# Indicates a student presenter

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Presenter	Poster Title
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Whitfield, Sheri	Creating Habitat for the Northern Sagebrush Lizard at Umatilla National Wildlife Refuge.
Williams, Olivia	Conservation Status, Research Needs, and Management Recommendations for the Olympic Mudminnow (*Novumbra hubbsi*), Washington State's Only Endemic Fish.
Wilson, Anjanette[#]	Setting the Stage for Connectivity Assessments: Small Mammals in Forest Habitats as Potential Users of Wildlife Crossing Structures

2019 Poster Abstracts WATWS, SNVB, NWPARC Joint Annual Meeting

Mapping Amphibian Occurrence on the Road System at Mount Rainier National Park. Anthony S. Anderson*, *Mount Rainier National Park, Ashford, WA 98304*; *scott_anderson@nps.gov*; Darin D. Swinney, *Mount Rainier National Park; darin_swinney@nps.*gov; Rebecca A. Lofgren, *Mount Rainier National Park; rebecca_a_lofgren@nps.gov.*

We set out to map amphibian presence along several roads at Mount Rainier National Park (MORA) to help mitigate road-related impacts to amphibians. These impacts include vehicle collisions, annual road maintenance activities, and Federal Highways restoration projects. We conducted night road surveys from 2014 to 2016 following rain events in the spring through fall months on 44 miles of road. Our objectives were to (1) detect all amphibians present on the road during our surveys, and (2) identify amphibian hot spots. We conducted most surveys by vehicle at speeds averaging 5 mph which enabled us to detect juvenile frogs and small plethodontid salamanders. Amphibians encountered were identified to species, measured, locations recorded, and road-killed individuals collected. We detected 1009 amphibians between 2014 and 2016 with 42.4 % of those encountered road-killed. Twelve of 14 species known to occur at MORA were found on park roads during these surveys including 2 species of concern (*Plethodon larselli* and *P. vandykei*). The most common species detected were Coastal Tailed Frogs (*Ascaphus truei*), which accounted for 58.7 % of all amphibian species encountered (584 total, 47.1% road-killed). We identified several amphibian hotspots associated with wetland features. The mapping project has served as a resource for park management to mitigate impacts of road rehabilitation projects on amphibians, and to evaluate site specific options at known amphibian hotspots to mitigate impacts of road-associated maintenance operations.

Point Count Surveys Indicate a Decline in Raven Densities Following Control Efforts in Greater Sage-Grouse Habitat. Isaac Appleby-Hall*, *Whitworth University, 300 West Hawthorne Road, Spokane, WA 99251; iappleby-hall21@my.whitworth.edu*; Grant Casady, *Whitworth University; gcasady@whitworth.edu.*

The Greater Sage-Grouse (*Centrocercus urophasianus*) is an integral component of the sagebrush ecosystem because of their numerous predator-prey relations. For example, their eggs are taken by gopher snakes and Ravens, their chicks are hunted by owls and raptors, and they themselves are a yearlong food source for coyotes and badgers. The Common Raven (*Corvus corax*) is one predator that has recently become more of an issue to Sage-Grouse populations. Raven populations have tripled in the last thirty years, resulting in an increase in Sage-Grouse predation. With local Washington Sage-Grouse populations dwindling in numbers, efforts are being implemented to protect the surviving populations. One instance of those efforts is predator removal. The Washington Department of Fish and Wildlife (WDFW) has carried out Raven removal in the past, and has tracked Raven population trends over the subsequent years. It is important to accurately measure the impact of past predator population control in order to assess appropriate future actions. We analyzed Common Raven populations in order to find a more accurate estimated density of the Sage-Grouse predators near a lek in Lincoln County, Washington. We found that Raven population densities declined immediately after control efforts during a time of the year when densities are typically high.

Underestimation of Mesic Habitat May Call for Reassessment of Brooding Sage-grouse Habitat Preferences. Morgan Bucher*, *Whitworth University, 300 West Hawthorne Road, Spokane, WA 99251; mbucher20@my.whitworth.edu;* Ruth Hunter; *Whitworth University,; rhunter21@my.whitworth.edu*; Isaac Appleby-Hall; *Whitworth University; iappleby-hall21@my.whitworth.edu*; Dr. Grant Casady; *Whitworth University; gcasady@whitworth.edu*.

The sagebrush steppe ecosystem of North America is home to the Greater Sage-Grouse (*Centrocercus urophasianus*), and has been subject to a large amount of habitat fragmentation. Habitat fragmentation, along with other environmental factors, has impacted mesic regions and contributed to the decline in sage-grouse numbers in Washington. Literature agrees that Greater Sage-Grouse frequent such mesic areas during the brooding period. The Lincoln County, Washington population of Greater Sage-Grouse has been monitored in terms of their relative distance from mesic sites, with the conclusion that during the brooding period this specific group does not frequent mesic areas when compared to random points. This was assessed with a vegetation map produced using NAIP and World View-1 imagery from 2011. We traveled to randomly-selected mesic sites on public lands and measured mesic area extent using precision GPS. Data were collected in Lincoln County in June and July of 2018. While the vegetation polygon map was fairly accurate at detecting the location of mesic areas, it tended to underestimate the size of these areas. Previous conclusions about the proximity of brooding sage-grouse to mesic sites in Lincoln County should be reassessed in light of the potential underestimation of mesic extent.

Observations of three Harlequin Duck (*Histrionicus histrionicus*) **nests in the southern Washington Cascade Range.** Roy Morris, *roymorris10@gmail.com*; Russ Gibbs, Tara Chestnut, *tara_chestnut@nps.gov, National Park Service, Mount Rainier National Park, Ashford, WA, USA.*

Knowledge of species' natural history is critical to development of professional expertise and informing conservation priorities, yet basic life history information is lacking for many species. Even when global information is available, local natural history information to mitigate threats may still be lacking. The Harlequin Duck (*Histrionicus histrionicus*) is a small sea duck considered by the International Union for the Conservation of Nature (IUCN) to be "Apparently Secure – G4 N4" globally and nationally but in the United States it is considered "Imperiled" or "Critically Imperiled – S2B S1" at the state level throughout most of the southern portion of its breeding range. The Harlequin Duck Working Group identified breeding surveys as a key inventory need for the Pacific population, specifically in the Washington Cascade Range. We conducted opportunistic nest surveys at Mount Rainier National Park from 2001 to 2018 and report on the nest site descriptions of three Harlequin Duck nests detected in 2005 (n=2) and 2018 (n=1). Prior to this, only one Harlequin Duck nest was reported from Mount Rainier National Park in 1920.

