ACA grants in biodiversity

biennial report 2004/2005

Alberta Conservation Association

This 5th Biennial Reports series showcases final and progress reports of graduate students and Post Doctoral Fellows funded by the Alberta Conservation Association's (ACA) Grants in Biodiversity. ACA has provided almost $2.5 million dollars toward 244 research projects over the last 11 years on topics ranging from root fungi to grizzly bears; mallards to wood frogs, and fescue to flycatchers. Management decisions about marten trapping, forest habitat management, bull trout conservation, and the management of elk winter range, among many others, are better informed because of the work emerging from this Grants in Biodiversity program.

The financial support for this program comes through ACA from hunters, anglers, corporate donors and non-governmental organization partners to support research into Alberta's flora and fauna. Those who realize the value of nature in Alberta and who are active in outdoor activities of recreating, trapping, hunting, fishing, and habitat conservation are not only the supporters, but are also the direct beneficiaries of this research. These same outdoorsmen can be justifiably proud of their contributions to biodiversity.

It is my privilege to direct this award program with the excellent management assistance of Ms. Margaret Foxcroft and the input from our Biodiversity steering committee and adjudicators (Dr. Cam Goater, University of Lethbridge; Dr. Darren Bender, University of Calgary; Dr. Cindy Paszkowski, University of Alberta; Dr. Garry Scrimgeour and Dr. Doug Manzer, ACA) who evaluate the hard work of over 100 anonymous grant reviewers each year. Dr. Bill Samuel, previous director of ACA Biodiversity Grants continues to serve as a great source of program advice as well.

Margaret Foxcroft

Lee Foote

As this goes to print we are busily working on the 2005-2006 grant competition and we look forward to the continuation of this great program thanks to the graduate students, sportsmen and women of Alberta, and ACA!

Lee Foote, University of Alberta
Director, ACA Grants in Biodiversity

Final Reports

Reducing the effects of

Seismic lines on Boreal Forest Songbirds

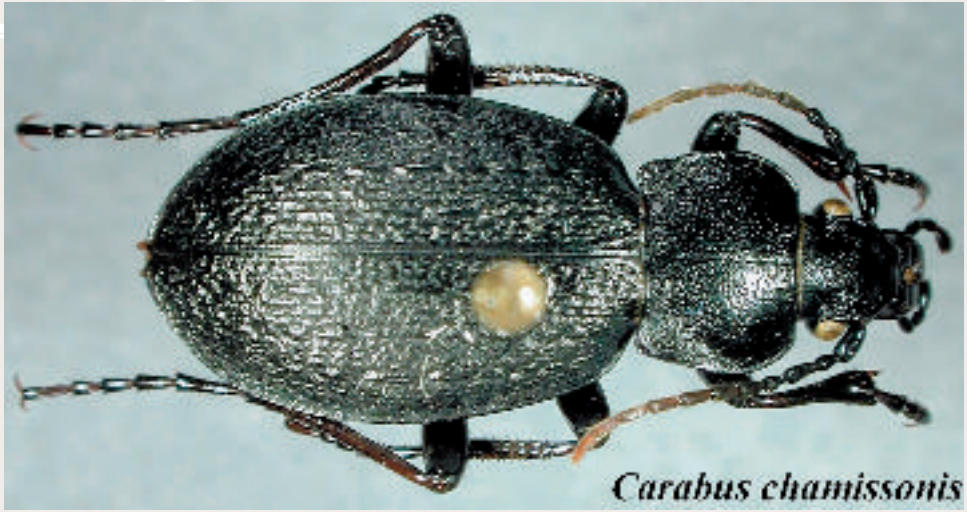
Dr. Erin M. Bayne
University of Alberta, Post-doc
Dr. Stan Boutin, Supervisor

