Collection of abstracts associated with the symposium 'Biology, management, & conservation of pikas & other montane animals'

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(ORAL) PAPERS:

Hannah Horn, David Hik, Univ. of Alberta, Edmonton, AB, Canada. ***Contact***: hlhorn@ualberta.ca; 8:30AM

Abstract: In November 2011, the collared pika (*Ochotona collaris*) was designated as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This designation reflected concerns about potential vulnerability to the effects of climate change. We present new information about the role of habitat quality and climate for the dynamics of occupancy and survival of a population of collared pikas in the Yukon.

We used data from comprehensive annual surveys of marked individuals over a 10 year period (1999 to 2009) within a geographically isolated metapopulation. The locations of individual pika territories were mapped to identify talus patches, topographic conditions, and to estimate the areal quantity and quality (NDVI) of vegetation. We analyzed climate relationships using regional climate data and modeled local climate data (North American Regional Reanalysis (NARR) data downscaled to 30m resolution).

Annual surveys of active haypiles in the study area between 1995 and 2011 show a large range of natural variability in the pika population, with a steady decline in population size between 1995 and 2003 and a recovery to high numbers from 2009 to 2011. The results of our analyses show significant correlations between habitat occupancy and survival and the quality of habitat within pika territories in terms of solar radiation, topography (aspect, slope and elevation) and vegetation quality (vegetation-to-talus ratio, NDVI value, and distance to high NDVI value vegetation). There are also strong correlations between pika survival and climate in terms of winter and spring temperatures (degree days below 0°C; precipitation as snow; average spring temperature) and the length of growing season. These results indicate that survival and occupancy among collared pikas is strongly driven by climate conditions and associated impacts on habitat quality and winter conditions.

Embere Hall[1], Annie Loosen[1], Erik Beever[2], Kerry Murphy[3], Leah Yandow[4], Laura Oles[5], [1]Conservation Research Center of Teton Science Schools, Jackson, WY, [2]Northern Rocky Mountain Science Center, USGS, Bozeman, MT, [3]Bridger-Teton National Forest, USFS, Jackson, WY, [4]Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie, WY, [5]Bridger-Teton National Forest, USFS, Kemmerer, WY, ***Contact***: embere.hall@tetonscience.org; 8:50 AM

Abstract: Contemporary climate change has altered classic extinction dynamics. Consequently, conservation in alpine ecosystems must consider habitat selection patterns under novel conditions. American pikas (*Ochotona princeps*) and are an ideal species for evaluating climate-driven changes in habitat selection because of their temperature sensitivity, dependence on snow and naturally patchy distribution.

Relatively little is known about pika distribution or habitat selection in the Greater Yellowstone Ecosystem, despite range-wide research initiatives. As a result, regional responses to climate change are largely speculative. To better assess pika habitat selection, we examined pika occupancy at 211 sites on the Bridger-Teton National Forest, June -October 2010 and 2011. We generated sample points in four elevation bands using a generalized random tessellation stratified (GRTS) sampling design. At each site we surveyed for

pikas in a 12m fixed-radius plot and used a 100m line-point intercept transect to quantify forage. We deployed 40 pairs of surface/subsurface temperature loggers at a subset of points to better understand the relationship between ambient and subterranean temperatures.

Forty-eight percent of sites were occupied within the 12m plots. Occupancy rates were higher with increased detection distance from plot center (0-200m, 67% occupancy). We used logistic regression models and AIC model selection to examine predictors of patch occupancy. Important predictors included elevation, forage availability and rock size. Low elevation loggers recorded temperatures below -10°C during 10.6% of 9,138 hours. In contrast, medium and high elevation temperatures were below -10°C during 2.1% and 2.7% of hours, respectively. We recorded no hours in which temperatures exceeded 28°C, a proposed limiting heat threshold.

Results of our work indicate that cold exposure and snow cover may be drivers of pika habitat selection. With continued temperature increases and low elevation snow depths predicted near zero by the end of the century, pikas and other alpine mammals will face increasing difficulty.

