SNVB

Snake Ecology Symposium

27-28 April 2023

Great Wolf Lodge

We are grateful to live within the unceded traditional territories of the Chehalis Tribe. We strive to responsibly address all forms of discrimination and create an equitable and inclusive community and partnerships for all.

Thursday - Fallen Timbers Room

Time	Talk Type	Speaker(s) in red; collaborators or co-investigators black)	Page
08:00-08:15	Introduction	**Marc P Hayes**	**14**
08:15-08:40	Plenary	**Charles R Peterson**/Patrick D Giltz	**29**
09:00-09:20	Regular	**Hallock, Lisa A** (and session moderator)	**12**
09:20-09:30	Short	**Pilliod, David S**/Lisa A Hallock/Mark P Miller/Thomas D Mullins/Susan M Haig	**30**
09:30-09:40	Short	**Campbell, Dustin R M**/Richard F Hoyer/Robert T Mason/Deanna H Olson	**8**
09:40-10:00	Regular	**Hoyer, Richard F**/Dustin R M Campbell	**16**
10:00-10:20	Break		
10:20-10:40	Regular	**Ovaska, Kristiina** (and moderator)/Christian Engelstoft/Lennart Sopuck	**25**
10:40-11:00	Regular	**Woodruff, Veronica R**/Leslie Anthony	**36**
11:00-11:20	Regular	**Leppin, Mark V**/Richard F Hoyer/Deanna H Olson/Robert T Mason	**20**
11:20-11:40	Regular	**Rombough, Chris J**	**32**
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12:00-01:20	Lunch – in Chehalis Room B		
01:20-01:40	Regular	**Mackessy, Steve P** (session moderator)	**21**
01:40-02:00	Regular	**Perry, Blair W**/Drew R Schield/Todd A Castoe	**28**
02:00-02:20	Regular	**Parker, Joshua**/Stephen F Spear/Charles R Peterson	**26**
02:20-02:40	Regular	**Cobb, Vincent A**	**9**
02:40-03:00	Break		
03:00-03:20	Regular	**Beck, Daniel D** (session moderator)/Jefferson Brooks, Joey Chase, Ray Geroso, C.M. Gienger, Aaron Gilbertson, Jared Horrocks, Caleb Loughran, Rich Lukose, John Rohrer	**6**
03:20-03:40	Regular	**Hamilton, Bryan T**	**13**
03:40-04:00	Regular	**Spear, Stephen F**/Charles R Peterson/Christopher L Jenkins/Lisette P Waits	**34**
04:00-04:20	Regular	**Bauder, Javan M**/Charles R Peterson	**5**

	In-person speaker
	Remote speaker

Friday - Fallen Timbers Room

Time	Talk Type	**Speaker(s)** (speakers in **red**; collaborators or co-investigators in **black**)	Page
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09:00-9:20	Regular	**Pilliod, David S**/Michelle I Jeffries/Robert S Arkle/Deanna H Olson	**30**
09:20-9:40	Regular	**Parker, Kristina J**/David S Pilliod/Jay D Carlisle/Matthew A Williamson	**27**
9:40-10:00	Regular	**D'Antonio, L Ashley/Gareth R Hopkins**/Blake H Looney	**10,15**
10:00-10:20	Break		
10:20-10:40	Regular	**Trunk, Laura H** (and session moderator)/Chris J Rombough	**4**
10:40-11:00	Regular	**Slade, Adrian C**/Tyler J Larsen	**33**
11:00-11:20	Regular	**Bronikowski, Anne M**	**7**
11:20-11:40	Regular	**Olson, Deanna H**/Matthew C Allender/Katherine H Haman/Jeffrey M Lorch/Jenna M Palmisano/Allan P Pessier	**24**
11:40-12:00	Regular	**Yrazabal, Megan**	**37**
12:00-01:20	Lunch (on your own)		
01:20-01:40	Snake Talk Podcast	**Chris Jenkins** (moderator) - Panelees: David Pilliod, Lisa Hallock, Lameace Hussain, Steve Mackessy	**19**
01:40-02:00			**30,12**
02:00-02:20			**18,21**
02:20-02:40			
02:40-03:00	Break		
03:00-03:20	Regular	**Hussain, Lameace E** (and session moderator)	**18**
03:20-03:40	Regular	**Frauenhofer, Chris A**	**4**
03:40-04:00	Regular	**Olson, Brenna R**/Charles R Peterson	**23**
04:00-04:20	Regular	**Hayes, Marc P**/Paul R Yarnold	**14**
04:20-04:45	Wrap-up	**Hayes, Marc P/Charles R Peterson**	**14,29**

(green)	**In-person speaker**
(yellow)	**Remote speaker**

Dr Javan Bauder, a native of the Pacific Northwest, grew up on the Washington Coast before moving to Idaho and earned his BS at the University of Idaho. He received his MS from Idaho State University where he studied the spatial ecology of prairie rattlesnakes in central Idaho. Javan then joined The Orianne Society, a nonprofit reptile conservation organization, which took him to the southeast where Javan worked on multiple taxa but primarily the federally threatened Eastern Indigo Snake. Javan continued his work with indigo snakes while earning his PhD from the University of Massachusetts Amherst where his dissertation focused on the effects of landscape features on Eastern Indigo Snake habitat selection, population viability, and landscape genetics. Javan expanded his taxonomic repertoire during his post-doc at the Illinois Natural History Survey working on mammalian furbearer population ecology and human-black bear conflict and at the Pennsylvania Cooperative Fish and Wildlife Research Unit working on white-tailed deer landscape genetics. Javan joined the Arizona Cooperative Fish and Wildlife Research Unit of the US Geological Survey at the University of Arizona in Tucson in 2021. His research program spans a variety of mammal, bird, and reptile (and even fish) taxa and addresses questions in wildlife population and landscape ecology to inform wildlife management and conservation. In his spare time, Javan enjoys reading a good history book and sharing the outdoors with his wife and three (soon to be four) daughters.

Does the presence of conspecifics influence the seasonal migrations of communally denning Prairie Rattlesnakes (*Crotalus viridis*)? Javan M. Bauder. *U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 1064 E Lowell Street, Tucson, AZ 85741; jbauder@arizona.edu*; Charles R. Peterson. *Idaho State University, Department of Biological Sciences, Pocatello, ID 83209; petechar@isu.edu.*

Prairie and Western Rattlesnakes (*Crotalus viridis* and *C. oreganus*) in the Intermountain West typically undertake seasonal migrations between communal hibernacula and summer foraging/mating habitat. Previous research has rarely considered the potential role of high conspecifics densities around communal hibernacula as a factor contributing towards such seasonal migrations. In this study, we examined how the presence of conspecifics within and among hibernacula influenced the seasonal migrations of Prairie Rattlesnakes in a mountainous landscape in a central Idaho wilderness. We radio-tracked 21 prairie rattlesnakes April through September 2008 from two hibernacula complexes <1 km apart each on opposite sides of a river valley. Rattlesnakes from opposite complexes rarely crossed the river towards the opposite complex but rather tended to move away from the opposite complex even though such movements were generally uphill. The longest movement distances (>1.5 km) were always observed by rattlesnakes moving away from the opposite complex. Movements towards the opposite complex were typically short (<1 km) and overlapped little with those of snakes from the other complex. Observed home range overlap between rattlesnakes from opposite complexes was less than expected if rattlesnakes moved in random directions from their hibernaculum. These results reveal that rattlesnakes may undertake seasonal migrations, in part, to avoid conspecifics from the same hibernaculum and conspecifics from other hibernacula. Additional research is needed to determine if communally denning rattlesnakes are competing for prey or foraging spaces and if seasonal migrations serve to reduce this competition.

