ACA grants in biodiversity

biennial report

2014/2015

Alberta Conservation Association

Dear Conservationists,

Twenty years ago biologist Bill Samuels had a vision for a research program that provided small research grants to students with a simple and broad objective: "to better understand the flora and fauna of Alberta." Through the support of all of you – representing the angling, hunting, research, government and industry communities of Alberta – the ACA Grants in Biodiversity program was born.

Twenty years, 4.5 million dollars and 444 graduate students later, we have come a long way in increasing our understanding of the biological diversity in this province, and we want to continue to highlight the most recent stories of conservation research with you. Stories that we have all been wondering but unable to answer, such as: *Why is that poplar canker growing in the nurseries? Do moose really use human development to avoid wolf predation? What makes the bighorn sheep big? What is the impact of agricultural run-off on waterbirds and invertebrates? And of course, what are the impacts of human disturbance on ground beetles assemblages?* Of varying scale, scope and perspective, these stories all increase our ability to make informed decisions to conserve the wildlife and natural resources around us.

There is also another change that has occurred this year: the ageless and bearded face of Lee Foote is no longer smiling up at you from this page! As I take the reins as third Director of this program, I want to acknowledge the great work and dedication Lee provided (and continues to provide) to this program and the mentorship he has shown me.

I want to thank Program Administrator Tracy Stewart and the most recent Adjudication Committee: Peter Aku and Doug Manzer (ACA), Mary Reid (UCalgary), Theresa Burg (ULethbridge), and Lee Foote (UAlberta), and Peter MacConnachie (Suncor) for their insight and experience. Coupled with the input of many anonymous reviewers, we have yet again awarded funds to another crop of excellent student research projects.

Lastly, I want to express my appreciation to Syncrude for their generous five year contribution to our program. The ACA Grants in Biodiversity is an innovative model that is admired across the country, and I look forward to working with all of you to keep it that way and make it even better.

John K. Pattison
Director, ACA Grants in Biodiversity

John K. Pattison
ACA Director

Tracy Stewart
ACA Adminstrator

SPONSORED BY

Syncrude

Photo Acknowledgements

Unless otherwise noted, photos are credited to the grant recipient.

Cover photo: Heather Polan

A breeding pair of American Avocets.

Final Reports
of students funded
2012 and 2013
2 to 40

Progress Reports
of students funded
2014
41 to 51

Final Reports

Influence of Physical Barriers on Dispersal of a Resident Songbird in Riparian Habitat

Year 2 Final Report

Rachael. V. Adams
University of Lethbridge, Ph.D.
Dr. Theresa M. Burg, Supervisor

Habitat loss and fragmentation affects the survival of populations by restricting the ability of individuals to disperse across landscapes. Dispersal corridors promote connections and play important roles in maintaining genetic variation of natural populations inhabiting fragmented landscapes. In the prairies, forests are restricted to riparian areas along river systems which act as important dispersal corridors across large expanses of grassland habitat. For species such as chickadees which are dependent on forests, the grasslands represent a barrier to dispersal whereas forested riparian habitat facilitates movement.

Mist net extraction of a black-capped chickadee

Within riparian corridors, natural (e.g. treeless canyons) and man-made (e.g. dams) barriers have fragmented these continuous linear features. Using genetic markers, my aim was to assess the influence of these barriers on dispersal of a common, resident songbird, the black-capped chickadee (Poecile atricapillus). I collected blood samples from 343 individuals from 28 locations along 10 river systems in Southern Alberta, and found evidence of five genetically distinct groups. Natural gaps in forest cover (≥ 100 km) appear to restrict movement, whereas man-made barriers have no significant effect on dispersal. Furthermore, changes in forest composition (e.g. cottonwood hybrid zones) correspond to some of the observed patterns. My work 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 environment. This information can facilitate predictions of their response to future change and promote effective management strategies to maintain genetic integrity of populations/species and ultimately, their survival.

Movement and Habitat Use of Long-Toed Salamanders in Waterton Lakes National Park

Year 2 Final Report

Matthew R. Atkinson-Adams
University of Alberta, M.Sc.
Dr. Cynthia A. Paszkowski, Supervisor
Dr. Garry J. Scrimgeour, Supervisor

Amphibian populations can vary widely in size through time in response to natural or anthropogenic factors that influence the success of breeding and recruitment. Many populations undertake annual migrations from terrestrial areas, used for foraging and overwintering, to and from aquatic breeding sites. The connection of terrestrial to aquatic habitats allows these populations to persist. Being able to characterize migration routes and suitable terrestrial habitats can help with conservation planning for populations threatened by anthropogenic disturbances. The long-toed salamander population at Linnet Lake in Waterton Lakes National Park showed an estimated 60% decline in size from 1994 to 2009. This decline was attributed to road mortality of adults during the annual breeding migration intercepted by a road that separates terrestrial over-wintering habitat from the aquatic breeding site. To stem the decline, Parks Canada installed four under-road wildlife crossing structures (tunnels) in 2008 to reduce road mortality during salamander migrations. In 2013 and 2014, I investigated movement patterns of migrating adult long-toed salamanders in this population by implanting individuals with microchips and using specialized equipment to relocate them in the terrestrial environment and monitor tunnel use. I found that migration overlapped heavily with two of the four tunnels, and that microchips are a useful alternative to cameras for monitoring tunnel use. This technology allowed me to locate overwintering salamanders and to document that Linnet Lake salamanders do not need to cross the road to overwinter successfully. bat fatalities at wind turbines, and this discovery may also lead to mitigation strategies.

Identifying a recaptured long-toed salamander that has been implanted with a microchip.

Patterns of Ageing in Populations of Duckweed

Year 2 Final Report

Patrick M. Barks
University of Lethbridge, Ph.D.
Dr. Robert Laird, Supervisor

Most organisms are subject to age-related deterioration (commonly known as 'ageing') – a seemingly maladaptive phenomenon that is nonetheless common. Both within- and among-species, there exists a great deal of variation in rates and patterns of ageing, and evolutionary biologists would like to understand the evolutionary pressures underlying this variation. For example, why might two different populations of the same species evolve differing rates of age-related deterioration? I conducted a study to examine variation in rates of ageing in the small aquatic plant 'common duckweed' (*Lemna minor*). I collected duckweed from 25 populations (i.e. wetlands) throughout Alberta and measured rates of age-related deterioration in plants derived from each population. I then sought to examine whether rates of ageing were associated with environmental characteristics (such as temperature and nutrient concentrations) of the sites of origin. Surprisingly, I found little among-population variation in rates of ageing, despite variation in other traits such as plant size and lifetime reproductive output. Therefore, the causes of variation in rates of ageing remain poorly understood. Nonetheless, the question of why some plant species exhibit among-population variation in rates of ageing while others (e.g. duckweed) do not, may yet provide important insight into the evolution of ageing.

Patrick collecting duckweed from a pond in Alberta

Species Survey of the Spruce Budworm, a Key Herbivore

Year 2 Final Report

Heather Bird Leibel
University of Alberta, M.Sc.
Dr. Felix Sperling, Supervisor

Spruce budworm caterpillars are pests native to North America, and when their populations reach outbreak levels they are the most destructive defoliators of our boreal forests. The damage they cause impacts the surrounding biodiversity and can even kill forests. Five of the eight spruce budworm species in North America are found in Alberta, but because some of these species look very similar and have overlapping ranges they are difficult to tell apart. Previous genetic work analyzing single genes produced conflicting stories about the relationships between these species and questioned whether two species in particular were actually a single species. Our genetic work sampled the entire genome and we found genetic markers to distinguish each species. We found that the jack pine budworm is very genetically distinct from the spruce and fir feeding budworms, but the two species that were hypothesized to be the same have very few distinguishing markers. Starting from the distinguishing markers, we searched the surrounding DNA sequence and found genes that could be involved in producing biological differences. These genes may influence the budworms' attraction to different plants, time of night that the moths fly, some morphological characteristics, and preference to mate with their own species. This research takes the first big step into discovering the genes that make the budworm species what they are.

A jack pine budworm pupae in its (partially dismantled) silk and pollen cone hammock, and a two-year cycle spruce budworm caterpillar displaying the white spots diagnostic for spruce budworms

Determinants of Risk in Bear-Train Interactions

Year 2 Final Report

Brianna Burley
University of Calgary, M.Sc.
Dr. Dianne Draper, Supervisor
Dr. Ralph Cartar, Supervisor

Wildlife-train collisions are an ongoing conservation challenge for wildlife managers. In Banff and Yoho National Parks, transportation corridor (railway/highway) wildlife- vehicle collisions remain the primary source of human caused wildlife mortality. My research focuses on the determinants of risk in bear encounters with trains along the Canadian Pacific Railway within Banff and Yoho National Parks. I used Go-Pro cameras mounted to the front of trains to capture the locations of and behavioral reactions to approaching trains. I attached cameras to trains for two field seasons, from den emergence to hibernation during 2012 and 2013, and observed 47 bear-train interactions. For each, interaction I later conducted on-the-ground site analysis, looking at the local topographical features (both of the track and of the local slope and vegetation) to determine what factors may be influencing a bear's behavioral reaction to a train. I examined three risk-based elements of bear responses to trains: flight initiation distance, whether to stay or flee, and flee speed, relating these to train speed, track angle, and vegetation and slope of the habitat surrounding the track. My analysis is still in progress, but it is already clear that this research will be useful in informing managers about site-specific and train characteristics that result in more risky bear-train interactions. This information will be valuable in helping address site-specific mitigations along the railway.

Screen shot of a bear-train interaction from a Go-Pro camera

‘Rock – Paper – Scissors’ Competition within Male Field Cricket Competitive Networks

Year 2 Final Report

Susan C. Bury
University of Lethbridge, M.Sc.
Dr. Rob Laird, Supervisor
Dr. Brandon Schamp, Supervisor

A basic ecological paradox is the sustained coexistence of competing species and genotypes despite competitive pressures. This study investigated the basic factors that determine individual competitive success, and how intransitive competition is a potential coexistence mechanism. How intransitivity produces sustainable cyclical competitive networks is most simply modeled by the ‘Rock–Paper–Scissors’ game, where each competitor is both dominant and subordinate to others.

