

Student presentations are denoted by an \diamond before the title. Presenting speaker's name is marked with an *.

Distribution, Occupancy, and Conservation Status of the Cascade Red Fox in Southern Washington. Jocelyn R Akins*, *Cascades Carnivore Project / University of California Davis, One Shields Ave., Davis, CA 95616; jakins@ucdavis.edu*; Mark Statham, *University of California Davis, One Shields Ave., Davis, CA 95616*; Keith Aubry, *Pacific Northwest Research Station, USDA Forest Service, 3625 93rd Ave. SW, Olympia, WA 98512; kaubry@fs.fed.us*; Benjamin N Sacks, *University of California Davis, One Shields Ave., Davis, CA 95616; bnsacks@ucdavis.edu*

The Cascade Red Fox (*Vulpes vulpes cascadenensis*) once occurred throughout the Cascade Range in Washington and southern British Columbia, where it was considered rare but widespread in the mountains. Current carnivore surveys suggest that substantial range losses may have occurred in recent decades, especially in the northern portion of its range. This rare carnivore represents a unique genetic, ecological, and morphological lineage of the Red Fox that is endemic to the Washington Cascade Range, where it may now be limited to a few isolated populations. A better understanding of its current distribution, habitat requirements, genetic diversity, and connectivity are needed to better inform conservation efforts. We employed noninvasive camera stations with hair-snagging devices, and genetic sampling along trails and fox snow tracks in southern Washington from 2008 to 2016. First, we developed a presence-absence species distribution model that reflects the key habitat correlates of fox occurrence in the southern portion of the range and predicts occurrence in the north. Second, we determined population structure, and estimated genetic diversity and effective population size from DNA samples using 32 microsatellite loci. We compared these estimates to historical ones as well as those from other montane Red Fox populations. Third, we determined landscape connectivity via resistance modeling using least-cost path analysis. Our field methods ensured high detection probabilities and we recommend systematic surveys in areas of high relative habitat suitability in the North Cascades Ecosystem as a conservation priority.

Creative Partnership for Columbian White-tailed Deer Conservation through a Section 7 Consultation. Mark E. Bakeman*, Kelly R. McAllister, Stu Smith, *Washington State Department of Transportation, 310 Maple Park SE, Olympia, WA 98504-7331; BakemaM@wsdot.wa.gov; mcallke@wsdot.wa.gov; smithstu@wsdot.wa.gov*

The Washington State Department of Transportation (WSDOT) conducted an Endangered Species Act (ESA) Section 7 Consultation with the U.S. Fish and Wildlife Service (USFWS) for a passenger rail project in Washington State. The project action area had ESA-listed translocated Columbian White-tailed Deer (*Odocoileus virginianus leucurus*; CWT deer). The project would lead to increased train-deer strikes and required formal ESA consultation. Tangible conservation actions were limited because the Federal Railroad Administration (FRA) had limited authority to make changes on a private rail line. The USFWS acknowledged this and required the FRA to develop a geographic information system (GIS) habitat connectivity model for CWT deer. WSDOT assembled a committee of CWT deer experts and GIS specialists to develop a habitat connectivity

model. We used a free GIS tool called Linkage Mapper. The committee worked collaboratively to develop the Linkage Mapper inputs. One important input identified occupied (cores) and unoccupied habitat patches (nodes) that we were interested in connecting. The other was a characterization of the landscape as a resistance surface, converting landscape features into a grid representation that described the suitability of landscape conditions for deer movement. Linkage Mapper used these inputs to produce a variety of map outputs including normalized corridors and cost-weighted distance maps that identify how deer might disperse outward from cores and nodes. The term and condition of the ESA consultation was satisfied by the collaboration of a large group of interested stakeholders that produced a conservation tool that has utility over a broad landscape.

The Fisher Candidate Conservation Agreement with Assurances and Fisher Recovery in Washington. Gary Bell*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; gary.bell@dfw.wa.gov*

As permittee, the Washington Department of Fish and Wildlife (WDFW) officially began implementation of the Candidate Conservation Agreement with Assurances (CCA) for Fisher (*Pekania pennanti*) in Washington upon permit approval in April 2016. The CCA is a conservation agreement between WDFW and the U.S. Fish and Wildlife Service (USFWS) designed to promote Fisher conservation while also addressing landowner concerns about future regulatory restrictions if Fisher were to ever become a listed species under the federal Endangered Species Act. Participating landowners agree to follow conservation measures detailed in the CCA to protect Fishers that may move onto their lands. In return, enrolled landowners receive assurances that USFWS will not require additional conservation measures or land, water, or resource use restrictions beyond those voluntarily agreed to in the CCA. WDFW continues to enroll interested landowners, and to date, 45 small and large forest landowners have been signed on, representing 1,204,089 ha of land enrolled in the CCA.

A Comparison of Nutrition and Foraging Behavior between Sympatric Mule and White-tailed Deer in Northeastern Washington. Stephanie Berry*, Lisa Shipley, *School of the Environment, Washington State University, Pullman, WA 99164; stephanie.berry@wsu.edu; shipley@wsu.edu*; Ryan Long, *Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844; ralong@uidaho.edu*; Mark Swanson, *School of the Environment, Washington State University, Pullman, WA 99164; markswanson@wsu.edu*; Chris Loggers, *Colville National Forest, USDA Forest Service, 255 West 11th Street, Kettle Falls, WA 99141; cloggers@fs.fed.us*

Mule Deer (*Odocoileus hemionus*) and White-tailed Deer (*O. virginianus*) co-occur in a north-south zone from Canada to Mexico along the Rocky Mountains. Over the last few decades, White-tailed Deer have expanded their distribution in many areas along this zone. Despite extensive research on life history and habitat use of sympatric Mule and White-tailed Deer, it is still unclear why current conditions seem to favor White-tailed Deer in many areas traditionally occupied by Mule Deer. However, no study has yet compared foraging behavior and nutrition of the two species in a controlled field setting. Therefore, we hand-raised Mule and White-tailed Deer, and transported them to 33 Ponderosa Pine (*Pinus ponderosa*)/Douglas fir (*Pseudotsuga menziesii*) stands in

northeastern Washington. At each site, we measured forage biomass, recorded deer behavior, and conducted foraging trials with 4-5 animals of each species during which we measured intake rate, and diet composition, selection, and nutritional quality. Mule and White-tailed Deer selected diets with similar plant composition and had the same preference ranking for 86% of available plants. Likewise, diet quality and time spent in different behavioral activities did not differ between the species. However, Mule Deer took larger bites and harvested food faster, whereas White-tailed Deer traveled further while foraging. Our findings suggest that Mule and White-tailed Deer have similar adaptations as large generalist herbivores to seek nutritious diets from available forage. Differences observed between free-ranging species likely reflect habitat choices occurring at larger spatial scales based on different adaptations for predator avoidance or reproduction.

Hazard becomes Habitat. Ken Bevis*, *Washington Department of Natural Resources, Stewardship Wildlife Biologist, 713 Bowers Rd, Ellensburg, WA 98926; Ken.Bevis@DNR.wa.gov*

All too often an outstanding opportunity to create a long-lasting habitat structure, a broken topped snag from a perceived "hazard" tree, is lost due to the ongoing routine practice of complete tree removal. Here I will suggest using Crown Reduction (aka "topping") as a way to reduce hazard from falling arboreal material, while maintaining habitat. Hazards can become habitat.

Wildlife Habitat Elements in East Cascades Fuels Reduction Projects: SLLOPPS. Ken Bevis*, *Washington Department of Natural Resources, Stewardship Wildlife Biologist, 713 Bowers Rd, Ellensburg, WA 98926; Ken.Bevis@DNR.wa.gov*

Fuels reduction projects are becoming widespread in dry forest settings on small, privately owned forest lands in eastern Washington. These treatments focus on the objective of reducing high intensity fire risk and increasing vigor of leave trees. Common practices of removing most small diameter trees and much of the shrub layer can result in degraded habitat conditions for many native wildlife species. However, when basic habitat elements are incorporated in the fuels reduction projects (Snags, Logs, Legacy, Openings, Patches, Piles and Shrubs) the outcome is very different, and multiple objectives can be accomplished. This presentation will describe case studies in eastern Washington and summarize habitat recommendations.

◇ **Mortality of Range Livestock in Wolf-Occupied Areas of Washington.** Jeffrey A. Brown*, Gabriel R. Spence, Zoe L. Hanley, Robert B. Wielgus, *Large Carnivore Conservation Laboratory, School of Environment, Washington State University, Pullman, WA 99164; jeff.brown@wsu.edu; gabriel.spence@wsu.edu; zoe.hanley@wsu.edu; wielgus@wsu.edu*

Large carnivore management is greatly influenced by human-carnivore conflict including actual and perceived threats. For Gray Wolves (*Canis lupus*), livestock depredations are one of the most important and controversial sources of conflict. However, the extent of wolf depredation on livestock is difficult to quantify accurately because detecting livestock carcasses shortly after cause of death is challenging, especially in remote landscapes where range Sheep (*Ovis aries*), Cattle (*Bos taurus*), and

wolves most often interact. To more accurately estimate losses at a population level of range livestock in wolf occupied areas, we radio-tagged 588 calves in 10 cattle herds and 176 sheep in one flock to determine cause-specific mortalities in Washington over two grazing seasons. We detected one sheep and one calf death, but no wolf kills during telemetry monitoring, despite all herds having spatial overlap with wolves. Our results indicated that losses due to wolves were not above 0.81% for cattle or 1.6% for sheep for livestock within Washington wolf pack territories. Though acute impacts of wolf depredations can occur and be detrimental to individual livestock operators, our results suggest that those severe events were rare and that overall depredation losses were very low in wolf-occupied areas of Washington.

Non-lead Ammunition and Outreach. Leland Brown*, *Non-lead Hunting Education, Oregon Zoo, 4001 SW Canyon Road, Portland, OR 97221; Leland.brown@oregonzoo.org*

Secondary wildlife lead exposure from rifle ammunition is widely documented, particularly in association with big game hunting. Additional research highlights lead exposure concerns with other types of hunting and wildlife management programs using lead bullets. At the same time, legal, well-regulated hunting is an important part of the North American Model of Wildlife Management. Use of non-lead ammunition removes risks of lead exposure, while continuing participation from the hunting community in both wildlife management programs, and connection to conservation of wildlife and habitat. Non-lead ammunition is recognized as high performing but requires shifts from conventional views on ammunition choices. Outreach is a crucial tool in promoting change in ammunition choices within the hunting and shooting communities, while encouraging continued participation in conservation actions.

The Ecological Role of Wildlife Trees. Timothy K. Brown*, *39650 Southeast Park Street, Snoqualmie, WA 98065; timothykbrown@msn.com*

North American forests consist of a canopy of softwoods and hardwoods that are the main habitat of many mammals, birds, amphibians, and reptiles. These animals use live, defective, or completely dead trees – as well as coarse woody debris on the forest floor arising from wind-throw or small-scale tree failure. Managing hazard trees present opportunities for the maintenance or enhancement of both snags and coarse woody debris structure. The relative scarcity of snags and coarse woody debris – the remnants of large trees now logs on the forest floor – ensures that it will remain in use after the *investment* in hazard reduction is made. I will provide examples of the role of large old trees in various forest types, successional stages and seasons of the year, especially regarding those species that rely on large defective trees or snags. I will also provide a small sampling of the many techniques that I have developed for modifying hazard trees (when needed) to reduce hazard and enhance habitat quality, including the functions of snags and coarse woody debris in soil retention and aquatic communities.

Leveraging Existing Data to Assess Climate Change Vulnerability of Wildlife.

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Conservation and natural resource practitioners are responsible for managing species with increasing threats such as climate change. Although climate vulnerability assessments have been completed for some high-profile species, their approaches differ considerably and the vast majority of species have not been assessed. Using publically available data, we demonstrate a generalizable methodology and assess the relative vulnerability to climate change of 251 animal species in southern and central Oregon. In addition to ranking each species' vulnerability to climate change, we summarize the factors that contribute most to their sensitivity across taxonomic groups. We found that a species' dependency on climate-sensitive habitats was most often identified as contributing to their overall sensitivity and often lead to high vulnerability. We also found that the vast majority of species assessed had relatively low confidence, highlighting the need for filling data gaps. Our approach demonstrates the utility of leveraging existing data to assess climate change vulnerability in the face of an uncertain future.