Dr Dan Beck grew up in the foothills of the Wasatch Mountains near Salt Lake City, Utah. His inspiration for herpetology came early, from raising chickens as a kid and working as a reptile keeper at Salt Lake's Hogle Zoo in the 1970s. He completed a BS and MS in Biology/Ecology from Utah State University and a PhD in Ecology, Evolutionary Biology and Physiology from the University of Arizona. He came to CWU in 1994, where he has taught courses ranging from introductory biology and biostatistics to herpetology and field ecology. He has mentored over 25 graduate students and hundreds of undergraduate students in ecological field research, much of it in Mexico. Dan has spent over 30 years investigating Gila monsters and Beaded lizards, from the Mojave, Sonoran, and Chihuahuan deserts of the southwestern USA to the tropical dry forests of Mexico. Dan's book "Biology of Gila monsters and Beaded Lizards" is now considered the standard reference for these "snakes on legs". Dan founded CWU's SOBRE Mexico program (Student Opportunities for Biological Research in Mexico), where CWU students worked with Mexican colleagues to investigate the web of biological interactions in tropical dry forests of Mexico. In the Pacific Northwest, Dan and his students have conducted numerous ecological studies of rattlesnakes and lizards of the shrub-steppe, turtles, amphibians, and other vertebrates. He lives with his wife and fellow biologist Kris Ernest in a straw bale home in Ellensburg, WA.

Ecological Variation of Washington Northern Pacific Rattlesnake (*Crotalus oreganus*) Populations in a World Shaped by Humans. *Daniel D. Beck, *Central Washington University Department of Biological Sciences, 400 E. University Way, Ellensburg, WA 98926*; beckd@cwu.edu; Jefferson Brooks, *621 Harvard Ave E, Apt. 35, Seattle, WA 98102*; jd.brooks@aecom.com; Joseph Chase, *Central Washington University Department of Biological Sciences, 400 E. University Way, Ellensburg, WA 98926;* joseph.chase@cwu.edu; C.M. Gienger, *Austin Peay State University Center for Excellence in Field Biology, P.O. Box 4718, Clarksville, TN 37044*; giengerc@apsu.edu; Jared Horrocks, *1101 North Columbia St, Ellensburg, WA 98926*; life46x2@gmail.com; Ray Geroso, *USDA Forest Service Savannah River PO Box 700 New Ellenton, SC 29809*; gorg1898@yahoo.com; Aaron Gilbertson, *7248 Capitol Blvd SE, Tumwater, WA 98501*; Aaron.Gilbert@cwu.edu; Caleb Loughran, *Department of Biology, New Mexico Highlands University, 810 National Ave, Las Vegas, NM 87701;* loughran@nmhu.edu; Richard Lukose, *1110 N 35th Ave, Yakima, Washington*; lukose@lifesci.ucsb.edu; and John Rohrer, *U.S. Forest Service, Okanogan-Wenatchee National Forest, Methow Valley Ranger District, 24 West Chewuch Road, Winthrop, WA 98862*; jrohrer@centurytel.net

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

Dr Anne M Bronikowski received her BS degree in Molecular Biology and Math at Marquette University (1987), her PhD in Evolutionary Biology at University of Chicago (1997) and did postdoctoral work at UC Irvine (1997-1999) and at University of Wisconsin, Madison (1999-2003). She began work at Iowa State University in 2003 and recently moved to Kellogg Biological Station of Michigan State University where she is now Professor of Integrative Biology (www.kbs.msu.edu). Bronikowski's teaching currently focuses on Evolutionary and Comparative Biology. She has had six PhD and five MS students and 10 post-doctoral researchers complete their studies with her. Dr Bronikowski has also mentored over 60 high school and undergraduate students in both field and lab settings. She is currently Co-PI and Director for research activities for a recently funded NSF Biology Integration Institute on Sex-specific Aging, Genomics, and Evolution (www.iisage.org). Her specific contributions to the Institute are to leverage long-term studies of wild populations for major lineages of reptiles (squamates, testudines, crocodilians, aves) to understand the causes of sex-specific life-histories. Through the BII and appointment at KBS, she continues to develop training and hands-on education for the next generation of field scientists, including safe and inclusive field work. And she continues to lead the newest research efforts on the Eagle Lake garter snakes, focused on understanding the recent extirpation of populations with habitat change.

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

Garter snakes in the vicinity of Eagle Lake have been an ideal ecological model for studying evolution since Stevan J. Arnold began their long-term study in 1974. I joined his Eagle Lake Garter Snake (ELGS) long-term project in 1993 as a graduate student and transitioned to a leadership role in 2006. We continue to conduct fieldwork annually with the last 30 years of data collection focusing on life-history evolution and ecology. One important discovery in the early 1990s was that two life-history phenotypes characterize populations of the Western Terrestrial Gartersnake (*Thamnophis elegans*): slower pace-of-life (POL) populations are comprised of individuals that are born smaller, grow slower, mature later, have lower annual reproductive output, and live longer than individuals in faster POL populations. These populations occupy habitats in either rocky lakeshore areas along the Eagle Lake shoreline (fast POL) or higher elevation meadows around the lake (slow POL). In turn, these two habitats have contrasting resource availabilities: either continuously available (lakeshore) or seasonally/annually restricted (meadow). Over the last 30 years of long-term CMR and blood sampling, weaddressed the following questions: 1) What are the predicted rates of growth for populations of the two contrasting ecotypes, 2) What are the genetic contributors to maintaining separate life-history ecotypes in the face of gene flow? And 3) How plastic are these ecotype-specific life-history traits with environmental variation? Using data collected through the present, we found that: 1) slow POL populations have stable growth, whereas fast POL populations have negative growth and are thus inherently unstable, 2) inversions in certain nuclear genomic regions, and mitochondrial genomes are ecotype-specific, and 3) phenotypic plasticity may contribute to the buffering of the slow POL ecotype in the face of dramatic habitat change.

Dustin Campbell received a BS in Zoology from Oregon State University (2021). He began working on his MS in the fall of 2022 when he joined the Mason Lab at Oregon State University. He is researching varying aspects of the life history of *Contia tenuis.* He is a graduate teaching assistant and is currently teaching the general biology lab. He participates in many different outreach events and loves to spread his passion for science. In his free time, he loves to hike, bird watch, play games, and go to the gym.

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

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

Dr. Vince Cobb received his B.S. at the University of Tennessee (1987), his M.S. at the University of Texas at Tyler (1989), and his Ph.D. at Idaho State University (1994). He joined the faculty at Ouachita Baptist University in Arkansas in 1994. In 1998, he moved to Northeastern State University in Oklahoma, and he has been at Middle Tennessee State University since 2002. His current teaching responsibilities are General Biology, Human Anatomy and Physiology, and Tropical Biology in Costa Rica. He has supervised 13 Masters students, many of whom now work in state or federal agencies or in academia. His primary research interest is the behavioral ecology of reptiles, particularly snakes.

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

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

Dr Ashley D'Antonio is an Associate Professor of Nature-Based Recreation Management in the Department of Forest Ecosystems and Society at Oregon State University. She is a recreation ecologist - which means her work focuses on understanding how outdoor recreation may cause disturbance to the environment. Her applied research centers on how to mitigate and manage for these disturbances to help park and protected areas meet conservation goals. Dr. D'Antonio specializes in using interdisciplinary and spatially-based approaches to understand visitor behaviors and the ecological consequences of those behaviors on natural resources. She also has expertise in visitor use management broadly, including visitor use estimation and outdoor recreation planning. Dr. D'Antonio has worked in numerous national parks across the West, including Grand Teton, Yellowstone, Yosemite, and Rocky Mountain National Parks. As well as urban-proximate protected areas in Park City, UT, Orange County, CA, and the San Francisco Bay Area. She hopes that managers and practitioners can use her research to better protect natural resources while continuing to provide quality recreation experiences to visitors in parks and other protected areas.

