2023 ABSTRACTS WATWS, NWPARC, SNVB JOINT ANNUAL MEETING

ORAL PRESENTATIONS

Beaver Translocation: Past, Present, and Future in Washington and Beyond. Molly Alves*, *Tulalip Tribes of Washington, 6406 Marine Drive, Tulalip, WA 98271; malves@tulaliptribes-nsn.gov; Utah State University Department of Wildland Resources, 5200 Old Main Hill, Logan, UT 84322; molly.alves@usu.edu*

Beaver translocation is becoming a popular management strategy for human-beaver conflict, habitat restoration, and rewilding across the northern hemisphere; however, there is a lack of peer-reviewed publications that can inform existing and future beaver translocation outcomes. So how did we get here? Why is beaver translocation becoming so prevalent? And what can we do to improve beaver translocation efficacy in the future? In this presentation, I will share how the Tulalip Tribes have helped to establish beaver translocation in the west and how new research can help determine what goes into making beaver translocation successful.

Population Estimation Methods for Northwestern Pond Turtles, Washington. Staci Amburgey*, *Washington Department of Fish and Wildlife, 1122 NE Boat St, Seattle, WA 98105; Staci.Amburgey@dfw.wa.gov*; Ilai Keren, *Washington Department of Fish and Wildlife, 1111 Washington St. SE, Olympia, WA 98501; Ilai.Keren@dfw.wa.gov*; Stefanie Bergh, *Washington Department of Fish and Wildlife, PO Box 484, White Salmon, WA 98672; Stefanie.Bergh@dfw.wa.gov*; Carly Wickhem, *Washington Department of Fish and Wildlife, PO Box 484, White Salmon, WA 98672; Carly.Wickhem@dfw.wa.gov*; Matt VanderHaegen, *retired Washington Department of Fish and Wildlife.*

Northwestern Pond Turtles (NWPT; *Actinemys marmorata*) in the state of Washington face a myriad of challenges, from emerging disease dynamics to climate limitations from being on the coolest edge of their range. Targeted population monitoring and estimation is key to understanding trends in abundance, identifying extrinsic and intrinsic drivers influencing survival probability, and assessing progress towards recovery goals. We describe our current use of Pollock's robust capture-recapture (CR) methodology, which combines closed population estimation approaches within-year with open population estimation approaches between years. We applied these methods to estimate abundance and survival probability over a decade at several sites in the Columbia River Gorge, which represent four of the six populations of NWPT in the state. We found that abundances at sites were generally stable, likely driven by a high survival probability, with recent trends in abundance potentially indicating effects of non-native predatory bullfrog removal and headstarting program efforts. However, sampling effort has been unbalanced across sites and years and the spatial delineation of sites and populations can be complicated, challenging estimation. Moving forward, we highlight potential issues and challenges with NWPT when using the robust CR modeling approach and discuss some potential future avenues to further develop our population estimation framework.

Breeding Response of Amphibians to Stochastic Aquatic Habitat Availability – Observations from JHTMON-9 Upper and Lower Campbell Reservoir Amphibian Assessment. Leah Ballin*, *Ecofish Research Ltd. 600 Comox Rd, Courtenay, BC V9N3P6; lballin@ecofishresearch.com*

Hydroelectric power provides clean energy but can affect ecological values. We designed and conducted a study to assess the impacts of hydroelectric reservoir operations on breeding amphibians on Vancouver Island; specifically, how fluctuating reservoir levels impact different amphibian species and the availability of amphibian breeding habitat (i.e., ponds). The study identified and characterized amphibian habitats in the reservoir drawdown zone through GIS analysis and two years of field studies; and predicted effects of increasing reservoir levels on these habitats over the breeding season. We mapped a total of 370 ponds covering 337,860 m^2. In the first year of the study (2019), reservoir levels did not increase over the breeding season as expected. Instead, water levels decreased below typical conditions, leaving many pond habitats dry for much of the breeding season, whereas in the second year (2020), water levels were more typical and rose over the breeding season. Field results indicate that Western Toad (*Anaxyrus boreas*) and Northern Pacific Treefrog (*Pseudacris regilla*) breed in both ephemeral and permanent ponds, whereas Northern Red-legged Frog (*Rana aurora*) and Northwestern Salamander (*Ambystoma gracile*) breed almost exclusively in permanent ponds. Comparison of differences in amphibian breeding location and timing indicated that some species are more susceptible to water level changes, whereas for others, modified timing of breeding or selection different ephemeral ponds occurs, the latter depending on available habitat. These observations provide evidence for the potential for some amphibian species to adapt to variable environmental conditions, which may have implications for species resilience to a changing climate.

Oregon Strategic Plan for Native Turtles. Susan Barnes*, *Oregon Department of Fish and Wildlife, West Region Office, 17330 SE Evelyn St., Clackamas, OR 97015*; *susan.p.barnes@odfw.oregon.gov*

Oregon has two native turtle species, the Western Painted Turtle (*Chrysemys picta bellii*) and the Western Pond Turtle (*Actinemys marmorata*). Both are Sensitive-Critical on Oregon's Sensitive Species List and are Species of Greatest Conservation Need in Oregon's State Wildlife Action Plan. The Western Pond Turtle is currently under review by the U.S. Fish and Wildlife Service for potential listing under the Endangered Species Act. Oregon Native Turtle Working Group partners have been working together to implement priority turtle conservation actions including completion of species conservation assessments, development of Best Management Practices, implementation of habitat restoration projects, and more. In 2017, Western Pond Turtle conservation partners were awarded a multi-state, multi-year Competitive State Wildlife Grant aimed at implementing key conservation actions. The project, "*Advancing Western Pond Turtle Conservation in Washington, Oregon and California*" ended in 2021. This presentation will provide an overview of grant accomplishments including occupancy modeling results based on three years of standardized Visual Encounter Surveys. A summary of the Western Pond Turtle Range-wide Conservation Coalition's Range-wide Management Strategy will be given. Several recent conservation efforts will be highlighted including Oregon's effort to identify

Priority Conservation Areas for turtles, establishment of a new long-term monitoring site, and the launch of a new Oregon Turtles app and website developed in partnership with Western Oregon University.

Prediction of Canada Lynx Habitat. Upscaling TLS Ground Cover Classifications to Landscape Level ALS. Jonathan L Batchelor*, *University of Washington; JonBatch@uw.edu;* Peter Gould, *Washington State Department of Natural Resources; Peter.Gould@dnr.wa.gov;* L. Monika Moskal, *University of Washington; lmmoskal@uw.edu*

Canada Lynx (*Lynx canadensis*) is listed as an endangered species in Washington State. A 2006 lynx management plan requires that the Washington State Department of Natural Resources (DNR) maintain forage habitat on DNR-managed lands within lynx management zones. The foraging area preference of the lynx is forest stands with a dense, brushy understory. Second growth forests between 15 to 40 years old tend to be ideal with a high density of young trees and saplings. Many of the preferred habitat elements for lynx are easily determined from airborne lidar and aerial imagery (e.g. tree heights, topographic complexity, and forest connectivity). However, understory that is "dense and brushy" is difficult to quantify from airborne sensors alone. The purpose of this study is to develop a high-quality training data set to predict horizontal cover from remote-sensing metrics. A terrestrial laser scanner (TLS) unit was used to make horizontal cover estimates via methods of voxelization and depth mapping. Voxelization essentially normalizes point densities within the viewshed of the TLS scanner allowing for the quantification of "amount of stuff" seen by the scanner. Depth mapping is creating rasters of average pulse distance traveled at all scan angle increments. The output is somewhat analogous to a digital elevation model. The use of TLS data should produce consistent horizontal cover estimates by eliminating the subjectivity of ocular estimates with a cover board. TLS plots were georeferenced and point clouds matched with existing airborne lidar data. Stepwise regression analysis was performed to determine what combination of ALS derived forest metrics had the greatest predictive power for modeling TLS derived horizontal cover.

Does the Presence of Conspecifics Influence the Seasonal Migrations of Communally Denning Prairie Rattlesnakes (*Crotalus viridis*)? Javan M. Bauder*, *U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 1064 E Lowell Street, Tucson, AZ 85741; jbauder@arizona.edu*; Charles R. Peterson, *Idaho State University, Department of Biological Sciences, Pocatello, ID 83209; petechar@isu.edu*

Prairie and Western Rattlesnakes (*Crotalus viridis* and *C. oreganus*) in the Intermountain West typically undertake seasonal migrations between communal hibernacula and summer foraging/mating habitat. Previous research has rarely considered the potential role of high conspecifics densities around communal hibernacula as a factor contributing towards such seasonal migrations. In this study, we examined how the presence of conspecifics within and among hibernacula influenced the seasonal migrations of Prairie Rattlesnakes in a mountainous landscape in a central Idaho wilderness. We radio-tracked 21 Prairie Rattlesnakes April through September 2008 from two hibernacula complexes <1 km apart each on opposite sides of a river valley. Rattlesnakes from opposite complexes rarely crossed the river towards the opposite

complex but rather tended to move away from the opposite complex even though such movements were generally uphill. The longest movement distances (>1.5 km) were always observed by rattlesnakes moving away from the opposite complex. Movements towards the opposite complex were typically short (<1 km) and overlapped little with those of snakes from the other complex. Observed home range overlap between rattlesnakes from opposite complexes was less than expected if rattlesnakes moved in random directions from their hibernaculum. These results reveal that rattlesnakes may undertake seasonal migrations, in part, to avoid conspecifics from the same hibernaculum and conspecifics from other hibernacula. Additional research is needed to determine if communally denning rattlesnakes are competing for prey or foraging spaces and if seasonal migrations serve to reduce this competition.

Supporting Biodiversity Protection Under Washington's Clean Energy Transition. Trina Bayard*, *Audubon Washington, 5902 Lake Washington Blvd. S. Seattle, WA 98118; trina.bayard@audubon.org*

Washington's Clean Energy Transformation Act commits the state to an electricity supply free of greenhouse gas emissions by 2045. As pressure grows to meet this goal, conservation advocates like Audubon are working to ensure that the build out of renewable energy infrastructure is completed with biodiversity, climate adaptation and landscape resilience in mind. There are currently close to 60 wind or solar energy projects at some stage of the development and permitting process in Washington, most of which are in the Columbia Plateau. Without better planning and input from wildlife professionals, these projects will impact shrub-steppe habitat connectivity and at-risk wildlife in an ecosystem that is already imperiled. In this talk I will highlight state policy and planning efforts that are currently underway to address this need, including the WSU-led Least Conflict project. I'll also highlight lessons learned from our SEPA comments on the Horse Heaven Hills Wind Project and examples of information gaps and regulatory and policy changes that are needed to better protect wildlife and shrub-steppe habitat connectivity in Washington's Columbia Plateau.

Ecological Variation of Washington Northern Pacific Rattlesnake (*Crotalus oreganus*) Populations in a World Shaped by Humans. Daniel D. Beck*, *Central Washington University Department of Biological Sciences, 400 E. University Way, Ellensburg, WA 98926; beckd@cwu.edu*; Jefferson Brooks, *621 Harvard Ave E, Apt. 35, Seattle, WA 98102; jd.brooks@aecom.com*; Joseph Chase, *Central Washington University Department of Biological Sciences, 400 E. University Way, Ellensburg, WA 98926; joseph.chase@cwu.edu*; *C. M. Gienger, Austin Peay State University Center for Excellence in Field Biology, P.O. Box 4718, Clarksville, TN 37044; giengerc@apsu.edu*; Jared Horrocks, *1101 North Columbia St, Ellensburg, WA 98926; life46x2@gmail.com*; Ray Geroso, *USDA Forest Service Savannah River PO Box 700 New Ellenton, SC 29809; gorg1898@yahoo.com*; Aaron Gilbertson, *7248 Capitol Blvd SE, Tumwater, WA 98501; Aaron.Gilbert@cwu.edu*; Caleb Loughran, *Department of Biology, New Mexico Highlands University, 810 National Ave, Las Vegas, NM 87701; loughran@nmhu.edu*; Richard Lukose, *1110 N 35th Ave, Yakima, Washington; lukose@lifesci.ucsb.edu*; and John Rohrer, *U.S. Forest Service, Okanogan-Wenatchee National*

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Since the mid-1990s, my students and I have investigated several Northern Pacific Rattlesnake populations in Washington State. Here, we present a retrospective summary of some of our field work, focusing on how variation in habitat – and the role of humans – influence growth rates, life history parameters, sexual dimorphism, responses to fire, coloration patterns (and others) at overwintering hibernacula. We refined a technique to assess body size (SVL) and growth by measuring widths of intact, individual rattle segments as rattlesnakes emerged in the spring from hibernacula. Because a new basal rattle segment forms each time a snake sheds, and basal segment width correlates strongly with body size, changes in segment widths along the rattle correspond to growth (changes in SVL) between shedding cycles. Using this method, we evaluated growth data across dens, sexes, years, fire conditions, and other variables. To explore color variation, we analyzed red/blue color ratios from standardized photographs of our subjects, and used GIS analyses of satellite imagery to characterize habitat. Female and male growth rates diverged significantly as females traded growth for reproduction at sexual maturity. Females began reproducing at smaller body sizes (younger) in populations with lower recapture rates (lower survivorship), a result possibly influenced by human predation. Population size structure shifted significantly toward smaller size/age classes in populations impacted by fire. Coloration varied greatly within and across populations, likely reflecting their variable and heterogenous habitats. Rattlesnakes showed sexual dimorphism in tail banding (sexual dichromatism), a result we discuss in the context of warning coloration.

Wildlife Habitat on Small Forest Ownerships: A Habitat Diversity Emphasis. Ken Bevis*, *Washington Department of Natural Resources, 1111 Washington Street Southeast, Olympia, WA 98501; ken.bevis@wadnr.gov*

Small forest landowners generally own between 5 and 100 acres, with deep emotional connection to their lands. In virtually all landowner surveys providing wildlife habitat rates is one of the top 4 objectives. Many landowners, however, lack deep understanding of the specific needs of the wildlife they enjoy. In my 10 years working with these landowners for the Washington Department of Natural Resources, I have arrived at a habitat-based approach to providing species diversity on small scales to provide for as many species as possible. In this talk, I will describe forest management options utilized by these landowners, and outline this general approach with some examples.

Epigenetic Aging of Endangered Cook Inlet Beluga. Eleanor K. Bors, *Oregon State University Marine Mammal Institute, 2030 SE Marine Science Drive, Newport, OR 97365 and NOAA Office of International Affairs, Trade, and Commerce, 1315 East-West Highway 5th Floor, Silver Spring, MD 20910*; eleanor.bors@noaa.gov; Keith M. Hernandez*, *Oregon State University Marine Mammal Institute, 2030 SE Marine Science Drive, Newport, OR 97365; keith.hernandez@oregonstate.edu;* Paul R. Wade, *NOAA Alaska Fisheries Science Center Marine Mammal Laboratory, 7600 Sand Point Way Northeast Building 4, Seattle WA 98115; paul.wade@noaa.gov;* Steve Horvath, *University of California Los Angeles Department of*

Biostatistics, 650 Charles E. Young Dr. South, Los Angeles, CA 90095 and Department of Human Genetics, 885 Tiverton Drive, Los Angeles, CA 90095 and Altos Labs, 5510 Morehouse Drive, San Diego, CA 92121; shorvath@mednet.ucla.edu, C. Scott Baker, *Oregon State University Marine Mammal Institute, 2030 SE Marine Science Drive, Newport, OR 97365; scott.baker@oregonstate.edu*

The age of an individual is an essential demographic parameter, but is difficult to determine for many species in the wild without lethal sampling. Molecular biomarkers, including DNA methylation, are increasingly being used for aging with non-lethal samples, particularly for stocks and species of conservation concern. We have developed an epigenetic clock model based on skin DNA methylation data to age Beluga Whales (*Delphinapterus leucas*) from the endangered Distinct Population Segment in Cook Inlet, Alaska. The models were trained on a set of individuals (n = 67) that had a corresponding tooth age estimate. Methylation at 37,491 cytosine-guanine sites (CpGs) was measured using a custom bead-based array. Penalized regression models selected 23 CpGs with an $R^2 = 0.92$ for the training data. A leave-one-out cross-validation resulted in an $R^2 = 0.74$ and a median absolute age error = 2.9 years. Application of the epigenetic clock to skin biopsy samples (n = 66) from living whales sampled between 2016 and 2019 resulted in age estimates between 10 and 67 years. These age estimates will prove useful to inform conservation and management of this endangered population. Finally, we discuss how this approach is being applied to another endangered marine mammal, the Māui Dolphin (*Cephalorhynchus hectori maui*) in New Zealand.

Cataloging the Canaries of the Sea: Investigating the Vocal Repertoire of the Endangered Cook Inlet Beluga Whale Population. Arial Brewer*, *School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat Street, Seattle, WA 98195; Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 7600 Sand Point Way NE, Seattle, WA 98115; arialb@uw.edu;* Manuel Castellote, *Cooperative Institute for Climate, Ocean and Ecosystem Studies, University of Washington, 3737 Brooklyn Avenue NE, Seattle, WA 98195; Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 7600 Sand Point Way NE, Seattle, WA 98115; manuel.castellote@noaa.gov;* Amy Van Cise, *School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat Street, Seattle, WA 98195; avancise@uw.edu;* Andrew Berdahl, *School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat Street, Seattle, WA 98195; berdahl@uw.edu;* Tom Gage, *Alaska Department of Fish and Game, 1255 West 8th Street, Juneau, AK 99811; tom.gage@alaska.gov*

Understanding vocal behavior is crucial in the study of endangered species that rely heavily on acoustic communication for survival. It can reveal critical information communicated among conspecifics regarding predator avoidance, foraging locations, mate selection, and group cohesion. Vocal repertoire analysis can provide a baseline for studies on conspecific communication, vocal learning in young animals, and population structure. Beluga whales (*Delphinapterus leucas*) are a highly gregarious and vocal species of cetacean and have a circumpolar distribution. Of the five populations in Alaska, the Cook Inlet population is the most

endangered with a population estimate of 279 individuals. Among the threats listed as high concern, impacts from anthropogenic noise have the potential to negatively impact how this population communicates to conspecifics. We measured the acoustic characteristics of Cook Inlet beluga vocalizations (n=1,633) from two critical habitat locations (Trading Bay and Susitna) across multiple seasons. Following previous beluga repertoire studies, we classified vocalizations into three categories: whistles (n=1,264, 77.4%, 25 types), pulsed calls (n=354, 21.68%, 15 types) and combined calls (n=15, 0.92%, 7 types). We then compared the Cook Inlet beluga vocal repertoire with published repertoires of other beluga populations to qualitatively describe geographic variation in call use. Since anthropogenic noise is considered a threat to this population, we also investigated the potential masking level that commercial ship noise may have on important vocalizations. Understanding how and which vocalizations may be masked could provide important information supporting the management and conservation of this endangered population.

Divergent Life-history Ecotypes in the Garter Snakes of Eagle Lake (Lassen National Forest, CA). Anne M. Bronikowski*, *Kellogg Biological Station, Michigan State University, Hickory Corners, MI 49060; abroniko@msu.edu*

Garter Snakes in the vicinity of Eagle Lake have been an ideal ecological model for studying evolution since Stevan J. Arnold began his long-term study in 1974. We continue to conduct fieldwork annually with the last 30 years of data collection focusing on life-history evolution and ecology. One important discovery in the early 1990s was that two life-history phenotypes characterize populations of the Western Terrestrial Gartersnake (*Thamnophis elegans*): slower pace-of-life (POL) populations are comprised of individuals that are born smaller, grow slower, mature later, have lower annual reproductive output, and live longer than individuals in faster POL populations. These populations occupy habitats in either rocky lakeshore areas along the Eagle Lake shoreline (fast POL) or higher elevation meadows around the lake (slow POL). In turn, these two habitats have contrasting resource availabilities: either continuously available (lakeshore) or seasonally/annually restricted (meadow). Over the last 30 years of long-term CMR and blood sampling, we addressed the following questions: 1) What are the predicted rates of growth for populations of the two contrasting ecotypes, 2) What are the genetic contributors to maintaining separate life-history ecotypes in the face of gene flow, and 3) How plastic are these ecotype-specific life-history traits with environmental variation? Using data collected through the present, we found that: 1) slow POL populations have stable growth, whereas fast POL populations have negative growth and are thus inherently unstable, 2) inversions in certain nuclear genomic regions, and mitochondrial genomes are ecotype-specific, and 3) phenotypic plasticity may contribute to the buffering of the slow POL ecotype in the face of dramatic habitat change.

Using Environmental DNA to Improve Beaver-related Restoration. Jesse Burgher* and Jonah Piovia-Scott, *Washington State University School of Biological Sciences, 14204 NE Salmon Creek Ave. Vancouver, WA 98686;* jesse.burgher@wsu.edu*; jonah.piovia-scott@wsu.edu;* Caren S. Goldberg, *Washington State University School of the Environment, 100 Dairy Rd. Pullman, WA 99164; caren.goldberg@wsu.edu;* Sarah Garrison, *Washington*

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The American Beaver (*Castor canadensis)* is an iconic ecosystem engineer whose damming behaviors can contribute to conservation of freshwater ecosystems under shifting climate regimes in the western United States. Beaver translocations to aid in restoration of aquatic habitat have been increasingly applied over the last decade. However, current understanding of beaver translocation success is limited by a lack of standard, sensitive monitoring methods. Additionally, a risk may exist that invasive species or pathogen movement could occur during beaver translocation. We evaluated the use of environmental DNA (eDNA) for monitoring translocated beavers by pairing radio tracking with eDNA sampling. Further, we assessed whether beavers may move aquatic invasive species or pathogens by evaluating sets of eDNA samples collected from beavers throughout the translocation process. We found that eDNA sampling provided a rapid and sensitive means for detecting beavers, with high eDNA detection rates over 2 km downstream within a week of translocation. We reliably detected beavers in release systems through time, with positive detections occurring in >90% of samples collected downstream of confirmed beaver locations 1-3 months after initial release. Additionally, we found that translocated beavers may be exposed to fish pathogens, especially if held at fish hatcheries, but other target invasive species or pathogens were rarely detected during this process. Our results suggest that eDNA methods are powerful tools in assessing beaver presence at translocation sites or beaver distributions on the landscape and that consideration of pathogen exposure during the quarantine process may be important.

Grazing, Fuels, and Fire… is There a Relationship? Is There a Goal? Jeffrey Burnham*, *1130 W University Way, Ellensburg, WA 98926; jeffrey.burnham@dfw.wa.gov*

Western public lands managers and private property owners are regularly exposed to messaging that promotes livestock grazing as an effective means of reducing fuels and therefore fire risk. In resulting discussions, however, important aspects of this claim – as well as assumptions underlying common rebuttals – are often not clearly specified. These include the specific type(s) of risk addressable by livestock grazing, available scientific evidence, efficacy of fire risk reduction weighed against risk of negative grazing-related impacts, and logistical constraints affecting livestock owners and land managers. Scientific literature is sampled for perspectives on these concepts, focusing on 1) possible objectives and associated prescriptions; 2) recent reports describing the relationship between fine fuels, fire, and native bunchgrass communities in the semi-arid West; and 3) possible influences of grazing on fire likelihood, fuel type and fire severity, cheatgrass, fuel moisture, spatial scale, and implications for fire suppression in different vegetation types.

Habitat Protection in An Urban Setting: Strategies to Inform Planning and Action in the City of Bellingham. Analiese Burns*, *City of Bellingham, 2200 Pacific Street, Bellingham, Washington 98229; acburns@cob.org*

Habitat protection in urban settings is complicated by societal needs for housing, transportation, equity, and public safety. Even so, many urban areas such as the City of Bellingham contain a rich variety of fish and wildlife habitats. They also function as gateways to larger habitat networks. The City of Bellingham contains over 75 miles of shoreline, approximately 1,000 acres of wetlands, and over 7,000 acres of forest. Protecting and restoring these habitats helps support fish and wildlife populations, builds resilience for climate change, and supports the quality of life we all enjoy. While the City's Restoration Program has proactively restored habitats for over 20 years, many of these actions were opportunistic. A more strategic approach is needed that allows habitat priorities to be considered alongside other societal priorities. Starting in 2013, the City embarked on a series of assessments to develop a more strategic approach to habitat protection and restoration. The City assessed marine, aquatic, and terrestrial habitats to better understand their current condition and importance in the larger landscape. The most recent assessment was the 2021 Wildlife Corridor Analysis. This presentation will provide an overview of these assessments and how the City intends to use them as tools to inform planning and action.

Age in a Population of Northwestern Pond Turtles (*Actinemys marmorata*): Long Lived Individuals and Averages. G. W. Bury*, Pacific Northwest Research Station, U.S. Forest Service, Corvallis, Oregon; *gwen.bury@gmail.com;* R. B. Bury, *1410 NW 12th St., Corvallis, OR 97330;* D. T. Ashton, *Applied Rivers Sciences, Arcata, CA 95521;* J. Bettaso, *USDA Six Rivers National Forest, Willow Creek, CA 95573;* D. J. Germano, *Dept. Biology, California State University, CA 93311.*

There is increased interest in research and management on the Northwestern Pond Turtle (*Actinemys marmorata*) because it is under review for Federal listing. A key life history characteristic of animals is maximum and average lifespan. We studied a stream population of Northwestern Pond Turtles for over five decades (starting in 1968) in northern California. We subsequently sampled five additional times from 2008-2018 that yielded 457 captures (new and recaptures). We recaptured 18 turtles marked 30 or more years earlier, including: nine marked 40-43 years prior, and one record of 50 years. The oldest individual was 5 years old when marked and is now a 55-year-old female and she had 9 eggs at the most recent capture. Less than 5% of adults in the population are over 40 years of age. Our evidence suggests that some Northwestern Pond Turtles may live over 50 years in the wild and females can remain reproductive at least to that age. However, an average female appears to produce eggs for about two decades of life between reaching sexual maturity and dying. Due to their extended life spans, it is important to design decades-long protection and recovery plans for populations of the Northwestern Pond Turtle.

Ecology, Status and Protection of the Western Pond Turtle in the Pacific Northwest: Overview of Efforts to Date and Remaining Questions. R. Bruce Bury*, *1410 NW 12th Street, Corvallis, OR 97331; clemmys@gmail.com*

The Northwestern Pond Turtle (*Actinemys marmorata*) was proposed for Federal listing in 1991 but was found not warranted. It is again under assessment. Washington recognizes it as

State Endangered and Oregon as a Species of Concern. This charismatic turtle has strong public support for its protection. Few ever occurred in Washington. Here, head-starting is used to increase recruitment and, apparently, shell disease occurs in some of these turtles later in the wild. This species is widespread in western Oregon and California, with large populations, but limited to patchily distributed areas of slow or standing water. To assess status and trends, we need inventories, density estimates and long-term monitoring. Several key questions remain, including: What uplands are used for nesting and overwintering? What is their daily and seasonal activity cycle? What are preferred aquatic features? What are threats and how can we reverse negative trends? How do invasive turtles impact our native turtles and how do we remove them? How do we effectively improve habitat? One potential management approach is to stagger efforts such as protecting nests not annually at one or a few sites but periodically (e.g., every 3rd year) and rotate efforts over wider geographic areas. Adults may live for decades so we need a long-term perspective seldom developed for wildlife species.

New Environmental DNA (eDNA) Protocols and Monitoring for Two Secretive Terrestrial Salamanders. Sky Button*, *Washington State University Vancouver, 14204 NE Salmon Creek Ave, Vancouver, WA 98686; sky.button@wsu.edu;* Caren Goldberg, *Washington State University Pullman, 100 Dairy Rd, Pullman, WA 99163; caren.goldberg@wsu.edu;* Jonah Piovia-Scott, *Washington State University Vancouver; jonah.piovia-scott@wsu.edu*

Van Dyke's salamanders (*Plethodon vandykei*) and Coeur d'Alene salamanders (*Plethodon idahoensis*) are two specialist species occurring along moist seep and stream margins in the Pacific Northwest, both with poorly understood conservation needs due to their secretive life histories. To improve monitoring capabilities for these species, we developed and tested an eDNA assay for each. For each species, we collected 2-3 eDNA samples on each of 3-5 visits made to six occupied sites in 2021. For *P. idahoensis*, aquatic eDNA-based detection reached 83% in May and October, was more efficient than daytime visual encounter surveys, and had similar efficacy to night-time visual encounter surveys for detecting this species. For *P. vandykei*, eDNA yielded higher detection rates (67%) than day- or night-time visual surveys (33%) at seeps and first-order streams (n = 3) during and one month after peak snowmelt but failed to detect this species later in the year and at larger streams. In 2022, we expanded our research on *P. vandykei*, resurveying 40 historically occupied localities across the species' range using a combination of eDNA and light-touch surveys. Our light-touch surveys indicated that *P. vandykei* remains present at > 60% of previously occupied sites, including sites downstream of logging activities and in the hottest portions of its range. These findings suggest that seeps and headwater stream riparian zones may serve as effective disturbance and climate refugia for *P. vandykei*, and that its secretive life history might lead to severe overestimates of its rarity unless imperfect detection is accounted for.

How Science is Applied to Wildlife Management Plans for Private Landowners. Fran Cafferata*, *Cafferata Consulting, PO Box 1123, Hillsboro, OR 97123, fran@cafferataconsulting.com*

The relationship between researchers and on-the-ground forest management is important for wildlife habitat in managed forest ecosystems. Cafferata Consulting works with researchers and private forestry companies to incorporate research findings into wildlife habitat management goals for over 800,000 acres across the Pacific Northwest. We will describe how forestry and wildlife research can influence forest planning to guide habitat management for the wildlife that call this area home.