Status and trends of Cascade Red Fox in Mount Rainier National Park. Tara Chestnut*, Elissa Gordon, *Mount Rainier National Park, Ashford, WA; tara_chestnut@nps.gov*

Cascade Red Fox (*Vulpes vulpes cascadenensis*), an endemic subspecies of Red Fox, inhabit alpine and subalpine areas of the Washington Cascades, including Mount Rainier National Park (MRNP). These foxes are morphologically, ecologically, and genetically unique from their nonnative lowland relatives, diverging during the last ice age. Over the last century, this subspecies of red fox, like many other furbearers, has experienced distribution and abundance loss largely due to trapping. Although no longer trapped, Cascade Red Fox populations have continued to decline in recent years and it is estimated that only three family groups of Cascade Red Foxes exist at MRNP today. Until recent years Cascade Red Foxes were considered a nuisance species at MRNP. Though a rare species, they were often observed approaching people, begging for food, and roaming around roads and in parking areas. The human conditioned foxes were at a peak in 2012 and without a clear reason, in 2015 and 2016 fox sightings drastically decreased. To determine if the fox declined or moved to different locations, we conducted trail-based surveys in 2016. Field crews hiked 585 km of trails through suitable fox habitat between approximately 730 m and 2225 m in elevation. We collected 53 potential fox scats for genetic, diet, and disease analysis to gain a better understanding of the Cascade Red Fox population and possible factors affecting this rare carnivore's population health.

Restoring Resilient Stand Structures, Spatial Patterns, and Ecosystem Functions: the ICO Approach. Derek J. Churchill*, Sean Jeronimo, Paul Fischer, Van R. Kane, *School of Environmental and Forest Sciences, University of Washington, Box 352100, Seattle, WA 98195-210; derekch@uw.edu; jeronimo@uw.edu; pfisch5@uw.edu; vkane@uw.edu; Andrew J. Larson, Department of Forest Management, College of Forestry and Conservation, University of Montana, Missoula, MT 59812; a.larson@umontana.edu*

Increasing forest resilience requires managing for desired structure, composition, and spatial pattern. Managers and stakeholders across the Interior West are increasingly focused on managing for the uneven-age, mosaic patterns of individual trees, tree clumps, and openings (ICO) associated with frequent fire forests. Until recently, methods to incorporate targets for spatial pattern into treatments were not well developed. In addition, relationships between pattern and desired ecosystem functions and processes are not well understood. We developed a silvicultural tool that incorporates spatial pattern targets from reference stands into prescriptions. We built a large dataset of reference stand conditions in frequent fire forests across central and eastern Washington and Oregon. Reference stands show a definable envelope of patterns that can serve as targets for restoration treatments and uneven-age management approaches. Results from treatment implementation indicate that explicit targets for spatial variability, in the form of clumping and opening targets, can be achieved in a practical, operational-scale manner. We also have developed monitoring tools to compare spatial pattern from any treatment to reference conditions. Recent developments include using LiDAR to quantify pattern, as well as the development of an Android App. Finally, we have conducted a comprehensive review of the scientific literature on how stand-level spatial pattern influences key ecosystem functions and processes such as wildlife habitat, fire behavior, regeneration, insect-caused tree mortality, and snow retention. Results from this review show a range of effects that can help managers better define explicit goals for spatial pattern in treatments.

Experience on Forest Certification Opening Remarks. Terrance W. Cundy*, *Potlatch Corporation, 301 D Street, Suite A, Lewiston, ID 83501*; Terry.Cundy@potlatchcorp.com

Potlatch is a forest land management company with approximately 566,560 ha in Arkansas, Alabama, Idaho, Minnesota and Mississippi. Potlatch's forest management operations have been third-party certified to the Forest Stewardship Council, ISO 14001, and Sustainable Forestry Initiative standards at various times and on various management units since 2002. This presentation provides some history on the standards as well as similarities and contrasts based on Potlatch's experience in forest certification.

Bundling Ecosystem Services to Increase Forestland Value and Highlight Multiple-Use Management on Public Lands. Robert L. Deal* and Nikola Smith, *USDA Forest Service, PNW Research Station, 620 SW Main St., Portland OR, 97205*; rdeal@fs.fed.us

Ecosystem services are increasingly recognized as a way of framing and describing the broad suite of benefits that people receive from forests and landscapes. These include commonly recognized goods like timber and fresh water, and processes like climate regulation, soil formation and cultural values. The USDA Forest Service has been exploring use of an ecosystem services framework as a way to describe forest values provided by federal lands, and the Agency has sought place-based applications of an ecosystem services framework to national forest management to better illustrate the concept for policymakers, managers, and forest stakeholders. There has also been increasing interest in the use of incentives and market-based strategies to add value for forest land and to help accomplish conservation goals. Forest products will continue to be a major resource from forest lands and other ecosystem services such as carbon credits, water quality and quantity, and conservation values can add financial value from forests

We outline some of the policy and regulatory frameworks for some of the emerging markets for ecosystem services and discuss the role that different regulatory agencies play for each of these services. We then assess the potential benefits for bundling different ecosystem services including carbon credits, water quality trading, and wetland and species mitigation banking. We also describe how an ecosystem service framework can be designed to address key ecosystem services identified from forest planning including recreational and cultural values along with more traditional commodities and services such as timber, water, wildlife and aquatic habitat.

Sage-grouse Initiative: Wildlife Conservation through Sustainable Ranching. Helen E. Dowling*, J. K. Unfried, M. G. Brown, *Pheasants Forever, Inc., 1783 Buerkle Circle, St. Paul, MN 55110; ldowling@pheasantsforever.org; junfried@pheasantsforever.org; mbrown@pheasantsforever.org*, D. C. Bachman, *Natural Resource Conservation Service, 316 W. Boone Ave., Suite 450, Spokane, WA 99201; Dominic.Bachman@wa.usda.gov*

The Sage Grouse Initiative (SGI) has changed the way conservation is implemented on the landscape. Since 2010, there have been 73 SGI contracts in Washington State effecting 29,461 ha of habitat for the Greater Sage-grouse (*Centrocercus urophasianus*) and other sagebrush obligate species through sustainable ranching. Washington SGI has received four grants from the Partners for Fish and Wildlife Program. One of these projects worked to enhance 14.2 ha of wet meadow habitat in the Deep Creek Watershed, two are working to remove 18 km of fence from the borders of Conservation Reserve Program and State Acres For Wildlife Enhancement fields improving habitat for Sage-grouse across 2,245 ha, and the fourth will fund the planting of pollinator habitat that will enhance brood rearing habitat in the area. In addition to the core mission of SGI to provide conservation through sustainable ranching, SGI 2.0 will launch a cropland program in 2017 that will provide financial assistance for cropland producers to convert marginal croplands into wildlife habitat. The goal of SGI cropland is to target agricultural areas within core areas for Sage-grouse and increase cover and connectivity across the landscape. Finally, SGI 2.0 is bringing to Washington the first opportunity for easement funding dedicated to the protection of shrub-steppe habitat specific for Sage-grouse. Over the next three years, Washington will receive approximately \$1.5 million through the Agricultural Conservation Easement – Agricultural Land Easements Program as well \$5,040,000 of funding that is specific for Sage-grouse.

Washington Transportation Maintenance Staff Assist with Wildlife Data Collection. Jeff Dreier*, Marion Carey, *Washington State Department of Transportation, 310 Maple Park Avenue SE, Olympia, WA 98504; dreierj@wsdot.wa.gov; careym@wsdot.wa.gov*

Washington State Department of Transportation Maintenance staff traditionally mow the roadsides, repair guard rail, remove snow and ice and perform other important functions, including wildlife carcass removal. Over the years, maintenance personnel have increasingly contributed data to WSDOT's wildlife management team. Their contributions increased substantially as a result of being provided with iPads. For the past two years, iPads have enabled data entry via drop down menus, complete with GPS-derived coordinates and paperless transfer to a master database. The increased efficiency

has allowed us to expand data collection to a broader range of species. Plus, when identification of a road-killed animal becomes difficult, they can take a picture and attach it to the record, allowing headquarters biologists to assist. This is important for some species, like Fisher (*Martes pennanti*) and Badger (*Taxidea taxus*), that are of interest to the Washington Department of Fish and Wildlife. To keep Maintenance staff informed and motivated, we periodically send printed color posters to maintenance offices statewide. Digital versions of the posters are also uploaded to a reference folder on agency iPads. Posters vary from a yearly poster showing the results of the wildlife roadkill data analysis to posters describing how to identify deer species found in our state. The use of modern technology has provided wildlife managers with the opportunity to obtain data on wildlife from a whole new set of personnel. We have found our maintenance personnel to be excellent partners in collecting wildlife data.

Prescribed Fire-When, Where and Cost. Matt Eberlein*, *Washington Department of Fish and Wildlife, 1240 2nd Ave. S, Okanogan, WA 98840; matt.eberlein@dfw.wa.gov*

To manage forests at the landscape level, it is important to determine when and where prescribed fire is needed, and the costs associated. A few determining factors for the use of fire are based on proximity to the Wildland Urban Interface, fire dependent landscapes and regimes, fuel loadings, timing, and terrain conducive to a safe and successful operation. Costs can fluctuate per acre. The more complex the landscape factors, the more preparation and resources are required on site. Commercial thinning and commercial timber harvest are additional considerations for the use of fire in land management practices to enhance resource productivity and health. Over the past several decades, wildfires have been far more devastating. A lack of land management practices, exclusion of fire, and other factors that limit fire on the landscape have contributed to the increased devastation. This has created a situation that requires focus and how we manage these landscapes. Applying fire in a controlled fashion can greatly reduce the hazards associated with wildfire and improve safety to the public, enhance ecosystems and improve wildlife habitat.

Logging for Wildlife? Timber Harvest Management to Promote Wildlife Habitat on the Lewis River. Kendel Emmerson*, *PacifiCorp, 825 NE Multnomah Suite 1500, Portland, OR 97232; kendel.emmerson@pacificorp.com*

The Lewis River Wildlife Habitat Management Plan (WHMP) was developed to offset habitat loss and impacts associated with PacifiCorp's Lewis River Hydroelectric Projects in southwest Washington. The WHMP manages for variety of species and habitats on over 5,260 ha in the Lewis River basin. Timber harvests and other silviculture practices are the primary tools to meet WHMP habitat goal and objectives and to achieve a mosaic of mid-, late-, and early-seral forest habitats. This includes conducting timber harvest to meet prescribed cover to forage ratio for Roosevelt Elk (*Cervus elaphus*), intense scarification, grass seeding, and silviculture practices to maintain big game foraging habitat for up to 20 years post-harvest. Additional wildlife management strategies include the recruitment of large down wood and retention of leave trees and shrubs to maximize diversity, structure and provide visual screening for wildlife.

WA DNR Experience with Dual Forest Certification. Allen Estep*, *Washington Department of Natural Resources, 1111 Washington Street SE, MS 47014, Olympia, WA 98504-7014; allen.estep@dnr.wa.gov*

The Washington State Department of Natural Resources (DNR) is dually certified to the Forest Stewardship Council® (FSC®) and Sustainable Forestry Initiative® (SFI) certification programs. DNR certified its western Washington managed lands to the SFI® program in 2005 and later its eastern Washington managed lands were certified in 2006; currently ~850,000 ha in total. DNR has been FSC certified since 2007 within its ~172,000 acre South Puget Habitat Conservation Plan planning unit, making this area dually certified. DNR has maintained its forest certification consistently across the landscape through three major management frameworks; Washington State's Forest Practices Rules, DNR's Trust Lands Habitat Conservation Plan, and Policy for Sustainable Forests. DNR values forest certification and resulting benefits including an additional public review of its management practices, expanded marketplace and continual improvement.

Conservation of the Hooded Grebe in Patagonia, Argentina – A Volunteer Experience. John Grettenberger*, *3138 Wilderness Dr. SE, Olympia, WA 98501; grettenbergerj@gmail.com*

I review the status of the endangered Hooded Grebe (*Podiceps gallardoi*), an endemic species found in southern Argentina, and describe the conservation project to restore the species. I also describe my experience working as a volunteer with the project in 2016.