Most intransitivity studies have focused on theoretical, multi-trophic level, or discrete phenotype systems, but my study investigated intransitivity within one species among only males where the range in physical traits was continuous. Competition between male field crickets, Gryllus veletis, was chosen as a highly controllable lab study system to investigate physical and motivational determinants of competitive success. This study tested how the factors of size and fighting experience affect overall fight outcome on a pairwise level. Effects on intransitivity were tested by analyzing outcomes of pairwise competitions when structured together in round-robin tournaments of six individuals; the less hierarchical the outcomes, the more intransitive the tournament. Fighting determinants of tournament size variance, aggression variance, and the mean number of courters all significantly affected degree of intransitivity. This study’s use of variation in physical and motivational fighting ability has the potential application for understanding intransitive competition in a wide variety of taxa that compete for mates.

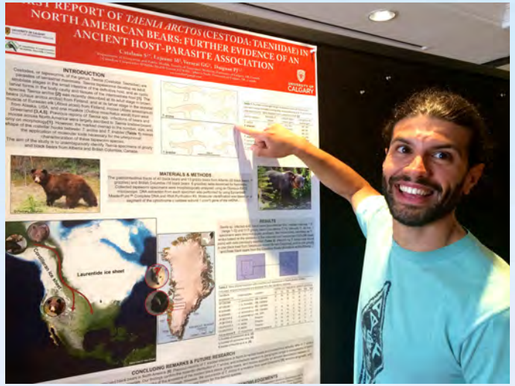
A male cricket in an isolation tube; these tubes were used to handle crickets and to isolate them as they rested between contests

Helminth Biodiversity and Evolution in Grizzly and Black Bears

Year 2 Final Report

Stefano Catalano
University of Calgary, M.Sc.
Dr. Pádraig J. Duignan

I examined carcasses and gastrointestinal tracts for helminths (parasitic worms), and I applied morphological and molecular techniques in parasitology to further our knowledge of parasite biodiversity and evolution in Canadian bears. The objective of our study was to investigate parasite biodiversity and infection parameters in grizzly and black bears from Alberta and to provide insight into the biology and ecology of the isolated helminths. Furthermore, this study explored the systematics of the ursine hookworm species *Uncinaria rauschi* and *Uncinaria yukonensis*, with the aim of building a preliminary framework to interpret the phylogeny of hookworms in North American bears.



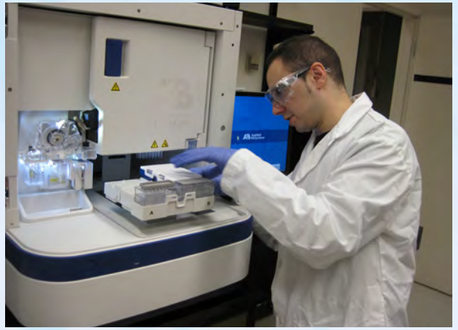
Stefano presenting his work at an international conference

Selectivity of Fisheries on Whitefish Alleles in Lesser Slave Lake

Year 2 Final Report

Jobran Maurice Chebib
University of Calgary, M.Sc.
Dr. Sean Rogers, Supervisor
Dr. Louis Bernatchez, Supervisor

Size-selective harvest is common practice in over-exploited commercial fish populations. Yet, whether size-selective harvest implicates non-random selection with regards to genetic composition in fisheries-induced evolution remains poorly understood. I investigated the role of within-generation selection in a historically over-exploited lake whitefish (*Coregonus clupeaformis*) population associated with fisheries-induced evolution in Lesser Slave Lake, Alberta, while considering the possibility of genetic population structure. Deoxyribonucleic Acid from archived, temporal samples of lake whitefish between 1986 and 1999 were genotyped by me at 20 non-coding sites and 51 gene coding sites associated with growth and reproduction. I discovered that lake whitefish of Lesser Slave Lake represented one genetic population. Commercial fishery harvests, using specific net sizes, phenotypically represented a non-random sample of the individuals harvested compared to index samples, with comparative genome scans of replicate cohorts within a generation elucidating selection in one gene coding site out of 28 candidates (3.6%). This gene coding site has previously been shown to exhibit parallel outliers of genetic divergence in species pairs of dwarf lake whitefish, an ecotype that has evolved smaller sizes and earlier reproduction similar to examples of fisheries-induced evolution. It is also associated with a gene encoding nucleoside diphosphate kinase A, a protein important for metabolism. Collectively, the results demonstrate that selection from overharvesting—and the resulting selective removal of genetic variation—could have unintended evolutionary consequences, highlighting the importance of within-generations signatures of selection in selection studies.



Jobran using DNA sequencer for genotyping lake whitefish.

Disrupted Mutualisms Limit Conifer Seedling Growth Following Bark Beetle Outbreak

Year 2 Final Report

Paul W. Cigan
University of Alberta, M.Sc.
Dr. Nadir Erbilgin, Supervisor
Dr. James F. Cahill Jr., Supervisor

In the greenhouse study, I tested the main effects and interactions of (1) light intensity, (2) pine needle litter addition, and (3) soil inoculation on first-year growth of seedlings of lodgepole pine and white spruce (*Picea glauca*). Soil inoculation had the greatest impact on accumulations of biomass, and sugar and starch reserves. Seedlings of lodgepole pine grown with inocula originating from uninfested stands had enhanced biomass accumulation relative to controls; accumulation was reduced when seedlings were inoculated with soils from MPB-infested stands. Changes in soil microbial communities may limit pine regeneration following outbreak, but field studies are needed confirm this effect.

Five month old seedlings of lodgepole pine and white spruce cultivated to test the effects of mountain pine beetle outbreak on growth, establishment, and survival

Current Limits and Future Potential Range of Whitebark Pine at its Northern Edge under a Changing Climate

Year 2 Final Report

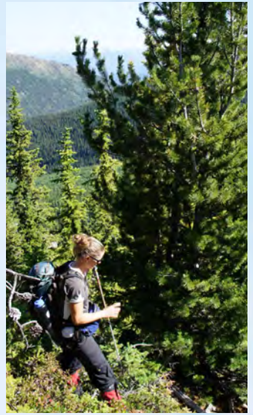
Alana Clason

University of Northern British Columbia, Ph.D.

Dr. Philip Burton, Supervisor

Dr. Eliot McIntire, Supervisor

Whitebark pine is an endangered mountain tree species undergoing range-wide decline as a result of an introduced pathogen (white pine blister rust), mortality from mountain pine beetle and stress from fire suppression and climate change. Many temperate tree species are predicted to migrate northwards with climate change in order to track suitable climate, however this assumes that these species are limited at their northern edge by climate, which is likely not the case for whitebark pine. My research then aims to better understand the current drivers of the northern range limit of whitebark pine in order to predict potential expansion under climate change. Specifically, range edge dynamics involve many processes that occur across multiple scales, so I use both statistical and simulation modelling to explore how climate, landscape and dispersal may be shaping the current range limit, and how these factors along with disturbance, may interact to influence future range expansion with a changing climate. Preliminary results predicting occurrence from multiple sources and qualities of seedling and tree density and occurrence data indicates suitable habitat in NW BC based on climate and landscape (e.g. heat or moisture availability). Current work is focused on simulating how bird dispersal of the seed may contribute to the current edge. Predicting how the probability of whitebark pine occurrence changes over time within and beyond the current range limit, considering multiple ecological processes interacting with climate will be useful information for those determining where to prioritize recovery efforts for this important tree species. climate will be useful information for those determining where to prioritize recovery efforts for this important tree species.



Alana examining a whitebark pine (photo: Eliot McIntire)

Characterizing Hybridization of Swallowtail Butterflies in Alberta

Year 2 Final Report

Julian R. Dupuis

University of Alberta, Ph.D.

Dr. Felix Sperling

Identifying and delimiting species is fundamental to conservation, management, and biodiversity estimation. Species groups that have complex evolutionary histories make species delimitation difficult, but often provide the greatest insights into our understanding of evolutionary dynamics. In particular, hybridization between distinct species or populations offers a unique opportunity to investigate how species boundaries are maintained. In this study, I used DNA and morphology to survey hybridization between two closely related species of swallowtail butterflies in Alberta, and assessed the influence of landscape features on butterfly movement and hybridization. Hybrid individuals were found throughout southwestern and central Alberta, but were less abundant than previous research had suggested. Preliminary analysis of the influence of landscape indicates that hybridization is correlated with climatic variables (e.g. extreme temperatures) as well as geographic features. I also compared my findings for this hybrid swarm to a similar study conducted ~30 years ago, and although there were some genetic differences, the hybrid swarm appears stable overall. Understanding how distinct species can maintain their genomic integrity despite gene flow allows us to better recognize the evolutionary complexity of biodiversity, which is essential for successful conservation.

Hybrid of the anise swallowtail, *Papilio zelicaon*, and the old world swallowtail, *P. machaon*

The Costs of Wing Wear Influencing Foraging Behaviour in a Bumble Bee Community

Year 2 Final Report

Gregory R. Earle
University of Calgary, M.Sc.
Dr. Ralph Cartar, Supervisor

Bumble bees acquire non-repairable wing damage (wing wear) while foraging. Wing wear has been linked with mortality, though the causes are unknown and are likely the result of elevated metabolism or reduced maneuverability. These costs are expected to lead to changes in bumble bee behaviour during flower visitation to collect nectar and pollen. Understanding the effects of wing wear on bumble bee foraging behaviour has implications for the effectiveness of bumble bees as pollinators of wild flowers. I observed bumble bees in the Sheep River Provincial Park, Kananaskis Country, and related their foraging behaviour to natural and experimental wing wear. I found wing-worn bumble bees reduced their wing use by flying less frequently and choosing circumstances that require less wing use. At the community level, I found wing-worn bees with long tongues were likely to visit flowers with shallow nectaries and the converse was observed for wing-worn bees with short tongues, allowing both tongue types to lower their wing use. Overall, bees reduce their wing use when faced with higher flight costs of wing wear, suggesting that flower visitation depends on more than rewards and density of competitors.

