes and flown into the vaporous exhalation of the whale. We tested several methods for preserving the spout samples in the field and for subsequent extraction of DNA in the laboratory. The results confirmed the potential for using a SnotBot to collect DNA of sufficient quality and quantity for sequencing of mtDNA haplotypes, sex identification and individual identification by microsatellite genotyping.

Twin Lakes Turtles: A Single Lake Study (2010-2018). Jamie B. Bettaso*, *Lower Trinity Ranger District, Six Rivers National Forest, POB 68, Willow Creek, CA 95573; jamiebettaso@gmail.com*; Justin M. Garwood, *California Department of Fish and Wildlife, 5341 Erikson Way, Arcata, CA 95521, justin.garwood@wildlife.ca.gov*; Ryan M. Bourque, *California Department of Fish and Wildlife, 619 2nd Street, Eureka, CA 95501; ryan.bourque@wildlife.ca.gov*; Christopher J. West, *Senior Wildlife Biologist, Yurok Tribe, Wildlife Program, Natural Resources Division, 190 Klamath Blvd, Klamath, CA 95548; cwest@yuroktribe.nsn.us*

Long-term demographic studies of long-lived species provide important information on population structure but often present logistical challenges to field biologists. We implemented a nine year mark-recapture study on a population of western pond turtles (*Actinemys marmorata*) at a single 3.5 hectare shallow, montane lake in Humboldt County of northern California. The lake is unique given its relative isolation and undisturbed montane setting (1148 meters) making it ideal for population monitoring. From 2010 to 2018, we conducted 25 site visits to obtain demographic parameters including: sizes, growth patterns, adult operating sex ratios, juvenile to adult ratios, and observations of nesting site mortality. We estimated population size using Schnabel methods, leading to density estimates. We also estimated the population biomass and relate it to previously reported data for this species. We also assisted a larger study exploring pathogens as a threat to the species across their range. Understanding of western pond turtle life history aspects can be difficult to ascertain without multiple-year efforts.

Two Introductions and a Few Successful Breeders: Genetics of Invasive Bullfrogs in the Yellowstone River Floodplain, Montana. Daniel M Bingham*, *Cramer Fish Sciences 7525 NE Ambassador Pl. Suite C, Portland, OR 97220; dan.bingham@fishsciences.net;* Adam Sepulveda, *United States Geological Survey, Northern Rocky Mountain Science Center 2327 University Way, Suite 2 Bozeman, Montana 59715; asepulveda@usgs.gov;* Sally Painter, *The University of*

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We analyzed seven microsatellites in invasive American bullfrogs (*Lithobates catesbeiana*) from the Yellowstone River floodplain, Montana, to describe genetic population structure, make inferences about locations of introductions, and characterize patterns of invasion. Microsatellites corroborate mitochondrial DNA results from previous research and suggest at least two independent introductions from genetically divergent populations followed by massive spread. One introduction is associated with the upstream extent of the invasion, and the other more broadly with downstream populations. Bullfrogs from the downstream introduction are highly successful invaders, as gene flow from this genetic group is apparent in nearly all sites. Downstream, long-distance invasion from the upstream introduction is also apparent. We found strong evidence for genetic bottlenecks in two locations, which may indicate they are the original locations of introduction and perhaps sources of bullfrogs in the region. We observed a pattern of isolation by distance among sample sites after correcting for independent introductions, suggesting genetic drift affects genetic structure of bullfrogs in the region. Finally, all sites are characterized by very small effective numbers of breeders (Nb< 50), which may indicate a small number of adults drive the invasion by generating massive propagule pressure.

Condition-dependent Movement of Juvenile Northern Red-legged Frogs and Implications for Dispersal in a Changing Climate. Evan M. Bredeweg*, *Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331; evan.bredeweg@oregonstate.edu;* Tiffany S. Garcia, *Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331; tiffany.garcia@oregonstate.edu;* Anita T. Morzillo, *Department of Natural Resources and the Environment, University of Connecticut, U-4087, 1376 Storrs Road, Storrs, CT 06269; anita.morzillo@uconn.edu;* Nathan Schumaker, *Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97331; nathan.schumaker@gmail.com*

Movement is a fundamental process through which animals interact with their environment. Animals with complex life histories often have multiple habitat needs that are scattered throughout a landscape and connected by movement. Assumptions about amphibian movement, an understudied aspect of amphibian biology, are now being critically evaluated to improve our conservation of this imperiled group of species. The direct, indirect, and carry-over effects of environmental factors influencing dispersal between isolated populations and habitats are of conservation concern, particularly as climate change influences precipitation gradients and, therefore, habitat availability and connectivity. Using an experimental approach, we explored carryover effects of larval habitat drying and direct effects of terrain moisture on the movement behavior of juvenile Northern Red-legged Frogs (*Rana aurora*). We found that juvenile body size and terrain moisture (wet or dry) were the strongest factors shaping movement behavior. The carryover effect of larval hydroperiod impacted juvenile movement by significantly altering size at metamorphosis and subsequent compensatory growth patterns. To assess how these factors scale up to impact populations, we developed a spatially-explicit, individual-based model using the HexSim simulator. This model allowed us to incorporate our experimental results into current and predicted climate scenarios. We found that landscape conditions resulting from future climates significantly delayed movement from natal patches but increased population connectivity in clumped landscapes. There is significant ground to cover in

our exploration of amphibian movement, and projects that span fieldwork, experiments, and simulation are key to building validated and relevant understand of the spatial ecology of amphibians.

Results of the 2018 Western *Asio flammeus* Landscape Study (WAfLS) in the Western United States. Joseph B. Buchanan, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; joseph.buchanan@dfw.wa.gov*

In North America, the Short-eared Owl (*Asio flammeus*) inhabits grasslands and similar open cover types in Alaska, Canada and the northern coterminous United States. A recently published status assessment suggested a substantial decline in its range-wide abundance, but acknowledged uncertainty because Breeding Bird Survey data are likely inadequate to assess trends in an owl species that breeds in early spring. Compounding this uncertainty, the species exhibits dramatic temporal and spatial variability in distribution and abundance, which makes assessing population status difficult. To better assess the status of the species and to address aspects of habitat use, we developed a regional project that used volunteer naturalists to collect survey data across eight western states. In 2018, the first year of the range-wide survey effort, 622 volunteers conducted road-based surveys on 368 transects in our study area of about 217 million acres in California, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. Short-eared Owls were detected on 57 transects. Preliminary results indicated that probability of detection declined with increasing Julian date, increasing wind speed, and greater percentage of area grazed. Probability of presence increased with an increasing amount of stubble agriculture and the proportion of the survey in cropland. We generated a map of the predicted occurrence of Short-eared Owls using Maximum Entropy modeling that incorporated 28 climatic, geographic and land cover attributes. Upon completion, the results of this three-year project should provide a greater spatial and temporal understanding of distribution, habitat use and abundance of Short-eared Owls.

Longevity of the Western Pond Turtle (*Actinemys marmorata*) Based on Studies over 50 Years. *R. Bruce Bury*, 1410 NW 12th St., Corvallis, OR 97330; burybr@peak.org; Gwen W. Bury, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331; buryg@oregonstate.edu; Don T. Ashton, McBain Associates, 980 7th St., Arcata, CA 95521; ashton.don@gmail.com; James Bettaso, Six Rivers National Forest, USDA Forest Service, Willow Creek, CA 95573; jbettaso@fs.fed.us; David J. Germano, Department of Biology, California State University, CA 93311; dgermano@csub.edu*

There is keen attention being focused on the status and population features of the Western Pond Turtle (*Actinemys marmorata*) because it is now under review for Federal listing. We have studied the species for over five decades starting in 1968 in Hayfork Creek, northern California. Here, we report on longevity of turtles based on five visits from 2008-2018 that yielded 457 captures (new and recaptures). We recaptured 18 turtles marked ≥30 y earlier, including three that we marked 40 y earlier, two at 41 y, four at 43 y, and one record of 50 y. The latter individual was 5 y old when marked in 1968 and 55-y old female in June 2018 (with a radiograph that revealed 9 eggs). The old-aged individuals (≥40 y) were rare in the population (<5% of adults), although we do not know how many more very old turtles occur in this population. This is a robust population because most (61%) were juveniles (≤12 y old). Further, numbers of turtles appear stable with no major changes over five decades. Our evidence suggests that some Western Pond Turtles may live 55 or more years in the wild and females can remain

reproductive at least to that age. This new information demonstrates the need for long-term protection, management, and recovery efforts for populations of Western Pond Turtles.

Western Pond Turtles (*Actinemys marmorata*): Clutch Sizes, Double Clutching, and Nesting Season in Washington. R. Bruce Bury*, *1410 NW 12th St., Corvallis, OR 97330; burybr@peak.org;* Frank and Kate Slavens, *P.O. Box 645, Lyle, WA 98635; frank@pondturtle.com;* Gwen W. Bury, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97330; buryg@oregonstate.edu*

There are no published records of reproductive features in Western Pond Turtles *(Actinemys marmorata)* in Washington. Thus, we investigated these features to add key life history information to the biology and conservation of the species. We attached radio transmitters to adult females in southern Washington just east of the Columbia River Gorge and followed individuals from early May to mid-July over 14 field seasons. We found 1,450 eggs in 235 nests (mean = 6.2 eggs/nest). The range was 1-12 eggs, but most nests (86%) had 4-8 eggs. There were 14 double clutches with more eggs (mean = 6.64; range 4-11) in the first clutch and fewer (mean = 5.14; range 4-9) in the second round. The interval between a mid-June and early July peak (44% fewer nests) was 28 days (range 22-31). We recorded some individuals over multiple years with one found over seven years varying at 3-7-5-6-8-5-6 eggs per season. There was no apparent pattern. Many of these eggs were incubated in captivity to provide hatchlings for a State program to raise turtles to larger sizes and release them into the wild. Overall, female *A. marmorata* in Washington State appear to deposit eggs annually and some had double clutches, which was unknown this far north in its range.

Western Pond Turtles (*Actinemys marmorata*) at a Recreation Area in the Mid-Willamette Valley, Oregon: Life history, algae infestation and conservation status. Gwendolynn W. Bury*, Arianna Ilharreguy, Ivan Arismendi, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon 97331; buryg@oregonstate.edu*; R. Bruce Bury, *1410 NW 12th St., Corvallis, OR 97330; burybr@peak.org*.

Luckiamute Natural Recreation Area is located in the central Willamette Valley, OR. There are two ponds on the property, one is managed as a fishing area, the other for wildlife. The staff mow identified Western Pond Turtle (*Actinemys marmorata*) nesting habitat, and place basking structures in the ponds. Since starting studying the area in 2012, we have now marked 61 individuals. Most of them were large-size adults, but 22% were younger than 7 years and 45% younger than 12 years of age. They grew at moderate rates, reaching 120 mm CL in 6 yrs. Radiographs of 11 adult females revealed a mean clutch of 6.0 eggs (range 5-8), which is similar to patterns observed in southern Washington. Unlike other populations, Luckiamute turtles had high infestation (85% occurrence) of the filamentous green alga, *Arnoldiella chelonum.* The eastern pond has the larger population, but last year was shallow and overgrown with algae and aquatic plants due to water shortage. The western pond is easily accessed, and the focus of our recent studies. We have started a set of interconnected studies of basking behavior and environmental correlates. This study encompasses Bluetooth-enabled sensors glued to turtle shells, placed near and in the pond, plus weekly observations, and timed-photo capture. Western Pond Turtles have not been observed basking since late October. Overall, the Luckiamute turtle population seems to be robust and we hope to track its status and ecology over future years.

Return of the Giants of the Salish Sea: Increased occurrence of humpback whales into the inside waters of Washington State. John Calambokidis*, Kiirsten Flynn, Gretchen Steiger, Elana Dobson,, *Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; Calambokidis@CascadiaResearch.org;* Mark Malleson, *Center for Whale Research, P.O. Box 1577, Friday Harbor WA 98250;* Brian Gisborne, *Juan de Fuca Express, Victoria, BC V8V 2G5;* Susan Berta, *Orca Network, 485 Labella Vista Way, Freeland WA 98249*.

Humpback whales were previously common in the Salish Sea and were largely eliminated by whalers based from a whaling station on southern Vancouver Island from 1907 to 1910 who hunted whales through the winter months. Cascadia Research and collaborators have conducted long-term studies of humpback whales along the US West Coast since the 1980s and documented their steady recovery from whaling; population increased at about 7-8% per year at least through about 2010 when there were some indications the population may have recovered to near pre-whaling numbers. In the late 2000s, we documented increased sighting reports of humpback whales in inside waters of Washington and extending into Puget Sound. Some of these whales also stayed through the winter months. Humpback whales have now become common in the Salish Sea and become a focus of some whale-watch operations on both the Washington and British Columbia side of the border (especially when killer whales are absent). We used photographic identification to investigate humpback whale movements and matches of identification photographs to other areas reveals that these whales travel to a mix of breeding areas including Hawaii, Mexico, and Central America in winter months. Matches also show many of these whales using inside waters represent whales that had been using outside offshore waters, suggesting a shift over time into inside waters. We speculate that humpback whales, which show site fidelity to specific regions, only returned to these former feeding areas when their recovering population size forced their expansion into inside waters.

Changes in abundance and status of the Pacific Coast Feeding Group of gray whales. John Calambokidis* and Alie Perez, *Cascadia Research Collective, 218½ W 4th Ave., Olympia WA 98501; Calambokidis@CascadiaResearch.org*.

A subgroup of the eastern North Pacific gray whale population that spending the spring through fall feeding in the Pacific Northwest from Norther California to British Columbia has been given the name the Pacific Coast Feeding Group (PCFG). These seasonally resident gray whales appear to be distinct from the overall E North Pacific population, based on repeat photo-identification sightings and mitochondrial DNA patterns. With support from National Marine Fisheries Service, we have conducted annual assessment of abundance and trends based on a collaborative effort gathering individual photographic identification of whale primarily since 1998. Mark-recapture calculations indicate a stable abundance estimate of about 200 whales though 2017. While there were some indications of outside immigration to this group from the overall gray whale population in the late 1990s, our more recent data indicates recruitment is primarily internal with new recruits to the population largely documented as offspring of known long-time PCFG mothers. The status and dynamics of this population have become of greater management importance with the proposed resumption of whale hunting by the Makah Tribe.

