ABSTRACT TABLE OF CONTENTS

A * immediately before the abstract title denotes a student poster. Posters will be hung by number in the poster session.

Effects of Temperature on Northern Red-legged Frog Tadpole Survival. Jessica Abbott*, *abbott@iws.org*; Brian Hudgens, *hudgens@iws.org*; and Kelcy McHarry, *mcharry@iws.org*, *Institute for Wildlife Studies, PO Box 1104 Arcata, CA 95518.*

Understanding how climate variables influence the demographic rates of sensitive species is the first step in predicting how climate change might impact their population viability in the future. We estimated the daily survival probability of Northern Red-legged Frog (*Rana Aurora*) tadpoles across three sites using capture-mark-recapture (CMR) methods. The three sites spanned a latitudinal range from Mendocino County, CA to Linn County, OR. We used visible implant elastomer (VIE) tags to mark tadpoles with a unique identifier for CMR analyses. We tagged a total of 1466 tadpoles across all sites and recapture rates ranged from 0.11 to 0.30. Average daily survival probabilities across the tadpole season were fairly consistent across sites and ranged from 0.976 to 0.979, but varied from week to week within each site. We also explored the influence of air temperature on tadpole survival probabilities and found that tadpole survival increased with temperature at the mid-latitude site. We found little evidence of a relationship between temperature and survival at the other two sites, however there was some indication that survival decreased at temperatures greater than 22º C at the highest latitude site. This data will be used in combination with data on other life stages (eggs, metamorphs, and adults) and from subsequent years, to create population dynamic models, which will be linked to climate projection models, and evaluated to determine how climate change will affect population persistence.

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

The Foothill Yellow-legged Frog (*Rana boylii*, FYF) relies on river edgewaters for reproduction, timing its oviposition with hydrograph cycles to minimize scour and desiccation risks to eggs while maximizing development time for offspring. Individual frogs initiate breeding using a suite of environmental cues. Dams can decouple the hydrology, hydraulics, and thermal regimes from other natural environmental cues, hampering oviposition choices of breeding FYF and thus diminishing reproductive success. Managing water resources for biotic benefits downstream requires insight on how organisms will respond to alternative flow release schedules. Climate and flow modeling simulations are often used to predict river conditions under a given flow release schedule and set of meteorological conditions. The Foothill Yellow-legged Frog Assessment Model (FYFAM, developed using support from US Forest Service) uses water temperature, depth, and velocity outputs from hydrologic, hydraulic, and water temperature models to assess potential differences in reproductive success under various hydrograph scenarios. FYFAM uses cell-specific environmental inputs and probabilities to simulate decisions by virtual frogs and tadpoles, and predicts developmental rate of eggs and

tadpoles on a daily time step. Currently, FYFAM simulations end at metamorphosis. Number of froglets produced per breeder and median date of metamorphosis are the metrics used for comparing hydrograph scenarios. As an example, we applied FYFAM to a time series of hydrograph scenarios, based on actual meteorological conditions in California's upper Tuolumne River. Model results suggest springtime water temperature and timing of high flows interact to influence reproductive success for this river-breeding frog.

Implementation of Oregon's Native Turtle BMPs: Case Studies & Lessons Learned. Susan Barnes*, *Oregon Department of Fish and Wildlife, West Region Office, 17330 SE Evelyn St., Clackamas, OR 97015*; susan.p.barnes@state.or.us

The Western Pond Turtle (*Actinemys marmorata*) and the Western Painted Turtle (*Chrysemys picta bellii*) are identified as Species of Greatest Conservation Need in Oregon's State Wildlife Action Plan. There has been growing demand for standard prescriptions for turtle habitat elements that can be incorporated into project designs to benefit these at-risk species, as well as for known techniques that successfully avoid/minimize harmful effects to turtles during the project construction implementation phase. In response, Oregon's Native Turtle Working Group produced "*Guidance for Conserving Oregon's Native Turtles including Best Management Practices*". Since its release in 2015, ODFW's conservation partners including private landowners are increasingly looking to the BMPs for insight and direction. Deliberate actions are being taken to incorporate recommended conservation actions into all types of projects, from off-channel/floodplain habitat restoration projects and culvert replacements to recreation trail development projects and invasive species control efforts. This presentation will highlight Turtle BMPs Case Studies – several actual on-the-ground projects that can serve as models for natural resource managers, project planners, and others interested in participating in native turtle conservation. The Case Studies will show how Oregon's Turtle BMPs were incorporated, starting from the conceptual design phase all the way to project implementation. Methods, results, and lessons learned will be presented.

Do native consumers mediate yellow bush lupine invasion and restoration? Daniel Barton*, Erik Liebrecht, Kyla Winthers-Barcelona, Elizabeth Elkinton, Ryan Baumbusch, Justin Deminaew, Kyla Garten, and Aliya McCarthy, *Department of Wildlife, Humboldt State University, 1 Harpst Street, Arcata, CA 95521; daniel.barton@humboldt.edu*

Native consumers may partly mediate the effects of plant invasion and restoration. Yellow bush lupine (*Lupinus arboreus*) invades northwestern California coastal dunes with demonstrable effects on ecosystem processes and native plant diversity, yet whether native consumers mediate these effects is unknown. We tested how small mammals affect lupine and native plant seed predation and germination, how small mammal populations and consumption respond to lupine removal, and the preferences of native seed consumers. Exclosure experiments revealed consumers negatively affected lupine and native plant germination across native and invaded plant associations. Natural experiments showed distance to mature lupine shrubs negatively affected lupine seed predation and small mammal capture frequency. Lupine removal experiments found small mammal abundance and seed predation were both remarkably high in a heavily invaded community, yet responded rapidly to manual lupine removal, and observational

study of lupine re-invasion following restoration showed recovery of small mammal communities over time. These experiments suggest that the process and effects of yellow bush lupine invasion and restoration are likely partly mediated by small mammals, yet further questions remain.

The Historical Distribution and Current Natural History of Porcupines in Northern California. Cara Appel *Humboldt State University, 1 Harpst St., Arcata, CA 95521; Cara.Appel@humboldt.edu;* William Zielinski *USDA Forest Service, 1700 Bayview Dr. Arcata, CA 95521; bzielinski@fs.fed.us;* Fredrick Schlexer *USDA Forest Service, 1700 Bayview Dr. Arcata, CA 95521; rschlexer@fs.fed.us;* Richard Callas *California Department of Fish and Wildlife, 1724 Ball Mountain Rd., Montague, CA 96064; Richard.Callas@wildlife.ca.gov;* William "Tim" Bean* *Humboldt State University, 1 Harpst St., Arcata, CA 95521 bean@humboldt.edu*

The North American Porcupine (*Erethizon dorsatum*) is one of the most widespread mammal species on the continent. However, very little is known about their status or ecology in California, at the southwestern edge of their range. Anecdotal evidence has suggested a drastic decline in the state and throughout the Pacific Northwest over the past two decades, but the causes and consequences are unclear. Here, we present results from two complementary studies. First, we collected historical and contemporary occurrence records for porcupines throughout northern California to document minimum known ranges over the past century. Second, we conducted an intensive study of habitat selection and diet in an apparently robust population in Tolowa Dunes State Park, Del Norte County. We found that, in contrast to some range maps, porcupines have been widely distributed throughout northern California for at least a century. While most records of porcupines were found in wooded areas of the Coast Ranges, Cascades and northern Sierras, they were also found in riparian areas of the Sacramento Valley. Porcupines in Tolowa Dunes followed the general pattern for Porcupine seasonal habitat selection and diet, spending most of their time in broad-leaved willow forests in summer and moving to conifers and open grasslands in the winter. Porcupines lost weight from summer to winter, but unlike in other parts of their range, this loss began much earlier in the fall. This work provides a base of information for better understanding the status and distribution of the North American porcupine in the West.

Impacts of Marijuana Cultivation on Aquatic Resources, with an Emphasis on Anadromous Fish. Patricia (Tricia) Bratcher*, *California Department of Fish and Wildlife, 601 Locust Street, Redding, CA 96001; Patricia.Bratcher@wildlife.ca.gov;* James Harrington, *California Department of Fish and Wildlife, Aquatic Bioassessment Lab, 2005 Nimbus Rd., Rancho Cordova, CA 95670; James.Harrington@wildlife.ca.gov;* Roy (Trey) Sherrell, *Regional Water Quality Control Board Region 5, 364 Knollcrest Drive, Suite 205, Redding, CA 96002; Roy.Sherrell@waterboards.ca.gov*

This study is intended to increase understanding of the effects that cultivation has on the nearby aquatic environment, with an emphasis on anadromous fish and more specifically, spring-run Chinook salmon *(Oncorhynchus mykiss) and* Central Valley Steelhead *(Oncorhynchus mykiss),* both listed species. The study site is located in Deer Creek watershed, Tehama County. Goals include (1) seeing if there is an effect on anadromous fish from marijuana cultivation

practices; (2) developing sampling protocols for use in assessing impacts in the future; and (3) determining the extent of impact from marijuana cultivation versus other land uses or natural perturbations. Study design and preliminary results will be shared, as well as the challenges such a study can face if others plan to study illegal grow sites.

*** Using Passive Integrated Transponder (PIT) Tags to Achieve Remote Detection of *Ensatina eschscholtzii*.** Christian E. Brown*, John O. Reiss, *Humboldt State Department of Biological Sciences, 1 Harpst St, Arcata, CA 95521; ceb525@humboldt.edu, john.reiss@humboldt.edu;* James Campbell-Spickler, *Eco-Ascension Research and Consulting, 1181 Nelson Way, McKinleyville, CA 95519; jim@eco-ascension.com*

For decades researchers have demonstrated the extensive use of subterranean burrows by terrestrial salamanders; however, limitations associated with tracking small vertebrates have led to a plateau in our understanding of terrestrial salamander habitat use while in their fossorial niche. Using newly developed passive integrated transponder (PIT) tags from Biomark, we tagged over 50 free-ranging Ensatina Salamanders (*Ensatina eschscholtzii*) from October 2015 to March 2016 and used HPR Plus PIT tag readers connected to BP Plus portable antennas from July 2016 to January 2017 in order to test the efficacy of remote detection of fossorial salamanders and track their movements across the landscape over time. Lab trials coupled with field investigations suggest no adverse effects of 8mm PIT tags on adult Ensatinas. Field surveys indicate that individuals were stationary during the dry summer months and no evidence suggesting that the animals remain active in fossorial systems was observed. Movement resumed when the rains arrived, although no distinct pattern in movement or burrow-philopatry has been observed to date. Furthermore, we saw an increased recapture rate using remote detection compared to visual cover-object surveys, both of which are encouraged over pit-fall traps and drift fences that disrupt amphibian movements and perhaps influence their habitat use. Our work offers a promising look into the advantages of using PIT tags to mark small plethodontids, and has already been applied to ongoing mark-recapture studies of the Wandering Salamander (*Aneides vagrans*) in the old-growth redwood canopy.

***Analysis of Abiotic Factors Influencing the Rate of Metamorphosis in the Great Basin Spadefoot Toad*, Spea intermontana,* in Eastern Washington State**. Corey Brumbaugh*, *Central Washington University, 400 E. University Way Ellensburg, WA 98926-7537; brumbaughc@cwu.edu*; R Steven Wagner; *WagnerS@cwu.edu;* Wayne S. Quirk; *QuirkW@cwu.edu;* Robert E Weaver*; weaverro@cwu.edu;*

Eastern Washington State has a wide variety of macro habitat types, from dense high elevation spruce-fir stands to Ponderosa Pine forests and shrub-steppe desert. However, agricultural lands, including annually irrigated crop fields, orchards, vineyards, and livestock farms are prominent features in this region. Recreational lands such as dunes are also found at scattered locations in the mid-Columbia Basin. Such areas are generally not considered suitable habitat for a number of species of amphibians and reptiles. However, anecdotal evidence suggests that the Great Basin Spadefoot Toad, *Spea intermontana*, is distributed among these agricultural and recreational sites. Our recent survey work has shown *S. intermontana* utilizing ephemeral ponds, narrow, water-filled tire tracks and small irrigation seeps for breeding at one such recreational site, the Beverley Dunes located near Beverley, Grant County, WA. The

purpose of our study was to examine the effects of temperature and water levels on survivorship, and rate of metamorphosis of tadpoles of *S. intermontana.* To conduct our study we collected egg masses and reared tadpoles under these varying abiotic conditions in the lab. We gathered data on rates of development, survival, body mass, snout-vent length, and hind leg length of metamorphs under 3 treatments: control, increasing temperature, decreasing water level, and a combination of these latter factors. Our findings show that temperature is the main factor influencing the time to survivorship and the rate of metamorphosis in *S. intermontana* in Washington State.

Restoring a species lost: an update on the Washington Cascade fisher project. Tara Chestnut, *Mount Rainier National Park, Ashford, WA 98304; Tara_Chestnut@nps.gov;* Jeffrey C. Lewis, *Washington Department of Fish and Wildlife, Olympia, WA 98501; Jeffrey.Lewis@dfw.wa.gov;* Jason Ransom, *North Cascades National Park, Sedro Woolley, WA 98284; Jason_I_Ransom@nps.gov;* David Werntz, *Conservation Northwest, Bellingham, WA 98225; dwerntz@conservationnw.org.*

Fishers (*Pekania pennanti*) were extirpated from Washington as a result of over-trapping, habitat loss, and predator eradication programs. A mid-sized member of the weasel family, fishers occurred in the coniferous forests of Washington until the early and mid-1900s. We established a partnership between federal, state, and non-profit organizations with the goal to restore fishers to their former range in Washington. This partnership reintroduced 90 fishers from British Columbia to Olympic National Park from 2008 to 2010, and we are now in the second year of a reintroduction project to restore fishers to Mount Rainier National Park (MRNP), Gifford Pinchot National Forest (GPNF) and the larger South Cascade Ecosystem. In Year 1 of the project, we released 23 fishers (11 F, 12 M; each with a radio-transmitter) at a single release site on the GPNF and we monitored their movements and survival via aerial and ground telemetry. So far in Year 2, we have released an additional 37 fishers (18 F, 19M; each with a radio-transmitter) including 16 (8 F, 8M) in MRNP and 21 (10 F, 12 M) in the GPNF. In the Year 1 cohort, we've relocated individual females an average of 19 times (range 2-30, standard deviation 8.6) and males 12 times (range 5-22, standard deviation 6.5). We documented an apparent survival rate of 78.3% (5 deaths of 23 released) in the Year 1 cohort, and surviving individuals appear to have localized. We did not document reproduction in Year 1, however nearly all released animals were age 0-1 in that time period. Year 3-5 of the project aims to release 80 fishers in the North Cascade Ecosystem, with continuing monitoring across both restoration areas.

***Pond Filling as a Method of Bullfrog (*Lithobates catesbeianus*) Control on the Mad River (Humboldt Co., CA, USA): Effectiveness and Considerations.** Madeline Cooper* and Sharyn Marks, *Humboldt State University, 1 Harpst St., Arcata, CA 95521, mcc31@humboldt.edu*

Bullfrogs are an invasive species in California, where they are known to have deleterious effects on native species. Carnivorous adults prey on native amphibians and fish, while herbivorous tadpoles outcompete native tadpoles for algal food resources. Bullfrogs have been successful at colonizing pools left over from mining activities; these relict pools are common on many California rivers. Information on the dispersal capabilities of Bullfrogs could inform management and population control decisions. Unfortunately, this information is lacking from

both their native and invasive range. From May to August of 2015, we used radio telemetry to track 29 Bullfrogs located in two gravel mining pools (164 m apart) on the lower Mad River in western Humboldt County, CA. Four frogs (14%) switched between the two ponds over the three-month tracking period. We did not observe any frogs using the river channel or seasonal wetlands. The mean home range size was 1,600 square meters and did not differ by sex or age class. As a Bullfrog removal effort, both ponds were filled in September 2015 by the California Department of Fish and Wildlife. Based on the timing of breeding and metamorphosis, as well as the lack of summer movements observed in this study, pond filling may be most effective as an eradication tool between the culmination of egg laying and the end of metamorphosis. In the year after ponds were filled, Bullfrogs did not return to the survey area, even when old pond sites contained water, or when nearby off-channel pools were present.