The energy sector in Alberta is seeking ways to reduce their habitat impacts, particularly those caused by seismic lines. Seismic lines are linear features that allow access for energy sector exploration. Erin Bayne assessed whether seismic lines impact boreal forest songbirds and evaluated ways the energy sector could reduce these impacts. He tested whether boreal forest birds react to conventional (8m wide) seismic lines and if changes in boreal forest bird communities occur with just one seismic line or only when a threshold level of seismic line density is reached. Based on measurements of movement derived from radio-tracking, Ovenbirds did not incorporate seismic lines within their territories. Computer simulations suggested this behavior should have resulted in a decrease of approximately 5% in the number of birds with every 1 km per km^2 increase in seismic line density. Decreases in Ovenbird abundance were not observed until a threshold seismic line density of 8.5 km per km^2 was reached however, suggesting Ovenbirds were able to compensate for the loss of habitat caused by seismic lines up to this threshold. At the community level, few other changes in the abundance of native species were observed with increasing seismic line density. Erin also tested whether shrinking the width of seismic lines reduced the impact on Ovenbirds. Ovenbirds did not perceive 3m wide (low-impact) seismic lines as gaps and they included these lines within their territories. Despite low-impact seismic line densities of 15 km per km^2, no differences in abundance of Ovenbirds or other species were observed relative to forest with no seismic lines. Although the effects of conventional seismic lines on boreal forest birds are small, Erin recommends the use of low-impact lines that more closely approximate natural gap widths in the boreal forest. ■

Ovenbirds tolerate seismic lines, up to a point

Fires, Forest Mosaics and Boreal Beetle Diversity

Colin Bergeron
University of Alberta, Ph.D.
Dr. John R. Spence, Supervisor



Colin Bergeron's research examines whether the presence of members of the beetle family Carabidae reflected habitat conditions in Alberta's boreal mixedwood. He studied the forest composition, age structure, density and growth rates at the EMEND study sites in Northwestern Alberta to see if they produce conditions from which beetle communities may be accurately predicted. Of particular interest were late succession tree assemblages found in areas of low fire-frequency. "Fire refugia" exist on north-facing and lowland regions where fires have been uncommon for the last 150 years and these restricted areas may support distinctive populations of wildlife, thereby meriting special attention for their potential contributions to biotic diversity. ■

Understory Plant Diversity and Composition Patterns in the

Mixedwood Boreal Forest of Alberta

Virginia Chávez
University of Alberta, Ph.D.
Dr. Ellen Macdonald, Supervisor

Virginia taking hemispherical photos

Canopy trees modify soil moisture, nutrients, temperature, microbial activity and light availability thereby affecting the diversity and distribution of understory species growing beneath them. The relationship between canopy trees and understory species is complex and site specific. During the summer of 2003 Virginia Chavez examined the understory plant dynamics of Lakeland Provincial Park near Lac La Biche, Alberta. She measured the micro scale differences between understory plant assemblages growing under conifers, broadleaf trees, mixed woods and canopy gaps. Virginia also recorded the effects of abiotic factors (soil macro nutrients and light availability) on understory diversity and composition. Preliminary results point toward canopy trees creating lower species richness in conifer-dominated plots, an intermediate diversity in deciduous-dominated plots and canopy gaps and a higher diversity in mixedwood dominated plots. Virginia's ongoing spatial analysis will evaluate how understory diversity and composition change at different scales in relation to mixedwood canopies. ■

Cumulative Effects of

Wildfire and Forest Harvesting on Boreal Beetles

Tyler P. Cobb
University of Alberta, Ph.D.
Dr. John R. Spence, Supervisor
Dr. David W. Langor, Supervisor

Few studies or regulations guide the post-fire salvage logging of timber in Alberta. This study examined responses of boreal mixedwood beetle communities to combinations of wildfire and forest harvesting leading to the overall hypothesis that the combined effects of wildfire and forest harvesting are cumulative. Tyler Cobb conducted a replicated, stand-level experiment within the boundaries of a large-scale wildfire that occurred during the spring of 2001 near Chisholm AB. He compared five stand treatments ranging from low intensity that were undisturbed by fire or harvesting to high intensity stands that were harvested and burned. Ground dwelling beetles were collected with pitfall traps and species attracted to trees and woody debris were collected with flight-intercept traps during the summers of 2002 and 2003. In total, 40,877 beetles from 23 families and 95 species were collected and identified. Analyses of these data suggest that fire and harvesting differentially altered beetle species composition and that the combined effects of these two disturbances were greater than either disturbance alone for many (>20%) species. Results also show that many of these differences are linked to changes in amounts of coarse and fine woody debris, suggesting that these two parameters could potentially be managed to mitigate the combined effects of wildfire and forest harvesting on beetle assemblages. By linking the recovery of beetle communities to changes in specific habitat parameters, like coarse and fine woody debris, he will be able to provide recommendations for the development of ecologically sensitive guidelines for post-fire salvage operations. ■

A pair of mating pine sawyer beetles (*Monochamus scutellatus*) on a burned jackpine tree

