EVOLUTION IN A RAPIDLY CHANGING ENVIRONMENT

Dr. David A. Eberth, Senior Research Scientist, Royal Tyrrell Museum of Palaeontology.

*Climate change and mass extinctions: A deep-time perspective.*

Deep Time in Earth History provides context to understand Earth’s large-scale and impactful physical and biological changes over 4.6 billion years. Due to the cumulative work of geologists and paleobiologists over the past 200 years, we are all familiar with at least a few of Deep Time’s greatest hits in changes in Earth History, including the mass extinction of dinosaurs, the evolution of birds from dinosaurs, and the most recent ice age with the emergence and ascendency of Homo sapiens. Whereas such events have previously been appreciated largely as novel factoids or curiosities—serving as plot lines for Disney and Hollywood movies—our current global environmental predicaments have elevated our need to better understand these and other Deep Time events to the status of required reading. Ten-thousand-year time-frames, and patterns of change in climate and atmospheric gases are now well documented for the Phanerozoic (the last 600 million years). When combined with similarly well-documented patterns of mass extinction, one conclusion is inescapable: although change is a permanent aspect of Earth History, rates of physico-environmental change commonly trump the abilities of many biological systems, communities, and populations to adapt and survive in abundance. Today we seem to be engaged in a man-made, real-time, multi-factorial experiment in climate change and declining macrobiological diversity. The lessons from Deep Time suggest that the rapid rate of the changes we have set in motion will ultimately pose challenges that we cannot yet imagine, while also providing new opportunities we cannot yet appreciate.

Dr. Theresa Burg, Associate Professor, University of Lethbridge
Co-author, Rachael V Adams; Biological Sciences, University of Lethbridge

*Using riparian dispersal corridors to connect populations in a changing landscape.*

Variation in landscape features influence individual dispersal and as a result can affect patterns of genetic variation within and between populations. Southern Alberta has a variety of habitats ranging from mountains to prairies creating an ideal study area to look at the impact of changing environment on population connectivity and dispersal across the landscape. For forest dependent species such as the black-capped chickadee, dispersal is limited to forested regions such as the foothills and riparian corridors. Dispersal corridors play important roles in maintaining gene flow of species in fragmented landscapes by promoting population connectivity. Within dispersal corridors habitat can be further fragmented as a result of natural and anthropogenic barriers. We used a landscape genetic approach to
assess the fine-scale genetic structure of black-capped chickadees along 10 different river systems in Southern Alberta. Several landscape features were found to have a significant effect on patterns of population genetic differentiation. As small spatial scales, natural breaks in otherwise continuous habitat reduced population connectivity. Interestingly, the artificial barriers within river systems do not appear to restrict gene flow. Dispersal is impeded between river systems by grasslands as evident by isolation of nearby populations (~ 50 km apart) and within river systems by large treeless canyons (>100 km). Significant population genetic differentiation within some rivers corresponded with zones of different cottonwood (riparian poplar) species. This study illustrates the importance of considering the impacts of habitat fragmentation at small spatial scales as well as other ecological processes to gain a better understanding of how organisms respond to their environmental connectivity. Here, even in a common and widespread songbird with high dispersal potential, small breaks in continuous habitats strongly influenced the spatial patterns of genetic variation.

Dr. David Coltman, Professor and Associate Dean/Research Science, University of Alberta.  
**Evolutionary changes in horn size of bighorn sheep under selective hunting.**

We studied the evolutionary dynamics of horn size in the bighorn sheep population at Ram Mountain, Alberta, which has been intensively studied since 1972. Up until the mid-1990s, trophy rams were harvested regularly under a 4/5 minimum curl restriction, and most rams were harvested between 5 and 7 years of age. Paternity analyses show that rams do not achieve social dominance and high reproductive success until age 8 to 10, therefore many trophy rams were harvested before they would have reached their reproductive peak. Trophy hunting therefore generates strong artificial selection on horn size. Since we have also shown that horn size is heritable and has a polygenic basis, evolutionary theory predicts that a response to selection should ensue, and over the same period of time, horn growth rate declined by 20%. In 2003, we showed that the observed decline in horn size was closely mirrored by declines in estimated breeding values, which are a measure of the genetic component of a given trait, suggesting the response was partly genetic. We have recently reanalysed these genetic trends using a more sophisticated modelling approach that better accounts for environmental effects and genetic drift, and including the period of time since trophy hunting ceased in the 1990s. These analyses confirm the trend for a genetic decline during the hunting period, show that the decline stopped at the same time that hunting stopped, and that the recovery following the cessation of hunting through natural selection is slow relative to the rate of decline brought about by artificial selection.
Dr. Marco Festa-Bianchet, Professor, Département de Biologie, Université de Sherbrooke.

**When does selective hunting lead to evolutionary change and so what if it does?**

Thirteen years ago, a paper by Dave Coltman alerted wildlife managers that unrestricted harvest of bighorn sheep based on a minimum curl may lead to an evolutionary change favoring small horns. A number of criticisms have been levelled at that paper, which was also used by anti-hunting groups to promote their cause. The serious statistical criticisms were incorporated in a new analysis by Gabriel Pigeon, who confirms Coltman’s conclusion and finds that evolutionary change stops when the artificial selective pressure is removed. I will examine other criticisms of this research, including its regional scope, the effects of alternative harvest strategies, the role of density-dependence, the possible genetic rescue from protected area, and biology-independent modelling approaches. Ram horns are getting smaller in Alberta and parts of BC where selective harvest is intense, but not where regulations or difficult access limit the harvest of large-horned rams. Ongoing climate change should have stimulated horn growth in rams, the opposite of what we observe. The evidence that intense selective hunting leads to evolutionary change in bighorn sheep is strong. Extrapolation to other species, however, must consider their mating system, harvest rates, and the age-specific determinants of male mating success. We know little about the determinants of paternity in other ungulates, and for some species it seems unlikely that selective hunting will lead to evolutionary change. We know how to limit the undesirable selective effects of selective hunting in bighorns in Alberta: let’s do it.

Dr. Stan Boutin, Professor Biological Science, Alberta Biodiversity Chair, and Alberta Biodiversity Monitoring Institute Co-Director Science, University of Alberta

**Will evolutionary rescue save populations in the face of climate change?**

In the near future, wildlife managers and conservationists will face the very real challenge of what to do with populations that will or currently exist outside of their traditional climate envelope. This will not be a problem if these populations are capable of adapting to new conditions and I will summarize the evidence for evolutionary rescue in mammals. I will then go on to discuss what to do with protected populations and habitats left out of the trailing edge of climate envelopes. Currently, national-level protective frameworks for endangered species mandate that protected populations and habitats be conserved, with no regard for the escalating costs this will entail for populations stranded outside of their climate envelopes or for habitats that no longer host a protected species but could provide other values to society. Unless protective frameworks are updated to incorporate guidance for the trailing edge, these types of situations will become commonplace, risking a loss of public support as protective frameworks are deemed expensive and ineffective.
Dr. Lorne Fitch, Professional Biologist, Retired Fish and Wildlife Biologist, Provincial Riparian Specialist with the Alberta Cows and Fish Program, and Adjunct Professor University of Calgary.

**Looking Back to See Ahead- Shifting Benchmarks and Resource Conservation.**

In the business of conservation we are often so intent on staring into the fog called tomorrow, we rarely turn around and look back at the pathway called yesterday stretching behind us. Yesterday was different than today, even though we may not perceive it to be so. Where we got on that pathway tends to dictate our view of the landscape. A retrospective look provides a sense of, even a snap shot of past ecosystems and the presence, abundance and distribution of fish and wildlife populations. This presentation uses archival images and information to paint a picture of Alberta’s biodiversity past.

The current status of fish and wildlife populations and their habitats cannot be appreciated until we acknowledge where we were by reviewing historical abundance and distribution. Only then, will we be ready to see where we need to be. By reviewing what was perhaps we can see what can be. If there is one thing we can learn about the past, it is to use the past to guide our vision of future conservation efforts.

We do not feel the need to mourn that which we do not understand enough to miss. A fundamentally important task for biologists and the conservation community is to provide perspectives on changes over time in ecosystem integrity and in biodiversity.

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**KEYNOTE**

Dr. Jennie Moore, Associate Dean Building Design and Construction Technology, Acting Director Sustainable Development and Environmental Stewardship British Columbia Institute of Technology (BCIT), School of Construction and the Environment Burnaby, BC.

**Wild Spaces and Urban Places: making the habitat conservation connection.**

Conservation of habitat has been an important strategy to ensure nature's long-term viability. However, in today’s increasingly urban world, this tried and true approach is proving inadequate. According to the World Wildlife Federation, representative populations of thousands of vertebrate species have declined by 52% since 1970. Simultaneously, the global human population has doubled with half of humanity now living in cities. Although cities can provide resource efficient lifestyles, they are also nodes of consumption. They draw in vast amounts of resources for food, energy and water and extrude equally vast amounts of wastes that ultimately must be absorbed by local and global ecosystems. This presentation explores the connections between wild spaces and urban places through ecological footprint analysis. Understanding the resources required to support an average North American lifestyle provides new insights about how to reduce impacts on ecosystems.
Natasha Annich, Erin Bayne and Cindy Paszkowski: University of Alberta

Use of bioacoustic technology to model Anaxyrus spp. habitat use and occupancy in northeastern Alberta. Methods for modeling species habitat use across a landscape often require a certainty of presence or absence of that species. When absence is uncertain, habitat use-availability modeling becomes the next step. Use of bioacoustics technology to collect repeated observations by day, by hour, and even by minute, allows for higher certainty when estimating occupancy. Autonomous recording units were deployed throughout the boreal forest of the Lower Athabasca region, Alberta, between the months of April to August (2013-2015). Recording units sampled a range of habitats, lowland and upland, to detect the vocalizations of two Anaxyrus spp. toads, the Canadian toad (A. hemiophrys) and western toad (A. boreas), along with other animals on the landscape. Both A. hemiophrys and A. boreas are not well understood within the province, giving them the legal status of data deficient. The extent of energy sector development in the study area potentially limits the distribution of toads. Acoustic data were processed through human listening and computer-recognition software. Recognizer data provided a higher certainty regarding absence from sampling locations, where all data were processed and no toads were detected. Logistic regression and occupancy models were used to evaluate Anaxyrus spp. detections with biotic and anthropogenic landscape characteristics. Human impact associated with Oil Sands development has resulted in significant habitat loss and noise pollution. The effect of these impacts on toad distributions are not known. Future monitoring and conservation planning will benefit from an improved understanding of the landscape characteristics selected by these toads.

Mark Boyce, University of Alberta

Nutrition, demography and genetics influence bighorn management. Val Geist has translated papers by Franz Vogt who conducted experiments on antler size in red deer in Nazi Germany between the 2 world wars. The 3 primary determinants of variation in antler size were in order: (1) age, (2) nutrition, and (3) genetics. Likewise, these same considerations determine variation in horn and antler size in every species of ungulate that has been studied, including bighorns in Alberta. Proposed changes to hunting regulations to impose a minimum full-curl restriction south of the Brazeau River will substantially reduce hunter harvest increasing the age composition among rams. But a full-curl harvest restriction will not resolve nutritional concerns from maintaining herds at carrying capacity nor will it resolve selection by hunters for large horns. Non-trophy sheep harvest has been shown to enhance range condition resulting in enhanced growth of bighorns, yet Alberta has progressively reduced non-trophy harvests since 1987. Return to 4/5 curl minimum horn size for rams and reinstating non-trophy harvests will restore sustainable harvests and growth of bighorns.