Wetland Meadow Habitats in the Cascade Range: Potential Refugia for Herpetofaunal Communities Accelerating Post Fire Ecosystem Recovery. Chris Cousins, Mark Leppin, Anna Neill*, Matt Radin, *Oregon State University Herpetology Club, 2820 SW Campus Way, Corvallis, OR, 97330; cousinsc@oregonstate.edu, leppinm@oregonstate.edu, welshan@oregonstate.edu, radinm@oregonstate.edu,* Deanna H. Olson, *U.S. Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us.*

Wildfire disturbances are increasing in frequency in the Pacific Northwest. Fire refugia for vertebrates, both aquatic and terrestrial, are understudied. Wetlands with associated meadow habitats may act as resilient wildfire refugia for herpetofauna, which could be important components of local food webs, helping to reestablish ecological connections during post-fire recovery. We examined amphibian occurrence in wetland-meadow complexes embedded within known recent wildfire areas in comparison to areas without wildfire, to examine potential resilience of wetland refugia and their fauna to fire events. To study this, in 2018, the Oregon State Herpetology Club in conjunction with the U.S. Forest service surveyed wetland-meadow complexes for amphibians using a combination of timed visual surveys and dip-net sampling in the Sisters Ranger District, Deschutes National Forest, Oregon. Nine study sites were chosen based on occurrence of meadow habitats adjacent to wetlands and fire history, inclusive of sites within the Milli, Pole Creek, B&B Complex, and Airport fires, 2003 to 2017. Sites also varied in some habitat features, having permanent or ephemeral water sources. Large quantities of amphibian larvae and metamorphs were found at several of the seasonally wet sites, regardless of fire history, suggesting that these habitat types are important breeding habitat and animals there are potentially resilient to fire disturbance. In particular, some sites appeared to be particularly important for either amybstomatids or anurans, or both. Our experience allows for a refinement of sampling protocols for future surveys and establishes a baseline understanding of species diversity in the area.

Nest-Site Preferences of American Bushtits (*Psaltriparus minimus)* in an Urban Campus Setting. Celeste Dylla*, *Biology Department, Seattle University, 901 12th Avenue, Seattle WA 98122; dyllac@seattleu.edu*; Hannah Samsen, *Biology Department, Seattle University;* Rebecca Hartley, *Biology Department, Seattle University.*

In an urban environment, the nest-site preferences of songbirds are affected by a variety of novel factors, including anthropogenic noise and an altered landscape of tree species. We investigated the nest-building locations of American Bushtits (*Psaltriparus minimus*) on the campus grounds of Seattle University in spring 2018. Based on prior observations, we hypothesized that bushtits prefer to nest in non-native cedars over other coniferous tree species. We also hypothesized that nest sites would be situated in areas of campus away from the noisier surrounding streets. In order to test these hypotheses, eight bushtit nests were located during campus surveys, and bird behaviors were noted at each nest for ten minutes once or twice weekly from March to July. Individual Blue Atlas Cedar (*Cedrus atlantica),* Deodar Cedar (*Cedrus deodara*), and other large coniferous trees were mapped and their locations compared to nest-building sites. Using the noise meter app Decibel X, we monitored ambient noise levels for one minute each on two separate autumn days at 20 locations throughout the study area. We found that although there are many large conifers on campus, bushtits displayed an overwhelming nesting preference towards non-native cedars. We suggest that bushtits may be choosing nest sites based on branch or needle architecture, insect food availability, proximity to nest-building materials (spider webs, moss, and lichen), or social learning. Bushtits seemed to avoid building nests along the exterior of campus, where ambient noise levels were significantly higher and could potentially hinder reproductive success.

Attitudes of California Wine Producers on the Use of Barn Owls (*Tyto alba*) as a Tool for Integrated Pest Management. Brooks Estes*, *Humboldt State University, Environment & Community Program, 1 Harpst St., Arcata, CA 95521; bre14@humboldt.edu;* Matthew Johnson, *Humboldt State University, Department of Wildlife,1 Harpst St., Arcata, CA 95521; mdj6@humboldt.edu.*

California is the epicenter of the United States wine industry, producing 85% of the nation's wine in 2017. Wine is unique as an agricultural commodity, being strongly tied to place and with nuances of quality being prized above quantity. This concern for quality leads to significant micro-management of outside influences, and one constant challenge is pest management. Pest management is often a highly toxic and destructive endeavor; new and innovative natural options are increasingly necessary to prevent continued environmental degradation. The wine industry is ideally positioned to pioneer and widely adopt such techniques, because what is good for the land is generally considered good for the wine. One technique that has been gaining in popularity is the use of barn owl (*Tyto alba*) boxes in vineyards for the reduction of rodent pests as part of integrated pest management (IPM) approaches. Ongoing spatial ecology research is looking at the potential efficacy of these owls in reducing rodent numbers in California vineyards. However, beyond the efficacy of the owls themselves, better understanding how to increase the adoption of such techniques more broadly requires an understanding of the views and beliefs of wine producers. This poster discusses a survey project investigating the connection between the use of barn owl boxes, general pest management practices, and environmental knowledge, values, and attitudes. The project is in its early phases; therefore, this poster will focus on survey composition and distribution techniques, in addition to any preliminary data.

The Sustainability in Prisons Project (SPP): Engaging Incarcerated People in Wildlife Research and Recovery. Philip Fischer*, *251 Rainbow Rock Ln, Naches WA, 98937; pcfischer@gmail.com;* Jessica Brown, *10638 Mill Rd, Yelm WA,*

98597; bright.jessica.h@gmail.com; Kelli Bush, *The Evergreen State College; bushk@evergreen.edu;* Teresa Lorenz, USDA *Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia WA 98512; tlorenz@fs.fed.us.*

The complexity and scope of species recovery efforts necessitates creative thinking and broader engagement. Incarcerated people have been overlooked for their interest in science education, creative thinking, problem solving, and a desire to make positive contributions. The Sustainability in Prisons Project (SPP) is a program designed to address some of these issues. It is a partnership founded by The Evergreen State College and Washington State Department of Corrections (WADOC). It enables collaborations among incarcerated people, biologists, corrections staff, and academics. SPP has been able to increase education and training for incarcerated people while assisting agencies in species research and recovery. We will present two SPP partnership examples. The first example is partnership with the U.S. Forest Service to identify threats to cavity nesting birds that are state species of concern. This project entails technicians assisting with the review of ~60,000 hours of video from a large scale research study. In the second example we will describe a project led by the Washington Department of Fish and Wildlife where incarcerated technicians assist in recovery of western pond turtle (*Actinemys marmorata*). Following acute veterinary care for diseased shell tissue, turtles arrive at one of two participating prisons where technicians provide extended care until turtles are released back into the wild. Our aim with this poster is to raise awareness of education and training opportunities that benefit incarcerated people, biologists, and wildlife.