Gregory with a bumble bee whose forewings are clamped. Wings are clamped to photograph them and measure wing wear; Gregory will mark and release her in order to measure changes in her foraging behaviour

The Influence of Zooplankton on Resuspended Sediments in Shallow Lakes

Year 2 Final Report

Erick L. Elgin
University of Calgary, M.Sc.
Dr. Leland Jackson, Supervisor

Many lakes in the prairie and aspen parkland ecoregions of Alberta are shallow, with watersheds primarily dominated by agriculture. These shallow lakes are often highly productive and generally exist in either a clear-water state dominated by submersed aquatic vegetation (SAV), or in a turbid state lacking SAV and dominated by suspended sediments and phytoplankton. Lakes in the turbid state have lost many of the ecosystem services they once provided (e.g. clean water for livestock, waterfowl production, critical habitat, etc.) and management is now necessary. SAV is the main factor stabilizing the clear-water state in shallow lakes by enhancing water clarity via reduction of phytoplankton and prevention of sediment resuspension. However, SAV require sufficient water clarity in the spring to establish and grow. The relative contributions of different suspended particles and factors influencing water clarity over time are not well studied in shallow lakes. I hypothesized that zooplankton grazing is one mechanism for reducing resuspended sediments and enhancing water clarity. I measured phytoplankton, organic particles, mineral particles, and zooplankton at high temporal resolution in six shallow lakes from May-August. Preliminary results show maximum concentration of suspended particles in early spring during SAV germination, with non-phytoplankton particles as the dominant contributors to reduced water clarity. Later in the spring, I observed sharp declines in suspended solids in lakes with high *Daphnia* spp. density followed by a dramatic increase in SAV biomass. My results suggest that zooplankton grazing on non-plankton particles may facilitate the spring clear water phase and help establish SAV dominance later in the season.

Erick sampling in a shallow lake

Individual Behavioural Variation and Applications to Elk Management

Year 2 Final Report

Robert B. Found
University of Alberta, Ph.D.
Dr. Colleen Cassady St. Clair, Supervisor

As human disturbance increasingly encroaches into habitat used by wild species, wild animals are either displaced or forced to modify their behaviour. Where species are no longer hunted by humans, such as in protected areas, they may desensitize, and eventually habituate to humans. This can result in conflict situations, but also disrupt whole ecosystem function. Ungulates are particularly prone to habituation, and as residence in human-disturbed areas confers novel fitness advantages, such as safety from predators and access to anthropogenic foods, they may abandon migratory behaviour. I developed an assay of 7 different behavioural traits in elk in Banff and Jasper National Parks and found elk with Bold rather than Shy personality types were most likely to abandon migration. To determine if habituation behaviour is correlated with personality, I recorded individual changes in flight response distance in response to consecutive non-aversive human approaches. I found wariness declined in Bold elk, but remained the same or slightly increased in Shy elk. The converse process, and a way to potentially reverse habituation behaviour, is increasing individual wariness in response to aversive stimuli. To determine if personality was also correlated with behavioural flexibility during this behaviour, I conducted aversive conditioning chases of Jasper elk and found Bold elk exhibited greater increases in wariness during conditioning then did Shy elk. Understanding how personality places evolutionary constraints on behaviour will increase our ability to predict wildlife responses to anthropogenic change, and how we might exploit this to improve the ethics and efficacy of wildlife management.

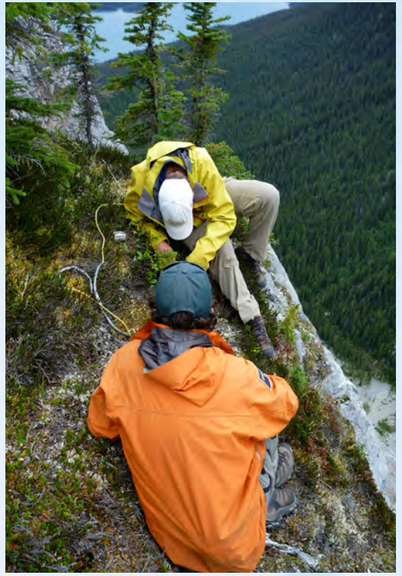
Objects that move on their own or can be moved by the elk inevitably produced the greatest variation in exploratory behaviour, from the individuals that avoided this object because the wheels spun in the wind, to this young adult that used its head to spin the wheels. It did this for over 30 minutes, even after the rest of the herd had moved off into the distance.

Drivers of Whitebark Pine Regeneration: Key to Restoring a Species

Year 2 Final Report

Matthew S. Gelderman
University of Alberta, M.Sc.
Dr. Ellen Macdonald, Supervisor
Dr. Joyce Gould, Supervisor

Understanding the regeneration processes of the endangered whitebark pine (*Pinus albicaulis*) will be important for developing approaches for recovery and restoration of the species. I investigated drivers of whitebark pine seedling presence, abundance, and growth in the northern Alberta Rocky Mountains. I established regeneration transects in multiple different community types within 29 different sites in Willmore Wilderness and Jasper National Park and examined microsites with and without whitebark pine seedlings. In forest communities, occurrence, growth rate and growth release were all favored in canopy gaps. Interestingly, whitebark pine occurred mostly with vegetation in open sites below treeline but exhibited growth release when able to grow apart from vegetation. This contrasted with the situation in alpine and treeline habitats, where increased growth rates, growth release and seedling presence were associated with warmer microsites that had higher vegetation cover. The greatest seedling density occurred in southwest facing transects. My results support the use of restoration activities such as thinning overstory trees and planting in open microsites while increased seedling density observed along southwest facing slopes suggests that these areas may be critical in maintaining long-term population health of whitebark pine.



Matthew and Parks Canada employee Etienne characterizing a microsite plot overlooking Maligne Lake in Jasper National Park

Understory Communities in Mature Lodgepole Pine Forest of Western Alberta

Year 2 Final Report

Benoit Gendreau-Berthiaume
University of Alberta, Ph.D.
Dr. S.Ellen Macdonald, Supervisor
J. John Stadt (ASRD), Supervisor

It is important to understand the dynamics of understory plant communities because they represent an important component of biodiversity, provide food and habitat for many other life forms, play important roles in nutrient cycling, and influence regeneration of tree species. Using five permanent plots established in mature lodgepole pine forest in 1967 the goal of this research was to quantify the long term compositional changes of understory communities as well as the factors controlling community composition and richness. My results show that these communities were still changing 100 years after the last stand replacing fire mainly due to the decline of open habitat species and increase abundance of more shade tolerant or moist adapted species. Furthermore, many late successional species appeared over the last 45 years suggesting that maintaining older lodgepole pine forest is important for landscape biodiversity. Following canopy closure, dispersal limitation of many understory species was the most important factor in structuring these communities while environmental factors (structure and composition of the tree canopy and micro-topography) seemed to only play a secondary role. Nevertheless, the environmental variables played an important role especially in dryer sites where our result suggest that moisture availability, shading by the canopy, competitive exclusion as well as organic matter accumulation might have been important processes. My project provides much needed information on the long term dynamics of forest understory communities as well as the ecological processes that create and maintain understory plant biodiversity in mature lodgepole pine ecosystems.

Supervisor Ellen Macdonald identifying an orchid species (*Plathantera orbiculata*) in the field

Blood Metal Concentrations of Passerines in the Athabasca Oilsands Region

Year 2 Final Report

Christine M. Godwin
University of Calgary, M.Sc.
Dr. Robert Barclay, Supervisor
Dr. Judit Smits, Supervisor

There is little information regarding avian exposure to heavy metals from oilsands mine development in northern Alberta. The objective of my study was to investigate the levels of heavy metals in passerines near oilsands operations. In 2011 and 2012, I measured 11 elements in the whole blood of tree swallows (*Tachycineta bicolor*), Tennessee warblers (*Oreothlypis peregrine*), and chipping sparrows (*Spizella passerine*). High variability in control samples was observed for strontium and copper, and the capillary tubes used for blood collection introduced cobalt contamination. These three elements were therefore excluded from statistical analyses. Blood levels of vanadium, chromium, nickel, arsenic, molybdenum, iron, zinc, and selenium in the three passerines were not elevated near oilsands operations compared to reference areas, although high variability was observed in the blood metal concentrations. Overall, laboratory analyses of blood samples demonstrated poor repeatability. The mass of the blood samples had a significant effect on the element concentration measurements. In each case, the amount of blood sampled was negatively related to the element concentration, suggesting that smaller samples had higher concentrations. While inaccurate measurements may result from small samples, the minimum observed element concentrations were well above the established detection limits. More study is needed to understand the relationship between blood volume and metal concentrations, and the interactions of metals in blood to determine if non-lethal methods such as blood collection to analyze for metals are appropriate to study the industrial effects on small birds, particularly in areas where metal contamination is low.

A Tennessee warbler (*Oreothlypis peregrine*)

Cold Temperatures Limit the Upper-Elevation Distribution of a Native Herb

Year 2 Final report

Anna L. Hargreaves
Queen's University, Ph.D.
Christopher G. Eckert, Advisor

Many climate-change projections of species' future distributions assume that current distributions are limited largely by climate, but a recent meta-analysis suggested that many species are limited by dispersal ability and/or interactions with other species (e.g. competition), rather than by climate alone. I studied the factors limiting the elevational distribution of the annual *Rhinanthus minor* in Kananaskis, Alberta, by surveying natural populations and transplanting seeds among elevations within the range and beyond the upper-elevation range limit. Both natural populations and transplants produce fewer seeds at the upper range limit than at lower elevations, indicating that environmental conditions deteriorate at the range limit. At and above the upper range limit, high-elevation seeds outperformed those from lower elevations, as they flowered earlier and at a smaller size, enabling plants to mature seeds in the shorter growing season. Less than <5% of seeds (all from high-elevations) planted above the range produced seeds during cold, short growing seasons (2011 and 2013), but up to 20% produced seeds during a longer growing season (2012), suggesting that climate does indeed limit the species' upper distribution. When we enclosed transplants in plastic cones that act as mini greenhouses, transplants from mid-elevations were able to mature seed at the upper range limit, and plants from the range limit matured seed above the range. These results confirm that *R. minor's* upper range limit is imposed by cold climate, and suggest the species could survive above its current distribution under climate warming.