Kate Broadley, University of Alberta

The Effect Of Density On Movement Rate And Implications For Wildlife Monitoring. Scientists and managers need to be able to monitor changes in unmarked populations accurately, and motion-based cameras are an increasingly popular tool for monitoring changes in populations. Cameras produce a series of detections over time, and many camera studies use changes in detection rate to estimate relative abundance. However, camera detections are affected by both density and movement rates of individuals. If
movement rates are density dependent and subject to variation within and between populations, then estimates of density from camera data are potentially confounded. My objective is to determine the magnitude of changes in movement rates across densities and what effect this may have on estimates of relative abundance for unmarked individuals. I performed a meta-analysis of studies that reported densities and movement rates for mammal species. I have also analyzed telemetry data for white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), and grey wolf (*Canis lupus*) to determine relationships between movement parameters within populations. I found that increases in population density were associated with significant decreases in movement rate and home range size. I also found significant heterogeneity in effect size amongst studies. I make recommendations on the use of camera data for monitoring unmarked populations.

**Cole Burton and Jason T. Fisher, Alberta Innovates Technology Futures**

**Validating Species Distribution Models: Can Provincial-Scale Models Predict Landscape-Scale Wildlife Distribution?** Reliable models of species distribution and abundance are a critical component of effective landscape management. Spatially explicit models are increasingly used to delineate wildlife habitats, anticipate responses to climate change and other impacts, and propose biodiversity offsets. Greater data availability is facilitating model development, but validations and characterizations of uncertainty lag behind. Uncertainty stems from sources such as observation error, model misspecification, or scale dependency. The Alberta Biodiversity Monitoring Institute generates species distribution models for a broad array of taxa, including terrestrial mammals, using data from provincial-scale monitoring. These models hold promise for informing management, but their predictive accuracy has not been assessed at landscape scales (e.g. industrial projects). We used an independent, three-year dataset on mammal occurrences within a 3000 km² area of Alberta’s boreal forest to examine the degree to which regional-scale models predicted finer-scale patterns for nine mammal species. Averaged across the entire study area, species rank abundances were reasonably similar between model predictions and observations (rs = 0.57). However, at the scale of individual sites (1 km²), correlations between predictions and observations were variable and generally low, being highest for ungulates (deer, r = 0.58; moose, r = 0.41) and lower for carnivores and smaller mammals (e.g., coyote, r = -0.10; hares, r = 0.07). Consistent with scale theory, our results suggest that down-scaling from regional models is challenging, and that care is needed in applying predictions to landscapes and patches. Greater integration of research and monitoring holds promise for strengthening model applications across scales.

**Lu Carbyn, University of Alberta**

**Evaluation of human activities on a 320 acre parcel of land in a boreal forest transition zone area.** Rapid advancement in theories, methods and applications are revolutionizing the way we think about wildlife conservation. The concept of the "balance of nature" is now being replaced by the idea of a" flux in nature". In this paper I examine the changes that have taken place on a 320 acre parcel of land over a 100 year period in central Alberta. Aerial photos and oral tradition were used to trace the changes from the late fur trade era, early homesteading days, abandonment of homesteading to ranching operations, private small scale logging, industrial logging,
and oil and gas extractions. In this paper I also present a detailed assessment of the current migratory breeding bird populations on one quarter-section of land. In addition, I will outline the broad scale faunal changes that have taken place and list the species currently considered endangered, threatened or are species that are otherwise of concern. Large carnivores (wolves and cougar) have increased in recent years, however their status was largely unknown from the early times within a 100 year frame work.


How Forestry Practices Shape Bird Communities In Alberta's Boreal Forest. Loss of biodiversity has been well established in the forestry industry, and attempts to mitigate these losses are numerous. One such practice, employed by Alberta Pacific Ltd in Alberta’s boreal forest is termed understory protection. The method involves harvesting trees in strips, with a 6m cleared strip, bounded by two 3m low-impact harvest strips, subsequently bounded by two 3m no-impact strips. This method retains high densities of understory spruce, while harvesting primarily old growth aspen. The purpose of my research is to compare bird communities using understory protection harvest areas to communities at classically harvested sites where only ~5% residual trees remain. Furthermore, I use unharvested patches of forest as a positive control test. Using autonomous recording units (ARUs) to acoustically survey bird communities, comparisons of richness, diversity, and abundance can be made. Survey work in 2015 allowed us to visit 47 sites (consisting of one of each treatment type). I will present preliminary analysis on how bird communities compare across these three treatment types. Furthermore, I will investigate harvest treatment changes over time, as well as how bird communities respond. I will use a comparative metric of beta and alpha diversity, as well as ordination plots to draw my conclusions. Furthermore, I will briefly present on future directions for this research, including the array of metrics which can, and hopefully will, be employed to interpret and analyze community differences between these treatments and over time.

Zack Dempsey, Theresa Burg, and Cameron Goater: University of Lethbridge

Using phylogenetic tools to determine the extent of Oreohelix snails in Southern Alberta. A primary goal of conservation biology is to determine the geographic extent of monophyletic lineages in the context of evolutionary history. This study’s primary objective is to examine phylogeographic patterns of terrestrial snails in the genus Oreohelix from Cypress Hills Provincial Park (CHPP, n=34 sites) and the Rocky Mountains (n=17) to determine if any species are potentially threatened. We used a combination of COI mitochondrial DNA and ITS nuclear DNA sequences as well as morphological and ecological measurements. Our data demonstrated the existence of three species within CHPP and two closely related lineages within the Rocky Mountains. O. subrudis is widespread throughout North America, but O. cooperi and an undescribed O. sp are highly restricted in their ranges. The O. cooperi clade contained small-bodied snails exclusively on scree slopes in CHPP. The large bodied snails, O. subrudis, live throughout western CHPP surrounding Elkwater Lake and O. sp are found throughout eastern CHPP, and both prefer aspen-dominated slopes. In the Rocky Mountains, O. subrudis is widespread and dominant regardless of slope cover. This phylogeographic pattern likely reflects a combination of low snail
vagility, local adaptation, and the complex glacial history of these regions.

Amanda Droghini and Stan Boutin: University of Alberta.  
**Snowstorms' effects on the movement and behaviour of grey wolves.** In the winter, snow affects the movement and behaviour of both predators and prey. Most studies have quantified these effects by measuring snow conditions such as depth and hardness; however, to our knowledge, none have considered the effects of snowstorms. We identified snowstorm events using daily pictures from remote cameras, and combined this information with telemetry data to evaluate how grey wolves were affected by heavy snowfalls. We considered 4 movement metrics: travel speed, maximum speed, proportion of travel behaviour, and daily distance travelled, and compared these metrics before, during, and after a storm. Of the 15 snowstorms we identified, most (67%) were highly localized, affecting only 1 wolf territory. We found a clear effect on wolves movements: on the night of a storm, wolves travelled slower and less frequently. Consequently, they also travelled nearly 4km less on storm days than on random days. Some of these effects persisted for up to 72hrs. after a storm, as we would expect if wolves response to storms was solely a response to deep, fresh snow. However, the proportion of travelling behaviour returned to pre-storm levels within 24hrs. We propose that wolves travel less during storms because they are less efficient hunters. Snowstorms likely affect wolves sensory abilities, especially their sense of smell, by clearing the air of odour particles and making it harder to detect prey. Investigating how prey are behaving in similar conditions would further our understanding of predator-prey interactions in northern regions.

**Population trends and reproduction of bald eagles at Besnard Lake, Saskatchewan, Canada 1968-2012.** The study of population regulation is crucial for understanding population dynamics and conservation. We report on trends in population size and reproduction of Bald Eagles (*Haliaetus leucocephalus*) at Besnard Lake, Saskatchewan, Canada, during 1968-2012 (with updates on trends through 2015). We investigated the relative importance of density-dependent (population size) and density-independent (climate) factors in explaining variation in population growth rate and productivity. The number of occupied Bald Eagle territories increased until 1988, but remained stable afterwards, fluctuating around 26 pairs. The number of successful pairs increased until 1977 and remained relatively stable or slightly declined afterwards (ca. 16 successful breeding pairs per year). We found a strong negative density-dependence in all reproduction parameters (mean productivity, nesting success, mean brood size at fledging). Annual production initially increased in the 1970s, but decreased afterwards, while nesting success decreased throughout the whole study period. We found strong density-dependence in population growth rate, indicating that the stabilized population was regulated. It probably reached its carrying capacity in the late 1970s, even though population size continued to increase until the late 1980s. Mean brood size at fledging was negatively related to the number of failed
nesting pairs. Density alone explained most of the variation in breeding performance, although milder springs were weakly associated with a higher nesting success. Finally, we found evidence for regular fluctuations in mean productivity, and in particular in nesting success, with a 5-yr period. We discuss possible mechanisms behind the observed patterns of density-dependent reproduction.

Alina Fisher: Environmental Studies, University of Victoria, John P. Volpe: University of Victoria and Jason T. Fisher: Alberta Innovates - Technology Futures, & University of Victoria.

Swimming Upstream: Invading Atlantic Salmon Occupancy Dynamics, And The Science Of Public Apathy. Chronic low-volume escapes of Atlantic salmon (*Salmo salar*) from farms into Pacific waters (leakage) are typically undetectable, and escape-reporting greatly underestimates the true number of escapes. To quantify the spatial extent of escaped Atlantic salmon in Canadian Pacific rivers, we systematically snorkel-surveyed 41 known Pacific salmon (*Oncorhynchus* spp.)-supporting rivers and creeks on Vancouver Island over a span of 3 years. We detected Atlantic salmon (AS) in 36.6 % of surveyed rivers. We used dynamic occupancy models which account for imperfect detection, and estimated that over half of Pacific coast streams were occupied by AS, which were more likely to occupy streams with high native Pacific salmon diversity and more likely to maintain occupancy across years potentially increasing competitive pressure on native salmonids. The implication is that either AS leakage is persistent or AS have naturalized. Given that farmed AS is the largest agricultural export product of British Columbia, the potential impact of policy decisions around salmon farming in provincial waters should have attracted attention. However, this study made little impact in either traditional or social media. Indeed few science papers seem to gain traction in the public sphere (average readership for a zoological paper is fewer less than half a dozen), whereas in contrast pseudoscience seems to gain escalating influence. I discuss recent research in science communications and illustrate how conservation research can engage the public to inform better policy.


Extensive Landscape Disturbance Explains Boreal Mammals' Distribution In The Alberta Oil Sands. Landscape disturbance is often synonymous with habitat and biodiversity loss. However, landscape disturbance may positively affect some species and negatively affect others, creating ecological winners and losers in human-dominated landscapes. In the oil sands, petroleum extraction interacts with logging and road building to create a landscape with few global analogs, and implicated in woodland caribou declines. We hypothesized that more than caribou are affected; that instead landscape disturbance is manifest across the boreal mammal community. We sampled mammalian occurrence in a 3000 km² area of Alberta’s boreal forest at 60 camera-trap stations between 2011 and 2014. We quantified natural land cover and anthropogenic disturbance from Geographic Information System (GIS) data and used generalized linear models to relate each species occurrence to landscape features in an information-theoretic approach. For every species examined, anthropogenic features were a key component of the best-supported model. Some species were positively, and others negatively, associated with landscape disturbance. Overall, anthropogenic features had greater effects on species than did...
natural land cover. We contend that these widespread effects signal a change in landscape function, with increasing landscape fragmentation and permeability favoring generalist predators and browsers at the expense of other species. As world leaders contemplate continental-scale pipelines and international climate change agreements, the regional-scale impacts of oil sands development take on global significance. The oil sands spatial footprint is manifested across the boreal forest mammal community, and the future trajectory of these species may hinge on global decisions.