Characteristics of Adult Coastal Giant and Cope's Giant Salamanders of the Pacific Northwest. Alex D. Foster*, *USDA Forest Service Pacific Northwest Research Station, 3625 93rd Avenue Southwest, Olympia, WA 98512; alexfoster@fs.fed.us*; Lawrence L.C. Jones, *Southwest Zoologists' League, Tucson, Arizona; gilaman@comcast.net.*

Cope's Giant (*Dicamptodon copei*) and Coastal Giant (*D. tenebrosus*) salamanders are members of a family (Dicamptodontidae) that is endemic to the Pacific Northwest. Coastal Giants are relatively widespread from northern California to southwestern British Columbia, while Cope's has a more limited range in western Washington and northwestern Oregon. Both are sympatric within the range of *D. tenebrosus*, except only Cope's occurs on the Olympic Peninsula. Both are aquatic species in their larval stage, and are often present in the same stream. They may be paedomorphic (especially *D. copei*), but may metamorphose into a terrestrial adult form. Confusion exists in the identification between metamorphosed adults. We collected 23 metamorphosed adults of both species from sympatric areas in western Washington. The animals were transported to a lab where they were photographed in several aspects including dorsal, ventral, and lateral views, using both full body and close up views under standardized lighting. The animals were measured including weight, total and SVL length, length of limbs, length of tail, width of head, etc. Tissue was taken and DNA results were acquired. We will describe morphologic and phenotypic characteristics between adults of both species. In addition we will describe environmental and habitat characteristics where each individual was found. This work will contribute to the developing state of knowledge of the mechanisms of coexistence, habitat, and microhabitat use by each species.

Interagency Pacific Marten (*Martes caurina*) Distribution Study on the Olympic Peninsula, Washington. Betsy Howell*, *Olympic National Forest, USDA Forest Service, 295142 Highway*

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Pacific Martens (*Martes caurina*) remain relatively common at high elevations in much of the Pacific Northwest, yet their distribution and status on Washington's Olympic Peninsula is uncertain. Only 10 reliable Marten detections were documented from the late 1970s to 2017, including 4 from remote-camera surveys from 2015 to 2017, and 6 from animals encountered opportunistically (late 1970s to 2015). The discovery of a dead juvenile female in 2008 indicates that Martens were reproducing on the Peninsula within the last decade. To evaluate the current distribution and status of Martens, we conducted high-density camera surveys in 2015 and 2016 in coastal habitats in Olympic National Park (ONP) and high-elevation forests in ONP and Olympic National Forest (ONF). A total of 193 camera stations yielded nearly 400,000 photographs, but only 1 station detected a Marten, in the upper Hoh watershed of ONP. In 2017, we installed 6 high-elevation camera stations coupled with automated scent dispensers to keep sites functional throughout the winter. We checked these stations in 2018, determining that 2/6 detected Martens—again in the upper Hoh. We also installed 24 additional cameras and 12 scent dispensers in summer 2018 in areas near historical and current Marten records at high elevations; these camera sites will be checked in summer 2019. We employed detection dog teams in late summer and fall 2018 to search trails in ONF for Marten scats. These teams collected 48 scats from 15/22 trails surveyed. Of these 48, DNA obtained from 40 was suitable for species identification; no Martens were detected. Available evidence suggests that Martens are absent from the lower elevations of the Olympic Peninsula and occur at very low densities at higher elevations. Thus, they appear to be at substantial risk of extirpation. Additional broad and fine-scaled surveys to collect genetic information will be needed to fully understand the trend in Marten populations on the Peninsula and develop appropriate conservation strategies.

Optimal Distance for Insect Trap Placement in the Sage-grouse Habitat. Ruth Hunter*, *Whitworth University, 300 W Hawthorne Road, Spokane, WA 99251; rhunter21@my.whitworth.edu;* Morgan Bucher, *Whitworth University; mbucher20@my.whitworth.edu;* Isaac Appleby-Hall, *Whitworth University; iappleby-hall21@my.whitworth.edu.*

The Greater Sage-grouse (*Centrocercus urophasianus*) feeds on certain types of insects such as ants and beetles (Drut et al. 1994). When evaluating Sage-grouse habitat, it is helpful to have a way of measuring the presence of preferred insects in some areas relative to others. One method for taking insect surveys is the use of pitfall traps. In order to avoid spatial autocorrelation and interference between traps, it is necessary to find the optimal distance apart that traps should be placed. If traps are too close together, many traps will only be representative of one sample. Furthermore, it is possible that traps close together can affect each other in various ways, either by reducing the number of insects in an area making insect density lower, or

by attracting more insects due to higher density of trap bait. In order to find the spacing necessary for traps to be far enough apart to avoid these effects, traps were placed at various distances away from each other and the number of insects caught in each trap was used to create a semivariogram. The semivariograms showed no consistent trend and thus the data were inconclusive.