Assessing the Impact of Illegal Pesticide Use on National Forest Headwater Stream Communities. Karen Pope, Adam Cummings*, *US Forest Service Pacific Southwest Research Station, Arcata, CA 95521; adamcummings@fs.fed.us*; Mourad Gabriel and Greta Wengert, *Integral Ecology Research Center, 239 Railroad Ave., Blue Lake, CA 95525; ierc@iercecology.org.*

The illegal cannabis industry continues to expand in California with “trespass grows” on US Forest Service lands also expanding dramatically. Unregulated grow operations on both public and private land are having dramatic, acute effects on the local ecology. In addition to drawing down headwater streams at the peak of the dry season, cannabis cultivators use numerous pesticides to prevent crop loss to herbivory and to kill nuisance animals. Dangerous pesticides such as anticoagulant rodenticides have been found to kill terrestrial mammals including fisher (*Pekania pennanti*) and black bear (*Ursus americanus*). Traces of Diazinon, one of the pesticides found on illegal grow sites, have been found in stream water directly downstream of recently eradicated grow sites on USFS lands. Here we present on an ongoing study into the effects of toxicants on headwater stream communities. In the fall of 2016 we established access to six cultivation sites on the Shasta-Trinity National Forest, delineated survey reaches up- and down-stream of the site run-off footprint, and deployed water quality monitoring devices in each reach. To characterize reach habitat conditions and benthic macroinvertebrates, we implemented the Surface Water Ambient Monitoring Program (SWAMP) bioassessment protocol. For amphibians, we collected Environmental DNA samples and conducted amphibian belt surveys. Samples are being processed this winter. Species encountered during initial surveys include coastal giant salamander (*Dicamptodon tenebrosus*), foothill yellow-legged frog (*Rana boylii*), coastal tailed frog (*Ascaphus truei*), and southern torrent salamander (*Rhyacotriton variegatus*). Spring resurveys will be conducted in March and April 2017.

***Effects of Invasive Trout Removal on a Herptile Community in the Trinity Alps Wilderness, CA: A Case Study Examining Hyperpredation on Native Fauna.** Justin A. Demianew*, *Department of Wildlife, Humboldt State University, 1 Harpst Street, Arcata, CA 95521; Justin.Demianew@humboldt.edu;* Justin M. Garwood, *California Department of Fish and Wildlife, 5241 Ericson Way, Arcata, CA 95521; Justin.Garwood@wildlife.ca.gov;* Daniel C. Barton, *Department of Wildlife, Humboldt State University, 1 Harpst Street, Arcata, CA 95521; Daniel.Barton@humboldt.edu*

In the western United States, invasive salmonids are a force majeure in restructuring amphibian assemblages through predation. Additionally, correlative evidence suggests that eastern Brook Trout (*Salvelinus fontinalis*) have catalyzed hyperpredation on the Cascades Frog (*Rana cascadae*), a California Species of Special Concern. Here, Brook Trout may have facilitated both an elevational range expansion and an increase in abundance of the Oregon Gartersnake (*Thamnophis atratus hydrophilus*) by serving as an alternative prey source. Moreover, increases in Oregon Gartersnakes abundance may have resulted in competitive exclusion of less aggressive Valley Gartersnakes (*Thamnophis sirtalis fitchi*) in habitats where Oregon Gartersnakes and Brook Trout co-occur. In 2014, the California Department of Fish and Wildlife (CDFW) began restoring sub-alpine perennial native amphibian habitat in the Trinity Alps Wilderness by removing invasive Brook Trout. In tandem with CDFW's removal activities, we are monitoring changes in the distribution, abundance, and survival of individually-marked frogs and snakes using mark-recapture methods and visual encounter surveys across removal and control basins. In addition, we're monitoring the degree to which gartersnake diet composition changes following trout removal. Initial results suggest that Brook Trout removal has caused shifts in habitat use and diet composition in Oregon Gartersnakes. Unveiling relationships between these processes will not only inform us about the effects of invasive species on sub-alpine food webs, but they can help guide ongoing and future conservation efforts aimed at protecting sensitive herpetofauna.

On the snakes' trail: tracking movements of the elusive Sharp-tailed Snakes (*Contia tenuis*) on Vancouver Island, British Columbia. Christian Engelstoft*, Lennart Sopuck, Kristiina Ovaska, *Biolinx Environmental Research Ltd., 1759 Colburne Place, North Saanich, British Columbia V8L 5A2; cengelstoft@gmail.com, Biolinx@shaw.ca, ke.ovaska@gmail.com*

Sharp-tailed Snake is listed as endangered under the *Species At Risk Act* in Canada. Since 2010, we have investigated its area of occupancy and habitat use on a federal property near Victoria to help with its management. We used two methods to track snakes: 1) an array of artificial cover-objects (ACOs) placed within semi-randomly chosen suitable microhabitats in a pattern with 3 stations of 2 ACOs at 54 plots; 2) PIT tags (Biomark™) implanted in the body cavity. Tagged snakes were detected with a handheld reader with a Biomark™ antenna (reading distance 25 cm) and since 2014 by a stationary automated system (reading distance ~5 cm). During 193 ACO checks, we found 178 Sharp-tailed Snakes, representing 103 individuals; 27% were captured >2 times. Most recaptured snakes were found only at one station or plot (93%); the longest movement from ACO data was 30 m. Of 31 snakes PIT-tagged since 2011, 22 have been found repeatedly. Individual snakes moved relatively little (mean max distance =24.5 m, range: 2.7–128 m), and home ranges were small (mean=44.7 m^2, range: 2.8–166.5 m^2), corroborating the results of ACO recapture data. Interestingly, PIT-tagged snakes were underground and would have been missed during 40% of visual ACO checks. To date, the automated scanner has detected only four snakes, but has provided information on activity patterns: 51% detections were in March-May; 93% occurred between 9:00–21:00 h. The ACO and PIT tag methods provide complementary data, but reading distance is limiting PIT tag detections.

Poisoning and Poaching of Wildlife at Marijuana Cultivation Sites in California.

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Numerous anecdotal accounts of dead wildlife poisoned or poached at marijuana cultivation sites on public and tribal lands in California are reported each year. Since 2012, we have compiled the first comprehensive list of the species and numbers of dead wildlife discovered at these sites. We incorporated both forensic pathology and ancillary diagnostic testing to confirm both the proximate and ultimate causes of mortality for the wildlife carcasses when possible. In addition, through collaboration with law enforcement and interviews with suspects in custody where dead wildlife, poisons and firearms were discovered, we provide previously undocumented insights for the methods and often malicious motivations behind these illegal actions.

A total of 108 independent cultivation locations containing 210 cultivation sites were visited between 2012-2016. Scientists were able to safely conduct thorough documentation at only 85 (79%) locations containing 184 sites (88%). Of these, dead wildlife were discovered at 46 (54%) locations. Causes of wildlife mortality were partitioned into three categories: confirmed poisoning, suspected poisoning, and poaching. Poaching was subdivided into being shot or trapped/ snared. We recorded a total of 90 dead individual animals at these locations, including 11 mammalian, 7 avian, and 3 herpetofaunal species (many federally or state-protected). Finally, we calculated the # deaths/year for our sample set and extrapolated this data using models to create an estimate of illegal take over the entire area of known cultivation sites from Year-Year. This foundational data set clearly demonstrates the potential additive mortality caused by this activity for California's wildlife.

Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands. Mourad W. Gabriel*, *Integral Ecology Research Center, P.O. Box 52, Blue Lake, CA 95525 & University of California at Davis, One Health Institute, Wildlife Health Center; mgabriel@IERCecology;*

Empirical data on the quantification of fertilizer and pesticide use at marijuana cultivation sites in California are sparse and often haphazardly collected. However, use of these data is essential for developing any conservation or remediation plans to address landscape and watershed threats to both flora and fauna. In an extensive collaboration, we collected data from marijuana cultivation locations on public, tribal and private timberlands in Northern California and Southern Oregon. This interdisciplinary effort between non-governmental research organizations, native American tribes, academia and state and federal law enforcement and research ecologists was instrumental in collecting this foundational data. We documented the amounts of soluble and liquid fertilizers, organophosphates, carbamates, rodenticides, pyrethroids, avermectins, molluscicides and strychnine alkaloids between 2012 and 2016 at 76 independent locations spanning 8 public lands, 3 private timberlands, 2 wilderness, and one Tribal land.

Specific toxicant and fertilizer matrices varied between locations with a combination of banned, restricted-use and over the counter examples. Trends of fertilizer and pesticide use over the years differed and may be a reflection of regulation changes during this time period. We took averages of each group and using known and modeled cultivation locations for California and Southern Oregon, we develop potential toxicant and fertilizer loads for these lands. The need to develop additional detailed data sets like these for private lands and other California regions is needed. Knowledge of the use and loads will shed light on nitrification threats to watersheds, toxicant risks to aquatic invertebrates/vertebrates, terrestrial and avian wildlife, and threats to scientists, recreationists, law enforcement officers, and human inhabitants below or adjacent to these sites.

Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California and Southern Oregon: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands. Mourad W. Gabriel*, *Integral Ecology Research Center, P.O. Box 52, Blue Lake, CA 95525 & University of California at Davis, One Health Institute, Wildlife Health Center; mgabriel@IERCecology;* Greta M. Wengert, *Integral Ecology Research Center, P.O. Box 52, Blue Lake, CA 95525;gwengert@IERCecology.org;* J. Mark Higley, *Hoopa Tribal Forestry, P.O. Box 368, Hoopa, CA 95546; mhigley@hoopa-nsn.gov; mhigley@hoopa-nsn.gov;* Deana Clifford, *Wildlife Investigations Lab, California Department of Fish and Wildlife, 1701 Nimbus Rd, Rancho Cordova, CA 95670 & University of California at Davis, One Health Institute, Wildlife Health Center; Deana.Clifford@wildlife.ca.gov;* Stephan Frick *USDA Forest Service, Law Enforcement and Investigations, 1323 Club Drive Vallejo, CA 94592; sfrick@fs.fed.us;* Robert Gaske (Retired), *Law Enforcement Division, California Fish and Wildlife 1416 Ninth Street, Room 1326, Sacramento CA 95814; rpgaske@gmail.com;* DeWayne Little, *Law Enforcement Division, California Fish and Wildlife 1416 Ninth Street, Room 1326, Sacramento CA 95814; DeWayne.Little@wildlife.ca.gov;* Peter Jordan, *USDA Forest Service, Law Enforcement and Investigations, 1323 Club Drive Vallejo, CA 94592; pjordan@fs.fed.us;* Brendan Lynch, *Law Enforcement Division, California Fish and Wildlife 1416 Ninth Street, Room 1326, Sacramento CA 95814; brendan.lynch@wildlife.ca.gov;* Robert Poppenga, *California Animal Health and Food Safety Laboratory, School of Veterinary Medicine, 620 West Health Science Dr., Davis, CA 95618; rhpoppenga@ucdavis.edu;* Chris Holland, *USDA Forest*

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Empirical data on fertilizer and pesticide use at marijuana cultivation sites in California are sparse and often haphazardly collected. However, this knowledge is essential for developing conservation or remediation plans to address landscape and watershed threats to flora and fauna. In an extensive collaboration, we collected data from cultivation locations on public, tribal and private timberlands in Northern California and Southern Oregon. This interdisciplinary effort between non-governmental research organizations, Native American tribes, academia and state/federal law enforcement and research ecologists was instrumental in collecting this foundational data. We documented the amounts of soluble and liquid fertilizers, organophosphates, Carbamates, rodenticides, pyrethroids, avermectins, molluscicides and strychnine alkaloids between 2012 and 2016 at 76 independent locations spanning 8 public lands, 3 private timberlands, 2 wildernesses, and one Tribal land.

Toxicant and fertilizer matrices varied between locations with a combination of banned, restricted-use and over-the-counter examples. Trends of fertilizer and pesticide use over the years differed and may be a reflection of regulation changes during this time period. We took averages of each group and using known and modeled cultivation locations for California and Southern Oregon, we developed potential toxicant and fertilizer loads across these lands. The need to develop additional detailed data sets like these for private lands and other California regions is needed. Knowledge of pesticide and fertilizer use and loads will shed light on nitrification threats to watersheds, toxicant risks to aquatic biota, terrestrial and avian wildlife, and threats to scientists, recreationists, law enforcement officers, and human inhabitants near these sites.

Genetic Characteristics of Red Foxes in Northeastern Oregon. Gregory A. Green, *Owl Ridge NRC, 22116 45th Avenue SE, Bothell, WA 98021*; ggreen@owlridgenrc.com; Benjamin N. Sacks, *Canid Diversity and Conservation Lab, 248 CCAH, Veterinary Genetics Laboratory, University of California, Davis, One Shields Avenue, Davis, CA 95618,* Leonard J. Erickson, *Oregon Department of Fish and Wildlife, 107 20th Street, La Grande, OR 97850*; Keith B. Aubry, *U.S. Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue. SW, Olympia, WA 98512*.

The Rocky Mountain Red Fox (*Vulpes vulpes macroura*), once common in the Blue Mountain ecoregion of northeastern Oregon, was considered rare in eastern Oregon by the 1930s and thought to be extirpated by the 1960s, when putatively new Red Fox populations began to appear. Although the new foxes were long presumed to be nonnative (originating from fur-farms), they were often phenotypically similar to native Red Foxes, suggesting the alternative possibility that they arose from range expansions, either by small numbers of remnant native foxes at higher elevations or by Rocky Mountain Red Foxes to the east. In this study, we used

mitochondrial DNA to investigate the origins of extant Red Fox populations in northeastern Oregon. Our findings indicate that both native and nonnative sources contributed to the Red Fox populations currently occupying this region. In particular, Red Foxes in montane habitats of their former range in northeastern Oregon reflect predominantly native ancestry, whereas those in more lowland habitats outside the boundaries of their former range represent a mix of native and nonnative ancestry.

Habitat Suitability and Selection of Northern Pacific Rattlesnakes (*Crotalus oreganus oreganus*) at Multiple Spatial Scales. Lee Hecker*, *8168 Crown Bay Marina, STE 404-530, St. Thomas, USVI, 00802; leejhecker@gmail.com* Dr. Sharyn Marks, *Department of Biological Sciences, Humboldt State University, 1 Harpst St. Arcata, CA, 95521; Sharyn.Marks@humboldt.edu*

Habitat modeling techniques are widely used to determine where species occur on the landscape and what habitat or environmental factors influence their presence. However, too often models focus on regional constraints or microhabitat selection; losing sight how of the two are related. We used MaxEnt to create an environmental niche model at two spatial scales to estimate where the suitable habitat for Northern Pacific Rattlesnakes (*Crotalus oreganus oreganus*) occurs in the Pacific Northwest and, more specifically, in coastal northern California. Our results indicate selection for warmer habitats throughout the Pacific Northwest and drier environments within coastal northern California. We also examined the selection and location of a key aspect of the habitat of *C. o. oreganus*, the hibernaculum. We used a paired resource selection function to determine microhabitat differences between rocky outcrops used as hibernacula and outcrops that are visually similar, but unoccupied by the rattlesnakes. Our top models reveal selection for outcrops with more crevices, fewer cover objects, and slopes facing due south (180° from North) for use as hibernacula. Lastly, we mapped the landslide activity within the vicinity of the hibernacula, which revealed a positive correlation between landslide presence and hibernacula. Combining these observations with the results of our models leads to a comprehensive understanding of the environmental niche of *C. o. oreganus* occurs in the Pacific Northwest.

Lion prey selection in the Sierra National Forest; influence of forest management and implications for mesocarnivores. Jordan Heiman*, *Great Basin Institute, Reno, NV 89511; jordanheiman89@gmail.com;* Craig Thompson, *USDA Forest Service, Pacific Southwest Research Station, Fresno, CA 93710*; cthompson05@fs.fed.us; Brad Nichols, *Department of Wildland Resources, Utah State University, Logan, UT 84322;beerad75@yahoo.com;* Eric M. Gese, *USDA-National Wildlife Research Center, Department of Wildland Resources, Utah State University, Logan, UT 84322; eric.gese@usu.edu;* Kathryn Purcell, *USDA Forest Service, Pacific Southwest Research Station, Fresno, CA 93710; kpurcell@fs.fed.us*

National Forest land has a long history of multiple uses and diverse management. Across much of the western United States, this has resulted in landscapes that are considered unsustainable in the face of changing climate and shifting disturbance regimes. In response, land management agencies have increased their efforts to reduce fuel loads and create more resilient forests. Apex predators such as mountain lions respond to these activities, and may benefit from the network of edge habitat that is often created by forest thinning or prescribed burning projects.