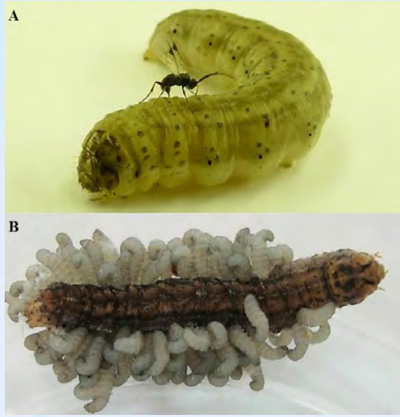
Anna monitoring seeds transplanted above their normal elevational range, enclosed in warming chambers to test whether cold temperatures limit their elevational distribution

Biodiversity and Life History of an Introduced Parasitoid Wasp

Year 2 Final Report

Vincent A. D. Hervet
University of Lethbridge, Ph.D.
Dr. Robert A. Laird, Supervisor
Dr. Kevin D. Floate, Supervisor

Parasitoids, which are insects that develop within other insects and eventually kill their host, form one of the most species-rich groups of organisms on Earth, and yet also one of the least known. Parasitoids have an important function in regulating insect populations by preventing outbreaks. In this capacity they play an important role in the regulation of crop-pest insects and others. In this study I surveyed parasitoids infecting cutworm caterpillars from a variety of areas and plants in southern Alberta in order to investigate the tri-trophic association between the type of plants, the caterpillars, and their parasitoids. So far I have found one parasitoid species new to Canada, *Cotesia vanessae*, along with two other undescribed species, amongst many more species yet to be identified. Cotesia vanessae is endemic to Eurasia. I investigated the host range of this species in its new environment and measured its fitness on each new host species found. I found that it was able to develop to maturity in 34 host species endemic to North America, most of them being significant crop pests. The parasitoid's fitness varied significantly between host species in terms of parasitism success, development time, offspring number per caterpillar, and offspring weight. These parameters of fitness also significantly varied depending on the amount of protein in the diet of the caterpillar hosts. These variations of fitness can be explained mainly by the size of the hosts, the quality of their food, and the ability of the host's immune system to counteract parasitoid infection.



Adult parasitoid wasp *Cotesia vanessae* parasitizing a cutworm (A) and larvae emerging from a cutworm (B), thus killing it

Pollination Ecology of Beeweed and Clammyweed in Southern Alberta

Year 2 Final Report

Mónica Higuera-Díaz
University of Alberta, Ph.D.
Dr. Jocelyn Hall, Supervisor
Dr. Jessamyn Manson, Supervisor

Plants that are visited by a diverse range of pollinators can be classified as having a generalist pollination system and provide valuable information about the availability of floral resources to pollinators. I investigated the flowering phenology, reproductive biology and pollinator community of Beeweed and Clammyweed, two native species with limited distribution in Alberta. The flowers exhibit a generalist pollination system, but differ in traits related to pollinator attraction such as petal color, inflorescence size and nectar display. Both species are able to cross-pollinate and start flowering in late June or early July with the flowering period lasting until late August. Beeweed produced highest nectar volume in the morning and highest sugar concentration by noon; while, Clammyweed produced highest nectar volume before noon but sugar concentrations were higher at sunset. Over two years of observations, I recorded 2206 insects corresponding to 150 species visiting both species. Beeweed flowers were visited by 2032 insects corresponding to 137 species, while Clammyweed flowers received 174 visits from 58 species. The pollinator community visiting both species included numerous species of butterflies, bees, flies, and wasps. I also reported the first nocturnal visitors for Beeweed and collected Synnervus plagiatus (sand wasp), a new record for Alberta. My results suggest that both plant species represent an important nectar and pollen resource and may help maintain native pollinator populations in the prairies. Promoting the conservation of natural prairie and native plants will support biodiversity of pollinators and ensure they continue to provide pollination services to natural and agricultural ecosystems.

Melissa blue (*Lycaeides melissa*) on Beeweed

Landscape Influences on Post-fledging Ferruginous Hawk Movement and Survivorship

Year 2 Final Report

Melynda A. Johnson
University of Alberta, M.Sc.
Dr. Erin Bayne, Supervisor
Dr. Troy Wellicome, Supervisor

Ferruginous Hawks (FEHA), the largest soaring hawk in North America, have experienced severe population declines in their Canadian breeding range and are Endangered in Alberta and Threatened nationally. Juvenile recruitment is an integral aspect of population dynamics and understanding factors that influence juvenile survival could be a key component in reversing population declines. The post-fledging (PF) period (i.e., from fledging to dispersal) represents a critical life-history stage because of the high mortality rates that occur in this period, and currently, the PF period of FEHA is poorly understood. I was interested in understanding how PF hawk movement around nests, dispersal patterns, and mortality were influenced by landscape features. In 2011 and 2012, I tracked 103 hawks (via radio-telemetry in Alberta and Saskatchewan) and discovered PF hawks stayed within 1km of the nest until approximately July 31 (i.e., 15-days post-fledge). Mortality rate was 39% (predominantly avian predation) with most mortalities occurring within the first two weeks of fledging. No single landscape feature explained differences in where PF hawks died versus where they went on the landscape; however, increased road density and native grassland appear to be predictors of mortality (grassland is likely a surrogate for another influencing factor, such as predators or availability of prey). Mortalities tended to occur closer to electrical transmission lines than non-mortality locations, although this result was not statistically significant. High variation in timing of dispersal and mortality indicated strong geographical and temporal effects. My results will contribute to the forthcoming national FEHA recovery strategy.

Dark morph Ferruginous Hawk fledgling wearing a backpack transmitter

Density-dependent Reproductive Success of Common Wildflowers in Logged Landscapes

Year 2 Final Report

Sarah Alexandra Johnson
University of Calgary, M.Sc.
Dr. Ralph Cartar, Supervisor

The majority of flowering plant species within the boreal and foothills forest understories depend on bees for sexual reproduction, and visitation by pollinators changes with the arrangement of local plant neighbourhoods. Given the current widespread conversion of old growth forest to clearcuts in Alberta, my research is significant in determining the impacts of landscape-level logging on reproduction in natural plant communities, while also simultaneously investigating smaller-scale properties. I ask a process-based question – what are the combined effects of floral density and pollinator abundance at different spatial scales on understory plant seed production? – with practical applications to forest management. In the summers of 2012 and 2013, I surveyed multiple species of flowers at 16 sites throughout Kananaskis Country, Alberta to consider both species- and community-level responses. I examined how plant reproduction (measured as seed size and number), varied with neighbourhood traits at different spatial scales. Reproduction of all species was best explained by some combination of local conditions (within 10 m2), including conspecific and heterospecific flower density and bee abundance. Clearcut logging affected seed production in some species but not others, but the large-scale effect of habitat-type (clearcut or forest) or landscape level of logging was always indirectly mediated through local con- and hetero-specific density. My results suggest that both local neighbourhoods and landscape traits affect reproductive success of wildflowers in foothills forests, but in such a way that in areas with different levels of logging, the composition of a local floral neighbourhood impacts seed production differently.

Sarah (left) and Savannah (right) recording local floral neighbourhood characteristics in Kananaskis Country, summer 2013

Acoustic Ecology of Mountain Pine Beetles

Year 2 Final Report

Mathias Kaiser
University of Calgary, M.Sc.
Dr. Mary Reid, Supervisor

Acoustic communication is widespread in insects and may allow them to use other acoustic cues from the environment. Most insect acoustic signals are very high pitched and contain ultrasonic frequencies. This previously led to the suggestion that insect herbivores could use drought-related ultrasonic acoustic emissions of plants to assess the quality of potential hosts. With my study I tested this hypothesis for mountain pine beetles, *Dendroctonus ponderosae,* and their preferred host tree lodgepole pine, Pinus contorta. I first identified the frequency range of beetle acoustic signals to be 2-60 kHz which I assumed as the possible auditory perception range for beetles because of its functional roles for the beetles. Through field measurements of lodgepole pine acoustic emissions within the same frequency range I found that the number of emissions was related to tree quality, in particular diurnal and seasonal water stress. Trees produced higher numbers of emissions later in the afternoon and later in the summer when mountain pine beetles are active. In a lab experiment I then tested whether female mountain pine beetle host choice was affected by acoustic emission playback and found a trend ($p=0.07$, $N=89$) for female preference to initiate breeding galleries in trees treated with acoustic emissions. My work provides support for the idea that mountain pine beetles may use acoustic cues in selecting host trees, meriting further research into host choice related to drought stress in bark beetles to improve our outbreak management opportunities.

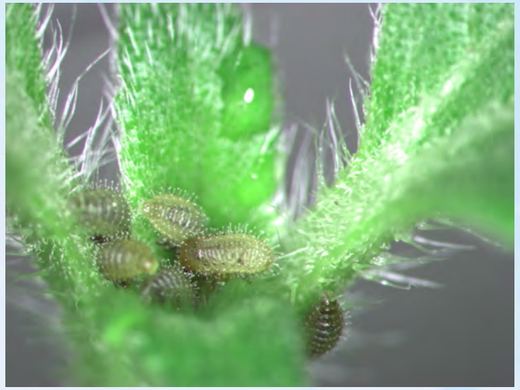
Mathias recording acoustic emissions of a lodgepole pine tree in Kananaskis Country

Inducible Anti-Herbivore Defences of the Annual Sunflower Against a Specialist Sunflower Beetle

Year 2 Final Report

Kevin E. Kwok
University of Lethbridge, M.Sc.
Dr. Robert A. Laird

Plant defences have evolved in response to the loss of plant fitness resulting from herbivory. These defences in turn have resulted in the loss of herbivore fitness due to decreased feeding and decreased nutrient uptake. This has resulted in the evolution of herbivore offence, which refers to the physiological and behavioural strategies utilized by herbivores to counter or circumvent plant defences. I investigated this relationship using the common annual sunflower (*Helianthus annuus*) and the specialist sunflower beetle (*Zygogramma exclamationis*). I first investigated the induction of sunflower plant defences through sunflower beetle feeding and mechanical damage applied to sunflower leaves, but was unable to detect an effect on sunflower beetle larval survival, relative growth rate, relative consumption rate, and efficiency of conversion of ingested food. I then investigated possible herbivore offence in sunflower beetles through selective oviposition on undamaged sunflowers, feeding avoidance of damaged plants, and gregarious feeding behaviour in sunflower beetle larvae. I found that sunflower beetles do not avoid damaged sunflowers in terms of larval feeding or oviposition, but possibly select sunflowers based on food availability. I also found that sunflower beetle larvae had significantly greater survival rates at higher larvae per plant densities than those of lower densities. The exact mechanisms behind this increase survivorship are yet to be determined.