Relating Pellet Counts to Snowshoe Hare Density in Lynx-occupied Areas of Washington. Paul Jensen*, *Washington State University, 1775 NE Stadium Way, Pullman, WA 99164; paulj@wsu.edu;* Daniel Thornton, *Washington State University; daniel.thornton@wsu.edu.*

Snowshoe hare (*Lepus americanus*) are the primary prey of the Canada lynx (*Lynx canadensis*), a state-endangered and federally threatened carnivore. Lynx persistence is likely tied closely to snowshoe hare density and distribution. However, we have limited knowledge of snowshoe hare density in lynx occupied areas and lack an assessment of the accuracy of different methods for estimating hare density. Although pellet counts as a method of estimating hare density has been applied many times throughout its range, for accurate calibration, localized conversions are necessary to account for differences in deposition and decomposition. We live trapped and used spatially-explicit capture-recapture (SECR) models to estimate snowshoe hare density and then related those densities to pellet counts at seven 10-ha sites in northcentral Washington. Live trapping was conducted over six consecutive days at each site and was followed by pellet counts from plots that were uncleared in previous years. We found reasonably high hare densities within lynx occupied habitat, and a strong correlation between our estimated hare density and pellet counts for our uncleared pellet plots. Based on our regression equations, some areas of the Kettle range, which do not currently support a resident lynx population, likely reach hare densities capable of supporting lynx. Our regression equation may be useful to further evaluate habitat use by snowshoe hare and to inform boreal forest managers with intent to preserve important hare habitat in support of lynx conservation.

Monitoring Habitat Connectivity on Washington State Route 26. Katrina Keleher*, *Washington State Department of Transportation, 310 Maple Park SE, Olympia, WA 98504; katrina.keleher@wsdot.wa.gov;* Kelly McAllister, *Washington State Department of Transportation; kelly.mcallister@wsdot.wa.gov.*

There is a section of SR26 that is among the top 10% of worst deer-vehicle collision areas in the State. Serving as a popular driving route to Washington State University from western Washington, this highway is frequented by students and their families. Simultaneously, it lies in the path of a seasonal Mule Deer migration. Several livestock crossing culverts pass under this section of highway at regular intervals, prompting the question of whether or not these structures could function to provide deer with a safer way to cross the highway. To address this question and to better understand the role the livestock structures play in assisting with safe crossings, we have set up ten trail cameras on either side of five structures to find out what animals are using them. After two years of monitoring, we have determined that these structures are simultaneously serving wildlife, including deer, along with the cows they were designed for. However, it is clear that the structures could easily be made more attractive to deer, in particular. To achieve maximum low cost effectiveness of this existing infrastructure, for reducing collisions and conserving wildlife, WSDOT will need to work out compromises with local

landowners and enlist the help of maintenance staff to keep tumbleweed and other nuisances from reducing the attractiveness of these highway structures. In addition, continued monitoring is vital to fully understanding this low-cost approach to reducing collisions through the increased use of structures by deer and other wildlife.

Cougar and Bobcat Population Estimation and Occupancy Modeling in the Lower Elwha Klallam Tribe's Historic Use Area. Cameron Macias*, *University of Idaho, College of Natural Resources, 975 W 6th St, Moscow, ID 83844; maci2896@vandals.uidaho.edu;* Jennifer Adams, *University of Idaho, College of Natural Resources; adamsj@uidaho.edu;* Lisette Waits, *University of Idaho, College of Natural Resources; lwaits@uidaho.edu;* Kim Sager-Fradkin, *Lower Elwha Klallam Tribe Natural Resources, 760 Stratton Road, Port Angeles, WA 98363; kim.sager@elwha.org.*

As a sovereign nation, the Lower Elwha Klallam Tribe sets annual harvest regulations that differ from those of Washington State. No data, however, have been collected on predator populations in the Tribe's historic use area and we lack information for setting annual tribal harvest regulations. To address this data gap, we used a combination of non-invasive genetic sampling, GPS radio collars, and a camera grid survey to estimate population size, genetic diversity, and occupancy of cougar (*Puma concolor*) and bobcat (*Lynx rufus*) populations on the north Olympic Peninsula of Washington State. First, we used specialized scat-detection dogs to locate and collect cougar and bobcat scat samples across the landscape. We divided our 606 km^2 study area into 32- 4x4 km sampling cells and the scat-detection teams surveyed one cell per day. Of the 207 scat samples collected during the 2018 survey, we had an 85% success rate for genetic species identification and identified 154 bobcat and 18 cougar samples. Individual identification analyses are ongoing. Second, we equipped 3 adult (1 male and 2 female) and 1 sub-adult cougar with GPS radio-collars in 2018 to observe movement and dispersal. Third, we deployed a 64-camera grid survey using the same 32-cell grid system. Each grid cell contained two cameras separated by >1 km. We will continue these three surveys through 2020. This research will provide baseline data on cougar and bobcat populations in the Tribe's historic use area and help us to develop non-invasive and cost-effective methodologies for long-term monitoring and management.

Characteristics of a High Elevation Western Pond Turtle Population. Max McClarnon*, *Biology Program, Southern Oregon University, Ashland, OR 97520*; *mcclarnom@sou.edu;* Ricky Clark, *Biology Program, Southern Oregon University*; Amanda Huffman, *Biology Program, Southern Oregon University*; Michael Parker, *Biology Program, Southern Oregon University*.

The Willow-Witt Ranch is located at approximately 1425 m (4,650 ft) elevation in the southern Oregon Cascades. A small (0.6 hectare) irrigation pond on the property is inhabited by a population of western pond turtles (*Actinemys marmorata*), and is one of the highest elevation populations in the region. Over two field seasons (2017-18) we surveyed this population to estimate population size, structure, and spatial distribution. To capture turtles, we used baited collapsible funnel traps set around the margin of the pond in areas with different vegetation densities. We took standard body size and weight measurements, estimated age and sex, and individually marked each turtle by filing notches in outer margins of carapace scutes. We captured and marked 51 individuals and used repeat mark-recapture methods and estimated population size to be 75 (41-202 95% CI). Size distribution ranged from 39-161mm carapace

length (CL) and ages were estimated to range from 1 to >20 yr. A relatively large proportion (31%) of small (≤ 69 mm CL), young (≤ 4 yr) turtles suggests that there has been successful recent reproduction and recruitment into this population. Comparing size at age data with other populations in SW Oregon shows that turtles within this high-elevation population have slower growth and attain smaller overall body sizes than most populations. We found that turtles were segregated by habitat and body size, with the smallest size classes (< 80 mm CL) captured predominantly in the densest vegetation and larger turtles (> 100 mm CL) most abundant in open water.