Changes in lion behavior will cascade down trophic levels, impacting not only primary prey species such as deer, but also smaller carnivores such as coyotes and fishers. To better understand the impacts of forest management on lion behavior and intraguild predation dynamics, we captured and collared 10 mountain lions on the Sierra National Forest and tracked their movements using GPS telemetry. Clusters of GPS locations were used to identify kill sites, and visits to these sites allowed for the collection of prey remains. To date, over 1000 potential kill sites have been visited, with 3 primary prey species identified; mule deer, grey fox, and coyote. Here, we present preliminary results on lion prey selection and discuss the potential impacts of changing predation dynamics on sensitive mesocarnivore species.

Barred Owl Exposure to Anticoagulant Rodenticide on the Hoopa Valley Indian Reservation, Potential Implications for Northern Spotted Owls J. Mark Higley*, *Hoopa Tribal Forestry, P.O. Box 368, Hoopa, CA 95546; mhigley@hoopa-nsn.gov;* Mourad W. Gabriel, *Integral Ecology Research Center, P.O. Box 52, Blue Lake, CA 95525 & University of California at Davis, One Health Institute, Wildlife Health Center; mgabriel@IERCecology;* Greta M.Wengert; and Bob Poppenga

Upwards of 85% of 101 wild fishers (*Pekania pennanti*) have tested positive for one or more anticoagulant rodenticides (AR) across two geographically and genetically distinct populations. Current data on northwestern private timberlands has demonstrated that over 40% barred owls are exposed to ARs. In the fall of 2013 we began implementing an experimental removal of barred owls (*Strix varia*) (Permit # MB14305B-2) from the Hoopa Valley Indian Reservation as part of a range wide experiment. To date, 220 barred owls have been removed and 176 have been tested for exposure to anticoagulant rodenticides. Of the 176 tested barred owls 114 (65%) have tested positive for one or more second generation AR. Exposure rates have not declined since the study began despite the change in California's regulations which effectively banned the personal use of second generation AR without a Restricted Pesticide applicators license in 2014.

Barred owls collected from 37 historic northern spotted owl (NSO) (*Strix occidentalis caurina*) territories have been tested for AR. Of these, at least one positive barred owl was collected from 31 (84%) of the 37 territories. Given the overlap in habitat used and prey consumed between barred and spotted owls it is very likely that spotted owls are equally at risk of exposure to AR. We hypothesize several reasons for possible differences between the private timberland and tribal barred owl datasets. In addition, resource competition between NSO and barred owls coupled with the fitness pressure of AR may be deleterious additive stressors previously undocumented and unaddressed.

New tools in the detection of Ascaphus species: A summary of studies on both Coastal Tailed Frog (*Ascaphus truei*) and Rocky Mountain tailed frog (*Ascaphus montanus*) using eDNA. Jared Hobbs*, Ian Adams, Nik Veldhoen, Jessica Round, Caren C. Helbing, Caren Goldberg *Hemmera Consulting. 303-1221 Broad Street, Victoria, BC, V8W 2A4, jhobbs@hemmera.com*

Two species of tailed frog (*Ascaphus sp.*) occur in BC. Both are designated as under Schedule 1 of the *Species at Risk Act* in Canada. Within BC, the coastal tailed frog (*A. truei*) species is known to be widely occurring west of the Coast Mountain Ranges; with their range

extending north almost as far as the Alaskan panhandle. The Rocky Mountain tailed frog (*A. montanus*) was known from only 19 stream reaches in BC within the Yahk and Flathead River basins.

In 2014-2016 suitable habitats within the range of both species in BC were strategically sampled using environmental DNA (eDNA) methods. Previous inventory efforts, using conventional time-constrained search (TCS) methods, had been applied at hundreds of sites within the two discrete study areas. Comparison of eDNA results with conventional methods illustrates that the detection rate for conventional TCS methods is generally much lower relative to detection rates using eDNA methods when applied to the same area and habitats within the species range.

The results of both studies expand the previously accepted distribution of both species of tailed frog in Canada and demonstrate the utility of eDNA as a preferred method for tailed frog survey. The rapid field collection associated with eDNA studies, the relatively low cost of filter materials, the elimination of observer bias, and relatively high efficacy suggest that eDNA methods are more efficient and more effective for tailed frog inventory than currently accepted time-constrained search methods.

Trialing Environmental DNA Sampling Techniques for Alberta's Boreal Amphibians: Successes and Challenges. Kris Kendell*, *101 9 Chippewa Road, Sherwood Park, AB T8A 6J7; kris.kendell@ab-conservation.com;* Brandon K. Booker, David W. Coltman, Corey S. Davis, Cynthia A. Paszkowski, *Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, AB T6G 2E9; bbooker@ualberta.ca, dcoltman@ualberta.ca, cordavis@ualberta.ca, cindy.paszkowski@ualberta.ca;* Doug Manzer, *Alberta Conservation Association; 12501 20 Ave., Crowsnest Pass, AB T0K 0E0; doug.manzer@ab-conservation.com*

Environmental DNA or eDNA refers to the DNA that organisms leave behind or shed as they pass through the environment. Technology has evolved to allow researchers to detect DNA signatures from material such as mucus, feces, urine or sloughed skin that is naturally contained within pond water and sediment. Major benefits of this new approach are the ability to collect water or sediment samples at any time of day or night, minimal time spent at a location, and the flexibly to engage non-specialists. We are evaluating three eDNA sampling techniques: 1) submersion of a collection container into the pond to collect a desired volume of water, 2) filtering a desired volume of water through a cellulose nitrate filter and 3) collecting a desired volume of surficial material from the top sediment profile of the pond bottom. Although there are some details to be resolved, our work has supported the theory that amphibian DNA in the environment can be used as a proxy for directly observing a target species once robust sample collection and assay protocols are established. We hope findings from this study will allow us to better understand the limitations of the eDNA method for short and long-term monitoring purposes of amphibians in Alberta. In 2017, we will research aquatic sediment trap designs that can be deployed in shallow lentic waters to collect sinking eDNA material and that can operate over an extended period of time similar to that of an autonomous recording unit or remote trail camera.

60 Years of Bat Monitoring at Oregon Caves National Monument. Tony Kerwin*, *Bureau of Land Management, 3040 Biddle Road, Medford, OR 97504; akerwin@blm.gov.*

We surveyed bats in the late summer and early fall of 2015, continuing a series of surveys that have occurred since 1958. This was a mark-recapture study to develop a population estimate of Oregon Caves during the swarming (mating) season for six species of bats, five Myotis species and Townsend's Big-eared Bat, *Corynorhinus townsendii*. We surveyed two cave openings for six nights each between August 19 and September 24, 2015. I also conducted concurrent acoustic surveys inside and outside the cave in an attempt to correlate capture success with acoustic detections and to obtain preliminary data for continued acoustic monitoring in the future. We captured 367 bats including 47 recaptures. I will provide a synopsis of surveys and compare population estimates from surveys since 1958. The population estimate of the 2015 study was consistent with past surveys at approximately 1,056, but with a wide 95% confidence interval. Acoustic monitoring detected 4,232 bat passes at rates that ranged at various sites from 7 to 146 bat passes/hour. Multiple acoustic surveys at the same sites showed consistent and fairly high activity in spite of variable capture success.

Using Cortisol Levels in Hair as a Measure of Chronic Stress: a Case Study in Pacific Fishers. Jennifer Kordosky*, *Department of Wildland Resources, Utah State University, Logan, UT 84322; jrkordosky@gmail.com;* Eric M. Gese, *USDA-National Wildlife Research Center, Department of Wildland Resources, Utah State University, Logan, UT 84322; eric.gese@usu.edu;* Susannah French, *Department of Biology and the Ecology Center, Utah State University, Logan, UT 84322; sfrench@biology.usu.edu;* Craig Thompson, *USDA-Forest Service, Pacific Southwest Research Station, Fresno, CA 93710; cthompson05@fs.fed.us*

Cortisol is an energy mobilizing hormone that can serve as an indicator of stress in mammals. Measures of cortisol can be obtained from different types of samples (e.g., hair, blood, feces) that may provide varying levels of cortisol. By noninvasively measuring cortisol in hair samples, it is possible to measure chronic stress as opposed to acute stress in an individual, as deposition in hair occurs over a longer timeframe. Chronic stress is known to lead to serious health problems in mammals such as suppressed immune function and reduced reproductive output. My study focuses on an isolated fisher (*Pekania pennanti*) population in the central Sierra Nevada Mountains, California. We are examining the influence of disturbance (e.g., human activities, habitat fragmentation, forest management actions) within an individual fisher's home range on physiological stress as measured by cortisol concentrations in the hair. By collecting fisher hair and measuring an individual's cortisol level over time, we can evaluate the physiological response of the animal to disturbance in their home range. We hypothesize that animals living in areas with higher disturbance levels will have higher cortisol levels and lower health than animals living in less disturbed areas, and that these impacts will persist post-disturbance. Ultimately, these relationships may influence animal survival and fitness (i.e., survival and reproduction).

***Morphological Variation in the Oral Apparatus of Larval Coastal Tailed Frogs (*Ascaphus truei*).** Mark Leppin*, Gwen W. Bury[1], *Oregon State University, Department of Integrative*

Biology, 3029 Cordley Hall, Corvallis, OR 97331; *leppinm@oregonstate.edu*, R. B. Bury[1], (*Emeritus) U.S. Geological Survey. [1]Current address: 1410 NW 12th St., Corvallis, OR* 97330.

Over the past 2-3 decades, several Pacific Northwest amphibians have been split into multiple species with the aid of morphological and molecular data. Recent phylogenetic research shows that the Rocky Mountain Tailed Frog (*Ascaphus montanus*) is made up of two clades and Coastal Tailed Frog (*Ascaphus truei*) consists of four to five clades. The goal of our research was to identify morphological traits in larval *Ascaphus* and their relationship to these clades, as well as to facilitate identification of specimens in the field. For this, we examined >150 *Ascaphus* larvae from over 20 different populations. Most of the specimens were from museum collections and were from Oregon populations. We collected data on nine variables, with a focus on the oral apparatus, as it includes structures used in the identification of many anuran larvae. Our preliminary analyses indicate that the number of posterior tooth rows may be useful in identification of *Ascaphus* larvae to clades. Our work is continuing on other differences in the oral apparatus (e.g. upper jaw sheath = scraper), and additional geographic samples. These morphological traits may prove to be useful for identifying *Ascaphus* larvae to clades in the field.

Developing and Testing a Winter Protocol for Detecting Wolverines and other Low-Density Carnivores with Camera Traps and an Automated Scent Dispenser.

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Fishers, martens, and wolverines are of scientific and conservation interest in the Pacific Northwest. Although noninvasive methods for surveying mustelids have been well-tested and refined in recent years, such surveys must typically be conducted during winter, when detection rates tend to be highest. In northern climates, winter field research can be both labor- and time-intensive, as well as dangerous to carry out in locations where access via trails or snowmobiles is limited and avalanche risk high.

We developed a survey protocol for wolverines that enables the operation of scented camera trap stations for many months in areas with deep and varying snow accumulation, and requiring no revisits by researchers. The method relies on: (1) attaching remote cameras to tree boles at the maximum predicted snow depth; (2) rotating cameras 90 degrees such that the detection and image capture frames are vertical and extend from ground to camera height; and (3) utilizing an ultra-low power scent lure dispenser specially designed and built for this project.

We tested this protocol at 24 survey stations in the North Cascades of Washington from September 2015–July 2016, and detected wolverines at 13 of the 24 (54%) stations. Mean duration from deployment to detection was 5.9 months, with one detection occurring as late as 8.2 months. These results strongly suggest that the protocol was effectively attracting and detecting wolverines for many months following deployment. Although DNA results from hair samples collected on snagging devices are still pending, photos confirm that some individuals were previously identified as part of a 10-year USDA Forest Service study, while others had not been previously detected. Our stations also routinely detected Pacific martens and black bears, and occasionally Canada lynx, cougars, coyotes, and bobcats. We are currently testing a second-generation version of the scent dispenser at new stations in the North Cascades, and also as part

of the 4-state (Montana, Wyoming, Idaho, and Washington) baseline survey of wolverine distribution in the contiguous U.S.

***Influence of Multi-scaled Drivers on Stream Salamander Occupancy and Abundance in an Exurban Landscape.** D. Cristina Macklem*, *Department of Natural Resources and the Environment, University of Connecticut, 1376 Storrs Road, Unit 4087, Storrs, CT 06269; diana.macklem@uconn.edu;* Tracy A.G. Rittenhouse, *tracy.rittenhouse@uconn.edu*

Exurban development is the fastest growing form of land use in the United States and dominates the New England landscape, creating a landscape of mature forest that is perforated by low-density residential development. Development (both housing age and density) affects amphibians across multiple spatial and temporal ecological scales. Initially, housing construction removes habitat, creates a pulse of sedimentation, and alters hydrological processes. Over time, runoff can contribute to warmer, flashier streams with reduced dissolved oxygen concentrations and increased pollution and sedimentation that may lead to reduced or extirpated amphibian populations. We compared the occupancy and abundance of two stream salamanders, *Eurycea bislineata* and *Desmognathus fuscus*, that differ in their tolerance to development to determine what stream and watershed features support persistence in an exurban landscape. We found strong support for an interaction between housing age and the amount of development in a watershed influencing *E. bislineata* occupancy and abundance, which suggests that *E. bislineata* populations have a delayed response to development and that populations have the potential to recover at low densities of development. Fine-scale features, including soil temperature, conductivity, dissolved oxygen, and sediment distribution, best predicted *D. fuscus* occupancy. Our estimates of relative *D. fuscus* abundance were notably lower than previous studies using comparable sampling efforts. Both *E. bislineata* and *D. fuscus* exhibited watershed area-sensitivity, which could be a concern for their long-term persistence because both species are in low relative abundance and have limited dispersal abilities. Future decisions about wildlife management in exurban landscapes should consider interactions between housing age and development, and headwater streams inhabited by *D. fuscus* should be managed for fine-scale stream features.

Interagency Pacific Marten (*Martes caurina*) Distribution Study on the Olympic Peninsula, Washington. Katie Moriarty, *Pacific Northwest Research Station, USDA Forest Service, 3625 93rd Avenue, Olympia, WA 98512; kmoriarty@fs.fed.us;* Betsy Howell*, *Olympic National Forest, USDA Forest Service, 1835 Black Lake Blvd. Southwest, Olympia, WA 98512; blhowell@fs.fed.us;* Connor Morozumi, *Oregon State University, 140 Peavy Hall, 3100 Southwest Jefferson Way, Corvallis, OR 97333; connor.morozumi@emory.edu;* Patti Happe, *Olympic National Park, National Park Service, 600 E Park Ave Port Angeles, WA 98362; patti_happe@nps.gov;* Kurt Jenkins, *Forest and Rangeland Ecosystem Science Center-Olympic Field Station, U.S. Geological Survey, 600 E Park Ave Port Angeles, WA 98362; kurt_jenkins@usgs.gov;* Keith Aubry, *Pacific Northwest Research Station, USDA Forest Service, 3625 93rd Avenue, Olympia, WA 98512; kaubry@fs.fed.us*

From November 2015–October 2016, we surveyed for coastal Pacific martens (*Martes caurina*) in Olympic National Forest and Olympic National Park. We concentrated our surveys in the Olympic National Park's coastal strip because coastal martens in Oregon are being

documented within 1 kilometer of the ocean, and at high elevations in Park and Forest because that's where the two most recent records from June 2015 were located. Combining both the winter and summer survey efforts, we established a total of 193 survey stations in 97 sample units, resulting in 17,897 camera-nights of sampling effort and almost 400,000 photographs. Based on the initial assessment to confirm the presence of martens, as well as fishers, we determined that martens were detected at only one site during the summer sampling season at high-elevation in Olympic National Park, and none were detected during the winter effort on the coast. By contrast, we detected fishers at 44% of the stations sampled during the winter, but none in the summer. From this 2016 work, in addition to earlier efforts, we conclude that Pacific martens appear to be very limited in distribution and at critically low numbers throughout most of their former range on the Olympic Peninsula in Washington. As a next step, we hope to employ non-invasive collection of DNA, long-lasting scent lure dispensers, and scat-sniffing dogs, to further quantify the geographic extent and genetic diversity of the current population, or to definitively demonstrate the species' absence from this segment of its former range.