Adapting Natural Resource Management to Climate Change in the Pacific Northwest: the Blue Mountains, South-central Oregon, and Southwest Washington Adaptation Partnerships. Jessica E. Halofsky*, *University of Washington, School of Environmental and Forest Sciences, Box 352100, Seattle, WA 98195-2100; jhalo@uw.edu*; David L. Peterson, *U.S. Forest Service, 400 North 34th Street, Suite 201, Seattle, WA 98103; dpeterson@fs.fed.us*

Concrete ways to adapt to climate change are needed to help natural resource managers take the first steps to incorporate climate change into management and minimize the negative effects of climate change. We recently initiated three science-management climate change adaptation partnerships in the Pacific Northwest, encompassing seven national forests and one national park. Goals of the partnerships were to: (1) synthesize published information and data to assess the exposure, sensitivity, and adaptive capacity of key resource areas including water use, infrastructure, fisheries, vegetation and disturbance, and wildlife; (2) develop science-based adaptation strategies and tactics that will help to mitigate the negative effects of climate change and assist the transition of biological systems and management to a warmer climate; (3) ensure adaptation strategies and tactics are incorporated into relevant planning documents; and (4) foster an enduring partnership to facilitate ongoing dialogue and activities related to climate change in the partnerships regions. After an initial vulnerability assessment by agency and university scientists and local resource specialists, adaptation strategies and tactics were developed in a series of scientist-manager workshops. The final vulnerability assessments and adaptation actions are incorporated in technical reports. The partnerships

produced concrete adaptation options for national forest and other natural resource managers and illustrated the utility of place-based vulnerability assessments and scientist-manager workshops in adapting to climate change.

White-Nose Syndrome in Washington: What We Know, What We Don't, and where we're Going. Katie Haman*, Abigail Tobin, *Washington Department of Fish and Wildlife, Olympia, WA 98501; Katherine.haman@dfw.wa.gov*

The first detection of white-nose syndrome (WNS) and its causative agent, *Pseudogymnoascus destructans* (Pd) in the western United States was on March 11, 2016 in King County, Washington. Since this time, two additional detections of the fungus, but not the disease (WNS) have been found in Washington. One was from a bat submitted to the Department of Health for rabies testing (March 2016) and later relinquished to the Washington Department of Fish and Wildlife (WDFW) for Pd testing. The third detection was from guano collected under a bridge between April and July (2016) roughly five miles from the location of the initial case in King County. It remains unknown at this point how widespread Pd is on the landscape and what the impacts of WNS will be on western bat populations. Therefore, to address some of these knowledge gaps WDFW has launched a highly collaborative, comprehensive response that encompasses bat population monitoring and both active and passive surveillance. In this presentation, we will provide an overview of what we know to date regarding WNS and Pd in Washington, and where we are going from here.

Forecasting Cattle Depredation Risk by Recolonizing Gray Wolves in Washington. Zoë Hanley*, Robert Wielgus, *Large Carnivore Conservation Lab, Washington State University, PO Box 642812, Pullman, WA 99163; zoe.hanley@wsu.edu; wielgus@wsu.edu*

Preventing carnivore-livestock conflicts requires identifying conditions placing livestock at risk and focusing outreach and adaptive management at a local scale. I investigated characteristics of Cattle (*Bos taurus*) depredations by Gray Wolves (*Canis lupus*) in Idaho and Montana from 1991 through 2008 to predict cattle depredation risk by a recolonizing wolf population in Washington (90 wolves in 18 packs as of December 2015). Risk models were developed at two spatial scales, (1) wolf pack territory ($n = 137$) and (2) cattle grazing allotment ($n = 69$) to test hypotheses that cattle depredations by wolves were associated with wolf demographics, cattle and wild prey abundance, allotment characteristics, and land cover types. Within wolf pack territories, cattle depredation risk increased as cattle abundance increased and if the pack depredated the previous year. Adult wolf removal showed weaker evidence in its relationship with cattle depredation probability. Similarly, cattle depredation risk increased for larger livestock grazing allotments with more cattle and wolves. Wolf pack reproduction, livestock turnout date, and percent grassland cover indicated high variability in the direction of their relationship with cattle depredation probability. Forecast maps for Washington identified hotspots of high (81 – 90%) depredation risk in Yakima, Kittitas, and Columbia counties. Cattle grazing allotments only occur east of the Cascade Range, and hotspots in Okanogan, Ferry, and Yakima counties were recognized as intermediate (61 – 80%) depredation risk. These risk models and maps provide locations to focus

depredation prevention measures and a template for future analyses as wolves continue to recolonize Washington.

Seasonal diet of Southern Resident Killer Whales. M. Bradley Hanson*, Candice K. Emmons, Michael J. Ford, Kim Parsons, Jennifer Hempelmann, *National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA 98112*; brad.hanson@noaa.gov; Donald M. Van Doornik, *Northwest Fisheries Science Center, Manchester Research Station, Manchester, WA 98353*; Gregory S. Schorr, *Marecotel, Seabeck, WA 98380*; Jeff Jacobsen, *Biowaves, Inc., McKinleyville, CA 95519*; Mark Sears, *Seattle, WA 98146*; John G. Sneva, *Washington Department of Fish and Wildlife, Olympia, WA 98501*; Robin W. Baird, *Cascadia Research Collective, Olympia, WA 98501*; Lynne Barre, *National Marine Fisheries Service, West Coast Regional Office, Seattle, WA 98115*

Southern Resident Killer Whales (*Orcinus orca*; SRKW) are an ESA-listed population that occurs primarily in the inland and coastal waters of Washington and British Columbia. Based on past dietary studies in their summer range in the inland waters of Washington and southern British Columbia, this ecotype has been found to have a specialized diet focused on almost exclusively salmon, and in particular Chinook Salmon (*Oncorhynchus tshawytscha*). We collected predation event and fecal samples from the whales during fall, winter, and spring in inland and coastal waters of U.S. and Canada. Identification of species and, for Chinook, stock, were obtained from the prey samples. Quantitative analysis of proportional prey composition from DNA in the feces both showed that Chinook continued to be an important prey item although their diet was more diverse in these seasons and areas. In Puget Sound in the fall, Chum Salmon (*O. keta*) constituted the majority of the prey samples whereas feces showed an approximately even split between Chum and Chinook. In coastal waters Chinook represented about 75% of the prey samples with nearly 25% Steelhead (*O. mykiss*). Fecal samples showed a wider variety of prey including Lingcod (*Ophiodon elongates*) and Skate (Rajidae). Chinook prey collected in California were primarily from the Central Valley, whereas samples collected off Washington were comprised of 14 different stocks, although over half originated in the Columbia River. SRKW appear to prey primarily on Chinook throughout the year from stocks spanning most of the major watersheds from the Central Valley in California to northern British Columbia.

Non-Native Mountain Goats in the Olympic Mountains: Would You Like to Meet Your Native Cousins in the Cascades? Richard B. Harris*, *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501*; Richard.harris@dfw.wa.gov; Patti Happe, *600 E Park Ave., Olympic National Park, Port Angeles, WA 98362*; patti_happe@nps.gov

Mountain Goats (*Oreamnos americanus*) were introduced in the Olympic Mountains during the 1920s prior to the establishment of Olympic National Park (ONP) and have increased in abundance and geographic distribution despite numerous transplants outside of the Olympic Peninsula (OP). National Park Service (NPS) policy favors managing for the full complement of native species and discouraging non-natives; as well, Mountain Goats in ONP damage native plants. Previous initiatives to reduce or eliminate Mountain Goats in ONP have faced logistic challenges, political opposition, or

both. Meanwhile, misunderstandings of Mountain Goat biology among state game agencies have, until recently, led to over-harvest where goats are hunted. Thus, Washington today has abundant goats where they are non-native, while many (albeit not all) native habitats are underpopulated. The NPS, working with the Washington Department of Fish and Wildlife and the USFS, are soon to release a draft Environmental Impact Statement and Plan, in which two of the four alternatives propose a possible win-win solution; OP Mountain Goats would be captured and transported to specified locations within the North Cascades where information suggests habitats are suitable but goat populations are weak. From a longer list of potential reintroduction/augmentation areas, we've identified 12 sites that we hope can form the nucleus of goat populations formed from OP animals that will, in time, interbreed with native goats. The long-term goals are demographically robust, inter-connected, genetically healthy Mountain Goats throughout the North Cascades, as well as a trajectory toward the pre-European-settlement biotic community on the OP.

Historical structure, composition, and spatial patterning of fire-maintained forests of the eastern Cascades. Richy J. Harrod*, *US Forest Service, Okanogan-Wenatchee National Forest, 215 Melody Lane, Wenatchee, WA 98801, rharrod@fs.fed.us*

The structure and composition of today's dry- and mixed-conifer forests are dramatically different as compared to the past. Prior to European settlement, high frequency, low severity fire regimes promoted open structure with large trees, particularly Ponderosa Pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). Fire burned every 6-15 years in the eastern Cascade Range acting as a natural thinning agent by burning small trees, but resulting in low overstory mortality. Tree density was low with a clumped distribution and numerous canopy gaps, and canopy layering was minimal with few fire intolerant species such as Grand Fir (*Abies grandis*). Fire exclusion, livestock grazing, and past logging practices have combined to alter forest structure in dry coniferous forests over the past century, generally increasing stand density and basal area, altering forest tree species composition, and increasing densities of smaller trees that can serve as ladder fuels. This, in turn, has increased forest susceptibility to severe wildfire, and risks of widespread insect and disease outbreaks. Specific changes to forest vegetation in the eastern Cascades will be presented.

Fire Regimes in Eastern Washington: Contrasting the Early 20th and 21st Centuries. Paul Hessburg*, *USDA-FS, PNW Research Station & the University of Washington, SEFS*

Fire was arguably the most important forest and rangeland disturbance process in the Inland Northwest US for millennia. Fire regimes ranged from high severity, with return intervals spanning 1-5 centuries, to low severity with fire-free periods lasting 1-3 decades or less. Native American burning contributed to the historical fire ecology of grass, shrub, and woodlands, and low- and mid-montane pine and mixed-conifer forests. Two centuries of settlement, management, and climatic variation have transformed fire regimes in all forest types, and their associated successional and fuel patterns. In addition, these changes, along with climatic warming, have significantly altered the patterns and severity of naturally associated insect and disease disturbance processes. In this presentation, I contrast early 20th and 21st century fire regimes and characterize their

association with specific forest types. I show how fire regimes have changed—directly aided by specific settlement and management influences, and a warming climate. I discuss two naturally occurring positive feedbacks—one occurring at the patch, the other at the landscape scale—that were previously important to maintaining fire resilience at those scales. I show how changes in patterns of forest structure and composition translate to changes in fuel loads, fire behavior, and landscape vulnerability to insect outbreaks. I close with a short discussion of the management implications of restoring landscape successional patterns as a means of restoring disturbance regimes and more typical habitat patterns and distributions.

What's good for Fish is good for Others. Alicia Higgs*, *Herrera Environmental Consultants, 2200 Sixth Avenue, Suite 1100, Seattle, WA 98121; ahiggs@herrerainc.com*

Some of the best remaining floodplain and off-channel habitat within the Yakima River watershed is located south of Ellensburg, Washington, upstream of the Yakima River Canyon. The Kittitas County Flood Control Zone District completed habitat and flood/erosion assessments within a four-mile reach in this area, and along with agency and local community member support, began work on three “early action group” projects to restore habitat. While these projects target restoration of fish habitat, habitat benefits to other aquatic and terrestrial wildlife groups will be significant, including habitat for amphibians, raptors, migratory birds, herons, woodpeckers, ungulates, and bats.