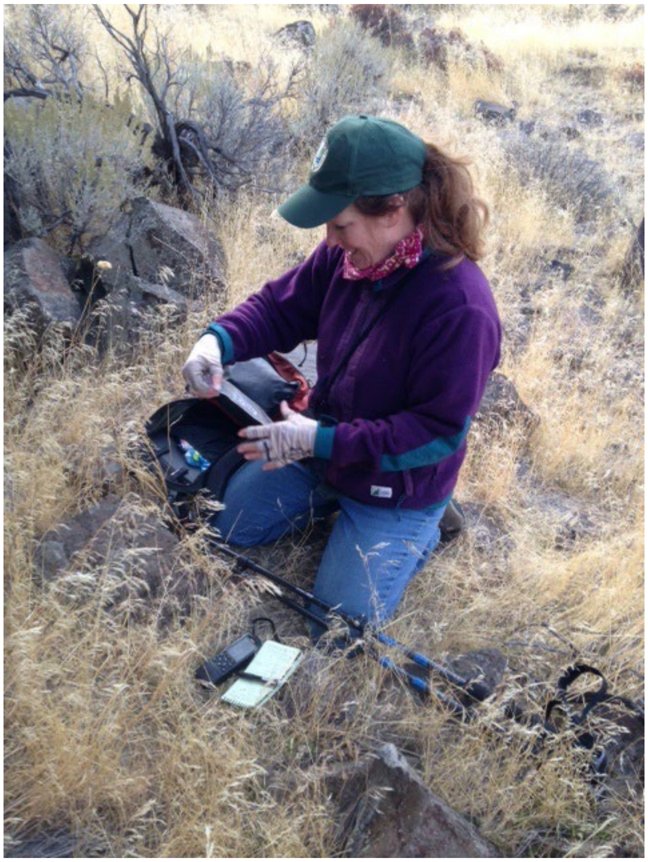
The effects of trail-based outdoor recreation on squamates in an urban proximate park. Blake H. Looney, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR 97361; saxonlooney@gmail.com;* Gareth R. Hopkins, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR 97361; hopkinsg@wou.edu;* Ashley L. D'Antonio, *Oregon State University, 320 Richardson Hall, Corvallis, OR 97330; Ashley.D'Antonio@oregonstate.edu*

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

Chris Frauenhofer is a wildlife biologist conducting wildlife management and research across the state of Utah on a variety of Department of Defense and state-managed lands with the Utah National Guard. Chris received his Master of Science Degree in conservation biology from Antioch University, New England. He has experience with a variety of taxa but is passionate about and versed with reptiles and amphibians. Areas of interest include movement ecology, conservation, and habitat management and restoration. Chris began his career conducting field work for the conservation of Blanding's and spotted turtles and exploration of vernal pool ecology in the Northeastern United States. After leaving the lush forests and wetlands of the northeast for the arid west, his current research includes studies of movement patterns and habitat use of Great Basin rattlesnakes and other species in Utah.

Movement ecology, management, and conservation of Great Basin Rattlesnake (*Crotalus oreganus lutosus*) on military training lands in northern Utah. Chris Frauenhofer, *Utah Army National Guard, 17800 Redwood Rd, Bluffdale, UT 84065; cfrauenhofer@utah.gov*.

The Great Basin Rattlesnake (*Crotalus oreganus lutosus*) is the only venomous reptile found on Army Garrison Camp Williams. A population and movement study was initiated in 2020 in response to human-rattlesnake interactions and substantial development around the military installation in the past 5-10 years. The objectives of this study are to both identify critical habitat features on the landscape (i.e., hibernacula) to conserve key habitats in anticipation of future development and monitor rattlesnake movement in relation to military training activities. The study is currently ongoing but 12 communal hibernacula have been identified and at least 22 adult rattlesnakes have been tracked using radio telemetry each year beginning in 2020. Movement data has enabled coordination with military trainers to limit negative interactions as well as insight to snake behavior on the installation. This presentation will highlight interesting patterns in movement and habitat use observed to date and how we apply it to management on an active military installation.



Lisa A Hallock is the herpetologist for Washington Department of Fish and Wildlife based in Olympia. Her work is focused on recovery of Oregon Spotted Frog, Northern Leopard Frog, Western Pond Turtle, and Striped Whipsnake, as well as conservation of amphibians and reptiles in Washington. From 1996-2009, she was the herpetologist for the Washington Natural Heritage Program. Much of that work involved amphibian and reptile inventories throughout Washington, as well as studies on Oregon Spotted Frog, Western Rattlesnake, and Striped Whipsnake. These inventories informed the Washington Herp Atlas, a project she led. Her first project in Washington State was the 1995 herpetological inventory of the Hanford Site. That was the start of her intrigue about Striped Whipsnakes because it was the only species she could not find. Originally from Michigan, her interest in herpetology had been ignited by Dr. J. Alan Holman, a paleontologist and herpetologist at Michigan State University. She showed up at his office one day because she heard he liked turtles and might be interested in her Green Sea Turtle volunteer work. He gave her a job as his scientific illustrator, and she took his herpetology class. After that, she only wanted to work with amphibians and reptiles. She received an NSF Research Experiences for Undergraduates (REU) grant doing paleoherpetology work in England, became his graduate student, and his teaching assistant for herpetology. For her Master's Thesis she studied the Eastern Massasauga (*Sisturus catenatus*). She obtained a BA and MA in Zoology from Michigan State University.

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

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

Bryan Hamilton received his BS from The Ohio State University in Zoology (1999) and MS and PhD degrees in Biology at Brigham Young University (2009, 2018). He began working at Great Basin National Park in 1999 and is now the Integrated Resource Program manager there. His primary responsibility is to manage natural and cultural resources, coordinate compliance, and develop science for park management. Most of his work has focused on fire management, rattlesnake ecology, bat conservation, and co-operative management of bighorn sheep. In his off-time, Bryan enjoys hunting, woodworking and basketball.

Survival, recruitment, population growth (*λ*) and abundance in Great Basin Rattlesnakes (*Crotalus lutosus*). Bryan T. Hamilton. *Great Basin National Park, Baker, Nevada 89311*; *bryan_hamilton@nps.gov*

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

Dr Marc Hayes is a field herpetologist of 50 years experience. With a French mother and Canadian American father, he grew up in Yuba City, California, a town voted the worst place to live in the US two years in a row but in an area famous for its almonds, peaches, plums, rice, and tomatoes. Interest in entomology and marine science led him to complete a BA at UC Santa Barbara. After graduation, he was entomologist for the Goleta Valley-Carpenteria Mosquito Abatement District, where he became fascinated by the amphibians and reptiles encountered during stream checks for *Anopheles* mosquito larvae. This fascination led him to do an MA in herpetology at California State University Chico under Dr Frank Cliff. Following three years of teaching at Butte College, Oroville, California, he began a PhD at the University of Southern California under Dr Jay Savage. When Savage moved to the University of Miami, Florida, he moved and completed his PhD on glass frog parental care there. Dr Hayes then re-emigrated to Oregon and worked as an environmental consultant and taught in the 1990s. In 2000, the Washington Department of Fish and Wildlife hired him to lead their Aquatic Research Section, where his work was amphibian-focused, especially in headwater streams. Over his career, he has also co-advised 3 PhD and 26 Masters students from diverse institutions. He retired in 2021 in Eagle Point, Oregon but continues his fieldwork and consults under the aegis of his Aquatic & Herpetological Research firm.