Wildlife crossing structure use in the Bow Valley, Alberta between 2008-2015. It is well documented that habitat fragmentation has adverse ecological consequences for animals. Wildlife crossing structures (WCS) aid in the mitigation of habitat fragmentation by increasing connectivity for wildlife. Using remote-sensing cameras we monitored the use of WCSs and jumpouts situated around the Trans-Canada Highway, near Canmore Alberta from 2008 to 2015. WCS were used by 15 species a total of 14747 times. Jumpouts were used by 8 species a total of 168 times. Temporal, seasonal and annual changes in use of crossing structures for each species were analysed. While some species utilisation of crossing structures has increased over time, other species use has dramatically declined. Mule deer use has declined from n=139 in 2008 to only n=10 in 2015. Total use of WCS by all deer species combined has declined from n= 1525 in 2009 to n=489 in 2014.

Trends in seasonal use show higher use of the underpasses over the summer months. We found a strong positive correlation (n=0.86) between cougar and elk temporal use of underpasses. We also found that anthropogenic influences may have affected wildlife underpass use. The long term monitoring of WCS is important to improve future design, placement of crossing structures and to highlight deficiencies in current crossing structures for certain species. In addition declines in the use of crossing structures by certain species could possibly be the first indicator of larger population dynamics such as shifts in range/habitat use or population decline.

Glynnis Hood, University of Alberta

The old, the new, and the alternative: Managing human-wildlife conflicts in rural municipalities. Human-wildlife conflicts can create social, economic and environmental issues within urban and rural municipalities. Increasingly, rural municipalities are tasked with managing these conflicts, despite sometimes unclear jurisdictional and political boundaries. Wildlife, as a public good, is also highly valued by Albertans for recreational and aesthetic reasons. This study developed species-specific management tools that reflect the diverse ecosystems and land uses across rural municipalities. Data specific to wildlife species managed by Beaver County were then developed into an interactive map for use by County managers. Additionally, a cost-benefit analysis was applied to human-beaver conflicts to offer a comparison of traditional and alternative management approaches at the County level. This research provides greater insight into how wildlife are managed at a municipal level and how well these management actions perform relative to economic and ecological metrics.

**Does Conspecific Attraction Affect Density Of Canada Warblers In Harvested Landscapes?** Selection based on direct habitat cues, such as vegetative composition and structure, is a major driver of species distribution. However, some models suggest individuals may use indirect social cues, such as presence of conspecifics, to assess habitat suitability. This conspecific attraction can result in clustering of individuals, irrespective of habitat. Canada Warblers (*Cardellina canadensis*) are purported to exhibit clumped distributions. In Alberta, high densities are found in old-growth deciduous-dominated stands with dense understory, while other areas with apparently similar habitat are unoccupied. Lower densities have also been detected in stands altered by timber harvesting. Furthermore, in their northern breeding range Canada Warblers are one of the last forest bird species to arrive from spring migration, leaving limited time to assess habitat directly. Hence, proximity of conspecifics may be important when selecting an area. It has not been examined whether Canada Warbler density and clumping patterns are linked solely to underlying habitat, or whether conspecific attraction plays a role. The objective of this study was to determine how density of territorial male Canada Warblers within managed stands is affected by 1) stand attributes: amount of post-harvest stands, time since harvest, patch metrics, understory metrics, and surrounding forest context; and 2) conspecific attraction. Data from 2014-2015 playback point count surveys in Alberta’s managed boreal forest will be used to quantify effects of forestry activities on Canada Warbler density, and understand the role of conspecific attraction. This will provide information for species distribution modelling and inform recovery strategies for this species at risk.

Elly Knight, and Erin Bayne: University of Alberta

**Use of Automatic Acoustic Recognition Software for Common Nighthawk Habitat Modelling.** Habitat modelling is imperative for species at risk management and conservation, both from a practical and a legal perspective; however, adequate inventory data is necessary to produce robust habitat models. Species with cryptic or nocturnal life histories, large geographic ranges, and remote habitats can be difficult to inventory using conventional methods. Common Nighthawks (*Chordeiles minor*), in particular, are highly understudied because their crepuscular habits preclude them from detection on survey such as the Breeding Bird Survey. As a result, little is known about the habitat relationships of this federally Threatened species, particularly in the boreal forest, but initial Canada-wide models suggest high population densities in the boreal forest. Bioacoustic survey methods are ideal for inventorying Common Nighthawks because their simple, frequent vocalizations make them easy to detect with automatic recognition software, which is increasingly being used to overcome the challenge of processing the large volumes of data produced through bioacoustic survey methods. I will present a habitat modelling case study from northeastern Alberta that uses automatic recognition of autonomous recording unit (ARU) data. Results presented will include an assessment of automatic recognition methods and recommendations for bioacoustic surveys for Common Nighthawks. Habitat models presented will provide the first assessment of boreal habitat relationships for Common Nighthawks, and will include habitat relationships with anthropogenic land-use types in the Lower Athabasca region.
Joshua Killeen, Evelyn Merrill, Holger Bohm, Jodi Berg: University of Alberta and Scott Eggeman, Mark Hebblewhite: University of Montana

The changing migration patterns of the declining Ya Ha Tinda elk herd. Migration is an iconic process that allows animals to exploit variation in resource availability. Global declines in migratory ungulate populations have focused attention on protecting migration corridors. However, use of migration corridors is generally thought of as a relatively constant phenomenon, while in some cases use of migration routes may in fact change rapidly, necessitating more wide-ranging protection. Using 12 years of data from 2002 to 2014 on movements from the partially migratory Ya Ha Tinda elk herd, we applied an improved net squared displacement method to classify elk as residents or migrants and identified the major corridors used by migratory elk to reach summer ranges. On average 51% of the population was resident and 49% was migratory. We identified six major migration routes and quantified how proportional use of these routes has changed over time as the population has declined. The proportion of the population migrating along 5 of the 6 migration routes has declined while one has increased during this period. The largest drop in use (from 33% to 19%) was on the western route along the Red Deer River drainage, whereas there was an increase (from 4% to 26%) in elk migrating eastward onto low elevation, industrial forestry lands. We report on the variability in timing of migration between years and between migration routes and examine how greenness indexes, predation risk, and burning influence when and where elk migrate. We discuss the importance of considering landscape changes on population-level migratory behaviour when protecting migratory ungulates.

Nicola Koper, Claire Curry, Bridget Antze: University of Manitoba, and Miya Warrington: St. George’s University, Grenada, WI.

Effects of energy infrastructure operating noise on behaviour of savannah and Baird’s sparrows. New oil and gas wells are continually being drilled across the Great Plains, but we have little understanding of their impacts on grassland songbirds, or the reasons for these impacts. We evaluated effects of oil well pumpjacks and screwjacks on behaviour of two species of grassland songbirds in southern Alberta, Canada, from 2012-2015. To determine whether effects of infrastructure were caused by noise, in our design we included active wells, silent (inactive) wells, sites that lacked oil infrastructure but included large-scale continuous playbacks of infrastructure noise, and control sites with no infrastructure or playbacks. Behavioural experiments demonstrated that some observed effects may be caused by a breakdown in communication among birds in noisy sites. Adult Savannah sparrows did not respond appropriately to conspecific alarm calls in the noisiest sites. Alarm calls and songs of sparrows differed in frequency and amplitude in noisy and quiet sites. These species show some ability to alter their songs and calls to minimize effects of frequency masking by noise, but cannot effectively compensate for these effects in the presence of some types of noise.


The Use Of Citizen Science To Identify The Factors Affecting Bird-Window Collision Risk At Residential Houses. Bird-window collisions have been identified as a large source of mortality for North
American birds. However, it remains poorly understood which types of buildings and windows are most problematic. Understanding whether neighbourhood type, yard conditions, house attributes, or window types have the largest effect on collision rates is crucial for identifying which mitigation options might be most effective. A citizen science project was developed to gain a better understanding of the factors affecting collisions at residential houses. Factors at the yard level had the best model fit for predicting bird-window collision risk. Efforts to reduce collisions should target variables at this level and those factors that attract birds to an individual yard. As few homeowners are likely to take an approach that reduces the number of birds in their yards, focus should instead be given to bird-friendly urban design and developing the most effective window deterrents.

Andrew Ladle, Tal Avgar, and Mark S. Boyce: University of Alberta, Department of Biological Sciences

Camera-Based Geostatistical Modeling Of Human Recreational Activity. The use of wilderness by recreationists can be important in animal habitat selection and behaviour. Due to the difficulty in obtaining data, ecologists tend to use coarse metrics such as linear feature density, whereas the extent and timing of recreational activity is often ignored. Remote sensing equipment and its increasing use in ecological studies allows for large volumes of data on human activity to be collected. However, analysis of these data can be challenging. Using a two-stage modelling approach, we developed a method of estimating spatial and temporal variation in motorised and non-motorised activity across a complex linear-feature network. Trail cameras were set up between 2012-2014 to monitor motorised and non-motorised activity at 238 different trail locations across a 2,824km² region of the eastern slopes and foothills of central Alberta’s Rocky Mountains. Temporal variation in recreational activity was high, with the highest probability of activity taking place during the day, on long weekends and in the summer months (July, August). Activity was also inversely associated with average daily rainfall. Spatial interpolation using kriging was used to estimate pockets of the landscape with a high probability of recreational activity, mostly in the protected areas for non-motorised activity, and in the area of advertised ATV trails for motorised use. The trails surrounding Hinton all saw high probabilities of both motorised and non-motorised activity. This method offers a straightforward analysis that allows researchers to estimate both spatial and temporal variation in activity using remote cameras.


Forbidden fruit: Human settlement and abundant fruit create an ecological trap for an apex omnivore. Habitat choice is an evolutionary product of animals experiencing increased fitness when preferentially occupying high-quality habitat. However, when presented with novel conditions, an animal’s assessment of habitat quality may be poorly matched to its fitness resulting in an ecological trap. Here we use demographic and movement data for grizzly (brown) bears in an area with rich food resources and concentrated, human-settlement to test for an ecological trap. Our results demonstrate that a valley high in berry resources and human density was more attractive than surrounding areas and that bears occupying this region faced 17% lower apparent survival. Despite lower fitness, we detected a net flow of bears into the trap
contributing to a study-wide population decline. These results demonstrate the presence and pervasiveness of an ecological trap for an apex omnivore that lacks the evolutionary cues to assess tradeoffs between food resources and human-caused mortality resulting in maladaptive habitat selection.