Assessing the Potential Effects of Treponeme-associated Hoof Disease on Elk Population Dynamics in Southwest Washington. Brock Hoenes*, *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; brock.hoenes@dfw.wa.gov*; Kristin Mansfield, *Washington Department of Fish and Wildlife, 2315 North Discovery Place, Spokane Valley, WA 99216; Kristin.Mansfield@dfw.wa.gov*; Ilai Keren, *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; Ilai.Keren@dfw.wa.gov*; Brooke George, Eric Holman, Nicholle Stephens, *Washington Department of Fish and Wildlife, 2108 Grand Boulevard, Vancouver, WA 98661; Brooke.George@dfw.wa.gov; Eric.Holman@dfw.wa.gov; Nicholle.Stephens @dfw.wa.gov*; Rachel Cook, *Natural Council for Air and Stream Improvement, 1401 Gekeler Lane, La Grande, OR 97850; rachierae@gmail.com*

Treponeme-associated hoof disease (TAHD) has emerged as a significant disease of Elk (*Cervus elaphus*) in southwest Washington. We initiated research in February 2015 with the primary goal of increasing our understanding of how TAHD affects Elk vital rates. The project is ongoing, so findings to date are preliminary and mostly descriptive in nature. As of January 2017, we have captured 116 individual Elk across 169 capture events and have marked 113 Elk with GPS-equipped radio-collars, of which 82 had TAHD at time of initial capture (TAHD Elk) and 31 did not (control Elk). Estimated survival rates since project initiation have been 0.52 (95% C.I. = 0.43–0.62) for TAHD Elk and 0.80 (95% C.I. = 0.64–0.96) for control Elk. We have only documented three mortality events (2 human-caused, 1 accident) for control Elk. Conversely, we have documented 34 mortality events for TAHD Elk and have preliminarily assigned a cause of mortality in 29 cases. We have preliminarily attributed 41% (n=12), 28% (n=8), and 10% (n=3) of those events to general debilitation, cougar

predation, and human harvest, respectively. Pregnancy rates have ranged 0.30–0.58 for TAHD Elk and 0.67–0.84 for control Elk. Lactation rates have ranged 0.53–0.60 for control Elk and 0.40–0.43 for TAHD Elk. Mean estimates of ingesta-free body fat in late-autumn have been greatest for non-lactating control Elk (range = 7.7–8.7%) and similar among lactating control Elk (range = 4.9–6.8%), lactating TAHD Elk (5.1–5.6%), and non-lactating TAHD Elk (range = 5.1–5.5%).

Snag Conservation Working Group: Working to Conserve Snags on Federal and Private Lands. Jeffrey M. Kozma, *Yakama Nation, Fisheries Resource Management, Timber/Fish/Wildlife, PO Box 151, Toppenish, WA 98948; kozj@yakamafish-nsn.gov*; Scott Downes*, *Washington Dept. of Fish and Wildlife, 1701 S 24th Ave., Yakima, WA 98902; Scott.Downes@dfw.wa.gov*

Several National Forest lands in eastern Washington and eastern Oregon allow the harvest of standing dead trees (snags) for firewood, provided that they do not have visible cavities. This practice is highly detrimental to woodpeckers and other cavity-nesting wildlife because the high species diversity of cavity-nesting wildlife east of the Cascade Range requires high snag densities in order to meet the denning, nesting, and foraging needs of those species. Evolving research indicates that current snag density recommendations for forest management purposes fall way short of needed densities. In addition, the falling of snags containing active woodpecker nests have been documented on US Forest Service (USFS) lands in eastern Washington. The Snag Conservation Working Group (SCWG) is a 10-member working group consisting of representatives from conservation groups, state agencies, woodcutters, and private citizens that was developed in order to address the loss of snags on Federal and private lands. This presentation will describe the ways in which 1) the SCWG will educate the public on the importance of snags and deadwood for healthy forest ecosystems, and 2) presenting alternatives to the USFS for providing firewood for woodcutters in order to protect standing snags from being cut down.

The Cascade Fisher Reintroduction Project in Washington: Progress for Years 1 and 2. Jeffrey C. Lewis*, *Washington Department of Fish and Wildlife, Olympia, WA 98501; Jeffrey.Lewis@dfw.wa.gov*; Tara Chestnut, *Mount Rainier National Park, Ashford, WA 98304; Tara_Chestnut@nps.gov*; Jason Ransom, *North Cascades National Park, Sedro Woolley, WA 98284; Jason_I_Ransom@nps.gov*; David Werntz, *Conservation Northwest, Bellingham, WA 98225; dwerntz@conservationnw.org*

Fishers (*Pekania pennanti*) are a mid-sized member of the weasel family that once occurred in the coniferous forests of Washington but were extirpated in the early and mid-1900s as a result of over-trapping, habitat loss, and predator eradication programs. To restore Fishers in Washington, our organizations have reintroduced 90 Fishers from British Columbia to Olympic National Park from 2008 to 2010, and we are now in the second year of a reintroduction project to restore Fishers to Mount Rainier National Park (MRNP), Gifford Pinchot National Forest (GPNF) and the larger South Cascade Ecosystem. In Year 1 of the project, we released 23 Fishers (11 F, 12 M; each with a radio-transmitter) at a single release site on the GPNF and we monitored their movements and survival via aerial and ground telemetry. So far in Year 2, we have released an additional 41 Fishers with radio-transmitters including 16 (8 F, 8 M) in MRNP and 25

(14 F, 11 M) in the GPNF. The Year1 cohort survival rate appears to be 78.3% (5 deaths of 23 released) and surviving individuals appear to have initiated a home range. There was no documented reproduction in Year 1, but nearly all released females were ≤ 1 -year-old and were unable or unlikely to give birth. Our goal in Years 3-5 is to release 80 Fishers in the North Cascade Ecosystem, with continuing monitoring across both restoration areas.

Monitoring Wildlife Crossings of State Highways at Bridges and Culverts. Kelly R. McAllister*, *Washington State Department of Transportation, 310 Maple Park SE, Olympia, WA 98504-7331; mcallke@wsdot.wa.gov*

The Washington Department of Transportation's (WSDOT) Fish and Wildlife Program has been using motion-triggered cameras to quantify wildlife safe crossings of state highways since 2010 and to date has deployed cameras at 68 bridges and culverts. The barrier effect of roads is well known and safe crossing opportunities mitigate the harmful effect on individual wildlife and wildlife populations. A road that is permeable to wildlife allows individuals to cross safely to meet their life needs (e.g., food, shelter and mates). Ultimately, a permeable road provides for enhanced gene flow, improved demographic dynamics and more robust populations. Understanding road permeability involves assessing wildlife interactions with the road and quantifying safe crossings. Securing cameras from theft and vandalism along busy state highways has proved challenging. However, methods of securing and disguising cameras, without compromising wildlife detection, have improved over time. The results of camera monitoring have provided WSDOT with a better understanding of the crossing conditions that are attractive to a wide range of species. Camera data also provides insights to seasonal and daily variability in each species' activity and suggest relationships to the presence of people and traffic moving on the highway. To allow comparisons of crossings data from different geographic areas or between structure types, WSDOT has developed standards for camera monitoring and data analysis that include standardized terminology and minimum monitoring periods. I will describe all aspects of WSDOT's camera monitoring in this talk.

Habitat Use, Density, and Large Prey Selection by Bobcat on the Northwest Olympic Peninsula, Washington. Rob McCoy*, Shannon Murphie, *Makah Tribal Council, 21 Ba'adah Heights, PO Box 115, Neah Bay, WA 98357; rob.mccoy@makah.com, shannon.murphie@makah.com*

We captured 21 Bobcats (*Lynx rufus*) during 2012-2014 on the northwest Olympic Peninsula in Washington. We subsequently monitored 15 Bobcats with GPS collars and used complete GPS data from 8 adult males and 4 adult females to derive a local population density estimate, examine large prey selection, and evaluate different aspects of habitat using utilization distributions and resource use functions. We evaluated landscape influence on habitat use both within the home range of the individual and at the bobcat population level. Bobcat home range size averaged 9 km² for females and 13 km² for males, and no difference was detected between the two. Bobcats were generalists in their selection of habitat at the population level, while at the individual level we observed greater use of habitat as distance to public roads increased. We estimated the Bobcat population density at 0.58/km², for a total population estimate within the study area of

263 adult resident Bobcats. We found that Bobcat diets primarily consisted of Black-tailed Deer (*Odocoileus hemionus columbianus*; 39%), Mountain Beaver (*Aplodontia rufa*; 24.4%), other small prey (24.4%) such as small birds and rodents, grouse sp. (5.1%), and snowshoe hare (*Lepus americanus*; 3.4%). Deer that were killed (versus scavenged) consisted of 14 fawns and 2 adults, were only found at kill sites of male Bobcats, and did not differ between summer and winter timeframes. The Bobcat population studied appears stable and indicative of an unexploited population. Our study provides a baseline to measure changes after Gray Wolf (*Canis lupus*) re-colonization.

Insect and Pathogen Responses to Climate Change in Forest Ecosystems. Connie Mehmel*, *Okanogan-Wenatchee National Forest, Forestry Sciences Laboratory, 1133*

Changes in climate affect the distribution and abundance of forest insects and pathogens, as well as the way these agents interact with their hosts. Pathologists refer to the “disease triangle”, consisting of a susceptible host, a virulent pathogen and a favorable environment. In a changing climate, the disease triangle will probably shift from all angles. Whether considering a pathogen or an insect, climate affects tree phenology and defenses, as well as the interaction of pathogens and insects with their own natural enemies, competitors and mutualists. Forest managers and forest health specialists are finding it increasingly difficult to predict insect outbreaks in the face of climate change. I will review the life cycles of several major forest insects and pathogens, and analyze potential changes in their interactions with host and environment under anticipated future climate scenarios.

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

From November 2015–October 2016, we surveyed for coastal Pacific Martens (*Martes caurina*) in Olympic National Forest (ONF) and Olympic National Park (ONP). We concentrated our surveys in the ONP coastal strip because coastal martens in Oregon are being documented within 1 km of the ocean, and at high elevations in ONP and ONF because that is where the two most recent records from June 2015 were located. Combining both the winter and summer survey efforts, we established a total of 193 survey stations in 97 sample units, resulting in 17,897 camera-nights of sampling effort and almost 400,000 photographs. Based on the initial assessment to confirm the presence of martens, as well as Fishers (*Pekania pennanti*), we determined that martens were

detected at only one site during the summer sampling season at high-elevation in ONP, and none were detected during the winter effort on the coast. By contrast, we detected Fishers at 44% of the stations sampled during the winter, but none in the summer. From this 2016 work, in addition to earlier efforts, we conclude that Pacific Martens appear to be very limited in distribution and at critically low numbers throughout most of their former range on the Olympic Peninsula in Washington. As a next step, we hope to employ non-invasive collection of DNA, long-lasting scent lure dispensers, and scat-sniffing dogs (*Canis lupus familiaris*), to further quantify the geographic extent and absence from this segment of its former range.

Cougar Predation and Habitat Use on the Northwest Olympic Peninsula, Washington. Shannon Murphie*, Rob McCoy, *Makah Tribal Council, 21 Ba'adah Heights, PO Box 115, Neah Bay, WA 98357; shannon.murphie@makah.com, rob.mccoy@makah.com*

We monitored Cougars (*Puma concolor*) with GPS collars to collect baseline data, and evaluate site specific predation and habitat parameters on the northwest Olympic Peninsula in Washington. We captured 17 Cougars, of which 5 adult females and 2 adult males were used to estimate prey composition, selection, and predation rates through kill site investigations and large prey availability in the study area. We looked at different aspects of habitat use and overlap among individuals using utilization distributions and resource use functions. We evaluated landscape influence on habitat use both within the home range of the individual and at the Cougar population level. We found that overall prey composition consisted of 66% Black-tailed Deer (*Odocoileus hemionus columbianus*), 16.9% Elk (*Cervus elaphus roosevelti*), and 17.1% other species, but was different between male and female Cougars. Prey selection was greater for young-of-year, for both deer and Elk, based on population availability, and predation rates were higher during the summer and for females raising young. Female Cougars had a smaller mean annual home range size compared to males, but both showed high annual home range fidelity. Population level resource use analysis showed highest use of areas had a greater percentage of 6-15 year timber stands, closer distances to perennial streams and non-public roads, further distances to publicly accessible roads and gentler slopes. Individual resource use was much more variable, with consistency only for forest stand ages 0-5 years and 6-15 years, where prey resources were more likely encountered.