Life History Patterns of a Small Fossorial Snake, the Common Sharp-tailed Snake (*Contia tenuis*), that Thrives in the Cold in Western Oregon. Dustin R. M. Campbell* and Robert T. Mason, *Department of Integrative Biology, Oregon State University, Corvallis, OR, 97331; campbdus@oregonstate.edu; masonr@oregonstate.edu;* Richard F. Hoyer, *2121 NW Mulkey Ave., Corvallis, OR 97330; charinabottae@earthlink.net;* Deanna H. Olson, *USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, Oregon 97331; Deanna.Olson@usda.gov*

The Common Sharp-tailed Snake (*Contia tenuis*) is a small, fossorial snake native to the Pacific Northwest. A large mark-recapture dataset originally collected by Richard Hoyer is data rich for size and growth information on both male and female *C. tenuis.* These data have yet to be analyzed statistically and that analysis may shed light on the life history of this secretive, poorly studied species. Most of these data were collected at one field site, so we plan to search for more sites where this snake has been seen to refine the comparability of our data sets. Through analysis of these data and the collection of new data, we have the opportunity to reveal novel information in several areas, including growth rates by sex and season, size to sexual maturity, and initial size at hatching.

A Peek Under the Hood: Using Accelerometers to Infer Behavior and Energetics in Grizzly Bears. *Anthony Carnahan*, Washington State University, School of Biological Sciences, Pullman, WA 99164; acarnahan@wsu.edu;* Charles Robbins, *Washington State University, School of the Environment, Pullman, WA 99164; ctrobbins@wsu.edu*

As triaxial accelerometers have become available as options on commercial wildlife GPS collars, the interest in implementing these devices in wildlife studies has also increased. There have been many studies published using accelerometers to identify behavior. Fewer studies have also used accelerometers to calculate dynamic body acceleration (DBA) which can be used to estimate the energy an animal expends moving across the landscape. But how does one go from raw acceleration data to identifying behavior or calculating DBA? In this talk we will give an overview of this process using raw accelerometer data from nine captive Grizzly Bears (*Ursus arctos*) to show how to calculate DBA and which machine learning techniques are useful for identify behavior from acceleration data. We will discuss the mechanics of accelerometers, noteworthy r packages for machine learning, and overall best practices and problem areas to avoid when working with accelerometer data.

Bat Monitoring and White-nose Syndrome Surveillance in Washington's National Parks from 2017-2022. Tara Chestnut*, *Mount Rainier National Park, Ashford, WA, USA;*

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Emerging infectious diseases threaten ecosystem services, biodiversity, and our natural and cultural heritage. Therefore, it is critical to identify potential vectors and mechanisms of spread, as well as effectively communicate to managers, decision-makers, and the public. In response to the 2016 *Pseudogymnoascus destructans* (Pd) detection in Washington, the National Park Service (NPS) Pacific West Region (PWR) developed a regional response plan. The North Coast Cascades Network (NCCN) implemented bat monitoring and white-nose syndrome (WNS) surveillance following recommendations outlined in the NPS PWR WNS response plan. The primary research and monitoring goals were to identify known bat colonies, conduct WNS surveillance, and assess bat species occurrence in network parks using acoustic monitoring. We also implemented communication, education, and outreach activities targeting diverse audiences and stakeholder groups. We report on program activities conducted since 2017 and discuss future plans.

Do Aquatic Mammals Inadvertently Spread Amphibian Chytrid Fungus on their Fur? Tara Chestnut*, *Mount Rainier National Park, Ashford, WA, USA and Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR, USA; tara_chestnut@nps.gov, tarachestnut@gmail.com;* Jeff Bradley, *Burke Museum of Natural History and Culture, Mammalogy Collection, Seattle, WA, USA; jebrad@uw.edu*

Emerging infectious diseases threaten global biodiversity, ecosystem services, and natural and cultural heritage, therefore, it is critical to understand the pathways of spread and potential vectors. The amphibian chytrid fungus *Batrachochytrium dendrobatidis* (Bd) is a pathogen implicated in global amphibian declines that has multiple secondary animal hosts (e.g., waterfowl, crayfish, fish, aquatic insects) which can serve as environmental reservoirs and vectors for Bd spread and transmission. Our research sought to explore whether aquatic mammals could serve as local vectors for Bd via ectozoochory. Because Bd has an affinity toward keratinized structures in amphibian skin and has been detected on other keratinized structures, we hypothesized that mammal hair may be a suitable substrate for Bd to obtain nutrients as an alternative host when primary amphibian hosts are not present. We predicted that if Bd zoospores attach to or encyst on hair when aquatic mammals enter water with Bd present, that aquatic mammals could serve as a potential vector for Bd spread and new introductions to aquatic systems. We plucked hair samples from 12 prepared museum specimens and one fresh specimen representing 12 species from five mammalian taxonomic orders. We used two types of standard surgical sutures (nylon and plain gut—beef serosa or sheep submucosa) as controls. We did not observe evidence of Bd attachment, encystment, or growth on any of the substrates included in our experiment. Identifying the suite of alternate hosts, potential vectors, and

pathways for introduction is key to understanding host-pathogen dynamics and informing meaningful conservation actions.

Field Safety and Psychological First Aid. Tara Chestnut*, *Mount Rainier National Park, Ashford, WA, USA; tara_chestnut@nps.gov, tarachestnut@gmail.com;* Marwa Mahmoud, *Washington State University, School of the Environment, Pullman, WA, USA; marwa.mahmoud@wsu.edu*

On June 23, 2021, we were involved in a catastrophic accident while conducting surveys in the field. We will discuss the practices we implemented as part of our regular routine including effective Job Hazard Analysis and General Assessment of Risk, as well as informal ways to promote a safety culture. We will also discuss the importance of psychological first aid to facilitate harm reduction during emergency situations.

Gestation-site Selection by Gravid Great Basin Rattlesnakes (*Crotalus lutosus*) in Southeastern Idaho. Vincent A. Cobb*, *Middle Tennessee State University, Murfreesboro, Tennessee 37132; vincent.cobb@mtsu.edu*

Gravid viviparous snakes in temperate environments are well documented to behave differently than their intraspecific counterparts. This involves gravid snakes locating refuges that can provide adequate thermoregulatory opportunities but also protect the mother and her young from predators. Such gestation sites are likely not chosen at random and have physical attributes that enhance survival. To test this, I documented gestation-site selection by gravid Great Basin Rattlesnakes (*Crotalus lutosus*) in the sagebrush steppe desert of the Snake River Plain at the Idaho National Laboratory. Gravid *C. lutosus* at this site emerge from winter brumation in April-May and are usually associated with a gestation site by late June and remain there for about two weeks post-parturition. In July-August 2018, we located 22 gestation sites, monitored their continued use, and took measurements on the physical attributes of these and random sites once parturition was complete. For gestation, all gravid snakes used basalt outcrops with limited vegetation and less rodent activity than nearby random sites. Snakes nonrandomly selected larger rocks (median = 130 × 94 × 26 cm) for gestation over adjacent available rocks. Careful selection of rocky microhabitats, and specifically larger rocks, suggests snakes may be prioritizing thermoregulation and shelter from predators (e.g. badgers) over foraging.

Water Quality and Aquatic Ecosystem Responses Across Gradients of Forest Stand Age. Ashley A. Coble*, *NCASI, 2438 NW Professional Drive, Corvallis, Oregon 97330, acoble@ncasi.org;* Brooke E. Penaluna, *U.S. Forest Service, 3200 SW Jefferson Way, Corvallis Oregon 97331*; Jake Verschuyl, *NCASI, 1117 3rd Street Anacortes, Washington 98221.*

Forest successional stage can affect aquatic ecosystems through bottom-up food web processes by altering light, organic matter, and nutrient inputs, but can also affect physical habitat via recruitment of large wood or altered flow and thermal regimes. In Oregon, approximately 30% of federal lands have an area-weighted stand age > 120 years old while on private lands ≤ 5% carry these same characteristics. Accordingly, landscape composition differs

substantially from historic conditions when stands >160 years old dominated watersheds, and the consequences of these changes on aquatic species and their habitat are not well understood. Consequently, investigating watersheds that vary by ownership patterns can inform relationships between stand age and freshwater biodiversity across watersheds with complex site history. We sampled 24 watersheds across a gradient of stand age in coastal Oregon in 2019 and 2020 to promote a unified understanding of the consequences of intensive stand management for water quality, habitat, ecosystem function, and biological diversity. Preliminary analyses indicate mean watershed stand age was not strongly correlated with abiotic or biotic variables in 2019. Background stream chemistry across all 24 study sites indicate few trends in nutrient (as inorganic and total nitrogen and phosphorus) or dissolved organic carbon concentrations with mean watershed stand age. Similarly, periphyton biomass did not differ across this gradient. Monitoring across these watersheds will provide additional information on macroinvertebrate, fish and amphibian assemblages and will aid in our understanding of the role of legacy and ongoing forest management effects on aquatic ecosystems.

Using Close-kin Mark-recapture to Estimate Abundance and Survival of Bearded Seals in Alaska. Paul B. Conn*, *Marine Mammal Lab, NOAA Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115; paul.conn@noaa.gov;* Brian D. Taras, *Alaska Department of Fish and Game (retired), Statewide Marine Mammal Program, 1300 College Road, Fairbanks, AK 99701; bdtaras-dfg@alaska.gov*; Mark V. Bravington, *CSIRO Marine Lab, GPO Box 1538, Hobart 7001, TAS, Australia; Mark.Bravington@data61.csiro.au*; L. Quakenbush, *Alaska Department of Fish and Game, Arctic Marine Mammal Program, 1300 College Road, Fairbanks, AK 99701; lori.quakenbush@alaska.gov*; A. Kilian, *Diversity Arrays Technology Pty Ltd, University of Canberra, Bruce, ACT, Australia; zej@diversityarrays.com*; Aimee R. Lang, *Southwest Fisheries Science Center, NOAA-Fisheries, 3333 North Torrey Pines Court, La Jolla, CA 92037; aimee.lang@noaa.gov*; A. Bryan, *Alaska Department of Fish and Game, Arctic Marine Mammal Program, 1300 College Road, Fairbanks, AK 99701; anna.bryan@alaska.gov*

Close-kin mark-recapture (CKMR) provides a framework for estimating abundance and adult survival using frequencies of kinship relationships observed in animal samples. In this study, we used ~1,800 genetic samples from indigenous harvested bearded seals gathered over a ~20 year period to obtain DNA and estimate age. A ~3,000 locus single nucleotide polymorphism (SNP) panel was developed, and all samples were genotyped and sexed. Kin relationships were ultimately established for 1,484 seals at 2,569 loci resulting in 2 parent-offspring and 18-25 half-sibling or grandparent-grandchild pairs (depending on modeling assumptions). We then used a sequence of age-structured CKMR models embodying different assumptions about data and population structure to estimate mean abundance throughout our study period and to update a prior distribution for survival-at-age. Estimates of bearded seal abundance ranged from 200,000-400,000 depending on the assumptions used. These estimates are smaller, but of similar magnitude to those obtained through aerial surveys (~500,000 seals) and confidence intervals had substantial overlap. Although the observed frequencies of kinship relationships were considerably less than recommended for CKMR estimation, we were encouraged by our results and the ecological insights possible even with a limited dataset. We

plan to increase seal harvest data collection to further refine estimates and increase precision going into the future.

Analysis of Genetic Structure within the Cascade Torrent Salamander Suggests Distinct Lineages and Ancient Dispersal Events Form Present-Day Populations. Christopher Cousins*, *Oregon State University, 2820 SW Campus Way, Corvallis, OR 97331; Christopher.cousins@oregonstate.edu;* Michael J. Adams, *United States Geological Survey, 777 NW 9th St, Corvallis, OR 97330; mjadams@usgs.gov;* Christopher Pearl, *United States Geological Survey, 777 NW 9th St, Corvallis, OR 97330; christopher_pearl@usgs.gov;* Jennifer Rowe, *United States Geological Survey, 777 NW 9th St, Corvallis, OR 97330; jrowe@usgs.gov;* Tiffany Garcia, *Oregon State University, 2820 SW Campus Way, Corvallis, OR 97331; tiffany.garcia@oregonstate.edu*

The Cascade Torrent Salamander (*Rhyacotriton cascadae)* is endemic to the Pacific Northwest, where it lives in cold, fast-flowing headwater streams and seeps. Considered especially intolerant to desiccation and changes in temperature, even among other salamanders, the species is predicted to lose a significant portion of its habitat as a result of impacts from climate change and as a result is currently being considered for listing under the Federal Endangered Species Act (ESA). The success of conservation efforts is often predicated on accurate delineation of distinct populations, but no range wide genetic study on the species has been conducted to date. To assist with conservation and management efforts, we collected tissue from 144 individuals at 27 sites across the range of the Cascade Torrent Salamander in both Oregon and Washington. Using genotyping by sequencing (GBS), we used multiple filtering strategies producing datasets to examine genetic structure within the species. We identified genetically distinct populations, and observed low levels of admixture between them, suggesting that past dispersal events are largely shaping present-day genetic structure. Our results will make it possible for future conservation and management actions to take discrete populations into account, ensuring that this unique Pacific Northwest amphibian persists into the future.

Washington Northern Leopard Frog Recovery Program: Post-release Monitoring of Behavior and Predator Threats. Erica J. Crespi*, *School of Biological Sciences, Washington State University, Pullman, WA 99164; erica.crespi@wsu.edu;* Caren S. Goldberg, *School of the Environment, Washington State University, Pullman, WA 99164; caren.goldberg@wsu.edu;* Jeff Manning, *School of the Environment, Washington State University, Pullman, WA 99164; jeff.manning@wsu.edu;* Alexa Dulmage, *School of Biological Sciences, Washington State University, Pullman, WA 99164; alexa.dulmage@wsu.edu;* Robert Pearhill, *School of Biological Sciences, Washington State University, Pullman, WA 99164; robert.pearhill@wsu.edu;* Christina Kiepe, *School of the Environment, Washington State University, Pullman, WA 99164; christina.kiepe@wsu.edu;* Emily Grabowsky, *Washington Department of Fish and Wildlife, Region 2, 1550 Alder St. NW, Ephrata, WA 98823; emily.grabowsky@dfw.wa.gov*; Adam Haines, *Washington Department of Fish and Wildlife, Region 2, 1550 Alder St. NW, Ephrata, WA 98823; adam.haines@dfw.wa.gov*

Captive-rearing programs for amphibians are designed to boost population size by circumventing the high mortality rates experienced by early life stages in natural systems. However, captive-reared individuals may not have the behaviors necessary to survive once released. We assessed behavioral responsiveness and gross movements of captive-reared Northern Leopard Frogs (NLFs) upon release into two ponds at the Columbia National Wildlife Refuge (one where bullfrogs were excluded in 2022), as well as the responses of predators to the release. First, we conducted modified flight response assays at the release site to determine whether captive-reared frogs responded to an oncoming visual/audio cue similarly to the wild juvenile frogs at the natal site. In both 2021 and 2022, we found captive-reared frogs were less responsive to the visual/audio cue than wild frogs, but responsiveness improved after 5 days in soft-release enclosures. In 2022, we used visual encounter surveys and radio-tracked 11 frogs to monitor frog movements in the absence of bullfrogs and found NLFs using most of the pond area. Daily observations of soft-release enclosures after NLF release documented predation by garter snakes, within and in the vicinity of the soft-release enclosures, and an increase in bullfrog presence around the enclosures over time. Radiotracking of bullfrogs confirmed a pronounced change in bullfrog space use into the soft-release enclosure area when enclosures were opened. We will continue to work to understand how anti-predator training can be incorporated into this program and how to protect NLFs from predation during the population establishment process.

Cumulative Effects of Forest Management on Riparian System Aquatic Macroinvertebrates. Robert J. Danehy*, *Catchment Aquatic Ecology, 5335 Saratoga St., Eugene, OR 97405*; *danehy@catchmentae.com*

Freshwaters are essential to forest biota. The biological diversity includes fish, amphibians, mollusks, wetland biota, and a highly diverse instream community of hundreds of invertebrate species. Tolerance to various stressors of the macroinvertebrate species is the basis of biological water quality assessment programs. Current conditions in forested streams created by past natural disturbances and forest management offer thermal, sediment, nutrient, and large wood regimes to form aquatic habitat. Disturbance regimes and anthropogenic actions (e.g., robust removal of beaver) have impacted channels and riparian systems. Forest management practices include road network construction/operation and riparian harvesting, as well as active stand management including the use of forest chemicals. In the Pacific Northwest today, 300-500 aquatic macroinvertebrate species inhabit reaches of small streams for part or all their life. Spatial distribution, relative abundance, biomass, and life cycles of assemblage species exhibit wide diversity, with rare species comprising most of the full assemblage. Riparian systems were among the first to be harvested to facilitate typical log movement downstream for milling. Depending on silvicultural procedures and site conditions, locations are harvested every 50-75 years. Hence most locations have been harvested multiple times, with the first harvest to stream edge and more recent harvests using modern improved management practices. Using data from the PNW the possible cumulative effects of multiple harvests are explored.

Beaver Coexistence for More Resilient Urban Wetlands. Rachael Dirks*, *Beavers Northwest, 15833 11th Ave NE, Shoreline, WA 98155; rachael@beaversnw.org*

Beavers are distinguished ecosystem engineers, having more direct influence on their surroundings than almost any other animal on the planet. Among many benefits, beaver ponds create critical habitat for a breadth of other species, recharge groundwater, and improve downstream water quality. Beavers enhance and create wetlands that support greater ecosystem resilience on a watershed scale, so in the age of Climate Change, preserving these wetlands is more important now than ever before. However, when beavers move into urban and suburban streams, conflicts, both perceived and actual, often arise. There is thus an increasing need to build tolerance of beavers alongside addressing real conflicts, such as flooding of human infrastructure. How then can beavers and humans coexist? This talk will explore the trials, tribulations, and successes of in-place beaver management in the greater Seattle area. We will focus on discussing the development of current methods used by Beavers Northwest to mitigate beaver-induced flooding and discuss the pros and cons of various flow control devices used throughout the Puget Sound Region and beyond.

Expanding the Forest Management Toolbox: Large-Scale Field Experiment on Washington State Lands. Stacey Dixon*, *Anderson Hall, 3715 W Stevens Way NE, Seattle, WA 98195*; *sedixon@uw.edu*

The T3 Watershed Experiment is a 20,000-acre study examining potential new, innovative approaches to managing forests in the Olympic Experimental State Forest (OESF), managed by Washington Department of Natural Resources (WADNR). This study was initiated by the University of Washington (Olympic Natural Resources Center) and the WADNR (Forest Resources Division, Olympic Experimental State Forest, and Olympic Region). Through the application of science-based adaptive management at watershed and operational scales (forest management units of about 30 acres or larger), the goal of the study is to examine how sustainable ecosystems can consider both the wellbeing of the forest environment and proximate human communities. The study is in the implementation phase, with timber harvests expected over the next two to three years. This presentation will provide an overview of the T3 Watershed Experiment and highlight two experimental designs for the upland forest system.

Connecting the Landscape: How to Identify and Build a Strategy for Landscape Scale Wildlife Connectivity. Scott Downes*, *Washington Department of Fish and Wildlife, 1701 S24th Ave, Yakima WA 98902; Scott.Downes@dfw.wa.gov*

Successful wildlife connectivity on a landscape scale has many facets including providing passage through barriers such as roads and highways. Another facet of wildlife connectivity is conservation of the corridor at a landscape level. Development can often be a barrier equal to or greater than those posed by roads and highways. A successful strategy must then look at both the current passage barriers of roads and fences but also future changes in that corridor as a result of development or land use changes. The strategy must combine these factors to ensure the corridor contains effective habitat for the species the corridor was designed for.

Questions the landscape connectivity strategy should examine include identifying what species the corridor should plan for, which often range from small herptiles to large ungulates or carnivores. Another question is what current or potential future threats to the conservation of the corridor are. Using the answers to these questions enables landscape planners and biologists to work at addressing those issues to ensure long-term landscape conservation for connectivity. This talk will show some examples where this analysis was used, including highlighting the overall conservation strategy of the I-90 East project near Snoqualmie Pass. This talk will also highlight strategies and tools available to planners and biologists such as working with partners and various governmental levels from local to federal to ensure that long-term conservation strategy.

Monitoring for Marbled Murrelet and Northern Spotted Owl at Naval Radio Station Jim Creek with Implications for Future Marbled Murrelet Surveys. Adam Duarte*, *Pacific Northwest Research Station, USDA Forest Service, 3625 93rd Ave Southwest, Olympia, WA 98512; adam.duarte@usda.gov;* Alicia Higgs*, *Naval Facilities Engineering Systems Command, Naval Station Everett, 2000 West Marine View Drive, Everett, WA 98207; alicia.m.higgs.civ@us.navy.mil*; Alaina D. Thomas, *Pacific Northwest Research Station, USDA Forest Service, 3200 Southwest Jefferson Way, Corvallis, OR 97331; alaina.thomas@usda.gov*; Damon B. Lesmesister, *Pacific Northwest Research Station, USDA Forest Service, 3200 Southwest Jefferson Way, Corvallis, OR 97331; damon.lesmeister@usda.gov*

Naval Radio Station (Transmitter) Jim Creek is a 4,800-acre installation near Arlington, WA containing mature and old-growth forests. In order to meet requirements of the Sikes Act and the installation's Integrated Natural Resources Management Plan, the Navy must survey for species listed under the Endangered Species Act, including Marbled Murrelet (*Brachyramphus marmoratus*; MAMU) and Northern Spotted Owl (*Strix occidentalis caurina*; NSO). A bioacoustic survey protocol has recently been developed for NSO, which has also shown promise as a technique for detecting MAMU. During the peak nesting period in 2022, we deployed 39 audio recording units (ARUs) across the installation to survey for MAMU and NSO. We also conducted traditional audio-visual surveys for MAMU at 19 of our ARU survey stations to compare the detectability of MAMU using these two survey approaches. This study represents the first intensive survey effort for these two species on the installation and the most rigorous comparison of these survey approaches for MAMU to date. Our results demonstrate that managers can gather accurate presence/absence data for MAMU and NSO using bioacoustics surveys. However, more work is needed to determine how audio detections can be linked to the regulatory designation for occupancy, and thereby support MAMU conservation efforts on managed lands.

Potential Conservation Value of Slash Piles for Pacific Fishers in Working Forests. Jordan Ellison*, *Oregon State University, College of Forestry, 328 Peavy Forest Science Center, Corvallis, OR 97330; jordan.ellison@oregonstate.edu;* Katie Moriarty, *National Council for Air and Stream Improvement, 2438 NW Professional Drive, Corvallis, OR 97330; kmoriarty@ncasi.org;* Angela Larsen-Gray, *National Council for Air and Stream Improvement,*

Clemson, SC; alarsen-gray@ncasi.org; John Bailey, *Oregon State University, College of Forestry, 346 Peavy Forest Science Center, Corvallis, Or 97330; john.bailey@oregonstate.edu*

Identifying strategies to connect isolated populations of Pacific Fishers (*Pekania pennanti)* is a priority for their future conservation in the western United States. Fishers are associated with contiguous, structurally complex forests and typically avoid natural and created openings. Documented use of slash piles by Fishers may suggest utility for mitigating some connectivity challenges following harvest or large, high severity fires. We assessed whether retaining slash piles for cover and foraging could be used as a conservation tool for Fishers in recent clear-cuts (0 – 15 years). Using remote-cameras, we surveyed piles in stands derived from spatially-balanced sampling and within 5-km of a recent detection (n = 69). We detected Fishers at slash piles in 59% of stands where they were confirmed to be within 200m (n = 59). We used a GLMM to evaluate potential relationships between local conditions and the likelihood of detecting a fisher at a pile. At a subset of stands, we evaluated the effect of slash piles on prey availability by estimating differences in small mammal community metrics at piles and the surrounding landscape using mark-recapture data (18 replicates of 3 treatments: slash piles, adjacent forest, regenerating stands). Small mammal diversity, richness, and the relative abundances of common species were slightly higher at the sampled slash piles and regenerating stands relative to the adjacent forest. We describe opportunities for enhancing connectivity in managed forests and provide context and recommendations for further evaluation of slash piles for wildlife in managed forests or areas with large-scale disturbance.

Susceptibility of U.S. Pacific Northwest Native Amphibians to Fish Rhabdoviruses. Evi Emmenegger*,*USGS - Western Fisheries Research Center (WFRC), 6505 NE 65th Street, Seattle, WA, 98115; eemmenegger@usgs.gov;* Emma Bueren, *USGS-WFRC, Seattle, WA 98115 and Department of Biological Sciences, Virginia Polytechnic Institute and State University, 925 Prices Fork Road Blacksburg, VA 24060;* George Sanders, *Department of Comparative Medicine, University of Washington, Seattle, WA, 98195;* Noble Hendrix, *QEDA Consulting, 4007 Densmore Avenue N, Seattle, WA 98103 and School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195;* Carla Conway, *USGS-WFRC, Seattle, WA 98115;* Tamara Schroeder, *Fisheries and Oceans Canada (DFO) Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba R3T 2N6;* Sharon Clouthier, *DFO Freshwater Institute, Winnipeg, Manitoba R3T 2N6*

Spring viremia of carp virus (SVCV), infectious hematopoietic necrosis virus (IHNV), and viral hemorrhagic septicemia virus (VHSV) are aquatic rhabdoviruses that infect fishes. They can cause severe outbreaks in naïve fish stocks and are notifiable fish diseases listed by the World Organization for Animal Health. In 2015, SVCV was detected in distressed ornamental Chinese Firebelly Newts (*Cynops orientalis*) imported into the U.S. and appeared to be responsible for the observed morbidity. This discovery represented the first isolation of a rhabdovirus in an amphibian species. Susceptibility testing was initiated to better understand the potential host range of foreign (SVCV) and endemic (IHNV, VHSV) rhabdovirus strains in amphibians native to the Pacific Northwest. Pacific Tree Frog (*Pseudacris regilla*) tadpoles and/or larval Long-toed Salamander (*Ambystoma macrodactylum*) were exposed to the viruses

by either intra-peritoneal injection, immersion, or co-habitation with rhabdovirus-infected fish. The highest mortality occurred in amphibians exposed to specific SVCV strains (100%). Lower mortality was observed in amphibians challenged with VHSV (43%) or IHNV (38%) strains. SVCV was detected by plaque assay and RT-qPCR assay in both amphibian species regardless of the virus exposure/transmission method, and amphibian hosts displayed measurable levels of viable virus 28 days following exposure. Comparable sample analysis of IHNV or VHSV - exposed amphibian specimens are ongoing. Results thus far indicate that these aquatic rhabdoviruses can be transmitted and cause lethal disease in amphibian species. As such, amphibians may serve as virus carriers and pose a risk for sympatric fish and amphibian populations vulnerable to IHNV, VHSV, or SVCV.

Threats to Southern Resident Killer Whales in Expanded Critical Habitat Identified by Passive Acoustic Monitoring. Candice K. Emmons*, *Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Blvd East, Seattle, WA 98112; candice.emmons@noaa.gov*; M. Bradley Hanson, *brad.hanson@noaa.gov*; Emily Drappeau, *emily_drappeau@uri.edu*

Passive acoustic monitoring has been used to better understand year-round occurrence patterns of Southern Resident Killer Whales (SRKW) in the coastal waters of Washington. These data also provided near year-round monitoring of anthropogenic sound sources and insight into the potential threats to SRKW outside the Salish Sea. Exposure to mid frequency active sonar (MFA) and explosive sounds has been identified as being of concern to cetaceans in other areas and were both detected here. MFA events were rare (n=148 in 6 yrs.) and occurred in every month of the year, with the majority of events occurring between February and May when SRKW are most frequently detected. While these overlap temporally, MFA events were only detected on 1% of days at nearshore sites where SRKW are most frequently detected. Explosive sounds were detected in every month of the year peaking in the summer months when SRKW have been historically sighted in the Salish Sea. But SRKW presence on the outer coast has been increasing during the summer months, especially at the Juan de Fuca location. The characteristics of over 15,000 explosive sounds were compared to previously published descriptions of marine mammal deterrents, or seal bombs, and large military ordinances, and all but ten were identified as seal bombs. Since the use of seal bombs can lead to physical injury, behavioral changes, and displacement in other species, spatial and temporal trends in the occurrence of these sounds were further analyzed to identify the potential risk to SRKW in their coastal range.

Pikas Rock! Colonization and Use of Anthropogenic Rock Structures along Roads by the American Pika (*Ochotona princeps*), a Rocky Habitat Specialist. Kristina Ernest*, *Department of Biological Sciences, Central Washington University, 400 E University Way, Ellensburg, WA 98926; ernestk@cwu.edu*

The American Pika (*Ochotona princeps*) plays a key ecosystem role in montane western North America by consuming diverse plant species, creating food caches, adding nutrients via their latrines, and serving as prey for a variety of predators. Due to the patchy nature of their

broken-rock habitat and poor dispersal capacity, pikas exist in metapopulations with limited dispersal between subpopulations (rock patches). Roadways that create barriers for dispersal make connectivity between subpopulations even more tenuous. Here, I summarize a multi-year data set for how pikas respond to highway rock embankment and rock habitat in wildlife crossing structures. I conducted occupancy surveys for pikas in the I-90 Snoqualmie Pass East Project area of the Washington Cascade Range to track use and colonization of anthropogenic rock patches. Surveys included 15-minute focal observations to watch for pikas and listen for vocalizations, and transects across the patch to search for pika haypiles and latrines. Time to colonization of new rocky habitats varied from < 1 yr to > 8 yr. Pikas were detected at two of five new wildlife crossing structures with rock habitat. As other studies have shown for larger species, long-term monitoring is critical for assessing effectiveness of constructed habitat and crossing structures. Smaller species with lower mobility like pikas may take several years or more to disperse to and use created habitats, but these results show that such habitat features, properly placed, may help improve connectivity and thus provide some resilience in the face of climate change.