Lionel Leston, and Erin Bayne: University of Alberta. Mixture modelling and occupancy modelling of birds recorded by autonomous recording units in boreal wetland landscapes. Autonomous recording units (ARUs) are increasingly used to replace human observers on point count surveys across extensive study areas, particularly in poorly accessible habitats (e.g. wetlands, roadless areas). Preprogramming of battery-powered ARUs enables them to record at multiple specified intervals during the day or night, making them equivalent to multiple human visits per site, and reducing field work involving ARUs to deployment and pickup. In contrast to training field technicians to identify birds, time identifying birds is spent in the lab listening to recordings; however, the permanence of ARU records means that recordings can be evaluated repeatedly by the same or different persons, enabling assessment of observer effects. ARU-based point counts differ from traditional point counts in that accurate distances to individual birds in ARU recordings cannot be estimated. This means that researchers using ARU-based point counts cannot use distance-sampling methods to estimate densities of birds after accounting for detection probability declining with increasing distance of individual birds in different habitats; however, as ARU-based surveys may facilitate multiple recordings or visits per site, ARU-based point counts can be analyzed with mixture-modeling or occupancy-modelling methods to obtain better estimates bird abundance after accounting for non-distance factors affecting detection probability. Using the Le Conte’s Sparrow Ammodramus lecontei “a poorly studied wetland and grassland bird, we demonstrate how to use R to run mixture models and occupancy models of Le Conte’s Sparrow abundance and presence/absence, as recorded by ARUs deployed in boreal forest wetlands in northern Alberta.

Jeff MacAdams, Morgan Hocking, Ben Koop, and Brian Starzomski: University of Victoria. Environmental DNA detection of stream fish. Conventional monitoring of stream fish requires methods that are often harmful to the animal and their habitat, as well as considerable investments of time and taxonomic expertise. New methods have recently emerged that allow detection of aquatic animals simply from collecting stream water and extracting their DNA that has been shed to the environment (eDNA). My objective is to determine if this method can be applied quantitatively to monitor freshwater fish populations, specifically juvenile salmon. A series of experiments conducted at Goldstream hatchery, near Victoria, BC, address two key questions: What is the minimum fish density necessary for detection with eDNA? And, what is the relationship between fish density and quantity of DNA in the water? These experiments are designed to address known knowledge gaps in the field including the persistence of DNA in the environment after species have left the area, the effect of stream discharge and settling on DNA concentration, and the quantitative relationship between fish density and eDNA concentration. These experiments, which calibrate the method in controlled conditions, are the reference point against which field samples are compared. We surveyed fish communities using minnow traps and seine net in five study streams on BC’s Central Coast,
spanning a range of habitat types and biochemical composition. We have found high correlation between conventional and eDNA detection methods across this range of environmental variation. We also map the distribution of juvenile coho salmon through multiple tributaries of a productive salmon system.

Doug MacNearney, Barry Nobert, Karine Pigeon, and Laura Finnegan: FRI Research.

**Caribou behaviour and calving success in relation to oil and gas development: are all disturbances created equal?** Woodland caribou in Alberta are listed as a species at risk under federal and provincial legislation, due in part to the direct and indirect effects of oil and gas development within caribou range. Restoration of caribou habitat will play a critical role in the recovery of caribou, and restoration efforts will be most effective if directed towards actions that yield quantifiable improvements in habitat quality, survival, and reproductive success for caribou. Currently, areas disturbed by industrial infrastructure such as well sites, pipelines, roads, and seismic lines are treated equally despite a wide range in human activity and regeneration stage that may influence how caribou respond to these features. With the goal of refining priority areas for restoration for caribou, we investigated the relationship between caribou calf survival and the density, activity status, and regeneration stage of disturbance features. Results will be discussed in the context of prioritizing habitat restoration efforts and reducing future impacts of industrial development on woodland caribou in Alberta.

Cam McClelland, Anja Sorensen, Gord Stenhouse, Terry Larsen, and Sarah Milligan: FRI Research

**Citizen Science And Estimating Grizzly Bear Populations In The Yellowhead Bear Management Area.** In Alberta, efforts to estimate grizzly bear population size and trend have, to date, utilized costly DNA mark-recapture studies using barbwire hair traps. Researchers in Scandinavia have reduced costs by working with hunter volunteers to collect scat samples for DNA analysis. The goal of this project was to develop a non-invasive scat based DNA approach for estimating grizzly bear population distribution and abundance by engaging volunteer citizens, particularly hunters and trappers, in the collection of scientific information. To address the unique needs of this project, the research team developed a multi-platform smartphone application to gather the necessary spatial data accompanying scat samples, and importantly, communicate results back to participants. With the cooperation of local Fish and Wildlife offices, scat collection kits were made available for interested volunteers throughout the Yellowhead bear management area (BMA 3). Transects were also delineated throughout the study area and walked by researchers to supplement citizen data. While participation in this pilot project was limited, the development of the smartphone application provided us with a useful tool for future population monitoring and inventory work. This project identified important considerations for designing studies which rely on citizen scientists and data collection. Engaging citizens in scientific enquiry can be a powerful tool for biologists and
Logan McLeod: University of Alberta, Erin Bayne: University of Alberta, Kiel Drake: Bird Studies Canada, Peter Solymos: Alberta Biodiversity Monitoring Institute, and Daniel Yip: University of Alberta

**Estimating the population size of Yellow Rail using passive acoustics.** The Yellow Rail (*Coturnicops noveboracensis*) is one of the least understood birds in North America. They are not well sampled by standardized bird surveys such as the Breeding Bird Survey or even the Marsh Monitoring Program due to their secretive behaviour and tendency to call only during the middle of the night. In Alberta, most of our existing data was collected as part of industrial Environmental Impact Assessments (EIAs) and post-approval monitoring programs required by government. New data suggests that boreal fens in Northern Alberta may be more important for Yellow Rail than previously thought. Yellow Rail habitat in this area is under threat because fens are being lost to oil sands development. Passive acoustic monitoring, using fixed recording stations, has enabled us to detect and effectively monitor presence and absence of these birds. However, reliable estimation of the size of populations is necessary for informing management and conservation decisions. Density estimation using passive acoustic data is a relatively new field and it presents unique challenges. To be confident in our population estimate we accounted for several confounding factors: the distance over which Yellow Rail can be detected by a recorder, the detection probability (p) given a bird is present, our ability to discriminate multiple individuals calling at the same location, the impact of stratified sampling effort across variable wetland habitats, and the accuracy with which habitat could be classified to strata. Using this approach we present an estimate for the population size of Yellow Rail in Northeast Alberta.

Andrea Morehouse and Mark S. Boyce: University of Alberta.

**Grizzly bears without borders: monitoring grizzly bears in southwestern Alberta.** Agricultural grizzly bear-conflicts have increased in southwestern Alberta since 1999, possibly because of an increased grizzly bear population. The last grizzly bear population estimate for southwestern Alberta was 51 in 2007. We monitored grizzly bears using non-invasive genetic sampling and established 899 bear rub objects across the study area in BMA 6 during 2013 and 2014. We visited rub objects every 3 weeks from late May through early November (7 occasions/year). We allowed for opportunistic hair samples, e.g., trapped bears and at bear-conflict sites. We determined individual identity and sex via analysis of nuclear DNA extracted from hair follicles. In total, we identified 164 grizzly bears. Using spatially explicit capture recapture models, we estimated resident bear density. We first estimated density for each sex and year separately. Then, we did not allow density to vary yearly, and estimated a single density for each sex. Pooling data, we derived an abundance estimate of approximately 68 (95% CI 53 – 87) resident grizzly bears, a 4.2% per year increase since 2007, although we recognized that density varied between years. The population of bears using the study area, and potentially involved in conflict, estimated using traditional capture mark-recapture models was considerably higher (169 bears, 2013 SE=18, 2014 SE=24). Management decisions should consider both metrics. Over 50% of the bears we identified had been previously genotyped in Montana or British Columbia, highlighting that this bear population is not limited
to Alberta. We recommend increased inter-jurisdictional monitoring and management of this international grizzly bear population.

Libby Natola and Theresa Burg: University of Lethbridge. 

**Effects of migration on genetic variation in Sphyrapicus varius sapsuckers.** Evolutionary biologists study the forces driving evolution. Gene flow is a major evolutionary force, but its effects are often difficult to quantify due to the complexity of evolution. Migration, including seasonal migrations exhibited by many animal species, provides an opportunity for gene flow. Three closely related sapsucker species (*Sphyrapicus varius*, *S. nuchalis*, and *S. ruber*), are very similar in behaviour, ecology, and life history, but exhibit a range of migratory behaviours, with complete migrations (*S. varius*), partial migrations (*S. nuchalis*), and year round residency (*S. ruber*). These three species provide a unique opportunity to test the contribution of migration on gene flow because their similarities reduce possible confounding variables. I have compared measures of gene flow using a combination of mitochondrial and nuclear DNA markers in 488 sapsuckers collected from across the entire range of each species to test the hypothesis that migratory behaviours cause different levels of population differentiation. I predict that non-migratory *S. ruber* populations are the most genetically different from each other because they have the least opportunity for gene flow and migratory populations of *S. varius* will have lower levels of differentiation. These findings contribute to our understanding of evolutionary patterns and processes, particularly migration and gene flow.

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Eric Neilson and Stan Boutin: University of Alberta. 

**Moose refugia from predation by wolves near mines in the Athabasca oil sands.** The introduction of novel prey refugia can destabilize predator-prey densities due to decreased predation rates and subsequent increased prey population growth. Areas near human disturbance may become a refuge when predators are more likely to avoid human activities than their prey. I examined the extent to which moose (*Alces alces*) could be released from predation in winter near Alberta’s Athabasca oil sands due to wolf avoidance of mining infrastructure. Using moose and wolf GPS telemetry collected in the Athabasca oil sands region I estimated the distribution of moose home ranges and wolf territories using second-order resource selection functions. Whereas moose were more likely to be found near mines, wolves avoided areas within five km of mines when selecting the location of their territories. I will present the full results of the habitat selection models and discuss potential consequences for the moose population around the Athabasca oil sands. Understanding how human activities alter the spatial distribution and interactions of species in the heavily developed Athabasca oil sands region will enable industrial and government managers to plan regional land use strategies accordingly.

Janet W. Ng, Erin M. Bayne, and Troy I. Wellicome, Department of Biological Sciences, University of Alberta. 

**Integrating Home Range And Density Models Can Improve Habitat Predictions For Ferruginous Hawks (Buteo Regalis).** Integrating home range and density models can be a hierarchical approach that incorporates landscape-scaled spatially-explicit population parameters with home range habitat selection. Our
The objective was to evaluate whether home range models for Ferruginous Hawks (*Buteo regalis*) can be scaled up to predict nest density and to evaluate whether conservation and recovery planning can benefit from integrated home range and density models. We developed a home range habitat selection model using nests (n=1,309) that were used between 2004-2010 and we also developed a density model using surveys conducted in 2012 and 2013 (n=223). Home ranges and density surveys were located across a gradient of landcover types and industrial development in Alberta and Saskatchewan, Canada. Both models were validated using independent data sources. Home ranges were more likely to be selected in close proximity to grassland, but were also slightly positively associated with edge density. However, nest densities were strongly predicted by the proportion of surrounding grassland and were highest in areas with 49% grassland. Results from our home range and density models show a hierarchical influence of landcover on Ferruginous Hawk habitat selection. If management recommendations were solely based on home range models, grassland landcover would be identified as important habitat, but the landscape-level mosaic of grassland and cropland associated with high nest densities would not be recognized. At-risk species population management can benefit from habitat modeling such as ours, when that modeling is linked to spatially-explicit density estimates.