Grizzly Bear Recovery Planning in the North Cascades Ecosystem. Jack Oelfke*, *North Cascades National Park Service Complex, 810 State Route 20, Sedro-Woolley, WA 98284; jack_oelfke@nps.gov*

The roughly 25,900 km² North Cascades Ecosystem (NCE) in Washington no longer includes a functional Grizzly Bear (*Ursus arctos horribilis*) population. As one of the six Recovery Zones identified for Grizzly Bear recovery when it was listed under the Endangered Species Act in 1975, recovery efforts to date within the NCE have focused on habitat evaluation, research/monitoring, food and garbage sanitation, and public education and outreach. The final critical step ahead of recovery is the public planning process, which is now in year 2 of 3 through an Environmental Impact Statement. This presentation will discuss the various options being considered for Grizzly Bear recovery

for the NCE, given the stated goal of this effort being to determine *how* to restore Grizzly Bears to this ecosystem.

◇ **Simulation and Evaluation of Dynamics Related to Population Expansion of Introduced Mountain Goats in the Olympic Mountains of Washington State.** Melissa Oscarson*, David Wallin, *Western Washington University, 516 High Street, Bellingham, WA 98225; oscarasm@wwu.edu; david.wallin@wwu.edu*

Mountain Goats (*Oreamnos americanus*) are not native to the Olympic Peninsula, but 11-12 animals were introduced between 1925 and 1929. By 1970 they had colonized the entire Olympic Range and concerns about the management of this introduced species developed as damage to alpine soil and vegetation was noted. An aerial census of the Olympic Range conducted in July 1983 estimated the Mountain Goat population at 1175 ± 171 (SE). While a series of removals reduced the population to 389 ± 106 goats in 1990, positive growth has since been noted and efforts to mitigate damage to fragile alpine ecosystems have been revived. We sought to adapt and parameterize an existing population model for use with Mountain Goats. All modeling work was conducted in CDPOP; a simulation program that uses individual-based movement (including dispersal), reproduction, and mortality to predict the influence of landscape heterogeneity on population dynamics and genetic exchange. Population parameters for the model were derived from published literature. We validated the model by successfully simulating the population trajectory for Olympic Mountain Goats from establishment through the first census. Our modeled population closely tracks observed population dynamics and anecdotal reports of dispersal. This model could be utilized to inform current management decisions regarding the impact of removals from the current Olympic mountain goat population and proposals to use these animals to augment dwindling native populations in the Cascade Mountain Range.

◇ **Prey Availability for Reintroduced Fishers in the South Cascades of Washington.** Mitchell Parsons*; Laura Prugh; *School of Environmental and Forest Sciences, University of Washington, 4000 15th Ave NE, Seattle, WA 98195; pars2997@uw.edu; lprugh@uw.edu*

We used mark recapture and sign surveys to estimate abundance of small mammals, squirrels and Snowshoe Hares (*Lepus americanus*) at 10 sites in Gifford Pinchot National Forest in 2016. Our goal was to estimate prey availability for reintroduced Fishers (*Pekania pennanti*) in the south Cascades. We stratified our sampling by forest age in order to assess how management history influences prey availability for Fishers. Preliminary analyses suggest prey availability is influenced by woody debris, understory cover and basal area but not stand age. This indicates that methods of timber harvest that maintain these characteristics may be more influential than timing of timber harvest for Fisher prey. We will be returning to the field in summer 2017 to sample more locations, including sites on land managed by National Park Service, Department of Natural Resources and potentially private timber companies. This will allow for improved analysis and conclusions regarding land management and prey availability for Fishers in the south Cascades.

◇ Predator Species Identification from Saliva at Kill Sites with Limited Remains.

Laurel Peelle*, Aaron Wirsing, *University of Washington, School of Environmental and Forest Sciences, Box 352100, 3715 West Stevens Way NE, Seattle, WA 98195; laurelp@uw.edu*

Kill site investigations can yield valuable data about elusive predators and predator-prey interactions, provided that the predator species can be definitively identified as the one responsible for the predation event. The traditional method of visually analyzing prey remains to identify predators is prone to observer bias and may be particularly challenging when few remains are present or in systems with congeneric predators. Scat near a kill site may be difficult to reliably link to the responsible predator, and snow-tracking requires adequate substrate conditions. Swabbing for predator DNA from saliva is an objective yet underutilized method that has primarily been applied to larger carcasses. Our study demonstrates the usefulness of a saliva-swabbing method on limited remains. This is also the first study to compare saliva-swabbing success by sample type (carcass remains versus radio-collar). We employed forensic techniques to increase certainty about predator species identification at Snowshoe Hare (*Lepus americanus*) kill sites. Foam swab samples were preserved at room temperature and later tested for mtDNA using species-specific primers. This saliva-swabbing method yielded objective predator species identification for the majority (58.5%) of sampled kill sites ($N=31/53$) and contributed more predator identifications throughout the year than snow-tracking. Not only were minimal remains often able to yield predator DNA, but saliva swabs from radio-collars provided significantly more predator species identifications (4.04 OR). The expansion of saliva-swabbing methods to smaller prey, radio-collars, and limited remains allows for more definitive predator identifications at kill sites, thus improving our ability to understand species interactions and manage for wildlife.

American Tree Farm Program for Small Landowners. Tammie Perreault*, *Washington Tree Farm Program, P.O. Box 1814, Olympia, WA 98407; chair@wtree.org*

The Washington State Tree Farm Program offers a voluntary certification program that ensures healthy privately-owned forestlands that contribute to our state's clean water, wildlife habitat and recreational opportunities, while producing the jobs, wood and timber products we all need. Tree Farm Certification is for private forest landowners who own 4-4050 ha of managed forests that meet on-site inspection standards for sustainable forest management. There are over 900 Certified Tree Farms in Washington State managing over 161,000 ha.

Forest Restoration Projects and the Carlton Complex – Lessons Learned. David W. Peterson*, *USDA Forest Service, Pacific Northwest Research Station, 1133 N. Western Avenue, Wenatchee, WA 98801; davepeterson@fs.fed.us*

Dry forest restoration treatments have been applied in dry coniferous forests of western North America to improve forest health and make forests more resilient to wildfires. Recent studies have demonstrated that restoration treatments, particularly those that involved prescribed burning, have been effective at mitigating wildfire behavior and effects. However, there are almost certainly fire weather thresholds beyond which restoration treatments are rendered ineffective. Beyond greater tree survival, restoration treatments may improve post-fire soil stability and recovery of understory vegetation by

facilitating the establishment and persistence of fire-tolerant woody and herbaceous plant species that can rapidly re-sprout following fire, provide soil cover, and compete with exotic plant species. The 2014 Carlton Complex was the largest wildfire event in Washington State history, and much of the fire area burned under extreme weather conditions with explosive fire growth. Because the Carlton Complex burned over many recent fuel treatments, it offered an opportunity to evaluate if and how restoration treatments mitigated fire severity in this extreme wildfire event. Here, we report results from the first two years of a research project investigating restoration treatments effects on fire severity during the Carlton Fire and the combined effects of restoration treatments and fire severity on post-fire understory vegetation cover and biodiversity.

Eastside Forest Management: Follow the Money. Mark Rasmussen*, *Mason, Bruce & Girard, 707 SW Washington #1300, Portland OR, 97205*

Large-scale active management of forested landscapes can be achieved through commercial timber operations. Successful projects reflect an understanding of the business systems that provide the labor and capital. We build a basic model of an eastside forest management project and show how revenues, costs and labor flow through the system. We identify how markets and other uncertainties might affect project viability.

Update on the USDA Wildlife Services Wildlife Damage Management Program in Washington State. Laurence M. Schafer*, *USDA Wildlife Services, 720 O'Leary St NW, Olympia, WA 98502; laurence.m.schafer@aphis.usda.gov*

Wildlife cause damage to private and public property, other wildlife, habitats, agricultural crops, livestock, forests, and human structures. Some threaten human health and safety or are a nuisance. Prevention or control of wildlife damage, which often includes removal of the animals, is an essential and responsible part of wildlife management (TWS Standing Position on wildlife damage management). The mission of USDA Wildlife Services (WS) is to provide federal leadership and expertise to resolve wildlife conflicts and allow people and wildlife to coexist by managing damage caused by wildlife. WS is authorized to protect agriculture, natural resources, and human health and safety. WS does not manage lands and has no regulatory authority. WS has the only wildlife damage management research center in the world, totally devoted to developing new methods to resolve wildlife conflicts, with substantial emphasis on effective nonlethal methods. WS is supported by every U.S. natural resource and professional wildlife management organization. WS in WA conducts: predator control (protecting livestock, ESA-listed/candidate salmonids and birds); invasive species management; human health and safety protection (predators killing pets in cities, reducing bird strikes at airports, threats from disease, and flooding/road erosion from aquatic mammals); natural resources protection (reducing flooding and wetland degradation from aquatic mammals); and reducing conflicts with nuisance species (resident Canada Geese [*Branta canadensis*] damaging localized urban areas and European Starlings [*Sturnus vulgaris*] preferentially consuming high value livestock feed and fruits).

Asian Demand for prime Douglas-fir and Western Hemlock. William Schlosser*, *Lewis-Clark State College, TJH 204 Lewiston, ID 83501; weschlosser@lsc.edu*

Utilizing domestic marketing data, prediction models will be presented discussing the demand, values and sorts for prime logs of Douglas-fir (*Pseudotsuga menziesii*) and Western Hemlock (*Tsuga heterophylla*) in Asian markets. Chinese buyers are acutely attuned to prices of domestic logs and seek the sweet spot for their supply.

Variable Density Thinning and Thinning for Wildlife Habitat on National Forests.

Kevin Senderak*, *US Forest Service, 10024 US Highway 12, Randle, WA 98377*;
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Variable density thinning prescriptions are designed to hasten the development of late-successional forest structure to provide habitat in the future for those species dependent upon such. While not a new silvicultural technique, variable density thinning continues to present implementation challenges where there is a need to prepare immature, simplistic forest stands for transition to old-growth forests with large trees, multi-layered canopies and openings with diverse understories. In practice, tree marking methods such as Designation by Description and Designation by Prescription are utilized with varying degrees of practicality while striving to accelerate development of complex stand structure and species diversity. Application of prescriptions are further complicated by root disease presence, sensitive species, big game forage desires, generous riparian buffers and the establishment, and protection of understory species.

Wildlife and Climate Change: A Vulnerability Assessment for South-central Oregon. Peter H. Singleton*, *Pacific Northwest Research Station, USDA Forest Service, 1133 N. Western Ave., Wenatchee, WA 98801*; psingleton@fs.fed.us

Wildlife populations are responding to climate change in a variety of ways including changes in distribution, changes in behavior, and evolutionary adaptation. Ongoing ecosystem responses to climate change will produce complex biotic interactions that will impact animal populations by altering food availability, predator-prey dynamics, and availability of key habitat features including nesting or resting structures. Understanding the ways in which wildlife populations are vulnerable to climate change effects, understanding how climate effects interact with other stressors, identifying management strategies that promote resilience of habitats and populations, and providing opportunities for species to adapt in a rapidly changing environment are core challenges for land managers. We assessed the vulnerability of wildlife associated with eight focal habitats in south-central Oregon. For each focal habitat, we identified characteristic wildlife species, habitat features, exposure, sensitivity, adaptive capacity, non-climate stressors, and potential adaptation measures. High elevation cold habitats (cold forests, woodlands, and meadows) had very high exposure and sensitivity to climate change impacts, and limited adaptive capacity. The total area capable of supporting mid-elevation forest types was projected to either expand (for mid-elevation temperate conifer forest) or remain about the same (for dry conifer forest), however changes in disturbance regimes may substantially change habitat structure. Riparian, wetland, open water, and cold moving water habitats will be impacted by changes in hydrology, particularly the loss of high elevation snowpack, changes in seasonal water flow, and more frequent and intense winter floods.