Lyle Nichols[1], Liesl Erb[2], **Chris Ray**[2], [1]Santa Monica College, Santa Monica, CA, [2]University of Colorado, Boulder, CO, ***Contact***: cray@colorado.edu; 9:10 AM

Abstract: The American pika (*Ochotona princeps*) has been recorded throughout the Bodie Hills region of California in natural rocky patches and in ore dumps resulting from historical mining operations at Bodie State Historic Park (BSHP) and New York Hill (NYH). During the summers of 2008-2010, 172 of these rocky patches were surveyed for pikas and pika sign, including 104 patches at BSHP, 17 at NYH, and 51 in the surrounding 20x30-km region. Although pika fecal samples were obtained from all patches, living pikas were detected only among clusters of anthropogenic patches, occupying 47% of the patches at BSHP and 41% at NYH in 2010. To model effects of climate and habitat characteristics on pika persistence in this region, we first estimated the timing of each local extinction. The age of each fecal sample was estimated using the published rate of pika fecal pellet shrinkage for the Bodie Hills. The age of the youngest sample collected from a patch was used to estimate the last year pikas occupied that patch. Physical habitat characteristics (elevation, perimeter, rock size-class, etc.) were also recorded for each patch. PRISM estimates of temperature and precipitation were used to calculate long-term (1910-2009), historical (1910-1939) and recent (1980-2009) climatic patterns within this region. Because patches were clustered within 4x4-km PRISM cells, we used a hierarchical approach to model patch response (last year of occupancy) as a function of climatic and habitat variables. Model selection followed an information-theoretic approach. Our best models reflected the anthropogenic nature of habitats where pikas currently persist: in relatively small and spatially clustered patches of relatively small rocks. However, when we modeled pika persistence in natural patches only, we found important effects of climate. For example, pikas persisted longer where there was a lower long-term coefficient of variation in summer maximum temperatures.

Kimberly A. Hersey, Brian Maxfield, Keith Day, Anthony Wright, Masako Wright, Kevin Bunnell, John Shivik, Utah Division of Wildlife Resources, Salt Lake City, UT, ***Contact***: kimberlyasmus@utah.gov; 9:30 AM

Abstract: Utah has four of the five currently recognized subspecies of American pika (*Ochotona princeps*), including the endemic *O. p. uinta*. Given potential threats to pikas and their habitat, we sought to understand the distribution of and trend in pika populations statewide. We completed monitoring surveys employing multiple visits at randomly selected sites in predicted habitat during 2008 and 2011. The data supported single-season occupancy models where detection probability decreased with increasing maximum temperature and occupancy varied by subspecies, increased with latitude adjusted elevation, and increased where more of the surrounding landscape was classified as pika habitat. The estimated probability of occupancy of sites sampled in both years increased from 0.78 (SE = 0.04) to 0.92 (SE = 0.02). Colonization probability was 0.82 (SE =

0.08), whereas estimated extinction probability was 0.05 (SE = 0.03). In concurrence with metapopulation theory, sites that were less isolated and had a larger patch size had a greater probability of colonization. During targeted surveys we found pikas on 2 mountain ranges where the only known records dated to the 1960's and on several other mountain ranges we expanded the known extent of pikas. At this time, American pikas seem common in suitable habitat in Utah. Continued monitoring will allow us to document any changes in pika occupancy and implement conservation actions as needed.

Lucas Moyer-Horner, University of Wisconsin-Madison, Madison, WI, Contact: lrmoyerh@wisc.edu; 9:50 AM

Abstract: Within- and between-group observer variability can confound scientific discovery. If observer variability can be quantified and is addressed, data collected by participants with wide ranges of experience and training can yield more reliable inferences. The American pika (*Ochotona princeps*) is a mammalian sentinel of climate change that has received consideration for listing under the United States Endangered Species Act. As a result, numerous pika monitoring initiatives have been started throughout the mountains in western North America. Some initiatives employ research teams of biological science technicians (professionals), whereas many rely on networks of citizen scientists, or volunteers, for data collection. To date, few studies have quantified observer variability during pika surveys; none have explored the reliability of professional crews or volunteers. We conducted pika surveys in Glacier National Park, Montana, to quantify observer variability. We investigated observer variability 1) among a crew of professionals, 2) among volunteers, and 3) between professionals and volunteers. Professionals were more consistent at identifying pika signs and estimating potential home ranges and consistently found more pika signs than did the volunteers, with the exception of pika sightings. Estimates of pika occupancy were consistent at each site among volunteers conducting sitting surveys. We suggest that sitting surveys conducted by volunteers can reliably detect pika site occupancy. However, data on population dynamics of pikas (e.g., density) should be collected by professionals. Observer variability analyses of this nature should be common practice for wildlife-resource managers and scientists, especially with observers of varying levels of experience and motivation.