Activity Patterns and Foraging Behavior of American Pikas (*Ochotona princeps*) Differs Between Craters of the Moon and Alpine Talus in Idaho. Meghan Camp, *School of the Environment, Washington State University, Pullman, WA 99164; meghan.camp@wsu.edu*; Lisa A. Shipley*, *School of the Environment, Washington State University, Pullman, WA 99164;*

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Range contractions in the Great Basin over the last century suggest American pikas might be highly sensitive to climate change. However, documentation of pikas residing at relatively warmer, low-elevation sites has recently shed new light on the possible resilience of pika populations to warmer ambient conditions when they have access to cooler microhabitats for thermoregulation. To provide insight into possible behavioral mechanisms of adaptation to warmer habitats, we investigated activity patterns, foraging behavior, and space use of a population of pikas living in an atypical, warmer habitat at Craters of the Moon National Monument and Preserve, an extensive lava flow surrounded by high desert grassland and sagebrush communities in southern Idaho. We compared their behavior to that of a population in a typical, alpine habitat at Grays Peak in the nearby Pioneer Mountains in Idaho. Pikas were the least active midday when the surface temperatures were highest, and the insulating effect of the lava tubes was most pronounced. Pikas at Craters of the Moon spent less time haying and displayed fewer territorial behaviors than pikas at Grays but filled a similar number of haypiles. The vegetation community was less diverse and sparser at Craters than at Grays, and consequently, vegetation that was consumed and cached reflected these differences. Our results expand the body of literature on American pikas at their environmental limits and this study is the first step in identifying the unique suite of behaviors pikas use to persist in a seemingly inhospitable environment at Craters of the Moon.

Implementation of bat monitoring and white-nose syndrome surveillance in the North Coast Cascades Network in response to disease detection in western Washington. Tara Chestnut, *Mount Rainier National Park, Ashford, WA 98304; tara_chestnut@nps.gov.*

In response to the 2016 *Pseudogymnoascus destructans* (Pd) detection in Washington State, the National Park Service (NPS) North Coast Cascades Network implemented bat monitoring and white-nose syndrome (WNS) surveillance following recommendations outlined in the NPS Pacific West Region WNS response plan. The primary goals were to identify known bat colonies, conduct WNS surveillance, and assess bat species occurrence in network parks using acoustic monitoring. To identify known bat colonies, we surveyed park natural resource and maintenance staff to identify buildings where bats have been observed and compiled data from the 2000 NPS Natural Resources Challenge inventory. We conducted direct Pd/WNS sampling by swabbing bats in the hand, and passive Pd surveillance by placing clean plastic sheeting at known sites and collecting fresh guano. Finally, we implemented acoustic monitoring at all seven NCCN parks and an elevational study of bat occurrence at Mount Rainier National Park. We report on the preliminary results and lessons learned in project implementation.

March Mammal Madness: a Story about Science & Social Media. Tara Chestnut, *National Park Service, Mount Rainier National Park, Ashford, WA, USA*, tara_chestnut@nps.gov; Patrice K Connors, *University of Utah, Salt Lake City, UT, USA*; Jessica E Light, *Texas A&M University, College Station, TX, USA*; Brian P Tanis, *Oregon State University, Corvallis, OR, USA*; Joshua A Drew, *Columbia University, New York, NY, USA*; Chris N Anderson, *Dominican University, River Forest, IL*, USA; Anali M Perry, *Arizona State University, Tempe, AZ, USA* Charon E. Henning, *Odd Angel LLC, Bushnell, FL, USA;* Mary Casillas, *Texas A&M University, College Station, TX, USA;* Katie Hinde, *Arizona State University, Tempe, AZ, USA*, katie.hinde@asu.edu

Since 2013, the blog "Mammals Suck… Milk" has featured a virtual combat competition among 65 species of animals in a virtual tournament called March Mammal Madness, in honor of the NCAA College Basketball March Madness Championship Tournament. The competition started as a thought experiment among colleagues and has become a pedagogical innovation that engages people from around the globe by creatively integrating scientific literature, original artwork, and digital technologies. Briefly, the winners of simulated animal battles are determined by a probabilistic function of the two species' attributes within a preselected or randomized habitat. Scientific literature is cited to substantiate likely outcomes should the two species encounter one another. Battles are "live-tweeted" by a team of scientists and battle summaries are available afterwards through various virtual media, including Facebook and a library guide created by Arizona State University. Throughout the multi-week competition, participants learn about biological concepts including inter-species interactions, how natural selection has shaped adaptations, conservation management, and the significance of both arts and sciences in education. Here, we summarize the success of the latest championship (#2018MMM) and early outreach of the current tournament (#2109MMM) by estimating the potential impact of broadcasting research through social media and classrooms, and by sharing reactions from participants. Our estimates strongly suggest that more people are participating in the championship every year, likely promoting one goal of the competition to inspire awe for the natural world.

Presence of Little Brown Myotis (*Myotis lucifugus*) Positively Associated with Trees and Negatively Associated with Artificial Light Within Waterfront Sites in Metro Vancouver.

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Anthropogenic activities can influence the presence and distribution of bats. We conducted this study to assess the influence of human development (changes to vegetation) and activity levels (artificial light and noise) on little brown myotis (*Myotis lucifugus*), a species listed as Endangered under the Canadian *Species at Risk Act*. We conducted surveys at 14 sites adjacent to the Fraser River and Burrard Inlet within Metro Vancouver to examine these factors within waterfront areas adjacent to fresh water and marine environments. We selected sites along a gradient of disturbance and anthropogenic activity levels (e.g., modified vegetation, light, noise). Time-constrained (15 minute) nocturnal (within three hours of sunset) surveys were conducted at each site using an Echo Meter Touch microphone alongside sound and light meters on three nights in each of July and September 2016. Surveys found little brown myotis was the most prevalent and widely distributed bat across the study area with detections recorded at 11/14 sites (79%). The first record of a Mexican free-tailed bat (*Tadarida brasiliensis*) in mainland British Columbia was recorded during the surveys. Stepwise regression models (GLM) found little brown myotis presence was positively associated with tree (>20 cm DBH) habitat and negatively associated with ambient light. Additionally, little brown myotis was detected more often within fresh water as compared to marine sites and was detected more frequently during surveys conducted in July (i.e., maternity period) as compared to September (i.e., migration/pre-hibernation period). Noise levels were not significantly related to the presence of little brown myotis.

Validating the Use of ddPCR for eDNA Analyses of Amphibian Abundance. Christopher Cousins*, Tiffany Garcia, Evan Bredeweg, Taal Levi, Jennifer Allen, *Oregon State University, 2820 SW Campus Way, Corvallis, OR 97331; cousinsc@oregonstate.edu; tiffany.garcia@oregonstate.edu; evan.bredeweg@oregonstate.edu; taal.levi@oregonstate.edu; allejenn@oregonstate.edu*

The management and conservation applications of environmental DNA (eDNA) include confirming species occupancy and monitoring for invasive or rare/endangered species. Recently, the technology has been extended to estimate population abundance, primarily using quantitative real-time PCR (qPCR) to establish a relationship between amplified DNA concentration and both counts of individuals and their total biomass in the system. Multiple studies have shown droplet-digital PCR (ddPCR) offers increased accuracy and precision for quantification of eDNA, which could improve estimates of species abundance and biomass. Importantly, these advantages increase with low eDNA concentrations. Studies using ddPCR suggest that eDNA is more predictive of species abundance than biomass, such that eDNA may be more practically used to estimate animal counts. To test these assumptions, we designed a controlled laboratory experiment using multiple larval age classes of American Bullfrogs (*Lithobates catesbeianus)* held in static control water. Our null hypothesis was that many small individuals produced the same amount of DNA as a few large individuals, thus confounding the direct relationship between abundance and eDNA concentration. Using treatments with varying numbers of individuals and standardized total biomass, we collected eDNA samples at 3 and 36 hours and quantified the amount of DNA amplified using ddPCR. eDNA concentration was positively correlated with abundance, but larval age was a stronger predictor of eDNA concentration. The results challenge the accuracy of abundance estimates using this technique and suggest that multiple factors could influence the amount of detectable DNA in a system.

Wildlife Trafficking in the Pacific Northwest. Jeanne Dodds*, *Endangered Species Coalition, P.O Box 65195, Washington, DC, 20035; jdodds@endangered.org*

This presentation will summarize current research concerning the status and scope of illegal wildlife trafficking in the Pacific Northwest. Wildlife trafficking is a significant and under-recognized regional issue, impacting native Northwest species such as Black Bear, (*Ursus americanus*); shellfish, including Pacific Geoduck (*Panopea generosa*); and Mule Deer, (*Odocoileus hemionus*). Issues of significance include a rising regional and global market for illegally traded species, declining species populations as a consequence of illegal hunting, limited enforcement capacity and weak penalties for traffickers. Along with the poaching and non-legitimate marketing of Pacific Northwest species, the presentation will touch on the 2015 Washington Animal Trafficking Act and provide examples of regional participation in the international wildlife trade.

Early Success of I-90 Wildlife Crossing Structures for Small Mammals in the Cascades Kristina Ernest*, *Central Washington University, 400 E University Way, Ellensburg, WA ErnestK@cwu.edu*

WSDOT is constructing > 20 major wildlife crossing structures in I-90 on the eastern slopes of the Cascades. At the first completed terrestrial wildlife undercrossing, four small mammal species – all habitat generalists – were live-captured in 2017. During 2018 we captured an additional species – a forest specialist – in the crossing structure.

Interannual Variability in the Acoustic Presence of Fin Whales (*Balaenoptera physalus*) in Relation to Environmental Conditions in the Southern Chukchi Sea. Erica Escajeda*, Kate Stafford, Rebecca Woodgate, Kristin Laidre, *University of Washington, 1122 Northeast Boat St, Seattle, WA 98105; escajeda@uw.edu; kate2@uw.edu; woodgate@apl.washington.edu; klaidre@uw.edu*

Fin Whales (*Balaenoptera physalus*) migrate to the Chukchi Sea to feed on seasonally-abundant prey in the summer. Fin Whale presence in the region exhibits high interannual variability and may reflect varying environmental conditions. Using acoustic recordings from three moored hydrophones, we identified Fin Whale calls during the open-water season (July–November) from 2009–2015 and investigated potential environmental drivers of Fin Whale interannual variability. We examined in-situ ocean temperature and salinity data, satellite-derived sea surface temperatures and sea ice melt/formation patterns in the Chukchi Sea and Bering Strait region. In addition, we estimated the water mass presence at each mooring using published temperature and salinity boundaries. Detections of Fin Whale calls were highest in 2012 and 2015, and the majority of detections (96%) were recorded at the mooring located at the confluence of the nutrient-rich Anadyr and Bering Shelf water masses, ~35 km north of Bering Strait (site A3). Interestingly, the two years with the highest detections had very different environmental conditions at this site. Colder temperatures, low salinities, and slow water speeds prevailed in 2012 while high temperatures and salinities, faster water speeds and thus higher transport through the Bering Strait prevailed in 2015. Additionally, the results of a chi-squared test of independence suggest that the occurrence of Fin Whale calls is dependent on the occurrence of water masses at the mooring site ($p < 0.001$). The disparity between 2012 and 2015 suggests there may be multiple combinations of environmental factors that draw Fin Whales into the Alaskan Arctic.

WNS National Response in 2019. *Ann Froschauer, *U.S. Fish and Wildlife Service 510 Desmond Dr SE # 102, Lacey, WA 98503; ann_froschauer@fws.gov,* Bronwyn Hogan, *U.S. Fish and Wildlife Service 2800 Cottage Way, Sacramento, CA 95825; bronwyn_hogan@fws.gov,* Kimberly Dickerson, *U.S. Fish and Wildlife Service 5353 Yellowstone Rd, Suite 308A Cheyenne, WY 82009; Kimberly_Dickerson@fws.gov,* Jennifer Smith-Castro, *U.S. Fish and Wildlife, 16639 W Hardy Rd, Houston, TX 77060; jennifer_smith-castro@fws.gov,* Jonathan Reichard, and Jeremy Coleman, 300 Westgate Center Dr, Hadley, MA 01035; *jonathan_reichard@fws.gov; jeremy_coleman@fws.gov*

White-nose syndrome (WNS) has been a fixture in research and conservation efforts for North American bats since its appearance in 2007. The causative fungus *Pseudogymnoascus destructans (Pd)* is now present in at least 36 states and 7 provinces in North America, where 11 bat species have been confirmed with the disease and 6 others identified bearing *Pd* without disease. Framed by sister plans in the U.S. and Canada, the community of scientists and stakeholders have propelled comprehensive planning and response actions to establish topic-focused working groups to address research and management needs for WNS. The U.S. Fish and Wildlife Service is the lead federal agency coordinating the response in the U.S., and since 2008 the agency has provided millions in research and capacity grants to institutions, conservation organizations, and government agencies to address WNS. Scientists are contributing to our understanding of this disease from all angles, including life history and ecology of *Pd*, the dynamics of fungal infection and transmission, and bat hibernation physiology and immunology

in their search for a way to control the fungus and conserve native bats. In 2019, the Service plans to offer funding opportunities for state-initiated management actions, high priority research, development of disease treatments, and innovative ideas to stop the impacts of WNS. Through the working groups of the WNS National Plan, we will produce guidance for surveillance and diagnostics, decision frameworks for management of bats and their habitats, resources for monitoring bat populations, and outreach materials in support of national priorities.

Moose Population Size and Demography in Northeastern Washington. James Goerz, *University of Montana – Missoula, Montana Cooperative Wildlife Research Unit, Missoula, MT 59812;* Jared Oyster, *Washington Department of Fish and Wildlife, Spokane, WA 99216; Pennsylvania Game Commission, Harrisburg, PA;* Rich Harris*, *Washington Department of Fish and Wildlife, Olympia, WA 98501; Richard.harris@dfw.wa.gov*

Newcomers to the state, moose (*Alces alces shirasi*) increased in abundance and distribution throughout northeastern Washington from the 1970s through 2013. In that year, the Washington Department of Fish and Wildlife and the University of Montana began a cooperative study of moose demography in 2 adjacent study areas north of Spokane, Washington (one with wolf packs, one without). We followed the fate of 46 GPS-collared cow moose (and their calves) in the northern area, and 27 in the southern study area captured during Decembers of 2013, 2014, and 2016. Our estimates of mean annual adult female survival were similar in the 2 study areas, but causes of death differed. Mean annual calf survival was 0.11-0.31 in the northern study area, and 0.48-0.68 in the southern study area (depending on assumptions). Estimated mean fecundity (calves/females in early summer) was 0.56 in the north and 0.70 in the south. Point estimates of the annual growth rate (λ) for each area were 0.75—0.84 for the northern and 0.94—0.99 for the southern area. Concurrently, we used a Bayesian hierarchical approach to helicopter-based mark-recapture distance sampling to estimate moose abundance for all of northeastern Washington. We tallied 166 detections of moose groups along 2,241 km of systematically placed line transects within 29 survey blocks selected using a stratified-random design. We estimated moose density over the entire survey area as 0.49/km^2 (95% credible interval = 0.33–0.67/km^2). Extrapolated to the 10,513-km^2 survey area, we estimated 5,169 moose (95% credible interval = 3,510–7,034) prior to the decline.