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

Snout-vent length (SVL) is arguably the most basic parameter for body size in snakes, and one around which snake stories, like their fish counterparts, have flourished. Emergence of crowd-sourced data in which measurement of body size is becoming part of some routines has led to a need for alternate ways to obtain SVLs in snakes, particularly for road kills where body damage frequently prevents obtaining SVL directly. We explore one method that uses tail length (TL) to obtain SVL data from predictive regressions. This method requires three assumptions: 1) tails must be complete; 2) the relationship between TL and SVL should be predictable ($r^2 > 0.95$) and preferably linear; and 3) females differ from males in TL in most snakes, so predictive regressions must be gender-specific. We chose to first examine this relationship in Gophersnakes (*Pituophis catenifer*) because of their seemingly high relative abundance and behavior that makes them highly vulnerable to road mortality. We used Gophersnake data from their Pacific slope distribution in Pacific Coast states extracted from Stull (1940). Culling individuals with partial tails, we found SVL regressed on TL gave highly predictable linear relationships for both female and male Gophersnakes ($r^2 \geq 0.95$). We also evaluated whether Gophersnakes SVL could be predicted beyond the limits for which our regressions had data. We will discuss this method and its limitations.

Dr Gareth Hopkins is an Associate Professor of Biology at Western Oregon University. His research is focused on how organisms are affected by, and respond to, environmental change. This research spans layers of biological organization, from the behavioral and physiological responses of individuals to the evolutionary responses of populations and the ecological responses of communities. His work is fundamentally integrative and collaborative, integrating lab and field studies, and working across disciplines and with state agencies to develop effective conservation solutions. Dr Hopkins was trained as a herpetologist and entomologist in Canada (BSc: University of Northern British Columbia), the United States (PhD: Utah State University), and Australia (Post-doc University of Melbourne), and has studied the effects of environmental stressors ranging from salinity to artificial light at night to invasive species on organisms as diverse as newts, crickets, snakes, and turtles. His current work mostly centers around the responses of amphibians, reptiles, and insects to habitat restoration and recreation in terrestrial and aquatic environments in the mid-Willamette Valley of Oregon. He is particularly enthusiastic about introducing undergraduate students to the scientific process and has an active undergraduate research lab at WOU.

The effects of trail-based outdoor recreation on squamates in an urban proximate park. Blake H. Looney, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR 97361; saxonlooney@gmail.com;* Gareth R. Hopkins, *Western Oregon University, 345 Monmouth Ave. N. Monmouth, OR 97361; hopkinsg@wou.edu;* Ashley L. D'Antonio, *Oregon State University, 320 Richardson Hall, Corvallis, OR 97330; Ashley.D'Antonio@oregonstate.edu*

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

Richard Hoyer is arguably the most famous, notorious field herpetologist in Oregon still alive. He developed fame and notoriety doggedly persisting in long-term studies of sharp-tailed snakes and rubber boas. A superlatively insightful natural historian, he has been an advocate of caution interpreting the rarity in cryptic snakes without considering detectability long before detectability was part of sampling designs. Richard also has a fascinating personal history. Born in Oakland, California but long an Oregon resident, he became a birder at age 9 and chased snakes at age 10. He also fell in love with fishing at age 10, then basketball at 11, and at 15, became a falconer. He attended OSU during the Pre-Cambrian when it was Oregon State College, graduating at age 20. The following year, he became a US Air Force pilot, and at 24, he became a commercial helicopter bush pilot. At 28, he fell in love with biological research, and soon after, he became a tennis player. At 41, he started teaching at Corvallis High coaching freshman football and basketball, and varsity tennis. The following 16 years, he taught at Central Linn Middle and High Schools, ultimately focusing on science. The perennial competitor, Richard began tournament tennis at age 45. He retired from science teaching at 58. At 69, Richard married for the fourth time, his current wife, Sharon; all previous wives are dead. Today, at the ribald age of 89, Richard's foci are falconry, keeping up with Sharon, and last but not least, chasing snakes!

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

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

Dr David L Hubert got his BS and PhD in Integrative Biology from Oregon State University (2014, 2023). During his time as a student at OSU, he has conducted or assisted with research in several labs working with diverse organisms including corals, oysters, marine algae, torrent and Pacific giant salamanders, and several species of gartersnake. He has also served in various roles as an educator, doing curriculum development and teaching many introductory and upper division courses. As a graduate student under Bob Mason, his most recent research focused on the thermal biology of the Red-sided Gartersnake (*Thamnophis sirtalis parietalis*) employing a truly integrative approach. Combining behavioral, physiological, and molecular approaches, he explored thermal preferences, limitations, and transcriptional responses to thermal stress during their spring mating season and long winter dormancy. While finishing his PhD, he developed special interest in exploring metabolic changes over time using molecular techniques, and he plans to continue this avenue of investigation as he moves into a postdoctoral position this fall. David is currently teaching in the introductory biology series and the upper division evolution course for the Integrative Biology Department at OSU. When not doing research, writing, or teaching, you will find David spending time with his amazing wife and two children.

Dark, cold, and hungry: gene expression during prolonged winter dormancy in garter snakes. David L. Hubert, Ehren J. Bentz, and Robert T. Mason, *Department of Integrative Biology, 2180A7 Coast Range Building, Oregon State University, Corvallis, OR 97331; hubertd@oregonstate.edu*

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

Lameace Hussain initially received their BS from the University of Kentucky, with a focus in psychology and a minor in sociology. Lameace then received a post-bachalaurette BS degree in Wildlife Management from Eastern Kentucky University. Fascinated by herpetofauna and wetland ecology, Lameace focused much of their time in their wildlife degree doing research on amphibians in central Kentucky. Afterwards, they landed a job with the Washington Department of Fish and Wildlife conducting a plethora of surveys for reptiles and amphibians. For the past 8 years, Lameace has built their career working with various agencies, groups, and communities, working closely with research scientists, wildlife vets, and state herpetologists on projects ranging from endemic salamanders to snake surveys, to studying *Emydomyces testavoran* in Western Pond Turtles. One of their biggest drivers throughout their career has been outreach. Awarded WDFW's "Educator of the year" award in 2019, Lameace has created numerous programs for youth groups, college students, and the general public to get involved with the conservation of herpetofauna. In 2021, Lameace started their graduate career at the school for Wildlife, Ecology, and Conservation at the University of Florida combining their knowledge of herpetology with their love and knowledge of people. Their current PhD dissertation focuses on diversity, equity, and inclusion issues throughout the conservation realm, with a focus on course content for college students nationwide as well as the experiences of herpetologists from marginalized backgrounds.

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

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

Dr. Christopher L. Jenkins received a B.S. and M.S. from the University of Massachusetts in wildlife biology and wildlife conservation, respectively. He received his Ph.D. in biological sciences from Idaho State University. He has worked with Wildlife Conservation Society, the U.S. Forest Service, U.S. Fish and Wildlife Service, University of Massachusetts, University of British Columbia and National Geographic. Chris' current projects include land protection in Longleaf Pine ecosystems, ecology and conservation of Timber Rattlesnakes and the conservation of Giant Tortoises. He founded and formally chaired the IUCN Viper Specialist Group and has served on many boards and committees including the National Committee for Partners in Amphibian and Reptile Conservation, University of Georgia Press, and the Indian Ocean Tortoise Alliance. Chris has contributed to multiple scientific papers and has written multiple book chapters, including Modeling Snake Distribution and Habitat in the recently published book titled Snakes: Ecology and Conservation. Chris is the CEO of The Orianne Society, a nonprofit organization dedicated to the conservation of reptiles, amphibians and their habitats.