Connectivity of American Pika populations across an interstate highway, and the importance of anthropogenic habitat. Kristina A. Ernest, Central Washington University, Ellensburg, WA, ***Contact***: ernestk@cwu.edu; 1:30 PM

Abstract: American pikas (*Ochotona princeps*) are considered a talus-obligate species that typically inhabits high-elevation alpine areas. The patchy nature of talus habitats and their limited dispersal capacity often lends them a metapopulation structure. Along the eastern slopes of the Cascade Range in Washington State, pikas occur at elevations as low as 680 m, where significant human activity, especially the presence of a major interstate highway (I-90), has the potential to further fragment their populations and restrict dispersal. I tested the relationship between metapopulation structure and habitat type by mapping the distribution of suitable natural (i.e., talus) and anthropogenic (e.g., road-fill) habitat within an area of approximately 120 km2 surrounding I-90, and monitoring patch occupancy by pikas between 2008 and 2011. Overall occupancy was relatively high, but declined over the four years of the study. Occupancy was significantly higher for natural patches than anthropogenic patches. Relatively short distances between patches, and the surrounding matrix of forest habitat, may favor more pika dispersal than has been observed in high-elevation sites above timberline, and may contribute to most natural talus patches in this area being occupied. Although anthropogenic patches have lower occupancy rates, their presence may serve as stepping stones across a landscape with many disturbances and potential dispersal barriers. The spatial distribution and habitat features of existing patches (both anthropogenic and natural) provide critical information to Washington State Department of

Transportation as they oversee the construction and placement of wildlife overpasses and underpasses along I-90 to improve connectivity among populations of pikas and other species.

Using physiological samples to measure stress in American pikas. **Jennifer L. Wilkening**[1], Chris Ray[1], Karen Sweazea[2], [1]University of Colorado, Boulder, CO, [2]Arizona State University, Phoenix, AZ, ***Contact***: Jennifer.Wilkening@colorado.edu; 1:50 PM

Abstract: The American pika (*Ochotona princeps)* is considered a sentinel species for detecting ecological effects of climate change, but previous studies have focused on local pika extinction as a metric of change. We have validated simple procedures designed to provide an earlier warning signal, based on non-invasive sampling and analysis of physiological stress in living pikas. Pikas were sampled at several locations in the Rocky Mountains for the measurement of stress hormones (glucocorticoid metabolites, GCMs) in fecal samples as well as glucocorticoid concentration (GC) in plasma samples. Trapped pikas underwent data collection procedures known to induce stress, including blood sample collection via retro-orbital bleeding. Individuals were then held on site for up to 24 hours in a chamber specifically designed for non-invasive collection of fecal samples. Fecal samples were collected every 1-2 hours, and animals were released back into their home territories at the end of the collection period. All samples were frozen immediately, and later transferred to a lab for extraction and measurement. Collected fecal samples were analyzed for GCM concentrations, and comparisons were made between GCM levels measured in samples collected at different times subsequent to capture. Results reflect the expected increase in GCM level following a stressful event, and also identify the time delay (12.5 hours) between a pika's exposure to a known stressor and subsequent elevation of its GCM level. GC measured in plasma samples reflects individual variation seen in GCM levels, and further validates the techniques used. This is the first study to measure stress hormone metabolite levels in fecal samples for any species of pika. Non-invasive collection of fecal samples can be utilized to assess the physiological condition of pikas inhabiting different environments, and to determine whether local habitat variables specifically related to climate can explain levels of physiological stress in pikas.

Distribution and abundance of American pika in the Sierra Nevada and White Mountain ranges of California . **Robert C. Klinger**[1], Cody Massing[2], Sarah Stock[3], [1]U.S. Geological Survey, Western Ecological Research Center, Bishop, CA, [2]California Department of Fish & Game, Bishop, CA, [3]National Park Service, Yosemite National Park, CA, ***Contact***: rcklinger@usgs.gov; 2:10 PM