Assessing Structural Changes in Pacific Marten (*Martes caurina*) Rest Sites Over Time.
Katie Moriarty*, Postdoctoral Research Wildlife Biologist, *US Forest Service, Pacific Northwest Research Station. 3625 93rd Ave SW, Olympia, WA 98512; kmoriarty02@fs.fed.us;* Mark Linnell, ORISE Research Fellow, *Oak Ridge Institute for Science and Education, Department of Energy, Corvallis, OR 97331;* Brent Barry, M.S. Graduate Student, *College of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331.*

Spatial extent (distribution) and population size (abundance) are of interest for conservation and management of rare species. We used remote cameras and scent detection dog teams to assess distribution and identify potential populations of two forest-dependent carnivores of conservation concern. We then combined cameras, live-trapping, GPS telemetry, and spatial mark-resight models to assess density of one isolated population of each species. For distribution, we surveyed an area >45,000 km^2 using 3,403 remote camera stations at 575 sample units and detection dog teams at >100 units. Coastal martens (*Martes caurina*) were detected at 73 sample units: 27 martens were verified in Oregon, 2 in Washington. Fishers (*Pekania pennanti*) were detected at >40 sample units. We estimated density of female coastal martens in Oregon Dunes National Recreation Area as 0.7 per km^2. Each species appears limited in distribution, less than previously reported, and we estimated small population sizes (<50 adult female territories). Combining multiple survey techniques, allowed for rapid conservation assessment of these two species. Extant populations may experience threats such as habitat fragmentation and loss, disease, road mortalities, poisoning, and legal trapping in the case of the marten. Future direction could include conservation measures for persisting populations and identifying connected corridors for potential expansion.

Clarifying Distributions of Four Species of *Rana* in Southwestern British Columbia Using eDNA Methods.
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We investigated the distribution of four ranid frogs (*Rana aurora* - Northern Red-legged Frog, *R. cascadae* - Cascades Frog, *R. luteiventris* - Columbia Spotted Frog, *R. pretiosa* - Oregon Spotted Frog), focusing primarily on the endangered Oregon Spotted Frog. During two field sessions in May and June 2016, we collected three 1-litre water samples from 76 sites from 51 water bodies located from Pitt River in the Lower Fraser Valley eastward to Manning Provincial Park. Water samples were collected and filtered using BC Standard eDNA Collection Protocols. Isolated DNA was analysed with stringent polymerase chain reaction (qPCR) methods that included an innovative test for amplifiable DNA. To date, 144 field samples have been processed, of which 135 could be evaluated for the target species' DNA. In the Lower Fraser Valley, Oregon Spotted Frog DNA was detected or suspected in four of six water bodies with recent records of the species, two historical water bodies with no recent records, and four water bodies with no previous records. The presence of this species' DNA in two water bodies at higher elevations in the Skagit Valley is enigmatic. Red-legged Frog DNA was detected in nine and Columbia Spotted Frog DNA in one water body in the Lower Fraser Valley. The detection of Cascades Frog's DNA in one water body in the Skagit Valley is of interest, as the species has not been reported to occur in BC. Samples from higher elevations east of Skagit (from 28 sites in 22 water bodies) remain to be analysed.

River Reefs: The Role Beavers Have in Creating Salmonid Rearing Habitats and Promoting Vertebrate Biodiversity in Coastal California Streams Lacking Perennial Beaver Dams. Marisa Parish*, *California Department of Fish and Wildlife; Marisa.Parish@wildlife.ca.gov;* Justin Garwood, *California Department of Fish and Wildlife, 5341 Ericson Way, Arcata, CA 95521; Justin.Garwood@wildlife.ca.gov*

Restoration efforts are needed to aid in the recovery of salmonid populations throughout the Pacific Northwest. The ecological engineering activities of the North American beaver (*Castor canadensis*) have been shown to provide beneficial salmonid habitats. However, data showing beaver importance in coastal rivers where they are unable to create persistent dams is lacking. A substantial beaver population resides in and utilizes bank lodges in the mainstem and coastal tributaries of the Smith River basin in Northern California. This distribution overlaps almost entirely with the current distribution of federal and state ESA threatened Coho Salmon (*Oncorhynchus kisutch*). We conducted surveys during the summer 2014 and winter 2014-15 to evaluate multi-season occupancy parameters of juvenile salmonids including Coho Salmon at rearing habitats with and without beaver activity. Volume of fish cover created by beavers was found to have a positive influence on juvenile Coho Salmon occupancy during summer rearing. Volume of cover created by beavers was a better predictor of Coho Salmon occupancy than other habitat variables commonly used in restoration, such as large woody debris. These data suggest beavers create and enhance juvenile Coho Salmon rearing habitats in coastal river systems lacking channel-spanning dams. We also found beaver enhanced habitats were commonly used by other native fishes and herpetofauna. Because beaver populations play a large role in characterizing aquatic habitats, stream management and restoration decisions should consider beaver distribution, abundance and their capacity for aquatic habitat maintenance when designing restoration projects. Furthermore, the promotion of robust beaver populations, where compatible, is a holistic approach to habitat restoration.

Ecology of Larval Northwestern Salamanders (*Ambystoma gracile*) in a Spring-Fed Pond. Dan O'Loughlin, *15533 SW Bulrush Lane, Tigard, Oregon USA 97223; danolough@aol.com;*

Michael O'Loughlin, *12878 SW Village Park Lane, Tigard, Oregon USA 97223; molfamily@earthlink.net;* Chris Rombough*, *Rombough Biological, PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com*

We studied the ecology of a Northwestern salamander (*Ambystoma gracile*) population inhabiting a spring-fed pond in the Yamhill River basin of northwestern Oregon. We used a variety of methods to study the salamanders' ecology, with emphasis on demography, growth rate, behavior, and habitat use. We simultaneously collected detailed data on the abiotic and biotic characteristics of the salamanders' habitat. The latter features included topography, hydrology, water quality, vegetation, and other animal species present. We found that this population consisted of both metamorphosing (terrestrial) and neotenic individuals. From our data, we were able to determine growth rate of larvae, time to metamorphosis, and threshold size at transformation or neoteny. Habitat use data revealed that the population of aquatic (larval and neotenic) *A. gracile* was confined to a very small amount of the available (pond) area, apparently due to water quality. Our study provides data on previously unknown aspects of *A. gracile* biology and has considerable value for the conservation of this species.

How to Build a Snake Den. Chris Rombough*, *Rombough Biological, PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com*

Loss of suitable habitat is the single greatest threat to most wildlife. Although habitat restoration has recently become popular, there is little to no information on the re-creation of many habitat types. Here, I will show you how to build effective artificial hibernacula for a number of Pacific Northwest snake species. I will outline basic methods, techniques, and materials for creating reptile habitat, and discuss important considerations such as timing, location, and species biology. Finally, I will give advice on how to undertake projects on a limited budget. The information presented here is based on 20 years' study of Northwest snakes and their habitat, as well as the results of a dozen successful snake habitat projects. I recommend this talk to anyone with an interest in Northwest reptiles or habitat restoration.

Construction and Colonization of an Artificial Snake Den. Chris Rombough*, *Rombough Biological, PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com;* Laura Trunk, *Jackson Bottom Wetlands Preserve, 2600 SW Hillsboro Hwy., Hillsboro, OR 97123; laura_trunk@hillsboro-oregon.gov*

In 2012, we built a snake den (hibernacula) to support a population of garter snakes (*Thamnophis sirtalis* and *T. ordinoides*) whose original habitat had been destroyed. The project was successful: Use of the hibernacula began immediately (2012), and has increased annually through 2016. In addition, our observations indicate an increase in the size of the resident snake population, along with an interesting shift in patterns of habitat use. Here, we give a step-by-step description of the project and provide information for those interested in building their own hibernacula.

Factors Influencing Coexistence of Native Amphibian Communities with Invasive Bullfrogs in the Willamette Valley, OR. Jennifer C. Rowe*, *USGS Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331; jrowe@usgs.gov;* Adam Duarte, *Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, Oregon 97331;*

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A challenge in wildlife monitoring studies is disentangling the effects of habitat and species interactions on population dynamics. Amphibian communities in the Willamette Valley have been extensively studied in the context of invasive species and habitat alteration, but efforts are typically restricted to one or two species, short-term time periods, or fail to account for sampling errors that are inherent in such data. These limitations can distort our understanding of the factors driving patterns in species occurrence and inhibit effective management. We monitored amphibian communities and measured habitat characteristics for 12 years across 38 sites within the Willamette Valley. Using these data, we fit a hierarchical multi-species dynamic occupancy model to assess the influence of invasive species and habitat characteristics on the demography of five native amphibian species. In addition to accounting for imperfect detection, the model we developed also accommodated potential false-positive detections of two species that are morphologically similar and difficult to distinguish in larval form – the Northwestern Salamander (*Ambystoma gracile*) and the Long-toed Salamander (*A. macrodactylum*). Preliminary findings suggest effects of invasive American Bullfrogs (*Lithobates catesbeianus*) on the native amphibian community were conditional on habitat characteristics such as vegetation cover and pond drawdown rate. This study provides new insight into the potential role of habitat in mediating the effects of invasive species on native amphibians. Given the difficulty of eradicating established invaders, habitat management offers an alternative approach to maintain native amphibian diversity despite detrimental invasive species.

***Historic Species Distribution Models of an Endangered Burrowing Rodent Do Not Match Existing Historic Range Estimate.** Abigail Rutrough*, *Department of Wildlife, Humboldt State University, 1 Harpst St., Arcata, CA 95521; alr569@humboldt.edu;* William T. Bean, *Department of Wildlife, Humboldt State University, 1 Harpst St., Arcata, CA 95521; Tim.Bean@humboldt.edu*

The California endemic Giant Kangaroo Rat (*Dipodomys ingens*) is federally and state endangered due to anthropogenic habitat loss. Irrigation projects in the mid-20th century lead to the expansion of agriculture into core habitat, and the Giant Kangaroo Rat is now thought to be restricted to less than 2% of its historical range. A single historical range map exists for the giant kangaroo rat and it is used for all recovery planning, range reduction estimates and current literature. However, this map is twenty-five years old, based mostly on expert opinion, includes limited trapping data from before the range restriction, and has not been quantitatively verified. To better estimate historical range, we created historical species distribution models using the machine learning program Maxent. We independently acquired Giant Kangaroo Rat detections by systematically surveying historical (1930-1958) aerial photographs for Giant Kangaroo Rat burrows. Our model also incorporated historical climate, slope and soil texture as predictors; and used AICc model selection to determine top models. We found burrows up to 10 km outside of the existing range estimate. New historical range estimates are 5.17-23.36% smaller, more patchily distributed, and spread over a wider area than the existing estimate. For species that have experienced dramatic range restrictions, understanding their historical distribution can help

managers identify better restoration targets and may lead to different distribution models under future climate projections.

Habitat Mediate Interactions between Humboldt Martens and Bobcats: Evidence from Diet, Habitat Selection, and Gradients in Landscape Composition. Keith Slauson, *Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, CA 95521; keithmslauson@fs.fed.us*

Most research on the Humboldt marten has focused on direct effects of habitat to provide daily (rest structures) and annual needs (home ranges). However, indirect effects influencing sensitive demographic characteristics can affect population performance. Bobcats have emerged as an important marten predator and survival most influences marten population growth. I synthesized data from 2000-2016 to retrospectively evaluate the role habitat plays in indirectly mediating marten-bobcat interactions using multiple lines of evidence: diet, habitat selection, and responses to gradients in landscape composition. Diets reconstructed from scats for martens (n = 528) and bobcats (n >400) are both dominated by mammals but martens prey on species associated with mature/late-seral forest with dense shrub cover (e.g., chipmunks, tree squirrels) whereas bobcats prey primarily on early seral forest associated herbivores (e.g., *Neotoma*, *Silvilagus*). Martens select for large patches of late seral forest or serpentine habitat with dense shrub layers. Bobcats select for early seral stands (<30 years), use older stands in proportion to availability, but are nearly absent where early seral habitat in lacking. Where martens and bobcats co-occur, ~25% of landscape in early seral stands, bobcats killed 45% of martens monitored over a 2-year period. Where early seral stands increased to >50% of the landscape over time, the marten distribution contracted. Collectively this suggests landscape composition mediates interactions between these species by affecting both their distributions, increasing marten predation when bobcats are present, and reducing marten survival and distribution in landscapes increasingly composed of younger stands favoring bobcats.

***Determining Spatial Responses of Pacific Fisher (*Pekania pennanti*) to Fuel Reduction Treatments in Southwestern Oregon.** Tessa R. Smith*, *Department of Wildland Resources, Utah State University, Logan, UT 84322, Tessa.Rene.Smith@gmail.com*; Eric M. Gese, *USDA-National Wildlife Research Center, Department of Wildland Resources, Utah State University, Logan, UT 84322; Eric.Gese@usu.edu*; Pat A. Terletzky, *Department of Wildland Resources, Utah State University, Logan, UT 84322; Pat.Terletzky@usu.edu;* Craig M. Thompson, *USDA-Pacific Southwest Research Station, Fresno, CA 93710; CThompson05@fs.fed.us;* Dave Clayton, *USDA, Rogue River-Siskiyou National Forest, Medford, OR 97504; DClayton@fs.fed.us*

In the last century, fire suppression and historic logging practices have transformed the structure and composition of mixed-conifer forests. Accumulation of surface fuels and dense stands of trees have created the potential for devastating wildfires that can alter ecosystems throughout the western United States. In order to mitigate substantial losses to landscape diversity and prevent stand-replacing wildfires, forest managers are implementing fuel reduction treatments, which include thinning, prescribed burns and tree harvesting. While these practices benefit forest health by creating open understories and reducing fuel loads, the modifications to stand dynamics may impact wildlife behavior and their movement patterns. The Pacific fisher (*Pekania pennanti*) relies upon dense canopy cover and complex structures, which may be removed during fuel reduction operations. In southwestern Oregon, we examined the spatial

responses of fishers in areas exposed to fuel reduction treatments compared with control units (i.e., no fuel reduction). From 2010 to 2016, 10 fishers were captured and fitted with GPS radio-collars that collected location data before, during and after treatments occurred. Currently we are establishing fisher home ranges and space use in control and treatment areas. Preliminary results suggest fishers select dense canopy cover (>50%) and higher basal area sites in the control units and pre-treatment. Further analysis will assess whether habitat modifications from treatments influence rest and den site selection for fishers.

Is the Lack of Suitable Nest Foundations a Limiting Factor for Arboreal Rodents in Young Forests? James K. Swingle*, Eric D. Forsman, Damon B. Lesmeister, *USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331*; *jswingle@fs.fed.us*; Mark A. Linnell, Dennis J. Baumsteiger, Chad A. Marks-Fife, and John D. Bailey, *College of Forestry, Oregon State University, Richardson Hall, Corvallis, OR 97331*.

Species distribution models indicate that red tree voles (*Arborimus longicaudus*) primarily occur in mature and old-growth forests. We and many others have found populations of tree voles in young forest (20–80 years old), particularly in stands with broken tops, dense branch whorls, and forked trunks. This lead us to speculate that one of the limiting factors of tree vole occurrence in young forest is the lack of suitable foundations upon which they can build nests. In 2015, we installed artificial nest platforms at young forest sites adjacent to old forest where we documented tree vole nests. The mean number of artificial nest platforms that we installed per stand was 25 (range = 14–36) for the 18 young forest sites. We constructed artificial nests consisting of moss and conifer sprigs on a base of hexagonal mesh fixed to branches in conifers at a density of 2 per ha. In 2016, we checked 414 of the 429 platforms for use by tree voles and other arboreal rodents. We did not check 15 of the 51 platforms where we encountered hornets or wasps. Based on nest material examined by tree climbing biologists, the mean percentage of platforms per stand that were northern flying squirrels (*Glaucomys sabrinus*) or Douglas' Squirrels (*Tamiasciurus douglasii*) was 17% (range 0–54%). The mean percentage of platforms per stand that tree voles nested in was 30% (range = 0–11%), including 12% (range = 0–44%) that were occupied by tree voles.