Evaluating the Current Extent of Van Dyke's Salamander (*Plethodon vandykei*) Distribution Based on Historic Localities: A Collaborative Effort. Aimee P McIntyre*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; aimee.mcintyre@dfw.wa.gov;* Reed Ojala-Barbour, *Washington Department of Fish and Wildlife; reed.ojala-barbour@dfw.wa.gov;* Julie A Tyson, *Washington Department of Fish and Wildlife; julie.tyson@dfw.wa.gov;* Timothy Quinn, *Washington Department of Fish and Wildlife; timothy.quinn@dfw.wa.gov;* Marc P Hayes, *Washington Department of Fish and Wildlife; marc.hayes@dfw.wa.gov;* Alex D Foster, *Pacific Northwest Research Station, US Forest Service, 3625 93rd Avenue Southwest, Olympia, WA 98512; alexfoster@fs.fed.us;* Andrew J Kroll, *Weyerhaeuser, 220 Occidental Avenue South, Seattle, WA 98104; AJ.Kroll@weyerhaeuser.com.*

The Van Dyke's Salamander (*Plethodon vandykei*) is endemic to western Washington and is a state candidate for listing. The species is known from three disjunct geographic regions: the Cascade Mountains, Willapa Hills, and Olympic Peninsula. Lungless terrestrial salamanders respire cutaneously and require moist skin for gas exchange. The Van Dyke's Salamander is the most closely associated with water of any Pacific Northwest congener. Historically, the species was considered an old-growth obligate. However, more recently it has been associated with geomorphic and hydrologic microhabitats, such as stream channel morphology and substrate, which are not necessarily related to forest age. These considerations, in conjunction with its relatively low temperature requirements, have resulted in uncertainty surrounding its resiliency to the impacts of forest management and climate change. We designed a study to evaluate species persistence at known sites. First, in 2018 we compiled a comprehensive database of the locations of historic occurrences. Next, we identified partners throughout the species geographic distribution, including private timber landowners, state agencies, national forests and national parks. We plan to visit historically occupied sites in 2019 and 2020, document presence, and collect stand age, habitat and other covariate information. We will evaluate whether changes in occupancy are associated with stand age, forest management history, or other factors. We will inform species distribution and factors that affect detectability through modelling efforts. We will also collect tissue for genetic analysis for an evaluation of intra-specific diversity. This suite of analyses will inform conservation efforts and future studies on the species.

Wetland Meadow Habitats in the Cascade Range: Potential Refugia for Herpetofaunal Communities Accelerating Post Fire Ecosystem Recovery. Anna Neill*, *Oregon State University Herpetology Club, 2820 SW Campus Way, Corvallis, OR, 97330;welshan@oregonstate.edu;* Chris Cousins, *Oregon State University Herpetology Club; cousinsc@oregonstate.edu*; Mark Leppin, *Oregon State University Herpetology Club*; *leppinm@oregonstate.edu*; Matt Radin, *Oregon State University Herpetology Club;*

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Wildfire disturbances are increasing in frequency in the Pacific Northwest. Fire refugia for vertebrates, both aquatic and terrestrial, are understudied. Wetlands with associated meadow habitats may act as resilient wildfire refugia for herpetofauna, which could be important components of local food webs, helping to reestablish ecological connections during post-fire recovery. We examined amphibian occurrence in wetland-meadow complexes embedded within known recent wildfire areas in comparison to areas without wildfire, to examine potential resilience of wetland refugia and their fauna to fire events. To study this, in 2018, the Oregon State Herpetology Club in conjunction with the U.S. Forest service surveyed wetland-meadow complexes for amphibians using a combination of timed visual surveys and dip-net sampling in the Sisters Ranger District, Deschutes National Forest, Oregon. Nine study sites were chosen based on occurrence of meadow habitats adjacent to wetlands and fire history, inclusive of sites within the Milli, Pole Creek, B&B Complex, and Airport fires, 2003 to 2017. Sites also varied in some habitat features, having permanent or ephemeral water sources. Large quantities of amphibian larvae and metamorphs were found at several of the seasonally wet sites, regardless of fire history, suggesting that these habitat types are important breeding habitat and animals there are potentially resilient to fire disturbance. In particular, some sites appeared to be particularly important for either amybstomatids or anurans, or both. Our experience allows for a refinement of sampling protocols for future surveys and establishes a baseline understanding of species diversity in the area.

Locating Oregon Spotted Frog Over-Wintering Sites at the Parsnip Lakes, OR. Michael S. Parker*, *Biology Program, Southern Oregon University, 1250 Siskiyou Blvd., Ashland, OR 97520*; *parker@sou.edu*; David Hering, *Crater Lake National Park, Crater Lake, OR 97604*; *david_hering@nps.gov.*

Egg mass surveys at the Parsnip Lakes show that > 90% of total Oregon spotted frog (OSF) reproduction over the past 16 years has taken place within a single pond. The pond is experiencing dramatic habitat loss due to absence of beavers and deterioration of the beaver dam, resulting in declining water depth and succession of hydrophytic vegetation. Historically, the beaver dam, bank dens, and lodge provided important over-wintering habitat for the OSF population. Current over-wintering sites are unknown, but we hypothesized that the inflow spring, which does not freeze during the winter, may now represent the best remaining habitat at the site. To determine distribution before and during movement into over-wintering sites, we used funnel traps to capture frogs in late October-early November. Frogs were PIT-tagged and released at the site of capture. Subsequent recaptures allowed determination of movement patterns and distances, and mobile PIT tag antennae were used to relocate frogs within their overwintering sites. Over 15 trap-nights (> 10,000 total trap hours), we captured 9 adult OSF (7 males; 2 females). In spite of this very small sample size, multiple observations support the hypothesis that the inflow spring is the primary over-wintering site: (1) all frogs captured were within or near the spring inflow; (2) directional traps captured frogs moving upstream from the pond into the spring channel; (3) recaptured frogs had moved 18-32 m upstream within the spring channel; and (4) pit-tagged frogs were relocated within the spring channel in January and February. Identifying over-wintering sites is critical to habitat conservation and restoration planning.

Selection of Rest Structures and Microsites by Fishers in the Cascade Range of southern Oregon. Catherine M. Raley*, *USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512; craley@fs.fed.us*; Keith B. Aubry, *USDA Forest Service, Pacific Northwest Research Station; kaubry@fs.fed.us*.