Abstract: We used a combination of line transect and point count surveys to collect data on distribution, abundance and habitat use of American pika (*Ochotona princeps*) in the Sierra Nevada and White Mountain ranges of California between 2008 and 2011. In the Sierra Nevada, observations were made each year along a minimum of 9 (2008) and a maximum of 21 (2011) 10-km transects, and at a minimum of 40 (2008) and a maximum of 210 (2011) point count stations. In the White Mountains, six transects 1.5 to 8 km long were sampled each year. Pika occurred widely throughout the alpine and subalpine zones of both ranges, but their distribution was very patchy and occupancy and abundance highly variable. Approximately 37% of the study area was occupied by pika, but variability in occurrence within a given geographic region was as high as variability between regions. Site occupancy expanded between 2008 and 2009 but 50% fewer sites were occupied in 2011 following the second consecutive heavy and extended winter in as many years. Land cover and topography variables had greater predictive value of occupancy than climate variables. Density was highly variable at patch, local, and regional scales; areas in both mountain ranges that had high abundance in one year could have much lower abundance the next year and vice versa. Density in the White Mountain range was generally 3-4 times greater than that in the Sierra Nevada (12.2 km^2 ± 1.4 SE vs. 3.5 km^2 ± 0.4, respectively), but density decreased by about 50% in both ranges following the winter of 2010/2011. The distribution and

abundance of pika in the Sierra Nevada and White Mountain ranges are very dynamic, but even in years when populations are low tens of thousands of individuals occur in the two mountain ranges.

Microclimatic drivers of pika population density in the Southern Rocky Mountains. Liesl P. Erb, Chris Ray, Robert Guralnick, University of Colorado, Boulder, CO, ***Contact***: liesl.erb@colorado.edu; 2:30 PM

Abstract: Alpine species are among those most threatened by climatic shifts due to their physiological and geographic constraints. One such species is the American pika (*Ochotona princeps*), an alpine mammal found in rocky habitats throughout much of western North America. Recent evidence from the Great Basin shows extensive climate-driven local population extirpation, and yet population extirpations have been less frequent in the Southern Rocky Mountain Region. In this study we investigated local population density as a more precise metric of population response. The density of 20 pika populations was estimated in both 2009 and 2010 using line transect-based distance sampling methods. While three different types of pika sign (scat, vegetation caches, and visible individuals) were investigated, pika scat as the most consistent and stable metric of population density. To better understand the mechanisms driving differential density patterns across the landscape, we collected habitat data including vegetation, talus depth and elevation and also used data loggers to record microclimate at each site.

Local pika densities and climatic trends are highly variable across the Southern Rockies. In an analysis of habitat and microhabitat variables, the best predictors of pika population density were climatic factors. Density was lowest at sites with highest mean summer temperature and lowest mean annual precipitation. Site aspect, elevation, latitude, and talus depth were not predictive of pika population density. Our findings indicate that hotter, drier sites do not support pikas in high densities. Direct thermal stress is implicated as a driver of lower densities at hotter sites. Data from sub-talus temperature loggers implicate a lack of snowpack at drier sites as the precipitation-based driver behind low pika densities. Reduced snow cover reduces the thermal insulation available to pikas during winter, but may also reduce water content in forage resources.

Incorporating ecohydrologic variables into modeling of patterns of montane-mammal distribution and abundance. **Erik A. Beever**[1], Solomon Dobrowski[2], Embere Hall[3], Annie Loosen[4], [1]U.S. Geological Survey, Northern Rocky Mountain Science Center, Bozeman, MT, [2]University of Montana (Department of Forest Management, College of Forestry and Conservation), Missoula, MT, [3]Teton Science Schools and Univ. of WY, Jackson, WY, [4]Teton Science Schools, Jackson, WY, Contact: EBeever@usgs.gov; 2:50 PM

Abstract: Montane ecosystems have been suggested by both paleontological and contemporary research to often be systems of relatively rapid faunal change, compared to many valley-bottom counterparts. In addition to often (but not always) experiencing greater magnitudes of contemporary change in climatic parameters than species in other ecosystems, mountain-dwelling wildlife must also accommodate often-greater intra-annual swings in temperature and wind speeds, poorly developed soils, and generally harsher conditions. Here, we sought to understand whether combinations of biogeographic, land-use, topographic, and climatic variables predicted abundance of American pikas (*Ochotona princeps* Richardson) across the 38.2-million-ha hydrographic Great Basin, and to quantitatively assess the ability of pikas to use behavioral plasticity to adapt to changing climates. We present new results of pikas that illustrate how biologically relevant derived hydrological variables such as growing-season precipitation and maximum snow-water equivalent can be important predictors of abundance (quantified using paired double-observer distance sampling on line transects). We also present new results from pikas and other taxa in the Northern Rocky Mountains that illustrate how behavioral plasticity can, in at least some cases, 'soften' the boundaries of species' bioclimatic niches. We describe several emerging efforts, technologies, and approaches that may contribute greatly to broad-scale, mechanism-based investigations to inform management and conservation of diverse montane wildlife and the ecosystem components with which they interact. Based on our empirical findings and our