Terrestrial Salamanders in Managed Forests: Impacts of Harvest Practices on Oregon Slender salamander and Ensatina Occupancy and Abundance. Tiffany Garcia*, *Oregon State University, 104 Nash Hall, College of Agricultural Sciences, Corvallis OR 97330; tiffany.garcia@oregonstate.edu*; A.J. Kroll, *Weyerhaeuser, 785 N 42nd Street, Springfield, OR 97478; AJ.Kroll@weyerhaeuser.com*; Claudine Reynolds, *Port Blakely Tree Farm, Olympia, WA 98501; creynolds@portblakely.com*; Josh Johnson, *Weyerhaeuser, Lebanon, OR 97355; Josh.Johnson@weyerhaeuser.com*; David Shaw, *Oregon State University, College of Forestry, Corvallis, OR 97331; dave.shaw@oregonstate.edu*

Understanding how sensitive taxa respond to timber harvest practices is a critical component of sustainable forest management. We used multi-scale models to estimate occupancy and abundance of the Oregon slender (*Batrachoseps wrighti*) and Ensatina (*Ensatina eschscholtzii*) salamander, two terrestrial, forest-associated salamanders, to harvest practices in the western Oregon Cascades, USA. The Oregon slender salamander is strongly associated with decaying downed wood. In contrast, Ensatina are relatively common and show less dependency on downed wood. Our Before/After, Control/Impact experiment used a staggered design in

which a subset of 88 stands were harvested in each year of the 6 year study. The impact of harvest was estimated from the expected pre-to-post change in occupancy and abundance on harvested sites relative to control sites. Treatment effect estimates for Oregon slender salamanders indicated lower mean values on harvested plots relative to control conditions, but with uncertainty due to posterior credible intervals that included 0. Ensatina salamanders also showed reduced mean occupancy and abundance values in harvested plots relative to controls, but with enough certainty to conclude a short-term negative response to harvest. Occupancy and abundance for both Oregon slender and Ensatina salamanders increased with downed wood counts at the plot level. This information will assist in the status assessment of Oregon slender salamanders, as the species was petitioned for listing under the Endangered Species Act.

not presenting **Environmental DNA Detection of Amphibians: Lessons Learned in the First Decade.** Caren S. Goldberg*, *Washington State University, School of the Environment, 100 Dairy Road, Pullman, WA 99164; caren.goldberg@wsu.edu.*

The field of environmental DNA (eDNA) detection of vertebrates has been growing exponentially, with over 200 papers published in the last few years. To bring this powerful new technique into use for conservation, a series of challenges needs to be overcome: maximizing detection, minimizing contamination, and interpreting uncertainty. I used empirical results of eDNA analyses conducted by my research group for 28 amphibians in lotic and lentic systems across the western U.S., in Florida, and internationally to inform a synthetic understanding of eDNA detection for rare amphibians. Important lessons learned include: 1) contrary to early expectations, eDNA of vertebrates is not uniformly distributed even in small wetlands (<0.1 ha) and declines quickly with distance from source in streams; 2) eDNA detection probability increases with temperature as ectothermic animals become more active and decreases as temperatures reach degradative conditions (~25°C); 3) eDNA signal can disappear quickly when animals leave lotic systems to bask; 4) some species are more difficult to detect than others, even within taxonomic groups; and 5) eDNA production among and within individuals is highly variable. Even when sampling designs are highly informed by these issues, eDNA signals from low-density populations can be inconsistent and difficult to distinguish from background noise. This uncertainty presents a challenge for conservation and management decision-making, as well as for regulatory application. I will discuss how other countries have addressed these issues and some challenges and opportunities for developing analogous efforts for amphibians listed under the U.S. Endangered Species Act.

not presenting **Detecting Rare Amphibians in Sierra Nevada Meadows with Backpack eDNA Sampling.** Caren S. Goldberg*, *Washington State University, School of the Environment, 100 Dairy Road, Pullman, WA 99164; caren.goldberg@wsu.edu;* Karen Pope, *USFS Pacific Southwest Research Station, 1700 Bayview Dr., Arcata, CA 95521*; kpope@fs.fed.us; Nicolette Nelson, Jonah Piovia-Scott, *Washington State University, School of Biological Sciences, 14204 NE Salmon Creek Ave., Vancouver, WA 98686; nicolette.nelson@wsu.edu; jonah.piovia-scott@wsu.edu*

Environmental DNA detection of amphibians can be an efficient and effective survey method in stream and wetland systems. However, recent work has demonstrated that eDNA does not travel far from the source, presenting a challenge for eDNA detection of rare species in complex aquatic systems such as meadows. In the summer of 2017, we conducted visual encounter surveys (VES) and used a backpack sampler (ANDe; Smith-Root) to collect

concurrent eDNA water filter samples from 65 sites in 15 Sierra Nevada meadows. Sample volumes ranged from 380 mL to more than 2 L per filter and took 3-20 minutes to collect. Samples were analyzed using species-specific qPCR assays for *Rana sierrae, R. cascadae, R. catesbeiana,* and *Pacifastacus leniusculus*. Within meadows, we detected *R. sierrae at* 19 sites: 4 with eDNA only, 1 by VES only, and 14 with both methods. Detections for *R. cascadae* were similar, with 5 sites detected by eDNA only, no sites with VES only, and 11 sites with both methods. We also detected *R. catesbeiana* and *P. leniusculus* at the one sampling site each where they were visually observed. There was some evidence that the number of individuals detected in the VES survey was related to the amount of target species eDNA in the sample ($p=0.07$) but sites with low VES detections had a wide range of eDNA amounts from the target species, leading to overall low explanatory power of this relationship ($r^2=0.07$). This method provides an efficient way to detect rare amphibians in complex aquatic systems.

Influence of Occupation History and Habitat on Washington Sea Otter Diet. Jessica R. Hale*, *School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat Street, Seattle, WA 98105; jrh33@uw.edu;* Kristin L. Laidre, *School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat Street, Seattle, WA 98105, and Polar Science Center, Applied Physics Laboratory, University of Washington, 1013 NE 40th Street, Seattle, WA 98105; klaidre@uw.edu;* M. Tim Tinker, *Department of Ecology and Evolutionary Biology, University of California, Center for Ocean Health, 100 Scheffer Road, Santa Cruz, CA 95060, and Nhydra Ecological Consulting, Head of St. Margaret's Bay, NS; ttinker@nhydra.com;* Ronald J. Jameson, *United States Geological Survey, Western Ecological Research Center, 7801 Folsom Boulevard, Suite 101, Sacramento, CA 95826; ronaldjam@comcast.net;* Steven J. Jeffries, *Washington Department of Fish and Wildlife, Wildlife Science Program, Marine Mammal Investigations, 7801 Phillips Road SW, Lakewood WA 98498; Steven.Jeffries@dfw.wa.gov;* Shawn E. Larson,*Seattle Aquarium, 1483 Alaskan Way, Seattle, WA 98101; S.Larson@seattleaquarium.org;* James L. Bodkin**,** *U.S. Geological Survey, Alaska Science Center, 4210 University Drive, Anchorage, AK 99508, USA; jldbodkin@gmail.com.*

Habitat characteristics are primary determinants of nearshore marine communities. However, biological drivers like predation can also be important for community composition. Sea otters (*Enhydra lutris sspp*.) are a salient example of a keystone species exerting top-down control on ecosystem community structure. The translocation and subsequent population growth and range expansion of the northern sea otter (*Enhydra lutris kenyoni*) in Washington State over the last 5 decades has created a spatio-temporal gradient in sea otter occupation time and density, and acts as a natural experiment to quantify how sea otter occupation history and habitat type influence sea otter diet. We collected focal observations of sea otters foraging at sites across the gradient, in varying habitat types between 2010 and 2017. We quantified sea otter diet composition and diversity, and long-term rates of energy gain across the gradient. We found that sea otter diet diversity was positively correlated with cumulative sea otter density, while rate of energy gain was negatively correlated with cumulative density. Additionally, we found that habitat type explained 1.77 times more variance in sea otter diet composition than sea otter cumulative density. Long-term diet studies can provide a broader picture of sea otter population health in Washington State.

Shell Disease in Washington's Western Pond Turtles—A Quantitative Assessment Based on Computed Tomography. Katherine Haman*, Lisa Hallock, Lameace Kalisz, Ilai Keren,

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Shell disease in Washington's Western Pond Turtles (*Actinemys marmorata*) has the potential to limit the recovery of this state endangered species. Though the etiology of the shell disease is unknown at this time, there is an association with a fungal pathogen closely related to the pathogen that causes snake fungal disease. The overall impact of this disease on the recovery and conservation of Western Pond Turtles in Washington remains under investigation. To monitor the prevalence, disease progression, treatment success, and overall impacts of the disease on reproductive success of affected individuals, we developed a method for disease assessment based on computed tomography scans. This assessment allows us to quantify both the severity and extent of shell disease in individual turtles as well as clearly identify the prevalence of this disease in Washington populations of Western Pond Turtles. For this talk, we will focus on the assessment protocol and preliminary results from turtles that have had repeat CT scans over several years. We will highlight the usefulness of the assessment in monitoring disease progression in turtles that have been treated compared to those which have not. We will also discuss the use of this assessment to investigate the impacts of shell disease on reproductive success and thus its potential impacts on population recovery. In conclusion, we will review what is known to date regarding shell disease in Western Pond Turtles in Washington and mitigation efforts currently underway.

lmproving Methods for Data Collection Using Unmanned Aerial Surveys of Marine Mammal Populations in the California Current Ecosystem. Jeff Harris*, *Alaska Fisheries Science Center, NOAA, 7600 Sand Point Way Northeast, Seattle, WA 98115; jeff.harris@noaa.gov*

The addition of unmanned aerial systems (UAS) to historical survey techniques is enhancing the quality of data collected on marine mammal population demographics. During the 2018 pupping season, the California Current Ecosystems Marine Mammal division (CCEP) compared pup count data between UAS and historical (ground, vessel based, and aerial) counting methods of three species of pinniped. Pup counts using a UAS for Steller Sea Lions (*Eumetopias jubatus*), California Sea Lions (*Zalophus californianus*) and Northern Fur Seals (*Callorhinus ursinus*) increased accuracy of the counts while minimizing disturbance to pinnipeds as well as numerous species of nesting sea birds. While analyzing images collected at each rookery location, other relevant demographic data can be efficiently extracted, such as brand and tag identification, entanglement rates, and age and sex distribution in the rookery. Another management application of UAS surveys used by CCEP in 2018 was the assessment for evidence of entanglement in a foraging aggregation of humpback whales. A combination of fluke identification photos while simultaneously collecting aerial imagery allowed for a thorough assessment of 81 individual whales for both evidence of interaction with a gill-net fishery and body condition. UAS will continue to be used by CCEP to increase the quality of data collected and minimize disturbance to populations.

Mountain Goats Going Where They Are Wanted (They Know How to Take a Hint). Rich Harris*, *Washington Department of Fish and Wildlife, Olympia, WA 98501; Richard.harris@dfw.wa.gov;* Patti Happe, *Olympic National Park, Port Angeles*

In March 2017, we presented on plans to translocate mountain goats (*Oreamnos americanus*) from the Olympic Peninsula to selected portions of the North Cascades (primarily on U.S. Forest Service-administered lands). We will provide an overview of the initial translocations that occurred in September 2018, as well as our plans for additional work in summer 2019.

Casting a Broader Net: Using Multi-target Metagenomics to Capture Aquatic Biodiversity Data from Diverse Taxonomic Targets. Laura Hauck, Brooke Penaluna, Richard Cronn, *Pacific Northwest Research Station, USDA Forest Service, 3200 Southwest Jefferson Way, Corvallis, OR 97331*; *lhauck@fs.fed.us*; *bepenaluna@fs.fed.us*; *rcronn@fs.fed.us;* Kevin Weitemier*, Tiffany Garcia, *Oregon State University, Department of Fisheries and Wildlife, 104 Nash Hall, Corvallis, OR 97331*; *Kevin.Weitemier@oregonstate.edu*; *Tiffany.Garcia@oregonstate.edu*

Environmental DNA (eDNA) assays for single- and multi-species detection show promise for providing standardized assessment methods for diverse taxa, but techniques for evaluating multiple taxonomically-divergent assemblages are in their infancy. Here, we evaluated whether microfluidic multiplex metabarcoding and next-generation sequencing could identify diverse aquatic and riparian assemblages from 48 taxon-general and taxon-specific metabarcode primers per assay. eDNA screening was paired with electrofishing along a stream continuum to evaluate congruence between methods. A fish hatchery located in the transect provided a barrier to upstream passage of hatchery species, and a point source for one non-native species (White Sturgeon, *Acipenser transmontanus*).

Microfluidic metabarcoding detected all 13 species observed by electrofishing, with overall accuracy of 86%. Taxon-specific primers were more successful than taxon-general primers at classifying sequences to species. Taxon-specific and taxon-general markers detected a transition of downstream sites dominated by multiple fish species, to upstream sites dominated by a single species; however, we failed to detect similar transitions in amphibians along the same transect. White Sturgeon was only detected at the hatchery outflow, indicating eDNA transport was not detectable at ~2.4 km. Overall, we identified 878 predicted taxa, with most sequences (49.8%) derived from fish (Actinopteri, Petromyzontidae), Oomycetes (21.4%), Arthropoda (classes Insecta, Decapoda; 16.6%), and Apicomplexan parasites (3.83%). Taxa accounting for ~1% or less of sequences included freshwater red algae, diatoms, amphibians, and beaver. Our work shows that microfluidic metabarcoding can survey multiple phyla per assay, providing fine discrimination required to resolve closely-related species, and enabling data-driven prioritization for multiple forest health objectives.

Effectiveness of Autonomous Recording Units for Monitoring Owls in the Central Cascades of Washington. Jessica A. Homyack*, *Weyerhaeuser Company, 505 North Pearl St, Centralia, WA 98531; Jessica.homyack@weyerhaeuser.com;* Matt Hane, *Weyerhaeuser Company, P.O. Box 275, Springfield, OR 97477;* Storm Beech, *Weyerhaeuser Company, 505 North Pearl St, Centralia, WA 98531;* Michael J. Rochelle, *Weyerhaeuser Company, 34904 Brewster Rd, Lebanon, OR 97355*

Following the listing of Northern Spotted Owl (NSO, *Strix occidentalis caurina*) as threatened under the Endangered Species Act and the enactment of the Northwest Forest Plan, many landowners implemented call-back survey programs to detect presence and monitor reproduction. Landowners use this information on NSO to reduce risk of take from harvests or

other management activities. The development of automated devices that passively record NSO calls may increase efficiency and worker safety, reduce overall survey costs, and facilitate examining ecological interactions among multiple owl species. Thus, to understand whether a shift in survey methods is warranted, we are evaluating performance of Autonomous Recording Units (ARUs) relative to traditional owl surveys. We sampled 16 historic territories of NSO in the Central Cascades of Washington and selected a single call station to monitor owls in 2018 with both traditional call-back surveys and ARUs. During traditional surveys, survey personnel listened for >10-minutes and used digital recordings of NSO calls to elicit a call-back response. Additionally, we deployed ARUs for 3 months and programed them to record 2 hours at dusk and dawn nightly, and at an additional, randomly selected 2-hour period during night-time hours. We are estimating occupancy and detection of NSO and Barred Owls (*Strix varia*) from acoustic data files analyzed with Kaleidoscope software. We will compare detection probabilities and occupancy between traditional and bioacoustic surveys to estimate effectiveness of a potential alternative survey type.