Threats Contributing to the Ferruginous Hawk's Declining Status in Washington. Jason Fidorra*, *Washington Dept. of Fish & Wildlife, 2620 North Commercial Avenue, Pasco WA 99310; Jason.Fidorra@dfw.wa.gov;* Jim Watson, *Washington Dept. of Fish & Wildlife, PO Box 43200, Concrete WA 98504; James.Watson@dfw.wa.gov*

The Ferruginous Hawk (*Buteo regalis*) is a shrubsteppe nesting raptor typically considered to specialize on mammalian prey. The species was listed as Threatened in WA in 1983. This presentation summarizes 30 years of state surveys and key findings from movement studies that informed the Washington Dept. of Fish & Wildlife's decision to up list the species to endangered in 2021. Various cumulative impacts reduced the WA population from an average of 55 breeding pairs (1992-2003) to 31 pairs (2010-2021). The impacts likely occurred on breeding as well as wintering ranges. Studies on movements and migration have illuminated a complicated migration pattern with individuals covering vast distances over 10 western states during an annual migration, subjecting them to various hazards across the landscape. During breeding, the species maintains very large home ranges (e.g., 378 sq km) in WA compared to other populations such as those in Alberta (e.g., 36 sq km), likely related to reduced differences in prey resources and habitat suitability. The lack of improvement in habitat conditions or amelioration of primary threats were the primary reason behind the status change of the Ferruginous Hawk from threatened to endangered status in Washington.

Movement Ecology, Management, and Conservation of Great Basin Rattlesnakes (*Crotalus oreganus lutosus*) on Military Training Lands in Northern Utah. Chris Frauenhofer*, *Utah Army National Guard, 17800 Redwood Rd, Bluffdale, UT 84065; cfrauenhofer@utah.gov*

The Great Basin Rattlesnake (*Crotalus oreganus lutosus*) is the only venomous reptile found on Army Garrison Camp Williams. A population and movement study was initiated in 2020 in response to human-rattlesnake interactions and substantial development around the military installation in the past 5-10 years. The objectives of this study are to both identify

critical habitat features on the landscape (i.e., hibernacula) to conserve key habitats in anticipation of future development and monitor rattlesnake movement in relation to military training activities. The study is currently ongoing but 12 communal hibernacula have been identified and at least 22 adult rattlesnakes have been tracked using radio telemetry each year beginning in 2020. Movement data has enabled coordination with military trainers to limit negative interactions as well as insight to snake behavior on the installation. This presentation will highlight interesting patterns in movement and habitat use observed to date and how we apply it to management on an active military installation.

Healthy Whales and Healthy Ecosystems. Ari S. Friedlaender*, *Professor, Ocean Sciences Department, University of California Santa Cruz, 115 McAllister Way, Santa Cruz, CA 95060*; *ari.friedlaender@ucsc.edu*

Baleen whales in the Southern Ocean are recovering from 20th century commercial whaling. As they recover, we have an opportunity to better understand their ecological role and how their presence (or absence) affects marine ecosystems. Recent advances in biologging and UAS technology have provided tools to quantify their underwater behavior and measure their size and engulfment capacities. Combined with concurrent prey surveys we can accurately estimate the consumption rates of baleen whales. This information also provides the necessary means to show how baleen whales act as ecosystem engineers by recycling nutrients that may otherwise be limiting to phytoplankton growth in the upper ocean. By recycling nutrients and helping to seed primary productivity on their feeding grounds, the presence of baleen whales likely has a net positive effect on the abundance of primary producers and their prey. As the waters around the Antarctic Peninsula continue to warm and annual sea ice decreases, the amount of Antarctic krill (the main prey for whales, seals, penguins, seabirds, and some fish) is being negatively impacted, as krill recruitment and survival is directly tied to sea ice cover. Combined with a burgeoning krill fishery that targets krill in the same areas where baleen whales feed, krill may be at risk. The presence and recovery of baleen whales in this marine ecosystem is therefore critical to help offset or combat these large-scale changes in krill availability and it is imperative that conservation measures such as marine protected areas consider the critical habitat and distribution of baleen whales.

Conservation Conundrum: How the Conservation Reserve Program Became Critical Habitat for the Columbia Basin Pygmy Rabbit. Jon Gallie*, *Wildlife Biologist Washington Department of Fish and Wildlife, 1550 Alder St. NW, Ephrata WA 98823*; *j.gallie@dfw.wa.gov*

The Federally Endangered Columbia Basin Pygmy Rabbit (*Brachylagus idahoensis*) is a sagebrush obligate, requiring deep soil shrubsteppe habitat for survival. Reintroduction efforts have been occurring since 2011 and have established two wild populations within their former range. As these populations dispersed across the landscape, we observed unexpected patterns of habitat use, primarily the disproportionate use of fields enrolled in the Conservation Reserve Program (CRP). In fact, 80-90% of all wild Columbia Basin Pygmy Rabbit active burrow sites are currently located in CRP fields compared to native shrubsteppe habitat. Looking into reasons as to why this habitat selection is occurring, we observed that: 1) CRP fields occur on deeper and more productive soil sites than native shrubsteppe, which are preferred for burrow sites; 2) CRP fields have sagebrush stands that are much younger, productive, and more nutritious compared to native shrubsteppe habitat; and 3) we observed mammalian predator visits at rabbit burrow sites were much higher in native shrubsteppe habitat than in CRP fields. The conservation conundrum comes about as we continuously promote efforts to restore and protect native shrubsteppe habitat and yet despite these efforts, Pygmy Rabbits and other threatened species (Greater Sage and Columbian Sharp-tailed Grouse) disproportionally use CRP habitat. Maintaining CRP habitat is logistically challenging as they: 1) primarily occur on privately owned land or agricultural lease;

2) they are not a permanent or protected landscape feature; and 3) their persistence is limited by a variety of economic limitations and voluntary participation.

There's Something in the Water: Steps to Understanding the Cues for Oregon Spotted frog (*Rana pretiosa*) Breeding. Andrea Gielens*, *Wildlife Preservation Canada, 27234 30th Ave, Aldergrove BC, V4W 3J6; andrea@wildlifepreservation.ca*

Reduced to a handful of declining and fragmented populations in the wetlands of B.C., the Oregon Spotted Frog is Canada's most imperiled amphibian, and listed as Vulnerable in the IUCN Red List. Conservation breeding and reintroduction is a necessary step to bring this species back from the brink. Ex situ recovery efforts have been ongoing for this species in some capacity since 1999. Captive-breeding efforts have included many different strategies which have had limited success; until recently the program experienced low egg production and egg viability. However, in 2021 males and females overwintered in separate enclosures were introduced in the female overwintering enclosure at the onset of observed breeding congregation in the wild. The result was a dramatic increase in the number of females who laid as well as the fertility of those egg masses. These methods and results were replicated in 2022. The program has seen an increase of an average of under 2,000 to over 20,000 fertile eggs a year. While the mechanism behind this phenomenon requires further study, this breakthrough has provided significantly more animals for release, benefitting reintroduction goals. We have also seen a decrease in the incidence of egg binding, thus enhancing the long-term survival of females in the ex-situ breeding colony.

The Efficacy of Two Novel Treatments (Ponazuril and Humatin) for *Cryptosporidium* sp. in Western Painted Turtles (*Chrysemys picta bellii*). Andrea Gielens*, Wildlife Preservation Canada, 27234 30th Ave, Aldergrove, BC V4W 3J6; andrea@wildlifepreservation.ca; Dr Adrian Walton, DVM, *11965 228 St, Maple Ridge, BC V2X 6M1; dewdneyvet@gmail.com*

The aim of this study is to assess the effectiveness of two novel treatments for Cryptosporidium in chelonians, specifically Western Painted Turtles (WPT). Since 2011, a program for ex situ hatching and rearing of WPT for population augmentation has been occurring as part of the larger WPT recovery program, guided by the provincial recovery team. Beginning with fewer than 20 individuals yearly, this program has grown to encompass more than 200 yearly releases and augmentation assistance to populations from the Sunshine Coast to Metro Vancouver and the Fraser Valley. The programs there have seen occurrences of what has been colloquially called "soft shell". When first observed this affected between 5-10% of the hatchlings. The condition presents no lesions, with the shell appearing cosmetically completely normal. Initial pathology reports suggested a generalized MBD diagnosis. Samples submitted to the AHC in 2020/21 requesting further investigation revealed a diagnosis of intestinal Cryptosporidiosis. Due to their aquatic nature turtles are often in contact with the faeces of conspecifics allowing transfer to occur more readily. Infected individuals, particularly young with a potentially less robust immune response, could be more at risk. Due to shedding of the parasite in faeces as well as its resilience due to encapsulation, these parasites can repeatedly infect individuals and transfer within an ex-situ population easily (Richter, 2012). Treatment of

the individual with anti-parasitic medication and disinfection of equipment with a non-chlorine-based oxidizing agent decreases or eliminates parasitic load in the individual (medication) and ex-situ environments (sterilization). We present the results of a hatchling rearing trial of Ponazuril and Humatin as prophylactic and reactive treatments to decrease parasite load and increase survival in hatchling WPT.

The Washington Shrubsteppe Restoration and Resiliency Initiative: A New Model for Shared Resource and Service Delivery for Shrubsteppe Conservation. Janet Gorrell*, *Landscape Conservation Section Manager, Washington Department of Fish and Wildlife; Janet.Gorrell@dfw.wa.gov*

In response to significant wildfires in fall 2020 that impacted both wildlife and human communities, the Washington State Legislature appropriated $2.35 million from the state general fund to the Washington Department of Fish and Wildlife (WDFW). To be appropriated each biennium, this funding is provided to restore and protect shrubsteppe habitat in Eastern Washington amid the ongoing threat of wildfires. This talk will give a general overview of the Washington Shrubsteppe Restoration and Resiliency Initiative (WSRRI), including its purpose, planning targets, and opportunities created for landowners through this initiative. Towards restoration of wildlife habitat, WSRRI aims to deliver support for restoration projects, expand and enhance available restoration resources, and be responsive with restoration resources and services within critical ecological windows. Our major accomplishments towards this end, and lessons learned, will be shared.

Updated Occupancy and Abundance for NW Pond Turtle and Western Painted Turtle in the Lower and Middle Willamette Watersheds. Laura Guderyahn*, *Earth, Environment and Society PhD Student, Portland State University, 1825 SW Broadway, Portland, OR 97201; gud@pdx.edu*

Regional changes in land use and climate are anticipated to have profound effects on the ranges of the native freshwater turtles in NW Oregon, so adequate baseline surveys are critical. The Lower and Middle Willamette watersheds are high priority for maintaining the current occupancy and abundance of native turtles as this region represents the only areas where the northern extent of the NW Pond Turtle (*Actinemys marmorata*) range and western extent of the Western Painted Turtle (*Chrysemys picta bellii*) range intersect. Both of Oregon's two native freshwater turtle species are listed as "sensitive-critical" by the State of Oregon and one, *A. marmorata*, has been petitioned for listing under the federal Endangered Species Act. To date, information on the distribution of native freshwater turtles in Oregon has been gathered largely opportunistically through varied surveys ranging from ones at sites of high conservation value to those that are the focus habitat modeling to predict occupancy based on key habitat variables. To address this deficiency, repeated basking surveys are being conducted at >300 aquatic sites throughout 7 counties in NW Oregon from 2021 through 2023 to provide that baseline, as well as better understanding of the distribution of the widespread exotic turtle, the Red-eared Slider (*Trachemys scripta elegans*). Preliminary comparison to historical survey data was performed to identify changes in distribution both within and outside major urban areas. A current rate of

occupancy was also developed for NW Oregon. Further study will focus on identifying key habitat variables that allow for sustainably reproducing populations.

Synopsis of Striped Whipsnake (*Coluber taeniatus*) Ecology in Washington State. Lisa Hallock*, *Washington Department of Fish and Wildlife, 1111 Washington Street SE, Olympia, WA 98501; Lisa.Hallock@dfw.wa.gov*

The Striped Whipsnake (*Coluber [Masticophis] taeniatus*) reaches the northern extent of its geographic range in Washington and is the rarest snake in the state. NatureServe state conservation status is critically imperiled (S1). All documented observations in Washington, since the first report in 1941 to the present time, cluster into 17 locations in the central Columbia Basin. Concern about the status of this species was triggered when no observations were made during large-scale herpetological inventories in Washington during the 1990s and very few observations had been submitted to the Washington Department of Fish and Wildlife. Subsequent surveys of previously documented sites revealed the species exclusively in the Vantage area (Grant County). Moreover, no Washington observations for this species have been reported to iNaturalist. Threats include, but are not limited to, habitat loss, degradation of habitat quality (e.g., cheatgrass, fire), and vehicular traffic. This presentation will provide a synopsis of what is known about this species in Washington with a focus on life history information collected while studying this population since 2004.

Survival, Recruitment, Population Growth (λ) and Abundance in Great Basin Rattlesnakes (*Crotalus lutosus*). Bryan T Hamilton*, *Great Basin National Park, Baker, Nevada 89311*; *bryan_hamilton@nps.gov*

Rattlesnakes are ecologically and culturally valuable and managers are implementing strategies to recover and maintain populations. Vital rates such as survival are important to describe population trends, quantify the effectiveness of management strategies, and assess population viability. We quantified survival in Great Basin Rattlesnakes (*Crotalus lutosus*; GBR) at seven sites over two decades using capture mark recapture (CMR) models and information theoretic methods to examine four questions: (1) What is the trend in survival over time? (2) Does survival vary with time, location, age or sex? (3) What are the average and maximum ages? (4) Do rattlesnakes respond negatively to capture and avoid recapture? We captured 742 GBR, 1,498 times (292 females and 440 males). Mean annual survival was ~80%. Maximum age was 20 years. Survival varied with age class with adult and subadult snakes surviving at similar rates (0.75) and young of year snakes surviving at the lowest rates (0.35). Survival did not vary with sex or site. Temporal variation in survival was supported but there was no linear trend. Incorporating vital rates such as survival into an adaptive management framework would allow assessment of management effects on rattlesnake population growth, the extent and magnitude of population declines, success or failure of translocations, and the influence of rattlesnakes on ecological services, such as rodent control, disease spread, and seed dispersal. Other demographic rates, such as recruitment and population growth, may be more sensitive than survival to resource availability and could provide valuable additional information for rattlesnake management.

Long-term Growth Rate and Survival of Green Recruitment Trees in a Managed Forest in Southwest Washington. Leif Hansen*, *Port Blakely, 8133 River Drive Southeast, Tumwater, WA 98501; lhansen@portblakely.com;* Claudine Reynolds, *Port Blakely; creynolds@portblakely.com*

Long-term conservation plans in managed forests predict future habitat conditions for target species based on assumptions about how the landscape will evolve with plan implementation. One objective of Port Blakely's Brooklyn HCP in southwest Washington is to develop large snags where they would not otherwise occur for cavity-dependent species in the 30-year period following even-aged harvest. The green retention tree (GRT) prescription for even-aged harvest operations was based on assumptions about annual tree diameter growth and rates of survival 30 years after even-aged harvest. We established an effectiveness monitoring program to test assumptions about GRT growth and survival. Between 1996 and 2015, we selected a representative sample of GRTs (n = 1,975) following even-aged harvest. For each sample tree we recorded species, initial diameter at breast height (DBH), and location (riparian versus upland, clumped versus scattered). At 5-year intervals (2000-2020), we re-measured DBH of sample trees and assessed overall condition. Twenty-three years of data show that annual DBH growth rates vary by species, and DBH of conifer GRTs grows at an average rate of 0.40 inches per year (SD = 0.23). GRT location appears to be a strong predictor of survival; survival is highest in upland clumps (≥73% of GRTs still alive) and lowest among scattered upland trees (≥40% of GRTs still alive). Because key assumptions are being met, the GRT retention strategy appears to be meeting the objective of developing large snags for cavity-dependent species. Future monitoring will continue to gauge the effectiveness of the GRT retention strategy.

Removing Non-native Mountain Goats from the Olympic Peninsula. Patti Happe*, *Olympic National Park, 600 E Park Ave., Port Angeles, Washington 98362; patti_happe@nps.gov;* William Moore, *Washington Department of Fish and Wildlife, 1130 W. University Way Ellensburg WA 98926; william.moore@dfw.wa.gov;* Susan Piper, *Umatilla National Forest, 71 W Main St. Pomeroy, WA 99347; susan.piper@usda.gov*; Bryan Murphie, *Washington Department of Fish and Wildlife, 375 Hudson St, Port Townsend, WA 98368; bryan.murphie@dfw.wa.gov;* Richard B. Harris[a,] *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501.*

In 2018, the National Park Service in cooperation with Washington Department of Fish and Wildlife and the U.S. Forest Service, initiated a project to remove all mountain goats (*Oreamnos americanus*) from Olympic National Park and contiguous habitat in Olympic National Forest (where they are not native). The initial phase of the two-part plan was capture and translocation followed by lethal removal, conducted primarily during 2 two-week periods of aerial operations during the summer months for up to 5 years. Our objectives for the initial phase were to remove 90% of the goat population, with approximately 50% removed during the capture and translocation operation. From September 2018 through August 2020, we conducted 4 capture sessions. During those operations, we removed 381 of the estimated 725 goats from the Olympic Peninsula, of which 325 were translocated selected locations with the Cascade Mountain range in Washington State, and 16 kids were distributed to zoos. Capture operations

halted at the end of the 4th session when goats became increasingly hard to catch and capture mortality exceeded 10%. Highly skilled ground-based volunteers began lethal removal in fall 2020. We subsequently conducted 2 two-week long aerial removal operations in both 2021 and 2022. Lethal removal brought the total number of goats removed to 548. The partners will now move into the next, less intensive, maintenance phase. Lessons learned from the capture, ground removal, and aerial removal phases, and the future of goat management in the Olympics will be discussed.

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Survival Patterns of Washington Mountain Goats, 2002-2022. Richard B. Harris[*a] *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501;* Patti Happe, *Olympic National Park, 600 E Park Ave., Port Angeles, Washington 98362; patti_happe@nps.gov;* William Moore, *Washington Department of Fish and Wildlife, 1130 W. University Way Ellensburg WA 98926;* Cliff Rice[b], *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501;* Jennifer Sevigny, *Stillaguamish Tribe of Indians, 22712 6th Ave NE, Arlington, WA 98223;* David Vales, *Muckleshoot Indian Tribe, 39015 172nd Ave SE, Auburn, WA 98092;* Emily Wirtz[c], *Sauk-Suiattle Tribe, 5318 Chief Brown Lane, Darrington, WA 98241*

Following declines in the late 20th century, Mountain Goat (*Oreamnos americanus*) populations in Washington stabilized, and modest hunting offtake was permitted in selected areas. However, slow recovery elsewhere in the Cascades prompted a multi-agency restoration effort by translocating (non-native) goats from the Olympic Peninsula. Radio-tagged adults displayed low initial survival, as expected given their need to adapt to novel environments. However, contrary to expectation, survival increased only modestly during the 3–4 years post-release, failing to achieve levels associated with population stability. Concurrent with the translocations, most native goat populations in Washington experienced substantial declines, including populations lacking translocated animals, suggesting that translocated goats may have encountered particularly challenging environments. To provide insight into survivorship of translocated goats (n = 216), we made use of an additional 107 resident goats monitored during 2002–2022 in a comprehensive assessment of the effects of age-class, gender, study area, translocation status, and selected weather variables hypothesized to affect goat behavior and demography. We aggregated survival data monthly, and entered encounter histories together with covariates into program MARK (n = 608 'goat-years'). Models best explaining survival included 3 age-categories, season, and the expected effects of translocation (gender explained little variation). However, a model that defined early (before 2011) and late (2011 on) periods regardless of translocation status had better support than one that categorized animals only as translocated or resident, suggesting that survival declined generally during the period. We present analyses of temperature, snow depths, and drought effects (i.e., climate change) on goat survival.

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Estimating Body Length from Tail Length Data in Gophersnakes (*Pituophis catenifer*). Marc P. Hayes*, *Aquatic & Herpetological Consultants, 1574 Brentwood Drive, Eagle Point, OR 97524; aardvarkdiners33@gmail.com;* Paul R. Yarnold, *Optimal Data Analysis LLC, 6348 N. Milwaukee Ave, Unit 163, Chicago, IL 60646; paul@planetyarnold.com*

Snout-vent length (SVL) is arguably the most basic parameter for body size in snakes, and one around which snake stories, like their fish counterparts, have flourished. Emergence of crowd-sourced data in which measurement of body size is becoming part of some routines has

led to a need for alternate ways to obtain SVLs in snakes, particularly for road kills where body damage frequently prevents obtaining SVL directly. We explore one method that uses tail length (TL) to obtain SVL data from predictive regressions. This method requires three assumptions: 1) tails must be complete; 2) the relationship between TL and SVL should be predictable (r^2 >0.95) and preferably linear; and 3) females differ from males in TL in most snakes, so predictive regressions must be gender-specific. We chose to first examine this relationship in Gophersnakes (*Pituophis catenifer*) because of their seemingly high relative abundance and behavior that makes them highly vulnerable to road mortality. We used Gophersnake data from their Pacific slope distribution in Pacific Coast states extracted from Stull (1940). Culling individuals with partial tails, we found SVL regressed on TL gave highly predictable linear relationships for both female (r^2 = 0.97) and male (r^2 = 0.98) Gophersnakes. We also evaluated whether Gophersnakes SVL could be predicted beyond the limits for which our regressions had data by partitioning the length of the TL axis for which data exist into equal-length segments and examining the among-segment variability. We will discuss the limitations of this method.

Bears and Boots: Bettering the Relationship between Wildlife and Recreation.
Kurt Hellmann*, *Conservation Northwest 1829 10th Avenue West Suite B, Seattle, WA 98119; kurt@conservationnw.org;* Carmen Vanbianchi, Anna Machowicz, Becca Windell, *Home Range Wildlife Research, PO Box 1345, Winthrop, WA 98862; info@homerange.org*

Outdoor recreation opportunities and participation have exploded in recent decades and the effects of recreation on wildlife behavior, fitness, and species populations is a growing conservation concern. Washington contains a myriad of unique ecoregions, diverse wildlife communities, and remarkable opportunities for recreation, highlighting the importance of a holistic understanding of the connections between wildlife and recreation. Conservation Northwest and Home Range Wildlife Research produced a report titled *Recreation and Wildlife in Washington: Considerations for Conservation* to provide a species-specific synthesis of recreation impacts for animals in Washington. The scope of this report is focused on the effects of year-round, land-based motorized and non-motorized recreational activities on certain terrestrial mammal and bird species. The report finds that recreation can impact wildlife in multiple ways depending on the interaction of numerous variables, including wildlife species, habitat type, and recreational activity. The report also collates Washington-specific knowledge gaps to aid conservation practitioners in identifying and protecting habitat that supports robust wildlife populations, while still accommodating outdoor recreation activities. The findings identify key areas where conservation practitioners in Washington can focus management and policy efforts. These include knowing the extent of wildlife-recreation overlap, measuring the thresholds at which varying levels of recreation intensity affect wildlife populations, protecting critical spatial and temporal refugia from recreation, and implementing management actions to mitigate recreation impacts.

AI for Gray Whales: Innovations in Support of Monitoring the Pacific Coast Feeding Group.
Jason Holmberg*, *Wild Me, 1726 N Terry Street, Portland, OR 97217; jason@wildme.org*

Wild Me (wildme.org) trained multiple machine learning and computer vision algorithms to find and individually identify gray whales (*Eschrichtius robustus*) in photos collected during third party mark-recapture studies of the species along the coast of the Pacific Northwest. Gray whales are considered a more difficult challenge in photo-identification due to variable and often incomplete presentation of their flanks as they surface as well as inter-annual changes in visual markings (e.g., new scarring). Wild Me engineers succeeded in creating a new machine learning ensemble algorithm using two individual matching algorithms (PIE v2 and HotSpotter). We achieved top-1 individual ID accuracy of 92%, and we successfully deployed the matching system in the multi-user Flukebook.org platform for collaborative individual ID of migratory gray whales across their ranges. The system is now in use by multiple organizations to match individuals across catalogs and borders with a focus on reconciling individuals between Mexico and the Pacific Northwest.

Effects of Vessels and Noise on Foraging Effort and Prey Capture by Southern Resident Killer Whales. Marla M. Holt*, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Blvd East, Seattle, WA, USA*; marla.holt@noaa.gov; Jennifer B. Tennessen, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Blvd East, Seattle, WA, USA under contract at Lynker, Inc., Leesburg, VA, USA;* jtenness@uw.edu; M. Bradley Hanson, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Blvd East, Seattle, WA, USA*; brad.hanson@noaa.gov; Candice K. Emmons, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Blvd East, Seattle, WA, USA;* candice.emmons@noaa.gov; Deborah A. Giles, *Department of Wildlife, Fish, & Conservation Biology, University of California, One Shields Avenue, Davis, CA, USA and University of Washington, Friday Harbor Laboratories, 620 University Road, Friday Harbor, WA, USA*; giles7@uw.edu; Jeffrey T. Hogan, *Cascadia Research Collective, 218½ 4th Avenue West, Olympia, WA, USA*; jeff@killerwhaletales.org; Eric J. Ward, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Blvd East, Seattle, WA, USA*; eric.ward@noaa.gov; Michael J. Ford, *Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Blvd East, Seattle, WA, USA*; mike.ford@noaa.gov

Vessels constitute a threat to many marine mammals. Vessels can strike individuals, introduce pollutants, disrupt behavior, and generate noise. Moreover, marine mammals face other threats such as altered prey fields due to anthropogenic factors. Yet, there is uncertainty regarding what aspects of these threats create the greatest risks given difficulties of studying marine mammal behavior. Here, we use high-resolution animal-borne Dtags to study the behavior of endangered Southern Resident Killer Whales (SRKW, *Orcinus orca*) and investigate how proximate vessels affect foraging behavior and outcomes. We used tag data to identify subsurface behavior, including foraging and prey capture events, and test several predictor

variables related to SRKW vessel/noise and prey risk factors on (1) behavioral state occurrence, (2) time spent within each state, (3) transition probabilities among states, (4) the probability of prey capture, and (5) multiple parameters of prey capture dives. Whales significantly spent less time in prey capture dives, with females more likely to transition to a non-foraging state, when vessels were closer (average distance < 400 yd/366 m). Additionally, lower abundance of preferred prey and higher vessel speed reduced the probability of prey capture, empirically confirming the interplay between prey and disturbance threats. Finally, whales dove to depth more slowly while increasing the duration of their prey capture dives when vessel emitted navigational sonar but dove more quickly with higher broadband noise and closer vessels. Findings advance awareness of the negative consequences of vessels, demonstrate an effect of echosounders on foraging behavior, and inform management of endangered species.

Mitigating the Risks of Climate Change on Timberlands: Perspectives of a Large Private Landowner. Jessica A. Homyack*, *Weyerhaeuser, Strategy and Technology, 505 North Pearl Street, Centralia, Washington 98531; jessica.homyack@weyerhaeuser.com*

Several interacting factors motivate private forestland landowners to respond proactively to growing risks of climate change. Climate change presents risks and opportunities to financial performance for timberland owners from changes to tree growth and survival, frequency of extreme events, and potential damage to infrastructure, among others. Investors, the public, and sustainability certification systems expect that forest landowners conduct efforts to identify, rank, and mitigate risks of climate change. Weyerhaeuser, one of the largest private landowners in the United States, has fully integrated climate change into its sustainability goals and systems, including our carbon-accounting efforts and emission reduction goals. Embedded in these climate science goals are indirect effects on fish and wildlife habitat. Here, I share Weyerhaeuser's broadscale approach to managing climate change, emphasizing risks and opportunities for fish and wildlife populations and their habitats in the Pacific Northwest.

Rapid Post-hatching Growth in the Common Sharp-tailed Snake (*Contia tenuis*). Richard F. Hoyer*, *2121 NW Mulkey Ave., Corvallis, OR 97330; charinabottae@earthlink.net*; Dustin R. M. Campbell, *Department of Integrative Biology, Oregon State University, Corvallis, OR, 97331; campbdus@oregonstate.edu*

A 4+ year (1997-2002) field and laboratory-supported study of the Common Sharp-tailed Snake, *Contia tenuis*, in Oregon revealed the following results: 1) At hatching, males and females are similar in length; 2) Juvenile and subadult males and females grow at similar rates; 3) Males reach adult status sooner, and at shorter lengths than females; 4) Sex can be determined for all size/age classes by differences in relative tail lengths; and 5) Both males and females are capable of attaining adult status within 12-14 months post-hatching. Follow-up field work during 2020-2022 produced supporting evidence that *C. tenuis* has the capacity to grow very rapidly and some individuals can attain adult size during their first year of life.

Amphibian Facilitation by Beavers: A Review and Next Steps to Address Knowledge Gaps. Julianna Hoza*, *julianna.hoza@wsu.edu*; Jesse Burgher, *jesse.burgher@wsu.edu*; Rohn

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Beavers (*Castor spp.*) alter ecosystems dramatically through their dam building, tree cutting, canal digging, and sediment moving, and these alterations can create critical habitat for amphibians. Amphibians are in global decline due to climate change, pollution, introduced pathogens, and habitat loss and fragmentation. One way to mitigate habitat loss is beaver-related restoration, including beaver reintroductions. Beaver-related restoration is gaining traction in both North America and Europe to reverse historic beaver declines and restore aquatic habitats for a variety of species, including amphibians. However, relatively few studies have considered the relationship between beaver ecosystem-engineering and amphibians. We reviewed all available literature that considers how beavers may impact amphibians to better understand how beaver recovery and beaver-related restoration may impact amphibian populations. We found that life history strategies play a large role in determining which species benefit most from beaver-created habitat. The reasons why amphibians benefit remain poorly understood, with emerging evidence that beavers create climate refugia, increase watershed-scale habitat heterogeneity and landscape connectivity, and alter site-specific characteristics such as light availability and hydroperiod. Further research should evaluate the causal mechanisms behind beaver facilitation of amphibians; this information could inform land management actions for amphibian conservation, with a particular focus on increasing climate change resiliency of critical amphibian habitat.