review of related literature, we propose tenets that may serve as foundational starting points for our expanding research on plasticity and adaptation vs. distributional change in montane animals across the Northern Rocky Mountains region.

Pikas in the mist: How to survive at low elevation. Johanna Varner, M. Denise Dearing, University of Utah, Salt Lake City, UT, Contact: johanna.varner@utah.edu; 3:40 PM

Abstract: American pikas (*Ochotona princeps*) are excellent indicators of climate change in montane ecosystems because of their strict habitat requirements, limited dispersal ability, and sensitivity to high ambient temperatures. Despite an apparent reliance on cold climates, pikas thrive near sea level in the warm temperate rainforests of the Columbia River Gorge (CRG). To understand the ecological factors that contribute to pika survival in this seemingly unsuitable climate, we conducted vegetation surveys, behavioral surveys, and deployed temperature dataloggers at four low elevation sites in the CRG and three high elevation sites on nearby Mt. Hood. CRG talus was unique in having high moss coverage (40-80%) compared to alpine sites (<15%), and two moss species in particular (*Racomitrium lanuginosum* and *Pleurozium schreberi*) comprised the majority of pikas' diet. Summer temperatures at and below the talus surface at moss-covered sites in the CRG were up to 15°C cooler than at CRG sites with low moss cover or high elevation habitat on Mt. Hood. Moss cover appears to serve a dual function for pika survival. First, it releases pikas from obligate trips out of the talus to forage and construct haypiles (i.e., because vegetation is available within the talus all year). Thus, surface activity requirements and predation pressure during the summer can be greatly reduced compared to high elevations. Second, moss cover appears to buffer against high summer surface temperatures in the CRG. Taken together, these results suggest that CRG pika populations may actually be better protected from heat stress caused by climate change than their counterparts living in the high mountains, who are obligated to construct substantial haypiles during the warmest parts of the summer. These results will advance our knowledge of pikas' true habitat requirements and climate sensitivity, and may also inform conservation plans.

Combining multiple sources of data to analyze population demographics of the alpine-endemic white-tailed ptarmigan. Gregory T. Wann[1], Cameron L. Aldridge[1], N. Thompson Hobbs[1], Clait E. Braun[2], [1]Colorado State University, Fort Collins, CO, [2]Grouse Inc., Tucson, AZ, Contact: greg.wann@colostate.edu; 4:00 PM

Abstract: Species endemic to alpine ecosystems have been receiving increasing attention due to concerns of warming trends in habitats largely defined by cold temperatures. Constraints of data collection in alpine habitats have led to a shortage of information on alpine-endemic species relative to those occurring at lower elevations, and little is known how alpine species have responded to recent warming. Long-term datasets are ideal for studying relationships between climate and population demographics because they span multiple decades which have undergone variations in climatic conditions. Here, we analyze a 43 year dataset available for a population of white-tailed ptarmigan in Colorado using an integrated population model that combines demographic information in the form of count, fecundity, and mark-recapture data. Estimates from the model are produced through a joint likelihood of the datasets and MCMC to sample from the joint posterior distribution. Data sources were linked using a female-based matrix population model, and covariates for different weather variables were fit to the model to examine the effects on survival and fecundity. Model estimates generally had higher precision than estimates produced from separate analyses of the datasets. Annual rates of population change varied considerably across the study period, but the average rate of population change was close to one and did not indicate strong trends in population size. Weather variables occurring post-hatch were found to have the strongest effects on annual fecundity, and low cumulative winter precipitation was found to negatively affect survival of breeding age birds. Our modeling approach provided a framework for combining multiple data sources to explore population demographics of an alpine-endemic

species and had the added benefit of increased precision in demographic estimates. Extending the model to forecast population sizes under different climate scenarios is currently underway and will provide insights into future vulnerability of this population to climate change.