Dr. Jenkins, who will be hosting the Snake Talk Panel Podcast for this meeting, is universally known for his Podcast series addressing snakes and his directorship of the Orianne Society, a unique conservation non-profit.

Mark Leppin is currently a MS candidate in the Department of Integrative Biology at Oregon State University where he received his B.S. in Zoology. His current research involves the natural history of the Northern Rubber Boa (*Charina bottae*) through long-term recapture datasets. He has been participating in amphibian and reptile field work and outreach in the Pacific Northwest since 2008. When he is not teaching labs or working frantically to finish his M.S. thesis, he enjoys nature-oriented activities like observing and interacting with amphibians and reptiles, diverse invertebrates, and wildflowers.

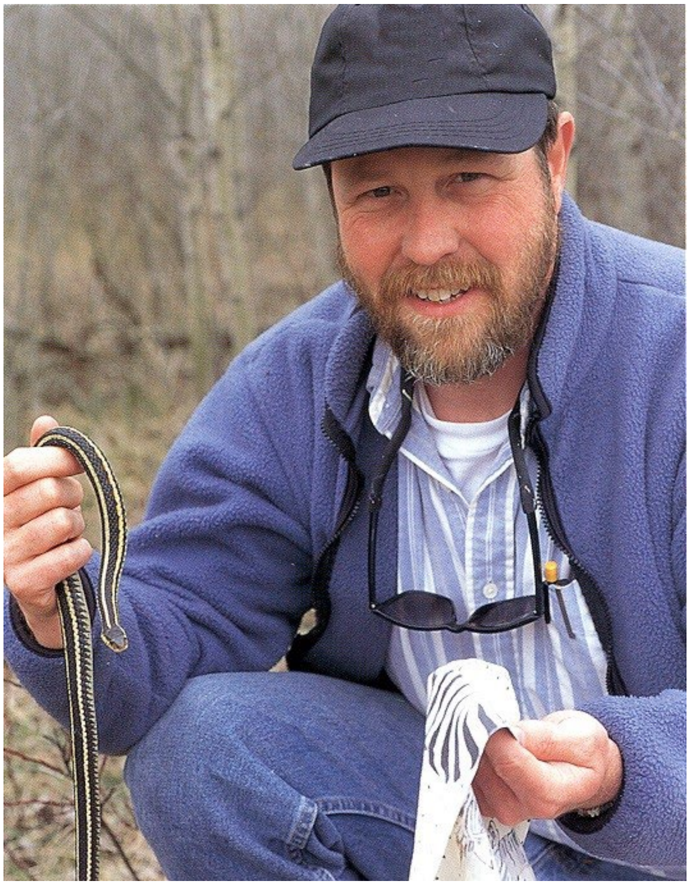
50 years of recaptures: Growth and longevity in the Northern Rubber Boa (*Charina bottae*) from long-term recapture datasets. Mark V. Leppin, *Department of Integrative Biology, Oregon State University, Corvallis, OR 97331; leppinm@oregonstate.edu*; Richard F. Hoyer, *2121 NW Mulkey Avenue, Corvallis,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

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

Dr Stephen P Mackessy is Professor of Biology in the Department of Biological Sciences at the University of Northern Colorado. His BA and MA in Biology (Ecology and Evolution section) were from the UC Santa Barbara, Department of Biology (with Dr. S. S. Sweet), and his PhD (with a minor in Biochemistry) was received from Washington State University, Department of Zoology (with Dr K V Kardong). He was a postdoctoral Research Associate at Colorado State University, Department of Biochemistry/Molecular Biology (with Dr A T Tu) before joining UNC in 1994. His research broadly encompasses the biology of venomous snakes and the biochemistry of snake venoms, and he has published many scientific papers, book chapters and several books. Mackessy has had 9 PhD, 24 Masters, and 67 undergraduate research students, and collaborations include colleagues from Singapore, Spain, México, Costa Rica, Argentina, Brazil, France, India, the Netherlands, and University of Texas. Mackessy also teaches graduate and undergraduate courses in biomedicine (Toxinology of Snake Venoms, Current Topics in Biomedical Research, Parasitology, Human Anatomy) and vertebrate biology (Herpetology, Comparative Anatomy, Mammalogy) at UNC, where he has received awards for outstanding research and teaching. Personal interests include fieldwork with venomous snakes and other reptiles, music and motorcycles, as well as traveling and camping.

Natural history of venoms and their role in the evolutionary success of viperid snakes. Stephen P. Mackessy, *Department of Biological Sciences, University of Northern Colorado, 501 20th St., CB 92, Greeley, CO 80639; stephen.mackessy@unco.edu*

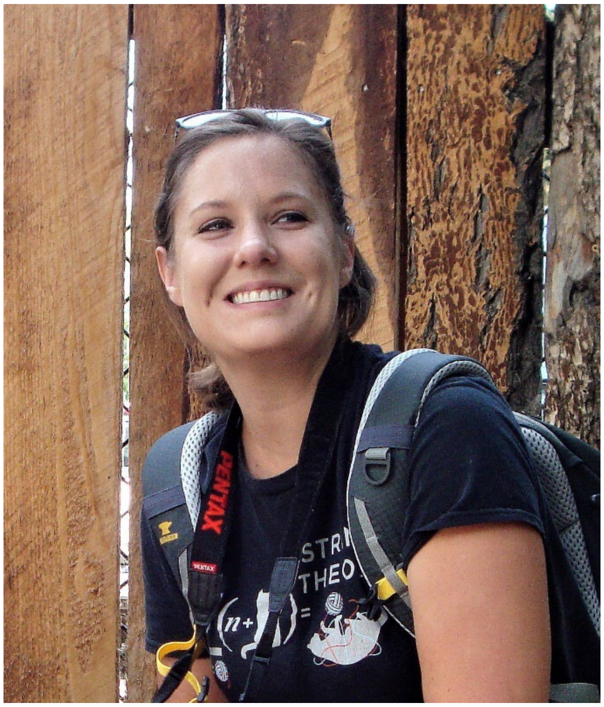
One of the most iconic features of vipers is the utilization of venoms as a chemical means of dispatching prey (as opposed to mechanical means such as constriction). Venoms have evolved primarily as specialized trophic adaptations, allowing snakes to immobilize prey quickly and remotely, to begin the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



Dr Bob Mason is Sandy and Elva Sanders Eminent Professor and J C Braly Curator of Vertebrates in the Department of Integrative Biology at Oregon State University where he has been located since 1991. He received his BS in Biology from Holy Cross College and his PhD in Zoology at the University of Texas at Austin in 1987 working with Dr David Crews on chemical ecology of gartersnakes. He did his postdoc work at the National Institutes of Health in Biophysical Chemistry Laboratory. During this time, Bob had the opportunity to work with John Daly's group working on poison-dart frog alkaloids. Early in his career, Mason identified and chemically characterized the first reptile pheromone, that of the Red-sided Gartersnake (*Thamnophis sirtalis parietalis*). Mason, his students and collaborators have conducted annual field work on the reproductive biology of the gartersnakes in Manitoba, Canada and that work has examined ultimate-level questions such as male body size and mating success, size-assortative mating, mating plugs, female mimicry, antipredator tactics, thermoregulatory behavior, migratory behavior and others. They are currently investigating the phenomenon of multiple mating, paternity analyses, and sperm competition in this species. Other work seeks to understand the neurophysiology of the chemical senses, specifically the vomeronasal organ and the perception of nonvolatile chemicals such as sex pheromones and prey chemoattractant.