Effects of Forest Fragmentation on the Red Squirrel

in Alberta's Aspen Parkland

Neil D. Darlow
University of Alberta, Ph.D.
Dr. Colleen C. St. Clair, Supervisor
Dr. Stan Boutin, Supervisor

Forest clearing for agriculture is the main loss of forest both worldwide and here in Alberta and yet little is known about how such activities affect wildlife species. Neil Darlow's work centers on the Beaverhills ecosystem of north-central Alberta in which aspen parkland has been largely replaced by agriculture resulting in a highly fragmented landscape. The main objective of this research is to identify the factors determining red squirrel occurrence in wooded patches across the fragmented landscape at a variety of spatial scales. Research to date has identified the components of suitable habitat for red squirrels in aspen parkland. Preliminary analysis of data indicates that increased abundance and height of beaked hazel shrubs is important for squirrel presence. Interestingly, the spatial arrangement of habitat of the landscape (i.e. configuration) seems to be more important than the amount of woodland habitat remaining on the landscape. In particular, the distance from a woodland patch to large areas of forest and the distance to nearest spruce patch are most important in determining whether squirrels are present or absent in a patch. By determining fragmentation effects for this small forest-dependent mammal, Neil may show us more about how fragmentation affects biodiversity in agriculturally fragmented areas more generally, with application to fragmentation in other ecosystems such as Alberta's boreal forest in which clearing for agriculture and industrial activities is increasing. ■

A juvenile red squirrel emerging from a natural cavity in a balsam poplar tree

Impacts of Delayed Spawning on Fathead Minnow Recruitment

Jeffrey N. Divino
University of Alberta, M.Sc.
Dr. William Tonn, Supervisor

Boreal lakes are characterized by short, cool summers and extended winters, resulting in slow growth rates for fish. Because fish size at the end of its first growing season can be critical for its survival, timing of reproduction may be important for the success of fish populations in northern Alberta. Jeff's research examined the effects that delayed spawning can have on early life stages of fish by experimentally delaying spawning in some fathead minnow populations by three weeks, relative to a reference group. Spawning duration, number of nests, and number of eggs produced were greater in early-spawning minnows than in late-spawners. Average nest size, nest longevity, and hatching success were comparable between groups. End-of-season length and weight of offspring were greater in the early-spawn treatments, although the extent of these differences in growth varied with respect to differences in hatchling densities. Jeff's results indicate that delayed spawning can affect population dynamics, both directly by reducing reproductive output in adult fish and indirectly by limiting growth and prolonging the maturation of their progeny. This suggests that if fish must postpone spawning, due to unfavorable environmental conditions for example, weaker year-classes could result. ■

Jeff collecting fish from experimental ponds

Maternal Effects on Post-Weaning Mass, Horn Growth and Social Rank in Juvenile Mountain Goats

Yanick Gendreau
Université de Sherbrooke, M.Sc.
Dr. Marco Festa-Bianchet, Supervisor
Dr. Dr. Steeve Côté, Supervisor

Yanick Gendreau undertook a detailed study of mountain goats (*Oreamnos americanus*) on the Caw Ridge, Alberta study sites to examine maternal effects on pre-weaning development. In particular he compared the mother's social rank and body condition with the welfare and social rank of their 1- and 2-year old offspring. Yanick assessed the effects of spring fecal crude protein (FCP), maternal age, reproductive status (with or without a kid of the year) and maternal social rank on the body mass, horn length and social rank of the young goats to reveal that maternal reproductive status and social rank did not affect the mass or horn length of either yearlings or 2-year-olds. Maternal age was positively correlated with body mass for yearling males but not for yearling females and 2-year-olds. Compared to younger mothers, older mothers were heavier, dominant and tended to produce more sons than daughters suggesting high-quality mothers may provide relatively more care for sons than for daughters. He also found a positive effect of mother's age and spring FCP on horn length of yearlings of both sexes, but no effects for 2-year-olds. None of the maternal characteristics examined directly affected the social rank of juveniles, which was positively correlated with body mass. Social rank in female mountain goats seems to be established early in life and maintained to adulthood. Detectable post-weaning maternal effects appear limited to yearlings in mountain goats and occurred mainly through the influence of mother's age. ■

Mountain goats were weighed when they entered baited boxes positioned on scales

Effects of Lactation Constraints on the Foraging Behaviour and the Summer Mass Gain of Mountain Goats