Differing Demographic Responses of Toad Populations to Regionally Synchronous and Declining Prevalence of Amphibian Chytrid Fungus. Blake Hossack, Ken Honeycutt, *USGS-Northern Rocky Mountain Science Center, Missoula, MT 59801*; *blake_hossack@usgs.gov; rhoneycutt@usgs.gov;* Rebecca McCaffery, *USGS-Forest and Rangeland Ecosystem Science Center, Port Angeles, WA 98362*; Robin Russell, *USGS-National Wildlife Health Center, Madison, WI 53711; rmccaffery@usgs.gov*

Batrachochytrium dendrobatidis (Bd), a fungal pathogen that causes amphibian chytridiomycosis, has been implicated in amphibian population declines globally. Some of the earliest evidence that Bd caused declines came from Boreal Toad (*Anaxyrus boreas*) populations in the western USA. However, >20 years after the pathogen was first described, there are still surprisingly few long-term studies that have estimated the effect of Bd on survival in the wild. To provide greater understanding of how Bd affects survival and how threats vary spatially and temporally, we incorporated disease sampling into 3 long-term (range: 9–13 yrs) capture-mark-recapture studies of Boreal Toads in western Montana. We also measured patterns of temporal synchrony in Bd prevalence among populations, quantified changes in population-level Bd prevalence over time, and the examined potential role of co-occurring Columbia Spotted Frogs (*Rana luteiventris*) in driving infection dynamics. We found remarkable variation in the effect of Bd on apparent survival, despite all toad populations being part of similar amphibian communities and experiencing similar climates. Temporal trends in apparent survival among populations did not correspond with the estimated effect of Bd infection on individuals, but there were common patterns in mean annual prevalence of Bd across populations within years that resulted in a strong synchrony in disease dynamics across the region. There were also strong population-level trends in Bd prevalence that did not seem clearly related to trends in temperature, dynamics of Boreal Toads, or *R. luteiventris*. Our results illustrate the complexity in understanding and predicting Bd dynamics in multi-host communities.

Fuel Reduction Logging Influences Forage Resources and Nutrient Intake of Deer in Northeastern Washington. Iver T. Hull, *School of the Environment, Washington State University, Pullman, WA 99164; iver.hull@wsu.edu*; Lisa A. Shipley*, *School of the Environment, Washington State University, Pullman, WA 99164; shipley@wsu.edu*; Stephanie L. Berry, *School of the Environment, Washington State University, Pullman, WA 99164;*

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Fire suppression over the last 100 years has resulted in densely-stocked forests with continuous overstories and heavy fuel loads in the interior western United States. Because these conditions promote severe wildfires that threaten human safety and alter natural forest communities, land managers have implemented fuels reduction treatments such as commercial thinning and prescribed burning to reduce chances of wildfire and promote healthy forests. These treatments reduce canopy cover and increase light penetration to the forest understory, which can improve forage resources for native wild herbivores. Therefore, we examined the biomass of understory vegetation and the nutrient intake of tractable mule and white-tailed deer across treated and untreated stands ranging from 0 – 100% canopy cover and 1 – 20 years post-thinning in the Colville National Forest of northeastern Washington. Forage biomass was higher in treated than untreated stands, decreased with overstory canopy cover, and increased curvilinearly with time since treatment, with peak biomass at < 14 yr post-treatment. Variables that reflected temperature and moisture gradients were also included in best-fit landscape predictive models. Daily digestible nutrient intake of deer increased with understory biomass, and met summer maintenance requirements for adult deer, whereas diet quality met lactation requirements. Deer selected diets that primarily consisted of nutritious deciduous shrubs and forbs promoted by open canopies. Our findings suggest that fuels reduction treatments, especially those reducing canopy to < 50%, benefit native wild herbivores by providing more abundant and nutritious forages that meet requirements for reproduction for at least for 2 decades post-treatment.

Satellite Tag Tracking of Male California Sea lions in the Pacific Northwest to Assess Haul-out and Foraging Behavior in Navy Testing and Training Areas. Steven Jeffries, Dyanna Lambourn, Josh Oliver, *Washington Department of Fish and Wildlife, 7801 Phillips Road SW, Lakewood WA 98498; Steven.Jeffries@dfw.wa.gov*; Robert DeLong, Sharon Melin, Jeff Harris, Pat Gearin, Tony Orr, Jeff Laake, *NMFS, Marine Mammal Laboratory, Alaska Fisheries Science Center in Seattle WA 98115*.

We conducted this study of California sea lions in Puget Sound for the Navy to 1) estimate number of sea lions using their facilities and 2) describe their behaviors for estimating MMPA takes. We counted sea lions weekly at four Navy facilities to estimate abundance and use patterns. We estimated the number of sea lions using Navy facilities was 788 (99% CI: 534-1186). Numbers using Navy facilities were highest during fall and winter, followed by spring, then near zero in summer. We also captured adult male sea lions at NAS Bremerton in December and January 2014/2015 and 2015/2016 and at Clam Bay in February 2016 to deploy Argos-linked Satellite Dive Recorders (SDRs) on 30 animals. Each SDR collected data on location, dive depth and proportion of time in the water. Deployments ranged from 8 to 184 days depending on animal. We recorded a total of 59,645 hourly locations, 234,034 dives and 12,786 hours of haul out behavior. For the instrumented sea lions, 11 remained in Puget Sound for up to four months with most foraging near capture locations; however, two travelled to Hood Canal and used Navy facilities at Bangor. The other 19 sea lions left within a month and moved to BC waters (8) or to WA/OR coast (11). Mean dive depths in Puget Sound were less than 20 m (max = 348 m). In other regions, mean dive depths were similar with maximum = 444 m. Dive durations averaged less than 4 minutes (max > 10 min).

Southern Resident Killer Whales: Present and Future. Katie Jones*, *Center for Whale Research, 355 Smuggler's Cove Road, Friday Harbor, WA 98250; katie@whaleresearch.com*

Since 1976 the Center for Whale Research (CWR) has collected detailed data on the health of the Southern Resident killer whales (SRKW) and has been a leading voice pushing for their conservation and protection. The data collected by the CWR includes photo identification surveys of both SRKW and transient (mammal-eating) killer whales which has allowed all individuals in the population to be identified. This unique long term dataset has given insight into the social structure, reproduction, behavior, and health of the whales. Through its work the CWR has been pivotal in securing legislation to protect the SRKW and continues to petition for the needs of the whales and the ecosystem as a whole.

This presentation will outline the current population demographics and fecundity of SRKW and what this data might indicate in terms of the long-term survival prospects for the population. Current threats to SRKW will be discussed with emphasis on the main threat to the population - lack of their preferred prey, Chinook salmon. New research endeavors will also be highlighted. CWR's goal is to monitor the Southern Resident orcas through the entire lifespan of a generation of known-age whales and although we have been collecting data for over 40 years we are only about half way to reaching this goal. The continued long term monitoring of this population is essential to provide the science needed for evidence based decision making to ensure the long-term health, recovery, and conservation of these magnificent creatures.

Reconnecting Habitats: The Washington State Department of Transportation's Approach to Integrating Habitat Connectivity Principles into the State's Transportation System. Glen P. Kalisz*, Kelly McAllister, *Washington State Department of Transportation, 310 Maple Park Avenue Southeast, Olympia, WA 98504; kaliszg@wsdot.wa.gov*; *McAllKe@wsdot.wa.gov*

Habitat connectivity is essential to maintaining healthy ecological processes and viable wildlife populations. While transportation infrastructure is often considered a barrier to wildlife movement, the Washington State Department of Transportation (WSDOT) is committed to making the highway system more permeable for wildlife. I will discuss WSDOT's efforts to incorporate habitat connectivity principles into the stewardship of the state's transportation system, including the basis for determining where on our sizeable highway system we can justify spending public dollars on improving highway conditions for wildlife, and how we should integrate habitat connectivity into our fish barrier corrections and other projects. I will highlight examples of WSDOT's accomplishments around the state and address components of our crossing structure monitoring program including the use of infrared trail cameras to collect and analyze data; as well as what we have learned about species' preferences for different types of habitat connectivity infrastructure. I will describe how we determine structure sizing, when and where to use jumpouts, wildlife fencing, and cattle guards, and provide some general recommendations for increasing the permeability of our highway system.

Waterfowl Surveying and Wetland Restoration in the Channeled Scablands of Eastern Washington. Victoria Kaufman*, *Washington Department of Fish & Wildlife, 2315 N Discovery Pl, Spokane Valley, WA 99216; featherblueLLC@gmail.com*; Matthew Wilson, *Washington Department of Fish & Wildlife, 1701 S 24th Ave, Yakima, WA 98902; matthew.wilson@dfw.wa.gov*; Tina Blewett, *Ducks Unlimited Inc., One Waterfowl Way, Memphis, TN 38120; tblewett@ducks.org*

The Intermountain West Joint Venture (IWJV) extends across eleven states and includes 18 separate wetland landscapes, all actively managed to increase natural resources and populations of priority bird species. IWJV management areas are an amalgamation of public and private lands, owned and operated by the Washington Department of Natural Resources, Bureau of Land Management, as well as corporate and private ownerships. The approach of IWJV outreach, surveying, and restoration management is a multifaceted, iterative process requiring constant adaptive management practices. Adaptive management plans call on an array of professional skills from biologists, engineers, land preservation specialists, and an informed community of farm-based landholders. In Washington, IWJV areas include the Channeled Scablands and Turnbull Wetlands, both seasonally flooded sagebrush steppe habitats with historic or current farming activity. These areas also play a significant role as stop-over habitat for hundreds of thousands of duck and geese species. Beginning in 2016 and continuing through 2020, spring waterfowl surveys have been a collaborative effort by government agencies and conservation organizations. Aerial and ground surveys gauge waterfowl density and quantify preferred wetland habitats of surveyed species. Results from ground and aerial survey data support continued prioritization of restoring threatened wetlands in both the Channeled Scablands and Turnbull Wetlands of Eastern Washington from drainage, soil-exhaustion, and over-grazing. Duck species of interest appear to thrive in shallow flooded agricultural fields, known as sheetwater ag., and these ephemeral flooded areas are managed to maximize desirable steppe flora that provide reliable food sources and seasonal refuge to migrating populations.

Broad-Scale Influence of Biotic and Abiotic Drivers to Lynx Occupancy in Washington State under Current and Future Climatic Conditions. Travis King*, Daniel Thornton, *Washington State University, 1775 NE Stadium Way, Pullman, WA 99164; Travis.w.king@wsu.edu, daniel.thornton@wsu.edu*

In Washington, the threatened Canada lynx (Lynx canadensis) is a sensitive indicator species for impacts of climate change. Increases in temperature and declines in snow extent and depth may reduce lynx foraging efficiency and result in competition with other terrestrial predators. Additionally, increases in frequency or intensity of forest fires associated with climate change may temporarily eliminate suitable lynx habitat. Despite these threats, our understanding of current lynx distribution in Washington is based on a series of small-scale studies focused solely in the state's "best lynx habitat". To gain a better understanding of distribution and the impact of biotic and abiotic drivers on large-scale lynx occupancy patterns, we conducted the largest systematic occupancy survey of lynx in Washington to date, utilizing a spatially extensive camera-trapping array covering 7000 km^2 of predicted lynx habitat. We used the resulting broad-scale database of rigorous presence-absence data to develop single-season occupancy models that indicate the influence of abiotic and biotic drivers on current state wide patterns of lynx occupancy and predict likely future lynx distribution based on climate change forecasts. Our results show lynx occupancy across the Washington landscape is fairly restricted and dictated largely by abiotic factors, disturbance regimes, and distance from source populations in Canada. Further, future predictions demonstrate a substantial northward retraction of lynx range in Washington by 2100. Our results add to the growing deliberations on federal status listings for this state endangered species, and help refine future management and monitoring of lynx to ensure continued population persistence within Washington.

Spatial and Temporal Factors Associated with Nest Survival of Gray Flycatchers in Managed Ponderosa Pine Forests. Jeffrey M. Kozma*, *Yakama Nation, Timber, Fish and Wildlife/Fisheries Resource Management, P.O. Box 151, Toppenish, WA 98948; kozj@yakamafish-nsn.gov;* Andrew J. Kroll, Jamie Thornton, *Timberlands Strategy & Technology, Weyerhaeuser, 220 Occidental Avenue S, Seattle, WA 98104; AJ.Kroll@weyerhaeuser.com, Jamie.Thornton@weyerhaeuser.com*

The Gray Flycatcher (*Empidonax wrightii*) breeds in a variety of habitats in the arid and semi-arid regions of the western United States. Detailed information on their breeding biology is lacking, especially in the recently expanded northern portion of their range where they nest in Ponderosa Pine (*Pinus ponderosa*) dominated forests. During May–July 2014 and 2015 we surveyed for singing male Gray Flycatchers, monitored flycatcher nests and measured vegetation at nest sites in ponderosa pine forests with a history of timber harvest. We used a logistic-exposure model fit within a Bayesian framework to model the daily survival probability of flycatcher nests. Predation accounted for 90% of failed nests while Brown-headed Cowbirds (*Molothrus ater*) accounted for only 3% of nest failures. We found evidence of a positive association between daily nest survival and both nest height and distance of nest substrate to the nearest tree. We found no support for other spatial covariates but did find evidence that period survival rate was higher during the nest building stage than the incubation and nestling stages. Higher nests may be less exposed to terrestrial predators and nests in trees that are farther from other trees may be less exposed to arboreal predators such as jays (Corvidae) and squirrels (Sciuridae) that may search for nests in patches with connected canopies.