Spatial and temporal variability in alpine meadow condition and boundaries in the Sierra Nevada mountain range of California. **Robert C. Klinger**[1], Otto Alvarez[2], Brian Hatfield[3], Matthew L. Brooks[4], John R. Matchett[4], Christopher E. Soulard[5], [1]U.S. Geological Survey-Western Ecological Research Center, Bishop, CA, [2]Sierra Nevada Research Institute, University of California, Merced, CA, [3]California Department of Fish & Game, Bishop, CA, [4]U.S. Geological Survey-Western Ecological Research Center, Oakhurst, CA, [5]US Geological Survey-Western Geographic Science Center, Menlo Park, CA, Contact: rcklinger@usgs.gov; 4:20 PM

Abstract: Alpine meadows provide critical habitat for many mammal species but are considered to be particularly vulnerable to climatic shifts. It is generally assumed that the loss or alteration of alpine meadow habitat would be from drying and/or transitions to woody dominated (conifers and/or shrubs) communities, but data on the degree to which this is actually occurring is lacking for the Sierra Nevada mountain range. Therefore, our goal was to use aerial photos and remote sensing data to analyze changes in alpine meadow boundaries and condition (productivity and wetness) across three degrees of latitude and 2650 meters of elevation in the Sierra Nevada. The analysis of the aerial photos indicated that conifer density increased in areas associated with meadow ecotones but there was little encroachment within the meadows themselves. GIS layers on downscaled climate and vegetation productivity (the normalized difference vegetation index, NDVI) were analyzed to evaluate if there was evidence of temporal or spatial change in meadow productivity from 1990-2010. Generalized additive models indicated there was substantial temporal variability in meadow productivity but little overall change or even a slight increase over the last 20 years. Principal Components Analysis indicated that meadows that had decreased in productivity were mostly small ones in the southern part of the range. The results suggest that climatically related changes to vegetation may be ongoing in lower elevation zones in the Sierra Nevada but have not occurred to the same extent in higher elevation zones. Overall, habitat conditions for many mammal species in the alpine zone of the Sierra Nevada are spatially and temporally variable but do not appear to be deteriorating in quality or quantity.

Do the effects of burrowing on alpine plant communities vary with increasing environmental stress? **C. Guillermo Bueno**, Isabel C Barrio, David S. Hik, University of Alberta, Edmonton, AB, Canada. Contact: buenogon@ualberta.ca; 4:40 PM

Abstract: Burrowing mammals have been often described as ecosystem engineers because the structures they create can favor the occurrence of other species. Burrows can be used by other animals as temporary or permanent refuge, or affect the structure and dynamics of plant communities through soil disturbance. Burrows create gaps for opportunistic plant species, locally increasing the diversity and richness of plant species. However, these effects may not be consistent across gradients of environmental stress if for example abiotic constraints limit the ability of plants to colonize the more stressful patches. We studied the effect of Arctic ground squirrel (*Urocitellus parryii*) burrows on plant communities of the alpine tundra in SW Yukon, by comparing plant community composition within and outside burrows at three different elevations, paralleling a gradient in extreme environmental conditions. We found that similarity indices within and outside Arctic ground squirrel burrows were greatest at higher elevations, indicating that plant communities within and outside burrows were less different at higher elevations. Multivariate results showed that plant communities differed both within and outside disturbances and across elevations. At all elevations burrows reduced the occurrence of mosses and lichens, and promoted the occurrence of grasses, forbs or tall shrubs. At intermediate and high elevations this change favoured grasses within burrows, whereas at low elevations responses were more diverse. One nitrophilous plant species, *Petasites frigidus*, only occurred within burrows.

Understanding the differential responses of alpine plant communities to soil disturbances with varying environmental stress can help predict the dynamics of these systems under changing environmental conditions.