To better inform forest management activities designed to improve resting habitat for Fisher (*Pekania pennanti*), we documented use of rest structures (e.g., live trees, snags, logs) and microsites (e.g., mistletoe brooms, platform branches, cavities) throughout the year by 12 female and 7 male fishers, and sampled the availability of rest structures and microsites on the west slope of the Cascade Range in southern Oregon from 1995 to 2001. Fishers primarily used live trees (65%), snags (14%), and logs (16%) for resting. Logistic regression models investigating selection of rest structures revealed that the presence of a suitable rest microsite best distinguished used from available structures: mistletoe broom or cavity in live trees, cavity in snags, and hollow end in logs. Only the snag and log models included covariates associated with tree size, likely reflecting the need for enclosed rest microsites to be large enough to contain an adult fisher. We also used logistic regression to model the ecological characteristics of available live trees, snags, and logs that contained suitable rest microsites. Whether a tree was a hemlock (*Tsuga* spp.) had the greatest effect on the presence of suitable mistletoe broom microsites, whereas moderate stages of decay and large diameter were the most important characteristics of snags with cavities and logs with hollow ends. To maximize benefits to fishers, we recommend that management for resting habitat be focused on retaining relatively large live trees, snags, and logs that already contain suitable rest microsites, rather than simply retaining the largest available structures.

Winter Bat Activity at Maternity Sites in Western Washington. Leah Rensel*, *University of British Columbia Okanagan, 1177 Research Road, Kelowna, BC V1V 1V7*; *leahrensel@att.net.*

The White Nose Syndrome (WNS) fungal pathogen, *Pseudogymnoascus destructans* (PD), infects and kills bats during the winter. There is very little information available about winter bat activity in the Pacific Northwest so the potential impact of WNS is unknown. WNS was confirmed in Washington bats in 2016. Therefore, understanding bat winter activity is vital to the conservation of bats in Washington. Site fidelity of bats to their summer maternity roosts is well documented, but maternity sites may also be used periodically by bats during the mild western Washington winter. We assessed whether three WNS vulnerable species of bats—Big Brown bat (*Eptesicus fuscus*), Little Brown bat (*Myotis lucifugus*) and Yuma bat (*Myotis yumanensis*)—use their maternity sites or summer roosts during winter. We placed passive acoustic detectors at three sites in Skagit and Snohomish Counties with evidence of summer bat activity and monitored them continuously from September 2017 until March 2018. We identified calls by species when possible. Yuma bats and Big Brown bats were active at their individual summertime maternity colony sites, but not Little Brown bats. Other wintertime activity of Silver-haired, Hoary and California bats were also recorded. These results suggest that, unlike their eastern relatives, Big Brown and Yuma bats in western Washington are periodically active during winter and that they may return to their summer maternity sites during this time.

Physical Characteristics of Northern Pacific Rattlesnake Hibernacula in the Methow Valley, WA. John J. Rohrer*, *Okanogan-Wenatchee National Forest, U.S. Forest Service,*

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Northern pacific rattlesnakes (*Crotalus oreganus*) survive the long, cold winters in the northern latitudes of their range by retreating to subsurface sites that provide protection from freezing temperatures. They congregate at suitable winter hibernacula, often in large numbers, and most use the same site for their entire life. Suitable hibernacula appear to be rare in the northern latitude landscape, and thus may be important sites to protect in order to maintain rattlesnake populations. We investigated the relationship between solar insolation, soil type, and winter hibernacula of northern pacific rattlesnakes in the Methow Valley of north-central Washington. We used visual ground searches and radio-telemetry tracking to locate 32 winter hibernacula from 2000 to 2018. A global information system that utilized slope, aspect, elevation, latitude, and surrounding topography was used to generate insolation values on selected dates. Each of the hibernacula located were in talus or rock outcrop soil types. Interstitial spaces in the talus and fissures in the rock outcrops provided subsurface access to areas below the frostline. Winter insolation values varied greatly. Twenty-seven of the 32 hibernacula sites had winter insolation values that were the highest available in the surrounding area. At the northern extent of their range, northern pacific rattlesnakes find suitable winter hibernacula in rocky soil types that have high winter insolation. These findings could assist land managers in determining areas to protect to help maintain healthy rattlesnake populations.

Can Pika Haypiles in Disturbed Habitats Facilitate Other Generalist and Specialist Species? Jordan Ryckman*, *Department of Biological Sciences, Central Washington University, 400 East University Way, Ellensburg, WA 98926-7537; Jordan.Ryckman@cwu.edu;* Kristina Ernest, *Department of Biological Sciences, Central Washington University; Kristina.Ernest@cwu.edu.*

Wildlife crossing structures are an effective way to improve wildlife connectivity across roads. Typically, their effectiveness is assessed by looking at particular focal species, often large mammals. Within the Interstate-90 (I-90) Snoqualmie Pass East Project, low-mobility species are also being targeted, and the America Pika (*Ochotona princeps*) was designated as one of the focal species. Pikas live in talus slopes at higher elevation but also inhabit rock embankment along I-90. During summer and fall, they collect vegetation to store in haypiles as their winter food supply. We asked whether pikas might attract other species to habitats along roads near crossing structures, thus serving to facilitate community composition. In fall 2017, we located 6 haypiles alongside I-90 and in other anthropogenic rock habitats. We placed a wildlife camera facing each one and covered the field of view with plywood or plastic sheeting to keep snow from obstructing the view. Cameras were left over winter and retrieved after snowmelt in spring 2018. We captured 678 images of 8 species (including pikas) from the six locations. As expected, the majority (94%) of captures was of pikas. We also captured evidence of kleptoparasitism, where other species were foraging in the haypile and taking vegetation. Determining which species visited these haypiles, and their behavior, provided a snapshot into the ways pikas may affect the community around them. We concluded that pikas can be a resource for other species, a potential additional benefit of designing wildlife crossing structures with habitat features to improve pika connectivity.