**John Paczkowski**, and **Sandra Code**, Alberta Environment and Parks

*Monitoring wildlife and human activity in designated wildlife corridors around Canmore, Alberta.* Alberta Parks in partnership with the Town of Canmore (TOC) are currently monitoring human and wildlife activity in wildlife corridors in the Bow Valley around the Town of Canmore, Alberta. This project comes in response to the TOC initiative called the “Human Use Management Review” (HUMR). The HUMR aims to develop clear achievable recommendations to address human use in wildlife corridors, identify the resources required and available, create an implementation plan with clear understanding of who is responsible for what, and have clear metrics in place to measure success ([www.canmore.ca](http://www.canmore.ca)). Specific implementation actions of the HUMR plan include: Improved signage, education, enforcement and trail decommissioning.

In order to monitor the effectiveness of the HUMR process Alberta Parks has deployed 90 cameras to date throughout the Bow Valley and plan to continue monitoring these cameras until at least May 2017. The cameras are systematically distributed at one camera per square kilometre and at higher densities in identified corridors. Half of the cameras are set on wildlife trails and half on human use trails in a checkerboard pattern. Interim results indicated that human activity in wildlife corridors is much higher than expected and wildlife use of these areas is very low. We hope that as we implement the HUMR plan in the coming years, we will see an increase in wildlife activity in wildlife corridors.

**Dee Patriquin**: Solstice Canada Corp.

*Beaver Hills Bioblitz: Bringing Biology to the People.* The Beaver Hills Bioblitz started in 2014 as a winter event intended to raise awareness of the role biologists play in managing the wildlife and habitat resources of the province. Initiated by ACTWS, with other partners, it has become an annual event, used to promote a variety of initiatives, citizen science projects and wildlife research projects. An associated citizen science project with the University of Alberta's
Augustana campus has provided annual winter tracking data for Miquelon Lake Provincial Park, as well as providing students with valuable skills. Although not yet truly a full ‘bioblitz’, with an inventory of wildlife resources in an area, the event has succeeded in building awareness and public interest in wildlife conservation, one of the other key goals of such events. This talk will highlight early outcomes of this newly established event, including an unexpected opportunity to build a broader community around wildlife conservation and support of the proposed UNESCO Beaver Hills Biosphere Reserve.


**The road less travelled: integrating elk habitat selection and movement.** Wildlife selection and movement behaviour in response to roads has varied and contradicted between systems. Roads can be perceived as risky or refuge, resulting in avoidance or selection of the area. Further, roads have been found to promote or impede movement by reducing friction of travel or creating barriers due to perceived risk or resulting mortality, respectively. Disentangling the effect of roads on elk selection and movement necessitates a comprehensive approach. Integrated step selection analysis (iSSA) uses conditional logistic regression to estimate selection and movement while incorporating spatial and temporal variation. We investigated fine scale habitat selection and movement of elk, with a focus on the response to roads using iSSA applied to GPS relocation data obtained from 150 elk collected from 2007 to 2013 during the winter season. After accounting for core movement and selection processes, we found that elk avoided roads and this response was sensitive to time of day. Avoidance was greatest during active foraging times (twilight), and lowest during times of low traffic (night). Elk moved greater distances when they were closer to roads, indicating a possible flight response to human disturbance. Findings from this research can inform management decisions pertaining to elk winter range habitats, which will help to maintain a viable elk population on Alberta’s rapidly changing landscapes.

Tara Russell and Danielle Pendlebury, Canadian Parks and Wilderness Society, Northern Alberta.

**Planning For Large, Connected, Protected Areas In Alberta.** We are facing a rapidly changing world where even moderate climate projections in Alberta predict a significant loss of boreal forest habitat by the end of the century. Species migrations and adaptations to this change will be even more challenging with the amount of fragmentation and lack of representative protected areas on the Alberta landscape. Protecting large, connected areas would address many of these adaptation challenges as well as contribute significantly to reducing the impacts of climate change.

This presentation will highlight CPAWS Northern Alberta’s work in conservation planning by discussing how our Conservation Blueprint of Northern Alberta and Caribou Range Planning projects are identifying large, connected, candidate protected areas in the province. Our Conservation Blueprint is a comprehensive GIS analysis using Marxan that takes into account coarse, landscape-level features as well as finer scale habitat preferences of at-risk species to identify priority conservation areas in Northern Alberta. Our Caribou Range Planning project assesses the status and threats for each caribou herd in Alberta and recommends priority areas for reclamation and protection. The federal recovery strategy requires provinces to complete range plans for all caribou herds by 2017,
presenting an important opportunity for the provincial government to create protected areas that will help ensure the long-term sustainability of the species. We will also discuss how CPAWS Northern Alberta is continuing to work in engaging citizens, government, First Nations communities, and industry in creating conservation solutions through the province’s regional land-use planning and caribou range planning processes.

Jim Schieck: Alberta Innovates – Technology Futures

**Understanding ecological change: what should we track?** Human development and habitat conversion in have already affected habitat and native species in Alberta, and these effects are expected to grow as development continues. Understanding the changes is critical to support management, and careful planning is required to ensure the appropriate response variables are tracked. Management information needed falls into two general categories: i) understanding how is the environment is changing to assess whether desired conditions are achieved, and ii) understanding causes of changes so that corrective management can be implemented. Due to broad spatial and temporal interactions among species and ecosystems, rigorously designed regional monitoring is required to track cumulative changes in the environment. This regional monitoring needs to include information about how the habitat/landscapes are changing, plus information on a breadth of species to identify biotic changes that are not closely tied to habitat changes. Special attention is required for species at risk and hunted/trapped/fished species because society is keenly interested in these. The second reason for monitoring “understanding the causes of environmental change“ requires detailed research on stressor-response relationships. This research requires more intensive data collection than that for broad regional monitoring. There are never sufficient resources to conduct detailed research on all species at all spatial and temporal scales; thus stressor-response research usually focuses on biggest changes expected for the highest profile species. Both broad monitoring of environmental change and stressor-response research will be stronger if data collection is integrated so that information that can be incorporated into both types of analyses.

Corey Scobie and Jocelyn Hudon: Royal Alberta Museum.

**Delineating a Yellow-bellied (Sphyrapicus varius)/ Red-naped (S. nuchalis) sapsucker hybrid zone in Alberta.** Ranges of the Yellow-bellied (Sphyrapicus varius) and Red-naped (S. nuchalis) sapsuckers overlap in the foothills of Alberta, but little work has been done to explore possible reproductive interactions between the two. Though molecular work indicates the two are not each other’s closest relative, the two species look very much alike and hybridization is suspected. Our objective was to ascertain hybridization between the sapsuckers, and if confirmed, quantify its extent. From 1995 to 2012, we found sapsucker nests and for each adult scored plumage characteristics that differ between the two species. We used these scores to identify individuals with hybrid characteristics and subsequently to delineate the extent of the hybrid zone. We found extensive hybridization between the two species where their ranges overlap. Individuals with the greatest amount of intermediate plumage characteristics occurred around 51.5 degrees latitude and plumage characteristics varied from almost 100% S. varius at 54 degrees latitude to 100% S. nuchalis at 49 degrees latitude. Across the hybrid zone, the female sapsuckers had plumage characteristics that were more typical of S. varius on average than the males. There
is also evidence that this hybrid zone may be shifting south. This study is the first to confirm hybridization between these two species in Alberta and delineate the geographic extent of the hybrid zone.

Matthew Scrafford and Mark Boyce: University of Alberta.  
Seasonal movement rates and activity patterns of wolverines in northwest Alberta.  
Wolverines (Gulo gulo) are solitary low-density carnivores that preside over large home ranges in remote regions of northern Alberta. To defend home range boundaries, find mates and territories, and detect food for scavenging and hunting, it is believed that wolverines move long distances in short periods of time. However, very little information is available on the movement rates of wolverines. Our aim is to test for differences in wolverine movement rates based on sex, age, season, and time of day. We hypothesize that movement rates can be used to describe important wolverine life history stages, including, denning, mating, exploration, and dispersal. Our research takes place in the lowland boreal forest of northwest Alberta near the town of Rainbow Lake. To calculate movement rates, we used step lengths from 27 wolverines (15 males, 12 females) created from GPS data collected at 2-hour intervals. We found that male movement rates are 3-4 x greater than female movement rates. Wolverine movement rates are greater during the day than at night, greater during the summer than during the winter, and are bimodal in relation to time of day. Movement rates for both sexes increased significantly during the denning period and mating season. Finally, movement rates differed markedly between home range and exploratory movements. We discuss these results in relation to wolverine life history and human activity in the region.

Julia Shonfield and Erin Bayne: University of Alberta.  
Assessing impacts of industrial noise on owl prey availability.  
Noise in an environment can mask signals and pose problems for animals that rely on acoustic communication. Noise may also be an issue for acoustic predators, such as owls, which rely on acoustic cues made by prey to hunt. Impacts on owl hunting ability may not be the primary issue however, if prey availability is affected by noise. A variety of predators prey on small mammals, including owls. Small mammals could be negatively affected if they are more vulnerable to predation in the presence of noise, or alternatively, could be positively affected if predator hunting success declines with increasing proximity to a noise source. We sought to determine if the abundance of small mammals, the main prey source of owls, is affected by chronic industrial noise. We conducted a mark-recapture study in northeastern Alberta by live-trapping small mammals in the summer months of 2014 and 2015 on 1.05 ha grids. The locations of trapping grids were selected based on three noise categories: chronic noise (adjacent to a compressor station), intermittent noise (adjacent to a road) and no noise (adjacent to a forest clearing). We found no difference in relative abundance of small mammals between the three noise categories, so our next step was to analyze whether the capture rate per trap was affected by distance from the noise source. This is the first study to look at whether noise affects small mammal abundance and will contribute to a growing body of research on the impacts of anthropogenic noise on wildlife.

Effects of habitat quality and anthropogenic disturbance on grizzly bear (Ursus arctos) home range fidelity.  
In the Rocky Mountains, grizzly bears (Ursus arctos) are threatened by habitat alteration and human disturbance. To assess the effects of habitat quality and anthropogenic disturbance on grizzly bear home range fidelity, we monitored the movements of 15 radiocollared adult females in the Elk Valley and Stillwater area of southern British Columbia, Canada, from 2008 to 2013. We used a home range fidelity index to quantify the degree to which bears preferred their home ranges over adjacent areas. We found that bears were more likely to remain in their home ranges during years with high habitat quality and low anthropogenic disturbance. However, the magnitude of this effect was small and the results were not statistically significant. We discuss the implications of these findings for grizzly bear conservation and management.
Mountain eastern slopes of Alberta, Canada, grizzly bears (*Ursus arctos*) live in a landscape heavily impacted by industrial development and human disturbance. Grizzly bears frequently utilize the abundance of herbaceous forage in disturbed sites however, their mortality risk increases substantially in these areas. We characterized the role of changing habitat quality and new disturbance features on patterns of home range fidelity and drift by comparing consecutive-year seasonal home ranges for solitary female grizzly bears in the Kakwa region of west-central Alberta. We relied on the geographic technique Spatial-Temporal Analysis of Moving Polygons (STAMP) to examine changes in habitat quality and new development between zones of home range fidelity, expansion and contraction. Areas considered to be high quality habitat were selected at a greater frequency than available and retained in zones of home range fidelity, but also vacated during home range contraction. Areas of decreasing habitat quality were equally present in zones of contraction, expansion, and stability. The proportion of new forest harvest areas and roads developed within the past year did not differ between zones of home range change, but the proportion of new wellsites was higher in contraction zones than stability zones. Our results showed that while considerable drift occurs, changes in habitat quality and recent anthropogenic disturbances cannot account for annual variation in home ranges, suggesting other important factors influencing behaviour and movement.