***Salmon Subsidize Reproductive Success of a Terrestrial Insectivore**
Marlene A. Wagner & John D. Reynolds, Earth2Ocean Research Group, Simon Fraser University, Burnaby, BC V5A 1S6 and Hakai Institute, Heriot Bay, BC V0P 1H0; mawagner@sfu.ca*

Resource subsidies that cross ecosystem boundaries can have strong and unforeseen ecological impacts. Marine-derived nutrients from Pacific salmon can be transferred to streams and riparian forests through diverse food web pathways, fertilizing forests and increasing invertebrate abundance, which may in turn affect breeding birds. We collected point-count data spanning two years to quantify the influence of salmon on abundance and composition of songbird communities across a wide range of salmon-spawning biomass on 14 streams along a remote coastal region of British Columbia, Canada. We combined salmon biomass and 16 environmental covariates in riparian forests to test for correlates with bird abundance, foraging guilds, individual species, and avian diversity. Bird abundance and diversity increased with salmon biomass and watershed size and forest composition were less important predictors. To

explore hypotheses surrounding this phenomenon, we measured prey abundance, and collected morphological and nesting data for an obligate insectivore, the Pacific wren, to examine how the salmon subsidy may influence songbird success. Nest density and invertebrate abundance within territories increased with salmon biomass, and individual wrens on streams with salmon were more likely to double-brood. We also compared nitrogen ($\delta^{15}N$) and carbon ($\delta^{13}C$) isotope ratios in feather and fecal samples to determine the contribution of marine-derived nutrients to wrens, and show that body condition increases with $\delta^{15}N$. Combined results suggest that fall spawning salmon provide significant benefits to songbirds during the spring breeding season. This work provides new evidence that salmon positively impact terrestrial ecosystems and emphasizes the need for ecosystem-based management.

Modeling to Predict the Probability of Trespass Marijuana Cultivation Site Presence in Fisher, Spotted Owl, and Humboldt Marten Habitat. Greta M.Wengert*, *Integral Ecology Research Center, P.O. Box 52, Blue Lake, CA 95525;gwengert@IERCecology.org;* J.Mark Higley, *Hoopa Tribal Forestry, P.O. Box 368, Hoopa, CA 95546; mhigley@hoopa-nsn.gov;* Mourad W. Gabriel, *Integral Ecology Research Center, P.O. Box 52, Blue Lake, CA 95525 & University of California at Davis, One Health Institute, Wildlife Health Center, Davis, CA 95616; mgabriel@IERCecology.org;* Heather Rustigian-Romsos, *Conservation Biology Institute, 136 SW Washington Ave, Suite #202, Corvallis, OR 97333; heather@consbio.org;* Wayne Spencer, *Conservation Biology Institute, 136 SW Washington Ave, Suite #202, Corvallis, OR 97333; wdspencer@consbio.org;* Deana Clifford, *Wildlife Investigations Lab, California Department of Fish and Wildlife, 1701 Nimbus Rd, Rancho Cordova, CA 95670 & University of California at Davis, One Health Institute, Wildlife Health Center; Davis, CA 95616; Deana.Clifford@wildlife.ca.gov*

Trespass marijuana cultivation has significant environmental impacts on public, tribal, and private lands in California and Oregon. Field investigations at numerous grow sites reveal that the chemicals, water diversions, and refuse present at sites have significant direct and indirect impacts on forest and stream biota, but there is insufficient information on the abundance and distribution of grow sites to estimate landscape-scale impacts.

We modeled the likely distribution of trespass grow sites on forested public lands in California and southwestern Oregon using Maxent distribution modeling software, locations of 1274 trespass sites eradicated by law enforcement from 2007-2014, and an array of environmental variables suspected to influence site selection by growers. Location data were filtered using a 2km nearest neighbor distance to decrease sample bias and predictor layers were smoothed to account for location data accuracy. The final model used 10 variables: latitude-adjusted elevation, slope, tree canopy cover, distance to private land, distance to roads, distance to disturbance, precipitation, distance to water, stand age, and aspect. Grow sites were concentrated closer to roads and water sources, on moderately steep slopes at mid-elevations, and in areas of dense canopy. We classified the model output into low, moderate, and high likelihood using strength of selection analysis. The model predicted moderate-high likelihood of grow site presence over 26.8% of the study area. Model predictions showed that large portions of habitat for sensitive forest species including the fisher, spotted owl, and Humboldt marten are at risk from the harmful effects of marijuana cultivation in forested habitats.

California Condor Recovery Feasibility in Northern California: Assessing Spatial and Temporal Patterns of Contaminants Using Turkey Vultures and Common Ravens as Surrogates. Christopher J. West*, *Yurok Tribe Wildlife Program, 190 Klamath Boulevard, Klamath CA 95548; cwest@yuroktribe.nsn.us;* Jared D. Wolfe, *USDA Forest Service Pacific Southwest Research Station, 1700 Bayview Street, Arcata, CA 95521; jareddwolfe@fs.fed.us;* Andrew Wiegardt, *Klamath Bird Observatory, P.O. Box 758, Ashland, OR 97520; akw@klamathbird.org;* Tiana Williams-Claussen, *Yurok Tribe Wildlife Program, 190 Klamath Boulevard, Klamath CA 95548; tiana@yuroktribe.nsn.us*

Areas of northern California have been identified for potential expansion of California Condor (*Gymnogyps californianus*) recovery efforts. Lead poisoning continues to complicate Condor recovery efforts and threatens viability of future propagules. Therefore, background levels of lead and other contaminants should be assessed as part of a feasibility and threats analysis prior to expanding the recovery program into northern California. A California-wide ban on the use of lead ammunition for hunting, scheduled to go into effect in 2019, coupled with hunter outreach programs aimed at reducing lead ammunition may present new opportunities for California Condor recovery in this region. As such, we studied two surrogate species, Common Ravens (*Corvus corax*) and Turkey Vultures (*Cathartes aura*), in coastal and near-coastal northern California to examine relationships between contaminant (lead, mercury, zinc, and copper) exposure through time, as a function of distance from coast (vultures and ravens), and hunting season (ravens only). Although blood-lead concentrations were found to be relatively low for vultures (5.99 μg per dL, n = 138), median blood-lead concentrations of ravens captured during non-hunting season (0.9 μg per dL, n = 17) increased seven-fold during hunting season (6.4 μg per dL, n = 10). We also found that with increasing distance from the coast, blood concentrations of mercury decreased while blood concentrations of lead increased in both species. Given the significant increase in lead among ravens during the hunting season, we believe that pervasive exposure to lead demonstrates risks facing potential propagules of California Condors throughout their historical range.

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

Betsy Howell*, *Olympic National Forest, USDA Forest Service, 1835 Black Lake Blvd. Southwest, Olympia, WA 98512; blhowell@fs.fed.us;* Katy Weil*, *Conservation Program, Metro Parks and Nature, 600 NE Grand Avenue, Portland OR 97232; katy.weil@oregonmetro.gov*

The Northwest Chapter of the national organization Partners in Amphibian and Reptile Conservation (NW PARC) began in 2008 and encompasses six western states and three Canadian provinces. PARC is a bottom-up organization with five regions and eight state chapters and our work focuses on conserving amphibians, reptiles, and their habitats as integral parts of our ecosystem and culture through proactive and coordinated public-private partnerships. Our membership includes individuals from government and nongovernmental organizations, conservation groups, museums, the trade industry, environmental education centers, energy and forestry industries, and herpetological societies. In addition to organizing an annual regional meeting each year focusing on different themes such as citizen science, energy development, and remote sensing techniques, the NW PARC steering committee and membership are involved in developing reference materials on amphibians and reptiles for professional and general audiences; recognizing outstanding individuals in the Northwest region for their contributions to herptile conservation; and serving on committees to address specific issues such as disease, education and outreach, transportation and mortality, and the designation of priority areas to conserve species and habitats. In 2017, our meeting will focus on top research and conservation priorities for amphibians as provided by several experienced amphibian specialists. NW PARC will also outline a top ten list as suggested by our membership.

2. Alternative Facts: Are Amphibians and Dollars in Decline, or are Opportunities Abundant? Priya Nanjappa*, *Association of Fish & Wildlife Agencies/Partners in Amphibian & Reptile Conservation, 1100 First Street NE, Suite 825, Washington, DC 20002; pnanjappa@fishwildlife.org*

There is little question that amphibians are declining, including some common species. There is also no question that funding has been sparse for these critters. Until the last 15 years, people studying amphibians were exceptionally creative and resourceful in finding support for their work. Around the time of PARC's inception in 1999, the United States also initiated the Amphibian Research and Monitoring Initiative (ARMI) and the State and Tribal Wildlife Grants (SWG) programs. Both provided funding for amphibian research or management, though in very different ways. In particular, the SWG program is the only source of Congressionally-appropriated funding that can be directly applied to the management of amphibian populations; funding through the Endangered Species Act (ESA) is very limited. The SWG program requires states, territories, and tribes to create State Wildlife Action Plans detailing priority species and conservation actions; a proactive conservation blueprint to help keep common species common. However, appropriations for SWG have been on a downward trend, not likely to increase for ESA, and both programs are under high scrutiny. The upward trend in ESA petitions for amphibian listings belies an upward trend in opportunities for partnerships to leverage personnel and funding. More and more relevant NGOs are available, including the Amphibian and Reptile Conservancy, Amphibian Ark, The Orianne Society, the Amphibian Survival Alliance, among others. Emerging threats, such as disease, and ongoing challenges, such as habitat degradation,

underscore the importance of working collaboratively toward amphibian conservation through partnerships.

3. ASG Canada: Research & Conservation Priorities for Amphibians in the North. Kristiina Ovaska*, *Biolinx Environmental Research Ltd., Victoria, BC V9E 2B7; ke.ovaska@gmail.com;* Sara Ashpole, *St. Lawrence University 23 Romoda Drive, Canton, NY 13617; sashpole@stlawu.edu*

ASG Canada is a regional group associated with the global IUCN Amphibian Specialist Group, focusing on conservation issues pertinent to Canadian amphibians. Through collaborations with various national and regional groups, we aim to address emerging issues in amphibian conservation, provide resources, and fill in key information gaps. Conservation issues for Canadian amphibians are basically the same as across North America, but the level of threat from different sources, protection needs, and availability of baseline information on trends are likely to differ. Of 48 species in Canada, almost half are deemed to be at risk. The majority of Canadian species' distributions are farther south, but all reach their northern limits here. Populations at the limits of species' distributions are thought to form important sources of variability in the face of environmental perturbations; therefore conservation of this variability in all its forms is important. We perceive the following issues as priorities (in no particular order): elucidating impacts of climate change, which is expected to proceed at a more rapid pace at higher latitudes; emerging diseases, including the prevention of their introduction and establishment, development of efficient detection methods, and epidemiology; prevention of habitat loss and fragmentation; identifying population and distribution trends through long-term monitoring, including a network of intensive monitoring sites and citizen-science atlas projects, to help in conservation planning; and identification, listing, and protecting evolutionary significant units below the species level. Presently, we are collaborating with the Canadian Herpetological Society and the Canadian Herpetofauna Health Working Group to address some of the above issues.

4. Critical Priorities for Amphibian Conservation and Research. Marc P Hayes*, *Washington Department of Fish and Wildlife, Habitat Program, Science Division, Aquatic Research Section, 600 Capitol Way North, Olympia, WA 98501; Marc.Hayes@dfw.wa.gov;* Christopher J Rombough*, *PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com;* Kyle S Tidwell, *Portland State University, Department of Biology , 1719 SW 10th Avenue, OR 97201; kylescotttidwell@gmail.com;* Klaus O. Richter, *11040 104th Avenue NE, Kirkland, WA 98033; korichter@comcast.net;* Amy E. Yahnke, *Washington Department of Ecology, Shoreline and Environmental Assistance Program, PO Box 47600, Olympia, WA 98504; ayah461@ecy.wa.gov;*

We developed a robust list of priorities for amphibian conservation and research using the following methods. First, we first independently scored what we regarded as priorities. We then ranked these across our lists by: 1) the frequency with which a priority category appeared across lists; 2) the frequency with which a priority category appeared in the lists of the two speakers for this presentation; and 3) assessing whether one priority category was support (or precursor) for another category. Ultimately, we acceded that four categories were of sufficient importance to not overshadow one another. These included: 1) information on basic biology and life history; 2)

improved capacity building; 3) improved conservation policy; and 4) improved education. We regard the first of these as fundamental to identifying any problem, and the remaining three as critical to developing an environment in which conservation can succeed and creating successful research programs to address it. Beyond the four target priorities, we viewed six other areas as critical to amphibian conservation and research, which are: 1) land use issues; 2) multiple stressors; 3) diseases; 4) pollution; 5) climate change; and 6) invasive species. To illustrate selected issues in more depth, we will elaborate on information gaps in two of these priorities: 1) basic biology and life history; and 2) invasive species.

5. Population Status of Herpetofauna on Pacific Northwest Landscapes: What are the Primary Threats to Native Species? Hartwell H. Welsh, Jr.*, Research Wildlife Ecologist, *USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, CA 95521; hwelsh@fs.fed.us*

This presentation reviews some of the primary causes of declines in populations of native amphibians and reptiles on landscapes of the Pacific Northwest. Causes addressed include new diseases, water management, introduced predators, and forestry-related impacts in both terrestrial and aquatic environments. Contaminants and non-forestry related roads are mentioned but not addressed specifically. We review three sets of studies from the speaker's research over the past 35 years: impacts of stream flow manipulations, and impacts of forest practices on both terrestrial and aquatic populations. While these investigations occurred primarily in Northern California, they have implications well beyond even the greater Pacific Northwest because the factors discussed are of widespread concern throughout the world.

6. Road to Resplendence: Importance of Listing Priorities for Species with Small Geographic Ranges, Endemism or Both. R. Bruce Bury*, *1410 NW 12th Street, Corvallis, OR 97330; clemmys@gmail.com*

In his fictional book of the "Turquoise Dragon" in the Klamath-Siskiyou Ecoregion, author David Rains Wallace deemed it to be resplendent: the quality of almost unbelievably majestic beauty or splendid in appearance. Many amphibians in the Pacific Northwest also fit this bill. While of awe, we have also doubled in number of species since 1960 primarily through genetic studies recognize full species from prior cryptic groups. Still, a few new species were described (e.g., the Scott Mountain Salamander) and more are to follow. Today, the Pacific Northwest has a high richness of species. Further, we have a marked diversity with some (e.g., Tailed Frogs) that had ancestors alive in the Age of Dinosaurs, yet persist today in specialized habitat. We have at least two patterns: (1) "broken plate" occurrence (one former wide-ranging species now fragmented into many forms); and (2) unique primitive taxa unlike any elsewhere on earth (e.g., Torrent Salamanders). Both patterns now include endemic species with small geographic ranges that put them in danger of threats just locally or regionally. As such, many of these "rare, range-restricted" forms merit special protective measures including consideration to be listed as threatened or endangered species.