Breeding and feeding: Harderian Gland constituents mediate vomeronasal functioning in gartersnakes.
Robert T. Mason, *Department of Integrative Biology, Oregon State University, Corvallis, OR 97331; masonr@oregonstate.edu*

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



Brenna Rose Olson is an MS student in Idaho State University's GIS program and is set to graduate this coming May. She began her graduate studies in the fall of 2018 while working for the USDA with the goal of learning how to use computer-based mapping technology to communicate scientific information for conservation purposes. She earned her drone license in the spring of 2019 and continued to build her knowledge of ecology with graduate elective courses. When she finally took a course on the native snakes of Idaho in the fall of 2021, she found her true passion for herpetology which has guided her research and career goals ever since. During 2022, she conducted several interdisciplinary projects. She delineated wetlands for consideration in a wetland mitigation banking system with the Idaho Transportation Department, contributed her mapping skills to research concerning herpetological road kills in Idaho, and conducted preliminary research to better define rocky habitats for the Great Basin Collared Lizard (*Crotaphytus bicinctores*) with remote sensing, machine learning, and deep learning. She is currently striving to publish her first journal article focusing on the utility of iNaturalist for extracting elevation ranges for Idaho's native snake species while also working for the City of Pocatello's Science and Environment Division. She looks forward to opportunities for more scaley (or slimy) work and research to guide wildlife management practices and educate the public about the value in conserving Idaho's native herpetofauna.

Determining Idaho native snake elevation ranges using iNaturalist data. Brenna R. Olson, Charles R. Peterson, Donna M. Delparte, *Idaho State University, 921 S. 8th Ave., Pocatello, ID 83209; brennaolson@isu.edu; charlespeterson@isu.edu; donnadelparte@isu.edu*

The goal of this study is to investigate how iNaturalist community science data can be used to calculate elevations for Idaho's 12 species of snakes, the elevational ranges of which are currently not well known. Elevation is an important descriptor of species ranges and how they shift temporally due to environmental factors such as climate change. Our specific objectives include: (1) developing a GIS workflow to extract elevation values from point data accounting for Digital Elevation Model (DEM) accuracy and the impact of horizontal point accuracy and topography; and (2) estimating the completeness of those data in describing the elevation ranges of Idaho snakes. We filtered data for species identification accuracy and a horizontal accuracy of ≤50 m and used zonal statistics in ArcGIS Pro to filter points to a vertical accuracy of ±10m leaving us with 1266 (41.3%) of 3067 points. About 73.1% of our final dataset was horizontally accurate to within 10 m. Idaho elevations range from 216 m along the Snake River in western Idaho to 3680 m on Mt. Borah in central Idaho. The elevations of the final iNaturalist observation points ranged from 227.6 m to 2578.1 m. We could not calculate ranges for 2 of the rare species: *Diadophis punctatus* and *Rhinocheilus lecontei*. We will use literature values from adjoining states to estimate the completeness of the iNaturalist-based ranges.

As a Research Ecologist with the US Forest Service at the Pacific Northwest Research Station (PNW), Deanna (Dede) H Olson addresses the sustainability of our natural resources, specifically biodiversity. Although she has worked with every vertebrate class, she currently focuses on amphibians, reptiles, and fishes. Her bachelor's degree at UC San Diego intersected with the first Conservation Biology Conference (1978), helping to build her passion for species conservation. Her PhD from the Zoology Department at Oregon State University brought her to the Pacific Northwest in 1981, where she has studied the amphibians and stream fish ecology – including the effects of different stream-riparian buffer widths with upland forest harvest on them, the ecology and management of little-known terrestrial salamanders, and threats to amphibians and reptiles – including diseases and climate change. She has >200 research publications on these topics. She leads the Aquatic Ecology and Management Team in Alaska, Washington, and Oregon which focuses on fish and amphibian ecology and threats. She serves as courtesy faculty at Oregon State University, Associate Editor for the diseases section of *Herpetological Review*, and she is the USA representative to the Amphibian Specialist Group of the World Conservation Union (IUCN). She is past-President of the Society for Northwestern Vertebrate Biology, past Co-Chair of Partners in Amphibian and Reptile Conservation (PARC: national and Northwest region), a member of the PARC Disease Task Team, and past co-lead of the North American *Bsal* (*Batrachochytrium Salamandrivorans*) Task Force.

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

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

Dr Kristiina Ovaska, MSc, PhD, received her doctorate in biology from the University of Victoria, followed by two post-doctoral stints in population biology and behavioral ecology of amphibians, respectively, at McGill University and University of British Columbia. Currently, she is a senior ecologist and partner at Biolinx Environmental Research Ltd. (Sidney, BC) and a research associate at the Royal BC Museum, (Victoria, BC). Over the past 30+ years, Kristiina has studied the ecology and behaviour of amphibians and reptiles in western North America, Central America, and the West Indies. Much of her recent work has been focused conservation of species at risk, including multi-year monitoring, habitat use, and stewardship projects. For 11 years, until 2021, she was co-chair of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Amphibians & Reptiles Specialist Subcommittee, and is currently serving as co-chair of IUCN's Amphibian Specialist Group Canada. She is a member of several recovery teams for Canadian amphibians and reptiles and has been an active participant in the Sharp-tailed Snake Recovery Team since its inception in 2001. Besides amphibians and reptiles, Kristiina's interests include terrestrial gastropods and their conservation. For the past five years, she has participated in an international team working on reintroducing captive-reared endemic Bermuda snails (genus *Poecilozonites*) into the wild to bring them back from the brink of extinction.

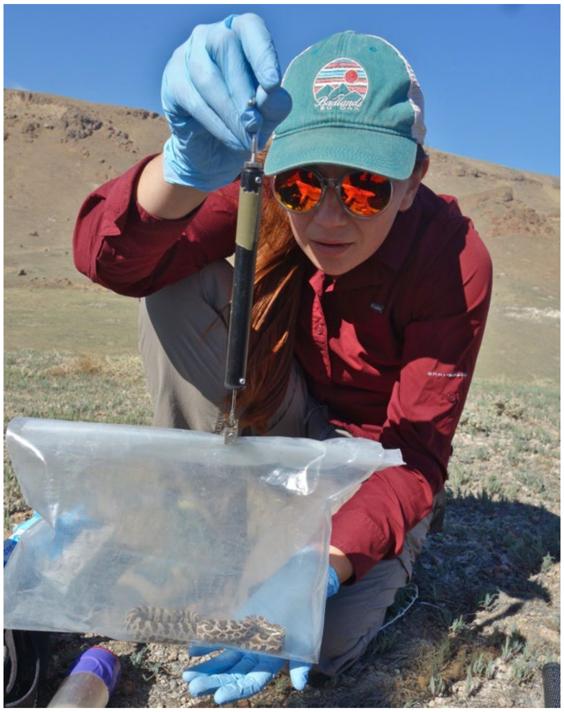
Tracking movements of Sharp-tailed Snakes (*Contia tenuis*) with PIT-tag telemetry on Vancouver Island, British Columbia. Kristiina Ovaska, Lennart Sopuck, and Christian Engelstoft. *Biolinx Environmental Research Ltd., 1759 Colburne Place, North Saanich BC, V8L 5A2;* ke.ovaska@gmail.com (KO); lennart@biolinx.ca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

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

Dr Joshua M Parker received his BS in Biological Sciences at California State University, Stanislaus (1996), and his MS and PhD in Zoology and Physiology at the University of Wyoming (2000, 2003). He began his teaching career at the College of Southern Nevada in Las Vegas, where he first earned tenure. After 7 years there, he moved to Clayton State University, a 4-year liberal arts university just outside Altanta, Georgia. After 5 years and before tenure, he decided to take his family back to California where he was born and raised and is now a tenured professor of biology at Fresno City College not far from where he grew up. His teaching has spanned all of the general biologies and his specialties like Evolution, Ecology, and Herpetology. He returned to herpetological research in 2009 after a break that allowed him to get used to a heavy teaching load. Since then, he has been PI and Co-PI in many research contracts focused on the ecology, conservation management, and basic research on Western Rattlesnakes, particularly the Midget Faded Rattlesnake and other species within the Western Rattlesnake Complex across the western and mountain states. He has also been involved in a lot of environmental consulting now that he is back in CA.