Sun flower beetle larvae

Assessing Genetic Diversity and Gene Expression in Didymo

Year 2 Final Report

Krista M. Larsen
University of Calgary, M.Sc.
Dr. Leland Jackson, Supervisor

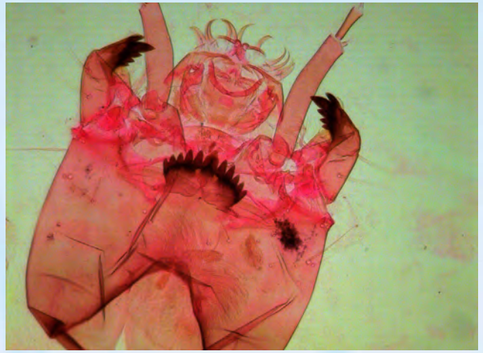
Didymo is a freshwater alga that thrives in quick running streams and rivers with low nutrient levels, low temperature, and ample sunlight. Under these conditions, Didymo cells can affix to rocky riverbeds and produce stalks. Cumulatively, stalks form unsightly mats, up to 30 cm thick, with ecological and economic consequences such as affecting food sources (aquatic insects) and spawning grounds of native fish. Although Didymo is considered native to Alberta and other parts of North America, nuisance algal mats have been increasingly documented across the continent and globally over the last 25 years. It is believed that this increase is due to one or more of the following: recent introductions, genetic variation and environmental change. My research explores genetic variation and differential gene expression in Didymo from mat-forming and non mat-forming sites in western Canada. Didymo samples were taken from various streams and rivers in Alberta and British Columbia. DNA and RNA were extracted from isolated cells and the sequencing of these samples is currently underway. Differences in DNA may point to an introduced or evolved mat-forming genetic variant. If the DNA of mat-forming and non-mat forming Didymo are similar, then the increase in nuisance mats is likely caused by environmental changes. Analysis of gene expression data (RNA) could reveal genes involved in, and causes of, stalk formation. Results of this study may also contribute to the creation or revision of Didymo management strategies.

Krista processing a Didymo sample taken using a drift net

What Affects the Distribution of Chironomid Midges in Alberta Wetlands?

Year 2 Final Report

Qi Liu
University of Alberta, M.Sc.
Dr. Heather C. Proctor, Supervisor
Dr. Rolf Vinebrooke, Supervisor



Head capsule of *Tanytarsus* sp. mounted on a slide

Non-biting midges (*Diptera: Chironomidae*) hold great potential for evaluating water quality and habitat health, as they are ubiquitous and abundant in most freshwater ecosystems, and exhibit a wide range of environmental tolerances. In Alberta, wetlands cover about 21% of the land. They provide a wide range of functions and values, from improving water quality, to storing floodwater to providing habitats for wildlife. However, over time wetlands in Alberta have been significantly impacted or even destroyed by human activities such as mining, agriculture, and urban and industrial development. In this study, I explored the diversity of chironomids from 270 wetlands across the province and examined how environmental (both natural and anthropogenic) factors are correlated with the structure of chironomid assemblages. In total, I found 49 genera of chironomids belonging to 3 subfamilies, which could provide baseline information for future wetland studies. Water quality variables (especially total phosphorus [TP] and salinity), and wetland physical characteristics (water depth, elevation and open water area) were most strongly associated with chironomid assemblage structure. I also identified that water quality could be easily altered by the surrounding land use. In particular, wetlands associated with more extensive agriculture activities tend to have higher TP and salinity that result in unique assemblages and lower taxon richness. Understanding how environmental factors affect chironomids will enable us to test the utility of chironomids as indicators of water quality and habitat health of Alberta wetlands in future studies.

Native Species Diversity Mediates Invasive Trout Impacts in Mountain Lakes

Year 2 Final Report

Charlie J.G. Loewen
University of Alberta, Ph.D.
Dr. Rolf D. Vinebrooke, Supervisor

Experimental mesocosm setup at the Barrier Lake Field Station in Kananaskis

Invasion of freshwater ecosystems by exotic sportfish has been facilitated by stocking programs worldwide and profoundly altered certain species-poor lake communities, including those in Alberta's mountain parks. I hypothesized that greater species diversity would lessen the impacts of invasive trout on zooplankton communities in naturally fishless alpine lakes by increasing the diversity of traits related to predator evasion. To test for interactions between species diversity and invasion in the context of climatic warming, I conducted an eight week mesocosm experiment using thirty-two 1000-L outdoor tanks ([rainbow trout absence vs. presence] x [ambient temperature vs. heated] x [local alpine vs. local alpine + regional montane species pool]). As predicted, local alpine zooplankton communities showed low resistance against introduced fingerlings. In contrast, colonization by several montane species from the regional species pool reversed the negative impacts of invasion and resulted in net positive effects on zooplankton diversity and biomass, irrespective of heating. I found that differing community invasion responses were primarily driven by their body-size distributions. This dramatic reversal interaction (i.e., ecological surprise) shows how invasion impacts can differ greatly based on the composition of native species and their functional traits, with implications for predicting impacts across different ecosystems and localities.

Carnivore Management in Western Canada: Perceptions, Values, Priorities, and Limitations

Year 2 Final Report

Victoria M. Lukasik
University of Calgary, Ph.D.
Dr. Shelley M. Alexander, Supervisor

Human perspectives towards large carnivores, including wolves, coyotes, and cougars, are often polarized. Historically, fear has been a driving emotion, and elimination of these predators was associated with "progress". Current understanding of the critical role of large carnivores in ecosystem diversity and balance has changed some people's perspectives, yet management of these species continues to employ kill-practices used 50-100 years ago. The threats of species extinctions and ecosystem collapse are ever-increasing: maintaining predators is part of buffering against such loss.

To better understand exactly what management practices are taking place with regard to the above-mentioned species, and how and why these practices have come about, I analysed government documents and interviewed wildlife managers across Alberta. Initial findings reveal human interests and politics limit management options, and lead to a system where carnivore management predominantly consists of (lethally) controlling these species for the protection of livestock or threatened species (e.g. caribou). Although perspectives and values vary greatly across the managers interviewed, a justification of lethal means by the ability of certain species (i.e. wolves and coyotes) to recover from a population perspective was common. Also expressed was a sense of making the best of a difficult political climate, where wildlife managers have limited power to restrict recreation and industrial activities across the landscapes they are supposed to manage. I am currently conducting further analyses of this data as well as interviewing managers from other parts of Western Canada to learn more, in the hopes of providing recommendations for improved wildlife management.

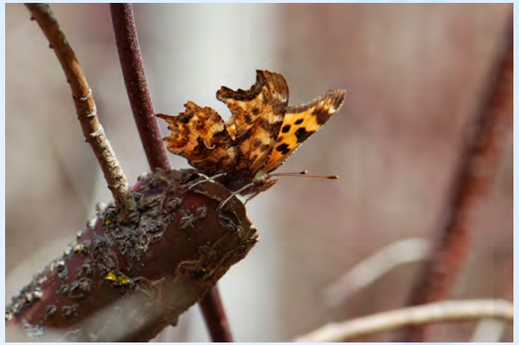
Victoria working with her transcript data and some of the many management documents she has sifted through

An Approach to Delimiting Difficult Butterfly Species Using Morphology and Molecules

Year 2 Final Report

Christianne M. McDonald
University of Alberta, M.Sc.
Dr. Felix Sperling, Supervisor
John Acorn, Supervisor

Species delimitation, the act of determining where one species ends and another begins, can be a challenging task in many plant and animal groups, especially those in species complexes. Without knowing which species are which, it is impossible to assess the conservation status of any distinct population and direct resources where they are needed most. By improving our delimitation and identification methods in the lab and in the field, we can be more accurate in our designations and statuses. I used molecular markers (mitochondrial DNA and Single Nucleotide Polymorphisms – SNPs), morphological characters (diagnostic field markings and RGB luminance values) and multivariate analyses to assess the effectiveness of diagnostic morphological characters in a genus of butterflies common in Alberta – *Polygonia* (*Lepidoptera: Nymphalidae*). Despite the morphological similarity of the butterflies, the colour values and wing characters selected from field guides were tightly associated with their genetic species clusters. I believe that colour is an under-utilized tool in taxonomy, likely because of the subjective nature of colour perception. By digitally measuring colour characters, it is possible to assess colour in an empirical, unbiased way, and it also becomes possible for those with colourblindness to compare wing spot colour accurately.



***Polygonia satyrus* sunning itself on a branch (Credit: John Acorn)**

Selection on Plant Mating Traits in Tall Larkspur

Year 2 Final Report

Lisa E. O'Donnell
University of Calgary, Ph.D.
Dr. Lawrence D. Harder, Supervisor

Sexual selection is an important influence on the evolution of traits that affect mating and fertilization success. The vast majority of flowering plants are hermaphroditic, however, little is known about how variation in plant mating traits influences male and female reproductive success, and in particular, the evolutionary consequences of such variation. My research aims to understand selection on mating traits of a native Alberta plant species, Tall Larkspur (*Delphinium glaucum*). Flowering plants can experience considerable variation in their mating environment; for instance, seasonal climatic conditions, the number of potential pollinators, and the number of potential mates can vary both within and among breeding seasons. I measured selection on potentially important mating traits (e.g. flower size, number of flowers produced, timing of flower opening, and floral longevity), and found considerable temporal variation in selection on mating traits through female function (e.g. seed production). Using genetic markers (i.e. microsatellites), I am examining how variation in mating traits affects selection through male function (e.g. siring success). Sexual selection is thought to be responsible for generating much of the diversity of plant reproductive strategies; the field studies supported by my ACA Grant in Biodiversity, have thus directly contributed to understanding a fundamental evolutionary process.