7. Open

8. Overcoming Challenges in Monitoring Populations of Fossorial Amphibians. Nancy E Karraker*, *Department of Natural Resources Science, University of Rhode Island, 1 Greenhouse Road, Kingston, RI 02881; nkarraker@uri.edu;* Anne Devan-Song, *Department of Natural Resources Science, University of Rhode Island, 1 Greenhouse Road, Kingston, RI 02881;devansong@gmail.com*

Natural fluctuations in amphibian populations make detecting declines challenging, particularly in fossorial species. In 2016, we tested two methods for gaining higher precision in population size estimates for Eastern Spadefoot Toads (*Scaphiopus holbrookii*) and Eastern Red-backed Salamanders (*Plethodon cinereus*) that are fossorial within and between seasons. In Virginia, we established four 25 x 25 m plots and surveyed each seven times for spadefoot toads. We scanned plot surfaces at night by spotlight, and captured, pit-tagged, and temporarily removed toads from plots. Using a ground-sweeping antenna, we scanned each plot to determine the number of marked toads present below ground. Mean proportion of marked toads below ground during surveys ranged from 70% in June, 45% in July, and 100% in August. In Rhode Island, we compared the effectiveness of 75 'artificial logs' (30 x 61 x 10 cm pine boxes filled with wood chips) and 75 traditional coverboards (30 x 61 x 2.5 cm pine), distributed in three paired plots of 25 coverboards and artificial logs each, for monitoring populations of salamanders. We checked cover objects six times from October to November and marked salamanders with elastomer. Salamander detections from artificial logs were 25% higher than under traditional coverboards, and recapture rates for this species with a small home range never exceeded 56%. Results from the two studies suggest that large proportions of amphibian populations may remain below ground even during the 'active season'; enhanced methods and careful timing may be necessary to differentiate natural population fluctuations from population declines.

9. Western Toad Winter Habitat Requirements in Modified Landscapes on Vancouver Island. Elke Wind. *E. Wind Consulting, Suite A - 114 Fifth Street, Nanaimo, BC V9R 1N2*; *ewind@telus.net*

Although the majority of amphibian species in BC spend most of the year in terrestrial environments, we have a poor understanding of the habitats they utilize outside of breeding. We tracked 29 adult Western Toads (*Anaxyrus boreas*) to winter hibernation sites on eastern Vancouver Island between 2014 and 2017. The landscape consisted of a combination of private and crown land, including clearcuts, forest, wetlands, streams, agricultural fields, houses, and roads. Toads were captured in early fall, fitted with BD-2 transmitters, tracked to hibernation sites, and in some cases, towards aquatic breeding sites post hibernation. Wildlife cameras were utilized to observe emergence and potential communal use. Summary analyses of the first 2 years of the study indicated that Western Toads in this landscape travelled uni-directionally towards hibernation sites in the fall, from an average distance of 500 m away, becoming dormant when average weekly air temperatures were at or below 8°C in late Oct. They moved through a variety of habitat types, often utilizing edge habitat as day rest areas. Most had to cross at least one road to get to their hibernation site in the fall. The majority of toads utilized some sort of woody structure for hibernation, such as stumps or large downed wood, often in edge habitats. Only 1 site was confirmed to be communal. Toads emerged from hibernation in late Jan. when

average weekly temperatures were at or above 5°C. On average, hibernation sites were 340 m from aquatic breeding sites, with females hibernating farther than males.

10. Wetland Stewardship for Amphibians in the Northwestern United States and Western Canada. Kris Kendell*, *Alberta Conservation Association, 101, 9 Chippewa Road, Sherwood Park, AB T8A 6J7; kris.kendell@ab-conservation.com;* David S Pilliod, *US Geological Survey, Forest and Rangeland Ecosystem Science Center, 970 Lusk Street, Boise, ID 83706; dpilliod@usgs.gov*

Conservation priorities for amphibians in North America arise from reports of multiple stressors that work alone or interact to contribute to population declines. Conservation actions are thus directed towards the most serious and ubiquitous threats to populations for species of conservation concern. We assessed the effectiveness of wetland stewardship as mitigation for habitat loss and other threats to pond-breeding amphibians in North America. Wetland stewardship, which includes the protection of wetlands from degradation, the restoration of degraded wetlands, and the construction of new wetlands, are key strategies for conserving amphibians on private and public lands. Simply put, providing sources of clean water on the landscape provides many ecosystem services, including reliable water sources for agriculture, livestock, and wildlife. However, scientific evidence suggests these wetlands must be carefully designed and managed to provide suitable habitat for amphibians that can sustain populations. Besides providing requisite habitat suitability for amphibians, wetlands may also need to withstand multiple uses (e.g., livestock watering), maintain water levels during drought, and discourage colonization or minimize impacts by invasive species. Amphibian habitat suitability includes conditions influencing both reproduction and survival. We present examples for the Northern Leopard Frog (*Lithobates pipiens*) and Columbia Spotted Frog (*Rana luteiventris*) to highlight what works well and what might be avoided, and we discuss the long-term implications of wetland stewardship for amphibian conservation.

11. Incorporating Amphibian Habitat Connectivity into Conservation Planning in the Pacific Northwest. Audrey Hatch*, *Independent Biologist, 812 NW Polk Ave, Corvallis, OR 97330; audrey.hatch@gmail.com*

Amphibians depend on both aquatic and terrestrial habitats at different stages of their life cycle. Loss of available habitat due to conversion or degradation concerns conservation planners and may contribute to amphibian population declines. Loss of vital connections among patches of high quality habitat is also of concern. The state of Oregon is well situated within the lush and diverse Pacific Northwest to provide habitat for many species of amphibians, and this habitat will become increasingly vital as ecosystems shift in response to a changing climate. However, specific amphibian habitat uses are poorly understood, amphibians are difficult to survey, and there are few long-term ongoing amphibian data collection efforts. Where empirical observations are lacking, modeled information about potential amphibian habitat can inform conservation planning. Both types of information are useful and can be made available through planning tools to help practitioners find information quickly. Foresters, transportation and land use planners, the energy industry, and others are making important decisions that could affect habitats, and they can incorporate information about wildlife species into the project scoping and planning process if they can find that information easily and early. Recommendations and examples of online

planning tools that incorporate amphibian habitat information will be explored, along with recommendations for biologists and the research community to update and continually inform these planning tools.

12. Context-specific Effects of Drought on California Anuran Populations. Brian J. Halstead*, *U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620; bhalstead@usgs.gov;* Patrick M. Kleeman, *U.S. Geological Survey, Western Ecological Research Center, Point Reyes Field Station, 1 Bear Valley Road, Point Reyes Station, CA 94956; pkleeman@usgs.gov;* Richard Kim, *U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620; rkim@usgs.gov*

Amphibians are declining worldwide, and amphibian populations face diverse stressors ranging from habitat loss to introduced species to a changing climate. The effects of different stressors on amphibian populations vary, and the same stressor can have contrasting effects on different species and populations. We examined the effects of drought on three anuran species at two sites in California, and demonstrate the context-specificity of the effects of drought on these populations. A 16-year mark-recapture study of Sierra Nevada Yellow-legged Frogs (*Rana sierrae*) in Yosemite National Park indicated that both recruitment and survival were positively related to water availability. In severe drought years, recruitment into the adult population from *in situ* reproduction was nonexistent, and adult abundance decreased markedly. In contrast, double-observer surveys for all life stages of California Red-legged Frogs (*Rana draytonii*) and Sierran Treefrogs (*Hyliola sierra*) at a coastal site in 2014 and 2015 indicated an increase in abundance of all life stages of both species following the drying of a lake and elimination of non-native fishes and reductions in American Bullfrog (*Lithobates catesbeianus*) abundance. These differing effects of drought on amphibian populations indicates the context-specificity of the response of amphibian populations to stressors. The challenge for scientists and resource managers is to identify in which context a given stressor is likely to be important, and take appropriate steps to ensure the persistence of amphibian populations under multiple stressors.

13. Climate Change Impacts on Pacific Northwest Amphibians. Gwendolynn W. Bury, *1410 NW. 12th, Corvallis, OR 97330; gwen.bury@gmail.com.*

Human-driven climate change is projected to have a wide variety of impacts on the Pacific Northwest. Forecasts show, on average, increased temperature, changed hydrologic patterns, and subsequent habitat changes, increased fires, and lower summer water levels. Many of these changes have already begun. Across the diverse ecosystems inhabited by amphibians in the Pacific Northwest, climate change will cause a wide variety of threats that will interact with other human-caused environmental changes such as habitat loss, invasive species, and resource extraction. Amphibian species which will be most negatively impacted include those with narrow environmental requirements, isolated or small populations, and those subject to multiple threats. These high-risk categories include many of the species of amphibians native to the Pacific Northwest.

14. Ecological Function of Stream Amphibians in Stream-Riparian Food Webs. David Roon*, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331;*

david.roon@oregonstate.edu; Brooke Penaluna, *Pacific Northwest Research Station, USDA Forest Service, Corvallis, OR 97331; brooke.penaluna@oregonstate.edu;* Alba Argerich, *Department of Forest Engineering, Oregon State University, Corvallis, OR 97331; alba.argerich@oregonstate.edu;* Ivan Arismendi, *Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331; ivan.arismendi@oregonstate.edu;*

Understanding the roles of amphibians to ecosystem functions and processes is an emerging need due to the challenges involved with balancing the complexity of ecosystems and efficiencies required for their management. Amphibians are often monitored as bioindicators in response to ecosystem disturbance due to their sensitivity to environmental conditions and locations in food webs as both predators and prey. Stream amphibians are increasingly recognized as playing a major role in structuring aquatic-riparian communities, as exemplified by the assemblages in headwater streams and riparian forests of the Pacific Northwest. Here, we provide examples of the various direct and indirect interactions between amphibians and their stream communities focusing on their ecological functions. For example, current research is using diets and stable isotopes to track nutrient sources and the trophic role of stream amphibians in response to changing riparian forest conditions and examining top-down effects of amphibians on ecosystem function at multiple spatial scales. This understanding of the ecological role of stream amphibians in the community dynamics of stream-riparian food webs is advancing our knowledge of system heterogeneity and their responses to future environmental changes.

15. The Role of Beavers in Amphibian Conservation: Uncertainties and Opportunities.
John M. Romansic*, *Washington State University, 14204 NE Salmon Creek Avenue, Vancouver, WA 98686; john.romansic@wsu.edu;* Deanna H. Olson, *US Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us*

Ecologists have long recognized the ecosystem engineering capabilities of beavers. Today, conservationists and land managers are harnessing and mimicking beaver dams to restore degraded streams, create habitat complexity, increase water retention, facilitate climate change adaptation, and aid threatened wildlife, especially in regions where precipitation is predicted to decrease. The dam-building and feeding activities of beavers likely benefit many amphibian species by increasing habitat quality and/or quality, but little research addresses this topic. Greater understanding of the role of beavers in the bottom-up and top-down processes that influence amphibians is needed to inform management strategies. Although beaver-engineered alteration of streams holds great potential for bolstering amphibian populations, it is likely that beavers negatively affect some species - for example, by decreasing habitat availability for lotic-dependent species. We propose collaboration between diverse research groups and land managers to determine when, where, and how to implement beaver-related management actions in support of amphibians and overall ecosystem health. In particular, we need to formulate guidelines to prevent undesirable negative effects on imperiled amphibians, especially when stakeholders are considering beaver reintroductions. To facilitate this effort, we present a set of critical hypotheses about how beavers affect amphibian populations, highlighting the fact that beavers may impact amphibians via multiple causal pathways.

16. Behavioral and Developmental Carry-over Effects can Mediate Impacts of Stocked Game Fish on Anurans.
Tiffany Garcia*, *Department of Fisheries and Wildlife, 104 Nash Hall,*

Corvallis OR 97331; Jenny Urbina, *Environmental Science Program, Oregon State University*; Evan Bredeweg, *Department of Fisheries and Wildlife, 104 Nash Hall, Corvallis OR 97331*; Maud Ferrari, *University Of Saskatchewan, Department of Veterinary Biomedical Sciences, 52 Campus Drive, Saskatoon, Canada SK S7N 5B4*

Carry-over effects, or the influence of early experiences on trait response in later life stages, can strongly influence survivorship and reproduction. Many anuran species exhibit behavioral and developmental carry-over effects, with some species able to preemptively recognize and respond to novel predators. Management has yet to incorporate carry-over effects in conservation strategies, and we posit that this information may be vital in mediating invasive species. In a series of experiments, we conditioned both invasive and native anuran species (American bullfrog, *Lithobates catesbeianus*, and Pacific chorus frog, *Pseudacris regilla*) to chemical cues from fish predators commonly stocked in the Pacific Northwest. We found evidence for both behavioral and developmental carry-over effects in both species. In the invasive bullfrogs, individuals conditioned to Largemouth bass cues showed a learned response when exposed as larvae. Pacific chorus frogs also showed a learned response, with larvae responding to risk cues from Rainbow trout. We also assessed developmental carry-over effects by quantifying larval body size at 90 days post-hatch in predator conditioned vs non-conditioned individuals. While bullfrogs conditioned to cues from stocked game fish were larger relative to larvae with no embryonic conditioning, Pacific chorus frogs were smaller. This research contributes to our understanding of behavioral and developmental carry-over effects in anuran species with vastly different management priorities, revealing the importance of life history considerations and early exposure.

17. AmphibiaWeb's Response to the Global Emerging Infectious Disease Crisis in Amphibians. Michelle S. Koo*, *associate director AmphibiaWeb & Staff Curator, Museum of Vertebrate Zoology, University of California, 3101 Valley Life Sciences, Berkeley, CA 94720-3160; mkoo@berkeley.edu*; David C. Blackburn, *Associate Curator & Professor, University of Florida, Gainesville, FL 32611; dblackburn@flmnh.ufl.edu*; David Cannatella, *Professor & Curator, University of Texas, Austin, TX 78712; catfish@austin.utexas.edu*; Alessandro Catenazzi, *Assistant Professor, Southern Illinois University, Carbondale, IL 62901; acatenazzi@siu.edu*; Vance T. Vredenburg, *associate director AmphibiaWeb & Professor, San Francisco State University, San Francisco, CA 94132; vancev@berkeley.edu;* David B. Wake, *director AmphibiaWeb & Curator, Museum of Vertebrate Zoology, University of California, 3101 Valley Life Sciences, Berkeley, CA 94720-3160; wakelab@berkeley.edu*; and Deanna H. Olson, *Research Ecologist, USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331;dedeolson@fs.fed.us*

Amphibians comprise the most endangered group of vertebrates, with about one-third of the world's amphibian species under threat of extinction. Chytridiomycosis, an emerging infectious disease, is especially devastating to many amphibian species, infecting all three living orders (*Batrachochytrium dendrobatidis*, or Bd) or specifically salamanders (*B. salamandrivorans*, or Bsal). One of the founding goals of AmphibiaWeb is to directly address the urgent need to facilitate research in amphibian biodiversity and emerging infectious disease. AmphibiaWeb provides primary information on amphibian biology, taxonomy, and conservation by integrating data from VertNet, producing species accounts, tracking and mapping new species

and more. By harnessing informatics tools and networks, we aim to facilitate collaborative efforts nationally and internationally. This is particularly critical to understanding the disease dynamics across many species and in a variety of habitats through time. In collaboration with the US Forest Service, AmphibiaWeb launched a new portal to track Bd and Bsal around the world (https://amphibiandisease.org) but with the aim to facilitate monitoring efforts and data-gathering in the US and Canada where Bsal is anticipated. The portal enables users to find and reference archived datasets in publications, as well as easily download and reuse datasets from previous research. Records can be queried and viewed (as both a list and on a map) by sample, project, taxon, and both disease and morbidity status. Using this portal, researchers can coordinate and collaborate in efforts to understand disease impacts on amphibian biodiversity, including privately sharing data on projects prior to publication.

18. Context Matters: Tipping Points between Amphibian Risks and Threats – Disease Examples of being Benign or Leading to Declines Deanna H. Olson*, *Pacific Northwest Research Station, US Forest Service, 3200 SW Jefferson Way, Corvallis OR 97331;* Andrew R. Blaustein, *Department of Integrative Biology, 3029 Cordley Hall, Oregon State University, Corvallis OR 97331.*

After a quarter century of research addressing amphibian conservation issues, one overarching theme spans threat factors: the context of a risk factor can flip it from being benign to contributing to a decline. Unraveling the context of such tipping points is a priority for research to contribute to efficient and effective conservation actions. Emerging infectious diseases are a perfect case in point. Disease susceptibility can vary with amphibian host species, amphibian population, amphibian life stage, pathogen type or strain, location and habitat type, and climate factors including microclimate regime and timeframe such as season. Taxonomic and life history traits are emerging as indicators of susceptibility, yet no global framework is possible given myriad interacting contexts. Disease synergisms with other risk factors are increasingly recognized, including coinfections with other diseases and environmental stressors such as ultraviolet radiation or chemical contaminants. As sublethal effects are identified, fitness effects become nuanced. Experimental approaches are key to unraveling these threads, yet the scope of inference of each study becomes a nontrivial consideration. For future forestalling of tipping points for other context-dependent risk factors, lessons learned from amphibian disease researchers examining this complex web of concerns includes increasing the pace and breadth of investigations by interdisciplinary collaborations and networking, information sharing, expedited publication processes, and timely syntheses to encapsulate the ever-increasing knowledge for application to actions on the ground.