Predictive modeling of a cryptic species, *Crotalus oreganus concolor*, to inform management decisions in the face of energy development in Wyoming and Colorado. Joshua M. Parker, *State Center Community College District, 1171 Fulton St., Fresno, CA 93721;* joshua.parker@fresnocitycollege.edu; Stephen F. Spear, *Upper Midwest Environmental Science Center, 2630 Fanta Reed Rd., La Crosse, WI 54603; sfspear@usgs.gov;* Charles R. Peterson, *Idaho State University, 921 S. 8th Ave., Pocatello, ID 83209; charlespeterson@isu.edu*

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



Kristina Parker received their BS and MS degrees in Biology from Boise State University (2016, 2021). Their thesis assessed the effects of the cheatgrass-fire cycle on reptiles in sagebrush steppe and evaluated the genetic structure of the Great Basin rattlesnake in southwest Idaho. Besides their thesis research, Parker engaged in efforts to assess and mitigate threats to overall reptile populations. They collaborated with researchers to assess snake persecution on conservation areas, determine the extent of snake fungal disease in Idaho, and evaluate lead contamination in snakes. They provided snake safety training sessions and coordinated BioBlitz school field trips. Parker is currently working at US Geological Survey in the Pacific Northwest environmental-DNA laboratory.

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

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

Dr Blair W Perry received his BS in Zoology at The Ohio State University (2015) and Ph.D. in Quantitative Biology in the lab of Dr Todd Castoe at the University of Texas Arlington (2021). He is currently an NSF Post-Doctoral Research Fellow at Washington State University (WASU), Pullman, until recently in the lab of Dr Joanna Kelley. Perry's research uses genomic approaches to investigate the underlying mechanisms and evolution of complex adaptations. Much of this work seeks to understand the genomic basis and regulation of rattlesnake venoms, with a focus on understanding intra- and interspecific venom variation. At WSU, he is studying the evolution and regulation of hibernation in brown bears.

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

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

Dr Charles R Peterson received his BS and MS degrees in Zoology at the University of Illinois-Urbana (1971, 1974), his PhD in Zoology at Washington State University (1982), and conducted his postdoctoral work at the University of Chicago (1983-1988). He began working at Idaho State University in 1988 and is currently an Emeritus Professor of Zoology in the Department of Biological Sciences and the Affiliate Curator of Herpetology for the Idaho Museum of Natural History. Peterson's current teaching responsibilities at ISU include Herpetology and Nature Photography. Peterson has had five PhD, four DA and 20 Master's students complete their degrees under his supervision. His research interests include the spatial, physiological, and conservation ecology of amphibians and reptiles. Most of his work has focused on amphibian and reptile populations in the Northern Intermountain West. He is currently working on community science projects utilizing the iNaturalist mobile application to document the distribution and activity of amphibians and reptiles in Idaho and the Greater Yellowstone Area. Peterson is an avid nature photographer and seeks to use his photography to conserve and restore amphibian and reptile populations and their habitats (https://www.flickr.com/photos/petechar/). He is the 2023 Artist in Residence for the Sagebrush Steppe Land Trust.

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

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

Dr David Pilliod is a Supervisory Research Ecologist at the US Geological Survey's Forest and Rangeland Ecosystem Science Center located in Boise, Idaho. He is graduate faculty at Boise State University and lead scientist at the Pacific Northwest Environmental DNA Laboratory. David leads a team of scientists whose research focuses on species conservation and habitat restoration in the Great Basin and Intermountain West. He has published over 120 scientific journal articles. David received his BA from the University of California Santa Cruz and PhD from Idaho State University. In graduate school, David was a Gloria Barron Wilderness Society Fellow, a scholarship to encourage individuals who have the potential to make a significant positive difference in understanding wilderness and how to protect it. He spent four years as a post-doc at the Aldo Leopold Wilderness Research Institute and Rocky Mountain Research Station before accepting a position at California Polytechnic State University as an Assistant Professor. He has worked for USGS for 17 years.

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

We assessed changes in fundamental climate niches for snake species in western North America under time and emission scenarios to help prepare resource managers for possible species conservation and habitat management issues. We used eight species distribution modelling approaches for each species, resulting in 32 models per species for each of the six time-by-climate scenarios. We then combined the highest-performing models for a species into a single ensemble model for each scenario. Binary maps were generated from the ensemble models to depict the climate niche for each species and scenario. Patterns of richness and niche shifts were calculated from the binary projections at the scale of the entire study area and for individual states and provinces. Preliminary results suggest that the climate niche for the recent scenario and published ranges for species were highly correlated ($R^2 = 0.81$). Across western North America, snake climate niche space is projected to move north in the future, resulting in increasing species richness in much of the western United States and Canada. The majority of species are projected to expand their current climate niche rather than to shift, contract, or remain stable. Few species are projected to lose climate niche in the future and few species were projected to go extinct at the state or province level, although species often were projected to occupy novel areas of the state or province, and often at higher elevations. As climate niches move northward, species are predicted to cross administrative borders, resulting in novel conservation scenarios for local agencies. However, information on species dispersal abilities and local landscapes (e.g., barriers) will help contextualize predictions relative to realized niche expansion.

Conservation genetics of the Striped Whipsnake (*Coluber* [*Masticophis*] *taeniatus*) in Washington**, USA**. David S. Pilliod*, *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83702; dpilliod@usgs.gov*; Lisa A. Hallock, *Washington Department of Fish and Wildlife, Olympia, WA 98504; lisa.hallock@dfw.wa.gov*; Mark P. Miller*, U.S. Geological Survey, Water Resources Mission Area - Office of*

Planning and Programming, Lakewood, CO 80225; [mpmiller@usgs.gov;](mailto:mpmiller@usgs.gov) Thomas D. Mullins*, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR 97331;* Susan M. Haig*, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR 97331* (retired)

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

Chris Rombough is a wildlife biologist, but his parents love him anyway. He has 27 years of professional field experience studying Pacific Northwest amphibians, reptiles, and their habitats. Besides snakes, his interests/hobbies include fishing, growing cacti, and collecting ridiculous amounts of data. In partnership with the remarkably capable Laura Trunk, he has conducted habitat restoration and research on restored habitats, especially wetlands, for the last 15 years. Along with restoring wetlands, Chris also enjoys building artificial hibernacula for reptiles (snake dens).

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

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

The Ring-necked Snake (*Diadophis punctatus*) in northwestern Oregon: a successful population translocation.
Chris Rombough, *PO Box 365, Aurora, OR 97002; rambo2718@yahoo.com*.