Lisa with a potted *D. glaucum* individual

Beaver Dams in Rocky Mountain Streams: Effects on Downstream Food Webs

Year 2 Final Report

Kristin Jenna Painter
University of Saskatchewan, M.Sc.
Dr. Timothy Jardine, Supervisor

Beavers (*Castor canadensis*) build dams in stream channels, resulting in flooding of riparian areas. This "ecosystem engineering" can provide benefits such as improving landscape heterogeneity, creation of habitat for invertebrates and fish, and improved angling opportunities, but it can also enhance mercury export downstream. Mercury is deposited in many areas, even far from point sources, due to the large circulating global pool. Areas recently flooded by beavers can become ideal environments for the methylation of mercury that biomagnifies to high concentrations at the top of the food chain. Because beaver impoundments have also been known to boost productivity, increases in mercury can be accompanied by increases in nutrients and biomass of algae and invertebrates downstream. I found increased concentrations of methylmercury in water, algae, and invertebrates downstream from beaver dams in the southern Canadian Rockies near Kananaskis Country. There was, however, no increase in nutrients or biomass downstream from impoundments. I also found that uptake of methylmercury is enhanced at low concentrations in these systems. The uptake pathway from water to algae is especially important (an increase of 80,000 times) but is diminished higher in the food chain due to a small relative difference in trophic level between predators and prey. Low background concentrations mean that methylmercury is not biomagnifying to dangerous levels in these low-productivity mountain systems far from point sources; but, in systems that are mercury-sensitive such as acidic streams of eastern Canada, impoundments should be considered as a potential source of methylmercury.

Kristin next to a recently constructed beaver pond in Kananaskis Country

Impact of Mountain Pine Beetle Disturbance on Fungal Community Assembly

Year 2 Final Report

Gregory J. Pec
University of Alberta, Ph.D.
Dr. James F. Cahill, Jr., Supervisor

In recent decades, large-scale insect outbreaks have increased in both frequency and scale, killing millions of hectares of lodgepole pine forests in western North America. Soil fungal communities, in particular, are considered susceptible to declines in tree loss across the landscape. These organisms are critical to ecosystem processes such as the movement of carbon and nutrients within the forest system and critical for tree regeneration and forest recovery. To investigate the cascading effects of mountain pine beetle-induced tree mortality on soil fungi, I identified eleven sites in mature lodgepole pine forest in west central Alberta that exhibited a gradient of recent beetle-induced tree mortality. I assessed fungal diversity across two spatial scales looking at both the community and functional group level using next generation sequencing. Using these data, I examined the relationship between fungal diversity and tree loss, and between fungal diversity and changes in abiotic conditions following insect outbreak. I found that beetle-induced tree mortality has rapid and profound effects on fungal diversity. Richness of the fungal communities declined with increased tree loss, driven by a decline in ectomycorrhizal fungi. Ectomycorrhizal fungi also declined with increased soil moisture levels and decreased soil phenolics. Although fungal richness declined, fungal communities became more evenly distributed across the gradient of beetle-induced tree mortality. These data provide a look at the complex changes in soil fungal communities following insect outbreak due to the severity of tree loss, but also to changes in abiotic conditions following insect-induced disturbance.

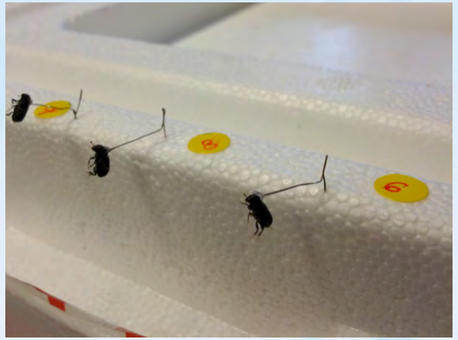
Fruiting body of coral fungus present on forest floor in a severely attacked lodgepole pine stand.

Ecology and Fitness Effects of Phoretic Mites on Mountain Pine Beetles

Year 2 Final Report

Haydeé Peralta-Vázquez
University of Calgary, Ph.D.
Dr. Mary Reid, Supervisor

The mountain pine beetle (Dendroctonus ponderosae) is a major forest threat to Albertan woodlands, and fundamental aspects of the beetle's ecology, such as the influence of interaction with other organisms, are almost completely ignored. Phoretic organisms, like mites that use adult beetles to get a ride to the next reproductive site, are common associates during the beetles' life cycle that may influence their dispersal capability and reproduction. These life history traits are key components of successful beetle colonization particularly during periods of outbreak expansion. Therefore, it is of relevance to determine whether phoretic mites may play either a "friend" or a "foe" role during and after the dispersal of the mountain pine beetle. My study aims to determine three ecological aspects of the beetle-phoretic mite interaction. First, to identify the species of phoretic mites that associate with the mountain pine beetle; second, to evaluate potential costs of carrying mites while dispersing and third, to measure the fitness effects during the beetle reproduction (after dispersal). Until now I have identified who the little travelers are and what their distributions are in northern Alberta. Currently, I am examining in the laboratory if these hitchhikers affect beetle departure and transfer with behavioral bioassays using flight mills.



Mountain pine beetles getting ready for their dispersal work out on the flight mills

Adaptations of Little Brown Bats in Northern Environments

Year 2 Final Report

Jesika Reimer
University of Calgary, M.Sc.
Dr. Robert Barclay, Supervisor

With the rapid spread of White-nose syndrome (WNS), a novel disease responsible for killing millions of bats across North America, assessing bat species diversity and seasonal activity in uninfected areas is important. In addition, studying foraging and reproductive adaptations may give insight into how these nocturnal hibernators are able to persist at northern latitudes with the constraints of short summers and reduced night-length. My study focused on the behaviour of the little brown bat in Wood Buffalo National Park. Using radio telemetry and echolocation recordings, I found that little brown bats remain active at much cooler temperatures than previously observed and have adjusted their foraging behaviour to increase efficiency during short nights. They also emerge from hibernation earlier than expected given the cool spring temperatures. I found no evidence of White-nose syndrome at the hibernacula and observed large populations of both big brown and northern long-eared bats using the same caves as the little brown bat. In addition, I identified two migratory bat species, the hoary bat and silver-haired bat that are present during summer in Wood Buffalo National Park. My study identifies the importance of Wood Buffalo NP as habitat for both resident and migratory bat species and gives insight into how the little brown bat persists at northern latitudes given the summer and night length constraints.

Jesika using radio telemetry to observe the activity of a little brown bat

Epidemiology of an Emerging Virus in Tiger Salamanders in Southwestern Alberta

Year 2 Final Report

Stephanie A. Reimer
University of Lethbridge, M.Sc.
Dr. Cam Goater, Supervisor

Emerging infectious diseases are one of the factors that have contributed to global amphibian declines over the past few decades. The recent emergence of the highly virulent Ambystoma tigrinum virus (ATV) in tiger salamanders in three sites in Alberta has led to concerns regarding the population status of this prairie icon. I surveyed wetlands throughout southwestern Alberta to gather baseline data on this species, and assess the ATV infection status at previously untested sites. Results from my population surveys showed that tiger salamanders occurred in approximately 50% of 15 sites, but densities were low. In an intensive survey of a salamander population in Livingston Lake, Alberta over 2 years, I found that the prevalence of ATV was strongly seasonal, increasing from 0 to 100% between early July and mid-August. Despite a consistent seasonal pattern of exposure to ATV, salamander mortality was high in one year, but low in the next. My results suggest that ecological factors (i.e. triggers) act in addition to virus exposure to contribute to ATV outbreaks at Livingston Lake. Further studies are needed to examine the impact of possible triggers, such as water temperature or salamander density, on ATV associated mortality events.

A larval tiger salamander captured at a southwestern Alberta wetland. A piece of tissue was removed from the tip of the tail to test for the Ambystoma tigrinum virus (ATV).

Biased Sex Ratios and Habitat Fragmentation in a Native Minnow

Year 1 Final Report

Haley Rae Tunna
University of Calgary, M.Sc.
Dr. Leland Jackson, Supervisor
Dr. Sean Rogers, Supervisor

Haley with her study species, longnose dace

Human induced environmental change occurs rapidly and challenges the persistence of organisms. I studied two leading causes of habitat and biodiversity loss, pollution and habitat fragmentation on the native minnow, longnose dace. Calgary's three wastewater treatment plants form the Bow Rivers' largest anthropogenic footprint and the Oldman River has a heavy agricultural and cattle production footprint. I found a shift from female-biases at the oldest age classes at sites examined upstream of anthropogenic inputs to female biases at all age classes at sites downstream of human activity, which suggests that contaminants are associated with sex ratios downstream of anthropogenic inputs. However sex ratios were highly variable from year-to-year. Dams and weirs are barriers to fish movement and this habitat fragmentation is predicted to reduce connectivity of populations. The Bow River has one dam and two weirs between sites sampled in this study. The Oldman River has only one dam within this study reach. I used molecular makers to study the connectivity of longnose dace in the Bow and Oldman River. My results show that longnose dace are a panmictic population, which suggests substantial gene flow within and between the Bow and Oldman Rivers. Consequently, dams and weirs do not alter the connectivity of longnose dace in this system. My study shows that although there is evidence of altered sex ratios in association with contaminates, connectivity remains high despite habitat fragmentation.

Invasion Pathway and Transmission Dynamics of Introduced Lancet Liver Fluke in Ungulates in Cypress Hills Park, Alberta

Year 2 Final Report

Bradley van Paridon
University of Lethbridge, Ph.D
Dr. Cameron P. Goater, Supervisor
Dr. John Gilleard, Supervisor

A view from our study site, the Cypress Hills Interprovincial Park

Invasive parasites pose a potential threat to native hosts and ecosystems in the new habitats they invade and due to increased anthropogenic animal movement invasions are becoming more common. Once established these types of parasites are often hard to manage so stopping further introductions from the source of invasion one of the few strategies to control increased spread. In this study, which started as a Master's thesis and is now a PhD, I aimed to use molecular genetic techniques to identify the source of an invasive liver parasite *Dicrocoelium dendriticum* in the Cypress Hills Provincial Park. I collected parasites from cattle hosts in the park and by reaching out to parasitologists in Europe obtained samples from parts of Albania, the UK, Greece, Norway and Germany. In total 55 individual worms were genotyped using two genetic markers, one from the mitochondrial genome and the other from the nuclear genome. Results showed that, even across the large distance between Europe and Alberta, the worms were more genetically similar than expected. I was able to determine that worms from Alberta, Germany and the UK were more similar than the rest, suggesting a western European origin of the parasites in Alberta. The project is ongoing and I continue to investigate different aspects of the parasite life cycle in Alberta. I am communicating with vets and researchers in order to find more areas infected with this parasite both in Europe and in North America.