Dark, Cold, and Hungry: Gene Expression during Prolonged Winter Dormancy in Garter Snakes. David L. Hubert*, Ehren J. Bentz, and Robert T. Mason, *Department of Integrative Biology, 2180A7 Coast Range Building, Oregon State University, Corvallis, OR 97331; hubertd@oregonstate.edu*

Long-term seasonal dormancy, such as hibernation, is a widely experienced phenomenon for temperate vertebrates in response to extreme temperature and low resource availability. During hibernation, organisms must carefully regulate energy and metabolic processes to maintain homeostasis until conditions become more favorable. While lipids stored in adipose tissue provide a source for a long-lasting, high-density energy substrate that is gradually used during dormancy by most hibernating organisms, some animals have been shown to maintain primary lipid reserves during winter dormancy. These animals are thought to rely on stored glycogen, and the breakdown of proteins stored in muscle instead of stored lipids. To better understand this alternate long-term winter dormancy survival strategy, we explored energy utilization and metabolic processes during the exceptionally long hibernation (7 months) of the Red-sided Gartersnake (*Thamnophis sirtalis parietalis*). We collected liver and testis tissues from artificially hibernated male garter snakes at five time points throughout hibernation (n = 8 each time point). Time series transcriptional analysis was conducted for each tissue, creating a transcriptional profile spanning hibernation. These transcriptional profiles provided a clear set of patterns representing both a response to extremely cold temperatures and prolonged starvation. In this presentation, we reveal transcriptional evidence for a thermally induced energy substrate

switch, providing insights into the unusual energy use reported in some species during long-term hibernation.

From Herps to Humans: How Outreach and Human Dimensions Can Help Shape the Future of Snake Conservation. Lameace Hussain*, *Department of Wildlife, Ecology, and Conservation, University of Florida, Gainesville, FL 32603; lhussain1@ufl.edu*

As the field of snake biology grows, raising new conservation concerns, the importance of public interest becomes increasingly critical. An often overlooked question is whether lack of public awareness or interest in snake conservation comes from their historical—frequently fictional depictions, misunderstandings of what herpetologists do, a lack of gender and racial-ethnic diversity among scientists in the field, barriers to scientific and management information, and/or barriers preventing access to outdoor spaces. Science communication can be a powerful way to engage the public, especially to change perceptions of snakes, which are often vilified. Additionally, many racial and ethnic minority communities, women and other gender non-conforming communities, as well as lower-income communities have been and remain excluded from science communication, which limits diverse perspectives and potential interest in the field. Therefore, cultural competency, representation, and an understanding of diverse human experiences are all important factors when designing science communication programs, particularly for snakes. This talk will highlight some ways the science community that studies snakes can reach diverse audiences and how to change the perception of "what a herpetologist looks like" for future generations.

Geospatial Data and Tools to Support Thoughtful Decision Making in the Shrubsteppe. Vincent Jansen*, *Washington Department of Fish and Wildlife, 1111 Washington St SE, Olympia, WA 98501-1091*; *vincent.jansen@dfw.wa.gov*

Recent advances in geospatial technology (e.g., satellites) and computer science have produced a variety of datasets and online tools which provide near-real time climate and vegetation data for science and decision support. In this talk, I will cover a variety of climate and vegetation related web-based tools that maybe helpful to land managers as well as scientists who are interested shrubsteppe vegetation and species conservation. I will also discuss some lessons learned in creating geospatial tools, and ideas on how to apply satellite-based climate and vegetation information in tandem with field data for thoughtful decision making.

Cruising the Road to Conservation: The Citizen Science that Drives our Understanding of Snake Ecology. Jason L. Jones*, *Nevada Department of Wildlife, 3373 Pepper Lane, Las Vegas, NV 89120; jljones@ndow.org*; Bob W. McKeever, *Nevada Department of Wildlife, Las Vegas, NV 89120; rwmckeever@earthlink.net;* Stephen E. Stocking, *Nevada Department of Wildlife, Las Vegas, NV 89120; steve.stocking@colostate.edu*

Road cruising has long been employed as a means of surveying for nocturnal snakes and other herpetofauna in the arid/semi-arid regions of the United States. Though many biases and assumptions are associated with road cruising, past studies have revealed that it can provide a

reliable means of evaluating species occurrence, community structure, and possibly abundance across time. For rare and secretive species, road cruising data can dramatically refine species distribution models. Studies evaluating snake community trends are necessary for understanding the response of ectothermic communities to current and future changes in climate and habitat. Although long-term monitoring is rare and often cost prohibitive, citizen science provides a novel opportunity to re-evaluate these efforts, particularly since study designs, sampling methodologies, and equipment remains consistent and cost effective. In this study, we explore reptile species occurrence and community composition using citizen scientists. We explore the contributions of citizen scientists and the potential management implications of these contributions. We selected eight roads across the Mojave Desert of southern Nevada and surveyed these roads for over five years, with over 1,500 surveys occurring from April to October. We salvaged and accessioned over 1,000 specimens (whole body and tissue) into accredited museums. We used species occurrence data to inform species distribution models and plan to use these models to inform future surveys efforts. We also re-evaluated historical (pre-2000) road transects and documented community composition changes across twenty years. These results reinforce the idea that citizen scientists can make meaningful contributions to desert reptile ecology and inform management decisions at both the landscape and species levels.

Habitat Connectivity in Action: Updates, Success Stories, and Lessons Learned from the Interstate 90 Snoqualmie Pass East Wildlife Crossing Project. Glen Kalisz*, *Washington State Department of Transportation, 310 Maple Park SE, Olympia, WA 98504; KalisGL@wsdot.wa.gov*

The Interstate 90 (I-90) Snoqualmie Pass East Project will improve a 15-mile stretch of I-90 in the Central Cascades, addressing safety and capacity needs, as well as reconnecting habitats bisected by the interstate. As of winter 2022, the Washington State Department of Transportation has completed the first half of the project, including 11 large wildlife crossing structures, approximately five miles of wildlife exclusion fencing, and 30 acres of restored habitat. Intensive monitoring at completed structures and pre-construction sites is documenting wildlife use, which will be used to measure success and inform future construction. A combination of live thermal video cameras able to detect wildlife from a quarter mile away, high-definition color video cameras, and remotely triggered trail cameras continuously evaluate the efficacy of Snoqualmie Pass East wildlife infrastructure. Academic researchers and students conduct systematic surveys to detect animals often missed by cameras, such as small mammals, amphibians, reptiles, fish, and bats. The end of 2022 marked the 20,000th successful wildlife crossing documented via cameras at completed structures in the project area. Across all monitored years, observations included Elk, Black Bear, Cougar, and Coyote, among other common species, as well as rare ones like Marten, Fisher, and Moose. Furthermore, small mammal surveys revealed Pika and Flying Squirrel use, snorkel surveys documented Pacific Giant Salamanders and threatened Bull Trout crossing beneath new bridges, and radio-tagged western toads ventured across the overpass. This presentation will describe the people and technology that have made this project possible, while sharing lessons learned and success stories.

Highways and Habitat Connectivity: How are Habitat Connectivity Priorities Determined by the Washington State Department of Transportation and Where Are They? Glen Kalisz*, *Washington State Department of Transportation, 310 Maple Park SE, Olympia, WA 98504; KalisGL@wsdot.wa.gov*

Washington's highways that provide for the movement of people across the state also impact terrestrial and aquatic habitats. Highways can reduce and degrade natural habitat, create wildlife movement barriers, and cause wildlife mortality via vehicle collisions. Recognizing the impacts of roads on wildlife, the Washington State Department of Transportation (WSDOT) enacted Executive Order 1031, which says, in part, that the WSDOT, "in partnership with other agencies, organizations, and the public, will assure that road and highway programs recognize, together with other needs, the importance of protecting ecosystem health, the viability of aquatic and terrestrial wildlife species, and the preservation of biodiversity." This led to the creation of the Washington Wildlife Habitat Connectivity Working Group whose role helped develop a framework for prioritizing the state highway system for habitat connectivity investments. This effort was produced at the local scale, identifying priority areas along state-managed roads using one-mile-long segments. These are useful in their own regard, but the need to identify longer, contiguous lengths of highway that represent habitat connectivity priority zones became apparent. A high-level overview of the collaborative development of habitat connectivity priority zones will be discussed, focusing on three of the top 12 draft areas identified: two along Interstate 5 that create a substantial barrier to animal movement, and one along US 97 in a top deer-vehicle collision area. The current state of connectivity will be discussed for each location, as well as ideal next steps required to ultimately provide landscape connectivity and significantly decrease wildlife-vehicle collisions.

A Preliminary Analysis of the Influence of Outdoor Recreation on Freshwater Turtles in an Urban-Proximate Park. Joshua R. Kesling, *Oregon State University, 320 Richardson Hall, Corvallis, OR 97330; keslingj@oregonstate.edu;* Gareth R. Hopkins, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR 97361; hopkinsg@wou.edu;* Ashley L. D'Antonio*, *Oregon State University, 320 Richardson Hall, Corvallis, OR 97330; Ashley.D'Antonio@oregonstate.edu*

Few studies have examined the potential disturbance of outdoor recreational activities on freshwater turtles. Disturbance from outdoor recreation can be especially acute in heavily visited, urban-proximate parks and protected areas. We conducted observational surveys on the level, activity, type, and behavior of visitors to popular trails and ponds across five different sites in Minto-Brown Island Park in Salem, Oregon, as well as the noise (dB) level at each site. Simultaneously, we recorded turtle presence and behavioral responses to visitors for Red-eared Sliders (*Trachemys scripta elegans*), Northwestern Pond Turtles (*Actinemys marmorata*), and Western Painted Turtles (*Chrysemys picta bellii)*. We observed 120 unique turtles, the majority of which were Red-eared Sliders, and over 2,000 visitors (mostly walkers) proximate to ponds in Minto-Brown Island Park. Noise levels, number of visitors, and number of turtles varied by site. For most sites, there was a negative relationship between the number of turtles seen and the number of visitors and noise levels observed. In response to the presence of a person, turtles

usually immediately stopped basking and entered the water, vs. more subtle shifts in behavior (e.g., shifting positions). Our results suggest that Red-eared Sliders responded less frequently to the presence of recreationists, as compared to native species, which almost always responded to the presence of people by stopping basking. Findings from this work can be used to inform management approaches parks could implement to reduce visitor disturbance to native turtle species.

Twenty-six Years and Counting: The Ecology of the Northwestern Pond Turtle on the Mad River, Humboldt County, CA. Matt R. Kluber*and David W. Lamphear, *Green Diamond Resource Company, PO Box 68, Korbel, CA 95550; matt.kluber@greendiamond.com; dlamphear@greendiamond.com;* Trent McDonald, *McDonald Data Sciences, LLC, 1529 Rainbow Avenue, Laramie, WY 82070; trent@mcdonalddatasciences.com*

Since 1993 Green Diamond Resource Company (GDRCo) has documented Northwestern Pond Turtles (*Actinemys marmorata*; NWPT) on its California timberlands. Distribution is limited to relatively large perennial ponds with low canopy cover and mainstem channels of large rivers and adjacent upland habitats. In 1994, NWPTs were detected in the Mad River during snorkel surveys for Summer Steelhead (*Oncorhynchus mykiss*). This survey revealed the occurrence of significant numbers of NWPTs in the Mad River, providing justification for a more detailed study of population demographics. Since 1997, GDRCo biologists have been conducting annual capture-mark-recapture surveys for NWPTs on a 5.2 km reach of the Mad River in an effort to estimate the population size, track trends over time and describe the spatial ecology of the monitored population. This project has resulted in a twenty-six-year dataset in which 405 individual turtles have been marked. A total of 897 captures (initial captures and recaptures) have been recorded with 55% (221 turtles) of marked turtles being recaptured at least once. This study has also documented evidence of consistent recruitment within this population, as juvenile turtles have routinely been captured since the initiation of this study. To exploit the information inherent in the spatial configuration of individual detections and account for individuals moving in and out of our study reach, we used spatial capture-recapture methodology. Examination of our data indicates high survival rates, persistence of relatively long-lived individuals and consistent recruitment, suggesting that this a healthy, stable population.

Annual Survival of Adult White-headed Woodpeckers in Ponderosa Pine Forest with a History of Forest Management. Jeffrey M. Kozma*, *Yakama Nation Fisheries/Timber, Fish, and Wildlife, P.O. Box 151, Toppenish, WA 98948; kozj@yakamafish-nsn.gov;* Andrew J. Kroll, *Weyerhaeuser, Springfield, OR 97478; AJ.Kroll@weyerhaeuser.com;* Kevin S. Lucas, *Yakima, WA 98908.*

Vital rates for many North American birds, including woodpeckers (Picidae), are not well-documented. We estimated adult annual survival of the White-headed Woodpecker (*Dryobates albolarvatus*) across a 10-year period (2011-2021) in managed ponderosa pine (*Pinus ponderosa*) forests of the eastern Cascade Range, WA. We banded woodpeckers with unique color band combinations and re-sighted birds on breeding territories from March-July in

each year. We banded 118 woodpeckers and aged most birds as hatch-year (n = 49) or second-year (n = 32) when banded. All birds were past the critical dependence period when mortality is highest. We estimated recapture and annual survival probabilities for 33 breeding males and 24 breeding females using open-population Cormack-Jolly-Seber models with two covariates: age at first capture (AGE) and sex (SEX). We combined birds into 3 AGE classes: class one (hatch-year), class two (second-year and after hatch-year), and class three (≥ after second-year). Female recapture probabilities were higher than males, although both were >0.85. AGE class 1 birds had the lowest recapture probabilities (0.73, 90% CI: 0.55, 0.91), but the estimates were imprecise. Survival probabilities were >0.80 for all birds, regardless of which model we evaluated, and did not differ by SEX or AGE. These survival estimates could be inflated because some adults that dispersed from the study area may have lower rates of survival. Our results suggested that, despite managed ponderosa pine stands having trees smaller in diameter and greater in density than historic stands, White-headed Woodpeckers had a high probability of surviving year to year in this forest type.

Characteristics of Snags Used by Woodpeckers in the Western Cascades: Implications for Forest Management. Jeffrey M. Kozma*, *Yakama Nation Fisheries/Timber, Fish, and Wildlife, P.O. Box 151, Toppenish, WA 98948; kozj@yakamafish-nsn.gov;* Teresa J. Lorenz, *U.S. Fish and Wildlife Service, 215 Melody Lane, Wenatchee, WA 98801; teresa_lorenz@fws.gov*

To conserve populations of primary cavity excavators in managed forests of the inland Northwest, managers require information about the nest substrates (e.g., trees and snags) in which woodpeckers excavate cavities. Here we present a summary of findings on snag use from a long-term study of White-headed (*Dryobates albolarvatus*) and Hairy Woodpeckers (*D. villosus*), and Northern Flicker (*Colaptes auratus*) in managed forests dominated by ponderosa pine (*Pinus ponderosa*), Yakima and Kittitas Counties, Washington, 2003–2020. All three species most frequently excavated cavities in snags with broken tops. Flickers excavated cavities in snags with significantly larger diameter at breast height and with softer wood than the other two species. Control snags (random snags without nest cavities) had significantly harder wood and significantly lower levels of cellobiase, an extracellular fungal enzyme that breaks down cellulose in wood, compared to snags used for cavity excavation. Visual cues on snags such as fungal conks, percent top loss, percent blackened bark, and percent bark loss were poor at predicting levels of fungal enzymes and thus, wood hardness. Overall, it has been estimated that only 14% of the snags on the landscape at any one time are suitable (i.e., contain soft enough wood) for cavity excavation by White-headed Woodpeckers. We recommend that higher densities of snags be provided for primary cavity excavators than is currently required by the Washington State Forest Practices rules, because past research likely overestimated the abundance of suitable nest sites while underestimating the number of snags required to sustain woodpecker populations.

Retention and Recruitment of Coarse Woody Debris as Measurable Forest Management Targets. A.J. Kroll*, *Weyerhaeuser, 1581 SW 53rd, Corvallis, OR, 97333; aj.kroll@weyerhaeuser.com*

Maintaining ecological function and resilience is an unresolved contemporary challenge as human populations expand. Most ecosystems face substantial threats although urgency for production ecosystems is acute given direct and indirect stressors, including management intensification and increasing per capita rates of resource consumption. In the Pacific Northwest, USA, extended intervals between stand-replacing disturbances characterized pre-settlement mesic forest ecosystems. During these periods, numerous, long-lived conifer species, several of which exceeded 90 m in height and 3 m in diameter, created compositionally and structurally complex canopies, and led to substantial accumulations of live and dead woody biomass. In these forests, large Douglas-fir (*Pseudotzuga menziesii*) dominated based on abundance and total biomass, as well as individual tree size. Historical activities as well as contemporary anthropogenic and natural disturbance regimes and policy frameworks reorganized distributions of these habitat structures with known, as well as unquantified, ecosystem effects. Here, I discuss the context and constraints around restoring large conifers in the ecological and economic infrastructures of the PNW, USA. Specifically, I evaluate vertebrate and invertebrate responses from three multi-year experimental studies of CWD and green tree retention from Oregon and Washington in the context of forest practices regulations for private forests. To maintain ecosystem functionality and support human communities, I identify research needs to understand how disturbance frequency and intensity, anthropogenic climate instability, and evolving socio-economic regimes will modify spatial and temporal distributions of large Douglas-fir at the landscape scale.

Emerging Health Concerns in Western Pond Turtles. Max R. Lambert*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia WA 98501*; *Max.Lambert@dfw.wa.gov*

In Washington state, respiratory and shell diseases have been a serious cause of Western Pond Turtle declines and have stymied conservation actions. Beyond Washington, however, disease and other physiological health challenges have seldom been a concern for this species. I report on emerging health concerns in Western Pond Turtles, particularly around the San Francisco Bay area in California. Specifically, I detail the recent discovery of the "shell devouring" fungus – *Emydomyces testavorans* – the hypothesized causative agent of the ulcerative shell disease that has constrained conservation efforts in Washington. Further, I present troubling shell conditions that are apparently unrelated to *E. testavorans*. Beyond shell issues, I also detail a case study whereby an otherwise robust, large, and healthy population of turtles experience a mass mortality event due to starvation. This starvation appears to be a consequence of extreme weather events that erode the base of the food chain at this site. As part of this case study, I detail how a coordinated management effort is working to mediate this problem and develop climate-resilient strategies. I also briefly discuss how invasive turtles may impair the body condition of native Western Pond Turtles, potentially by competing for basking sites or food. With continued impacts from human actions and climate change, Western Pond Turtles range wide may experience increasing health consequences that further impair their conservation.

Sea Otters: Population Status Worldwide, an Update on their Recovery and their Long History with People and how they Shaped Pacific Coastal Communities. Shawn Larson*, *Senior Conservation Research Manager, Seattle Aquarium; IUCN OSG deputy Enhydra lutris species coordinator; s.larson@seattleaquarium.org*

The Sea Otter (*Enhydra lutris*) story is one of partial recovery from widespread extirpation from the Maritime Fur Trade (1741-1911), which eliminated 99% of Sea Otters throughout the North Pacific nearshore. In the first half of the 20th century these remnant groups subsequently recovered to pre-harvest levels in many parts of its range. Yet in many areas Sea Otters remained extinct. Management actions in the second half of the 20th century resulted in successful translocations that account for 30% of the otters today. However, many areas remain unoccupied or underoccupied suggesting otters have not fully recovered. What does full Sea Otter recovery look like? Here we explore the long history people have had with Sea Otters dating back 1000s of years, from Indigenous peoples to the maritime fur trade to the present day. The Sea Otter is still recovering in many parts of its range. With its recovery comes more interactions with humans, both positive and negative.

Ripple Effects: Changing Forests and Freshwater Mussel Communities. Andrew J. Lawrence*, *Center for Environmental Management of Military Lands, Colorado State University, Fort Collins, CO 80524; andrew.lawrence@colostate.edu;* Cindy Matuch, *NOAA Center for Coastal and Marine Ecosystems, Applied Environmental Science Department, California State University, Monterey Bay, Seaside, CA 93955; cmatuch@csumb.edu;* Jacquelyn J. Hancock, *U.S. Army Garrison Fort Hunter Liggett, U.S. Army, Fort Hunter Liggett, CA 93928; jacquelyn.j.hancock.civ@army.mil;* Andrew L. Rypel, *Department of Wildlife, Fish & Conservation Biology and Center for Watershed Sciences, University of California, Davis, Davis, CA 95616; rypel@ucdavis.edu;* Laura A. Eliassen, *Center for Environmental Management of Military Lands, Colorado State University, Fort Collins, CO 80524; laura.a.eliassen.ctr@army.mil*

Aquatic ecosystems across the western U.S. are facing increased threats from drought, wildfires, and terrestrial inputs that are being induced by climate change. Freshwater mussels are especially susceptible to the impacts of these largescale disturbances due to their sensitivity to poor water quality and low vagility. To better understand the relationship between forest management and freshwater mussels, we provide an overview of mussel natural history and how forestry activities and changing forests can impact mussel populations. Furthermore, we describe the response of California Floaters (*Anodonta californiensis*) to extreme hydric erosion following a wildfire in California. Our pre-wildfire runoff mussel surveys documented a robust and reproducing mussel population and three species of native fishes. Following wildfire runoff, we did not detect live mussels and observed only two species of small-bodied fishes at our study site. River substrates shifted to predominantly sand and thalweg depth decreased from 1.77 m to only 0.2 m. The potential for forest management and climate-driven changes to forests to shape aquatic communities should be more broadly evaluated. Wildfires and precipitation whiplash events in particular appear to be major future and additional challenges to freshwater mussels and ecosystems worldwide.

Conserving the Shrub Steppe Through Public-Private Partnerships. Ryan Lefler*, *Foster Creek Conservation District, 203 S. Rainier (3rd floor, Douglas County Courthouse), P.O. Box 398, Waterville, WA 98858-0398*; *RLefler@FosterCreekCD.org*

The Waterville Plateau is well known as a bastion of intact shrub steppe habitat. It is home to the largest population of greater sage grouse left in Washington and the only remaining population of Columbia Basin pygmy rabbits, along with a host of other iconic species. However, historic farming practices, overgrazing, and changing land use have long put this important ecological landscape in a state of gradual decline. Foster Creek Conservation District (FCCD) works with numerous public and private partners to create positive change in ecological conditions on the Waterville Plateau. Join Restoration Program Manager Ryan Lefler to learn about the efforts in which FCCD is engaged to promote regenerative agriculture, stream restoration, invasive species management, and wildlife friendly ranching practices on private land in this unique part of North Central Washington.

50 Years of Recaptures: Growth and Longevity in the Northern Rubber Boa (*Charina bottae*) from Long-term Recapture Datasets. Mark V. Leppin*, *Department of Integrative Biology, Oregon State University, Corvallis, OR 97331; leppinm@oregonstate.edu*; Richard F. Hoyer, *2121 NW Mulkey Avenue, Corvallis, OR 97330*; *charinabottae@earthlink.net*; Deanna H. Olson, *U.S.D.A. Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331; Deanna.Olson@usda.gov*; Robert T. Mason, *Department of Integrative Biology, Oregon State University, Corvallis, OR 97331; masonr@oregonstate.edu*

Published long-term recapture research (LTRR) of the boa superfamily (Booidea) are among the rarest for snakes. The LTRR can provide fundamental information for ecology and evolution of long-lived species such as growth rates, longevity, and reproduction. This LTRR is of a difficult to study species, the Northern Rubber Boa (*C. bottae*), and is one of a few that exceeds 30 years in any snake taxa. We explored growth rates and longevity estimates of several long-term recapture datasets from three different ecoregions in Oregon: the Willamette Valley, the Cascades, and the Northern Basin & Range. We found that growth was relatively slow and may take about 7 or more years to reach maturity for females. We also found that several females were estimated to be over 30 years old. Although we will primarily focus on females, males will be compared where possible.

The Effects of Trail-based Outdoor Recreation on Squamates in an Urban Proximate Park.
Blake H. Looney, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR 97361; saxonlooney@gmail.com;* Gareth R. Hopkins*, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR 97361; hopkinsg@wou.edu;* Ashley L. D'Antonio*, *Oregon State University, 320 Richardson Hall, Corvallis, OR 97330; Ashley.D'Antonio@oregonstate.edu*

The field of recreation ecology aims to understand and mitigate the ecological disturbances caused by outdoor recreation. Urban-proximate parks are often popular destinations for recreationists but can also provide important habitat for wildlife. While the number of recreation ecology studies focused on wildlife disturbance has increased rapidly in recent years, examination of recreation impacts on squamates is rare. Bald Hill Natural Area is an urban-proximate park near Corvallis, Oregon, USA that provides diverse outdoor recreation opportunities, including a multi-use (biking, walking, dog-walking), 2.0 km paved pathway. Numerous species of squamates are also found within this natural area, and the paved pathway provides opportunities for efficient thermoregulation. Ball Hill's pathway provides a test case to examine the potential cost-benefit tradeoffs of pavement use by snakes and lizards and the impacts of recreation on these animals. We conducted observational counts of human use by activity type and use of the path by 4 species of snakes and 2 species of lizards across 40 walking surveys during the summer of 2019. We also measured 4 environmental variables along the path to model which factors (human or environmental) best predicted squamate presence. We encountered squamates infrequently along the path (mean <1/survey). However, we did find a significantly lower probability of observing animals in sections of the path popular for walking. Our study provides an important first step in understanding the impacts of recreation on squamates, but also highlights the significant challenges inherent in conducting recreation ecology studies on these cryptic animals.

Wheat or Wild? Mule Deer Habitat Selection and Migration in an Agricultural Landscape in Southeastern Washington.
Rebekah A. Lumkes Hellesto, *Washington State University, 1226 Webster Hall, Pullman WA 99164-2318; Rebekah.lumkes@wsu.edu;* Lisa A. Shipley*, *Washington State University, 1226 Webster Hall, Pullman WA 99164-2318;shipley@wsu.edu*

Although usually found in more rugged landscapes, Mule Deer (*Odocoileus hemionus*) also reside in southeastern Washington, which is dominated by row-crop cereal agriculture intermixed with patches of native rangelands and croplands restored through the federal Conservation Reserve Program (CRP). Our objectives were to determine how agriculture and CRP influence movements and seasonal habitat selection of female Mule Deer in the Palouse Ecoregion. We acquired GPS locations from 59 adult females at 4-hour intervals from 2018-2022. We used Migration Mapper software to detect migration and created Resource Selection Function models. Thirty percent of deer migrated each year for an average of 30 km. Residents and migrants had the same annual survival rate of 84%. When selecting home ranges within the study area in both seasons, grasslands followed by shrublands (both native and CRP) were the highest ranked habitats, and cereal agriculture and fallow were low to moderate. Within their home ranges, shrublands followed by grasslands (including CRP) were the highest ranked habitats and cereal agriculture and fallow the lowest ranked in summer. In winter, grasslands and

agriculture were ranked highest. Mule Deer used different components of the landscape mosaics seasonally, selecting vertical provided by shrubs and trees during fawn rearing and areas with young wheat and broad-leaved forbs on croplands and grasslands for winter food. Because CRP was a consistently a highly ranked habitat for Mule Deer, our work demonstrates the importance of CRP program for deer in agricultural landscapes.

Evaluating Genetic, Telemetry and Camera-Based Methods for Counting Cougars.
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The Lower Elwha Klallam Tribe (LEKT) sets wildlife harvest regulations each year that differ from those of Washington State. Until now, predator densities had not been estimated in the tribe's traditional use areas on the Olympic Peninsula, so we lacked information needed to set sustainable harvest regulations and address long-term conservation concerns. To address this data gap, we used a combination of noninvasive genetic sampling, GPS collars, and motion-sensing trail cameras to estimate cougar (*Puma concolor*) and bobcat (*Lynx rufus*) densities in the tribe's historic use areas. First, we used detection dogs to locate and collect felid scat samples across our 606 km^2 study area. We genotyped scat samples to estimate densities using spatial capture-recapture and genotype spatial partial identity models. Of the 665 scat samples collected during 2018-2020, we identified 168 cougar scats and 424 bobcat scats. We identified a minimum count of 27 individual cougars using 11 microsatellite loci. Genetic individual identification of bobcat samples is ongoing. Second, we equipped 14 cougars and 6 bobcats with GPS collars between 2018-2022 to estimate minimum counts using home range overlap estimation. Third, we deployed a 74-camera grid each summer during 2019-2022 to estimate cougar and bobcat densities using space-to-event modeling. We will report density estimates for each enumeration method and compare their credible intervals. If we can demonstrate that cameras produce abundance estimates that are comparable to established enumeration methods, cameras could provide the LEKT with a noninvasive and cost-effective approach to long-term wildlife monitoring.

Natural History of Venoms and Their Role in the Evolutionary Success of Viperid Snakes.
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One of the most iconic features of vipers is the utilization of venoms as a chemical means of dispatching prey (as opposed to mechanical means such as constriction). Venoms have evolved primarily as specialized trophic adaptations, allowing snakes to immobilize prey quickly and remotely, to begin the breakdown of prey tissues and secondarily to be used in antipredator

defense. However, this adaptation is often overlooked in studies of the natural history and ecology of these snakes, even though it is arguably the most important feature of venomous snakes that has allowed for their tremendous evolutionary success. Vipers, and specifically rattlesnakes, are often the most abundant species of snakes in a given habitat, and they can result in profound predation pressures on small rodent communities. This talk will discuss some of the basics of venom biochemistry that allow rattlesnakes to stay ahead of their prey in an evolutionary arms race, as well as consider some compensatory adaptations seen in some (but not all) members of rodent populations on the plains of eastern Colorado. In particular, the presence of taxon-specific toxins (such as myotoxin a) allows rattlesnakes to immobilize certain prey exceptionally rapidly, greatly facilitating predatory success. However, the same biochemical "strategy" seen in one population may not be employed in another location, illustrating the dynamic nature of these chemical weapons and their deployment. Specific examples will be drawn from our work with the Prairie Rattlesnake (*Crotalus viridis viridis*) and the Western Rattlesnake species complex, with extension to other viper groups globally.