Return of the Guadalupe Fur Seal and Unusual Sightings of Artic Seals in the Pacific Northwest. Dyanna. M. Lambourn*, Steve. J. Jeffries, *Washington Department of Fish and Wildlife, 7081 Phillips Lakewood WA 98498; Dyanna.Lambourn@dfw.wa.gov; Steven.Jeffries@dfw.wa.gov;* Erin D'Agnese, Woutrina Smith, *School of Veterinary Medicine, One Health Institute, University of California, Davis, One Shields Ave, Davis CA, 95616; erdagnese@ucdavis.edu; wasmith@ucdavis.edu;* Kristin Wilkinson, *NOAA/NMFS, 7600 Sand Point Way NE, Seattle WA 98115; Kristin.Wilkinson@noaa.gov;* Jessica Huggins, *Cascadia Research, 218 ½ W 4th Ave, Olympia WA 98501; JHuggins@cascadiaresearch.org;* James Rice, *Oregon State University, Marine Mammal Institute, Hatfield Marine Science Center, Newport OR; Jim.Rice@oregonstate.edu;* Deborah Duffield, *Portland State University, Portland OR 97207; duffieldd@pdx.edu;* Michael Grigg; *Laboratory of Parasitic Diseases, National Institute of Health, NIAID, 4 Center Drive, MSC0425, Bethesda MD 20892; griggm@niaid.nih.gov;* Stephen A. Raverty; *British Columbia Ministry of Agriculture and Food, Animal Health Center, 1767 Angus Campbell Road, Abbotsford, British Columbia V3G 2M3; Stephen.Raverty@gov.bc.ca*

In modern times, the occurrence of Guadalupe Fur Seals (GFS) (*Arctocephalus townsendi*) in the Pacific Northwest had generally been considered a rare event, although there is historical evidence of their presence in the Ozette archaeological site of the northwest coast from 1500 to 1700 A.D. Since that time, only two records exist prior to 2005, both in 1992. Since 2005, there have been 199 recorded strandings of GFS in Oregon and Washington; occurring annually from 2005 to 2018. In 2012, strandings totaled a high of 56. Additionally, there have been numerous confirmed live sightings of GFS off the Washington coast since 2007, providing further evidence that this species may be returning to the Pacific Northwest portion of its former

range. The re-emergence of this population in the Pacific Northwest is a testament to the effective implementation of the Marine Mammal Protection Act and Endangered Species Act.

Two species of Artic pinnipeds (Ribbon and Ringed Seals) have also recently been documented in Pacific Northwest. Contrary to the GFS, there is no evidence that this region is part of their historical range and these occurrences are considered to be anomalous and possibly related to warming ocean conditions. As the climate continues to change there may be continued sighting of these Artic ice seals in the future.

Sea Otter Genetics Update:Diversity, Population Structure and Taxonomy. Shawn Larson*, *Curator of Conservation Research, The Seattle Aquarium, 1483 Alaskan Way, pier 59, Seattle, WA 98101; s.larson@seattleaquarium.org*

Sea otters (*Enhydra lutris)* were once abundant along the nearshore areas of the north Pacific Rim from northern Japan to Baja California, Mexico. Starting in 1741 the Pacific maritime fur trade eliminated sea otter populations throughout nearly all of their range and by 1910 resulted in 13 small scattered populations, totaling less than 1% of their original abundance. Previous work found lower genetic diversity in sea otters sampled in the early 1990s compared to pre-fur trade samples. Sea otter populations were re-sampled between 2008-2011 throughout much of their range and analyzed using 20 microsatellite markers. Here we report genetic diversity and population structure compared to samples collected 20 years earlier. Genetic diversity was found to increase in most sampled locations but particularly in those founded by translocations founded by more than one population and those experiencing immigration from adjacent groups. We also investigated taxonomic relationships between populations. There are currently three recognized sea otter subspecies based on skull morphology: Russian (*E.l. lutris*), Northern (*E.l.kenyoni*), and Southern (*E.l. nereis*). Microsatellite and the mitochondrial DNA D loop variability suggest there may be more than three taxonomically distinct populations.

Larval Morphology of the Coastal Tailed Frog (*Ascaphus truei*) Differentiate Geographic Clades. Mark Leppin*****, *Oregon State University, Department of Integrative Biology, Corvallis, OR 97331; leppinm@oregonstate.edu*; Gwen W. Bury, *Oregon State University, Department of Fisheries and Wildlife, 104 Nash Hall, Corvallis, OR 97331*; R. B. Bury, (*Emeritus) U.S. Geological Survey, current address: 1410 NW 12th Street, Corvallis, OR* 97330.

Molecular data, both published and unpublished, indicates that the Coastal Tailed Frog (*Ascaphus truei*) consists of 4 clades south of the Columbia River. For that region, we compared the oral apparatus of larvae to determine if their morphological features reflect the pattern observed in genetic clades. We examined nine morphological characters in >400 larvae from >40 populations with approximately 60% of our material based on museum specimens. Also, we compared intrapopulation chronological variation in two populations which had samples taken about 20 years apart; these were similar. Our analyses indicate presence of at least three clades south of the Columbia River based on the number of posterior tooth rows and number of teeth along the third posterior tooth row. One of these morphological traits may be useful for field identification of these clades.

Lynx Conservation in Washington: Combatting the Effects of Fire, Climate and a Small, Isolated Population. Washington Lynx Conservation Strategy Team, *Washington Department of Fish and Wildlife, Olympia, WA 98501; Jeffrey.Lewis@dfw.wa.gov;*

DWerntz@conservationnw.org; *Gary.Bell@dfw.wa.gov; Scott.Fitkin@dfw.wa.gov; Scott.Fisher@dnr.wa.gov; Daniel.Thornton@wsu.edu*; and *Karen.Hodges@ubc.ca.*

Lynx (*Lynx canadensis*) once occupied the high-elevation spruce, fir, and pine forests of northern and northeastern Washington in Okanogan, Ferry, Stevens, and Pend Oreille Counties. Despite protection from trapping since 1991, and state (1993) and federal (2000) listings as a threatened species, the conservation status of the lynx has only worsened. Since the lynx was listed, its range has contracted to the west and it is now restricted to western Okanogan County. The causes for this contraction are poorly understood. Within the last twenty years, an unprecedented number of large fires has occurred within western Okanogan County. Currently, lynx occupy 4 localized areas within western Okanogan county and lynx persistence in these areas is threatened by continued habitat loss and fragmentation via wildfires, and limited immigration from British Columbia. In the summer of 2018, fires occurred within each of these 4 occupied areas. A number of lynx conservation strategies have been proposed and implemented in the last 5 years, but large fire events outpace these protections and conservation actions and are not expected to become less severe in the future. We propose ongoing and heightened protections of remaining lynx habitats and prioritization of those known to be occupied. We also promote ongoing occupancy surveys to determine where lynx currently occur in this fast-changing landscape, so as to target conservation actions where they can be most effective. We provide details on these approaches and challenges as we consider what recent events could mean for lynx persistence in Washington.

The Cascade Fisher Reintroduction Project in Washington: Progress in the South Cascades and Launching a New Reintroduction in the North Cascades. Jeffrey C. Lewis*, *Washington Department of Fish and Wildlife, Olympia, WA 98501; Jeffrey.Lewis@dfw.wa.gov;* Tara Chestnut, *Mount Rainier National Park, Ashford, WA 98304; Tara_Chestnut@nps.gov;* Jason Ransom, *North Cascades National Park, Sedro Woolley, WA 98284; Jason_I_Ransom@nps.gov;* David Werntz, *Conservation Northwest, Bellingham, WA 98225; dwerntz@conservationnw.org.*

Fishers (*Pekania pennanti*) are a mid-sized member of the weasel family that once occurred in the coniferous forests of Washington but were extirpated in the early and mid-1900s as a result of over-trapping, habitat loss, and predator eradication programs. To restore fishers in Washington, we reintroduced 90 fishers to Olympic National Park (2008-2010), 73 fishers to the South Cascades (2015-2018), and we recently initiated (in December 2018) a fisher reintroduction to the North Cascades Ecosystem. Our recent findings in the South Cascades indicated that the large majority of released fishers (all had radio-transmitters) remained within the reintroduction area, >50% of females established home ranges in the first year following release, annual survival rates for fishers ranged from moderate to high, and females are reproducing. While these are initial and preliminary findings, they are positive and consistent with successful reintroductions. We will also share details about numerous, substantial changes in our reintroduction strategies (i.e., new source population, partners, operations, and research opportunities) that are part of the reintroduction now underway in the North Cascades, where we plan to release 80 or more fishers between 2018 and 2020.

Northern Spotted Owl (*Strix occidentalis caurina*) Occupancy Dynamics and Breeding Propensity in a Protected Area: Factors Related to Habitat, Weather and Barred Owl (S. varia) presence. Anna O. Mangan, *Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon, USA,*

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The federally threatened Northern Spotted Owl (*Strix occidentalis caurina*) occurs on public lands throughout the Pacific Northwest, including Mount Rainier National Park (MRNP), Washington, USA. MRNP provides an ideal place to evaluate potential impacts of climate change and the invasive Barred Owl (*Strix varia*) on Northern Spotted Owl demographics because it has virtually no history of timber harvest or large forest disturbance within its boundaries since the park's creation in 1899. We used a multi-state, multi-season occupancy model to investigate the effects of Barred Owl presence, local and regional weather, and habitat characteristics on Northern Spotted Owl occupancy dynamics and breeding propensity at MRNP from 1997-2016. Occupancy of spotted owl territories in MRNP has declined by 50% in the last 20 years and rates of occupancy by breeding spotted owls decreased to a low of 25% in 2016. Occupancy rates were higher on territories with steeper terrain. Breeding propensity was lower when Barred Owls were detected, but higher when early nesting season temperatures during March and April were higher. Detection probabilities for breeding Spotted Owls decreased when Barred Owls were present in the territory. Other habitat characteristics were not associated with Spotted Owl occupancy dynamics, which likely reflected the long history of conservation in the park, with old-growth forest predominating in most areas. This study illustrates the strong relationship between the presence of Barred Owls and Spotted Owl demographics and breeding site selection on protected lands where habitat loss through timber harvest and wildfire has not occurred.

Snake Activity Monitoring after Dike Repair at a Coastal Hibernaculum. Brent M. Matsuda*, *Hatch, 1066 West Hastings Street, Vancouver, BC, Canada V6E 3X2; brent.matsuda@hatch.com,* Lorraine Andrusiak, *SNC-Lavalin Inc., 8648 Commerce Court, Burnaby, BC V5A 4N6; Lorraine.Andrusiak@snclavalin.com,* Erin Clement, *City of Delta, 4500 Clarence Taylor Crescent, Delta, BC V4K 3E2; EClement@delta.ca,* Purnima Govindarajulu, *BC Ministry of Environment, Ecosystems Branch, 3930 Braefoot Road, Victoria, BC V8P 3T2; Purnima.Govindarajulu@gov.bc.ca,* Katie Bell, *565 Broadway Street, Victoria, BC V8Z 2G3; kahbell04@gmail.com*

In February 2015, 577 gartersnakes were removed during dike repairs in Delta, BC and overwintered at an off-site facility. They were released back to the dike post-construction in spring 2015, coinciding with natural hibernation emergence. Of the 494 snakes released, 192 snakes had Passive Integrated Transponder (PIT) tags inserted in them. Post-release surveys conducted during this period recorded 263 snakes in the area. Surveys were repeated in fall 2015 to assess movement back to the hibernaculm for overwintering, and in spring 2016 to assess post-hibernation emergence. Combined, 84 of 379 snakes caught had been previously PIT-tagged and 29 new snakes tagged. Adjusting for multiple captures, 65% were recaptures indicating strong site fidelity. 91% were Western Gartersnakes (*Thamnophis elegans*), 7% were

Northwestern Gartersnakes (*Thamnophis ordinoides*), and 2% were Common Gartersnakes (*Thamnophis sirtalis*). 71% were adults, 20% were neonates and 9% juveniles. During the surveys, 49% were caught on the same dike transect and 37% were incidental catches. Many incidentals occurred on transects but were caught after the transect survey had ended so were recorded as incidentals. Almost all neonates were caught incidentally by overturning cover objects on the dike. The high number of recaptures during spring emergence and mating indicates that snakes still use the site for hibernation and the number of neonates indicates that breeding is successfully occurring post-construction. The short duration of this study does not reflect population stability, survival rates, or other population parameters, which can only be assessed with continued long-term monitoring and data collection.

Patterns of Small Mammal Recolonization Following Elwha River Dam Removal. Rebecca McCaffery*, Kurt Jenkins, *USGS-Forest and Rangeland Ecosystem Science Center, 600 E. Park Ave, Port Angeles, WA 98362; rmccaffery@usgs.gov*; *kurt_jenkins@usgs.gov*; Kim Sager-Fradkin, *Lower Elwha Klallam Tribe, 760 Stratton Road, Port Angeles, WA 9836; kim.sager@elwha.org*

Terrestrial wildlife communities have been overlooked components of ecosystem restoration following dam removal, but are part of the river restoration process. The removal of large dams results in significant ecological disturbance, including the exposure of substrate on the former reservoirs behind the dams. Restoration of those lakebeds involves a successional process of revegetation and animal recolonization. We investigated patterns of small mammal recolonization following the removal of two large dams on the Elwha River on the Olympic Peninsula. From 2014 to 2016, we live-trapped small mammals in grid plots along transects located perpendicular to the river on both lakebeds. We also collected data on vegetation, substrate, and overstory characteristics in each study plot. We used community occupancy models to estimate species diversity and composition over time and in association with habitat characteristics. We used mark-recapture models to estimate density of two *Peromyscus* species. We captured 14 species representing 9 genera over the three years, with *P. maniculatus* and *P. keeni* dominating captures. While the two *Peromyscus* species were found in all habitat types, shrew and vole species were restricted to plots that contained a vegetative overstory. Mice had a strong association with bare plots containing little to no vegetation, as well as habitats containing downed logs. These data provide a valuable baseline for understanding the patterns and trajectory of small mammal recolonization and use of dewatered reservoirs following large-scale dam removals. This work also highlights the importance of considering terrestrial wildlife as key players in these large scale restoration projects.