19. Partnership Driven Species Conservation Programs Christopher L. Jenkins, *The Orianne Society, Tiger, GA 30576;* cljenkins@oriannesociety.org*; Stephen Spear, The Wilds, Cumberland, OH 43732;* sspear@thewilds.org*; Mark Mandica, The Amphibian Foundation, Atlanta, GA 30309; mark@mandica.com.*

Single species conservation programs have been criticized for focusing too narrowly, but in many cases they can be critical due to the immediate threats facing a species. In addition, single species programs can do important things for the conservation of other species and

broader ecosystems. For example, the conservation of keystone and umbrella species can have significant impacts on other components of ecosystems. When the point is reached that a single species focused program is required often the resources needed to implement such a program are so great that broad coalitions of partners typically provide the best chances of success. Not only do diverse partners bring more resources to the table they often bring specific expertise that when put together with the expertise of other partners can cumulatively build a much more comprehensive program. The Eastern Hellbender and the Flatwoods Salamanders are examples of species so threatened that they require a focused conservation effort that brings together a broad partnership to achieve conservation. In both cases, a diverse group of partners ranging from universities, nonprofits, government agencies, zoos and aquariums, private citizens, to public and private schools have assumed different roles as part of larger conservation programs. Progress has been made on the conservation of both species, progress that would not have been possible if only one entity had implemented the program.

20. Broaden our Base, Show Value, and Capitalize Karen Pope*, *USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Lab, Arcata, CA 95521;* kpope@fs.fed.us*;* Jonah Piovia-Scott, *Washington State University, Vancouver, WA 98686; jonah.piovia-scott@wsu.edu*

To effectively address vital conservation concerns for amphibians, we believe it is imperative to create a sense of wonder in the eyes of the public, show the importance of amphibians to ecosystems, and build collaborations to create new conservation opportunities. In order for amphibian conservation to stay relevant, we need to gain support from the American public, especially the young. Even researchers should attempt to instill wonder and curiosity about our beautiful frogs and salamanders to gain support from a broader and more diverse base of people who care about the fate of amphibians. Research that highlights the values and roles of amphibians will be useful in this effort. In addition to documenting declines, let's find those remaining intact systems and document how amphibians transfer energy, regulate forest processes and increase productivity. Finally, instead of just competing for conservation and restoration dollars with other disciplines, let's join forces to create positive solutions that maximize benefits to amphibians even when the funding is for other priorities such as anadromous fish, forest, or meadow restoration. When we work with practitioners and managers on restoration efforts, we can better incorporate the needs of target amphibians and prevent creating habitat for aquatic invasives. In summary, let's broaden our base by creating wonder, ensure that our research focuses on showing value, and capitalize on opportunities that may not be amphibian-focused to help attain amphibian conservation goals.

A * immediately before the abstract title denotes a student poster. Posters will be hung by number in the poster session.

1. Best Management Practices for Conserving Oregon's Native Turtles: An Overview.
Susan Barnes, *Oregon Department of Fish and Wildlife, West Region Office, 17330 SE Evelyn St., Clackamas, OR 97015; susan.p.barnes@state.or.us*

The Western Pond Turtle (*Actinemys marmorata*) and the Western Painted Turtle (*Chrysemys picta bellii*) are identified as Species of Greatest Conservation Need in Oregon's State Wildlife Action Plan. Actions that involve ground disturbance, in-water work, and use of heavy equipment are only a few types of activities known to affect turtles. Albeit unintentional, these activities can actually make habitat less suitable for turtles and even result in direct injury and mortality to turtles present at a project site. There has been growing demand for known techniques for successfully avoiding and minimizing harmful effects to turtles at project sites and during project implementation. Additionally, with increasing awareness of the plight of Oregon's turtles, there is a growing desire to incorporate turtle habitat elements into project designs. In response, Oregon's Native Turtle Working Group produced "Guidance for Conserving Oregon's Native Turtles including Best Management Practices" in 2015. The document is a compilation of peer-reviewed, recommended best methods for creating suitable turtle habitat and for avoiding and minimizing harmful impacts to turtles and their habitats during implementation of various project types. The BMPs also includes useful information on turtle ecology, when to best conduct certain project actions, and tips for responding to common turtle related scenarios (e.g., what to do if you find a turtle in the middle of the road).

2. Pacific Fisher (*Pekania pennanti)* Distribution in Southwestern Oregon.
Brent Barry, *Oregon State University, 104 Nash Hall, 2820 SW Campus Way, Corvallis, OR 97331,* Katie Moriarty, *USFS Pacific Northwest Research Station, 3625 93rd Ave, Olympia, WA 98512, and Taal Levi, Oregon State University, 104 Nash Hall, 2820 Campus Way, Corvallis, OR 97331*

Fishers (*Pekania pennanti*) are medium sized carnivores that were once widely distributed throughout boreal-forested areas in North America. In the Pacific states fishers were proposed for Federal listing under the Endangered Species Act as a West Coast Distinct Population Segment in 2014 but deemed not warranted in 2016. In Oregon two fisher populations exist, a remnant indigenous population in the Klamath Mountains of southwestern Oregon, and a genetically distinct reintroduced population near Crater Lake in the southern Cascades. Surveys were conducted in 2015 and 2016 using motion-activated cameras to assess the contemporary distribution of these populations, potential corridors, and detectability of fisher in this region. The results from these surveys differed from expected outcomes and appear to show a shift or contraction of the southern Cascades introduced population, and a stable indigenous population.

3. *The Interaction of Terrestrial Environmental and Tadpole Rearing Conditions on Juvenile Movement Behavior in Northern Red-legged Frogs.
Evan M. Bredeweg, *104 Nash*

Hall, Oregon State University, Corvallis, OR 97331; evan.bredeweg@oregonstate.edu; Tiffany Garcia, *104 Nash Hall, Oregon State University, Corvallis, OR 97331; tiffany.garcia@oregonstate.edu*; Anita Morzillo, *University of Connecticut, U-4087, 1376 Storrs Road, Storrs, CT 06269; anita.morzillo@uconn.edu*

Understanding the movement ecology of amphibians is vitally important as they are one of the most threatened taxa on the planet. We explored how intrinsic and extrinsic factors interact in shaping the movement behavior of juvenile Northern Red-legged Frogs (*Rana aurora*). This species can plastically modify its growth, development, and behavior as tadpoles in response to their larval aquatic environment. Yet after metamorphosis, this species must navigate an entirely different and terrestrial environment. We experimentally manipulated both the larval environments and terrestrial conditions to assess the response in movement behavior of post-metamorphic juveniles. To quantify individual movement behavior, we used a combination of semi-natural enclosed runways and controlled-release powder tracking sessions. Results suggested that latent effect of the larval environment and direct effects of the terrestrial conditions both have impacts on movement behavior. Individuals reared in permeant hydroperiods metamorphosed into larger individuals relative to ephemeral conditions, and size was the strongest predictor of movement distances. For direct effects of the environment, individuals exposed to dry terrestrial conditions were less likely to move away from a moistened refuge than those in wet conditions. Yet when individuals in dry conditions did move away from refuge, they moved greater distances than those in wet conditions. These effects may predispose some populations to be sources or sinks for dispersal based on a particular combination of conditions. These results highlight that behavior interacts with the environment to shape individual movement and potentially population connectivity and persistence across landscapes.

4. *Olfactory Structure of the Rough-Skinned Newt (*Taricha granulosa*) Changes between Aquatic and Terrestrial Phases. Allison Bronson, *Richard Gilder Graduate School, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024; abronson@amnh.org;* Ethan Snee, *Humboldt State University, Department of Biological Sciences, 1 Harpst Street, Arcata, CA 95521;* ethan.snee@humboldt.edu*;* Adam Cummings, *Humboldt State University, Department of Biological Sciences, 1 Harpst Street, Arcata, CA 95521; adam.cummings@humboldt.edu;* John Reiss, *Humboldt State University, Department of Biological Sciences, 1 Harpst Street, Arcata, CA 95521; john.reiss@humboldt.edu*

Rough-skinned Newts, *Taricha granulosa*, feed in both aquatic and terrestrial environments and show olfactory-mediated mating behaviors in the water and homing behaviors on land. To understand the structural basis for these behaviors, the olfactory organs and associated tissues in larval, aquatic adult, and terrestrial adult Rough-skinned Newts were examined by scanning electron microscopy and traditional histology. In both aquatic- and terrestrial-phase adult newts the olfactory organs are paired, flattened sacs, extending from the external nares anteriorly to the internal nares posteriorly. The ventrolateral border of the main olfactory cavity (MOC) outpockets to form the lateral nasal groove, which houses sensory cells of the vomeronasal organ (VNO). The nasolacrimal duct joins the lateral nasal groove. The olfactory epithelium of the MOC comprises strips of sensory and supporting cells set between raised ridges of respiratory epithelium. In aquatic adults, the respiratory epithelium is covered with long, presumably motile cilia. The olfactory epithelium has shorter cilia. By contrast, the

respiratory epithelium of terrestrial animals almost completely lacks cilia, and the ridges bearing it are much more pronounced. The respiratory epithelium of the lateral nasal groove is ciliated in both aquatic and terrestrial forms, with long, thick, presumably motile cilia, while the VNO sensory epithelium has shorter, more slender cilia. Larval animals resemble aquatic adults. These structural changes following the animals' transition between media likely indicate a change in olfactory mechanism and sensitivity to chemical cues.

5. *Utilization of a Predictive Model of *Spea intermontana*: Implications for Survey and Management of Cryptic and Endangered Species. Corey Brumbaugh, *Central Washington University, 400 E. University Way Ellensburg, WA 98926-7537; brumbaughc@cwu.edu;* R Steven Wagner*; WagnerS@cwu.edu;* Wayne S. Quirk*; QuirkW@cwu.edu;* Robert E Weaver*; weaverro@cwu.edu*

Throughout the years, researchers have conducted field studies to locate, monitor and effectively manage new wildlife populations. Often researchers may struggle with identifying starting points in the search for populations of cryptic or endangered species. The use of Geographic Information Systems (GIS) is one tool that may be used to find such starting points. This in turn, may lead to further areas of ecological study. We created a predictive distribution model to locate and map novel populations of the Great Basin Spadefoot Toad, *Spea intermontana* in eastern Washington State. Our predictive model is created using 5 criteria: hydrography, elevation, soil type, land use, and land cover. Data files on these 5 criteria were available from local and government agencies. Combining these data files with recent ecological and behavioral data sets on *S. intermontana* from a single survey site, we were able to produce a predictive model suitable for Washington State. This model can be adapted to use a variety of other variables, such as: cost distance analyses, road networks, direct human disturbance and many others. Such a model will allow researchers to make methodical choices during initial stages of surveying for a target species. We feel our model can serve as an excellent example of an applied GIS based approach to survey and management techniques. This is an important first step toward facilitating the ease and efficacy of field based research. It could also be an integral tool when addressing questions about the status of endangered or cryptic species.

6. *Central Washington University SOAR and MOSAIC GEAR UP. Corey Brumbaugh, *Central Washington University, 400 E. University Way Ellensburg, WA 98926-7537; brumbaughc@cwu.edu;* R Steven Wagner*; WagnerS@cwu.edu*

The Central Washington University (CWU) GEAR UP Project serves 5,800 students in two grant programs. The MOSAIC grant (Moving Our Students Academically into College and Careers) serves 2,300 11th and 12th grade students in select Title I high schools. The SOAR grant (Success, Opportunity, Affordability Rigor, Relevance, and Relationships) serves 3,500 8th and 9th grade students in select Title 1 middle schools. This two-grade cohort model begins in 6th and 7th grade and comprises a student body smaller than many urban high schools but it represents a vast, rural and isolated area in North Central Washington. The program provides services in each middle and high school building for seven years to build a sustainable culture of college-awareness and preparation by the project's end. GEAR UP is a discretionary federal grant program designed to increase the number of low-income students prepared to enter and succeed in postsecondary education. Through GEAR UP partnerships, local schools, community-

based organizations, businesses, and institutions of higher education work together to strengthen academic programs and student services in the schools so that students are prepared academically and financially to enter and succeed in college. At CWU we have a Science Connections Team that creates lessons and activities to support and enrich the curriculum within our schools. The Team then presents the lessons to the students at their home site. The sole purpose of our Science Connections Team is to help encourage and inspire the youth of today to become the minds of tomorrow.

7. *Top 10 Conservation and Research Priorities for Reptiles. Christopher Cousins[1], Jesi Hessong[1], Mark Leppin[1], Carson Lillard[1], Deanna H. Olson[2], John M. Romansic[3] [1]*Oregon State University, Nash Hall, 2820 SW Campus Way, Corvallis, OR 97331;* cousinsc@oregonstate.edu, hessongj@oregonstate.edu, leppinm@oregonstate.edu, lillardc@oregonstate.edu*;* [2]*US Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331;* dedeolson@fs.fed.us*;* [3]*Washington State University, 14204 NE Salmon Creek Avenue, Vancouver, WA 98686;* john.romansic@wsu.edu

We conducted a literature synthesis to derive the 10 most important conservation and research priorities for reptiles, with global to local considerations. Broad categories of priorities include: 1) habitat loss, fragmentation, and degradation; 2) invasive species; 3) over-harvesting, collection, and exploitation; 4) climate change; 5) disease and parasitism; 6) long-term population monitoring, accurate species-level assessment of conservation status, and inventory; 7) understanding the role of reptiles in ecosystems and ecosystem services; 8) gaps in phylogenetic knowledge; 9) engagement of the public to enhance human valuation of reptiles and secure assistance from citizen scientists and other volunteers; and 10) identification and prioritization of the most pressing issues. Although each of these broad categories are critical for conservation of biodiversity in general, we will focus on pivotal issues specific to reptiles. For example, we will discuss regional and population size biases as well as taxonomic gaps in phylogenetic knowledge that hinder assessment of species conservation status and leave reptiles underserved, with less than half of known species assessed. We will also discuss valuation of feared or persecuted reptiles and ways to improve the social and cultural status of reptiles to encourage public support.

8. Building a Regional Genetic Library for Aquatic Species: The Barcode Bank. Emily Dziedzic, *Oregon State University, Department of Fisheries and Wildlife Sciences, Nash Hall, 2820 SW Campus Way, Corvallis, OR 97331; dziedzie@oregonstate.edu*; Brooke Penaluna, *United States Forest Service, Pacific Northwest Forest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; bepenaluna@fs.fed.us*; Taal Levi, *Oregon State University, Department of Fisheries and Wildlife, Nash Hall, 2820 SW Campus Way, Corvallis, OR 97331; taal.levi@oregonstate.edu*; Dede Olson, *United States Forest Service, Pacific Northwest Forest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us*

Environmental DNA [eDNA] is a powerful tool that can be used to detect a range of taxa in aquatic habitats. The genetic material available in eDNA consists of mitochondrial DNA, and to reliably discern species from samples it is necessary to have adequate genetic data for comparison. Current methods for the detection of multiple taxa can involve amplification using species-specific or species-general primers or high-throughput sequencing and access to a comprehensive genetic library. Individual species can be identified in samples targeted with

species-specific primers and amplified using quantitative or droplet digital PCR. One impediment to the application of eDNA for species detection is that current genetic databases are not sufficiently comprehensive to identify all target taxa present in a sample. Building a genetic library using mitogenomes would likely make species detection more reliable and would also facilitate the creation of species-specific probes and primers. The purpose of this project will be to sequence the mitogenomes of a variety of aquatic taxa found in Oregon and Washington and to construct a regional library in the form of a database to provide the basis of genetic information for all eDNA approaches. We are currently soliciting voucher specimens and are requesting submissions throughout the 2017 and 2018 field seasons. We hope to include *coldwater fishes*, including Salmon/Trout, Lamprey, Suckers, Minnows, Trout-perch, Sturgeon, and Sculpin; *warmwater fishes*, including Bass, Sunfish, and Catfish; *amphibians*, including aquatic-dependent frogs, salamanders, and newts; and *invertebrates*, including crayfish, mollusks, and macroinvertebrates.