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

Adrian Slade is a naturalist and herpetologist based in Central Washington state. Her interests are in natural history and conservation of reptiles, particularly its intersection with anthropogenic activity and development. After a life-changing interview with the wonderful Dr Dan Beck in 2015, she moved from Seattle to Ellensburg to attend Central Washington University and never looked back. She spent nearly a decade honing non-intrusive observational skills of reptiles, particularly rattlesnakes, and moves snakes and other critters off of busy roads in her spare time. She obtained her BS in 2020 and is working on her MS in Biology under the sustained mentorship of Dr. Beck. While at CWU, she has spent several seasons as a field technician and crew lead on the I-90 Snoqualmie Pass East Wildlife Project, collecting baseline data and documenting reptiles and amphibians' use of wildlife crossing structures. She spent the spring of 2021 interning at Blue Mountain Wildlife, where she learned about wildlife rehabilitation techniques and gained insight into the many functional levels of wildlife conservation. She provides various "snake services" to her region, offering relocations, consultations, and educational events to the public as well as private organizations. All her free time spent passively monitoring snake populations in the shrub-steppe has led her to become deeply passionate about the ecology and conservation of arid environments. Her Masters Thesis focuses on the impacts of utility-scale solar energy development on reptiles in the Colorado subregion of the Sonoran desert in California.

Road crossing ecology of snakes in central Washington shrub-steppe: a snapshot of mortality, occurrence, and activity. Adrian C. Slade* and Tyler J. Larsen, *Central Washington University, 400 E. University Way, Ellensburg, WA 98926; slade.oreganus@gmail.com (AS), larsen.ty.97@gmail.com (TL)*

Snakes are particularly vulnerable to the impact of road traffic and direct mortality from collisions with vehicles, which may contribute to long-term population declines. We examined crepuscular and nocturnal patterns of road-crossing for 4 sympatric snake species: *Crotalus oreganus oreganus* (Northern Pacific Rattlesnake), *Charina bottae bottae* (Northern Rubber Boa), *Hypsiglena chlorophaea deserticola* (Northern Desert Nightsnake), and *Pituophis catenifer deserticola* (Great Basin Gopher Snake). To evaluate road-crossing patterns, we conducted 130 nighttime transect surveys during one active season (May-October 2017 on three unique roads in the Columbia River basin of central Washington state: a low-traffic road bisecting a wildlife area, a county highway, and a high-traffic state route. We collected data on 924 total snakes and analyzed their occurrence, movement, and mortality in the context of anthropogenic factors, season, life history, and adjacent habitat. Gopher snakes and rattlesnakes comprised the majority (90%) of observed snakes. Gopher snakes were encountered more frequently than rattlesnakes in spring and fall, whereas rattlesnakes dominated summer crossings. Our data reveal an allopatric distribution for the two more cryptic species, *H. c. deserticola* and *C. b. bottae*, along a shrub-steppe habitat gradient and identify high-density crossing areas for all four species. Snakes on the busiest road have only a 30% chance of surviving a crossing.

Stephen F Spear received his BS degree at the University of Richmond (2001), his MS degree at Idaho State University (2004), and PhD from Washington State University (2009). He is currently a Research Biologist with the Upper Midwest Environmental Sciences Center of the US Geological Survey in La Crosse, Wisconsin, a position he has held since 2020. Previously he worked as the Director of Wildlife Ecology at The Wilds (2016-2020) and as a Conservation Scientist with the Orianne Society (2010-2016). He serves as co-chair of the IUCN Viper Specialist Group, a position he has held since 2019. Throughout his career, a major focus of his research has been to use molecular tools to inform questions rooted in ecology, with an emphasis on relevance for applied management. This research has included using landscape genetics to understand the effect of disturbance and fragmentation on Pacific Northwest amphibians and rattlesnakes and environmental DNA (eDNA) monitoring of hellbenders and mudpuppies in the Appalachian region. He also works with partners in Costa Rica to develop and evaluate survey techniques for the endemic black-headed bushmaster. Current projects are primarily focused on eDNA monitoring including tracking invasive carp spread and spawning, development of rapid field-based eDNA protocols for early detection and rapid response, and metabarcoding for a variety of native species including pollinators and stream macroinvertebrates.

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

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

Laura Trunk received a BS degree in Biological Sciences from the University of Southern California and MS degree in Fisheries and Wildlife Administration from Oregon State University. She has worked for the City of Hillsboro at Jackson Bottom Wetlands Preserve for the last 15 years as a habitat restoration specialist, wildlife biologist, and a natural resource manager. Over this time, she has restored more than 400 acres of wetland habitat, which has helped to recover their native amphibian and reptile populations. Additionally, with the help of herpetologist Chris Rombough, she has designed and built custom hibernacula for native garter snakes. Her research interests focus on determining how amphibians and reptiles respond to habitat restoration in the long-term.

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

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

Veronica Woodruff has worked as an environmental professional for more than two decades in government, non-profit organizations, and consulting. She has worked extensively with Coastal Tailed Frogs, Rubber Boa, and the Common Sharp-tailed Snake. Her deep community connections and boundless fascination with the natural processes within the watersheds of British Columbia recently converged to support the completion of her Master of Arts in Leadership from Royal Roads. Although her recent work focuses on disaster risk reduction, the topics she has explored on the importance of collaboration between governments and communities have relevance for other areas of conservation. When the Common Sharp-tailed Snake was first identified from the British Columbia mainland in Pemberton in 2011, she used all her connections through the non-profit she founded—Stewardship Pemberton Society—to collaborate with local government, developers, First Nations, academics, trails groups, and other wildlife associations. Together they have initiated many important programs in assessment, conservation, and protection for both the Common Sharp-tailed Snakes and other reptiles and amphibians in the region.

Advancing protections for a relict population of Sharp-tailed Snakes (*Contia tenuis*) through collaboration, community engagement and indigenous monitoring. Veronica R. Woodruff, *Stewardship Pemberton Society,* *vwoodruff@clearcourse.ca*; Leslie Anthony, *Independent Biologist,* docleslie@me.com

In August 2011, Canada's only known mainland population of Sharp-tailed Snake (*Contia tenuis*) was discovered in Pemberton, British Columbia, an inland valley roughly 200 km north of island-dwelling populations in the central Salish Sea, and about 350 km north of the nearest mainland record. This northernmost outpost of the spottily distributed *C. tenuis* is a presumptive post-Pleistocene relict of significant taxonomic and conservation interest. To date, 11 years of study in Pemberton involving ca. 1,000 h of search effort have revealed the species to be confined to suitable habitat along a 5-km transect of one landform. Most of the ca, 14 sites where *C. tenuis* has been found are threatened by rapidly encroaching residential development and explosion of recreational pressure; several sites are already presumed extinct. Unfortunately, gaps in Canada's species-at-risk legislation, lack of provincial levers for protection, lack of capacity by the local municipality, and legal wrangling by developers have left this small isolate without inherent or pending protections. To address this population's vulnerability to multiple stressors, a local environmental NGO with limited resources initiated collaborative partnerships that have resulted in a series of positive outcomes. These include increased understanding of distribution via both expert and citizen-science monitoring, community engagement and outreach, training and capacity-building with the Lil'wat First Nation, and stakeholder actions for managing land-use and recreational impacts. Although such a collaborative model appears to be the only way to currently address potential risks to *C. tenuis* in Pemberton, its greater speed and utility vs. the limited reach and protracted timeframes of formal protections may actually present a better standard for addressing such recently discovered species-at-risk.

Megan Yrazabal received her BS degree in Biology, with a Zoology emphasis, along with a minor in Basque Studies from Boise State University (2012). She has over 9 years experience working as a veterinary technician in a small animal veterinary hospital before shifting towards a career in biology. She started working for the Idaho Army National Guard as a seasonal field technician in 2015 and is currently employed through their Environmental Management Office as a Natural Resource Specialist. She serves as co-chair for the National Military Fish and Wildlife Association's Herpetology Working Group and is also a Department of Defense Partners in Amphibian and Reptile Conservation representative.

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

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