Are Highways Stressful for Pikas? Analysis of Stress Hormones of *Ochotona princeps* Living Adjacent to Interstate 90 in the Washington Cascade Range. Thomas McIntyre*, Kristina Ernest, *Department of Biological Sciences, Central Washington University, 400 East University Way, Ellensburg, WA 98926; thomas.mcintyre@cwu.edu; ErnestK@cwu.edu;* Meghan Camp, Lisa Shipley, *Department of Natural Resource Sciences, Washington State University, PO Box 642812, Pullman, WA 99164; meghan.camp@wsu.edu; shipley@wsu.edu*

Human-modified landscapes disrupt ecosystem connectivity, harming many wildlife populations. Some wildlife species live in modified habitats along roads, but their fitness in these stressful environments is poorly understood. Chronic stress alters behavior, reduces reproduction rates, and has been linked to reduced survival. In the Cascade Range of central Washington,

American pikas (*Ochotona princeps*) have colonized anthropogenic rock embankment used for stabilization along Interstate 90 (I-90), but no research to date has determined the fitness or success of this population. We used basal stress levels to infer the overall health of a population. We extracted fecal glucocorticoid metabolite (GCM) concentrations from fresh fecal samples to determine chronic stress levels in pikas along I-90 compared with those living in similar rock embankment in a rails-to-trails state park, and in natural talus patches. GCM concentrations varied between the 3 populations. In our preliminary analysis, animals in the I-90 populations had the lowest GCM levels, potentially indicating a suppressed stress response due to their chronic exposure to stressors. We also assessed the correlation of potential stressors at a subset of sites by measuring environmental temperatures, elevation, and noise levels. A generalized linear mixed model was used to determine differences in GCM concentrations among habitats and assess the potential effects of these environmental variables on stress. Our results offer insights into pika success in potentially stressful environments and may provide a good indicator of stress levels expected for pikas as they colonize wildlife crossing structures now being constructed to improve wildlife connectivity across I-90.

not presenting **Genetic Monitoring of the Columbia Basin Pygmy Rabbit (Brachylagus idahoensis): From Captive Breeding to Wild Populations.** Stacey A. Nerkowski*, Janet L. Rachlow, Lisette P. Waits, *Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844*; *staceyn@uidaho.edu, jrachlow@uidaho.edu, lwaits@uidaho.edu*; Stephanie M. DeMay, *Department of Fisheries, Wildlife & Conservation, University of Minnesota, St. Paul, MN 55112*; Jon A. Gallie, *Washington Department of Fish and Wildlife, 1550 Alder St NW, Ephrata, WA 98823; Jon.Gallie@dfw.wa.gov*; Paul A. Hohenlohe, *Department of Biological Sciences, University of Idaho, Moscow, ID 83844; hohenlohe@uidaho.edu*; Jennifer R. Adams, *Laboratory for Ecological, Evolutionary and Conservation Genetics, University of Idaho, Moscow, ID 83844; adamsj@uidaho.edu*

Loss and fragmentation of habitat due to agricultural conversion has led to the near extirpation of the disjunct pygmy rabbit (PYRA) population in the Columbia Basin (CB) of Washington State (WA). In 2003, the CB PYRA was listed as a distinct population segment under the Endangered Species Act. In 2001, sixteen CB rabbits were taken from the last remaining population in Sagebrush Flat (SBF), WA to start a captive breeding program, and Idaho rabbits were added to counteract the effects of inbreeding. Rabbits were moved to semi-wild breeding enclosures at SBF (2011), and since then ~1947 mixed ancestry rabbits have been released into the wild. Thus far, one population of wild PYRA has been re-established in SBF and attempts at establishing two additional populations began in 2018. Monitoring of reintroduced populations is crucial in evaluating the progress and success of the PYRA reintroduction effort within central WA. Genetic samples have been taken from all enclosure/released rabbits and fecal pellets have been collected during winter burrow surveys. Microsatellite genotyping and DNA fingerprinting of these samples have been used to determine a minimum count of wild rabbits and the proportion of released versus those born in the wild. The number of active burrows has increased since from 100 (2011) to 346 (2018). The results of this study will provide critical information on the success of the reintroduction efforts and provide information for future conservation and management efforts.

Killer Whale Necropsies Provide Insight into Relationships Between Killer Whale Body Condition, Health, and Nutritional State. Dawn P. Noren*, *Marine Mammal and Seabird*

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Southern Resident Killer Whales (*Orcinus orca*) face many threats, and assessing individual body condition and health is a management priority. Data collected during necropsies can be used to understand relationships between body condition and health. Straight body length, body girth at the anterior dorsal fin insertion, and blubber thickness measured at three standard sites (dorsal, mid-lateral, and ventral surfaces) were used to assess body condition of stranded Killer Whales. Body condition index (BCI) was calculated from two measurements (body girth at the anterior dorsal fin insertion: straight body length). Blubber samples were also collected to assess blubber lipid content. The results show that body condition indices are influenced by age, reproductive status, and health. Killer Whale blubber thickness increases with body length. Female reproductive status as well as cause of death (starvation, disease, trauma) are related to both BCI and blubber thickness. For example, blubber thickness and BCI of both chronically diseased and starved Killer Whales are significantly lower than those of Killer Whales that died from acute trauma. Blubber lipid content tends to increase with BCI, and thus not surprisingly, an individual that died from trauma had the greatest blubber lipid content. Interestingly, the leading causes of death for nine Southern Resident Killer Whale carcasses recovered since 2002 are trauma and reproductive issues. This study demonstrates that morphometric indices of body condition alone cannot be used to differentiate starving from diseased Killer Whales and establishes a better understanding of relationships between body condition and health in free-ranging Killer Whales.

Agonistic Behavior in Female Oregon Spotted Frogs (*Rana pretiosa*). Stephen Nyman*, *Whatcom County Amphibian Monitoring Program, 1058 West Smith Road, Bellingham, Washington 98226; stephen@whatfrogs.org*

I present the first report of intraspecific agonistic behavior in adult female Oregon Spotted Frogs (*Rana pretiosa*) witnessed at a wetland pool in the Samish River watershed, Whatcom County, Washington on October 10, 2018. Slow motion analysis of recorded video provides evidence of a stereotyped form of aggression and a possible visual or acoustic display, behaviors not previously documented in female North American ranids. I suggest that the interaction represented site tenacity associated with access to prey, and outline further studies needed to determine whether agonistic behavior affects individual spacing or seasonal habitat use in Oregon Spotted Frog.

Stream-buffer Effects on Aquatic Vertebrates in Forested Headwaters: 5-years after a 2nd Density Management Harvest. Deanna H. Olson*, *US Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us*; Adrian

Ares, *Virginia Tech, Blacksburg, VA*; Klaus J. Puettmann, *College of Forestry, Oregon State University, Corvallis, OR 97331*

The Density Management and Riparian Buffer Study of western Oregon examines upland thinning approaches to accelerate development of late-successional forest conditions, while retaining headwater stream habitats and biota. Eight secondary-forest sites on lands administered by the Bureau of Land Management have been thinned twice (430-600 trees per hectare [tph] to 200 tph to 85 tph), with 64 stream reaches included in an examination of the effects of four different riparian buffer treatments on instream and bank vertebrates. Non-metric multidimensional scaling ordination and multi-response permutation procedure (MRPP) supported a greater effect of hydrological flow characterization (hydrotype; i.e., spring and summer surface flow types) on aquatic vertebrates than forest harvest and buffer type. MRPP analyses showed a significant effect of buffer treatments on counts of all fish together, all amphibians, stream-breeding amphibians as a group, sculpins, coastal giant salamanders, and torrent salamanders (southern and Columbia, combined). There were higher animal counts in the 1-site potential tree height riparian buffer treatment (1-Tree, ~ 70 m) than three other buffers: variable-width buffer (~15-m minimum width); streamside-retention buffer (~6 m); and thin-through buffer (2-tree riparian buffer [~145 m] thinned to 150 tph, stream disturbance avoided). Indicator species analyses showed species associations with buffers: torrent salamanders with controls (streams in unthinned uplands); northern red-legged frogs with streamside-retention buffers; and Oregon slender salamanders with thin-through buffers. Effects of sequential forest management entries and possible lag effects on relatively long-lived animals with sensitive status remain key concerns.

Importance of Winter Snowpack to Oregon Spotted Frog Breeding Success at the Parsnip Lakes, Cascade-Siskiyou National Monument. Michael S. Parker, *Biology Program, Southern Oregon University, Ashland, OR 97520*; *parker@sou.edu.*

Sixteen years of egg mass surveys at the Parsnip Lakes provides sufficient observations to explore the relationship between interannual precipitation variability and breeding effort/success. Breeding effort is not correlated with total annual or total winter precipitation, but is strongly positively correlated with December-March snowfall. Total egg mass abundance and number of oviposition sites within and among ponds increase with increased snowfall due to more open water habitat and reduced standing vegetation at oviposition sites, and greater opportunities for dispersal among sites and ponds.

Water, Water Everywhere: Can eDNA from Seawater Provide Insight into Population Genetic Structure of Small Cetaceans? Kim M. Parsons, *Marine Mammal Laboratory, Alaska Fisheries Science Center, NOAA Fisheries, 7600 Sand Point Way NE, Seattle, WA 98115; kim.parsons@noaa.gov*

Although research methodologies for collecting genetic samples are numerous, some species are particularly elusive and conventional methods of tissue sampling has left critical gaps in population assessments. This is particularly true for the smallest of cetaceans in the family Phocoenidae. One of the smallest cetaceans in the Northern Hemisphere, Harbor Porpoise (*Phocoena phocoena*) are distributed throughout shallow coastal waters in the North Pacific. In Alaska, this preference for nearshore waters makes them highly vulnerable to incidental fisheries bycatch and the effects of habitat degradation. Concern for localized impact on undefined Harbor

Porpoise stocks motivated population genetic analyses using archived tissue samples; however, sample sizes were severely limited in key geographic areas and efforts to supplement strandings and fisheries bycatch with remotely collected tissue biopsies has proved challenging for these small and elusive cetaceans. By exploiting the naturally shed cellular debris in seawater and the power of next generation sequencing, we developed a novel approach for generating population level mitochondrial sequence data from environmental DNA (eDNA) using surface seawater samples. We generated mitochondrial sequence data for 41 Harbor Porpoise eDNA samples using next generation sequencing. These mtDNA haplotypes can be incorporated into a traditional framework for examining genetic diversity among Harbor Porpoise in the coastal waters of Southeast Alaska and evaluating evidence for stock structure. This indirect sampling tactic for characterizing stock structure of small and endangered marine mammals has the potential to revolutionize population assessment for otherwise inaccessible marine taxa.

Comparing Multispecies eDNA to Traditional Approaches to Evaluate Species-level Aquatic Biodiversity in a Stream Network. Brooke Penaluna, Laura Hauck, Richard Cronn, *Pacific Northwest Research Station, USDA Forest Service, 3200 Southwest Jefferson Way, Corvallis, OR 97331*; *bepenaluna@fs.fed.us*; *lhauck@fs.fed.us*; *rcronn@fs.fed.us;* Tiffany Garcia, Kevin Weitemier*, *Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331*; *Tiffany.Garcia@oregonstate.edu*; *Kevin.Weitemier@oregonstate.edu*

Aquatic biodiversity has long-been a proxy for assessing environmental change. Traditional approaches for measuring aquatic biodiversity, however, have not been very comprehensive or standardized, and they can be time-consuming, expensive, and limited to certain taxa and habitats. Alternatively, environmental DNA is revolutionizing how we can survey biodiversity in streams by offering a rapid, accurate, and standard assessment of multiple aquatic species from various taxa. Here, we compare detection of multiple aquatic species using eDNA metabarcoding of taxon-general and taxon-specific primers using microfluidic multiplexed PCR and high-throughput sequencing to traditional approaches of electrofishing to understand the utility of multiplexed eDNA counts as a qualitative and semi-quantitative proxy for species-level identification of aquatic biodiversity. We evaluate the detection of multiple aquatic species of fish, amphibians, invertebrates, and pathogens in four neighboring stream networks below and above where fish reside in the network in the Trask Watershed in northern Coastal Oregon. In this study, we are able to assess whether streams that are hotspots in productivity of fish are also hotspots in their upstream tributaries for amphibians. Our study also allows us to examine questions about assay performance, such as reproducibility, minimum detection limits, and the ability to estimate global aquatic biodiversity at individual sites and the global network. Our work broadens the scope of eDNA research by allowing for data-driven prioritization of conservation actions for multiple aquatic species.

Remote Sensing of Habitat Restoration for the Columbia Spotted Frog. David S. Pilliod*, *US Geological Survey Forest and Rangeland Ecosystem Science Center, 970 Lusk Street, Boise, ID 83706; dpilliod@usgs.gov;* Mark B. Hausner, *Division of Hydrologic Sciences, Desert Research Institute, Reno, NV; Mark.Hausner@dri.edu;* Rick D. Scherer, *Conservation Science Partners Inc., Fort Collins, CO; scherer.rick.d@gmail.com;* Chad Mellison, *US Fish and Wildlife Service, Reno, NV; chad_mellison@fws.gov*

In central Nevada's Toiyabe Mountains, recent drought conditions and habitat degradation have threatened local populations of the Columbia Spotted Frog (*Rana luteiventris*). To mitigate these threats, resource managers constructed a series of ponds along several reaches of a small stream where spotted frogs were known to breed. We assessed the riparian vegetation response of these restoration projects and then related this response to annual survival and recruitment rates of frog populations. We first established the pre-restoration relationships between annual precipitation and Landsat-based normalized difference vegetation index (NDVI). We then tested the post-restoration data to identify changes in those relationships that we could attribute to habitat restoration activities. Finally, we used the NDVI values as predictors in a population model to assess the effect of annual NDVI (as a proxy for near-surface water availability) on the demography of local frog populations. Preliminary results suggest that it is possible to quantify the effects of restoration activities on riparian vegetation (i.e., frog habitats) using these remote sensing approaches. Annual survival and recruitment rates of adult frogs were variable through time, but preliminary results suggest that some of this variability could be explained by habitat restoration activities.

Mountain Goat Surveys at Mount St. Helens. Nathaniel D. Reynolds, Erik White, *Cowlitz Indian Tribe, PO Box 2547 Longview, WA 98632; nreynolds@cowlitz.org, ewhite@cowlitz.org;* Stefanie Bergh*, *Washington Department of Fish and Wildlife, PO Box 484, White Salmon, WA 98672; stefanie.bergh@dfw.wa.gov;* Eric Holman, Nicholle Stephens, *Washington Department of Fish and Wildlife, 5525 South 11th St, Ridgefield, WA 98642; eric.holman@dfw.wa.gov, nicholle.stephens@dfw.wa.gov;* James M. Wainwright (ret.), *Mount St. Helens National Volcanic Monument, 42218 NE Yale Bridge Rd, Amboy, WA 98601*

After receiving anecdotal reports of an increasing population of Mountain Goats (*Oreamnos americanus*) in the Mount St. Helens and Mount Margaret Backcountry areas of Washington State, a cooperative group of staff and volunteers from the Cowlitz Indian Tribe, Washington Department of Fish and Wildlife (WDFW), Mount St. Helens Institute, and US Forest Service developed a ground-based survey protocol to estimate this population. Surveys were conducted each August from 2014 through 2018, with multiple teams surveying concurrently, using hiking routes to access assigned viewpoints. After each survey, sighting maps and observation times were reviewed to resolve double-counting between teams. We determined minimum population sizes each year and observed a generally increasing trend with a peak count of 169 in 2018. Immediately following the 2017 ground survey, WDFW conducted a helicopter survey in the same areas, using a sightability model (Rice and others 2009) to estimate the goat population, revealing 246 goats. While our ground survey trend shows an increasing population over time, aerial survey is a more accurate, though more expensive, methodology. Based on a population of >200 goats in 2017, WDFW established 2 new mountain goat tags for this population, and these were successfully hunted in fall 2018.