*Forest Succession and Nutritional Carrying Capacity for Elk since the 1980 Eruption of Mount St. Helens.* Thirty-five years after the eruption of Mount St. Helens (MSH), forest succession in some areas adjacent to MSH has resulted in forest canopy closure and associated loss of the ungulate forage, whereas in highly disturbed areas forage is just now peaking in abundance. We used information from remote sensing and changes in forage abundance from long-term plots to assess the 30-year trend in the nutritional carrying capacity (NCC) of elk given varying trajectories of forest succession across the landscape. We hypothesized that advancing forest succession at high elevations has not offset the decline in elk summer range across the broader landscape. We adapted the FRESH model developed for deer to estimate the number of female elk (animal days) that can be supported at 5-year intervals since 1980. We incorporated data on elk diet selection, forage digestible energy, and elk nutritional requirements from field studies and the literature to estimate available NCC at the stand level. We adjusted stand-level estimates to landscape-level estimates of NCC based on elk home range size and habitat selection constraints related to topographic and human activity to reflect more realistic use of the area. We show a gradient in NCC that reflects initial disturbance severity from the eruption and post-eruption management that supports our hypothesis. We argue landscape-level changes in NCC based on selected elk forage and habitat selection provides an important tool for assessing consequences of current forest succession trends and alternative management scenarios in a spatially explicit context for elk populations in this region.

**Predation risk posed to bighorn sheep by a carnivore community in the rocky mountains of Alberta.** Determining how large carnivores interact to distribute themselves in a heterogeneous landscape is a key first step toward quantifying how they collectively pose risk to their shared prey. During the summers of 2014 and 2015, we collected carnivore scats using detection dogs along 319-km of transects located within bighorn sheep ranges distributed throughout 41 5x5-km grid cells. We use scat locations of 5 predator species to quantify predation risk to bighorn sheep using a multi-species resource selection function and weight the mapped predictions for relative intensity-of-use by each carnivore species using remote camera data from the same 41 study cells. Using the camera-adjusted RSF predictions, we compare relative predation risk to bighorn sheep in the Panther, Dormer, and Red Deer river drainages inside Banff National Park and outside in portions of Wildlife Management Units 416, 417, 418, and 420. Results from this study can be used in management and conservation of Alberta’s bighorn sheep.


**Genetic evidence for fisher re-colonization success in central Alberta: implications for provincial-scale connectivity.** Fisher (*Pekania [Martes] pennanti*) were re-introduced to Alberta’s Cooking Lake Moraine (CLM) in the early 1990s. To date, contemporary individuals were believed to be descendants from re-introduced animals representing a landscape that is genetically isolated from the rest of the province. An alternative situation is that contemporary individuals are closely related to fisher from other parts of the province, which would indicate the CLM is functionally connected to other provincial areas despite being surrounded by vast agriculture. Using a combination of fisher genetic samples from re-introduction populations and across Alberta, wildlife cameras, and GPS collars we are assessing functional connectivity of fisher at both the landscape- and provincial-scales by measuring gene flow and individual movement. Preliminary genetic analyses suggest that fisher in Alberta’s CLM are descendants from other Alberta individuals, representing a failed re-introduction attempt but successful re-colonization of this species to its native range. This re-colonization event suggests that functional connectivity for fisher is much larger than previously thought and exists at the provincial-scale. It provides an example of over-confidence in re-introductions and underestimation in a species ability to disperse and colonize. Importantly, it highlights the importance of critically assessing re-introduction success using genetic techniques.

Mary Toews: University of Victoria, Cole Burton: University of Victoria and Alberta Innovates Technology Futures, and Francis Juanes: University of Victoria

**The Cumulative Effects Conundrum: Mammal Responses To Human Footprint Vary Across Species And Stressors.** A rapidly expanding human footprint is profoundly affecting wildlife distributions worldwide. Managing the cumulative effects of human
footprint with respect to the impacts on large mammals holds promise for conservation and management. However, implementing this approach remains challenging, particularly due to a lack of research at regional scales and subsequent uncertainties in how to manage for multiple species. In addressing these uncertainties, we asked a) is there a strong response by large mammals to footprint at a regional scale, b) is this response most influenced by the cumulative effects of footprint, or are certain features dominant and c) are the species-specific responses to footprint consistent, or are they highly variable, such that community-level implications need to be considered? We used over a decade of snowtrack surveys (2001-2013) coupled with regional footprint data from the Alberta Biodiversity Monitoring Institute to develop generalized linear mixed effects models relating gray wolf (Canis lupus), Canada lynx (Lynx canadensis), coyote (Canis latrans), white-tailed deer (Odocoileus virginianus) and moose (Alces alces) relative abundance to competing models describing variation in human footprint. We found a strong but varied response to human footprint, both to cumulative effects and to individual features. Industrial linear features, agriculture and cutblocks were influential for several species, reinforcing that cumulative effects management must consider footprints across multiple industries. Given the diverse responses of large mammals to land-use dynamics across Alberta’s boreal forest, landscape management must continue to focus on assessing and monitoring the community-level cumulative effects of an expanding industrial footprint.


Movement patterns of two species at risk within an industrial landscape. In Alberta, woodland caribou (Rangifer tarandus) and grizzly bear (Ursus arctos) are two species at risk that are exposed to anthropogenic disturbance from the forestry and oil and gas industries. Anthropogenic disturbance can potentially influence the daily movement patterns and energetic requirements of wildlife. In general, animals are thought to have slow, sinuous movements within relatively high quality habitat, and fast, linear movements across low quality habitat. We are examining how roads, pipelines, seismic lines, well pads, and cut blocks in West-Central Alberta affect the daily movement rates and path sinuosity of caribou and grizzly bears, and whether regeneration levels of vegetation on seismic lines and cut blocks (measured using LiDAR) reduces this effect. Preliminary results suggest that the daily movement rates of both caribou and grizzly bears are best explained by models including the regeneration levels of vegetation and the density of disturbance features. Results will be discussed in terms of the relationship between industrial features and the energetic requirements and movement rates of animals. This study could help inform priorities towards the mitigation of human impacts within the ranges of these species at risk in West-Central Alberta.

Camille Warbington and Mark S. Boyce: University of Alberta.

Estimating Density of Sitatunga in Central Uganda. A well-regulated hunt can provide crucial conservation funds, especially in areas seldom visited by tourists. However, sustainable harvest management requires knowledge about populations and habitats. Sitatunga is a unique, spiral-horned, semi-aquatic African antelope that provides economic incentive for conservation of wetlands, yet we know little about this spiral-horned species. In 2015, we began a
research project to estimate the density of sitatunga in central Uganda using mark-resight population estimation and spatially-explicit capture-recapture models. Although data analysis is ongoing, we calculated a coarse density estimate for sitatunga in the study area of 6.8 per square kilometer (95% confidence interval: 2.7 - 17.1). Future steps in this research include GPS telemetry to facilitate estimation of home range size, habitat use, and activity patterns; mapping the extent of suitable habitat in the study area and across Uganda; and DNA analysis to characterize the genetic diversity of the population, and estimate immigration and genetic mixing among populations. This research will improve harvest management on a local scale, specifically in Uganda, and provide a framework for sitatunga management throughout its range in sub-Saharan Africa. Enhanced harvest management for sitatunga can contribute to sustainable economies in rural Africa and motivate landowners to conserve wetlands.

Catherine Welke, Theresa Burg, Cameron Goater and David Logue: University of Lethbridge.

**Effect of geographic and climatic barriers on genetic variation in white-crowned sparrow populations (Zonotrichia leucophrys).** Gene flow in populations can be restricted by barriers, leading to genetic differentiation and speciation. Barriers that separate populations may be climatic, geographic, or behavioural. In montane systems, gene flow can be restricted between populations separated by large physical barriers and within populations across small distances, for example along elevational gradients where environmental pressures change rapidly with altitude. The influence of barriers on gene flow can be determined by examining patterns in genetic variation. Blood samples from two non-migratory subspecies of white-crowned sparrow (Zonotrichia leucophrys oriantha and Z. l. gambelii) which have strong breeding site-fidelity will be collected from breeding sites in the Rocky Mountains of southern Alberta and British Columbia. Genetic variation will be analyzed using nuclear and mitochondrial loci. I hypothesize that: (1) mountains restrict dispersal in Z. l. oriantha and Z. l. gambelii, (2) gene flow is reduced along elevational gradients and (3) levels of hybridization will be associated with barriers in the contact zone of Z. l. oriantha and Z. l. gambelii. It will be beneficial to use this widespread and ubiquitous species to increase our understanding of the effect of barriers on gene flow in montane habitats, since mountains are important zones for biodiversity. Species with high breeding site-fidelity also have special conservation concerns because they are more sensitive to habitat degradation.

Scott Wilson and Erin Bayne: University of Alberta

**Songbird response to vegetation recovery on reclaimed well sites in the boreal forest of Alberta.** Industry is required to reclaim oil and gas well sites in Alberta with the intention of recovery to an equivalent ecological function as prior to disturbance. Bird community response to forest regeneration following various types of disturbance is well studied. However, limited information exists on how bird communities change with vegetation recovery on reclaimed well sites. This study will use biacoustic methods to determine how bird communities are influenced by well site reclamation efforts. Autonomous recording units (ARUs) were used to determine bird community composition on and surrounding reclaimed well sites (n=43) near Lac la Biche, AB in 2015. Grids of GPS time synced ARUs were deployed at a subset of sites (n=9) in order to use the method of acoustic localization. This method uses the time of arrival
difference of a vocalization to subsequent recording units to triangulate the singing locations of individual birds. Variation in bird community composition based on vegetation characteristics was assessed using Canonical Correspondence Analysis. Relative abundance of individual species was determined using single season N-mixture models. Preliminary acoustic localization data found that alder flycatcher (Empidonax alnorum) and clay-coloured sparrow (Spizella pallida) sang from regenerated well sites. The potential to use bioacoustic methods to collect spatial data on birds will be evaluated. These results will provide insight into the strategies that have been effective in promoting bird use of reclaimed well sites.


**Standardizing audio recording and human observer detection distance for integrated analysis of point count data.** Autonomous recording units (ARUs) are increasingly being used as an alternative or complimentary method of conducting point counts. ARUs give researchers the ability to conduct repeat visits in areas and time periods that are often under sampled due to logistical concerns (i.e. safety, access, remoteness, etc). However, whether count data is impacted by the use of ARUs is a topic that needs further study and integration of ARU and human point count data, especially for long term data sets, is problematic. Here, we investigate detection distances for a variety of species found in the boreal forest region of Alberta. We compared detection distance of four commonly used ARUs as well as human observers and developed corrections to standardize and integrate point count data from different sources.