Intradermal Clefting in a Cachexic Ball Python (*Python regius*). Susanna Masecar*; *School of Biological Sciences, Washington State University, 14204 Northeast Salmon Creek Avenue, Vancouver, WA 98686; susanna.masecar@wsu.edu*

Dermatological lesions are common in both captive and wild snakes. While infectious causes of herpetological skin diseases are currently a hot topic (e.g. *Ophidiomyces ophiodiicola*), it is important to also consider non-infectious etiologies. Appropriate consideration of etiologies is crucial for guiding case management in captive and wild populations alike. A 2-year-old female caramel Ball Python (*Python regius*) was presented for retained shed. This snake was a personal pet with adequate husbandry. Initial examination revealed a poor body condition, small body size, dehydration, dysecdysis, increased epidermal mobility, and numerous dermal bullae (large skin blisters) throughout the ventrum. Aspiration of the bullae demonstrated clear, acellular fluid with no growth on microbial cultures, consistent with a non-infectious process. Despite treatment, the lesions progressed and euthanasia was elected. Histopathology demonstrated intradermal clefting (separation of skin layers), dermal atrophy, and reduced collagen. Collagen is critical for skin elasticity and connectivity between layers of the skin. The dermatological findings are analogous to mammalian skin fragility syndrome, in which a severe catabolic state leads to impaired collagen production, and reduced collagen facilitates skin layer separation. A similar syndrome was the presumed cause of this snake's bullae. The underlying cause of the cachexia remains unclear. This case highlights the importance of considering non-infectious causes of serpentid dermatological lesions. Considering diseases that develop secondarily to cachexia may be particularly relevant for unthrifty captive serpentids, such as those with poor appetites or high stress levels, because these animals are at risk of developing a catabolic state.

Breeding and Feeding: Harderian Gland Constituents Mediate Vomeronasal Functioning in Garter Snakes. Robert T. Mason*, *Department of Integrative Biology, Oregon State University, Corvallis, OR 97331; masonr@oregonstate.edu*

The Harderian gland (HG) is the largest cephalic gland in most terrestrial vertebrates, but despite numerous studies for more than 300 years, its physiological function remains unresolved. Male Red-sided Garter snakes (*Thamnophis sirtalis parietalis*) use their vomeronasal organ exclusively to locate and evaluate potential mates based on female sex pheromones. Protein components of HG secretions are essential to vomeronasal chemosensory function enabling the detection of sex pheromones and prey kairomones, chemical signals essential to mate recognition, mate selection, and feeding. The HG of *T. s. parietalis* exhibits sexually dimorphic seasonal structural changes coinciding with a mutually exclusive shift in behavior from spring mating to summer feeding. Using an integrated approach employing high throughput RNA-sequencing paired with protein mass-spectrometry, we examined the functional characteristics of the HG transcriptome as well as identified and functionally characterized the proteins present in vomeronasal secretions to describe a sexually dimorphic and seasonally variable role of this tissue. Analysis of protein components in the fluid of the vomeronasal organ showed an abundance of lipid-binding proteins and extracellular immune proteins with sexually dimorphic expression patterns likely to be targets of selection and important to the natural history of these snakes.

Introduced Red-eared Slider (*Trachemys scripta elegans*) in British Columbia, Canada: (1) Current Status and (2) Evidence of Successful Hatching. Brent M. Matsuda*, *Biodiversity West Environmental Consulting, 7121 Broadway, Burnaby, BC V5A 1R7*; brent.matsuda@gmail.com; and Aimee Mitchell*, *Coastal Painted Turtle Project (CPTP) operated by Coastal Partners in Conservation Society*[1], *4-2422 Hawthorne Avenue, Port Coquitlam, British Columbia VC3 6K7;* wptrecovery@gmail.com; Vanessa L. Kilburn, *Ecorana Environmental Ltd., 3601 Hillcrest Avenue, North Vancouver, British Columbia V7R 4B7;* vanessakilburn@gmail.com; Rebecca Seifert[1], rebecca.seifert@gmail.com; Deanna Mactavish[1]; mactavish.deanna@gmail.com

Globally, competition and disease from introduced Red-eared Slider (*Trachemys scripta elegans*) is a threat to co-existing native turtles. The Red-eared Slider (RES) has been introduced throughout south coastal British Columbia (BC), mainly as pet turtle releases. Competition and disease introduction from RES likely contributes to the continued decline of the Threatened Western Painted Turtle (WPT), particularly at sites with low WPT numbers. Removal of RES, as a precautionary approach, has also proven difficult and recovery of WPT populations at shared sites may be limited if RES breeding cannot be curtailed or if WPT numbers have fallen below the minimum critical breeding population size. Public awareness of the problems associated with RES as pets has greatly increased in the past 10 years as no stores could be found within these areas that currently sell RES. However, despite provincial legislation and municipal bans prohibiting their sales, RES can still be purchased online. Surveys conducted by the CPTP within wetlands in cities and municipalities surrounding Vancouver, on southern Vancouver Island, and on the southern mainland coast of BC found significantly more RES than the native Western Painted Turtle (*Chrysemys picta bellii*) Pacific Coast population at a ratio of 4.5:1 (n = 42 sites). Prior to this study, there had been no evidence of RES successfully hatching in the wild in BC. We observed complete development, with 19 neonates from three different nesting sites between

2015 and 2017. The scale and mechanisms of impacts that these findings have on native WPT populations are discussed.

Response of Stream-associated Amphibians to Timber Harvest with Alternative Riparian Buffer Configurations. Aimee P. McIntyre and Reed Ojala-Barbour*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; aimee.mcintyre@dfw.wa.gov; reed.ojala-barbour@dfw.wa.gov;* Jay E. Jones, *Weyerhaeuser, 220 Occidental Ave. S, Seattle, WA 98104; jay.jones@weyerhaeuser.com;* Timothy Quinn, *Washington Department of Fish and Wildlife; 1111 Washington Street Southeast, Olympia, WA 98501; timothy.quinn@dfw.wa.gov;* Andrew J. Kroll, *Weyerhaeuser, 785 N 42nd Street, Springfield, OR 97478; aj.kroll@weyerhaeuser.com;* Marc P. Hayes, *Washington Department of Fish and Wildlife, retired, 1574 Brentwood Dr, Eagle Point, OR 97524; aardvarkdiners33@gmail.com*

Headwater streams comprise the majority of stream miles in forests of the Pacific Northwest and provide important habitat for stream-associated amphibian species. A substantial proportion of headwater streams are managed for timber production. During clearcut harvest, landowners retain riparian buffers to protect amphibians and important ecosystem functions. We monitored the density of stream-breeding amphibians in a replicated Before-After Control-Impact (BACI) experiment with alternative riparian buffer configurations (continuous buffer, patchy buffer, and clearcut riparian area) and unharvested reference basins. We conducted amphibian surveys in three pre-harvest years, and in post-harvest years one, two, seven and eight. We estimated amphibian density using count data adjusted for variation in detection. In the eight years following harvest, we observed a substantial reduction in larval Coastal Tailed Frog (*Ascaphus truei*) density in all buffer configurations, with no obvious difference in the reduction among buffer configurations. The greatest reduction in mean larval tailed frog density was -93% (95% credible interval (CI): -98%, -73%) in basins with a patchy buffer. We also observed a -71% (CI: -82%, -52%) and -97% (CI: -99%, -86%) reduction in post-metamorphic tailed frog densities in basins with continuous and patchy buffers, respectively, and a -64% (CI: -86%, -10%) reduction in Torrent Salamander (*Rhyacotriton* spp.) density in basins with a patchy buffer. Finally, we observed no difference in the change in giant salamander (*Dicamptodon* spp.) density among buffer configurations. While longer-term monitoring is encouraged, observed declines, especially for Tailed Frog, suggest some at least short-term effect of forest management on amphibians.

Management and Monitoring of Oregon's Easternmost Northwestern Pond Turtle Population. Andrew Meyers*, *Oregon Department of Fish and Wildlife, 3561 Klindt Dr., The Dalles, OR 97058; Andrew.r.meyers@odfw.oregon.gov;* Tessa Ott, *Oregon Department of Fish and Wildlife, 3561 Klindt Dr., The Dalles, OR 97058; Tessa.b.ott@odfw.oregon.gov;* Kalysta Adkins, *Oregon Department of Fish and Wildlife, 61374 Parrell Road, Bend, Oregon 97702; kalysta.i.adkins@odfw.oregon.gov*; Jeremy Thompson, *Oregon Department of Fish and Wildlife, 3561 Klindt Dr., The Dalles, OR 97058; Jeremy.l.thompson@odfw.oregon.gov*

In the early 1990s, the United States Forest Service, in conjunction with Wasco County established the Morganson Road Management Area (MRMA) near Mosier, OR to protect habitats within known areas of Northwestern Pond Turtle (*Actinemys marmorata*, hereafter NWPT) occupation by limiting certain land uses. The MRMA was created in response to an initial assessment conducted by the Western Aquatic Turtle Research Consortium, which determined that the NWPT population within Wasco County consisted of a group of isolated individuals totaling approximately 75-80 total turtles. In 2009, the Oregon Department of Fish and Wildlife (ODFW) initiated a monitoring effort for NWPTs within the MRMA to better inform both planning comments submitted to the county and overall understanding of local NWPT biology. From 2009-2017, approximately 190 individual NWPTs were marked along the exterior scutes. In 2018, ODFW moved to utilizing PIT tag technology to better refine data collection and individual identification. Since 2018, a total of approximately 220 WPT's have been marked via PIT tagging. In 2021, ODFW deployed VHF radio transmitters in an attempt to locate nesting events and overwinter hibernation sites. Data collection to date has allowed ODFW to estimate current adult NWPT populations within MRMA, expanded known areas of occupation, and enabled a better understanding of upland habitat use. Future work will focus on continuation of current monitoring as well as increasing understanding of juvenile life history traits from nesting to sub-adult recruitment.

Pushing Ice Seal Surveys to the Edge: Automated Detection in the Arctic. Erin Moreland*,Yuval Boss, Ben Hou, Stacie Hardy, Peter Boveng, *NOAA Fisheries, Alaska Fisheries Science Center, Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115; erin.moreland@noaa.gov*

Ice seals in the Arctic are broadly distributed across expansive frozen oceans in the spring each year, providing a window of opportunity to count seals hauled out on the sea ice and estimate abundance. Conducting aerial surveys at low altitude hundreds of miles offshore is dangerous and some areas remain inaccessible due to safety considerations or overlap with coastal subsistence activities. Efforts over the past ten years have focused on developing technical methodologies to support safer surveys and the integration of unoccupied aircraft. During 2021 surveys of the southern Beaufort Sea, machine learning models were run in-flight for real-time multispectral image processing. Results indicate successful execution of edge processing and significant gains in personnel efficiency. Efforts are also underway to integrate this payload system onto a long-range unoccupied aircraft. Model approach and performance results from the 2021 survey will be shared in addition to plans for future development.

Enhancing Climate Connectivity as a Strategy for Wildlife Resilience to Climate Change. Harriet Morgan*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; harriet.morgan@dfw.wa.gov*

Fish and wildlife have historically used movement or dispersal to adapt to changes in the climate, shifting ranges to stay within climatically suitable habitat. Species are using movement to adapt to present-day climate change, but the current rate of change is so rapid that many species will have difficulty moving fast enough to keep pace with the changing environment.

Additionally, human land use (e.g., highways, cities, farms) presents significant barriers to wildlife movement across landscapes. Enhancing habitat connectivity – the ability of species to move across the landscape – is a leading strategy for helping wildlife respond to climate change. Increasing landscape connectivity is expected to enhance resilience to climate change by facilitating species' adaptive range shifts, while also reducing existing stresses associated with habitat fragmentation.

Dead Birds for Conservation Science and Advocacy. Joshua Morris*, *Seattle Audubon, 8050 35th Ave NE, Seattle, WA 98112; joshm@seattleaudubon.org*

Billions of wild birds are killed each year in the United States from human-related causes, including predation by outdoor, free-ranging domestic cats; collisions with buildings and vehicles; and entanglement in trash. Due to scavenging and other factors, personal observation of birds harmed by these anthropogenic sources is infrequent and the magnitude of the environmental carnage remains hidden. Crowd-sourcing reports of dead and injured birds can help. dBird is a low-barrier, easy to use, online platform that allows researchers and conservationists to collect opportunistic reports of bird injury and mortality from anyone with an internet connection. The reports can improve local understanding of anthropogenic hazards to birds, help direct hazard mitigation resources, and have been successfully used to inspire policy changes.

The Merits, Missteps and Persistent Mysteries of Beaver-related Restoration. Caroline Nash*, *CK Blueshift LLC; cnash@ckblueshift.com*

Of the diversity of approaches to process-based restoration, perhaps none have captured public interest quite as much as beaver-related restoration. By aiming to either directly harness, attract or mimic the beavers' dam-building capabilities, land managers hope to increase water availability, improve water quality, enhance biodiversity, and restore degraded ecosystems at a fraction of the cost of traditional, form-based approaches. These great expectations have fueled considerable interest and increasing amounts of funding towards the use of beaver-related restoration tactics by both private landowners and public land managers. However, as is often the case in restoration, the practice has greatly outpaced the science documenting not only outcomes, but also the premise itself. Is beavers' absence the driving factor behind persistent stream degradation throughout the Western U.S.? Will their reintroduction, or dam mimicry, result in the scale and magnitude of persistent changes to the environment practitioners are aiming for? This presentation will draw on case studies and peer-reviewed literature to provide a brief overview of beaver-related restoration, examining its premise, evolution, and current state of practice and science. This presentation will introduce the concept of process-pathways and process-based evaluation techniques as a tool to explore the degree of uncertainty implicit various beaver-related restoration projects, including site selection, habitat requirements, and stakeholder engagement. In addition, we will examine outstanding questions related to the implementation of beaver-related restoration projects, including social conditions, long-term maintenance, and permitting.

Genetic Monitoring of the Columbia Basin Pygmy Rabbit (*Brachylagus idahoensis*): A 12-Year Study (2011-2023). Stacey A. Nerkowski*, *Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844; staceyn@uidaho.edu*; Paul A. Hohenlohe, *Department of Biological Sciences, University of Idaho, Moscow, ID 83844*; *hohenlohe@uidaho.edu;* Lisette P. Waits, *Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844; lwaits@uidaho.edu*

Loss and fragmentation of habitat from agricultural conversion has led to the near extirpation of the Pygmy Rabbit (PYRA), *Brachylagus idahoensis*, population in the Columbia Basin (CB) of Washington, USA. Recovery efforts began in 2001 and included captive breeding, translocations, and reintroduction into native habitat. Through noninvasive invasive genetic sampling, we evaluated demographic and population genetic parameters on three translocated populations of pygmy rabbits (SBF, BH, CHB) over 12 years (2011-2023). For each population, microsatellite genotyping was used to evaluate spatial distribution, apparent survival rates, post-release dispersal distance, genetic diversity, and the persistence of CB ancestry. Over the course of this study, 2016 rabbits have been reintroduced through a cooperation between state and federal agencies (SBF-1479, BH-461, and CHB-76). Despite translocations of rabbits from other regions for genetic rescue, CB ancestry persisted in the SBF population averaging between 14.85-27.46% across the years in which post 2015, every rabbit contained CB ancestry. From 2011-2014, rabbits detected had been released that year with minimal new wild-born rabbits occurring through wild reproduction. From 2015, the number of wild-born rabbits became the dominant detection in the minimum count. Post-release dispersal at SBF averaged 988m (juveniles) and 783m (adults); 2nd-year detections were greater for males (804m) than females (351m). Our findings provide critical information on the success of the reintroduction efforts and provide information for future conservation.

Determining Idaho Native Snake Elevation Ranges Using iNaturalist Data. Brenna R. Olson*, *Idaho State University, 921 S. 8th Ave., Pocatello, ID 83209; brennaolson@isu.edu;* Charles R. Peterson, *Idaho State University, 921 S. 8th Ave., Pocatello, ID 83209; charlespeterson@isu.edu;* Donna M. Delparte, *Idaho State University, 921 S. 8th Ave., Pocatello, ID 83209; donnadelparte@isu.edu*

The goal of this study is to investigate how iNaturalist community science data can be used to calculate elevations for Idaho's 12 species of snakes, the elevational ranges of which are currently not well known. Elevation is an important descriptor of species ranges and how they shift temporally due to environmental factors such as climate change. Our specific objectives include: (1) developing a GIS workflow to extract elevation values from point data accounting for Digital Elevation Model (DEM) accuracy and the impact of horizontal point accuracy and topography; and (2) estimating the completeness of those data in describing the elevation ranges of Idaho snakes. We filtered data for species identification accuracy and a horizontal accuracy of ≤50 m and used zonal statistics in ArcGIS Pro to filter points to a vertical accuracy of ±10m leaving us with 1266 (41.3%) of 3067 points. About 73.1% of our final dataset was horizontally accurate to within 10 m. Idaho elevations range from 216 m along the Snake River in western Idaho to 3680 m on Mt. Borah in central Idaho. The elevations of the final iNaturalist

observation points ranged from 227.6 m to 2578.1 m. We could not calculate ranges for 2 of the rare species: *Diadophis punctatus* and *Rhinocheilus lecontei*. We will use literature values from adjoining states to estimate the completeness of the iNaturalist-based ranges.

Snake Fungal Diseases: Status and Strategy. Deanna H. Olson*, *USDA Forest Service Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; deanna.olson@usda.gov;* Matthew C. Allender, *Department of Veterinary Clinical Medicine, College of Veterinary Medicine, University of Illinois Urbana-Champaign, 2001 S. Lincoln Ave, Urbana, IL 61802; mcallend@illinois.edu;* Katherine H. Haman, *Wildlife Program, Washington Department of Fish and Wildlife, 1111 Washington Street SE, Olympia, WA 98501; Katherine.haman@dfw.wa.gov;* Ellen K. Haynes, *Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, University of Georgia, 501 D.W. Brooks Dr., Athens, GA 30602; ekh27@cornell.edu;* Jeffrey M. Lorch, *US Geological Survey, National Wildlife Health Center, 6006 Schroeder Rd, Madison, WI 53711; jlorch@usgs.gov;* Jenna N. Palmisano, *Department of Biology, University of Central Florida, 4110 Libra Drive, Orlando, FL 32816; jpalmisano@knights.ucf.edu;* Allan P. Pessier, *Washington Animal Disease Diagnostic Laboratory, Washington State University, 1940 SE Olympia Ave, Pullman, WA 99164; apessier@wsu.edu*

Increasing detections of snake fungal diseases have been reported in North American snakes over the last decade, with initial reports stemming from the mid-1980s. Ophidiomycosis is an emerging infectious disease caused by *Ophidiomyces ophidiicola* (formerly *ophiodiicola*), which may be an introduced pathogen. It is primarily a skin disease with clinical signs ranging from minor scale abnormalities to severe lesions, and in some cases it has been associated with high mortality. Most *Oo* infections are known from the eastern USA. Occurrences in the West remain scant at this time with emergence anticipated; for example, there have been recent *Oo* detections in Idaho and California. In Washington state, skin infections of garter snakes by a second fungal pathogen, *Paranannizziopsis* spp., have recently been reported, elevating the relevance of diagnostic analyses to distinguish between fungal etiologies. Strategically, elevated awareness of snake health is warranted in the Pacific Northwest to understand the scope and extent of infections, and their causes and their consequences. Until a reptile disease data management system is developed, partnerships of wildlife enthusiasts, scientists, and managers among state, provincial, and national levels can help track disease occurrences, manage status assessments, and formulate biosecurity and conservation priorities.

Stream-Riparian Forest Management: Beyond BMPs. Deanna H. Olson*, *USDA Forest Service Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; deanna.olson@usda.gov;* Ashley A. Coble, *National Council for Air and Stream Improvement, Inc., 227 NW Third Street, Corvallis, Oregon 97330, USA;* Jessica A. Homyack, *Weyerhaeuser 505 North Pearl Street, Centralia, Washington, 98531, USA*

In contemporary forest landscapes, aquatic–riparian management approaches are addressing ecological integrity of site-to-landscape components that extend beyond the reach of traditional best management practices (BMPs), which have focused primarily on protecting water

quality and fish habitat conditions. We highlight the intersection of BMPs that have guided past priorities with integrated interdisciplinary geomorphic, hydrologic, and biological perspectives of joint aquatic–terrestrial ecosystem management and restoration in forests. Beyond-BMP considerations include adapting prescribed BMPs for broader species protections and recognizing the need for coordinated stream-to-upland ecosystem restoration, in addition to protection from project-specific actions. Riparian management area (i.e., riparian buffer) designs, site-specific management, and watershed set-asides are beyond-BMP approaches that can be used to address abiotic resources such as light, temperature, nutrients, and downed wood, as well as a broader suite of biotic concerns, multi-species' habitats at whole-watershed scales, and the ecological functions and processes to which they are tied. Aquatic–riparian ecosystems are inherently dynamic and managing for spatial and temporal heterogeneity has emerged as a priority restoration goal. To aid in complex protection and restoration aims across watershed scales, multi-forest stakeholder collaborative groups are seeking to ensure delivery of broad ecosystem services (i.e., the range of goods and values desired by people from forests) across watersheds or landscapes, rather than on each project area or land ownership. In this way, beyond-BMP approaches are integrating management of geomorphic, hydrologic, and biological concerns to provide both a sustainable supply chain of wood and a host of other ecosystem services.

Tracking Movements of Sharp-tailed Snakes (*Contia tenuis*) with PIT-tag Telemetry on Vancouver Island, British Columbia. Kristiina Ovaska*, Lennart Sopuck, and Christian Engelstoft. *Biolinx Environmental Research Ltd., 1759 Colburne Place, North Saanich BC, V8L 5A2; ke.ovaska@gmail.com; lennart@biolinx.ca; cengelstoft@gmail.com*

The ecology of Sharp-tailed Snakes is poorly known, largely due to the difficulties of studying this semi-fossorial species with cryptic habits and small body size, which is unsuitable for radiotelemetry. Since 2011, we have surgically implanted PIT-tags into the body cavity of 92 adult snakes and followed their movements using portable scanners, and since 2019 and 2021, respectively, two types of stationary automated scanners. The solar-powered automated scanners consisted of a single-loop antenna with a perimeter of 100 m set around a hibernation site and two "tendril" systems consisting of 16 loop antennae with perimeter of 1 m; each loop was covered by an artificial cover-object to increase detection probability. The systems were set in areas used by several PIT-tagged snakes. The automated scanners revealed significant surface activity in July and August, unlike indicated previously from artificial cover-object checks. Fall surface activity was greatly reduced in 2022, probably due to a prolonged drought. Most activity occurred in early evening and at night throughout the activity season. Individuals confined their movements within relatively small areas with only minor seasonal shifts in habitat use. The longest movement was by a male with a displacement distance of 235 m horizontally and 90 m in elevation over 3 months. With expanded monitoring with automated scanners at this and another site, we hope to gain detailed information on habitat use that will aid in conservation of this species listed as endangered in Canada.

Responses to Change: Ecophysiology and Demography of Antarctic Baleen Whales. Logan J. Pallin*, *Department of Ecology and Evolutionary Biology and Department of Ocean Sciences,*

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Baleen whale populations in the Southern Ocean are recovering after intense commercial whaling in the 20th century. As these populations recover, they continue to experience threats, including habitat change and prey limitations driven by rapid warming. The latter is exacerbated by a commercial krill fishery along the Western Antarctic Peninsula (WAP). Understanding how climate-driven changes influence the population dynamics of whales in this region is critical for conserving the structure and function of this marine ecosystem. Here, we use an eight-year dataset (2013–2020), to show that inter-annual Humpback Whale (*Megaptera novaeangliae*) pregnancy rates, as determined from skin-blubber biopsy samples (n = 616), are positively correlated with krill availability and fluctuations in ice cover in the previous year. Pregnancy rates varied significantly, between 29% and 86% interannually. Our results indicate that krill availability is in fact, limiting and affecting reproductive rates. This suggests that this population of humpback whales may be at a threshold for population growth due to prey limitations. As a result, continued warming and increased fishing along the WAP, which continue to reduce krill stocks, will likely impact this humpback whale population. Humpback whales are sentinel

species of ecosystem health, and changes in pregnancy rates can provide quantifiable signals of the impact of environmental change at the population level. Our findings must be considered paramount in developing new and more restrictive conservation and management plans for the Antarctic marine ecosystem and minimizing the negative impacts of human activities in the region.

Predictive Modeling of a Cryptic Species, *Crotalus oreganus concolor*, to Inform Management Decisions in the Face of Energy Development in Wyoming and Colorado.
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The Midget Faded Rattlesnake (*Crotalus concolor*) is protected as a state and federal Species of Special Concern across their range in Utah, Wyoming, and Colorado. This means that take is prohibited and management agencies must include them in any land development plans. Energy development is the greatest threat to populations across their range and their overwintering habitat is the most critical and sensitive. Due to their cryptic nature, finding these snakes and their overwintering habitat is extremely difficult. We gleaned data from previous studies conducted by the authors to develop predictive habitat models based on known den locations. We also used hundreds of tissue samples from across their range in Wyoming to conduct landscape genetics to better understand the effects of landscape conditions on their populations, which also includes features associated with development. Not only did we develop models based on available data, but we also collected new data to validate those models. The final den model in Wyoming was 85% accurate in its predictions. The den models developed for the Colorado portion of their range were less accurate at 75% because the landscape was far more complex in Colorado than in Wyoming. The landscape genetics revealed genetically isolated populations due to past urban development and an interstate highway, and that even low-traffic access roads are a major disturbance to gene flow. The models that we produced using GIS and landscape genetics techniques have proven to be invaluable in the conservation and management of the species in Wyoming and Colorado.

Effects of the Cheatgrass-fire Cycle on Snakes in Sagebrush Steppe. Kristina J. Parker*, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83702; kparker@usgs.gov;* David S. Pilliod, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83702; dpilliod@usgs.gov;* Jay D. Carlisle, *Intermountain Bird Observatory, Department of Biological Sciences, Boise State University, Boise, ID 83725; jaycarlisle@boisestate.edu;* Matthew A. Williamson, *Human-Environment Systems, Boise State University, Boise, ID 83725; mattwilliamson@boisestate.edu*

Reptiles inhabiting shrub-steppe ecosystems of the Intermountain West have adapted to harsh, unpredictable desert conditions, but a legacy of human land use and recent changes in disturbance regimes may put species at risk. In southwest Idaho, cheatgrass (*Bromus tectorum*) has altered the fire regime resulting in vast conversion of shrub steppe to mostly annual grasslands that burn too frequently to allow shrublands to recover. We examined how repeat fires and changes in sagebrush steppe habitats influenced native snakes. We predicted that occupancy of snakes that prefer shrublands would decline with increased number of times burned and cheatgrass cover. We used a combination of trapping and visual encounter surveys to quantify the effect of previous wildfires, cheatgrass, and other habitat metrics on snake occupancy. Preliminary results indicated that snake occupancy was negatively affected by wildfire frequency but the effects of cheatgrass cover on occupancy varied. We concluded that the effect of the cheatgrass-fire cycle may be species-specific, with winners and losers depending on a combination of habitat associations, life history, and environmental sensitivities.

Do Boat Activities Affect the Behavior of Sounders in Inland Waters? A Study on Gray Whales (*Eschrichtius robustus*) in North Puget Sound. Alexander Pavlinovic*, *Cascadia Research Collective, 218 4th Ave W, Olympia, WA 98501, alexpavlinovic@hotmail.com;* Kiirsten Flynn, *Cascadia Research Collective, 218 4th Ave W, Olympia, WA 98501, kflynn@cascadiaresearch.org;* Dr. John Kirkpatrick, *The Evergreen State College, The Evergreen State College Mailstop labII 2257 2700 Evergreen Parkway NW Olympia, WA 9850, kirkpatj@evergreen.edu;* John Calambokidis, *Cascadia Research Collective, 218 4th Ave W, Olympia, WA 98501, calambokidis@cascadiaresearch.org*

Understanding the impacts of vessel presence on whale behavior is a crucial aspect of cetacean conservation. “The Sounders” are a small group of gray whales that stop to feed in North Puget Sound during their annual migration. This leg of their journey exposes them to whale-watching boat-based operations, recreational, and commercial vessel traffic. Research on other cetacean species has indicated that boat presence may have adverse effects, such as disrupted foraging and avoidance of heavily trafficked areas. There are limited studies on gray whales regarding the behavioral impacts of boat presence. To address this gap, land-based research was conducted from Hat Island, Washington, using a theodolite to record the locations and movements of gray whales. The presence or absence of vessels within one km were also tracked. These observations began on March 14 and ended on May 14, 2021. Whales were tracked for 51 days for a total of 78 hours. 39% of all whale observations occurred while boats were within 1000 m. Results indicated that whale’s speed, inter-breath intervals, deviation, and direction indices differed when boats were within 1000 m of the whale. However, analyses are

proceeding, looking at the potential influence of other variables that may help provide further insight into this question. The Sounders' prolonged periods of foraging close to shore provided an ideal opportunity to study the impacts of boats on gray whales, the results of which may better inform the conservation and regulation of the species.

Freshwater Biodiversity across Forest Stand Age. Brooke Penaluna* and Ashley Coble *, *Pacific Northwest Research Station, USDA Forest Service; brooke.penaluna@usda.gov*

Global freshwater biodiversity is in crisis and although recent research has linked terrestrial biodiversity to forests, spatial data linking freshwater biodiversity to forests is lacking. Theory predicts that biodiversity is maximized when ecological disturbance or intensity of management is at intermediate levels owing to presence of pioneering and rare, specialized species. Alternatively, biodiversity is shown to be best conserved by minimizing human effects in intact landscapes, such as old growth forests owing to complexity in habitats allowing for rare, specialized species. Here we link freshwater biodiversity from stream water environmental DNA across a gradient of watershed stand ages from coastal Oregon from young to old coastal temperate forests ranging from 30 to 100 years. We evaluate biodiversity across taxa and by species to understand the spatial patterns in detections, which will help to inform resource management decisions.