Evaluating the Susceptibility of Native Amphibians from Pacific States to the Fungal Pathogen *Bsal*. Jonah Piovia-Scott*, John Romansic, *School of Biological Sciences, Washington State University, 14204 NE Salmon Creek Ave, Vancouver, WA 98686; jonah.piovia-scott@wsu.edu; john.romansic@wsu.edu;* Matt Gray, Davis Carter, Deb Miller, *Center for Wildlife Health, University of Tennessee, 2431 Joe Johnson Drive, Knoxville, TN 37996; mgray11@utk.edu; ecarte27@utk.edu; dmille42@utk.edu*

The fungal pathogen *Batrochochytrium salamandrivorans* (*Bsal*) poses a serious threat to native amphibians, especially salamanders, in the Pacific Northwest and throughout North America. *Bsal* is thought to have originated in East and Southeast Asia and spread to Europe through the pet trade, where it is responsible for dramatic declines in some European salamander species. *Bsal* is not known to have colonized North America, a global center for salamander biodiversity. Our study seeks to provide a detailed assessment of the risk *Bsal* poses to native amphibians in Pacific states by evaluating susceptibility using controlled laboratory exposure experiments. To date, we have conducted such trials for six species (or subspecies) native to Pacific states: *Taricha granulosa, T. torosa, Ensatina eschscholtzii klauberi, E. e. xanthoptica, Pseudacris regilla*, and *Plethodon dunni*. Some species were found to be highly susceptible, such as *E. e. klauberi*, while others carried high levels of infection with only low or moderate levels of mortality, such as the two *Taricha* species. Taken together, our results provide insight into the risk *Bsal* poses to native amphibians, as well as the regional epidemiological dynamics that may occur if this pathogen invades western North America.

Collaborative Monitoring to Assess Declines in Northwestern Bat Populations via Bat Grid and NABat Monitoring Programs. Roger Rodriguez*, *Northwestern Hub for Bat Population Research and Monitoring, Oregon State University-Cascades, 1500 SW Chandler Avenue, Bend, OR 97702; roger.rodriguez@osucascades.edu;* Thomas J. Rodhouse, *U.S. National Park Service, Upper Columbia Basin Network Inventory & Monitoring Program, 1500 SW Chandler Avenue, Bend, OR 97702; tom_rodhouse@nps.gov;* Pat Ormsbee, *U.S. Forest Service (retired), Eugene, OR;* Kathryn Irvine, *U.S. Geological Survey, Northern Rocky Mountain Science Center, 2327 University Way, Suite 2, Bozeman, MT 59715; kirvine@usgs.gov;* Jenny Barnett, *US Fish & Wildlife Service Region 1 Inventory & Monitoring Program, 64 Maple Street, Burbank, WA 99323; jenny_barnett@fws.gov;* Sarah Reif, *Oregon Department of Fish and Wildlife, 4034 Fairview Industrial Drive SE, Salem, OR 97302; sarah.j.reif@state.or.us*

The original interagency Bat Grid, led by the U.S. Forest Service and with participation by many partners across Oregon and Washington from 2003-2010, established baseline distributional data for bats throughout Oregon and Washington and provided the foundation for the North American Bat Monitoring Program (NABat). In 2016-2018, collaborative acoustic bat monitoring (referred to locally as "Bat Grid 2.0") was continued across Oregon and Washington by state and federal partners at original Bat Grid survey locations and at new locations selected via the NABat master sample. One primary objective was to enable comparisons between 2003-2010 Bat Grid 1.0 baseline and current probabilities of occurrence to evaluate potential population declines in light of the regional expansion of wind energy developments during the intervening years and the recent arrival of white-nose syndrome (WNS) to Washington. Within a Bayesian occupancy modeling framework, we used the occurrence probabilities estimated after 2010 as informative priors to update and map new posterior distributions with data from 2016-2018 for several species including *Myotis lucifugus* and *Lasiurus cinereus* considered to be vulnerable to these emerging threats. We discuss the emerging trends from these results and outline next steps. We emphasize that model uncertainty and only three years of additional data make these findings provisional and best considered as testable hypotheses that guide conservation decisions including allocation of resources for further research and monitoring.

Symbiosis Between Green Algae and Northern Red-legged Frogs (*Rana aurora*). Chris Rombough*, *Rombough Biological, PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com;*

Laura Trunk, *Jackson Bottom Wetlands Preserve, 2600 SW Hillsboro Hwy., Hillsboro, OR 97123; laura_trunk@hillsboro-oregon.gov*

The role of algae in amphibian egg jelly has been debated for nearly a century. In 2017 and 2018, we conducted detailed field measurements of oxygen concentrations within Northern Red-legged Frog (*Rana aurora*) egg masses. Our data revealed that, contrary to current belief, the egg jelly of *R. aurora* is largely impermeable to ambient dissolved oxygen. Instead, the development and survival of the embryos in our study was dependent on the growth of green algae within the egg jelly itself. Successful development of *R. aurora* embryos to hatching is determined by a complex interaction between temperature, illumination, and timing of spawning. We will discuss some of the implications of our results, how cool they are, and our work on related species.

Large Whale Entanglements and Responses in the Pacific Northwest. Doug Sandilands*, *SR3 Sealife Response Rehab and Research, #101 - 2255 Harbor Ave SW Seattle, WA; 98126; dsandilands@sealifer3.org*

From 1994 to 2017, there were an average of four large whale entanglements reported in Washington and Oregon. In 2018, there was a notable increase of 19 credible reports of large whale entanglements. The Pacific Northwest Large Whale Entanglement Response Network (PNWLWERN) is a network of seven organizations that respond to entangled whales. Responses focus on removing all of the life-threatening gear on the whale and collecting documentation of the whale, entanglement and entangling gear to better understand how entanglements occur. The network provides information learned from entanglement responses to managers and fishermen to help develop solutions to prevent entanglements. This talk will summarize the PNWLWERN, recent entanglement reports, and the type of information collected during responses.

Washington State Common Loons: Multi-state Occupancy Modeling Using Citizen Science and Survey Data. Hannah A. Sipe*, *Quantitative Ecology and Resource Management Graduate Program, University of Washington, 1122 NE Boat St, Seattle, WA, 98105*; *sipeh@uw.edu*; Sarah J. Converse, *U.S. Geological Survey, Washington Cooperative Fish and Wildlife Research Unit, School of Environmental and Forest Sciences (SEFS) & School of Aquatic and Fishery Sciences (SAFS), University of Washington, 1122 NE Boat St, Seattle, WA, 98105; sconver@uw.edu*

The Common Loon (*Gavia immer*) is a migratory aquatic bird found throughout the year in Washington State, i.e. in marine waters during the winter or fresh waterbodies during the summer. A low-lifetime reproductive rate and high summer site-fidelity make this species particularly sensitive to habitat degradation and human disturbance; as such, Washington State has listed the common loon as a state Sensitive Species. However, little is known about Common Loon distribution or the factors affecting distribution within Washington State. Given the size of the area of interest, obtaining the data necessary for a robust analysis of Common Loon occupancy presents a challenge. Citizen science eBird data is easily available in large quantities and can be used in distribution modeling. Through integrating professional survey data with citizen science eBird data in a multi-state occupancy model, the distribution and habitat associations of summer Common Loons were formally evaluated. Preliminary results show a probability of occupancy for the state (around 25%) and the probability of reproduction is low (around 10%), with low probability of detection in the non-breeding state and high probability of detection in the reproductive state. Further results of the occupancy model fit to the survey and eBird data, significant habitat associations, and detection-effort relationships determined during modeling will be presented. Issues relating to the use of eBird data in the context of this

application will also be discussed. Understanding distribution, and the factors influencing it, will help management make informed conservation decisions for Common Loons in Washington.

Adaptive use of Nonlethal Strategies for Minimizing Wolf–Livestock Conflict. Suzanne A. Stone*, *Department of Field Conservation, Defenders of Wildlife, 1130 17th St. NW, Washington, D.C. 20036, sstone@defenders.org;* Stewart W. Breck, *United States Department of Agriculture – Wildlife Services – National Wildlife Research Center, 4101 LaPorte Ave., Fort Collins, CO 80521; swbreck@gmail.com;* Jesse Timberlake, *Department of Field Conservation, Defenders of Wildlife, 1130 17th St. NW, Washington, D.C. 2003;* Peter M. Haswell, *School of Biological Sciences, Bangor University, Bangor, Gwynedd LL57 2UW, United Kingdom;* Fernando Najera, *Faculty of Veterinary Medicine, Complutense University of Madrid, 28040 Madrid, Spain;* Brian S. Bean, *Lava Lake Land & Livestock, LLC and Lava Lake Institute for Science & Conservation, 215 N. Main Street, Suite 204, Hailey, ID 83333;* Daniel J. Thornhill, *Department of Biological Sciences, Auburn University, 101 Rouse Life Sciences Building, Auburn, AL 36849*

Native predators are often killed to protect livestock, which can undermine wildlife conservation efforts and create conflicts among stakeholders. In Washington, wolves (*Canis lupus*) are currently recolonizing parts of their historic range. While livestock losses to wolves represent a small fraction of overall livestock mortality, the response to these depredations results in widespread conflicts including significant lethal wolf control efforts to protect livestock for producers. A variety of nonlethal methods have proven effective in reducing livestock losses to wolves in small-scale operations but in large-scale, open-range grazing operations, nonlethal management strategies are often presumed ineffective or infeasible. Our study in Idaho demonstrates that nonlethal techniques can be effective at large scales through adaptive nonlethal predator deterrents and animal husbandry techniques (i.e., terrain, proximity to den or rendezvous sites, avoiding overexposure lights or sound devices that could result in wolves losing their fear of that device, etc.). Over the 7-year study period comparing losses between the study Protected Area (PA) and the Adjacent Unprotected Area (NPA), wolf depredation of sheep were 3.5 times higher in the NPA than in the PA. Furthermore, no wolves were lethally controlled within the PA but were frequently killed in the NPA. Sheep depredation losses to wolves in the PA were just 0.02% of the total number of sheep present, the lowest loss rate among sheep-grazing areas in wolf range statewide. Similar cattle protection measures that effectively minimize losses to wolves and bears will also be presented.

Wildlife Response to Tourism in Glacier Bay National Park, AK. Mira Sytsma*, Laura Prugh, Beth Gardner, *University of Washington School of Environmental and Forest Sciences, 3715 W Stevens Way NE, Seattle, WA 98195; mirasytsma@gmail.com; lprugh@uw.edu, bg43@uw.edu*; Tania Lewis, *National Park Service, 1 Park RD, Gustavus AK 99826; tania_lewis@nps.gov*

Visitation to Glacier Bay National Park (GLBA) is very low compared to most national parks, but has nearly doubled in the past 20 years, leading to undocumented impacts of tourism on wildlife activity patterns and space use. We studied wildlife responses to tourism using 40 remote cameras installed at 10 study sites that were categorized as either areas where tour vessels drop off tourists on the shore (treatment), or areas where the vessels do not drop off tourists (control). The four mammals studied were Brown bear (*Ursus arctos*), Black bear (*Ursus americanus*), Moose (*Alces alces*), and Gray wolf (*Canis lupus*). Black bear detection increased

in high use areas, but they shifted their activity to avoid humans temporally. Moose increased activity around humans, but did not respond to human use spatially. Wolves demonstrated activity patterns consistent with avoidance of humans and detections decreased with increasing human activity. Brown bear were not impacted spatially or temporally by humans. Detection for all species dropped to below one photo/week when the number of human photos/week across sites reaches 26, indicating a threshold value for disturbance to wildlife. This study demonstrates that wildlife responses to humans were detectable in a system with very low use, indicating that true baselines for estimating anthropogenic impacts may be difficult to obtain. The findings from this study will be used to assist park management in making yearly decisions regarding tour vessels and visitor access in GLBA to ensure significant resource degradation does not occur in popular tourist destinations.

Development of a Fully-integrated eDNA Sampling System. Austen C. Thomas*, Jesse Howard, Phong Nguyen, *Smith-Root, 16603 NE 50th Avenue, Vancouver, WA 98686; athomas@smith-root.com; jhoward@smith-root.com; pnguyen@smith-root.com;* Tracie A. Seimon, *Wildlife Conservation Society, 2300 Southern Blvd., Bronx, NY 10460; tSeimon@wcs.org;* Caren S. Goldberg, *School of the Environment, Washington State University, Pullman, WA 99163; caren.goldberg@wsu.edu*

Environmental DNA (eDNA) sampling is being rapidly adopted by agencies as a low-impact means of species detection in aquatic environments. Until recently, eDNA sampling technology has consisted of tools designed for other scientific fields such as groundwater monitoring and microbiology. Here, we present the development of a purpose-built eDNA sampling system designed to improve the sterility and efficiency of eDNA sampling. The system also gives the user control of important filtration parameters (e.g., pressure, flow rate, filter pore size) that affect eDNA capture. Pilot studies with the system indicate a peak in filtration efficiency at a flow rate threshold of 1.0 L/m, and we found that 5 µm filters captured significantly more target eDNA than 1 µm filters when the water volume was maximized. Results also suggest that high filtration pressures may reduce eDNA retention, which implies that pressure should be standardized to avoid biasing detection data. Lastly, we report on our efforts to develop a biodegradable filter housing to reduce plastic waste associated with eDNA sampling.

Pinniped Monitoring Program at Bonneville Dam: A Review of the Last 15 Years and Update on Recent Advancements. Kyle S. Tidwell*, Brett A. Carrothers, Kristen N. Bayley, Lindsay N. Magill, and Bjorn K. van der Leeuw. *U.S. Army Corps of Engineers, Portland District, Fisheries Field Unit, Bonneville Lock and Dam, Cascade Locks, OR 97014; Kyle.S.Tidwell@usace.army.mil*

California sea lions (CSL; *Zalophus californianus***)** and Steller sea lions (SSL; *Eumetopias jubatus*) aggregate at the base of Bonneville Dam, where they feed on Pacific salmon and steelhead (*Oncorhynchus spp.*) This season we monitored the traditional spring period (January – May), and for the first time, we sampled the fall and winter months (August – December). We conducted point counts to enumerate the minimum daily abundance of sea lions. To estimate the number of fish consumed, we conducted surface observations of sea lion foraging events using a stratified random sampling procedure and bootstrapped weekly (strata) estimates to provide confidence intervals of the mean number of fish killed by each species of sea lion. During the fall and winter period we documented high levels of abundance and

residency for SSLs, and novel consumption impacts to all available runs of Pacific salmon and White Sturgeon (*Acipenser transmontanus*). During the spring monitoring period we found that SSLs are now the most abundant pinniped at Bonneville, occurring for 11 months out of the year. In contrast, the abundance and residency metrics for CSLs declined again this year. The consumption of spring Chinook was slightly less than the previous year (2.9% of the run), but the impacts to winter Steelhead, provided due to the fall and winter monitoring, found that 6.8% of the run was consumed. The increased presence of SSLs and reduced abundance of CSLs suggest the predator dynamics have changed but the impacts remain and are expanding to different runs and different fish species.