◇ **Wolf Predation in Livestock Occupied Areas of Washington State.** Gabriel Spence*, Robert Wielgus, *Large Carnivore Conservation Lab, Washington State University, PO Box 642812, Pullman, WA 99164; gabriel.spence@wsu.edu; wielgus@wsu.edu*

To determine the extent of depredation on livestock by Gray Wolves (*Canis lupus*), we documented kills found at clusters of locations from GPS collared wolves in five packs that overlapped grazing areas of Cattle (*Bos taurus*) or Sheep (*Ovis aries*) for three grazing seasons in 2014, 2015, and 2016. We located 439 kills at cluster locations; 6% of the kills were livestock and 94% were wild prey. Of the wild prey, Mule Deer (*Odocoileus hemionus*) and White-tailed Deer (*Odocoileus virginianus*) were the most common prey at 50%, followed by Moose (*Alces alces*) at 27%, and Elk (*Cervus elaphus*) at 9%. At the pack level, livestock made up between 0% and 67% of the kills located, however nine out of the 15 pack years had no livestock kills, and three pack years had less than 5% livestock kills. Variation in proportion of livestock kills per pack may have to do with the number of livestock available in a wolf pack territory, animal husbandry practices, and location of wolf and livestock core areas. Kill rate varied considerably among packs. Mean kill rate for all packs for all prey types was 0.23 kills/pack/day (95% C.I. 0.044), or about 43 kills (95% C.I. 35-52 kills) for the 184-day long summer season. Variance in kill rates may be due to pack size, type of prey available, individual differences among collared wolves, and collar fix success.

Eelgrass, Dikes, and Waterfowl Management. Kyle Spragens*, *Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501; Kyle.Spragens@dfw.wa.gov*

Wetlands throughout Washington sustain not only local breeding populations of dabbling, diving and sea ducks, but also provide critical winter and migration habitats for migratory birds that breed in Alaska, western Canada, and even Russia. Over 35 species and subspecies of ducks, geese, and swans depend on Washington wetlands, which span a rich diversity of ecosystems including alluvial oxbows, beaver ponds, coastal estuaries, desert potholes, lakes and sloughs. Much of the wetland habitat has been altered from its natural state. These altered wetland habitats have typically isolated one wetland type of a dynamic system, and management actions have promoted maintenance of that type. However, in ecological terms, the ecotone that has been altered is likely more valuable than either one of the habitats isolated. Waterfowl species composition in particular habitats is the ecological response to cope with this gradient, and abundance or density per unit area is linked to the bioenergetic relationship that a particular habitat is able to support. Often neglected in these discussions is the ecological role and importance of coastal wetlands of the Pacific Northwest. These dynamic wetlands are some of the most northern latitude wintering habitats for dabbling duck species, the most diverse winter water habitats for diving and sea duck species, but also provide critical habitat, on a flyway-scale, as a migration staging area for millions of waterfowl that rely upon seasonal pulse food sources rich in protein that directly link to reproductive responses across waterfowl species.

SFI Forest Certification. Julie Stangell*, *Stangell Consulting, LLC, North Bend, WA 98045; julie.stangell@comcast.net*

The Sustainable Forestry Initiative (SFI®) 2015-2019 Forest Management Standard provides a framework for managing wildlife habitat in Objective 4, Conservation of Biological Diversity. The standard encourages stand- and landscape-level measures that promote a diversity of types of habitat and successional stages. The standard promotes conservation of plants and animals including aquatic species and, threatened and endangered species. Biodiversity is promoted through conservation of Forests with Exceptional Conservation Value, old growth forests and ecologically important sites. Forest certification has been around for about 20 years. Has forest management changed due to certification over that time span? Certification to SFI is voluntary and requires annual verification by a third-party auditor. Does it make sense to certify in a regulatory environment? The SFI Standard is updated every 5 years. Are there changes/ updates that need to be made in the standard? Requirements related to management of wildlife habitat as well as these questions will be discussed.

Western Gray Squirrel Resource Selection Related to Fire Fuel Management in the North Cascades. Kathryn Stuart*, *Science Group, School of Environmental and Forest Sciences, University of Washington, Box 352100, Seattle, WA 98195; kshipe@uw.edu;* W. Matthew Vander Haegen, *Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501; Matt.VanderHaegen@dfw.wa.gov;* Kurt Jenkins, *USGS-Forest and Rangeland Ecosystem Science Center, Olympic Field Station, Port Angeles, WA 98362; kurt_jenkins@usgs.gov;* Ilai Keren, *600 Capitol Way N, Olympia, WA 98501; Ilai.Keren@dfw.wa.gov;* Stephen D. West, *Wildlife Science Group, School of Environmental and Forest Sciences, University of Washington, Box 352100, Seattle, WA 98195; sdwest@uw.edu*

One of three population isolates of the Washington state-threatened Western Gray Squirrel (*Sciurus griseus*) occurs in the North Cascades, where long-term fire suppression has increased the risk of catastrophic wildfire. Land management agencies in this region have initiated fire fuel reduction programs that alter squirrel habitat and may affect their populations. From April 2008 to September 2011 we investigated resource selection of 38 radio-collared Western Gray Squirrels at two study sites in the North Cascades following fire fuel management. We developed conditional logistic models to examine resource selection at three spatial scales: nest trees, nest sites, and core areas within home ranges. The odds of a squirrel selecting a tree for nesting increased with dwarf mistletoe (*Arceuthobium* spp.) infection, a greater number of surrounding trees with interlocking branches, and greater diameter at breast height. Squirrels selected nest sites that had greater canopy cover, connectivity and presence of dwarf mistletoe than available unused sites. Core use areas had greater canopy cover, a mix of tree species and trees with higher live crowns compared to low use areas. Our results suggest that fire fuel treatments may negatively affect Western Gray Squirrels across all spatial scales, as most variables that were positively related to habitat selection are specifically targeted for reduction in fire fuel management plans. Future treatments that retain patches of mixed conifer/deciduous forest containing large trees with some mistletoe infection, and moderate levels of canopy cover and connectivity would conserve key elements of Western Gray Squirrel habitat in the North Cascades.

North American Market Update – Pacific Northwest Opportunities/Challenges. Joel Swanton*, *Western North America, Forest2Market, Kennewick, WA;*
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Review of the fundamental drivers for the North American forest industry, national and global factors that influence the Pacific Northwest, and implications for the region's industry, land owners and resource managers.

Washington State Sage-grouse Initiative 2.0 Update: 2010 – 2017. Julie Unfried*, H. E. Dowling, M. G. Brown, *Pheasants Forever, Inc., 1783 Buerkle Circle, St. Paul, MN 55110;* *junfried@pheasantsforever.org; ldowling@pheasantsforever.org, mbrown@pheasantsforever.org, D. C. Bachman, Natural Resource Conservation Service, 316 W. Boone Ave., Suite 450, Spokane, WA 99201;*
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Over the last seven years, NRCS has worked with partner organizations and private landowners to sign 73 Sage-grouse Initiative (SGI) contracts through various programs effecting 29,460 ha of habitat for Greater Sage-grouse (*Centrocercus urophasianus*) on rangelands throughout Washington State. Seventy-five percent of funding through SGI is focused on core areas around leks, known as Priority Areas for Conservation. Expanding on SGI's core mission to provide conservation through sustainable ranching, SGI in Washington will launch a cropland program in 2017 to provide financial assistance for cropland producers to convert marginal croplands into wildlife habitat.

Preliminary Results of a Radio-Marked Female Mule Deer Survival Study in Population Management Unit 33, Ellensburg to Yakima.

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The Muckleshoot Indian Tribe has radio-marked 186 female Mule Deer (*Odocoileus hemonius*) in Population Management Unit 33 since January 2013 to document survival, causes of mortality, pregnancy rates, and movement patterns. Mule Deer have declined and state hunting of female deer in this area has been closed since 2007. Cougar (*Puma concolor*) have been the primary cause of mortality of radio-marked deer; however, winterkill was substantial during 2015-2016 demonstrating the need for long-term studies, and complicating management options.

Dynamics of an Insular Population of Western Gray Squirrels. Matthew Vander Haegen*, Gene R. Orth, *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501;* *matt.vanderhaegen@dfw.wa.gov;* Aaron N. Johnston, *School of Environmental and Forest Sciences, University of Washington, Box 352100, Seattle, WA 98195;* ajohnston@usgs.gov

Habitat loss and fragmentation can have detrimental effects on wildlife populations and where pervasive can create population isolates that may experience reduced genetic diversity and lower persistence. Diseases that cause epizootics also can reduce wildlife populations and may have disproportionate effects on small populations.

From 2007-2012, we studied survival and reproduction of radio-marked Western Gray Squirrels (*Sciurus griseus*), a state-threatened species, on Joint Base Lewis-McChord in the southern Puget Trough of Washington. Adult survival was similar to that measured in more extensive squirrel populations but was strongly affected by an endemic disease with high epizootic potential. Most females attempted to breed each year ($\bar{x} = 90 \pm 5\%$ [SE]; $n = 73$) and annual production averaged 2.1 ± 0.22 (SE) young/breeding female ($n=39$); significantly lower than that in a more extensive population in south-central Washington. Population growth rate estimated using a stochastic model was 1.11 and simulations that increased or decreased vital rates revealed a population sensitive to small changes in survival and proportion of females successfully rearing young. Low productivity is consistent with inbreeding effects and the population may need periodic augmentation to maintain genetic diversity. We recommend that this small, isolated population be monitored regularly for indications of decline in number or occupancy. Increasing suitable habitat and maintaining connectivity between currently occupied range and potential habitat in the surrounding landscape will be crucial to the long-term viability of this population, but will be challenging in the urbanizing landscape of the Puget Trough.

Scavenging as a Food Acquisition Strategy by Peregrine Falcons during the Nonbreeding Season in Coastal Washington. Daniel E. Varland*, *Coastal Raptors, 90 Westview Drive, Hoquiam, WA 98550; danvarland@coastalraptors.org*; Joseph B. Buchanan, *Cascadia Research Collective, 218½ West Fourth Avenue, Suite 201, Olympia, WA 98501; jlrj@comcast.net*; and Tracy L. Fleming, *2516 NE 148th Street, Vancouver, WA 98686; Tlfleming@aol.com*

Although best known for capturing avian and other prey, five of the six North American falcon species are documented facultative scavengers. We observed Peregrine Falcons (*Falco peregrinus*) during 1,109 vehicle year-round surveys of three coastal beaches in Washington between 1983 and 2015. Beginning in 1995, we captured and color banded 192 Peregrines for individual identification. During the study, we made 200 observations of Peregrines hunting and 166 observations of feeding. Excluding records of Peregrine Falcons with food items of unknown origin ($n = 40$), we observed falcons with food items 171 times, including prey that we concluded the falcons had captured ($n = 77$), followed by carrion-feeding ($n = 49$), and prey that we saw being captured ($n = 45$). Carrion-feeding represented 28.6% of our observations involving Peregrine Falcons with food items in these three categories and food items were represented by 20 taxa. Seabirds and waterbirds were the most common food items consumed as carrion (44 of 49 items; 89.8%), whereas other captured or targeted prey were most often shorebirds or other small birds (204 of 277 items; 73.6%). We saw scavenging on ≥ 1 occasion by 21 color-banded individuals from < 1 yr. to 4 yr. of age. We observed more scavenging by immature falcons and detected no difference in the occurrence of scavenging by season.

Alternatives to Toxic Lead Bullets in Hunting Big Game. William O. Vogel*, *U.S. Fish and Wildlife Service, 510 Desmond Drive SE, Lacey, WA 98503; bill_vogel@fws.gov*

This presentation will focus on my personal experiences as a biologist and a hunter and do not in any way reflect any position held by my employer. I appreciate and support the national position of The Wildlife Society (TWS) on this topic and strive to

help with the intent of that policy position. The TWS policy encourages using outreach and education instead of regulations to facilitate a change. I hope to introduce the audience to the issue and to share what I have learned in the last 10 years. This presentation will cover the pros and cons of switching from lead to alternative bullets, encourage you and others to switch, encourage you to address this issue with the hunting and conservation communities, and will provide ideas about talking to hunters and others about this important and sensitive topic. The primary reasons for changing are to reduce secondary poisoning of raptors and scavengers, to reduce the potential for human consumption of lead from fragmented bullets, and to improve the effectiveness of bullets so that hunters are better able to retrieve wounded game. Copper bullets have proven to be an excellent alternative to lead bullets with regard to hunting.

Tree Growth and Stand Development. William O. Vogel*, *U.S. Fish and Wildlife Service, 510 Desmond Drive SE, Lacey, WA 98503; bill_vogel@fws.gov*

This presentation will focus on the basics of tree growth and physiological priorities, and how those principles relate to stand development. We will discuss different aspects of tree growth as influenced by site quality and stand density. The focus of this presentation will be to give the audience a common understanding of basic silvicultural principles and terms so that the remaining session will be easier to understand, especially for wildlife students and professionals that are new to the field of forestry.