Vertebrate life history variation along elevational gradients: a global a meta-analysis. W. Alice Boyle[1], Brett K. Sandercock[2], Jeffery B. Joy[3], Kathy M. Martin[4], [1]UBC / Kansas State University, Vancouver, BC, Canada; [2]Kansas State University, Manhattan, KS, [3]Simon Fraser University, Vancouver, BC, Canada; [4]UBC, Vancouver, BC, Canada. Contact: aboyle7@mail.ubc.ca; 5:00 PM

Abstract: Understanding how animal life history strategies differ between high and low elevation populations can yield critical insights into the factors shaping life history evolution. Life history differences between high- and low-elevation populations also influences adaptability to changing climates, and choice of management actions. Key abiotic gradients (temperature, radiation, and O2 partial pressure) covary with elevation globally. These gradients could affect vital rates directly, or operate via several indirect factors. In a meta-analysis of >1000 records obtained from >250 intra-specific empirical studies (sites ≤5º lat, ≥300 m elevation), we (1) describe patterns of variation in life history strategies (using multiple traits) along elevational gradients in terrestrial birds, mammals, reptiles, and amphibians, and (2) test mechanistic hypotheses to explain these patterns by analyzing several covariates. We analysed all data using vote-counting and means methods, and a restricted dataset in formal meta-analyses. Overall, we found evidence for widespread shifts toward slower life histories at high elevations in all taxonomic groups. However, the traits differing most consistently varied by taxonomic group, with decreases in fecundity-related traits in birds, and increases in survival-related traits in "herps" at higher elevations. Although the data are biased toward studies from 30º-60ºN, our results reveal geographically widespread patterns in life-history evolution, implying that abiotic processes general to mountains around the world are the most important in shaping life history variation. A shift to slower life histories suggests that any increase in adult mortality in highland populations will have more severe effects on population growth rates (and those rates will recover more slowly in response to recovery efforts) relative to lowland counterparts. This is of particular concern in the face of changing climates as highland populations in many regions now represent relictual populations of formerly elevationally-widespread species.

POSTERS:

Dispersal and home range movement of the American pika on Snoqualmie Pass, Washington. Jill R. Peoples, Central Washington University, Ellensburg, WA, ***Contact***: peoplesj@cwu.edu

Abstract: The fragmenting of landscapes caused by human development has caused concern for species dispersal, instigating a growing awareness of the significance of wildlife corridors. On Snoqualmie Pass, the Washington State Department of Transportation (WSDOT) developed the Snoqualmie Pass East Project (SPEP) to link natural habitat north and south of I-90 (a critical wildlife movement zone through the Cascades) by constructing a variety of structures (bridges, underpasses, culverts) that wildlife can use to safely cross the highway. The objective of my project is to investigate the movements of a small lagomorph, the American pika (*Ochotona princeps*), chosen as a focal species by the SPEP for monitoring due to their relatively low mobility and restricted habitat use. I am studying the influence of habitat attributes in and adjacent to primary habitat patches (talus slopes) during home range and dispersal movements to better manage for travel across I-90. In particular, I am testing how: patch distance to other patches and the surrounding habitat influence movement. Locations of pikas are points collected from radio telemetry and fluorescent powder tracking methods, determining used habitat. At these points, the amount of protection (canopy cover, vegetation height, rock or logs) and forage potential (species composition, abundance) is recorded. The used locations will be

compared to adjacent unused habitat in the same area. If an individual disperses, the path and distance between patches is recorded. I predict that pikas select paths that offer the most protection when compared to other areas in their home ranges. Previous research has not identified preferred habitat used by dispersing pikas (critical for achieving the SPEP's goal); therefore, answering questions on environmental factors affecting pika movement and applying this information to species management and conservation is the focus of my study.

A comparative analysis of natural and human-made rock habitats for American pikas along I-90 in the Central Washington Cascades. Raychel A. Parks, Kristina A. Ernest, Central Washington University, Ellensburg, WA, ***Contact***: raychelparks@gmail.com

Abstract: American Pikas (*Ochotona princeps*) are small mammals that occupy rock-debris slopes (an accumulation of broken and fallen rocks at the base of a cliff or slope) and other rocky habitats in mountainous areas of western North America. In the Washington Cascades, pikas have been found living in human-made rock habitats, including both road-fill along highways and riprap along stream banks, as well as in natural rock-debris slopes. Washington State Department of Transportation (WSDOT) plans to build a number of wildlife bridges and overpasses in this area that will help wildlife safely cross the highway. Our objective was to compare habitat characteristics of natural and human-made rock habitat adjacent to I-90 and provide WSDOT with recommendations on habitat features that could be incorporated into the crossing structures to improve their suitability for pikas. We measured slope, aspect, canopy cover, average rock size, patch size, and distance to nearest neighbor patch; and recorded subsurface temperatures with data loggers. Multivariate statistical analysis was used to identify differences in habitat characteristics between pika-occupied and unoccupied sites, and among natural rock-debris slopes, road-fill, and riprap patches. Significant differences among habitat types and between occupied and unoccupied sites (non-parametric MANOVA, $P = 0.036$). Natural rock-debris slopes had significantly greater area than riprap patches (Kruskal-Wallis, $P=0.003$). Average minimum temperatures in summer and average daily temperatures in winter were significantly different among patch types. These results suggest that unoccupied rocky habitats differ in some features from occupied habitats. Common features among different habitat types occupied by pikas, and differences between occupied and unoccupied sites, will provide critical information to WSDOT in their design of wildlife crossing structures suitable for pikas.