Genomic Insight into the Biology of Rattlesnakes. Blair W. Perry*, *Washington State University, Pullman, WA 99164; blair.perry@wsu.edu;* Drew R. Schield, *University of Colorado Boulder, Boulder, CO 80309; drew.schield@colorado.edu;* Todd A. Castoe, *University of Texas at Arlington, Arlington, TX 76019-0498; todd.castoe@uta.edu*

As genome sequencing technologies increase in both capability and affordability, we have entered an era in which genomic approaches can be used to understand the evolution, biology, and ecology of virtually any organism. In only a few years since the publication of the first rattlesnake genome assembly in 2019, we have made great strides in understanding numerous aspects of their unique biology. For example, population-level genomic studies have provided insight into the demographic history of North American rattlesnakes, emphasizing the frequency of hybridization between diverging lineages and shedding light on challenges to elucidate the systematics of this group. More recently, genomic investigations of rattlesnake venom have provided new perspectives on the evolution of venom genes and the remarkable variation seen both within and across rattlesnake venoms. Despite this progress, genomic resources for rattlesnakes, and snakes in general, lag behind those for other major vertebrate lineages. Moving forward, efforts to increase the generation of genomic resources (i.e., genome assemblies) and genomic datasets (i.e., population-level genome resequencing) for snakes will increase our ability to both study and manage diverse snake lineages in North America.

Acquiring and Using Crowdsourced Data for Snake Ecology Studies and Conservation. Charles R. Peterson* and Dan Giltz. *Idaho State University, Department of Biological Sciences, Pocatello, ID 83209; petechar@isu.edu; dangiltz@isu.edu*

The objectives of this presentation are to: (1) describe the importance of crowdsourced and community science data to snake ecology studies and conservation activities; (2) explain how to acquire these data; and (3) provide suggestions on how to use the data effectively. The practice of obtaining information by enlisting the services of many people, typically through the internet, is called crowdsourcing. Research conducted through public participation is termed community or citizen science. This presentation is based on our experience with the iNaturalist app and website (iNaturalist.org) to create a project to acquire and share observations of Idaho amphibians and reptiles (www.inaturalist.org/projects/idaho-amphibian-and-reptile-inaturalist-project). As of 2022, we have acquired over 2500 observations of Idaho snakes, including all 12 native species. Identification accuracy of the observations is high because of photo vouchers and volunteer identifiers. These data can be used in many ways, especially for documenting occurrence and distribution, seasonal activity patterns, and road mortality. Although most of the observations are for common, widespread species, observations of rare species like nightsnakes can be very important. Strengths of crowdsourcing include large amounts of recent data over a broad area, low cost, accurate spatial coordinates, photovouchers, and public education and engagement. Weaknesses include the lack of a sampling design and the absence of negative data which makes it hard to quantify observation effort. New techniques are being developed to at least partially address these weaknesses. Crowdsourced data can be an important complement to traditional sources of data like museum specimens and formal surveys.

Black Bear Denning Ecology Relative to Intensively Managed Forests. Vanessa Petro*, *Oregon State University, 321 Richardson Hall, Corvallis, OR 97331; vanessa.petro@odf.oregon.gov;* Jimmy Taylor, *USDA National Wildlife Research Center, Corvallis Field Station, 321 Richardson Hall, Corvallis, OR 97331; jimmy.d.taylor@usda.gov*

Black Bear (*Ursus Americanus*) peeling of conifers in the Pacific Northwest is well documented and the magnitude of economic damage to timber is estimated in the millions annually. Local knowledge assumes bears den in older forests primarily on public lands, then damage trees on adjacent younger industrial forestland in the spring. To challenge this assumption, we documented denning chronology, den structure characteristics, presence of tree peeling at den sites, and den habitat associations. This work was part of a larger multi-year study that investigated bear peeling on industrial forestlands in western Washington and Oregon during 2016-2018. We live-captured bears suspected of peeling in intensively managed forests adjacent to public lands and fitted 49 bears with Iridium-GPS collars. We recorded 28 entrance and 21 emergence events during two denning periods among 24 bears. We confirmed 26 den sites for 18 bears. Contrary to popular belief, we found 62% of surveyed dens occurred in intensively managed forests. Dens were disproportionally associated with tree structures (77%). Other den structures included ground nests (19%) and a single dirt mound. Fresh peeling was documented at one den site post-emergence. At the site scale, dens were frequently found mid-slope on hillsides with south facing aspects in stands with high understory cover. Den sites at the home range scale were located more frequently in young forests on mildly steep slopes adjacent to a nearby water source, but away from roads. Our results will help managers better understand the relationship between bear damage and denning behavior across multiple ownerships.

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Conservation Genetics of the Striped Whipsnake (*Coluber* [*Masticophis*] *taeniatus*) in Washington, USA. David S. Pilliod*, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83702; dpilliod@usgs.gov;* Lisa A. Hallock, *Washington Department of Fish and Wildlife, Olympia, WA 98504; lisa.hallock@dfw.wa.gov;* Mark P. Miller, *U.S. Geological Survey, Water Resources Mission Area - Office of Planning and Programming, Lakewood, CO 80225; mpmiller@usgs.gov;* Thomas D. Mullins, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR 97331;* Susan M. Haig, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR 97331 (retired)*

Conservation of wide-ranging species is aided by population genetic information that provides insights into adaptive potential, population size, interpopulation connectivity, and even extinction risk in portions of a species range. The Striped Whipsnake (Coluber [*Masticophis*] *taeniatus*) occurs across 11 western U.S. states and into Mexico but has experienced population declines in parts of its range, particularly in Washington State. We analyzed nuclear and mitochondrial DNA extracted from 192 shed skins, 63 muscle tissue samples, and one mouth swab to assess local genetic diversity and differentiation within and between the last known whipsnake populations in Washington. We then viewed that information in a regional context to better understand levels of differentiation and diversity among whipsnake populations in the northwestern portion of its geographic range. Microsatellite data analyses revealed comparable genetic diversity between the two extant Washington populations, but gene flow may be somewhat limited. We found moderate to high levels of genetic differentiation among states across all markers, including five microsatellites, two nuclear genes, and two mitochondrial genes. Pairwise state-level comparisons and dendrograms suggest that Washington whipsnakes are most closely related to those in Oregon, and distinct from Idaho, Nevada, and Utah, approximately following an isolation by distance model. We conclude that Washington populations of whipsnakes have experienced recent isolating events, but they have yet to lose genetic diversity. The longevity and high vagility of the species may provide opportunity for conservation of whipsnakes in the state as long as relatively open native shrubland habitat is available.

Climate Futures for Snakes in the Pacific Northwest. David S. Pilliod*, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83702; dpilliod@usgs.gov;* Michelle I. Jeffries, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83702; mjeffries@usgs.gov;* Robert S. Arkle, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83702; rarkle@usgs.gov;* Deanna H. Olson, *U.S.D.A. Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331; dede.olson@usda.gov*

We assessed changes in fundamental climate niches for snake species in western North America under time and emission scenarios to help prepare resource managers for possible species conservation and habitat management issues. We used eight species distribution modelling approaches for each species, resulting in 32 models per species for each of the six time-by-climate scenarios. We then combined the highest-performing models for a species into a

single ensemble model for each scenario. Binary maps were generated from the ensemble models to depict the climate niche for each species and scenario. Patterns of richness and niche shifts were calculated from the binary projections at the scale of the entire study area and for individual states and provinces. Preliminary results suggest that the climate niche for the recent scenario and published ranges for species were highly correlated ($R^2 = 0.81$). Across western North America, snake climate niche space is projected to move north in the future, resulting in increasing species richness in much of the western United States and Canada. The majority of species are projected to expand their current climate niche rather than to shift, contract, or remain stable. Few species are projected to lose climate niche in the future and few species were projected to go extinct at the state or province level, although species often were projected to occupy novel areas of the state or province, and often at higher elevations. As climate niches move northward, species are predicted to cross administrative borders, resulting in novel conservation scenarios for local agencies. However, information on species dispersal abilities and local landscapes (e.g., barriers) will help contextualize predictions relative to realized niche expansion.

Evolving Relationships between Beaver and Salmonids in the Context of Climate Change.
Michael Pollock*, *NOAA Northwest Fisheries Science Center, 2725 Montlake Blvd E. Seattle Washington 98112. michael.pollock@noaa.gov*

We review the evolving understanding of the ecosystem functions of beaver dams relative to salmonid habitat restoration and present research results from our restoration and monitoring efforts to use beaver and beaver dam analogues to assist in the recovery of ESA-listed coho salmon populations in the context of climate change and increasing demand for limited water resources.

Determining Spatiotemporal Responses of Elk to Recreation in the Western Cascades.
Michael Procko*, *School of Environmental and Forest Sciences, University of Washington, Seattle, WA 98195; xprockox@gmail.com;* Samantha G. Winder, *Outdoor R&D, University of Washington, Seattle, WA 98195;* Spencer A. Wood, *Outdoor R&D, University of Washington, Seattle, WA 98195; eScience Institute, University of Washington, Seattle, WA 98195;* Laura R. Prugh, *School of Environmental and Forest Sciences, University of Washington, Seattle, WA 98195*

Elk (*Cervus canadensis*) are important culturally and economically for humans, and they also play integral roles in maintaining ecosystem function. In the Cascade Range of Washington, Elk habitat overlaps with areas that are popular for hiking, mountain biking, and other recreational activities. Given the dramatic increase in the amount of outdoor recreation over the past decade, there are questions about whether these activities displace Elk in the area. Here, we use camera traps and recreational visitation models that incorporate social media to estimate wildlife and human use within the North Rainier Elk herd range in western Washington. We then use these data to test for Elk habitat displacement at multiple temporal scales using random forest models. At coarser (multi-week) temporal scales, we found little evidence that Elk were displaced by recreation. However, at the weekly temporal scale Elk habitat use decreased in

areas of higher recreation, and Elk were similarly detected less frequently on weekends which corresponded to greater human visitation. Furthermore, Elk shifted towards more nocturnal behavior in areas of higher recreation. Our work utilizes novel methods of data acquisition and analysis to estimate recreation impacts on Elk, with the potential to incorporate these tools into larger-scale efforts of informing recreation and wildlife management. In turn, our results can inform science-based policies that balance outdoor recreation and wildlife conservation, which is a critical step towards honoring rights and title of Indigenous peoples across the region.

Evaluation of Upland Hardwood Patches Using Three Taxa in Douglas-fir Production Forests. Claudine R Reynolds*, *Port Blakely, 8133 River Drive Southeast, Tumwater, WA 98501; creynolds@portblakely.com;* John C Withey, *The Evergreen State College, 2700 Evergreen Parkway NW, Olympia, WA 98505; witheyj@evergreen.edu*

Forests are biologically and ecologically productive in both natural and managed settings. They provide ecosystem functions and societal benefits including water filtration, carbon storage, and habitat for fish and wildlife. More than 10 million acres of forestland are managed for forest products and ecosystem services in Washington State. Managers of forestlands have the opportunity, through intentional conservation and silvicultural practices, to manage for forest resiliency and biological diversity while maintaining alignment with business and societal objectives. Managed forests form a mosaic of habitat types across the landscape, many of which are conifer-dominated with hardwood patches scattered throughout. For this study, I examined the use of conifer- and hardwood-dominated habitat types by three forest taxa (ground beetles, amphibians, and songbirds), as well as components of forest structure and composition. Small, upland hardwood patches within the managed conifer matrix were utilized by all taxa. Of the 43 species that were analyzed, 14 (33%) were unique to one habitat type or the other, with four species unique to conifer-dominated habitats, and ten species unique to hardwood-dominated habitats. The mean species richness of ground beetles and birds was similar in both conifer- and hardwood-dominated plots ($p=0.99$, $p<0.31$), while the mean species richness of the herpetofauna community was greater in hardwood-dominated plots ($p<0.06$). Across all surveys, significantly more plant species occurred in hardwood-dominated plots than in conifer-dominated plots ($p<0.01$). These results suggest that upland hardwood patches within the managed forest setting provide conservation value for many species.

Testing the Efficacy of a New Turtle Basking Platform Incorporating a Planted Blind. Emilio Ricci* *Western Oregon University, 345 Monmouth Ave N, 97361, ericci18@wou.edu*, Brian C. Smith, *City of Salem Parks and Recreation 555 Liberty St. SE, Salem, OR, 97301; bcsmith@cityofsalem.net;* Matthew Johnston *City of Salem Parks and Recreation 555 Liberty St. SE, Salem, OR, 97301; mjohnston@cityofsalem.net;* Susan P. Barnes *Oregon Department of Fish and Wildlife, 17330 SE Evelyn Street, Clackamas, OR, 97015; susan.p.barnes@odfw.oregon.gov;* and Gareth R. Hopkins *Western Oregon University, 345 Monmouth Ave N, 97361; hopkinsg@wou.edu*

Restoration of basking habitat for freshwater turtles often occurs in urban areas with high visitor usage. This creates a potential conflict between effectively restoring basking habitat and

possible disturbance of the animals. We examined this conflict and experimentally tested a potential resolution at the semi-urbanized Minto Brown Island Park, in Salem, Oregon. Examination of basking behavior of turtles (Red-eared Sliders, Northwestern Pond Turtles, and Western Painted Turtles) in response to human recreation in this park suggest that turtles may avoid sites with large numbers of people, raising the question whether basking structures currently being deployed could be improved to shield turtles from people. In this study, we experimentally modified basking structures at three different sites varying in number of recreationists. At each site, we deployed two basking structures: a control structure based on the current structure design with an added floating ring of PVC, and an experimentally modified platform with plants (*Carex* and *Juncus* plugs) planted in the PVC ring, creating a blind. Surveys were completed utilizing a camera monitoring system where images were taken every 15 minutes from 7 am to 7 pm between April 22nd and October 16th, and included recording light and temperature. Preliminary investigations demonstrated that few turtles used either type of platform in this first year. This may be due to the high usage (and vandalism) by nutria and waterfowl, recent deployment of the platforms, or poor basking weather. These inconclusive patterns suggest that longer-term data is needed to determine the possible efficacy of modified basking platforms.

Review of Remote Sedation Techniques for Field Immobilization and Disentanglement of Free-Ranging Pinnipeds. Michelle Rivard*, James Powell, Casey Mclean; *SR3 (SeaLife Response, Rehab, Research), 22650 Dock Ave. S., Des Moines, WA, 98198; mrivard@sr3.org*

Marine debris entanglement is a global concern for a variety of marine mammal species and is becoming increasingly recognized as a source anthropogenic trauma and mortality. Pinnipeds can become entangled or ingest marine debris or derelict fishing gear, which when not acutely fatal, can cause persistent, life-long problems. The debris type that most commonly causes pinniped entanglements varies depending on geographic location and typically consists of packing bands, monofilament, net, rope and crab traps. Ingested fishing gear includes flashers, longline gear, hook and line and spinners/spoons. The pinniped species most commonly affected by entanglement along the Pacific coastline in North America are California Sea Lions (*Zalophus californianus*) and Steller Sea Lions (*Eumetopias jubatus*). Remote sedation with the use of a hydrophone dart has been developed and adapted and shown to be a safe and effective tool for field sedation of pinnipeds to remove lethal entanglements. There are many factors that impact the success of a capture, to include environmental conditions, location of the animal, animal health status, capture equipment, experience of responding personnel and adaptive strategies. The aim of this presentation is to discuss pinniped field sedation techniques for entangled animals, logistics and lessons learned.

Transmission and Lesion Progression of Treponeme-Associated Hoof Disease in Captive Elk (*Cervus canadensis*). Zachary B. Robinson*, *Department of Veterinary Microbiology and Pathology, College of Veterinary Medicine, Washington State University, PO Box 64-7040, Pullman, Washington 99164; zrob.robinson@wsu.edu;* Devendra H. Shah. *School of Veterinary Medicine, Texas Tech University, 7671 Evans Drive, Amarillo TX 79106*; Devendra.shah@ttu.edu; Kyle R. Taylor. *Department of Veterinary Microbiology and*

Pathology, College of Veterinary Medicine, Washington State University, PO Box 64-7040, Pullman, Washington 99164; Washington Animal Disease Diagnostic Laboratory, Washington State University, Pullman, Washington 99164; k.taylor@wsu.edu; Margaret A. Wild. *Department of Veterinary Microbiology and Pathology, College of Veterinary Medicine, Washington State University, PO Box 64-7040, Pullman, Washington 99164; margaret.wild@wsu.edu*

Treponeme-associated hoof disease (TAHD) is a debilitating disease of free-ranging Elk (*Cervus canadensis*) in the northwestern U.S. While *Treponema* spp. is associated with lesions, the etiology, and transmissibility between Elk remains undetermined. Our objective was to determine the transmissibility and lesion progression of TAHD in Elk. Four individually housed treatment Elk and two individually housed control Elk were challenged with inoculum prepared from soil mixed with hooves of TAHD-positive free-ranging Elk or autoclaved hooves from normal Elk, respectively. Elk were challenged eight times during a 138-day challenge period by applying challenge inoculum to the interdigital space (IDS) and to pen soil at 1-4-week intervals. The lesion development, body condition, and lameness were assessed during the challenge period, followed by a 170-day monitoring period. Skin scrapings from the IDS were collected prior to each challenge for 16S rRNA amplicon sequencing and IDS biopsies were collected for histological examination at each period's conclusion. All treatment Elk, but no control Elk, developed gross and histologic lesions consistent with TAHD, and *Treponema* spp. were detected in varying proportions. In treatment Elk, lameness was correlated to lesion development ($R=0.702$, $p<0.001$), activity was reduced during the challenge ($p<0.001$) and monitoring periods ($p=0.004$), and body condition at endpoints was significantly lower ($p=0.006$). Three of four treatment Elk were euthanized when they reached humane endpoints, and one Elk recovered. These results provide the first direct evidence that TAHD is a transmissible infectious disease in Elk. As such, actions that reduce transmission risk can support disease management and prevention.

The Ring-necked Snake (*Diadophis punctatus*) in the Pacific Northwest: Life History, Behavior, and Habitat Use. Chris Rombough*, *PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com*

Little is known about the biology of Ring-necked Snakes (*Diadophis punctatus*) in the Pacific Northwest. From 2007 to 2022, I studied the life history of Ring-necked Snakes across several habitat types in the northern Willamette Valley of Oregon and the Columbia River Gorge of Washington. I used a range of techniques to examine population demography, longevity, and age and growth. I also studied habitat use, behavior, and activity patterns of individual snakes. Here, I describe the basic life history of Ring-necked Snakes in the Pacific Northwest, and present selected data from populations in different habitat types.

The Ring-necked Snake (*Diadophis punctatus*) in Northwestern Oregon: a Successful Population Translocation. Chris Rombough*, *PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com*

In response to the destruction of a study site, I translocated a population of Ring-necked Snakes (*Diadophis punctatus*) to a new location. Prior to destruction of the original site, I collected >5 years of baseline data on the snake population and its habitat. These data were used to construct artificial habitat in a new location that did not previously support ring-necked snakes. Following the relocation, I studied the snakes' behavior, movements, and habitat use for the next 5 years. Over this period, the project was a success: snakes adapted to the new habitat, established regular activity patterns, and exhibited rates of growth and reproduction equivalent to those observed at the original site. In addition, the behavior and habitat use of the translocated snakes revealed surprising new information about the species' biology. In this presentation, I will describe the translocation and present some of the key features, lessons, and discoveries of this interesting project.

Olympic Cougar Project. Kim Sager-Fradkin*, *Lower Elwha Klallam Tribe, 2851 Lower Elwha Road, Port Angeles 98363; kim.sager@Elwha.org;* Mark Elbroch*, *Panthera, 8 West 40th Street, 18th floor, New York, NY 10018; melbroch@panthera.org*

Cougars on the Olympic Peninsula suffer lower genetic diversity and higher inbreeding coefficients than other Cougars in Washington. Connectivity modeling highlights barriers between Olympic and lower Cascadia Cougar populations. The Interstate-5 corridor is among the fastest growing regions in the U.S., and connectivity for wildlife between the Olympic Peninsula and southern Cascades will be further limited by human population growth and development. The Olympic Cougar Project (OCP) is an ongoing, Olympic Peninsula-wide study of connectivity, with the goal of supporting healthy human-wildlife communities. Cougars are the largest and widest-ranging carnivore on the Peninsula, potentially acting as an umbrella species. The OCP is co-led by the Lower Elwha Klallam Tribe and Panthera in collaboration with the Makah, Quinault, Jamestown S'Klallam, Port Gamble S'Klallam, and Skokomish Tribes, the Washington Department of Transportation, EarthRanger, and several university partners. The OCP is involved in many activities and research topics related to Cougars (e.g., genetics, demographics, movement patterns), and has deployed a large camera grid to test a coordinated approach to monitoring and conserving this region's wildlife diversity. Five mammalian species of cultural importance to the tribes (Black-tailed Deer, Elk, Bobcat, Black Bear, and Coyote) each interact with Cougars, either as prey or as consumers of meat left behind at kill sites. With over 450 cameras and movement data from over 90 Cougars collared and monitored since 2018, the OCP is in a unique position to identify potential safe passages and bottlenecks to wildlife movements. We will present preliminary findings relevant to regional landscape connectivity.

Dynamic Models to Guide Columbia Basin Shrubsteppe Conservation in an Era of Rapid Environmental Change. Andrew Shirk*, *Executive Director, TerrAdapt; andrew@terradapt.org*

The Washington Shrubsteppe Restoration and Resilience Initiative (WSRRI) is a collaborative effort among state agencies and a diverse array of partners to create a more fire-resilient shrubsteppe landscape in the Columbia Basin, with a key focus on benefitting regional wildlife. The long-term strategy for this initiative calls out the need to map spatial priority areas

where partners would optimally invest in habitat protection and restoration to foster a more resilient shrubsteppe ecosystem. A key aspect of our approach is to map spatial priorities dynamically based on synthesis of remote sensing and other datasets annually. We are using TerrAdapt, an automated and dynamic cloud-based workflow for modeling and spatial prioritization developed using Google Earth Engine), to monitor environmental change, assess impacts of change to select species and habitat types in the region, and map spatial priority areas for restoring and protecting habitat that maximize ecological resilience to threats from wildfire and other disturbances. Mapping spatial priorities in the TerrAdapt workflow is underway and expected to be complete by the end of 2023. When finished, it will provide shrubsteppe habitat managers with always up-to-date information on the condition of shrubsteppe habitat and current spatial priorities for where habitat protection and restoration would ideally occur to provide the greatest benefit to resiliency.

Describing Marten (*Martes caurina*) Activity Patterns using Accelerometers and Remote Cameras. Ian Shriner*, *ian.m.shriner@gmail.com;* Katie Moriarty, *National Council for Air & Stream Improvement Inc., 2438 Professional Drive, Corvallis, OR 97330; kmoriarty@ncasi.org;* Marie Martin, *Oregon State University, 3100 SW Jefferson Way, Corvallis, OR 97330; marie.martin@oregonstate.edu;* Mark Linnell, *U.S.D.A Forest Service, 3200 SW Jefferson Way, Corvallis, OR 97330; marcolinnell@yahoo.com;* Patrick Tweedy, *Sierra Pacific Industries, 3115 Kuper Rd, Centralia, WA 98531; pjtweedy@gmail.com;* Matt Delheimer, *U.S.D.A Forest Service, 2480 Carson Rd., Placerville, CA 95667; mattdelheimer@gmail.com*

Studying species' activity patterns (diurnal, crepuscular) is key to understanding ecological and evolutionary processes, such as habitat use and species interactions. Collecting activity data for elusive or rare species is difficult, often with studies lacking appropriate sample sizes or being unable to correlate findings with individual fitness. We deployed micro-GPS collars fitted with activity sensors (accelerometers) on adult Pacific Martens (*Martes caurina*) in Lassen National Forest, California (n = 6 females, 11 males, 2010-2013) and Oregon Dunes National Recreation Area (n = 1 female, 3 males, 2015). Accelerometers collected an index of activity every 2 minutes, providing consistent and continuous activity data. We evaluated individual activity types in relation to season (snowfree, snow) and sex. Martens were polyphasic and active for relatively short periods of time followed by rest. Nonetheless, martens were often active during periods that best matched available prey, especially in Lassen during snow-on periods. We posit adults may forage most during peak prey activity (e.g., diurnal in summer maximizing ground squirrel overlap) and subordinate animals (juveniles, subadults) may offset activity times to avoid dominant individuals. We further compared patterns with extensive remote camera data and found accelerometer-derived patterns were not well represented in remote camera data. Although the relatively short battery life of micro-GPS collars currently presents some limitations, our data suggest that accelerometers are a promising research tool that can provide valuable insights into animal activity and ecology.

Road Crossing Ecology of Snakes in Central Washington Shrub-steppe: a Snapshot of Mortality, Occurrence, and Activity. Adrian Slade* and Tyler Larsen, *Central Washington University, 400 E. University Way, Ellensburg, WA 98926; slade.oreganus@gmail.com; larsen.ty.97@gmail.com*

Snakes are particularly vulnerable to the impact of road traffic and direct mortality from collisions with vehicles, which may contribute to long-term population declines. We examined crepuscular and nocturnal patterns of road-crossing for 4 sympatric snake species: *Crotalus oreganus oreganus* (Northern Pacific Rattlesnake), *Charina bottae bottae* (Northern Rubber Boa), *Hypsiglena chlorophaea deserticola* (Northern Desert Nightsnake), and *Pituophis catenifer deserticola* (Great Basin Gopher Snake). To evaluate road-crossing patterns, we conducted 130 nighttime transect surveys during one active season (May-October 2017 on three unique roads in the Columbia River basin of central Washington state: a low-traffic road bisecting a wildlife area, a county highway, and a high-traffic state route. We collected data on 924 total snakes and analyzed their occurrence, movement, and mortality in the context of anthropogenic factors, season, life history, and adjacent habitat. Gopher snakes and rattlesnakes

comprised the majority (90%) of observed snakes. Gopher snakes were encountered more frequently than rattlesnakes in spring and fall, whereas rattlesnakes dominated summer crossings. Our data reveal an allopatric distribution for the two more cryptic species, *H. c. deserticola* and *C. b. bottae*, along a shrub-steppe habitat gradient and identify high-density crossing areas for all four species. Snakes on the busiest road have only a 30% chance of surviving a crossing.

Occurrence and Distribution of Invasive Snapping Turtles in Oregon. Madison I. Smith*, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR, 97361 msmith17@mail.wou.edu;* David M. Szpakowski, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR, 97361; szpakowskid@mail.wou.edu;* Susan P. Barnes, *Oregon Department of Fish and Wildlife, 17330 SE Evelyn Street, Clackamas, OR, 97015; susan.p.barnes@odfw.oregon.gov;* Rick J. Boatner, *4034 Fairview Industrial Dr SE, Salem, OR 97302; rick.j.boatner@odfw.oregon.gov;* and Gareth R. Hopkins, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR, 97361; hopkinsg@mail.wou.edu*

Snapping Turtles (*Chelydra serpentina*) are an invasive species and classified in rule as prohibited in Oregon, native to eastern North America. Despite reports of Snapping Turtles dating back to 1995, a systematic examination of their distribution and natural history in the State has been lacking. By documenting their spatial-temporal distribution, and general morphological and reproductive characteristics, researchers can implement management strategies to protect native biodiversity. The goal of this study was to document the spatial-temporal patterns and characterize the general morphological and reproductive characteristics of snapping turtles in Oregon. Data were collected between 1995–2022 via targeted surveys and verified public-reported observations, and were analyzed using spatial-temporal analyses. Snapping Turtles are primarily found in western Oregon, and our emerging hot spot analyses identified sporadic clusters in the Portland area. Eighty-four percent of turtles were found within 200 m of rivers and streams, and half were in parks. Sightings were most common in June, which aligns with nesting observations. Average clutch size was similar to that found in their native range; however, turtles in Oregon were smaller on average. The public has played a large role in data collection, with twice as many incidental sightings reported than survey observations. Our examination of Snapping Turtles is limited due to lack of data and systematic surveying, making it difficult to disentangle reporting effort from actual population trends. More surveys, as well as continued public outreach, are required in order to fully understand the true distribution and extent of this invasive species' threat to Oregon's native biodiversity.

Modeling Western Rattlesnake Habitat Use and Connectivity. Stephen F. Spear*, *IUCN Viper Specialist Group, 1502 Loomis Street, La Crosse, WI 54603; sfspear2@gmail.com;* Joshua M. Parker, *Fresno City College, 1101 East University Avenue, Fresno, CA 93741; Joshua.parker@fresnocitycollege.edu;* Charles R. Peterson, *Idaho State University, 921 South 8th Avenue, Pocatello, ID 83209; petechar@isu.edu;* Christopher L. Jenkins, *The Orianne Society, 11 Old Fruit Stand Lane, Tiger, GA 30576; cljenkins@oriannesociety.org;* Lisette P. Waits, *University of Idaho, 875 Perimeter Drive, Moscow, ID 83844; lwaits@uidaho.edu*

Connectivity and corridor models have become important tools for managers and conservationists to plan habitat conservation efforts. Such models may be especially useful for species that often rely on specialized habitat. For instance, Western Rattlesnakes (*Crotalus oreganus*) typically use communal den sites in the winter and move away from the den in the active season and are therefore especially vulnerable to fragmentation. We used connectivity modeling to identify important habitat variables and connectivity corridors for two subspecies of Western Rattlesnakes: *Crotalus oreganus concolor* in Wyoming and *Crotalus oreganus oreganus* in Washington. Both studies used observation data modeled with Maxent to identify core habitat areas. In the case of *C. o. concolor*, the model was highly successful in identifying new den sites. We used two different approaches to investigate connectivity and habitat fragmentation in the two subspecies. For *C. o. concolor*, we genotyped individuals using microsatellites and developed landscape genetic models to identify what variables had the highest resistance, which were used to define connectivity corridors. Our analysis indicated that low-use roads were significantly associated with fragmentation. For *C. o. oreganus*, we estimated connectivity using an expert opinion resistance surface. This network is reliant on a linear backbone that if fragmented, could lead to isolated populations. Like *C. o.* concolor, the presence of roads provides the greatest predicted disruption to connectivity. These studies provide a demonstration of an approach suitable for assessing connectivity and fragmentation of viper species, particularly those reliant on patchy resources.