◇ **Black Bear Population Density in the North Cascades: Habitat and Human Influences.** Lindsay Welfelt*, *Washington State University, PO Box 641020, Pullman, WA 99164; lindsay.welfelt@wsu.edu*; Richard Beausoleil, *3515 State Highway 97A, Wenatchee, WA 98801; richard.beausoleil@dfw.wa.gov*; Robert Wielgus, *Washington State University, PO Box 641020, Pullman, WA 99164; wielgus@wsu.edu*

Density and habitat quality are frequently considered interchangeable in terms of wildlife populations, whereby more individuals are expected to occupy higher quality habitats. Because density estimates of wildlife are often used to formulate management goals and objectives, understanding the relationship between a species' habitat and relative abundance is an important strategy for effective management. Throughout Washington, Black Bears (*Ursus americanus*) are projected to occur at an average of 39 bears/100 km² in western Washington and an average of 18 bears/100 km² in eastern Washington based on estimates generated in the 1970's. We used spatially-explicit capture-recapture methods to estimate the density of Black Bears in a range of habitats on the east and west slopes of the Cascades from 2013-2016. Density results were spatially variable, but habitat-density relationships were not consistent with current agency estimates. We present these findings and discuss the importance of more rigorous monitoring and a better understanding of how a combination of habitat and human factors might influence density.

Resource Competition and Apparent Competition in Declining Mule Deer. Robert Wielgus*, *Large Carnivore Conservation Lab, Washington State University, PO Box 642812, Pullman, WA 99164; wielgus@wsu.edu*

Resource competition and apparent competition have both been suggested as the cause of Mule Deer (*Odocoileus hemionus*) declines concurrent with White-tailed Deer

(*Odocoileus virginianus*) increases. I tested for both hypotheses by conducting a “press” and “release” experiment in a Mule Deer, White-tailed Deer, and Cougar (*Puma concolor*) community. If resource competition is causal, predation should decrease – but other sources of mortality should increase following increased mortality of Cougars and release of White-tailed Deer. If apparent competition is causal, predation should decrease and Mule Deer should increase following increased mortality of Cougars and release of White-tailed Deer. I accepted the apparent competition hypothesis because high mortality of female Cougars and Cougar population decline was associated with both White-tailed Deer and Mule Deer population growth. However, high mortality of male Cougars (with increased male immigration) appeared to result in sexually segregated prey-switching by females with cubs from abundant White-tailed Deer to rare Mule Deer to avoid sexually selected infanticide. High mortality of resident male Cougars may have precipitated the Mule Deer decline in the first place.

◇ **A Simple, Web-based Tool to Monitor Spring Waterfowl Migration in the Channeled Scablands of Eastern Washington.** Luke Wilde*, *Department of Biology Gonzaga University, MSC 1355 502 E. Boone Ave., Spokane, WA 99258;* lukewilde95@gmail.com; Matthew Wilson, *Species and Ecosystem Science, 1111 Washington St. Southeast, Olympia, WA 98501;* Matthew.Wilson@dfw.wa.gov; Tina Blewett, *Ducks Unlimited Inc., 8305 N Valerie St, Spokane, WA 99208;* tblewett@ducks.org; Mike Rule, *Turnbull National Wildlife Refuge, 26010 S. Smith Rd, Cheney, WA 99004;* mike_rule@fws.gov; Stephen Hayes, *Department of Biology Gonzaga University, AD Box 005 502 E. Boone Ave., Spokane, WA 99258;* hayes@gonzaga.edu

Monitoring the timing of spring waterfowl migration and the abundance and distribution of species is critical to their conservation and management. If critical stopover sites can be identified and characterized during spring migration, managers can develop specific conservation strategies for those areas in real time. In Spring 2016, Washington Department of Fish and Wildlife and multiple Washington waterfowl organizations began conducting extensive ground surveys within six areas of the Channeled Scablands in eastern Washington. Birds were surveyed 11 times, from February to late April, along defined driving routes or individual wetland locations. Total counts of waterfowl, by species, were summarized for each sub-area in the route, generating extensive data sets for each observation date. We used R and R Shiny to develop a web-based tool that biologists and stakeholders can use to explore spring waterfowl migration across time and space. The tool is available from any Internet browser and allows the user to interactively visualize waterfowl abundance within user-specified date ranges on a variety of interactive maps of the Channeled Scablands. The tool provides biologists with a standardized data entry protocol, generates abundance summaries by species, and can be maintained to provide rapid exploratory analysis while migration is underway.

East Meets West: Ecological Forestry Approach to Mitigate Wildfire Hazards and Restore Habitat for the Reintroduction of the Northern Bobwhite. Robert R. Williams*, *Pine Creek Forestry, LLC, 1405 Chews Landing Road, Suite 31, Laurel Springs, NJ 08021;* bob@pinecreekforestry.com

We have reintroduced commercial forestry to the Pinelands National Reserve (PNR) based upon the ecological approach of Franklin and Johnson. After 15 years, the results have allowed Tall Timbers Research Station, etc. along with New Jersey Audubon to reintroduce wild Northern Bobwhite (*Colinus virginianus*) from Georgia to PNR in southern New Jersey. This species was last known to be in the Reserve more than 30 years ago. The issues of wildfire, fire suppression and wildlife restoration are similar across the nation in many pine ecosystems. My background of work in forestry of 12 years in Washington State gives me a unique perspective nationally as I have managed pine forests in southern New Jersey for the past 25 years.

◇ **Evaluating Tradeoffs in Risks Perceived by Foraging Herbivores.** Meghan J. Camp*, Lisa A. Shipley, *Washington State University, Pullman, WA 99163*; Jennifer Sorenson Forbey, *Boise State University, Boise, ID 83725*; Janet L. Rachlow, Timothy. R. Johnson, *University of Idaho, Moscow, ID 83844*

When selecting foraging patches, herbivores are faced with multiple risks imposed by their environment such as the risk of consuming food that does not meet their daily energy requirements, the risk of toxicity from plant secondary compounds, and the risk of predation. Because these risks operate simultaneously, animals must make tradeoffs between them when selecting foraging patches. To better understand how animals trade off food and predation risks, we manipulated both in a series of experiments with Pygmy Rabbits (*Brachylagus idahoensis*) and Mountain Cottontail Rabbits (*Sylvilagus nuttallii*), which differ in their size, ability to digest fiber and detoxify toxins, and use of burrows. In these experiments, rabbits were given a choice between two foraging patches that varied in the amount of fiber, toxins, level of exposure to predators, and distance from a burrow. Using the method of paired comparisons, we estimated and compared relative risks and tradeoffs both within and between species. Fiber, toxins, exposure to predators, and distance from a burrow all increased the risk of patches for Pygmy Rabbits, whereas only fiber and toxins did so for cottontails. In addition, the relative risk of toxins was lower, and the relative risk of distance was higher for Pygmy Rabbits than cottontails. Pygmy Rabbits traded off food quality for safety whereas cottontails traded off safety for food quality. This study provides a functional understanding of how the quality of food and predation risk influence habitat use by these rabbits, advancing our ability to assess habitat quality for mammals across landscapes.

◇ **Do Recolonizing Wolves Impact Deer Hunter Success?** Apryle D. Craig*, Zachary Szablewski, Aaron Wirsing, *University of Washington, 110 Winkenwerder Hall, 4000 15th Avenue NE, Seattle, WA 98195-2100*; apryle@uw.edu

Deer hunting serves as a popular activity, generates income for state agencies through license sales, and supports thousands of jobs involved in the manufacture or sale of hunting and outdoor products and services. The recolonization by Gray Wolves (*Canis lupus*) in the western United States may impact hunter harvest of deer (*Odocoileus* spp.), the main prey of wolves in Washington. We used harvest data from the Washington Department of Fish and Game to calculate harvest success as the number of deer harvested per hunter per day per square kilometer. We explored trends in deer harvest success in game management units (GMUs) before and after wolf recolonization and in nearby GMUs that remained uncolonized. Our preliminary results suggest that wolf recolonization had no impact on deer harvest success and harvest success has generally increased from 2000 to present. Future analyses will include Elk (*Cervus elaphus*) harvest success in Washington and deer and Elk harvest success in Oregon, Idaho, Montana, and Wyoming. These analyses may inform hunting regulations and wolf management.

◇ **Do Greater Sage-Grouse Movements Influence Survival on the Yakima Training Center, Washington, USA.** Kyle Ebenhoch*, *523 Heald Hall, Pullman, WA 99164*; kyle.ebenhoch@wsu.edu

The Greater Sage-grouse (*Centrocercus urophasianus*) has experienced a steady decline in numbers and subsequently a loss of genetic heterogeneity, which has led to its current listing as a state-threatened species in Washington. It is often assumed that as a species movement increases over a period of time, their probability of survival decreases. These individuals are

likely expending more energy and disproportionately exposing themselves to predation which thereby reduces their likelihood of surviving that interval. To test this hypothesis as it relates to sage-grouse, I examined interseasonal and daily movement rates of approximately 175 radio-collared individuals on the Yakima Training Center in Yakima, WA, USA from 1999-2016. I modeled both movement metrics separately and then analyzed how they, and other predictors, influenced survival over time. This research will examine how sage-grouse movements vary over time (daily and seasonal) and whether these are contributing to a decreased probability of survival and potentially the population growth rate.

Blood Parasites in a Pacific Northwest Woodpecker Community. Tierra C. Groff, Ravinder N. M. Sehgal, *Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132; tierrag2@gmail.com*; Teresa J. Lorenz*, *Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512*

Blood parasites have been studied in many wild bird populations throughout the world but no basic prevalence studies have been done on woodpeckers in the Pacific Northwest. In 2016 we began a study examining the prevalence of haematozoan parasites in woodpeckers in eastern Washington focusing on the White-headed Woodpecker (*Picoides albolarvatus*), Black-backed Woodpecker (*P. arcticus*), and American Three-toed Woodpecker (*P. dorsalis*). For samples collected during a pilot study in 2016 ($n = 27$), we found evidence of infections in five individuals, all of them captured at our Rimrock Lake study site (Wenatchee National Forest; approximately 46° 40' 16" N, 121° 06' 14" W). With DNA sequencing we also confirmed that a *Haemoproteus* infection was responsible for the death of one juvenile White-headed Woodpecker from our Rimrock Lake study site in 2015. We found no evidence of blood parasites for woodpeckers sampled in the nearby Rattlesnake Creek study site ($n = 12$; approximately 46° 47' 12" N, 121° 04' 49" W), although sample sizes are too small to assess whether parasite infections vary by study site. Analysis of tissue samples is ongoing and sampling will continue in 2017. This project will shed light on the biotic and abiotic factors affecting the prevalence and distribution of haemosporidian parasites in woodpeckers in eastern Washington.

Prey Use and Parental Care at Golden Eagle Nests in Western Washington Timberlands. Leif Hansen*, *Sierra Pacific Industries, 3115 Kuper Road, Centralia, WA 98531; lhansen@spi-ind.com*

I used direct observation to monitor prey use and parental care at four Golden Eagle (*Aquila chrysaetos*) nests located on an industrial tree farm in the southwest foothills of the Cascade Range during two breeding seasons in 2015-2016. I tested the hypothesis that the increasing difficulty of processing larger or avian prey confines female parents to the nest longer in the nestling period and limits foraging by the female, which has been observed in Golden Eagle populations using larger mammals and avian prey. I watched nests from blinds weekly for 10-hour periods during the breeding season, and recorded prey deliveries to the nest as well as bouts of incubation, sheltering, and feeding by parents. Mountain Beavers (*Aplodontia rufa*) accounted for over 70 percent of prey items delivered to nests. Female parents primarily incubated, sheltered, and fed offspring in the nest, but were occasionally relieved from these duties by males. Males provided the majority of prey to the nest (87.7 percent of observed prey deliveries). The amount of prey delivered by females did not increase after nestlings gained independence in thermoregulation and partitioning prey. These results suggest that factors

beyond the difficulty of processing prey (such the ecology of the primary prey species) influence the behavior of female Golden Eagles during the nesting season.