Coping with your neighbours: Spatial distribution of alpine mammals in the tundra. Isabel C Barrio, David S. Hik, University of Alberta, Edmonton, AB, Canada. ***Contact***: catalanb@ualberta.ca

Abstract: Interspecific interactions play a decisive role in the structure and stability of biotic communities. In low productivity and highly seasonal environments such as the alpine tundra, most interactions take place during a short, snow-free period. The strength and direction of such interactions is likely to be determined by the availability of resources, particularly among species of the same ecological guild. Understanding how species interact in such extreme environments can provide insights into the conditions that allow for their coexistence. A first step to identifying the processes involved is the analysis of the species' spatial distribution and their spatial association with co-occurring species. We analyzed the potential for interspecific interactions among three resident medium-sized mammalian herbivores inhabiting the alpine tundra: collared pikas (*Ochotona collaris*), hoary marmots (*Marmota caligata*) and Arctic ground squirrels (*Urocitellus parryii*). We determined their spatial distribution and habitat selection to investigate how they share available space and resources. Overlap in their activity areas indicated that these species were aggregated at a landscape scale, but segregated at a finer scale. Habitat use was primarily associated with shorter distances to heterospecifics and secondly, with habitat features related to shelter and escape from predation. Our results suggest that these species can (and do) co-exist by partitioning their ecological niches at a finer scale, and that competition is likely not a major factor in structuring these communities. In turn, a number of facilitative mechanisms may

allow co-occurrence of these three sympatric herbivores at relatively high densities in such extreme environments.

Movements and resource selection of mountain goats inhabiting a gradient of helicopter activity associated with heli-skiing in Northwest British Columbia. **Becky Cadsand**[1], Michael Gillingham[1], Douglas Heard[2], Katherine Parker[3], [1]University of Northern British Columbia, Prince george, BC, Canada; [2]2British Columbia Ministry of Forests, Lands and Natural Resource Operations, Prince George, BC, Canada; [3]University of Northern British Columbia, Prince George, BC, Canada. ***Contact***: becky.cadsand@gmail.com

Abstract: Helicopter-related disturbance may result in heightened energetic expenditures and displacement of mountain goats (*Oreamnos americanus*); impacts that could have adverse demographic implications especially during winter. From 2007-2010, we collected location data from 11 GPS-collared female mountain goats, inhabiting a gradient of heliskiing activity, and from GPS-helicopter tracks (100-m locations) obtained in cooperation with Last Frontier Heliskiing. We related proximity and visibility of helicopter flights to mountain goats, both spatially and temporally. We identified longer-distance anomalous movements occurring within 48h of helicopter approaches that were <2km. Using logistic regression and an information-theoretic model selection process, we determined the probability of anomalous movements increased: 1) as helicopter proximity decreased; and 2) with increasing distance to escape terrain. Paired comparisons pre- and post-helicopter approaches indicated increased medium-term range size in 3 of 11 animals, but no medium-term displacement effects. Seasonal movement rates, range sizes, and the frequency of anomalous movements were independent of helicopter exposure rates. Based on individual resource selection strategies, the majority of goats selected for higher elevations, steeper slopes and southern aspects during the heliskiing season. Several of the animals inhabiting high-use heliskiing areas selected more strongly for security-related attributes than aspect, a potential trade-off to reduce perceived risk from heliskiing activity. Our work suggests that while helicopter activity can result in medium-term movement effects, minimizing close-proximity approaches, perhaps by avoiding habitats most used by goats, can prevent these medium-term effects from translating to larger-scale seasonal effects.