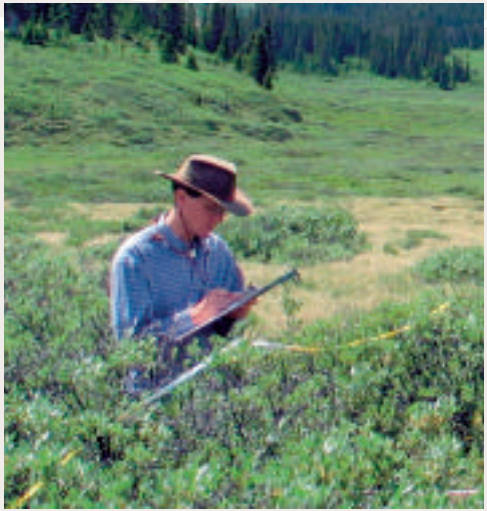
Sandra Hamel
Université Laval, M.Sc.
Dr. Steeve Côté, Supervisor

Sandra Hamel examined the effects of lactation on the foraging behaviour and the summer mass gain of adult female mountain goats. She compared summer mass gain in females, to see if the energetic costs of lactation were fully compensated by foraging at the Caw Ridge research site. Vegetation samples were collected at foraging sites of lactating and non-lactating females to determine vegetation quantity and quality. Electronic platform scales were used at bait sites to weigh goats without having to handle them. Lactating females took on average 27% more bites per minute spent foraging than non-lactating females and they ruminated more intensively than non-lactating females, suggesting that they may be more efficient at assimilating nutrients. Foraging times and vegetation quality and abundance at foraging sites were similar for all female goats. Lactating females increased foraging intensity and rumination efficiency to increase their intake, but they did not seem to use better or safer foraging sites. Lactating females moulted their winter coat on average 8 days later than non-lactating females, suggesting they had fewer nutrients to allocate to growth of a new coat than non-lactating females. ■

Sandra installing a visual collar on a 2 year old female mountain goat

Human Impacts on Ungulate Forage Species

Mark Hebblewhite
University of Alberta, Ph.D.
Dr. Evelyn Merrill, Supervisor



Mark examines elk forage plots on the Ya Ha Tinda Ranch

The Ya Ha Tinda Ranch is home to one of Alberta's largest and most important elk (*Cervus elaphus*) herds. Recent land-use changes in the region surrounding Ya Ha Tinda include 1) prescribed fire, 2) habitat enhancement projects, 3) salvage logging, and 4) cutblocks burned after harvest. Mark Hebblewhite sampled summer range vegetation and estimated the intensity of ungulate use. Early results show salvage logging and unharvested burned areas to support different levels of plant diversity and ungulate forage biomass. Areas harvested prior to being burned later produced increased ungulate forage and different plant communities. The 10-year old habitat enhancement projects in Bighorn creek increased ungulate forage biomass, but diet analyses suggest that plant species in these habitat enhancement projects were of low value to elk. ■

For updated information on the Ya Ha Tinda elk and wolf project, interested readers may visit the project website at: http://ursus.biology.ualberta.ca/yhtelkwolfproject/

Forest Fragmentation and the Behaviour and Nesting Success of Northern Saw-whet Owls

Heather L. Hinam
University of Alberta, Ph.D.
Dr. Colleen C. St. Clair, Supervisor

To fully understand the effects of forest fragmentation on a species, it is necessary to examine its effects on an individual's behaviour, which in turn may affect its reproductive success and survival. Heather Hinam's research compares aspects of Northern Saw-whet Owl (*Aegolius acadicus*) behaviour and reproductive success across differing degrees of forest fragmentation. Specifically she examined 1) male foraging behaviour and provisioning of young, 2) nestling condition, growth rate and nest success, and 3) post-fledging movements and juvenile condition. Data came from a system of 250 nest boxes erected north and east of Edmonton, and radio-tracking of male owls as they foraged throughout their home range. The condition of young owls is derived from blood samples taken just prior to fledging to compare their condition across different degrees of forest fragmentation. Preliminary results suggest that adult males maintained larger home ranges and remained at hunting perches for less time in areas with greater forest cover. Individual nest success increased with forest cover Juveniles hatched in larger nest patches remained within them longer, and remained in their parents' home range longer prior to migration in landscapes with greater forest cover. Heather's detailed study of Saw-whet Owl behaviour across a range of forest fragmentation improves our understanding of fragmentation effects on a forest-dependent species through measurable links to reproductive success and individual condition. ■