◇ **Habitat Use by Columbian White-tailed Deer along the Lower Columbia River.** Jon Heale*, Lisa Shipley, Dan Thornton, *Washington State University, Pullman, WA 99164;* *jonathon.heale@wsu.edu; shipley@wsu.edu; daniel.thornton@wsu.edu;* Paul Meyers, *US Fish and Wildlife Service, PO Box 566, Cathlamet, WA 98612; paul_meyers@usfws.gov*

In 2013, an imminent dike failure along the Columbia River threatened the Julia Butler Hansen Refuge (JBH) in Cathlamet, Washington. Subsequently, the US Fish and Wildlife Service translocated 88 Columbian White-tailed Deer (*Odocoileus virginianus leucurus*) from JBH and surrounding areas to Ridgefield National Wildlife Refuge (RNWR). Both Refuges employ mowing, cattle grazing, and haying as part of their management scheme. Therefore, habitat use and availability is likely irregularly distributed across various spatial and temporal scales. We hypothesized that deer select areas that are close to cover or riparian habitat, while avoiding areas that have been mowed, grazed, or hayed. We also hypothesized that resident deer are selecting habitat with available cover more strongly than translocated deer. To test this, we examined GPS data from collars that were placed on resident (JBH) and translocated (RNWR) deer, overlaid them on habitat maps, and modeled habitat selection using a resource selection function. Preliminary results indicate that deer select areas with more cover. These results suggest potential approaches for enhancing vegetation at RNWR and JBH that will assist in the recovery of this federally-listed distinct population segment.

◇ **Assessing Connectivity Improvements across an Interstate Highway by Testing Use of Habitat Features by Small Mammals.** Lindsay Millward*, Kristina Ernest, *Central Washington University, 400 E University Way, Ellensburg, WA 98926;* *lindsay.millward@cwu.edu; ErnestK@cwu.edu*

Dispersal is vital for maintaining genetic variability in populations, allowing for colonization of habitats, and supporting functioning food webs. Increasing human population size and mobility via transportation corridors have fractured ecosystems and reduced organism movement globally. Interstate-90 (I-90), bisecting the Cascade Range of Washington State, is undergoing expansion as part of the I-90 Snoqualmie Pass East Project. Washington State Department of Transportation (WSDOT) has planned to build wildlife crossing structures (WCS) to address the effects on wildlife of increased traffic volumes, wider roads, and wildlife-vehicle collisions. Few studies have evaluated the use of wildlife underpasses by small mammals, despite them being particularly vulnerable to the effects of roads. WSDOT intentionally designed WCS to have features similar to the natural environment of native species. The objective of my proposed research is to evaluate use of constructed habitat features by small mammals at a wildlife underpass to determine how well they mimic natural habitats and encourage movement. In summer 2017, I will use mark-recapture, transect surveys, track plots, and wildlife cameras to quantify small mammal use of rock piles, logs, and snags at a wildlife underpass. Number of individuals and number of different species using each habitat feature type (rock piles vs. logs vs. snags) will be compared between habitat types (crossing structure vs. secondary forest). The results of this study will aid in evaluating the success of the current structures for small mammals, provide baseline data for future assessments, and suggest habitat restoration guidelines for future WCS.

Pileated Woodpecker Occupancy and the Occurrence and Recruitment of Key Habitat Attributes in a Managed Forest. Amber Mount*, *Green Diamond Resource Company, 215 North Third Street, Shelton, WA 98584; amount@greendiamond.com*

We studied Pileated Woodpecker (*Dryocopus pileatus*) occupancy and key habitat components on Green Diamond Resource Company's Olympic Tree Farm. We assessed the occurrence and recruitment of standing dead trees (snags). We surveyed for Pileated Woodpeckers and modeled detection and occupancy using PRESENCE (<http://www.mbr-pwrc.usgs.gov/software/presenece.html>). We estimated that Pileated Woodpeckers occupied 27.5% of survey locations. The models that performed best included the amount of forest aged 30-45 years within 277 hectares (ha) of a survey location, which was negatively correlated with occupancy, and the amount of mature forest within 277 ha, which was positively correlated with occupancy. With a one percent increase in 30-45 year-old forest within the 277 ha home range, we found a 10.25% decrease in the likelihood of a site being occupied by Pileated Woodpeckers. With a one percent increase in mature forest in the 277 ha home range, we found a 3.68% increase in the chance of the site being occupied by Pileated Woodpeckers. Our findings suggest that mature forest reserves are necessary for maintaining Pileated Woodpecker habitat. Mature forest reserves will become increasingly important as intensively managed forests move to a younger rotation age.

Monitoring Biological Response of Wetlands and Waterfowl Following Invasive Rough Fish Removal. Heidi Newsome, Kelsey Lotz*, *U.S. Fish and Wildlife Service, Mid-Columbia River National Wildlife Refuge Complex, 64 Maple Street, Burbank, WA 99323; Heidi_newsome@fws.gov; Kelsey_lotz@fws.gov*

In the fall of 2013 and winter 2014, four sloughs at McNary National Wildlife Refuge were treated with Rotenone, a pesticide used to control invasive rough fish. This management action was undertaken to enhance environmental conditions in the McNary Sloughs by reducing the population of rough fish, including Common Carp (*Cyprinus carpio*) and bullheads (*Ameiurus* spp.). Sampling conducted in 2012 found that three of the four pools of the McNary Sloughs were effectively denuded of any submerged aquatic vegetation (SAV) and all four pools showed high turbidity, a common symptom of carp infestation. Rough fish are thought to be a significant threat to the function of these wetland ecosystems due to their impacts on SAV through uprooting and consuming plants and increasing water turbidity. SAV is an important food source for migratory waterfowl and serves as a productive wetland component for micro and macro invertebrates. We have been monitoring the post-management recovery of the wetland sloughs at McNary through SAV, zooplankton and aquatic invertebrate sampling, as well as analyzing the waterfowl use trends pre and post-rotenone treatments. This presentation will highlight results from our SAV surveys and waterfowl response data. Within one year post treatment, our surveys indicate a significant increase in both SAV abundance and diversity in all treated sloughs, and a resulting greater number of waterfowl using the refuge sloughs, with an especially large increase in diving duck species.

Forest Owner Field Days: a Twenty-Year Success in Washington State. Andrew B. Perleberg*, *Washington State University Extension, 400 Washington Street, Wenatchee, WA 98801; andyp@wsu.edu*

Field days are old technologies that still work. However, like a healthy forest, a successful field day is no accident. Field days convey new and emerging information to forest

landowners as well as unite products and services with participants enabling them to accomplish personal objectives and avoid risks. Extending relevant and unbiased information to uninformed and previously unengaged audiences is a challenge in Washington State where 215,000 families control 2.4 million ha of forest land. Presented here is a 20-year longitudinal summary of post-program evaluation results. Since 1995, successful delivery of field days to over 13,000 landowners has been accomplished. Interagency cooperation between Washington State University Extension and the Washington Department of Natural Resources, as well as other cooperators, has made these successful events possible.

Win-Win: The Candidate Conservation Agreement with Assurances for Fishers. Zach Radmer*, *U.S. Fish and Wildlife Service, 510 Desmond Drive SE, Lacey, WA 98503; zachary_radmer@fws.gov*; Gary Bell, Jeffrey Lewis, *1111 Washington Street SE, Olympia, WA 98501; gary.bell@dfw.wa.gov; jeffrey.lewis@dfw.wa.gov*

Fishers (*Pekania pennanti*) are a medium-sized carnivore in the weasel family that sport a dark brown coat of fur and roam over large areas in search of a varied diet dominated by small and mid-sized mammals. Unfortunately, Fishers were extirpated from Washington for many decades as a result of over-trapping, habitat loss, and indiscriminant predator control. Currently the Washington Department of Fish and Wildlife (WDFW), National Park Service (NPS), and Conservation Northwest (CNW) are continuing Fisher restoration in Washington by reintroducing Fisher to their historical range within the Cascades. At the same time, the U.S. Fish and Wildlife Service (USFWS) has worked with WDFW and interested parties to develop a cooperative tool for conserving Fishers on non-federal lands. Under the Candidate Conservation Agreement with Assurances, enrollees who implement a known set of conservation measures to reduce threats on their lands receive assurances that they would have no further obligations to Fishers should they become a listed species under the Endangered Species Act. Forty-five landowners with almost 1.2 million ha of forested lands have enrolled in the agreement and WDFW/NPS/CNW continues to track reintroduced Fishers that are using those lands for part of their home range. The USFWS and WDFW are encouraging more landowners to enroll in this successful program.

Wolverine Distribution and Ecology in the North Cascades Ecosystem: Preliminary Results of a 10-year Study. Catherine M. Raley*, Keith B. Aubry, *U.S. Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue Southwest, Olympia, WA 98512; crale@fs.fed.us*; John Rohrer, *U.S. Forest Service, Okanogan-Wenatchee National Forest, Methow Valley Ranger District, 24 Chewuch Road, Winthrop, WA 98862*; Scott Fitkin, *Washington Department of Fish and Wildlife, Okanogan District, 350 Bear Creek Road, Winthrop, WA 98862*

The Wolverine (*Gulo gulo*) is a species of conservation concern in the contiguous U.S. primarily because it occurs only in areas where snow cover persists into late spring, making it potentially vulnerable to the effects of climate change on both the extent and connectivity of suitable habitat. Consequently, understanding the distribution, genetic affinities, and ecological relations of Wolverines in the North Cascades Ecosystem in Washington is essential for informing management and conservation efforts in the contiguous U.S. We conducted a telemetry study in the North Cascades from 2006 thru 2015 using Argos satellite transmitters. We captured 14 Wolverines and tracked 12 individuals (seven females and five males) long enough to obtain reliable data on their spatial-use patterns. Activity areas (100% MCP of

locations during any continuous monitoring period lasting ≥ 3 months) were relatively large: 535–1,969 km² for females and 1,149–2,992 km² for males. Two of the 12 Wolverines we monitored did not appear to be residents within our study area, but made long-distance exploratory movements covering at least 483 kilometers during a 7-week period (a sub-adult female) and 564 kilometers during a 12-week period (a sub-adult male). In addition, we located and described two natal dens, demonstrating that reproduction is occurring in the North Cascades Ecosystem. Genetic and field data indicate that our study population is connected to Wolverine populations in the Coast Ranges of British Columbia, rather than those occurring in the northern Rocky Mountains of Idaho, Montana, or Wyoming.

Assessing Habitat Connectivity for Forest Wildlife in Central Vietnam. Peter H. Singleton*, *Pacific Northwest Research Station, USDA Forest Service, 1133 N. Western Ave., Wenatchee, WA 98801; psingleton@fs.fed.us*; Huynh Tien Dung, *Huong Tran Lan, Vietnam Forests and Deltas Program, Hanoi, Vietnam*

Montane tropical forests of central Vietnam are widely recognized as an area of global biodiversity significance. The United Nations sanctioned Western Nghe An Man and Biosphere Reserve encompasses over 1.3 million ha near the Vietnam – Laos border, and contains over 80 rare or endangered animal species. It is also home to over 800,000 people from eight indigenous minority groups. Threats to wildlife in this area include habitat loss and fragmentation, and exploitation for the lucrative southeast Asian wildlife trade. Conserving or restoring habitat connectivity patterns between nature reserves while providing opportunities for indigenous agriculture and forest products cultivation will be important components of effective biodiversity conservation in this landscape. The U.S. Forest Service, International Program was invited to provide technical support for evaluating connectivity patterns between existing reserves as part of the Vietnam Forests and Deltas Program, supported by the U.S. Agency for International Development. Our goal is to assess connectivity of natural forest cover types between the seven nature reserves and national parks in and near the biosphere reserve to identify opportunities and priorities for connectivity conservation and restoration. We are using methods and tools developed by the Washington Wildlife Habitat Working Group for this assessment. Planned products include 1) identification and prioritization of areas for habitat connectivity conservation or restoration, 2) habitat connectivity assessment training workshops for land managers and GIS analysts in Vietnam, and 3) identification of demonstration areas where community-based ecological forestry projects can be implemented in collaboration with local land managers and the Vietnam Forests and Deltas Program.