Whole-genome Sequencing of Blue Whales across Ocean Basins to Describe Population Structure. Angie Sremba*, *Cooperative Institute for Marine Ecosystem and Research Studies, Oregon State University, 2030 SE Marine Science Drive, Newport, OR, 97394, NOAA Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA, 98115, Marine Mammal Institute, Oregon State University, 2030 SE Marine Science Drive, Newport, OR, 97394; Angela.Sremba@oregonstate.edu;* Aimée Lang, *Southwest Fisheries Science Center, 8901 La Jolla Shores Drive, La Jolla, CA, 92037; Aimee.Lang@noaa.gov;* Juan Pablo Torres *Flores, Centro Ballena Azul/Blue Whale Center, Independencia 641, Valdivia, Chile; jptorresflorez@gmail.com;* Daniel M. Palacios, *Marine Mammal Institute, Oregon State University, 2030 SE Marine Science Drive, Newport, OR, 97394; daniel.palacios@oregonstate.edu;* Leigh G. Torres, *Marine Mammal Institute, Oregon State University, 2030 SE Marine Science Drive, Newport, OR, 97394; Leigh.Torres@oregonstate.edu;* John Calambokidis, *Cascadia Research Collective, 218 4th Ave W Olympia, WA, 98501; Calambokidis@cascadiaresearch.org;* James Gilpatrick, *Southwest Fisheries Science Center, 8901 La Jolla Shores Drive, La Jolla, CA, 92037; jim.gilpatrick@noaa.gov;* Koji Matsuoka, *Institute of Cetacean Research, 4-5, Toyomi, Chuo, Tokyo, 104-0055, Japan; matsuoka@cetacean.jp;* C. Scott Baker, *Marine Mammal Institute, Oregon State University, 2030 SE Marine Science Drive, Newport, OR, 97394; Scott.Baker@oregonstate.edu; Robert P, Dziak, NOAA Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA, 98115; robert.p.dziak@noaa.gov; and* Matt Galaska,* *NOAA Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA, 98115; matt.galaska@noaa.gov*

Blue Whale populations have been differentiated using both genetics and acoustics. Four subspecies and up to 11 populations of Blue Whales are recognized. Delineation of these units, which is important for conservation and management, has relied on morphology, genetics, and acoustics. However, our understanding of Blue Whale population structure and subspecies taxonomy is challenged by temporal and spatial overlap of populations and subspecies on some parts of their range. Here, our goal is to improve understanding of Blue Whale population structure and subspecies taxonomy through the use of whole genome sequences of individuals from multiple regions, including the eastern North Pacific, eastern tropical Pacific, central western North Pacific, New Zealand, North Atlantic and Southern Ocean. These include Blue Whales from several populations previously delineated by variability in acoustic call and song structure. To date, we have sequenced the genome of 90 Blue Whales. The average depth of each nucleotide for each reconstructed genome was 10 unique reads, which increases the confidence in the reconstructed genome. We assembled several genome-wide single nucleotide polymorphism datasets with varying filter parameters. These genome-wide datasets, which provide greatly increased power to detect and describe differentiation between regions when compared to more traditional genetic markers, will be used to evaluate Blue Whale population structure across ocean basins. The results will have implications for the taxonomy and conservation of this long-lived, endangered marine mammal.

Space-use Strategies Drive Diet Composition of Baffin Bay Polar Bears. Jennifer H. Stern*, *School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98105;* *jhstern@uw.edu*; Kristin L. Laidre, *Polar Science Center, Applied Physics Laboratory, University of Washington, Seattle, WA 98105, Greenland Institute of Natural Resources, PO Box 570, 3900 Nuuk, Greenland*; Erik W. Born, *Greenland Institute of Natural Resources, PO Box 570, 3900 Nuuk, Greenland*; Øystein Wiig, *Natural History Museum, University of Oslo, PO Box 1172 Blindern, 0318 Oslo, Norway*; Christian Sonne, *Department of Ecoscience, Arctic Research Centre, Aarhus University, 4000 Roskilde, Denmark*; Rune Dietz, *Department of Ecoscience, Arctic Research Centre, Aarhus University, 4000 Roskilde, Denmark*; Melissa A. McKinney, *Department of Natural Resource Sciences, McGill University, Ste.-Anne-de-Bellevue, QC H9X 3V9*

Polar Bears (*Ursus maritimus*) depend on sea ice to hunt their ice-associated prey. However, climate-induced sea ice loss is leading to changes in space-use strategies of Polar Bears, with bears in some subpopulations spending more time on land or selecting alternative habitats. One such documented alternative habitat is freshwater glacier ice, which provides year-round access to prey, although the feeding habits of Polar Bears using glacier ice relative to those following the retreating ice and/or seasonally moving onshore are not known. Here, we use fatty acid analysis of adipose tissue from Polar Bears (n = 114) from the Baffin Bay subpopulation live-captured in West Greenland during the springs of 2009 to 2013 to investigate dietary patterns between offshore and coastal space-use strategies. 'Offshore' adult females, which make long-distance movements across the pack ice, showed a strong linkage to the pelagic food chain with high proportions of C22-chain length monosaturated fatty acids and quantitative fatty acid signature analysis-generated diet estimates that included Beluga/Narwhal and Harp/Hooded Seal. 'Coastal' adult females, which remain resident at glacier fronts in Northwest Greenland year-

round including during the sea ice-free season, consumed proportionally more ringed seals and similar proportions of bearded seal, but essentially no beluga/narwhal and harp/hooded seal. Thus, space-use strategy is a major driver of intrapopulation diet variability, and as space-use strategies change with ongoing loss of sea ice habitat, our results suggest important ramifications for Polar Bear feeding patterns.

Washington Wildlife Habitat Connectivity Working Group: Cascades to Coast Connectivity Analysis. Brian Stewart*, *Conservation Northwest, 642 Jorgensen Rd., Onalaska, WA 98570; bstewart@conservationnw.org*

The Washington Wildlife Habitat Connectivity Working Group is a collaborative partnership for the development of science-based tools and analyses. Their work has identified opportunities for maintaining and enhancing habitat connectivity throughout Washington. Their statewide analysis identified the need for a finer-scale analyses within a region extending from the Southern Cascades through southwestern Washington and into the Olympic Peninsula. This more detailed analyses was deemed necessary to prioritize and inform actions to maintain and restore habitat connectivity within this region. In that analysis, we modeled five species to represent the connectivity needs of a broader assemblage of wildlife. We also created a model of landscape integrity. The results highlighted a series of connected arcs and key linkage zones that together (a) can provide north-south habitat connectivity for a wide array of species; and (b) highlights key opportunities for habitat connectivity between these connected arcs. This presentation describes this regional-scale analysis and will highlight these and other key findings.

Diel Patterns of Foraging Behavior in Southern Resident Killer Whales. Jennifer B. Tennessen*, *Center for Ecosystem Sentinels, Department of Biology, University of Washington, Life Science Building, Box 351800, Seattle, WA 98195; jtenness@uw.edu;* Marla M. Holt, *NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112; marla.holt@noaa.gov;* M. Brad Hanson, *NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112; brad.hanson@noaa.gov;* Candice K. Emmons, *NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112; candice.emmons@noaa.gov;* Deborah A. Giles, *Friday Harbor Laboratories, University of Washington, 620 University Road, Friday Harbor, WA 98250; giles7@uw.edu;* Jeffrey T. Hogan; *The Whale Museum, 62 First St. N, Friday Harbor, WA 98250; jeff@killerwhaletales.org;* Arial Brewer, *NOAA Fisheries, Alaska Fisheries Science Center, Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115 and School of Aquatic and Fisheries Sciences, University of Washington, 1122 NE Boat St, Seattle, WA 98195;* Sheila J. Thornton, *Pacific Science Enterprise Centre, Fisheries and Oceans Canada, 4160 Marine Drive, West Vancouver, British Columbia V7V 1N6*

Killer Whales (*Orcinus orca*) are ecosystem sentinels iconic to the Pacific Northwest. An endangered population of fish-eating killer whales, the Southern Residents (SRKW), spends much of the year in the Salish Sea, the inland and coastal waters of Washington and British Columbia. One of the primary threats to SRKW is limited availability/accessibility of their

preferred salmonid prey. Previous research has shown that disturbance from vessels reduces the likelihood of daytime foraging behaviors and prey capture by SRKW, raising concerns that human activities may be limiting daytime foraging opportunities. Whether SRKW forage overnight during periods of less disturbance, however, is poorly understood. We conducted a 4-year study to characterize diel patterns of foraging by SRKW. We deployed 11 suction cup-attached movement and sound biologging tags programmed to remain on SRKW for up to 23 hours. We followed tagged whales during daylight hours to document behaviors at the surface and to opportunistically collect prey samples, and we returned the following day to recover the tag and download the data. For each deployment, on a dive-by-dive basis, we computed fine-scale movement variables previously demonstrated to be associated with foraging, including jerk (rate of change of acceleration), roll angle, heading variance, and stroke rate, and we additionally identified all occurrences of bouts of slow and fast clicking, buzzing, and prey handling sounds including tearing and crunching. In this presentation, we will share key differences in patterns of foraging behavior during daytime and nighttime periods, and discuss implications for conservation of this endangered population.

Overview of Shrubsteppe Habitat, Threats, Conservation and Challenges to Restoration. Mark Teske*, *Washington Department of Fish and Wildlife, 1130 W. University Way, Ellensburg, WA 98926; mark.teske@dfw.wa.gov*

Shrubsteppe, a native habitat in Washington State, is under threat from natural and anthropogenic sources. Numerous wildlife species are closely associated with this habitat type and a surprising number and diversity of other species utilize shrubsteppe. This presentation will introduce key natural history concepts pertaining to shrubsteppe, species needs, management challenges, and on-going conservation work.

Wildlife Habitat Connectivity Concepts. Mark Teske*, *Washington Department of Fish and Wildlife, 1130 W. University Way, Ellensburg, WA 98926; mark.teske@dfw.wa.gov*

In a rapidly developing state such as Washington, wildlife species need a permeable landscape that allows them to move in response to disturbance, loss of habitat and weather extremes. Well distributed, well connected wildlife populations are important for maintaining healthy populations through time. Our understanding of wildlife habitat connectivity, challenges, techniques, and opportunities for connectivity will be presented.

Prioritizing Populations in Conservation Directly: A How-to-guide with Examples from Amphibians, Marmots, and Caribou in Canada. Mark D. Thompson*, *Ecologist and Project Manager, EcoLogic Consultants Ltd., 9516 Old Summit Lake Road, Prince George, BC, V2K* 5S8 *and Adjunct Professor, University of Northern British Columbia, 3333 University Way Prince George, BC, Canada, V2N 4Z9; mthompson@ecologicconsultants.com*

Ecosystems constructed through the biological and geological duration of a species are being diminished through a joint process of extirpation and extinction. Standard conservation practice ranks, discusses, and prioritizes actions on species. Hence, regulations allow for

extirpation before extinction. Each single species is identified as a taxon before being listed into legislation for priority assigned into action. A new theory is presented; stated simply: if we prioritize populations, without bias, using a sufficient random draw of species, then we will have better conservation outcomes of fewer extinctions and increased ecological resilience. In this way, population richness can be prioritized as a detour around the standard practice of single species conservation. The rationale is that few populations of select species are critically monitored in the process of inferring risk in ranking of priority status (e.g., threatened, rare, or endangered) that puts population-level threats into a deadly abyss. Conservation work on amphibians, marmots, and caribou from Canada will be presented in an argument for populations. This work involves partner collaborations with First Nations and multi-year and multi-pronged engagement with government, industry, and non-profits. A how-to-guide using 'in the dirt' conservation work is provided, including descriptions of remote sensing technology (e.g., radar, optical, software, statistical) that can assist in the sampling, mapping, and monitoring of populations using habitat suitability models, migration analysis, and demographic monitoring programs. This work is being slowly advanced in efforts to target conservation action and priority onto populations directly.

Rangewide Characterization of Habitat Suitability for Headwater Stream-Associated Torrent Salamanders. Lindsey Thurman*, *U.S. Geological Survey, Northwest Climate Adaptation Science Center, 777 NW 9th St. Suite 410, Corvallis, OR 97330; lthurman@usgs.gov;* Christopher Cousins, *Oregon State University, 104 Nash Hall, Corvallis, OR 97331; christopher.cousins@oregonstate.edu;* Tiffany Garcia, *Oregon State University, 104 Nash Hall, Corvallis, OR 97331; tiffany.garcia@oregonstate.edu;* Brooke Penaluna, *USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; brooke.penaluna@usda.gov;* Dede Olson, *USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; deanna.olson@usda.gov*

Within the moist, coniferous forests of the Pacific Northwest exists a dense network of headwater streams that support high levels of amphibian species endemism and diversity. Headwater stream-associated amphibians, such as the Torrent Salamanders (*Rhyacotriton spp.*), are important barometers of forest ecosystem health and function but are vulnerable to climate change and habitat degradation. The Columbia and Cascade Torrent Salamanders (*R. kezeri* and *R. cascadae*, respectively) are considered species of conservation concerns but have a dearth of basic ecological information needed to support ongoing conservation assessments. We sought to determine the current distributional extent and prevalence of both species across their respective ranges, and to characterize landscape-scale habitat suitability based on occupancy and abundance. We conducted rangewide surveys for both species and used a robust process of model development and refinement to characterize habitat suitability at 30-m resolution based on climatic, topoedaphic, forest structure, hydrological, and water-balance drivers of occupancy. Additionally, we used abundance data to quantify thresholds of habitat suitability (i.e., low, moderate, and high suitability habitat) to help inform conservation prioritization and decision-making for these vulnerable species and their unique headwater ecosystems.

Don't Take the Snakes! Reptile Management at a Public Preserve. Laura H. Trunk*, *City of Hillsboro, 2600 SW Hillsboro Highway, Hillsboro, OR 97123; laura.trunk@hillsboro-oregon.gov*; Chris J. Rombough, *PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com*

Managing wildlife in publicly accessible areas is often difficult, especially when those wildlife are accessible, desirable, and vulnerable to human activities. From 2010-2022, we managed populations of two native snakes, the Northwestern Gartersnake (*Thamnophis ordinoides*) and the Common Gartersnake (*T. sirtalis*), at a popular nature preserve that receives over 60,000 visitors a year. Over this period, our snake populations have faced a diverse range of threats to their existence. These began in 2010, when the snakes were nearly extirpated through habitat destruction, and have continued through the present, with the increase in popularity of social media platforms that provide exact locality data to the public. In our presentation, we describe some of the major threats – both conventional and unexpected – that our snake populations have faced, and the solutions we devised to ensure their survival.

Sphagnum, P.I.: On the Case of Bog Lemmings in Washington. Ben Turnock*, *Washington Department of Fish and Wildlife, 755 S Main Street, Colville, WA 99114; benjamin.turnock@dfw.wa.gov*

The Northern Bog Lemming (*Synaptomys borealis*) is a boreal species found in high-elevation wet meadows, bogs, and fens (dominated by sphagnum moss) in northern Washington. Northern Bog Lemmings are present in low numbers in our state, occurring in small, isolated populations. They are identified as a Species of Greatest Conservation Need in Washington Department of Fish and Wildlife's (WDFW) State Wildlife Action Plan but data on the current distribution, habitat requirements, and population demographics of Northern Bog Lemmings are needed for the development of effective conservation measures. WDFW has joined other northern states to collect more information about this little-known species and WDFW biologists have been searching for these elusive small mammals for the past two summers (2021 and 2022). Bog Lemmings are challenging to locate, and biologists must comb through sphagnum-dominated bogs in search of scat samples for DNA analysis. This involves a lot of bending over and parting grass, looking for scat that is only 4 to 6 mm long—about as close to a needle in a haystack as a biologist can get. WDFW did not detect Bog Lemmings in summer 2021 and results from summer 2022 are forthcoming. Due to its dependency on cold, wet environments, the northern Bog Lemming is particularly vulnerable to climate change. WDFW plans to continue surveying for Bog Lemmings in the future to document their distribution and presence in Washington.

Genetic Diversity and Effective Population Size of the Selkirk Grizzly Bear Population.

Megan Turnock*, *Kalispel Tribe, 1981 LeClerc Rd N, Cusick, WA 99119; mturnock@knrd.org;* Lisette Waits, *Department of Fish and Wildlife Sciences, University of Idaho, 875 Perimeter Drive MS1136, Moscow, ID 83844; lwaits@uidaho.edu;* Wayne Kasworm, *U.S. Fish and Wildlife Service, 385 Fish Hatchery Rd, Libby, MT 59923; wayne_kasworm@fws.gov;* Justin Teisberg, *U.S. Fish and Wildlife Service; justin_teisberg@fws.gov*

Grizzly Bears (*Ursus arctos*) in the conterminous United States are classified as threatened under the Endangered Species Act and the southern extent of their distribution consists of multiple populations that are largely isolated from each other. One of these populations is located in the Selkirk Ecosystem, which includes parts of northeastern Washington, northern Idaho, and southern British Columbia. Over the past century, this small population of approximately 90 bears has experienced genetic isolation and drift, resulting in low levels of genetic diversity. Monitoring has shown that gene flow between the Selkirk population and other populations is increasing, but the effects of gene flow on population genetic metrics are unclear. In addition, effective population size of the Selkirk population is unknown. To address these knowledge gaps, we used a long-term dataset of microsatellite genotypes from 276 bears collected between 1985-2021 in the Selkirk Ecosystem using live capture and noninvasive genetic sampling methods. To test the hypothesis that gene flow has led to an increase in genetic diversity, we examined trends in heterozygosity, allelic richness and inbreeding coefficients over time. We also estimated effective population size using multiple methods. Unbiased expected heterozygosity and allelic richness increased after gene flow, and although these increases were not statistically significant, they reversed a declining trend in genetic diversity over multiple generations. The results from this study provide updated and novel genetic information on the

Selkirk population of Grizzly Bears and underscore the importance of gene flow to small, fragmented populations.

Conservation Challenges and Successes for Amphibians during Road Construction on the West Coast of Vancouver Island. Krysia Tuttle*, *LGL Limited environmental research associates, 9768 Second Street, Sidney, BC V8L3Y8; ktuttle@lgl.com;* Barb Beasley, *Association of Wetland Stewards for Clayoquot & Barkley Sounds, P.O. Box 927, Ucluelet, BC V0R 3A0, beasley@island.net;* Katie Turner*; katiet500@gmail.com*

The need to find effective ways to mitigate the adverse effects of roads on wildlife is paramount as global biodiversity continues to decline and road networks expand. A road upgrading project on the west coast of Vancouver Island, BC presented the opportunity to use and test various mitigation approaches aimed at increasing the survival of amphibians both during construction and over the long-term. With support from the Huu-ay-aht First Nations, and in collaboration with industry, we put work windows and temporary road closures in place to protect amphibians dispersing/migrating across the road en route to and from an important breeding site. This resulted in a two-month closure that allowed tens of thousands of post-metamorphic Western Toads (*Anaxyrus boreas*) to disperse. We organized pre-construction salvage of amphibians that included sweeps of ponded and dry roadside verges before ditching, grubbing, and replacing culverts. Approximately 900 individuals from seven species of amphibian were relocated or held and then released. After collecting three seasons of data on the location of amphibian crossings, we were able to direct the repair/replacement of drainage culverts and the installation of new box culverts and fences to provide underpasses to reduce road mortality of Western Toads. This was particularly important as traffic is expected to increase once the road is improved. Wildlife cameras will be used to verify the long-term effectiveness of the underpasses for migration and dispersal of adult and post-metamorphic toads, respectively.

Oak Woodland and Prairie Restoration on the Scatter Creek Wildlife Area in Western Washington. Richard Tveten*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; Richard.Tveten@dfw.wa.gov*

Douglas Fir (*Pseudotsuga menziesii*) encroachment has contributed to Oregon White Oak (*Quercus garryana*) woodland and prairie loss in the South Puget Sound Region of Western Washington since the advent of modern settlement in the 1850s. Prairie and oak woodland loss has contributed to the decline and listing of multiple species under the Endangered Species Act including the Mazama Pocket Gopher (*Thomomys mazama*). In 2018, the Washington Department of Fish and Wildlife completed a 52-acre commercial harvest of Douglas fir on the Scatter Creek Wildlife Area to restore 27 acres of Oregon White Oak woodland and 25 acres of prairie. The project included the removal of 102 tons of wood per acre followed by seeding with native grasses and forbs. Within five months of harvest, Mazama Pocket Gopher activity was observed in the treated areas. Within seven months after harvest, Mazama Pocket Gophers had colonized the most distant back edge of the treatment areas, which is more than 800 feet from the pre-restoration prairie edge. They have persisted for four years.

A Modern History of Beavers in the Puget Sound Lowlands, and the Planning for Beavers Manual. Jen Vanderhoof*, *King County Department of Natural Resources and Parks, 201 S. Jackson Street, Suite 5600, Seattle, WA 98104; jennifer.vanderhoof@kingcounty.gov*

North American Beavers (*Castor canadensis*) are native to the Pacific Northwest and were nearly eradicated from the region in the mid-1800s. Efforts to re-establish beaver in Washington began in the 1920s, and trapping for fur commenced again as beaver numbers increased. Laws that regulate trapping changed in 2000, when voter-approved restrictions on types of traps made it more expensive and difficult to trap beavers recreationally. Fur prices coincidentally dropped about the same time. The effect of those two changes was a decrease in trapping state-wide. Salmon recovery efforts ramped up in Puget Sound about the same time and typically includes planting trees and shrubs along streams and rivers. These water bodies of King County's Puget Sound Lowlands are almost always intrinsically suitable for beavers, with the exception of food supply. As native vegetation continues to be planted as part of restoration efforts, more and more habitat becomes suitable for beavers in this area with a large human population. The Planning for Beavers Manual is a pro-active approach to restoration planning, as it assumes the arrival of beavers at project sites and incorporates beaver activity into each step of project planning and design. The manual helps reduce impacts to neighbors, reduce project uncertainty, and maximize project effectiveness. This manual is pragmatic while helping shift the paradigm from tolerance to partnership. An improved understanding of the role of beavers as agents of change is needed to further shift the paradigm to one of seeing beavers as essential for ecosystem health and resilience.

Biodiversity Responses to Experimental Forest Retention Treatments. Jake Verschuyl*, *NCASI, Inc., P.O. Box 1259, Anacortes, WA 98221; jverschuyl@ncasi.org;* A. J. Kroll, *Weyerhaeuser, Eugene, Oregon, 97405; AJ.Kroll@weyerhaeuser.com;* Sean Sultaire, *Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824; sultaires@gmail.com;* Gary Roloff, *Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824; Roloff@msu.edu*

Regulations dictate that a portion of live, or "green-trees", be retained during harvest to add conservation value to regenerating forest stands in the Pacific Northwest, USA. Retention requirements are often met by aggregating retention trees in inoperable portions of the stand or adjacent to other required buffers, often in the riparian zone. Despite long-standing requirements for retention, little is known about how animal abundance or vital rates (litter size, fecundity, survival) respond to variation in the slope position or aggregation of post-harvest structural retention. Therefore, we implemented a multi-year experimental study to evaluate responses of small mammal and beetle assemblages to five different retention prescriptions in Oregon and Washington. These prescriptions varied in the amount and spacing of green-trees and created snags retained in clearcut harvest units. We used spatial mark-recapture methods to estimate treatment responses for the three most abundant species: Townsend's Chipmunk (*Neotamias townsendii*), Deer Mouse (*Peromyscus maniculatus*), and Creeping Vole (*Microtus oregoni*). Chipmunk densities were highest with dispersed upland retention while creeping vole densities were highest in the upland aggregated treatment. Species richness of small mammals was highest

in retention patches concentrated along riparian buffers and functional diversity of ground-dwelling beetles was higher in retention patches than in the surrounding harvested stand, except in the dispersed treatment. Treatment effects on the fate of retention trees varied, with dispersed retention experiencing 50 percent mortality within 5 years. Collectively, these results suggest that a variety of retention patterns should be considered while planning harvest units on commercially managed timberlands.

How Many Times Should a Bullet Kill? Have You Switched to Copper? Bill Vogel*, *Independent. 700 Sleater-Kinney Road SE, Suite B Box 184, Lacey, WA 98503; william_o_vogel@yahoo.com*

Hunters have contributed substantially to conservation in North America. Hunters that support conservation also understand the issue of lead poisoning and may need additional tools to communicate with their fellow hunters to convince them to voluntarily switch from lead to copper bullets. This presentation will cover the basics of "single projectile" bullets used for big game and the issues surrounding lead bullets. We will discuss the fragmentation of lead bullets and the advancements in copper bullets. From the author's perspective, some reasons for switching to copper (e.g., enhanced harvest success) appear more effective in speaking with hunters than other reasons (e.g., preventing secondary poisoning). This presentation will also include some tips on how to select and test loads when switching, and some real-life examples of the effectiveness of copper bullets.

Identifying Individual Polar Bears From DNA in Footprints. Andrew L. Von Duyke, *North Slope Borough, P. O. Box 69, Utqiagvik, AK 99723; Andrew.VonDuyke@north-slope.org;* Jennifer R. Adams*, *University of Idaho, 875 Perimeter Drive MS1136, Moscow, ID 83844; adamsj@uidaho.edu;* Justin Crawford, *Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701; justin.crawford@alaska.gov;* Lori Quakenbush, *Alaska Department of Fish and Game, 1300 College Road, Fairbanks, AK 99701; lori.quakenbush@alaska.gov;* Lisette P. Waits, *University of Idaho, 875 Perimeter Drive MS1136, Moscow, ID 83844; lwaits@uidaho.edu*

Polar Bears *(Ursus maritimus)*, a marine mammal listed as vulnerable globally, are threatened with the continued loss of critical Arctic, sea-ice habitat. Capture and survey methods of polar bear populations have become difficult due to sea ice ephemerality and stability and are concerning from an animal welfare standpoint. Thus, there is a need for a less invasive approach to monitor polar bear populations that is also adaptable to a changing Arctic environment. Here, we demonstrate the ability to isolate DNA from Polar Bear footprints in snow and generate an individual genotype and sex. Snow was collected and pooled from 5, 10 and 20 footprints, melted and then run through a filter using standard eDNA sampling protocols. DNA was extracted from whole filters that had been stored in ethanol and frozen. Samples were screened for PCR amplification success using seven microsatellites and one sex marker. A total of 16 bears (11 male, 3 female, 2 unconfirmed sex) were identified across two years of pilot sample collection. Genotyping success varied depending upon the number of tracks sampled, however, increasing the number of tracks per sample increased the chance of sampling DNA from more

than one bear. These results suggest sampling footprints in snow may provide a viable alternative to more invasive capture and survey methods for Polar Bears. In addition, this survey method could further engage Indigenous peoples in Polar Bear conservation and management.

Assessing Spatial and Temporal Variation in the Upper Extent of Coastal Cutthroat Trout (*Oncorhynchus clarkii*) Distribution Within Headwater Streams in Southwest Washington, USA. Jason K. Walter*, *Weyerhaeuser, 505 North Pearl Street, Centralia, WA 98531; jason.walter@weyerhaeuser.com;* Miranda J. Fix, *Weyerhaeuser, 220 Occidental Avenue South, Seattle, WA 98104; miranda.fix@weyerhaeuser.com;* Rene Tarosky, *Weyerhaeuser, 505 North Pearl Street, Centralia, WA 98531; renata.tarosky2@weyerhaeuser.com;* Travis Schill, *Weyerhaeuser, 505 North Pearl Street, Centralia, WA 98531; travis.schill@weyerhaeuser.com;* Jay Jones, *Weyerhaeuser, 220 Occidental Avenue South, Seattle, WA 98104; jay.jones@weyerhaeuser.com;* Andrew J. Kroll, *Weyerhaeuser, 1581Southwest 53rd, Corvalis, OR 97333; aj.kroll@weyerhaeuser.com;* Brian Fransen, *496 Hyada Boulevard Northeast, Tacoma, WA 98422; brianfransen@outlook.com*

Washington forest practice rules require different protective measures on fish (Type-F) streams than non-fish (Type-N) streams during the application of forest management activities. To address the potential for temporal variability in fish distribution, surveys incorporate the extent of "habitat likely to be used by fish" when delineating the break between Type-F and Type-N waters. Increased understanding of the temporal variability that exists in the location of the uppermost fish can support more accurate determinations of 'potential fish habitat'. Between 2015 and 2020, we sampled 201 streams in forested watersheds in western Washington, USA, to assess annual and seasonal variability in the upstream extent of Cutthroat Trout (*Oncorhynchus clarkii*) distribution. Where the location of the uppermost detected fish changed relative to the original survey, we measured the distance to that previous last fish point and recorded stream habitat characteristics associated with the new uppermost fish point. Study results indicate minimal temporal variability in the upstream extent of fish distribution. Where variability did exist, movement was almost always incorporated into the extent of habitat likely to be used by fish that was identified in the original survey. Results from a logistic regression model indicated that where upstream bankfull width is 2 feet (0.61 m) and upstream gradient is 20%, the estimated probability of upstream fish movement (95% CI) is 0.10 (0.06, 0.18) for Lateral points and 0.30 (0.19, 0.43) for Terminal points. The estimated probability of upstream fish movement increases with increasing upstream bankfull width and decreasing upstream gradient.