**Dr. Todd Zimmerling**: President and CEO, Alberta Conservation Association.

**Can Conservation Biologists Survive In The Rapidly Changing, Social Media Ecosystem?** The rapid expansion of social media platforms across the globe has significantly altered the way wildlife conservation occurs today. Whereas 20 years ago public input on a project may have involved a few town hall meetings between biologists and the general public, in locations close to the project area; today’s “public engagement” involves potentially thousands of people from around the world, all communicating in real time, over social media, and very few with any real knowledge of the issue. While climate change may be presenting challenges for various species and the biologists who study them, it is the rapid change in the “social media ecosystem” that conservation organizations need to pay more attention to. The social media ecosystem is a place where information never needs to be verified to be disseminated as truth; where all opinions are considered equal, regardless of the complexity of the topic; where emotion is far more important than substance; where perceived anonymity results in far more ill-mannered and disrespectful comments than ever encountered in face-to-face conversations; and where a well-designed campaign can harness all these attributes to make or break a conservation project, politically or economically. This is the domain of the "Communication Expert" not the biologist and the sooner biologists development a symbiotic relationship with these people the more likely we are to survive in this new and ever changing ecosystem.
**Terrestrial Movement Of Polar Bears (Ursus maritimus) In Response To Ambient Temperature.** The Western Hudson Bay polar bear (*Ursus maritimus*) population spends the ice-free summer months conserving energy on land. Temperature variations impact polar bear behavior and movements. Understanding how polar bear behavior is influenced by temperature is paramount for their preservation. The results of this study will determine how air temperature inland of Hudson Bay influences terrestrial movement rates. Previous research of cold-adapted species like polar bears suggests individual movement could decrease in response to hyperthermia, or warming. Additional studies established that warmer temperatures might cause a decrease in movement as a method of energy conservation. This research examines the influence of ambient temperature on polar bear terrestrial movement rates. Climate change will continue to decrease the amount of time polar bears spend on land. Knowing how temperature influences their terrestrial behavior will contribute to our ability to influence polar bear conservation.

**Human Activity Results In Differential Recruitment For A Partially Migratory Elk Herd.** Seasonal migration of ungulate species is an adaptive behavioural strategy used to reduce the risk of predation while gaining access to high-quality forage. The increasing use of wildlife habitats by humans has led to anthropogenic disturbances that can influence the migratory behaviour of ungulates with implications for predator-prey and population dynamics. Recently, the migratory behaviour of the Ya Ha Tinda elk herd has shifted, with more elk remaining on winter range year-round and more elk migrating to the east of YHT into a human-disturbed landscape, rather than migrating west into protected areas. In 2014-2015, calf:cow ratios were 19:100 for residents, compared to 54:100 for migrants. We address one hypothesis that this shift is related to higher human use of areas that results in a predator refuge. We use a new method to interpolate human use data from traffic counters and remote cameras along trails to predict the distribution of human activity in elk calving areas. Using these predictions we show how the human activity gradient across the study area differentially affects migrant and resident elk during 2 critical time periods: 1-10 days post-calving (when calves are hidden and stationary) and the rest of summer (when calves are mobile). These data will be further used to investigate competing hypotheses that landscape heterogeneity and trade-offs in forage availability and predation risk at multiple scales are driving higher recruitment in the eastern migrants. Our results have implications for persistence of migratory behavior in the face of anthropogenic change.
below the 15-20% threshold necessary to maintain populations. The decrease is largely attributed to increased predation resulting from habitat alteration, specifically loss of native prairie. Buffalo Lake and Viking are centers of duck production hotspots within the Alberta parklands and are the focus of a 2015-2017 study on upland duck nesting success and use of intensive nest predation reduction methods. In both the 2016 and 2017 nesting seasons, each of 200 hen houses installed in the Buffalo Lake region will be visited a minimum of 3 times, and active nests will be regularly monitored for incubation stage and nest fate. Use and predation rates of hen houses will be calculated. From March-July of each study year, professional trappers will target mesopredators including coyotes, skunks, foxes, and raccoons on select upland plots, while corvids will be removed opportunistically. Nest searching will be done on all trapped and control plots at least 3 times per season using the chain-drag method, and active nests regularly monitored. An estimate of nesting success will be determined for both regions, and used to evaluate the efficacy of each management tool. Habitat associations with successful versus depredated nests might help to identify those habitats where nest predators would have least consequence.

Sandra Frey: University of Victoria and Jason T. Fisher: Alberta Innovates Technology Futures.

Is Landscape Development Affecting Species Interactions And Temporal Niche Partitioning In Predator Communities? Understanding the broader consequences of human-mediated apex predator declines is an important step for prioritizing conservation decisions and managing land-use policies. However, given the highly complex interactions between anthropogenic disturbance and differential responses of both apex and mesopredator species, characterizing and disentangling the drivers of carnivore community structure and interspecies interactions poses a considerable challenge. Recently, changes to behavioural patterns (e.g. activity periods) and altered spatio-temporal niche partitioning between predator species has been linked to anthropogenic disturbance. Human-mediated disruption to niche partitioning may limit the capacity of predators to reduce competition and avoid intra-guild predation, thereby compromising community-level biodiversity. Employing a large suite of datasets collected by more than 200 camera traps across western Alberta including the Willmore Wilderness Area, Kananaskis Country/East Slopes, Cooking Lake Moraine, and Elk Island National Park, I am characterizing the functional and demographic responses of mesopredators in relation to anthropogenic disturbance and apex predator occurrence. I am also quantifying imposed changes to niche partitioning manifested as differential spatio-temporal niche overlap within the carnivore guild across a landscape disturbance gradient. Predicting apex predator loss and resultant mesopredator community destabilization has proven particularly challenging given that regional-scale temporal and spatial complexities dominate response profiles. This research will not only extend fundamental ecological theory, but may also help improve conservation-oriented land-use policies.

Jocelyn Gregoire and Erin Bayne: University of Alberta.

Bird Response to Linear Feature Width and Recovery Level. Energy sector growth in Northern Alberta has raised concerns about the effects on the biodiversity of boreal forest ecosystems. Linear features, such as seismic lines, flow lines and pipelines, make up a large component of this industry and represent a significant
challenge to environmental management. Three central issues exist in understanding how to best mitigate the effects of linear features on boreal forest birds: 1) establishing whether the metric of successful mitigation is behavioural or numerical; 2) whether traditional methods of measuring birds (i.e. point counts) are sufficiently precise to measure the desired response; and 3) whether the response is measured locally or at landscape scale. My proposal is to assess the interaction between vegetative recovery and linear feature width and its effect on use/avoidance of edge habitat by boreal songbirds in response to invasive grassland species. To do this, I will use grids of time-synchronized audio recording units along a gradient of linear feature widths and recovery states to conduct acoustic triangulation and locate the position of territorial birds. Experimental trials using playback of various bird species have been as accurate as 9.23 ± 1.16 m. Local models will then be used to predict population level responses which can be compared to population estimates from 50km² grids (600m spacing) established on a minimum of 10 industrial lease sites by members of the Bayne Lab. This research will help to define what is recovered from an ecological perspective and provide industry with an accurate means of evaluating ecological impacts.

Tracey Hammer, Peter Neuhaus, Kathreen Ruckstuhl, and Susan Kutz: University of Calgary.

Causes Of Intra- And Inter-Litter Variation In Susceptibility To Parasitic Intensity And Diversity In Columbian Ground Squirrels (Urocitellus columbianus). Individuals can vary in susceptibility to parasitic infection due to diverse mechanisms which largely fall into four categories: genotype, physiology, behaviour, and environmental conditions. The effect of body size, body condition, and hormones like testosterone on parasite load has been explored in adult wild animals. The strength and direction of these effects can change with external versus internal parasites, modes of transmission, and potency of the parasite. For example, clutch size is correlated in opposite directions depending on the length of the ecto-parasite’s life-cycle, yet is not correlated to internal parasites. Offspring susceptibility to parasites has been little explored and likely varies with mechanisms that create disparities between and within litters. Examples of inter-litter sources of variation are litter size, mother’s age and experience, mother’s body condition, nest location, and nest hygiene. Intra-litter variation is expected to stem from offspring body size, sex, position in litter hierarchy, and paternal genetics. Highly infested offspring are expected to have lower first year survival. These mechanisms will be tested on a wild population of Columbian ground squirrels located in Sheep River Provincial Park, Alberta. Multiple parasites will be tested: two external parasites (fleas and mites) and three gastrointestinal parasites (eimeria, ascarid, and strongylid sp). If sources of intrinsic variation in offspring parasite susceptibility can be determined, this could provide vital information for the conservation of wild species, especially where rodents act as a parasite reservoir or as a main prey source, and also help focus treatment in wild, captive and domestic animals.

Michelle Knaggs, Erin Bayne and Scott Nielsen: University of Alberta.

Effects Of Fire Severity On Bird Communities In Absence Of Salvage Logging In The Northern Boreal Forest. Fire is the most important natural disturbance in the boreal forest, and climate change models predict increased fire frequency and severity due to increases in atmospheric temperature and drought. Songbird
population trends have been declining and it is important to understand how increases in burned habitat on their breeding grounds will affect populations. The objective of this project is to determine the effects that fire severity composition and configuration in the absence of salvage logging has on bird communities in the northern boreal forest. Two large fires that burned southwest of Yellowknife in 2014 provide a unique opportunity to study this. These fires resulted in a study area that is in an accessible region where there is no forestry or salvage logging, creating the opportunity to study changes in bird communities in a naturally regenerating region of boreal forest. A sampling season was completed in 2015 and will be replicated in 2016. Auditory bird surveys are conducted using automated recording units (ARUs). ARUs record sounds in the field that are interpreted visually and aurally by trained individuals using computer software. Preliminary results will be discussed. This will be the first study in the northern boreal forest to investigate the effects of fire severity on bird communities in absence of salvage logging.

Anne Loosen, Andrea T. Morehouse, and Mark S. Boyce: University of Alberta.

Living In Sympatry: Habitat Selection By Grizzly And Black Bears In A Multi-Use Landscape For The Winter. Southwestern Alberta is an important area for maintaining connectivity with wildlife populations in British Columbia and Montana; it is also a biologically diverse and multi-use landscape with agriculture as the primary industry. The area supports populations of both grizzly bears (*Ursus arctos*) and black bears (*U. americanus*), where population-level effects of competition may result in habitat partitioning. While both species use similar food resources, black bears typically have lower nutritional requirements and a higher tolerance for human-disturbed landscapes relative to grizzlies. In 2013 and 2014, we established 899 non-invasive genetic sampling stations to collect hair samples from grizzly and black bears. Rub objects were sampled every 3 weeks from May to November. We identified species, sex, and unique individuals using nuclear DNA extracted from hair follicles. In southwestern Alberta the resident grizzly bear population is growing 4.2% annually and expanding their range eastward, while anecdotaly black bears appear also to be shifting their spatial patterns of habitat use. We hypothesize that relative to grizzly bears, black bears would be more likely to select habitats closer to roads, areas with higher road density, and closer to human settlements. While there are limitations in evaluating interspecific competition based on species habitat selection patterns, the inherent variation across our study area will allow us to evaluate selection patterns based on proximity to human developments and habitat types. We will present preliminary data on the spatial distribution of grizzly and black bear detections in the summer and fall.

Brianna Lorentz and Glynnis A. Hood: University of Alberta, Augustana Campus.