Distribution and Abundance of Western Tiger Salamanders in the Beaver Hills

Year 2 Final Report

Kyle J. Welsh
University of Alberta, M.Sc.
Dr. Cynthia Paszkowski, Supervisor

Adult Western Tiger Salamander captured in minnow trap

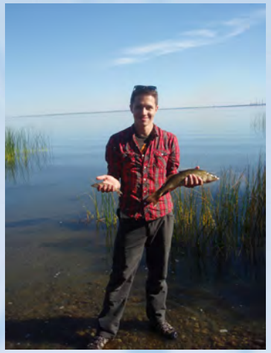
The Western Tiger Salamander is a species of special concern in the Canadian prairie provinces, where it occurs throughout the prairie ecoregions and reaches the northern edge of its distribution in the transition zone between the Aspen Parkland and southern Boreal mixed-wood forests. Like other pond-breeding amphibians, tiger salamanders require suitable aquatic breeding habitat and adjacent terrestrial overwintering habitat. However, their preferred terrestrial habitat is poorly understood, particularly for Canadian populations. Aside from being the northern extent of the species, Western Tiger Salamander populations along the Aspen Parkland/Boreal forest transition zone are unique because they exist within a heterogeneous terrestrial landscape with hundreds of thousands of potentially suitable breeding ponds, providing the perfect setting to ask: If controlling for aquatic habitat, are Western Tiger Salamander distribution and abundance driven by specific terrestrial habitat features? I found the presence and abundance of Western Tiger Salamanders are not significantly related to macro-habitat terrestrial features like land-cover, but are significantly influenced by the abundance of small-mammal burrows, particularly those of Northern Pocket Gophers, within which the salamanders can overwinter. Next I will address the question of how relative salamander abundances gathered from short-term surveys translate to actual salamander population sizes.

Progress Reports

Integration of genetics into freshwater fishery management strategies

Brandon Allen
University of Calgary
Supervisor: Sean Rogers

Adaptive management strategies for Walleye have been used to prevent population collapse, with long term evolutionary consequences left largely ignored. Determining the effectiveness of management strategies in preserving growth rates and genetic variability will help create a more sustainable Walleye fishery for Albertans.



Juvenile and adult Walleye captured with AESRD

Mapping amphibian distribution in northern Alberta using bioacoustics surveys

Natasha Annich
University of Alberta
Supervisor: Cynthia Paszkowski

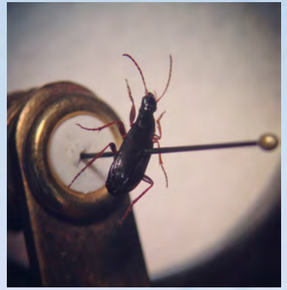
Northern Alberta is experiencing extensive land-use change with the expansion of the energy sector, and it is important to understand how amphibians are responding to this industrial growth. Through the use of acoustic surveys, the selection of different habitat types by amphibians can be better understood, and these areas can be managed to minimize habitat loss for boreal species.

Western toad (*Anaxyrus boreas*) found at a study site

Effects of disturbance and recovery of lodgepole pine forest on carabid assemblages (Coleoptera: Carabidae)

Vincent Del Bel Belluz
University of Alberta
Supervisors: John Spence and David Langor

Carabid beetles are a suitable indicator species to different environmental conditions that vary through forest succession. Collecting carabids and understanding their assemblages in post-harvest lodgepole stands of western Alberta is therefore a good way to monitor recovery of the forest.



Mounted specimen of *Calathus advena*, a common species found in all levels of succession

Peatland reclamation on an oil and gas mine site

Mallory Hazell
University of Alberta
Supervisor: Lee Foote

Understanding how to reclaim peatlands is important because peatlands contribute to landscape biodiversity, play an important role in the global carbon cycle, and collectively filter millions of litres of water a day. Findings from my project will increase our understanding of how environmental conditions effect peat used for reclamation, and contribute to the development of future peatland reclamation guidelines and designs..

A plot used to determine the survival of water sedge planted in Syncrude's Sandhill Fen

Assessing recreation impacts on large mammal ecology in Kananaskis Country, Alberta

Cheryl Hojnowski
University of California, Berkeley
Supervisor: Justin Brashares

My project is generating an unprecedented amount of new information about grizzly bear behavior and visitor use dynamics in Kananaskis Country. I expect that my project results will be used to guide development of trails and facilities in a way that promotes continued coexistence between bears and people in multiple-use, front country environments

Assistant checks a camera trap set to monitor human and wildlife activity on a trail in Peter Lougheed

Impact and interaction of a wasp and nitrogen on an invasive plant species

Gregory Holmes
University of Lethbridge
Supervisor: Robert Laird

This project is the first time that the impact of this wasp has been shown on its native host, and the influence of nitrogen on this plant species. The interaction between wasp and nitrogen is useful for release strategies and modeling, given the changing conditions on the invasion front due to increased nitrogen availability due to human activity and climate change.

Each of these galls contains a wasp larvae, that will mature into an adult before chewing its way out, then going on to lay eggs within other leaves

Simplifying bear predation detection using space-time statistics

Joseph Kermish-Wells
University of Calgary
Supervisor: Marco Musiani

Threatened grizzly bears are known predators of young ungulates, including Canada's endangered caribou, in the industrially fragmented west-central Alberta. For my project, we predict and visit grizzly bear kill sites from GPS collared bears in order to better comprehend the effects of bear predation on ungulate calves in a complicated ecosystem.

Joseph is taking detailed notes at a grizzly bear kill site

Coyote occurrence relative to people in Glenbow Ranch Provincial Park

Jamie Lantz
University of Calgary
Supervisor: Shelley Alexander

Coexisting with coyotes is crucial because they play an important ecological role by naturally controlling rodent populations through depredation, helping maintain biological diversity and acting as scavengers. My research explores how coyotes and humans live alongside one another in Glenbow Ranch Provincial Park in order to determine how to manage conflict and achieve coexistence.

A remotely-triggered camera snaps a coyote walking along a human-use trail in Glenbow Ranch Provincial Park

Species richness, functional diversity, and their influence on fisheries productivity

Preston Lennox
University of Lethbridge
Supervisor: Joseph Rasmussen

Showcasing a fraction of the equipment used to sample these communities, including a dip net, fish finder, seine net, gil net, clip board, and of course, a PFD

Freshwater ecosystem functions, such as fish biomass productivity, have long been assumed to be reliant on the diversity of species inhabiting those ecosystems; yet, despite this fact we continue to witness unprecedented declines in freshwater fish diversity. Developing a better understanding of the role diversity plays in regulating ecosystem functioning will provide support for conservation efforts, as well as promote better management strategies to mitigate the effects of species loss.responding to this industrial growth. Through the use of acoustic surveys, the selection of different habitat types by amphibians can be better understood, and these areas can be managed to minimize habitat loss for boreal species.

Conservation genetics of *Mimulus guttatus* in Alberta: the contribution of geographical and genetically distinct refugia to species management

Yan Liu
University of Calgary
Supervisor: Jana Vamosi

To monitor and manage rare species successfully, we must understand how genetic diversity and demographic history can affect the present population structure of a species. Thus, I am currently estimating the influence that past glacial periods have had in placing geographical barriers that determine the current geographic distribution and potential for range expansion of *Mimulus guttatus*.

Yan and assistant sampling *Mimulus guttatus* (individual plants in photo inset) along the ditch in the population of Crowsnest pass

Utilizing single nucleotide polymorphisms to understand genomic mechanisms underlying hybridization in westslope cutthroat trout and rainbow trout

Brian Meagher
University of Calgary
Supervisor: Sean Rogers

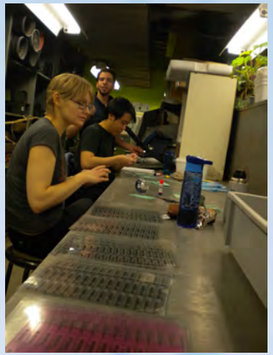
Westslope cutthroat trout populations have been decreasing across their native range which has implications for sustainability of this species as well as future concerns for recreational anglers. As part of the provincial species recovery strategy we have to find new ways to re-establish impacted populations and this project will allow us to use genetic tools to address concerns around hybridization and local adaptation.

Westslope cutthroat trout

Alberta's Achilles heel: an investigation of the features of susceptibility of Albertan balsam poplar to Septoria musiva

Ahmed Najar
University of Alberta
Supervisor: Nadir Erbilgin

Septoria poplar canker keeps on expanding on nurseries and hybrid plantations in both Alberta and BC, while it used to be at significantly lower levels in the past. The recent eruption in this form of poplar canker needs a closer look especially in Alberta where some of the most virulent forms of the pathogen were found.



Ahmed & assistants labelling around 1500 poplar trees

Moose refuge from wolves in the Athabasca oil sands

Eric Neilson
University of Alberta
Supervisor: Stan Boutin

Areas near human disturbance can become a refuge when predators are more likely to avoid human activities than their prey with population consequences for the predator's primary and secondary prey. My project is investigating how human disturbance affects moose (Alces alces) and wolf (Canis lupis) habitat use, spatial overlap and predation dynamics around oil sands mining features in the Athabasca Oil Sands region.