Engaging the Public to Promote Bat Conservation in Washington. Lori Salzer*, *Washington Department of Fish & Wildlife, 1111 Washington Street SE Olympia, WA 98501; Lori.Salzer@dfw.wa.gov;* Abigail Tobin, *Washington Department of Fish & Wildlife*; Rachel Blomker, *Washington Department of Fish & Wildlife;* Joe Buchanan, *Washington Department of Fish & Wildlife*; Treg Christopher, *Washington Department of Fish & Wildlife.*

In March 2016, white-nose syndrome (WNS) was documented in Washington for the first time. This disease has devastated bat populations in the eastern United States and many western bat species are likely vulnerable and may be similarly affected. Other states have used data from over-wintering sites to assess bat populations and the impact of WNS. In Washington, over-wintering strategies for most bat species are not understood and the locations of their hibernacula are poorly known. More information is available on maternity sites in Washington, but comprehensive surveys and long-term monitoring have not been conducted. The challenge to assess impacts of WNS without baseline information for summer and winter roosts, clarified that gathering multi-species, statewide bat roost information was an immediate priority. Because many of our bats use human-made structures for roosting, we focused efforts to educate and engage the public as a means to gather information on bats. An outreach plan included use of social media, community outreach activities and our web portal to report information on groups of bats and sick or dead bats. Social media (Facebook and Instagram), reached 166,807 accounts. The public provided over 562 reports; 164 of those were groups of bats, which lead to documentation of 49 new maternity colonies. From this effort we have learned that there is an abundance of public knowledge available to us about bats. We will continue to broaden our outreach strategies to better inform our knowledge of bat roosts in Washington.

Evaluating a Novel Method to Estimate Deer Densities in Forested Habitats. Lisa A. Shipley*, *School of the Environment, Washington State University, Pullman, WA 99164; shipley@wsu.edu*; Meghan Camp, *School of the Environment, Washington State University; meghan.camp@wsu.edu*; Daniel Thornton, *School of the Environment, Washington State University; daniel.thornton@wsu.edu.*

Changes in forest management over the last century, such as fuels reductions through thinning and prescribed burning, has the potential to influence populations and distributions of both mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) in forested landscapes. However, because deer are difficult to survey in forests using traditional methods, biologists currently lack a method to reliably estimate densities within these landscapes. Furthermore, we have a poor understanding of the spatial and temporal segregation of mule deer and white-tailed deer. Our project aims to address these problems by applying a novel method that uses camera traps to estimate species-specific densities within the Colville National Forest in northeastern Washington. During October 2017, we deployed cameras to test the feasibility of our larger study. To separately estimate densities of mule deer and white-tailed deer we estimated distances to recorded animals by comparing their distances to those of researchers in reference videos. We fit point transect models, adapted to camera trap data, using program Distance. The density estimates were 11.98 / km^2 for mule deer and 15.77 / km^2 for white-tailed deer. The 95% CI around the density estimates overlapped for mule deer (5.41 – 44.80/km^2) and white-tailed deer (11.20 – 39.29/km^2), indicating that densities were not significantly different in the sampled region. Our next step is to sample deer across a larger area

and variety of habitat types within the Colville National Forest and compare our new camera-based method of density estimates with density estimated by traditional techniques.

Do Fuel Treatment Applications in Forests Change Habitat Selection Factors for Fishers (*Pekania pennanti)*? Tessa R. Smith*, *Department of Wildland Resources, Utah State University, Logan, UT 84322; Tessa.Rene.Smith@gmail.com;* Eric M. Gese, *USDA-National Wildlife Research Center, Department of Wildland Resources, Utah State University Logan, UT 84322; Eric.Gese@usu.edu;* Pat A. Terletzky, *Department of Wildland Resources, Utah State University; Pat.Terletzky@usu.edu;* Craig M. Thompson, *Conservation Biology Institute,136 SW Washington Ave, Suite 202, Corvallis, OR 97333; Craig.Thomspson@consbio.org;* Dave Clayton, *USDA, Rogue River-Siskiyou National Forest, Medford, OR 9750; dclayton@fs.fed.us.*

Throughout the western United States, fuel reduction projects have increasingly become the management tool of choice for mitigating the rising costs and consequences of stand-replacing wildfires across the western United States. However, the removal of key structures and change in overall forest conditions may impact how habitat-obligate species, such as the fisher (*Pekania pennanti*), selects particular features for various behavioral states. Our research on a small fisher population near Ashland, Oregon, investigated which habitat elements a fisher uses on a home range scale in a pre/post treatment context. We captured and affixed GPS radio-collars to 10 fishers from 2010-2017 in the Ashland watershed unit where mechanical thinning methods and prescribed burns were being applied. Using a resource selection probability function, we then developed models to identify the habitat variables crucial to fisher space use before and after fuel reduction activities occurred. Chosen factors for data analysis included three important vegetation components relevant to previous literature results on fisher habitat selection: change in canopy cover, tree basal area, and remaining trees per hectare. We also integrated topographical and abiotic variables in the models to assess comparisons between our study and previous research findings. Although our analysis is still in progress, we anticipate our results may give insight to forest managers and wildlife biologists on how to implement fuels modification management that will conserve crucial habitat elements for fishers while safeguarding natural resources from potentially devastating wildfire effects.

A Comparison of Fundamental Nutritional Niches of White-tailed Deer (*Odocoileus virginianus*) and Mule Deer (*Odocoileus hemionus*). Anna Staudenmaier*, *School of the Environment, Washington State University, Pullman, WA 99164*; anna.staudenmaier@wsu.edu; Lisa A. Shipley, *School of the Environment, Washington State University*; *shipley@wsu.edu*; Daniel Thornton, *School of the Environment, Washington State University; daniel.thornton@wsu.edu*.

Although similar taxonomically and ecologically, ranges of mule and white-tailed deer are segregated across much of North America, except for a broad north-south zone roughly along the Rocky Mountains. Although free-ranging deer have been extensively studied in areas of both allopatry and sympatry, little is known about differences in their fundamental nutritional niches that might shape this distribution. However, field studies suggest that mule deer might be better able to tolerate plant fiber and plant secondary metabolites than white-tailed deer. Therefore, we directly compared the ability of mule and white-tailed deer to digest plant fiber and nutrients and to detoxify α-pinene, a monoterpene found in conifers and evergreen shrubs using in vivo digestion and feeding trials with 5-6 captive deer of each species. When fed a pelleted diet with 29% neutral detergent fiber, mule deer tended to have a higher dry matter, energy, and fiber

digestibility than did white-tailed deer, but a similar protein digestibility. However, both deer species had the same daily dry matter intake of pellets, and their intake declined linearly at the same rate as the percent of α-pinene increased from 0-4% over 11 days. For both species, intake of α-pinene increased to an asymptote of 0.62 g/kg body mass/day (SD = 0.24). These experiments suggest that the nutritional niches of mule and white-tailed deer are very similar, which might result in competition for food resources where sympatric. Our future experiments will compare the deers' tolerance for higher fiber forages and forages with condensed tannins.