Muskrat Lodge And Push-Up Distribution In Southern Boreal Wetlands. Muskrats (*Ondatra zibethicus*), as a semi-aquatic furbearer, are highly dependent on water levels and adjacent food resources to help them survive northern winters. In some areas, muskrats also act as an indicator species for monitoring changes in wetland ecosystems, such as in the deltas of the Mackenzie, Peace, and Athabasca rivers where both muskrat numbers and water levels have declined. To determine which environmental factors are most influential for winter habitat selection by muskrats, we applied a linear mixed-model approach to analyze the relationship among the
number of muskrat lodges and push-ups relative to various abiotic (e.g., water depth, degree of shoreline development, pond size) and biotic factors (beaver presence, vegetation characteristics). Our study was restricted to pothole wetlands in Alberta’s southern mixed-wood boreal forest. We used a geographic information system to assess lodge location and push-up distribution relative to the most important environmental variables arising from our models. Our research provides greater insight into a species that plays an important role as both predator and prey within wetland ecosystems.

Caitlin Mader and Nadir Erbilgin: University of Alberta.

**Parasitoid Ecology for Urban Forest Pest Biocontrol.** American elms are Carolinean trees that were once an important part of forests in Central-Eastern North America. After they were devastated within their natural range by Dutch elm disease, the urban forests in western Canada and US not afflicted with the disease became refugia for the trees. In these urban environments, other invasive pests continue to plague elms, and as municipalities seek sustainable alternatives to pesticides, biocontrol can be a promising option. However, finding a biocontrol agent that is effective but not damaging is a complicated task often destined for failure. My project examines European elm scale, a common pest on American elms in Southern Alberta, and a tiny Chalcid wasp, which is a potential biocontrol agent. Specifics of most of the wasp’s life history are currently unknown, so I am attempting to uncover them while evaluating the species’ viability for European elm scale control. Along the way I am exploring the interactions between the tree, the pest, and its predators, and how pesticide practices in Calgary have influenced these relationships.

Petra McDougall, Jake MacLaine, and Kathreen Ruckstuhl: University of Calgary.

**Behaviour Contagion Models In Bighorn Sheep.** Social, group-living animals often mimic the behaviours of others because behaving similarly is, in essence, the glue that holds groups together. If individuals pay no attention to one-another and act independently, a social group ceases to exist. Instead, it turns out that behaviours are surprisingly contagious within social groups. We refer to automatic, non-conscious mimicry of behaviours as behaviour contagion. Vigilance behaviour (raising one’s head while grazing) is examined in free ranging, bachelor groups of bighorn sheep (*Ovis canadensis*) to determine which social variables influence the contagiousness of vigilance behaviour. Vigilance bouts were more contagious from older rams and those in closer proximity. Interestingly, association status (the proportion of time individuals spend as nearest neighbours) did not affect vigilance contagion. Older rams are thus expected to be more influential in creating waves of contagious vigilance behaviour, but may also produce more false predator alarms. The increased vigilance contagion of older rams may also contribute to increased leadership and group decision-making by these individuals, but implies that the behaviour of these individuals has a greater effect on the health and survival of the general population in which they belong. Conservation efforts should therefore take measures to protect the older, more influential individuals in a population.


**Response Of Ferruginous Hawks (Buteo regalis) To Transmission Line Construction And Decommissioning.** Human disturbance and
land conversion are driving factors behind the decline of native prairie grasslands across North America, which now occupy under one third of their original range. In Alberta, mixed grasslands have undergone extensive modification for many purposes including agriculture and developments in the energy sector. Transmission lines are continuously developed as urban populations increase and, in parts of Alberta, run through critical habitat for several species. Using a before-after control impact study design and historical data, my research will examine the impact of transmission lines on the provincially Endangered Ferruginous Hawk (Buteo regalis) and assess if these alterations present the opportunity for an ecological trap “a preference for animals to select low quality habitat when high quality patches remain available”. I plan to monitor several measures of fitness (adult and juvenile survival, fledgling rate, nest survival) in addition to comparing nest success rates and nest densities between survey and control blocks along a major transmission line in southern Alberta. Further, to test for the presence of an ecological trap I will be assessing Ferruginous Hawk preference for select landscape features in habitat near and far from the transmission line. My results have the potential to assist in key management decisions at both the federal and provincial level and will help to improve our understanding of how Ferruginous Hawks are specifically affected by the presence of transmission lines.

Jed Petit, Evelyn Merrill, Joshua Killeen, Holger Bohm, Jodi Berg: University of Alberta and Mark Hebblewhite: University of Montana.

Density-dependent Winter Habitat Selection by Elk in the Ya Ha Tinda. Density-dependent habitat selection is a process by which preferential use of certain habitats on the landscape varies as a function of population density. Most research in this field indicates that at higher densities, animals are forced to seek out less desirable habitats. For ungulates, these less desirable habitats have been shown to include areas of high predation, low forage abundance, or high anthropogenic activity. Using elk GPS-location data spanning 13 winters (2002/03 – 2014/15), we investigate how habitat selection by elk on the winter range at Ya Ha Tinda Ranch in the Canadian Rocky Mountains is changing in response to declining population density. We have defined winter as November 1 to April 12 based on 95% of migrants being on the winter range during this time period. We employ a resource selection approach in which we compare elk locations to random points generated within a 95% minimum convex polygon (MCP) of the winter range. Covariates include plant biomass, distance to forest edge, distance to road or ranch facilities, wolf and cougar predation risk, weather variables and elk density. Habitat covariates are measured within a buffer with the radius equal to the median distance travelled by elk between 2-hour fixes (~175m). We test for changes in habitat selection by examining density-covariate interactions. Using these methods, we assess how elk habitat selection is affected by population density in winter and how this may influence the changing migratory patterns of Ya Ha Tinda elk.

Lisa Takats-Priestley and Chuck Priestley: STRIX Ecological Consulting.

Evidence of Partial Migration, Encounters of Northern Saw-whet Owls from Banding Stations in Alberta and Saskatchewan. Movements of banded Northern Saw-whet Owls (Aegolius acadicus) have been monitored extensively during spring and autumn in eastern North America, and re-encounter data indicates that Saw-
whets migrate in a north-south direction. Since 2002, researchers have established 12 monitoring stations in western Canada and have banded almost 10,000 owls during autumn, in Alberta and Saskatchewan, Canada. The first in Alberta began in 2002 at Beaverhill Lake (Beaverhill Bird Observatory), then Bragg Creek in 2003 (Calgary Bird Banding Society) Lesser Slave Lake Bird Observatory and Pletz Park near Millet (H. Pletz) in 2004, Gehlert’s Grove near Lindbrook in 2009 (B. Gehlert), and North Ministik in 2014 (L. Priestley and C. Priestley). In Saskatchewan, Matador was established in 2003, Last Mountain Lake National Wildlife Area (R. Dickson), Langham (M. Blom) and North Saskatoon (M. Stoffel) in 2004, Edenwold in 2006 (J. Clarke) and Nisbet Forest north of Prince Albert in 2007 (H. Fisher). Re-encounters of banded Saw-whets appear to be common in regions where banding effort is high. For example from 2002-2007, 61 band encounters were reported from these stations. We present re-encounter data from 2002 through 2015 which shows Saw-whet Owls in Alberta and Saskatchewan employ more than one movement strategy during the non-breeding season, including migrating, overwintering in the region, and further evidence of nomadism. This suggests the species is a variable partial migrant in these two prairie provinces. The direction of movement is likely influenced by the presence of suitable habitat en route.


Using Spring Arrival Dates And Singing Rate To Inform Habitat Quality For The Olive-Sided Flycatcher (Contopus cooperi). Boreal bird populations in North America are declining. Resources for conservation are limited, making it necessary to identify the highest quality habitat to protect. Identifying quality habitat requires knowledge about population density as well as individual reproduction and survival rates, which can be challenging and time consuming to determine. More efficient methods of measuring habitat quality are required. Acoustic recording techniques may provide the answer. Studies suggest spring arrival timing of birds can be used to infer habitat preference and birds who arrive first have the greatest number of choices of what habitat to select. Migratory songbirds sing to defend a breeding territory upon arrival to the breeding grounds. Therefore, comparing habitat-specific arrival dates using acoustic recordings to detect the first singing date in different habitats may provide a better index of habitat quality than simply bird abundance. Autonomous recording units (ARUs) can be used to record at hundreds of locations simultaneously, making large-scale comparisons of songbird arrival date and song rate in different habitats possible. My study will investigate the use of ARUs to collect arrival date and song rate information on the federally threatened Olive-sided flycatcher (Contopus cooperi) to determine habitat quality across their breeding range in the western boreal forest (ie. the Northwest Territories and northern Alberta). Field work will also include other measurements of habitat quality, including predator and prey abundances and behavioural indicators of reproductive success.

Phil Walker, Darcy Visscher, Keri McFarlane, Lucus Nanninga, Katie Dejong, Keelaina Loewen, and Karli Witter: The King’s University.

Non-Invasive Monitoring Of A Recolonizing Wolf Population In The Beaver Hills. Wolves have recently recolonized the Beaver Hills, which is a unique boreal forest eco-region embedded in the aspen parkland east of Edmonton. The re-establishment of this population...
may be aided by the presence of two protected areas in this region; Elk Island National Park (EINP) and Cooking Lake-Blackfoot Provincial Recreation Area (BPRA). The recolonizing of an apex predator may result in increased predation of livestock and may also result in trophic consequences within the protected park. To examine the status of this recolonizing wolf population we have been conducting non-invasive analysis based on remote camera observations and faecal samples. Remote cameras have been maintained throughout BPRA and along the shared border with EINP. Each month images are downloaded and species identified. These images can be used for an estimate of the recolonizing wolf population’s status, and additionally analysis of habitat selection. We are using faecal samples collected along the trail system of BPRA to monitor population changes using genotyping and genetic mark-recapture techniques. We are currently developing protocols for DNA extraction, amplification, and species identification using markers unique to canids in central Alberta. Faecal samples are also being used to estimate diet. Species determination is based on associated sign and tracks and confirmed in the lab with molecular tools. Published protocols and methodologies are being used to identify guard hairs with known hair libraries and identification keys. This will allow us to estimate the relative contribution of prey species to wolf diet and determine dietary overlap and competition with coyotes.

Camille Warbington and Mark S. Boyce: University of Alberta. 

**Estimating Density of Sitatunga in Central Uganda.** A well-regulated hunt can provide crucial conservation funds, especially in areas seldom visited by tourists. However, sustainable harvest management requires knowledge about populations and habitats. Sitatunga is a unique, spiral-horned, semi-aquatic African antelope that provides economic incentive for conservation of wetlands, yet we know little about this spiral-horned species. In 2015, we began a research project to estimate the density of sitatunga in central Uganda using mark-resight population estimation and spatially-explicit capture-recapture models. Although data analysis is ongoing, we calculated a coarse density estimate for sitatunga in the study area of 6.8 per square kilometer (95% confidence interval: 2.7 ± 17.1). Future steps in this research include GPS telemetry to facilitate estimation of home range size, habitat use, and activity patterns; mapping the extent of suitable habitat in the study area and across Uganda; and DNA analysis to characterize the genetic diversity of the population, and estimate immigration and genetic mixing among populations. This research will improve harvest management on a local scale, specifically in Uganda, and provide a framework for sitatunga management throughout its range in sub-Saharan Africa. Enhanced harvest management for sitatunga can contribute to sustainable economies in rural Africa and motivate landowners to conserve wetlands.