9. Preliminary Findings: Distributions of Carnivores and Small Mammals in Western Oregon. Jordan Ellison, Katie Moriarty, *USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue, Olympia WA 98512, Corvallis OR 97331;* Brent Barry, *Department of Fisheries and Wildlife, 104 Nash Hall, Corvallis OR 97331.*

The Pacific Northwest Research Station, Oregon State University, and partners conducted a series of large-scale camera survey efforts during 2015 and 2016, targeting Pacific Marten (*Martes caurina*) and Fisher (*Pekania pennanti*). Our survey efforts in the coast range, southern Cascades and northern Cascades of Oregon have provided over 4 million photographs. Species detections include a suite of Oregon's carnivores, such as Cougar (*Puma concolor*), Bobcat (*Lynx rufus*), and Grey Fox (*Urocyon cinereoargenteus*). We are processing the photographs with information to assess species distribution and detectability. We have used our preliminary assessment of the photographs to produce distribution maps of nine of Oregon's carnivores. For the selected carnivores, we summarize detection locations by ecoregion as a function of elevation, canopy cover, and stand age. We hope our preliminary maps and summaries can assist in catalyzing conversations about mammal distributions and landscape connectivity.

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elevation, canopy cover, and stand age. We hope our preliminary maps and summaries can assist in catalyzing conversations about mammal distributions and landscape connectivity.

11. Observations of Western *Aneides* Courtship provide insight into the Evolution of Courtship Behavior among Plethodontid Salamanders. Karen M. Kiemnec-Tyburczy, *Department of Biological Sciences, Humboldt State University, 1 Harpst St., Arcata, CA 95521; kmk877@humboldt.edu;* Jerod R. Sapp, *Department of Integrative Biology, Oregon State University, 3029 Cordley Hall, Corvallis, Oregon 97331; sappj@science.oregonstate.edu;* Stevan J. Arnold, *Department of Integrative Biology, Oregon State University, 3029 Cordley Hall, Corvallis, Oregon 97331; arnoldst@oregonstate.edu*

Salamander courtship behaviors are often studied in an evolutionary framework because male persuasive behaviors are frequently variable across taxa. We observed and quantified courtship behavior of two salamanders in the genus *Aneides* and interpret our results in a broader phylogenetic context. We first describe the courtship of the Black Salamander (*A. flavipunctatus*) and then describe a complete courtship sequence of the Arboreal Salamander (*A. lugubris*), a species whose courtship was only partially characterized from a single previous observation. Observations of staged courtship of male-female pairs in these two species demonstrate marked differences in courtship behaviors within the genus. *Aneides flavipunctatus* and *A. lugubris* courtships are similar to other plethodontids in that their courtships both include a tail-straddling walk, where the male leads the female in a linear fashion. Other behaviors, such as 'pulling' and 'turning back' are shared by all *Aneides* thus far observed, but not seen in many other plethodontids. The novel circular tail-straddling walk displayed by two other *Aneides* species was not observed in either *A. flavipunctatus* or *A. lugubris*. Finally, we map some of the conserved elements of *Aneides* courtship onto a larger plethodontid phylogeny to investigate the likely origins of these behaviors. We conclude that elements involved with sperm transfer are extremely conserved while those involved in pheromone delivery have more recent origins and are more variable.

12. Modifying Canopy Shading in the Riparian Zone during Timber Harvest: Preliminary Results from Coastal Giant Salamander (*Dicamptodon tenebrosus)* Monitoring in Northwestern California. Matt R. Kluber, *Green Diamond Resource Company, 900 Riverside Rd., Korbel, CA 95550; matt.kluber@greendiamond.com;* William D. Devenport, Matthew R. House, *Green Diamond Resource Company, 900 Riverside Rd., Korbel, CA 95550;* Lowell V. Diller, *Lowell Diller Environmental Consulting, 1639 Vine Ave., McKinleyville, CA 95519;* David A. Dimitrie, *Case Western Reserve University, Department of Biology, DeGrace Hall, 2080 Adelbert Rd., Cleveland, OH 44106*

Timber management approaches establishing continuous dense mature riparian buffers along watercourses with the intent of providing cold water temperatures, high levels of large wood, and sediment filtration may overlook the importance of overall productivity in aquatic ecosystems. Here we provide preliminary findings resulting from a pilot project in northwestern California evaluating the response of local instream productivity to riparian canopy thinning using a mark-recapture study of aquatic larval salamanders. Growth and movement of larval Coastal Giant Salamanders (*Dicamptodon tenebrosus*) have been monitored within a 520 m reach of continuous stream habitat since August 2014. Mark-recapture sampling was conducted utilizing visible implant elastomer and PIT tags in late summer and early winter prior to and

shortly following canopy thinning. Recapture efforts have continued bimonthly following treatment to examine the effects of the changes in the riparian structure on salamander growth and movement. Overall, an average of 325 larvae have been located per survey; however, only 16.4% of marked animals have been recaptured. The majority of recaptured larvae have demonstrated high fidelity to within site location, although downstream movements as great as 488 meters have been documented. Examination of the effects of the riparian treatment on growth and movement has thus far been inconclusive. Further preliminary results on salamander growth, movement, and density will be presented surrounding this study as well in the context of general *Dicamptodon tenebrosus* ecology.

13. Response of Headwater Amphibians to Logging Impacts and Assessing Potential for Restoration in Redwood National and State Parks. Alyssa Marquez, *Humboldt State University, 1 Harpst Street, Arcata, CA 95521; amm1700@humboldt.edu;* Lowell V. Diller, *Humboldt State University, 1 Harpst Street, Arcata, CA 95521; ldillerconsulting@gmail.com*

I compared headwater amphibian communities between a pristine old-growth and historically logged watershed in the Redwood and National State Parks (RNSP) using a paired watershed study design during the summer of 2016. I surveyed surface-accessible channels in the mainstem and tributaries of both watersheds for the Coastal Giant Salamander (*Dicamptodon tenebrosus*), the Coastal Tailed Frog (*Ascaphus truei*), and the Southern Torrent Salamander (*Rhyacotriton variegatus*), all which are thought to be excellent indicators of environmental stress. My objectives were to assess the impacts of logging on headwater amphibian populations and their habitat, and to determine if there are remnant source populations of amphibians and stream characteristics that could inform future restoration efforts. Preliminary amphibian species distribution maps suggest large differences between the two watersheds, and that the logged watershed is still impacted by historical forestry practices even 60 years post-logging. Recovery of the logged watershed appears to be hindered as a result of disrupted fluvial process caused by its naturally highly-erodible geology, low stream gradient, and excess wood debris. I will conduct a second field season in 2017 to account for annual variation in amphibian populations.

14. Thermal Characteristics of Pacific Marten Rest Structures and Habitat. Marie E Martin, *Oak Ridge Institute for Science and Education, 419 Peninsula Drive, Westwood, CA 96137*; *martin.marie.ellen@gmail.com*; Katie M Moriarty, *3625 93rd Ave SW, Olympia, WA 98512; kmoriarty02@fs.fed.us*

Balance between resource acquisition, movement, and thermoregulation is critical for endotherms such as the Pacific Marten (*Martes caurina*), a small and lean carnivore. To evaluate the thermal properties of marten rest structures and habitat we are 1) using environmental data loggers to understand the relationship between microsite use (e.g., subnivean chambers, tree cavities) and external temperature, and 2) maintaining ambient data loggers among various environmental strata to collect hourly temperature data. We deployed loggers at a subset of confirmed rest sites during Spring 2016 and Winter 2017. Temperature decreased at a slower rate inside microsites than at paired exposed sites ($\bar{x}_{in}$=21.8 minutes, $\bar{x}_{ex}$= 18.5 minutes, n=10), suggesting these structures exhibit insulative benefits. We will continue deploying loggers at rest structures for the next year, and will determine whether thermal efficiency varies among microsite types and seasons. In Fall 2016, we deployed 46 ambient temperature loggers at

locations stratified by vegetation class, elevation, and aspect. Preliminary data suggest that structurally complex vegetative stands experience less temperature fluctuation than simple or open stands; additionally, these complex stands accounted for the greatest number of marten resting and denning locations. In the future, we will extrapolate ambient temperature data to build a 'thermal landscape.' By pairing these data with fine-scale movement data from GPS collars, we hope to better understand the effect of temperature on duration and timing of marten movements and behavior.

15. People, Forests, and Change—Lessons From the Pacific Northwest with a Focus on Biodiversity. Deanna H. Olson, Beatrice Van Horne, *US Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us*

In the moist coniferous forests of the Pacific Northwest, the sustainability of human communities and forest resources, including biodiversity, is intimately intertwined. Maintaining both multi-faceted, biodiverse forest ecosystems and thriving forest-based human communities is challenging, particularly as climate change and other stressors add new dimensions to the complexity of managing forests for multiple goals. Our 20-chapter book (April 2017) with 59 contributing authors describes the factors that make human-forest ecosystems heterogeneous, synthesizes new knowledge from multiple scientific disciplines, and integrates findings to show how management of both natural and human resources could be strengthened. Key themes addressed include: 1) delivery of key ecosystem services, including species persistence, and how it is affected by dynamic forest processes intersecting with fixed boundaries of land-use allocations and landownerships with differing management objectives; 2) managing for sustainability with all people, all species, and all stressors in mind, which could require an all-lands integration approach combined with monitoring and adaptive management; and 3) multi-stakeholder, collaborative-group forest governance as a promising approach for managing multiple resources across landownerships at large spatial scales, although the complex issue of trust among partners will need to be addressed to ensure success. The lessons learned from this system are applicable to the management of coupled nature-human ecosystems well beyond the Pacific Northwest.

16. *Microhabitat Use of the Colorado Checkered Whiptail (*Aspidoscelis neotesselata*) In Grant County, Washington State. R. Troy Peterson, *Department of Biology, Central Washington University, 400 E. University Way, Ellensburg, WA 98926; petersonro@cwu.edu*

For the 2017 field season, I will be investigating the utilization of available microhabitats within the range of Colorado Checkered Whiptail (*Aspidoscelis neotesselata*) near Lind Coulee through the use of visual encounter surveys and through radio tracking of individual whiptail lizards. For visual encounter surveys, parallel transects will be established at each of the 4 sites (1 transect in shrub steppe habitat, 1 in disturbed habitat closer to the banks of Lind Coulee); each transect will be walked 3 times a day (morning, midday, and evening) with every lizard observed recorded for the duration of the seasonal whiptail activity. For every 3rd lizard observed, microhabitat variables will be recorded within a 1 m circular plot around the site of lizard observation. Microhabitat variables include prey items available, exposure to sunlight, distance to water and vegetation type. As a control, similar transects will be established and data recorded in areas of similar disturbance and habitat, without non-whiptail activity. To determine

the amount of time individual whiptails spend in available microhabitats, 8 individual whiptails will be fitted with an external radio transmitter (2 whiptails per each area of whiptail activity) and radio-tracked for 2 full days a month, for each month of the field season. Results will be analyzed with an analysis of variance test (ANOVA) paired with a Tukey test, a principal component analysis (PCA), and these data will then be uploaded into an Excel sheet and used to generate a predictive map via ESRI ArcGIS software.

17. *Winter Habitat Selection of *Corynorhinus townsendii* in Volcanic Caves at Lava Beds National Monument. Katrina Smith and Daniel C. Barton, *Department of Wildlife, Humboldt State University, 1 Harpst Street, Arcata, CA; ksmith@humboldt.edu*; d*aniel.Barton@humboldt.edu;* David A. Riggs, *Lava Beds National Monument, National Park Service, PO BOX 1240, Tulelake, CA; david_a_riggs@nps.gov*

The expansion of white-nose syndrome (WNS) threatens to affect bat population dynamics in the western United States. The degree of this effect is unknown, and warrants increased efficiency and power in bat monitoring to inform distribution models and disease surveillance. Monitoring of all bat species, including those suspected to survive the infection, should be emphasized. Annual occupancy and abundance surveys of Townsend's Big-eared Bat (*Corynorhinus townsendii*) hibernacula have been conducted in volcanic caves at Lava Beds National Monument, northeastern California, since the late 1980s for this species of special concern. Additionally, cave microclimate has been recorded using HOBO dataloggers at sites designated for long-term monitoring by the Klamath Inventory and Monitoring Network. Lava Beds maintains a database of the physical features of 700+ caves that vary substantially in morphology and microclimate. In other regions, cave microclimate and morphology have been used to assess which caves provide the cold, stable conditions necessary for *C. townsendii* to hibernate. Here, we used generalized linear models to examine the relationship between *C. townsendii* abundance and cave temperature, relative humidity, length, number of entrances, and passage depth to evaluate whether cave microclimate or morphology can predict *C. townsendii* occupancy and abundance. Such results could improve efficiency of population trend monitoring, a key tool for anticipating and managing the potential impacts of WNS in western North America.

18. *Selection of Ephemeral Pools for Oviposition by Pacific Chorus Frogs (*Pseudacris regilla*). Rebecca C. Watling and Mary E. McDermott, *Department of Wildlife, Humboldt State University, 1 Harpst Street, Arcata, CA 95521l; rcw177@humboldt.edu*

The selection of oviposition sites is an important factor that influences the survival rates of larval amphibians. Ephemeral pools in particular make good breeding sites because of their lack of aquatic predators, decreased interspecific competition, and lack of persistent diseases like chytridiomycosis. We wanted to know what microhabitat characteristics Pacific chorus frogs (*Pseudacris regilla*) were selecting for where they laid their eggs. We used a paired study design to compare oviposition site characteristics including area, depth, and percent emergent vegetation between occupied and available seasonal pools in Arcata, California in March 2016. On average, *P. regilla* selected pools of volume greater than 0.46 cubic meters and with 4-17% emergent vegetation. It is important to understand the habitat requirements of amphibians at all stages of their life history for the management and conservation of all species.

19. Assessing Reuse and Structural Changes over Time in Pacific Marten (*Martes caurina*) Rest Structures. Bryce Woodruff, Oak Ridge Institute for Science and Education Fellow, *US Forest Research Participation Program, 900 CA-36, Chester, CA 96020; brycewoodruff@gmail.com*; Katie Moriarty, PhD, Certified Wildlife Biologist, Postdoctoral Research Wildlife Biologist, *US Forest Service, Pacific Northwest Research Station. 3625 93rd Ave SW, Olympia, WA 98512;kmoriarty02@fs.fed.us;* Matthew Delheimer, Lead Biological Science Technician, *US Forest Service, Pacific Northwest Research Station, 3625 93rd Ave SW, Olympia, WA, 98512; mdelheimer@fs.fed.us;* Patrick Tweedy, M.S. Graduate Student, *College of Forestry, Oregon State University, Corvallis, OR 97331; Patrick.tweedy@oregonstate.edu.*

Pacific Martens (*Martes caurina*) use rest structures (live trees, snags, logs, stumps) for avoiding predators and reducing thermal stress. Rest structure selection by Pacific Martens has been well studied and suggests Pacific Martens prefer large woody structures (i.e., >90cm in diameter). However, there is little information on persistence, and long-term Pacific Marten reuse, of woody rest structures. Using novel techniques, we are finding Pacific Martens often use rest structures more than once over shorter time periods and occasionally, single structures are used by multiple individuals. In December 2016 and January 2017, we revisited 44 woody rest structures initially identified between 2009 and 2012 in the Lassen National Forest, California. We determined whether the structure had changed (i.e., live tree to snag, snag to log) and compared current to initially observed structure decay class. We placed remote cameras at relocated structures to quantify Pacific Marten reuse. Monitoring will continue for 3-6 months. We will assess proximity of Pacific Martens to these structures by conducting snow tracking surveys, evaluate Pacific Marten reuse 5-8 years after initial discovery, and quantify characteristics of structures with higher Pacific Marten reuse rates. Large structures with cavities are relatively rare and, we suspect, will be used disproportionately to their availability. Our research may help to establish a baseline rate at which rest structures become unusable, and determine if suitable structures continue to be used by Pacific Martens over longer time periods. We hope this information can be used to inform forest management strategies and restoration efforts.