Helping Beavers Help Us Restore Riverscapes: Insight from Beaver-based Restoration Projects in Washington and Colorado Watersheds. Alexa Whipple*, *Methow Beaver Project, 201 HWY 20, Twisp, WA 98856; alexa.mbp@methowsalmon.org;* Mark Beardsley, *Ecometrics, 15195 County Road 353c, Buena Vista, CO 81211; mark.ecometrics@gmail.com*

Riverscapes in North America were formed and maintained by the broad influence of hydrology, geology, and biology, but one biological organism is regarded as having influenced this biodiversity building triad more than any other: beavers, a quintessential keystone species. Most North American riverscapes are now degraded following historical extirpation of beavers and subsequent land use conversion following the fur trade. There is growing recognition and appreciation of beavers as masters in creating, maintaining, and restoring complex riverscapes for their benefit, while also benefiting people, biodiversity, and climate resilience. However, in many places, beaver populations are not making headway reestablishing in degraded riverscapes

and human=dominated environments on their own, even 150 years after the collapse of the nation building yet ecologically disastrous fur trade. Could beavers fare better with our help? Partnering with beavers to rebuild functional and resilient riverscapes is a practical and ecologically proven concept but requires thinking outside the box of traditional river restoration approaches, i.e., static, reach-based project design and economically driven single species recovery. Instead, Alexa demonstrates the need and practice of broader sustainable management of complexity, restoration of watershed scale natural processes, prioritizing ecosystem resilience and adaptation, modernizing critical keystone species management, and reconnecting social values with ecological sustainability. She highlights the practical aspects and challenges, successes and pitfalls of restoring sustainable riverscapes by partnering with beavers and people in Washington and Colorado Watersheds.

Association of Antler Asymmetry with Hoof Disease in Elk. Margaret A. Wild*, *Department of Veterinary Microbiology and Pathology, Washington State University, P. O. Box 647040, Pullman, WA 99164; margaret.wild@wsu.edu;* Glen A. Sargeant, *U. S. Geological Survey, Northern Prairie Wildlife Research Center, 8711 37th Street SE, Jamestown, ND 58401; gsargeant@usgs.gov;* Kyle Garrison, *Washington Department of Fish and Wildlife, P. O. Box 43141, Olympia, WA 98504; kyle.garrison@dfw.wa.gov*

Treponeme-associated hoof disease (TAHD) is an emerging disease affecting Elk (*Cervus canadensis*) in the U. S. Pacific West. Treponeme-associated hoof disease causes lesions that are usually restricted to the feet; however, anecdotal reports suggested increased prevalence of abnormal antlers in affected Elk. We used hunter harvest reports for 1,688 adult male Elk harvested in southwestern Washington during 2016–2018 to evaluate anecdotal reports. We used Akaike's Information Criterion to compare 18 logistic regression models describing the prevalence of asymmetrical antlers, indicated by unequal antler point counts. Our leading model (84% of model weight) described additive effects of TAHD and maximum number of antler points. Confidence intervals overlapped zero for all other parameters, which described ecotypic, geographic, and age-related effects. Effects of physical injury on antler development have been described elsewhere; however, injuries leading to instances of antler deformity do not have population-level management implications. In contrast, we describe effects of a transmissible disease that was reported by hunters in >35% of adult male Elk and was associated with an increase of at least 16 percentage points in the prevalence of antler asymmetry. Unequal point counts are not uncommon in Elk with otherwise typical antlers and seem unlikely to attract public notice or be attributed to hoof lesions; thus, we suspect our results and anecdotal reports reflect more prominent deformities that are important to stakeholders who enjoy hunting and viewing wildlife.

Associations between Hair Trace Mineral Concentrations and the Occurrence of Treponeme-associated Hoof Disease in Elk (*Cervus canadensis*). Steven N. Winter*, *Department of Veterinary Microbiology and Pathology, Washington State University, Pullman, WA 99164; steven.winter@wsu.edu;* Maria del Pilar Fernandez, *Paul G. Allen School for Global Health, Washington State University, Pullman, WA 99164; pilar.fernandez@wsu.edu;* Kyle R. Taylor, *Washington Animal Disease Diagnostic Laboratory, Washington State University,*

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Trace minerals are important for animal health. Mineral deficiency or excess can hinder immune function, wound healing, and hoof health in livestock, but normal concentrations and health impairment associated with mineral imbalances in wild animals are poorly understood. Treponeme-associated hoof disease (TAHD) is an emerging disease of free-ranging Elk (*Cervus canadensis*) in the U.S. Pacific Northwest. Selenium and copper levels identified in several Elk from areas where TAHD is established (i.e., southwest Washington) led to speculation that mineral deficiency may increase susceptibility to TAHD. Our objectives were to determine trace mineral concentrations using hair from Elk originating in TAHD affected areas of Washington, California, Idaho, and Oregon and assess their associations with TAHD. We identified limited associations between TAHD occurrence and severity with hair mineral concentrations in 72 free-ranging Elk, using Firth's logistic and multinomial regression models. We found consistent support for a priori hypotheses that selenium concentration, an important mineral for hoof health, is inversely associated with the occurrence of TAHD. Less consistent support was observed for effects of other minerals previously associated with hoof health (e.g., copper or zinc) or increased disease risk from potential toxicants. Trace mineral analysis of hair is a non-invasive sampling technique that offers feasibility in storage and collection from live animals and carcasses. For some minerals, levels in hair correlate with visceral organs that are challenging to obtain. Although our results revealed high variability in mineral concentrations between Elk, consistent relationship of possibly low selenium levels and TAHD suggest further investigations are warranted.

Advancing Protections for a Relict Population of Sharp-tailed Snakes (*Contia tenuis*) through Collaboration, Community Engagement, and Indigenous Monitoring. Veronica R. Woodruff*, *Stewardship Pemberton Society; vwoodruff@clearcourse.ca;* Leslie Anthony, *Independent Biologist, docleslie@me.com*

In August 2011, Canada's only known mainland population of Sharp-tailed Snake (*Contia tenuis*) was discovered in Pemberton, British Columbia, an inland valley roughly 200 km north of island-dwelling populations in the central Salish Sea, and about 350 km north of the nearest mainland record. This northernmost outpost of the spottily distributed *C. tenuis* is a presumptive post-Pleistocene relict of significant taxonomic and conservation interest. To date, 11 years of study in Pemberton involving ca. 1,000 h of search effort have revealed the species to be confined to suitable habitat along a 5-km transect of one landform. Most of the sites where *C. tenuis* has been found are threatened by rapidly encroaching residential development and an explosion of recreational pressure; several sites are already presumed extinct. Unfortunately, gaps in Canada's species-at-risk legislation, lack of provincial levers for protection, lack of capacity by the local municipality, and legal wrangling by developers have left this small isolate without inherent or pending protections. To address this population's vulnerability to multiple stressors, a local environmental NGO with limited resources initiated collaborative partnerships that have resulted in a series of positive outcomes. These include increased understanding of

distribution via both expert and citizen-science monitoring, community engagement and outreach, training and capacity-building with the Lil'wat First Nation, and stakeholder actions for managing land-use and recreational impacts. Although such a collaborative model appears to be the only way to currently address potential risks to *C. tenuis* in Pemberton, its greater speed and utility vs. the limited reach and protracted timeframes of formal protections may actually present a better standard for addressing such recently discovered species-at-risk.

Snake Fungal Disease on the Morley Nelson Snake River Birds of Prey National Conservation Area in Southwestern Idaho. Megan Yrazabal*, *Idaho Army National Guard, Boise, ID 83705; megan.yrazabal.nfg@army.mil*

Ophidiomycois or snake fungal disease (SFD) is an emerging pathogen in North America caused by the fungus *Ophidiomyces ophiodiicola*. SFD can cause severe lesions and often fatal fungal skin infections in wild snakes. Although SFD has predominantly affected snake populations in eastern North America, little is known about the spread of SFD across North America. We collaborated with the Department of Defense, Partners in Amphibian and Reptile Conservation, the Department of Defense Legacy Program, and the United States Geological Survey to assess the presence of SFD in southwestern Idaho on the Morley Nelson Snake River Birds of Prey National Conservation Area (NCA). The arid sagebrush steppe of the NCA has the highest snake richness in Idaho with 8 snake species. From 2018-2022, we swabbed a total of 132 individual snakes representing 7 species (*Crotalus oreganus, Pituophis catenifer, Coluber [Masticophis] taeniatus, Coluber constrictor, Rhinocheilus lecontei, Sonora semiannulata,* and *Thamnophis elegans*) for SFD on or near the NCA. Presence of *O. ophiodiicola* was determined through quantitative-PCR at the University of Illinois Wildlife Epidemiology Laboratory. Preliminary results revealed a positive detection of *O. ophiodiicola* on one *P. catenifer* in 2018. This is the first recorded case of SFD in Idaho.

POSTERS

Salish Sea Estuaries Avian Monitoring Framework. Trina Bayard*, *Audubon Washington, 5902 Lake Washington Blvd. S. Seattle, WA 98118; trina.bayard@audubon.org; Nicole Michel, National Audubon Society, 225 Varick St, New York, NY 10014; Nicole.michel@audubon.org; Gary Slater, Catie Porro, Ecostudies Institute, P.O. Box 1614, Olympia, WA 98507; glslater@ecoinst.org; cporro@ecoinst.org; Amanda Summers, Stillaguamish Tribe, 22712 6th Ave NE Arlington, WA 98223; asummers@stillaguamish.com; Kyle Spragens, Washington Department of Fish and Wildlife, 1111 Washington St SE, Olympia, WA 98504; Kyle.Spragens@dfw.wa.gov*

The Salish Sea Estuaries Avian Monitoring Framework is a collaboration of the Stillaguamish Tribe, Audubon Washington, Ecostudies Institute, and Washington Department of Fish and Wildlife. The Framework is part of a multi-year effort to support avian management and conservation in the region and was designed with the interests and capacity of end-users in mind. The ecological goal of the framework is to determine regionally specific avian habitat associations and patterns of estuary habitat use that informs site protection, restoration, and conservation efforts, evaluation of avian response to management, and informs modeling to predict the effects of climate change. The sampling design and survey protocols are focused on avian use of low marsh habitats. Target species groups include waterfowl, shorebirds, landbirds, and secretive wetland birds. There are distinct survey modules and survey protocols for the four target species groups that can be implemented on their own or in combination. Our vision is that by working together on a shared monitoring goal we can generate complimentary data sets that help elucidate avian habitat associations and meet long-standing stakeholder information needs for estuary management and restoration.

Coastal Tailed Frog Population Declines in Western Washington Managed Forests Eight Years After Timber Harvest. Wesley T. Bowens*, Aimee P. McIntyre, Reed Ojala-Barbour, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; wesley.bowens@dfw.wa.gov; aimee.mcintyre@dfw.wa.gov; reed.ojala-barbour@dfw.wa.gov;* Jay E. Jones, *Weyerhaeuser, 220 Occidental Ave. S, Seattle, WA 98104; jay.jones@weyerhaeuser.com;* Timothy Quinn, *Washington Department of Fish and Wildlife; 1111 Washington Street Southeast, Olympia, WA 98501; timothy.quinn@dfw.wa.gov;* Andrew J. Kroll, *Weyerhaeuser, 785 N 42nd Street, Springfield, OR 97478; aj.kroll@weyerhaeuser.com;* Marc P. Hayes, *Aquatic and Herpetological Consultants, 1574 Brentwood Dr, Eagle Point, OR 97524; aardvarkdiners33@gmail.com*

Coastal Tailed Frog (*Ascaphus truei*) is a stream-associated amphibian endemic to the headwaters of the Pacific Northwest. Tailed frogs have a long reproductive development period, rely on clear, flowing headwaters for reproduction, and can live up to 20 years. We experimentally evaluated the effectiveness of the current Washington State Forest Practice's riparian buffer requirements for non-fish-bearing streams in maintaining stream-associated

amphibian populations. We evaluated instream amphibian densities before and after clearcut timber harvest with alternative riparian buffer treatments and unharvested references in three pre-harvest years (2006-2008), one and two years post-harvest (2009-2010), and again seven and eight years post-harvest (2015-2016). In the first two years post-harvest, we documented no clear evidence of a change in larval tailed frog densities. However, larval Tailed Frogs declined an estimated 65-93% across all three riparian buffer treatments – including the most protective treatment – seven and eight years post-harvest. In response to these results, Forest Practices policy makers prioritized additional amphibian monitoring 14- and 15-years post-harvest. We are currently in our second of two years of continued monitoring for amphibian densities at our long-term study sites, with study results anticipated in 2024.

Parenting is No Yolk: Nesting Behaviors of Bushtits (*Psaltriparus minimus*) on the Seattle University Campus. Cecelia Bresee,* Catherine Gerst,* Brooke Milder, Gabe Veltri,* and Rebecca Hartley, *Department of Biology, Seattle University, 901 12th Ave, Seattle, WA, 98122; rhartley@seattleu.edu*

Bushtits (*Psaltriparus minimus*) are small gray passerine birds that are year-round residents in western Washington. These birds build unique hanging nests using moss, twigs, and lichen held together with spider webs (or synthetic fibers); nests are lined with feathers or plant fluff. We have been studying Bushtit nest activity on our urban campus for the past 4 years, using a video camera to sample adult behavior for 10-min intervals twice weekly between 8:00 am and 4:00 pm. Males and females can be distinguished by eye color and their beak contents are sometimes visible. Average clutch size has been reported to be 5-6 eggs. Using handwritten field notes and video analysis, we determined visit frequency, occupancy time, and individual contributions by males and females for 26 successful nests. Adult Bushtits visit the nest more frequently for shorter intervals as the brood progresses from newly hatched chicks to fledglings. Specifically, during nest building, egg laying, and incubation, we observed an average of one visit per ten minutes. During the nestling phase, adults gradually increased their efforts to nearly five visits per ten minutes prior to fledging. Adult Bushtits spent over half of the observation time inside the nest during the incubation and early nestling phases and spent the least amount of time in the nest during the six days prior to fledging. Males and females together support the developing young at an estimated rate of 25+ food deliveries per hour during the nestlings' final week of growth before fledging.

Staqeya: the Lone Wolf at the Edge of its Ecological Niche. Dylan Collins*, *The Tulalip Tribes 6406 Marine Dr, Tulalip, WA 98271 USA; dcollins@tulaliptribes-nsn.gov*; Cheryl Alexander, *Wild Awake Photography, 5010 Lockehaven Drive, Victoria, BC V8N 4J5 Canada; cheralexander@gmail.com;* Chris T. Darimont, *Department of Geography University of British Columbia, Box 1700, Stn CSC, Victoria, BC, V8W 2Y2 Canada; darimont@uvic.ca*

Employing non-invasive research techniques, we report on the range, foraging habits, and social biology of Staqeya; a lone wolf (*Canis lupus*) named by the Songhees Nation, that inhabited a tiny archipelago adjacent to a major city in coastal British Columbia. The unique

ecological and social-cultural context prompted us to reconsider the spatial ecology, dietary niche, and sociality of wolves, as well as to reflect on human coexistence with carnivores.

In Situ Treatment of Juvenile Cascades Frogs for Chytridiomycosis Can Reverse Population Declines. Kimberly Cook, *School of Biological Sciences, Washington State University, 14204 NE Salmon Creek Ave, Vancouver, WA 98686-9600; kimcook219@gmail.com;* Karen Pope, *Pacific Southwest Research Station, United States Forest Service, 1700 Bayview Drive, Arcata CA 95521-6013; karen.pope@usda.gov;* Adam Cummings, *Pacific Southwest Research Station, United States Forest Service, 1700 Bayview Drive, Arcata CA 95521-6013; adam.cummings@usda.gov;* Jonah Piovia-Scott*, *School of Biological Sciences, Washington State University, 14204 NE Salmon Creek Ave, Vancouver, WA 98686-9600; jonah.piovia-scott@wsu.edu*

Effective management of wildlife populations threatened by disease requires accurate predictions about the consequences of intervention. However, generating such predictions is challenging, especially for organisms with complex life histories that are also threatened by climate change, including many montane amphibians. Cascades Frogs (*Rana cascadae*) in northern California have experienced dramatic declines associated with the fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*), and remnant populations are also threatened by changing climate conditions. We evaluated the population-level impacts of treating Cascades Frog metamorphs with the antifungal chemical itraconazole using a field experiment and population simulations. We explored the influence of larval habitat on these treatment effects by including metamorphs from different larval habitat types. We found that frogs treated with itraconazole were more than four times more likely to survive their first winter than untreated controls and had reduced *Bd* infection intensity compared to other surviving frogs from the same cohort in the following year. We also found an effect of larval habitat type on *Bd* infection in recently metamorphosed frogs, with the lowest levels of infection occurring in frogs emerging from larval habitats that tend to be intermediate in temperature and drying rate. Applying the differential apparent overwinter survival of treated and untreated metamorphs to population projections suggests that intermittent antifungal treatment of metamorphs has the potential to restore population viability. Our results indicate that in situ treatment of individual hosts may be a useful component of a comprehensive management strategy to reduce the risk of pathogen-mediated population declines and extirpations.

Cispus River Elk Forage Management and Monitoring. Alex D. Foster*, *US Forest Service, PNW Research Station 3625 93rd Ave SE Olympia, WA; alex.foster@usda.gov;* Thomas D. Stokely, *The Nature Conservancy, 554 NE Irving Ave Bend, OR 97701; thomas.stokely@gmail.com*

Since the adoption of the Northwest Forest Plan, forest management on US federal lands in western Oregon and Washington generally forgo regeneration harvest in favor of thinning. Recently, variable density thinning (VDT) has been planned and implemented as a way of increasing forest diversity, moving forest stands toward old-growth and early seral gap disturbance characteristics, while simultaneously providing timber outputs. VDT involves the creation of canopy gaps and skips of various sizes as a way of increasing forest diversity. The general effects of VDT on forage production for native ungulates like Roosevelt Elk (*Cervus canadensis roosevelti*) are not well quantified in the Pacific Northwest. Likewise, effects on Elk

foraging behavior, and ungulate herbivory in general, are not well understood in a VDT context. Along the critical Elk winter range of the Cipsus River near Randle, WA, we used camera traps and vegetation surveys to determine how Elk use various gap sizes (2-9 acres, unplanted) compared to thinned and unharvested areas. We also sought to determine how native early seral vegetation re-growth plays a role in seasonal forage utilization. Initial surveys indicate that gap size and relative landscape configuration of VDT harvest units altered the foraging behavior of Elk, although cover to forage distances and proximity to roads are likely predominant factors in their use of closed-canopy forest, thinned stands and gaps. Large gaps and heavy thinning provided crucial summertime forage for Elk although many early successional shrubs were slow to respond to the harvests, potentially due to the high levels of herbivory observed during fall, winter, and spring. Therefore, larger gap harvests with strategic forage plantings may be necessary for sustaining forage regeneration in forested landscapes that provide overwintering Elk habitat, such as in westside Cascade localities like the upper Cispus River.

Community Reporting and Camera Traps Identify Habitat and Human Demographic Factors That Affect Urban Wildlife Distributions. Mercedes Garcia*, *Seattle University Department of Biology, 901 12th Avenue, Seattle, WA 98122; mgarcia3@seattleu.edu;* Sofia Ugarte*, *sugarte@seattleu.edu;* Taylor Umetsu, *tumetsu@seattleu.edu;* Mark J. Jordan, *jordanma@seattleu.edu*

Community reports of wildlife and camera traps are effective tools to monitor the impacts of urbanization on carnivores. Although community reports are not systematic, they can yield far more data points than camera traps. When reports are coupled with verifiable evidence, such as photographs, they are a good source of complementary data to a camera trapping study. We placed camera traps in a systematic array in urban, suburban, and exurban parks in the Seattle/Tacoma metropolitan area and collected community reports from this same region with the Carnivore Spotter website. We investigated human demographic factors that might affect reporting rate on Carnivore Spotter including race, income, and education level. We also compared the detection rates of different species between the two methods and estimated the effect of human demographic and habitat factors on species occupancy. Camera traps yielded estimates that allowed us to systematically test hypotheses about the effects of urbanization on occupancy. Carnivore Spotter data yielded more data points, though some regions were undersampled with a bias toward reports coming from higher income neighborhoods. More inclusive outreach efforts are necessary for community science projects to meet the coverage and study design considerations that can be built into a camera trapping study. Nevertheless, community science data provide a valuable supplemental source of data for urban wildlife researchers.

In-stream Breeding Conditions of the Western Toad (*Bufo = Anaxyrus boreas*) Across Washington's Chehalis Basin. Hannah Hougan*, *Washington Department of Fish and Wildlife, Post Office Box 43143, Olympia, WA 98504; Hannah.Hougan@dfw.wa.gov;* Kelly Perry*; *Kelly.Perry@dfw.wa.gov;* Julie A. Tyson; *Julie.Tyson@dfw.wa.gov;* Keith A. Douville; *Keith.Douville@dfw.wa.gov;* Marc P. Hayes; *Aquatic and Herpetological Research Consultants,*

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The Western Toad (*Bufo = Anaxyrus boreas*) is a Washington Species of Greatest Conservation Need (SGCN) and Priority Species. This amphibian is also a target species in the Chehalis Basin's Aquatic Species Restoration Plan (ASRP). We have conducted Western Toad instream breeding surveys to inform ASRP adaptive management goals for this species and other co-occurring aquatic species. Further, our work supports Programmatic Environmental Impact Statement and project-specific Environmental Impact Statement development for a proposed flood retention (dam) project. Because of the unique in-stream breeding of Chehalis Basin Western Toads, our surveys also inform restoration efforts in the Chehalis floodplain. From 2014-2022, we conducted basin-wide surveys for Western Toads, surveying 704 river miles over 9 years, of which 74 miles were re-sampled. The primary breeding locations include the upper Chehalis mainstem and its major tributaries in the Willapa Hills and Olympic Mountains. The mainstem Chehalis had the highest density of toad breeding overall. Breeding densities were relatively similar across streams in the Olympics and to the East Fork and West Fork Chehalis. Our analyses have found that Western Toads favor microhabitats within pools that are shallow (below 20cm and often below 10cm deep) and slow moving (typically below 0.001 cm/sec). Future restoration activities targeted at toads may benefit from creating or targeting sites with these microhabitat conditions. Importantly, toad breeding frequently co-occurs with juvenile coho salmon microhabitat use, which may mean that Western Toads may be a sensitive indicator species for Coho Salmon habitat conditions and restoration efficacy.

Microbe Surveillance in the Amphibian Pet Trade: Results from a Pilot Study. Robert A Pearhill*, *Washington State University, PO Box 644236, Pullman, WA 99163; robert.pearhill@wsu.edu;* Joshua Jones, *Pet Advisory Network, 1615 Duke Street Suite 100, Alexandria, VA 22314; Josh@petadvocacy.org;* Matt J. Gray, *Center for Wildlife Health University of Tennessee, 2505 E. J. Chapman Drive, Room 427 Knoxville, TN 37996; mgray11@utk.edu;* Jesse L Brunner, *Washington State University, PO Box 644236, Pullman, WA 99163; jesse.brunner@wsu.edu*

It is widely acknowledged that regional and global trade of live animals contributes to the spread and emergence of pathogens like *Batrachochytrium salamandrivorans* (*Bsal*), *B. dendrobatidis* (*Bd*), and *Ranavirus* spp. (*Rv*). Yet beyond small portions of large, complex trade networks (e.g., bullfrogs in U.S. ports, exotic amphibians sent through Hong Kong markets) little is known about how pathogens are amplified or diminished, or even how common they might be. As part of a larger effort to understand the amphibian pet trade in the U.S.A., we sent amphibian sampling kits to 14 businesses that volunteered to participate in an anonymous surveillance program. Kits contained a mix of animal swabs and environmental DNA (eDNA) filters commensurate with the number of terrestrial or aquatic housings present at a given business, as well as detailed written and video instructions. We tested returned samples for the presence of *Bd*, *Bsal*, *Rv*, and the beneficial microbe *Janthinobacterium lividum* (*Jliv*) with standard quantitative real time PCR (qPCR) assays. Of the 14 businesses that were shipped DNA collection supplies, eight returned samples. *Bd* was found in samples from two facilities, while

Bsal, *Rv*, and *Jliv* were ultimately undetected. A qPCR assay targeting a highly conserved region of vertebrate DNA (EBF3N) was used to validate successful sample collection across all sites. The results of this pilot study highlight the feasibility of sampling the pet trade more comprehensively, as well as an interest in such surveillance within the industry.

Preliminary Findings of a Long Term Freshwater Turtle Population Study on Lake Washington, Seattle. Joseph J Pignatelli III*, *Turtle Survival Alliance, 1030 Jenkins Rd. Ste. D, Charleston, South Carolina 29407, USA; and Puget Sound Energy, 6500 Ursula Place S., Seattle, Washington 98108, USA; Jpignatelli3@Gmail.com*

We established a long-term turtle population monitoring project at a site along Lake Washington, Seattle in 2021. We collected data on turtle species, sex, morphometrics, health, and age class, and compared our capture data to similar data collected in 1995 by the Washington Department of Fish and Wildlife. We identified similar species and captured them in similar numbers. We also collected leeches to assist USGS with a freshwater leech survey and collected blood samples to assist an international genetics study. The data collected will be built on and surveys will continue to allow TSA-NAFTRG to better understand the turtle populations of our study location.

Development of a Management Plan for the Western Painted Turtle at the Sandy River Delta, Oregon. Emma Scott*, *Portland State University, 1825 SW Broadway, Portland, OR 97201; emmscott@pdx.edu*

The Western Painted Turtle (*Chrysemys picta bellii*) inhabits a small wetland complex within the Sandy River Delta, a public park and natural area located at the confluence of the Sandy and Columbia Rivers in Troutdale, Oregon. Its population in this area has declined within the last century due to habitat fragmentation and degradation, with current population size and nesting locations unknown. We used presence/absence and hoop-net surveys in 2022 and 2023 to determine aquatic site locations of Western Painted Turtles at the Sandy River Delta. We identified several individual adult Painted Turtles at three aquatic sites within the park. Population size and nesting locations were not determined. Sites were evaluated and assigned rankings based on habitat suitability. These rankings were determined based on habitat features necessary to support basic life functions and successful reproduction of Western Painted Turtles. Survey results and habitat evaluations were then used to construct a management plan to be implemented by the Lower Columbia Estuary Partnership. This plan will be used to guide and inform actions for continued population monitoring and improvement of habitat for the Western Painted Turtle at the Sandy River Delta.

Movement of Coastal Tailed Frog Larvae Associated with Interstate 90. Marianne Thompson*, *PO Box 1491, Ellensburg, WA 98926*; *marianne.thompson@cwu.edu;* Jason T Irwin, *Biological Sciences, Central Washington University, 400 East University Way, Ellensburg, WA 98926; irwinj@cwu.edu*

Our study focuses on the movement of Coastal Tailed Frog larvae (*Ascaphus truei*) in streams that intersect I-90. Streams included in our study have been or will be improved from culverts to bridges with artificial streambeds as part of the I-90 Snoqualmie Pass East Project. *Ascaphus truei* inhabit cold, swift streams where larvae cling to large rocks with their suctorial mouths. This study included the capture, measurement, photographing and geolocation of individual larvae during multiple surveys of the same stream. Recaptured larvae were

identified by their unique tail markings. Of the two recaptured larvae, the first moved 4.2m upstream in 9 days, and the second moved 4.9m downstream over a period of 24 days. In the stream with the highest density of larvae, they were often found in clusters with larger body individuals located in the downstream portion of the cluster. Further research will continue to study the impacts of additional phases of the I-90 project on the population size and movements of *A. truei.*

Monitoring the Effectiveness of Beaver Dam Analogues as a Stream Restoration Tool in Western Washington. Daniel Trovillion*, Reed Ojala-Barbour, Tristan Weiss, and Aimee McIntyre, *Washington Department of Fish and Wildlife, 1111 Washington St SE, Olympia, WA 98501; Daniel.Trovillion@dfw.wa.gov;* Jamie Glasgow, *Wild Fish Conservancy, 15629 Main St NE, Duvall, WA 98019*

Human activities such as stream channel straightening, wood removal, and wetland filling have substantially altered western Washington watersheds contributing to stream channel incision and loss of floodplain wetland habitat, impacting native aquatic biota. Beaver (*Castor canadensis*) play a critical role in forming and maintaining floodplain wetlands, but Beaver trapping and deliberate dam removal have limited beavers' ability to establish these habitats. Beaver Dam Analogues (BDAs) are a processed-based restoration technique designed to mimic the form and function of natural Beaver dams by creating pools and wetland habitats and have been shown to restore a suite of ecological functions and provide hydrologic benefits in snowmelt-dominated arid streams. However, implementation and monitoring of BDAs in rain-dominated temperate streams like those found in the Chehalis Basin has been minimal. We are conducting pre- and post-installation monitoring along four streams treated with BDA structures within the Chehalis Basin, with construction planned for summer 2023. Monitoring will evaluate physical, hydrologic, and biological changes to aquatic habitats in response to BDA installation. Specifically, this work will use data loggers in conjunction with species distribution surveys and physical habitat monitoring to evaluate whether BDA structures increase: 1. fluvial habitat complexity, 2. floodplain connectivity, 3. thermal refugia opportunities for aquatic species, and 4. Beaver dam building. Our results will inform how BDAs can maximize habitat improvements for salmonids and other native aquatic and semi-aquatic species in Western Washington as a part of the Chehalis Basin Aquatic Species Restoration Plan, a multi-decade restoration endeavor in western Washington.

Forest Management on Washington Department of Fish and Wildlife Lands. Richard Tveten*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; Richard.Tveten@dfw.wa.gov*

The Washington Chapter of The Wilderness Society gave a 2021 Stewardship Award to the Washington Department of Fish and Wildlife's Forest Management Team. This poster describes the work associated with that award. It shows the locations of all 23,000 acres of forest health thinning and burning treatments that have been conducted on agency lands since 2015. Before and after photographs are included to show how these treatments have restored forest structure and fuel levels. Case histories are also provided for locations where wildfires burned

into treated areas to illustrate the effectiveness of different treatments in altering fire behavior and increasing forest resiliency.