Creating Habitat for the Northern Sagebrush Lizard at Umatilla National Wildlife Refuge. Sheri Whitfield*, *United States Fish & Wildlife Service, 64 Maple Street, Burbank, WA 99323*; *sheri_whitfield@fws.gov*; Heidi Newsome, *United States Fish & Wildlife Service, 64 Maple Street, Burbank, WA 99323*; *heidi_newsome@fws.gov.*

The Northern sagebrush lizard (*Sceloporus graciosus graciosus*) occurs in an area of the Umatilla National Wildlife Refuge (NWR) along a roadway where there is risk of mortality from vehicles. In proximity of the road, are tracts of Wyoming Sagebrush (*Artemisia tridentata*) and Antelope Bitterbrush (*Purshia tridentata*). The shrub component is largely comprised of a Cheatgrass (*Bromus tectorum* L.) understory. Lizards rely on open spaces for efficient movement while foraging or avoiding predators, are frequently less common in cheatgrass-dominated sites than in more intact shrub-bunchgrass communities. We used a meri crusher to crush vegetation over 3 years to increase open-ground and increase connectivity for the sagebrush lizard. We monitored each of the habitat types to determine lizard habitat use. Lizard surveys occurred weekly in 2017 and 2018 during the lizard active season April to September. Expected survey time is approximately 2 hours and on warm, sunny days (70-80 degrees Fahrenheit) with light winds (0-7 M.P.H.). Visual encounter surveys conducted in each habitat type (e.g., polygon, cut-in, corridor). The observer traveled along a line of fixed width of habitat and recorded all lizards visually observed. The interior of each of the polygons contain areas of open space without availability to shrub cover. Within the polygons, lizards tended to use edge areas near concealing vegetation. Monitoring sagebrush lizards has shown the lizards favored areas with open bare ground and scattered shrubs for shade and shelter. Shrubs and other vegetation within the perimeter of the polygons seemed to provide cover that lizards used. Observations during visual surveys indicated a relationship of lizard encounters in shrub areas with open ground in contrast to cheatgrass dominated areas. Habitat use by lizards occurred in polygon six and each of the five cut-ins. Lizards moved away from the roadway when habitat was created with reduced cheatgrass and increased open ground. This innovative project is the first attempt by actively managing sagebrush-steppe habitat for benefit to sagebrush lizard populations.

Conservation Status, Research Needs, and Management Recommendations for the Olympic Mudminnow (*Novumbra hubbsi*), Washington State's Only Endemic Fish. Oliva Williams*, *US Fish and Wildlife Service, Washington Fish and Wildlife Conservation Office, 510 Desmond Drive SE, Lacey WA 98503; Olivia_Williams@fws.gov;* Roger A. Tabor, *US Fish and Wildlife Service, Washington Fish and Wildlife Conservation Office; Roger_Tabor@fws.gov;* Patrick Dehaan, *US Fish and Wildlife Service, Washington Fish and Wildlife Conservation Office; Patrick_Dehaan@fws.gov*; Lauren Kuehne, *University of Washington, Fisheries Building, Room 318A, 1122 NE Boat St, Seattle, WA 98105; lkuehne@uw.edu;* Julian Olden, *University of Washington, Fisheries Building; olden@u.washington.edu;* Julie A. Tyson, *Washington Department of Fish and Wildlife, 600*

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The Olympic Mudminnow (*Novumbra hubbsi*) is Washington State's only endemic fish with a native range primarily in the Chehalis Basin, South Puget Sound, and watersheds of the Olympic Peninsula's outer coast to Ozette Lake. The preference of Olympic mudminnow for ponds, wetlands, and off-channel sloughs and oxbows means that they frequently co-occur with amphibian assemblages, and face similar threats to habitat loss or alteration. Lack of research attention and resources has also led to large knowledge gaps related to their ecology and conservation status. To help advance a research agenda for Olympic mudminnow, in December 2018 the University of Washington and U.S. Fish and Wildlife Service hosted a symposium to share current research and conservation knowledge, and to gain input from the conservation community to develop priority questions for future research.
At this meeting we share the outcomes of the 2018 Olympic Mudminnow Symposium with wildlife biologists outside traditional fisheries management forums. We also illustrate the complex and rich vertebrate assemblage in floodplain and off-channel lentic habitats of the Chehalis Basin by compiling data from multiple sources of amphibian, fishes, and lentic habitat inventories. Lastly, this poster will put special emphasis on the common threats, co-management, and differences between the needs of Olympic Mudminnow and native lentic breeding amphibians, including the federally listed Oregon spotted frog (*Rana pretiosa).*

Setting the Stage for Connectivity Assessments: Small Mammals in Forest Habitats as Potential Users of Wildlife Crossing Structures. Anjanette Wilson*, *1804 N Walnut St. Apt 4 Ellensburg, WA 98926; wilsonanj@cwu.edu;* Kristina Ernest, *Department of Biological Sciences, Central Washington University,400 E. University Way, Ellensburg, WA 98926; ernestk@cwu.edu.*

Highways create a major barrier to connectivity for wildlife populations. Interstate-90 in Washington State cuts through forest habitats along the eastern Cascades, where Washington State Department of Transportation (WSDOT) is now constructing multiple wildlife crossing structures to improve connectivity. As part of the pre-construction monitoring, we documented the species inhabiting the forest adjacent to planned crossing structures, and examined the temporal and spatial variation in species composition and relative abundance of small mammals. This study focuses on the Price-Noble Connectivity Emphasis Area, where a wildlife overcrossing, three undercrossings, and multiple culverts are being built as the highway expands. Small mammals were live-trapped on 50 m x 50 m grids with Sherman, Tomahawk, and pitfall traps for two consecutive nights during the summer in 2013, 2014, 2015, 2017, and 2018. We compared captures per trap-night among species, across sites and years. The most abundant species were Deer Mice (*Peromyscus maniculatus*) and Forest Deer Mice (*P. keeni*). The presence of other species was more variable among sites and showed lower relative abundance. We saw the lowest relative abundance of species in 2013 and the highest in 2017. Based on the data, we predict that Deer Mice (*P. maniculatus* and *P. keeni*), and chipmunks will be the first to use new crossing structures. Other species that are less abundant or have greater habitat specialization may require more time to use the crossing structures. This analysis provides baseline data for future studies evaluating the success of these wildlife crossing structures in improving connectivity.

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