Steller Sea Lions: Why Did They Decline in Alaska and Increase in the Pacific Northwest?
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Theories put forward to explain the increase of Steller Sea Lions in the Pacific Northwest and their decline in the Aleutian Islands and Gulf of Alaska have been difficult to test—and have led to a series of captive experiments, field studies and mathematical models to gain insight into this perplexing mystery. Collectively, these studies point to shifts during the 1970s in the quality and quantities of prey available to sea lions—and the impact that energy-poor prey have on the survival and birth rates of sea lions. Young sea lions cannot acquire sufficient energy from abundant low-quality prey (i.e., Pollock, Cod, and Atka Mackerel in Alaska) and have to suckle for 1 or 2 years longer than normal until their energy needs are low enough to be met by stomachs full of low-energy prey. In contrast, sea lions eating fattier higher-quality prey such as Sardines and Herring in the Pacific Northwest can wean in their first year and successfully transition to caloric-rich fish. Pups that take longer to wean reduce the reproductive fitness of their mothers and are likely more susceptible to predation by Killer Whales. Energy density of prey can have a greater impact on the population dynamics of marine species than prey biomass, and should be given greater consideration in ecosystem models and ecological studies. These findings also highlight the importance of combining field studies with captive research and mathematical models to fully understand the ecological changes that are underway in the North Pacific Ocean.

White-Nose Syndrome Surveillance: Assessing the Influence of DNA Concentration on Detection Probability from Bat Guano Samples.
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Emerging infectious diseases pose a major threat to global biodiversity. Among vertebrates, bats are acutely affected by a fungal pathogen implicated in population declines across North America. *Pseudogymnoascus destructans* (Pd) the causative agent of White-Nose Syndrome (WNS) in bats was first confirmed in the western United States by the Washington Department of Fish and Wildlife (WDFW) on March 31, 2016 in a Little Brown Bat (*Myotis lucifugus*). However, the current distribution of WNS in the region and potential species affected are unknown. Large-scale and noninvasive surveillance would be facilitated by the detection of Pd in bat guano, but the efficacy of this approach is not yet established due to uncertainty in how

the detection probability of Pd declines over time. To address this, we experimentally characterized DNA degradation rates in guano samples.

In six different sites at Mount Rainier National Park for each of three replicates, we inoculated ~1 gram of autoclaved guano with 1 ml of inoculum at five concentrations of genomic DNA (ng/ul) of Pd. After sampling all sites at five regular intervals (~14 days), we quantified the number of genomic equivalents per sample using quantitative-PCR. Our results show that Pd can be detected through time in samples inoculated with the highest concentration of the pathogen. Conversely, in samples inoculated with the lowest concentration of the pathogen, Pd was only detected during the first sampling events (~15 days). These results provide insight into sampling timing and frequency to detect Pd in guano and improve surveillance and monitoring efforts.

not presenting **Stress-mediated Risk Effects of Wolves on Free-ranging Cattle: Can Prey Gut Microbiome Predict Stress Response in Predator-prey Interactions?** Azzurra Valerio*, Mariacristina Valerio, Luca Casadei*; School of the Environment, Washington State University, 100 Dairy Road, Pullman, WA 99164; azzurra.valerio@wsu.edu; mariacristina.valerio@uniroma1.it; luca.casadei@uniroma1.it.*

As Wolves (*Canis lupus*) recolonize their former range in Western United States, encounters with free-ranging cattle (*Bos taurus*) are expected to increase in frequency. Understanding the physiological state of cattle, as a response to stress imposed by the presence of wolves (stress-mediated risk effects), will help to predict the effect of predators on their prey beyond direct consumption (density-mediated effects). Traditional measure of stress hormones (fecal glucocorticoids [GCM]), provide inconclusive results when applied on free-living animals. Since recent findings have shown that stress and anxiety-related behaviors influence the composition and the function of the gut microbiome we contrasted the fecal metabolome, a functional read-out of the gut microbiome, of cattle before and after known wolf encounters. To this end, we conducted a pilot study in northeastern Washington where we fit GPS collars equipped with proximity sensors on 2 wolves in 2 wolf packs, and on 40 range cows in 4 separate livestock herds. We collected fecal samples (N=452) from cows every 2 weeks and after each wolf-cow encounter recorded by the proximity sensors. We extracted cattle metabolic profiles from fecal samples by means of ^{1}H-nuclear magnetic resonance spectroscopy. Our results indicated that significant metabolic pathway shifts occurred in cattle before and after interactions with wolves, while GCM concentrations did not change. We conclude that by using new cutting-edge technologies such as metabolomic analysis and proximity sensors, we improved our understanding of the physiological state of the prey after interactions with predators.

Using Citizen Science to Inform Species Distributions: Washington's Sagebrush Songbird Survey. Matthew Vander Haegen*, *Washington Department of Fish and Wildlife, Natural Resources Building, P.O. Box 43200, Olympia, WA 98504; matt.vanderhaegen@dfw.wa.gov;* Christi Norman, *Audubon Washington, 5902 Lake Washington Blvd, Seattle, WA 98118; cnorman@audubon.org;* Trina Bayard, *Audubon Washington, 5902 Lake Washington Blvd, Seattle, WA 98118; tbayard@audubon.wa*

Agricultural conversion and fragmentation have reduced the amount of habitat suitable for shrubsteppe-associated passerines in Washington. National surveys are largely ineffective at documenting changes in the distribution of these species and state wildlife agencies lack the resources to survey for them effectively. Beginning in 2014, the Washington Department of Fish

and Wildlife partnered with Audubon Washington to develop a community science project focused on surveying for sagebrush-obligate and shrubsteppe-associated passerines in 16 counties in eastern Washington. The Sagebrush Songbird Survey has engaged 11 Audubon Chapters and has provided the opportunity for chapter members to participate in all aspects of the survey from locating and evaluating sites using ArcGIS Online to surveying remote sites and engaging with landowners. Over 100 volunteers from Audubon Chapters and other bird conservation NGOs have received training to safely navigate to sites and conduct standardized bird surveys. These trained observers have completed surveys at 283 sites on public and private lands and entered >20,000 project-specific records in eBird. Audubon staff and chapter volunteers work directly with private landowners and leaseholders, engaging them through invitations to participate in surveys and sharing project goals. Data from this project will inform state databases used for land management and conservation planning and allow analysis of factors influencing bird distributions.

Linking Multiple Types of Southern Resident Killer Whale (*Orcinus Orca*) Diet Data with Different Integration Windows to Estimate the Relative Importance of Prey Resources. Amanda Warlick*, *School of Aquatic and Fisheries Sciences, University of Washington, 1122 NE Boat St, Seattle, WA 98105; awarlick@uw.edu*; Eric Ward, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA 98112; eric.ward@noaa.gov;* Sandra O'Neill, *Environmental and Fisheries Sciences Division, Northwest Fisheries Science Center National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA 98112;* Brad Hanson, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA 98112;* Gina Ylitalo, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA 98112*

Understanding the foraging ecology and energetic needs of Southern Resident killer whales is critical for informing ongoing management and conservation strategies designed to recover the population. Directly estimating diet composition of large, free-ranging animals is challenging, and opportunistic sampling may introduce biases. Further, different sources of diet information integrate over different temporal windows (from single feeding events to several weeks). It is therefore beneficial to combine disparate diet data for a more comprehensive understanding of population-level diet. In this study, we examine interannual variability and seasonal differences in $\delta^{13}C$ and $\delta^{15}N$ stable isotope samples from 2004-2016 taken from 90 whales in the J, K, and L pods. Additionally, we use a subset of these data to demonstrate the integration of three diet data sources into a single chained Bayesian mixing model that can result in improved parameter estimation through the development of informative priors. Results indicate that $\delta^{15}N$ and $\delta^{13}C$ have varied annually and seasonally, potentially reflecting a change in nutritional status or the seasonal availability of preferred prey species. Diet composition estimates derived using the integrated model show that different diet data sources can yield both similar and divergent estimates depending on the relative contribution of the given prey species to overall whale diet. This work highlights the importance of considering the feeding window represented by the given source of diet data and can contribute to our understanding of whether nutritional stress may be affecting this depleted population.

NW PARC: An Overview and Top Research and Conservation Priorities from the Northwest Chapter of Partners in Amphibian and Reptile Conservation. Katy Weil,

Conservation Program, Metro Parks and Nature, 600 NE Grand Avenue, Portland OR 97232; katy.weil@oregonmetro.gov; Deanna H. Olson, *US Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331; dedeolson@fs.fed.us*

The Northwest Chapter of the national organization Partners in Amphibian and Reptile Conservation (NW PARC) began in 2008 and encompasses Alaska, Idaho, Montana, Oregon, Washington, Wyoming as well as British Columbia and Alberta. PARC is a bottom-up organization with five regions and eight state chapters and our work focuses on conserving amphibians, reptiles, and their habitats as integral parts of our ecosystem and culture through proactive and coordinated public-private partnerships. Our membership includes individuals from government and nongovernmental organizations, conservation groups, museums, the trade industry, environmental education centers, energy and forestry industries, and herpetological societies. In addition to organizing an annual regional meeting each year focusing on different themes such as community science, inventory and monitoring, and field identification techniques, the NW PARC steering committee and membership are involved in developing reference materials on amphibians and reptiles for professional and general audiences; recognizing outstanding individuals in the Northwest region for their contributions to herptile conservation; and serving on committees to address specific issues such as disease, education and outreach, transportation and mortality, and the designation of priority areas to conserve species and habitats. In 2019, our meeting will focus on eDNA and disease research progress for amphibians. We look forward to connecting with new and current members to collaborate in idea development for future workshops and meetings.

Is Climate Change Increasing Predation on Hoary Marmots in North Cascades National Park. Logan Whiles*, *School of the Environment, Washington State University, Pullman, WA, 99164*

Climate change is expected to contract ranges and reduce population size of high elevation obligates such as Hoary Marmots (*Marmota caligata*). In the North Cascades National Park Complex, marmots have experienced a > 50% decline over the last 10 years, and these declines may be driven by a combination of changing abiotic and biotic conditions. Using remotely-sensed snow data, marmot point-counts, behavioral observations, camera trapping, and genetic analysis of carnivore scat, our project examines whether reduced snowpack increases subalpine access by carnivores, in turn increasing predation rate on marmots.

A History of Bullfrog Control in Sunriver. Jodi Wilmoth, *3 Rivers Environmental, 55701 Swan Road, Bend, OR 97707; jodiwilmoth@icloud.com*

A dedicated group of scientists and volunteers work throughout the year in the Sunriver, Oregon area to support Oregon Spotted Frog (*Rana pretiosa*) recovery by controlling one of the world's worst invasive species, the American Bullfrog (*Lithobates catesbeianus*). The group employs a variety of techniques over several private properties to establish a bullfrog control zone, which provides the Oregon Spotted Frog a respite from this aggressive predator.

Giant Frogs of Bend—Chapter 2. Tlell Wolf, Jesse Short, Jay Bowerman*, *P.O. Box 4248, Sunriver, OR 97707; tlellwolf@gmail.com; jessoregon@gmail.com; jbowerman@bendbroadband.com*

A tiny pond in Bend, Oregon, already known for its giant adult Oregon Spotted Frogs (*R. pretiosa)*, has now yielded the first observations of significant juvenile growth between

metamorphosis and first winter. By October of 2017, some recently metamorphosed *R. pretiosa* had increased in length more than 20%, and more than tripled in weight. We present data and video evidence that support the hypothesis that an unusual combination of conditions, including warm temperature, early metamorphosis, and exceptional food resources contributed to the extraordinary growth and size at this site.

Optimizing and Evaluating Environmental DNA-based Detection of *Batrachochytrium salamandrivorans* in Trade and Captive Settings. Christian Yarber*, Caren Goldberg, Allan Pessier, & Jesse Brunner. *Washington State University, Pullman, WA 99164. christian.yarber@wsu.edu; caren.goldberg@wsu.edu; pessier@vetmed.wsu.edu; jesse.brunner@wsu.edu.*

Batrachochytrium salamandrivorans (Bsal) is an emerging fungal pathogen that threatens global salamander diversity. Its introduction into Europe through the pet trade from Southeast Asia caused rapid declines of ≥95% in some populations with no signs of recovery. Laboratory studies show numerous species not yet affected in the wild are lethally susceptible, and while Bsal has not been detected outside of Europe or Asia, its continued expansion through international trade appears inevitable. We know strong biosecurity and surveillance practices will be crucial to preventing the further spread and impacts of Bsal, but sampling enough animals within a shipment to detect Bsal with confidence using individual-based methods is simply unfeasible when the volume of animals to screen is so high (e.g. millions of live amphibians into US yearly). A rapidly developing technique that samples DNA shed into water and substrates – environmental DNA (eDNA)—offers a promising alternative to individual-based methods since it can, theoretically, sample from all animals in a shipment simultaneously. We conducted a series of laboratory experiments with Bsal spiked water to determine best practices for collecting Bsal eDNA: our initial findings suggest filtering results in 5 to 10-fold higher yields of Bsal DNA than centrifugation, the 95% limit of detection for Bsal when filtering is between 10 and 100 zoospores, and DNA recovery appears to scale linearly with water volume filtered. We conclude with a discussion of future experiments that address important considerations for how well our methods extend to real-world trade scenarios.

Developing New Satellite Tags for Large Whales: Improving Duration and Minimizing Impacts. Alexandre N. Zerbini*, *Cascadia Research Collective, 218 ½ W 4th Ave, Olympia, WA, 98501; Marine Ecology and Telemetry Research, 2468 Camp McKenzie Tr NW, Seabeck, WA, 98380; Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS/NOAA, 7600 Sand Point Way, Seattle, WA, 98115-6349; alex.zerbini@noaa.gov; azerbini@gmail.com*

The use of satellite tags has improved our understanding about cetacean behavior and spatial-temporal overlap with anthropogenic activities. Duration of transmissions depends on the method used to attach tags to the animals. For baleen/sperm whales, tags anchoring below the blubber provide longer durations, but are of greater risk for the health of the tagged individual. Here, results from a study designed to assess impacts of tags to whales and to understand causes of tag failure will be described. “Implantable” tags have been deployed in Gulf of Maine Humpback Whales (*Megaptera novaeangliae*) because their strong site fidelity, long feeding ground residency, and high observer effort result in repeated sightings of tagged animals. Tag flaws documented in early deployments indicated the need for improvements in this methodology. These flaws resulted in short transmission durations and in negative physiological effects to individuals. Modifications in the satellite tag design were performed to resolve the

flaws, including (1) changes in the anchoring system tip, retention devices, and anchor articulation and (2) removal of an interface between the transmitter and the anchor. Also, the use of novel 3D metal printing processes to manufacture integrated tags resulted in more robust designs ($p=0.033$). Deployments of new tags resulted in greater transmission duration ($p=0.021$) and in lower probabilities of observing severe physiological reactions (e.g., persistent swelling, $p = 0.012$). This study highlights the importance of developing tagging technology in association with observational studies and provides new tag designs that are structurally stronger and safer for use with large cetaceans.