Eric measuring the depth of wolf snow tracks north of Ft. Mackay, Alberta

Assisted migration to mitigate the effects of climate change on rare and range-restricted plants

Jennine Pedersen
University of Alberta
Supervisors: Scott Nielsen and Ellen Macdonald

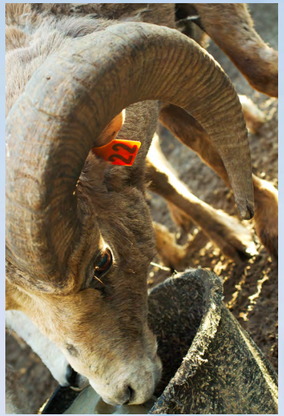
As climate change progresses alternative methods of conservation will need to be considered to prevent local extirpation of species. This project is important as it provides insight and tests whether assisted migration can be used as a conservation tool to prevent the extirpation of rare and range-restricted plant species that are limited in their ability to disperse (migrate) through fragmented landscapes.

Assisted migration trial in Lac La Biche, AB of northern blazing star (Liatris ligulistylis)

Constraints on the recovery of a population of bighorn sheep

Gabriel Pigeon
Université de Sherbrooke
Supervisor: Fanie Pelletier

Environmental conditions experienced at a young age can influence future individual fitness (via their effect on reproduction and survival), partly through carry-over effects on body mass. My project aims to quantify the influence of those effects in marked bighorn sheep to better understand how environmental variations can affect the population growth rate.



Baiting a corral trap with a salt block to capture sheep and then marking all individuals in the population (males are marked with unique coloured ear tags)

Impact of agriculture on waterbirds and aquatic invertebrate communities in non-permanent marshes

Heather Polan
University of Waterloo
Supervisor: Rebecca Rooney

Waterbirds have important social and ecological values, including contributing to plant and insect dispersal, and over 80% of North American waterbirds breed and rear young in my study area. Aquatic invertebrates are a major food source for waterbirds in the non-permanent marshes I am studying, especially while birds produce eggs and raise young, my project aims to further characterize these important taxa within non-permanent marshes.

Heather taking water level measurements in one of the marshes sampled

Effects of industrial noise on owls in northeastern Alberta

Julia Shonfield
University of Alberta
Supervisor: Erin Bayne

In the boreal forest of northeastern Alberta, increasing oil and gas development could be having negative impacts on owls because noise from industrial operations could mask owl calls and interfere with detecting acoustic cues from prey. By using acoustic surveys to determine where owls are present on the landscape, this project will contribute to understanding the impact of noise and better predict habitat loss for owls due to industrial development.

Julia picking up an automated recording unit at the end of the owl acoustic surveys

Nutrient limitation in the Bow River: Implications to wastewater treatment

Jarvis Singer
University of Calgary
Supervisor: Leland Jackson

Understanding the role that nitrogen and phosphorus play in limiting primary productivity is crucial to effectively design municipal nutrient reduction programs to avoid symptoms of eutrophication such as low DO concentrations. This project offers unique insight into the potential differences between nitrogen and phosphorus in limiting growth of periphyton (benthic algae) and macrophytes (aquatic plants) along approximately 100 km of the Bow River.

Jarvis collecting some preliminary sediment samples in the Bow River

Habitat and disturbance influence on ground beetle Assemblages

Linhao Wu
University of Alberta
Supervisor: John Spence

Ground beetle assemblages are frequently considered as indicators of ecosystem function. I seek to reveal its temporal variation during 15 years recovery after harvesting and relate it with habitat and disturbance, thus to make contribution to both ecological understanding and long-term forest sustainability and biodiversity management.

Ground beetle assemblages are frequently considered as indicators of ecosystem function

Understanding detection distances using acoustic bird surveys

Daniel Yip
University of Alberta
Supervisor: Erin Bayne

Point counts are a common method of surveying bird populations with most detections of birds occurring by sound. Many factors affect sound transmission of bird vocalizations which in turn affects our estimates of avian abundance and density. This study strives to account for variation in sound and increase our accuracy in bird population estimates.

Technicians conduct playback experiments using bird calls to investigate how avian vocalizations to deteriorate with distance

Mandate

This grant program has been established to increase knowledge of flora and fauna in Alberta and to support Alberta-based research, consequently, all work proposed for funding must take place in Alberta. The location of a student's university is of no consequence but their research must be done here.

We support research by graduate students in Alberta, and grants are for up to a maximum of $20,000 distributed over a 2-year funding period. Awards are made in early April each year. Mean award amounts are close to $11,000.

Serious potential applicants should visit our web site (http://www.acabiodiversity.ca) where information is updated annually, and application forms may be downloaded.

Terms of Reference of this Program

The ACA Grants in Biodiversity have been established to:

- increase knowledge of Alberta's heritage of living resources, specifically the flora and fauna,
- support research by graduate students in Alberta, and
- promote the development of highly qualified, Alberta-based conservation biologists.

Who is Eligible to Apply?

The Grants Program is open to graduate students doing work in Alberta. Applicants must be associated with a university as a graduate student (see specific limits of eligibility on our website).

Mandate

Research Mandate

The program supports research in fields of biodiversity, conservation biology and ecology, all broadly construed; all kinds of organisms are covered. The program was broadened in 2004 to encompass management responses of Alberta flora and fauna. Applications can deal with the study of Alberta's flora and fauna at any biological level, but such studies should be directly anchored in the real world. Applications will be adjudicated on the basis of: 1) research merit; 2) reasonable budget; and 3) ability of the applicant to conduct the proposed project.

Deadline: The deadline for receipt of applications is December 1 (or the last business day before December 1) each year. Check http://www.acabiodiversity.ca for exact deadline.

For more information please contact:

Tracy Stewart, Program Administrator
ACA Grants in Biodiversity
Department of Renewable Resources
751 General Services Building
University of Alberta T6G 2H1
Phone: 780-492-1903
Email: tracy.stewart@ualberta.ca

John K. Pattison, Program Director
Department of Resource Economics and
Environmental Sociology
University of Alberta
Edmonton, Alberta T6G 2H1
Phone: (780)878-5086 or +44(0)7462760784
Email: johnp@ualberta.ca
or jopa22@gmail.com

Reviewer Appreciation

Every application received for an ACA Grants in Biodiversity competition is sent to at least three volunteer reviewers. We appreciate the time, expertise, and effort of our reviewers for the last two years:

J. Acorn
B. Adams
Y. Alarie
R. Albricht
K. Armitage
D. Audet
R. Barclay
M. Barr
S. Bayley
E. Bayne
E. Beaubien
F. Beaulieu
C. Bishop
R. Bjorge
T. Bollinger
E. Bork
S. Boutin
M. Brigham
T. Broadbent
T. Burg
J.C. Cahill
L. Carbyn
R. Cartar
M. Cherry
J. Ciborowski
P. Comeau
G. Court
B. Dale
F. Dargent
S. Davis
A. Derocher
J. DeVink
S. Digweed
D. Donald
D. Duncan
D. Durall
B. Eaton
M. Edwards
N. Erbilgin
M. Evenden
K. Floate
L. Fraser
K. Friesen
J. Fryxell
C. Gates
D. Gillespie
M. Gillingham
C. Goater
T. Goater
J. Gould
P. Govindarajulu
K. Graham
T. Graves
K. Greenway
P. Gregory
K. Gurney
R. Hall
T. Hamilton
L. Harder
J. Hare

Reviewer Appreciation

M. Hebblewhite
D. Henderson
D. Hervieux
E. Higgs
D. Hik
D. Hodder
J. Hogg
T. Hogg
G. Hood
J. Hornung
C. Hughes
A. Hurly
G. Hvengaard
D. Irwin
R. Irwin
L. Jackson
S. Javorek
R. Jobin
C. Johnson
E. Johnson
C. Johnson
M. Jones
B. Joubert
A. Keddie
J. Keim
K. Kendell
C. Kennedy
R. Klafki
W. Knee
T. Knight
J. Krakowski
K. Kunkel
E. Lamb
S. Landhausser
B. Lanoil
D. Larson
C. Lausen
R. Lein
V. Lieffers
S. Lindgren
S. Lingle
S. Locke
R. Longair
E. Macdonald
D. MacIsaac
D. Mackenzie
D. MacNulty
A. Magoun
N. Mahony
J. Manson
K. Martin
A. McIntosh
E. Merrill
C. Messier
R. Mitchell
R. Moses
B. Mullens
J. Murie
B. Murray
S. Napper
S. Nielsen
J. Nishi
C. Notzke
T. Osko
R. Owen
D. Park
C. Paszkowski
W. Pattison
J. Pattison
A. Paul
G. Pearsell
M. Poesch
G. Pohl
J. Post
D. Prescott

Reviewer Appreciation

L. Priestley
H. Proctor
M. Proctor
C. Purchase
B. Purdy
M. Pybus
S. Quideau
J. Rasmussen
H. Reiswig
M. Richards
A. Rodgers
M. Rodtka
S. Rogers
J. Roland
M. Romuld
R. Rooney
L. Roy
B. Samuel
J. Schieck
J. Schmutz
R. Serrouya
A. Shostak
A. Sinclair
A. Smith
J. Smits
A. Smreciu
J. Spence
S. Spencer
F. Sperling
C. St. Clair
V. St.Louis
J. Stadt
B. Stelfox
G. Stenhouse
G. Sterling
C. Sturdy
E. Taylor
B. Tonn
M. Trites-Russell
J. Vamosi
M. van den Heuvel
S. Van Wilgenburg
E. Vander Wal
R. Vinebrooke
D. Vitt
P. Wallis
N. Webb
R. Wein
L. Wilkinson
C. Wilkinson
J. Wilson
B. Wishart
T. Work
D. Wrubleski
W. Yang

The ACA Grants in Biodiversity invites proposals from graduate student from any approved research university, regardless of province or country, to apply for financial support to conduct research on basic biology or management of Alberta's flora or fauna. We support studies of conservation biology, biodiversity, ecology and management, all broadly defined. All taxa of living organisms are acceptable. Proposal strengths may emerge from their logic, clarity, usefulness, general interest, or discovery; however a high level of scientific merit is essential.

For more details on program, applications, deadlines and sponsors see:

Biodiversity Grants:
http://www.acabiodiversity.ca/

Alberta Conservation Association:
www.ab-conservation.com

Program goals are to:

- Increase knowledge of Alberta's living resources, notably flora and fauna.
- Enhance training of highly qualified graduate students working in conservation biology in Alberta.
- Support the ACA's mission to promote conservation of Alberta resources.