Heather and a young Northern Saw-whet Owl

Effect of Environmental Warming on Alpine Zooplankton Communities

Angela M. Holzapfel
University of Alberta, M.Sc.
Dr. Rolf Vinebrooke, Supervisor

Distribution of cladocerans may provide clues about climate change in Alberta alpine lakes

Dispersal ability and temperature tolerance are key determinants of the ability of freshwater organisms to adapt to climate warming. Angela examined zooplankton communities in 379 lakes and ponds in the Canadian Rocky Mountains to assess zooplankton dispersal ability and environmental sensitivity. It appears that mountain zooplankton communities may be dispersal-limited and open to invasion by migrant species. Elevation and related extreme environmental conditions were the best predictors of community assemblages. High alpine zooplankton communities were generally species-poor and consisted of one calanoid copepod and one cladoceran species. A follow up experiment in Banff National Park's Pipit Lake tested the effects of increased dispersal and water warming and showed that warming suppressed alpine specialist species and allowed montane generalist species to colonize. If this pattern holds, climate warming may shift alpine zooplankton community structure towards daphnia species and affect primary production and food-web energy transfer. ■

Effects of Neighbours on the

Reproduction of a Cheating Orchid

Susan Elizabeth Jackson
University of Calgary, M.Sc.
Dr. John Addicott, Supervisor

Some plants, including many orchids, obtain pollination services without providing rewards to their pollinator(s); a strategy known as "cheating". Reproductive success in cheating plants is generally poor, but highly variable, making them more vulnerable to extinction. Susan studied how the variation in reproductive success depended upon the frequency and spatial distribution of a common cheater, the Venus Slipper Orchid (*Calypso bulbosa*), and co-occurring rewarding plants in Kananaskis Country, Alberta. Orchids that occurred in areas with high densities of rewarding plants received fewer pollinators' visits and produced fewer fruits compared to those orchids that occurred in areas with lower rewarding plants. The number of co-occurring Venus Slipper Orchids in an area did not affect the number of pollinators' visits or fruit set, thus cheating plants appear more successful in areas with few rewarding plants, because cheaters can not compete with rewarders for pollinators' visits. On a smaller scale, the Orchids were less likely to receive visits if their near neighbours were visited. Bees are known to fly farther distances after receiving no reward from a flower. New strategies based on managing co-occurring rewarding plants may help in the conservation of these beautiful, yet vulnerable cheating orchids. ■

The Venus Slipper Orchid commonly cheats insect pollinators

Impact of Earthworms on Bacteria-Decomposer Fungi Interactions

Tharindra Dinishi Jayasinghe
University of Calgary, M.Sc.
Dr. Dennis Parkinson, Supervisor

A small European earthworm, *Dendrobaena octaedra*, has recently invaded the Kananaskis Valley of the Rocky Mountains of Alberta. This earthworm affects the nutrient cycling and the biological diversity of the forest floor with far-reaching effects of reducing decomposer fungi in the soil by its effects on a group of soil bacteria called actinomycetes. Some actinomycetes can suppress pathogenic fungi in the soil. Actinomycetes are consumed by earthworms and can survive in their guts. The purpose of this research is to determine if actinomycetes antagonistic to decomposer fungi are transported by *Dendrobaena octaedra*. Tharindra counted numbers and types of earthworms present in Kananaskis Valley forest stands and found Aspen-poplar soil had both the highest density and diversity of actinomycetes, however actinomycetes antagonistic to decomposer fungi were isolated from earthworm casts at both the pine and aspen stands. Earthworms fed actinomycetes in the laboratory had live antagonistic actinomycetes in their casts after four days suggesting they may be vectors for fungi-inhibiting actinomycetes. ■

Tharindra sorting earthworms in the lab

Functional Diversity of Alberta Grassland Plants

Steven W. Kembel
University of Alberta, Ph.D.
Dr. James F. Cahill, Supervisor

Functional diversity is the diversity of morphological, physiological and phenological attributes of species growing together in a community. Grassland plant community structure and species diversity vary along major environmental gradients in Alberta, from the dry mixedgrass prairies in the south to the relatively mesic fescue prairies and parkland in the central parts of the province, but the functional diversity of these grasslands is poorly understood. Numerous ecological and evolutionary theories make predictions about how functional diversity should vary along environmental gradients and how different functional attributes should be related, but there have been few tests of these theories. Steven Kembel measured the functional diversity of plant communities in Alberta fescue and mixedgrass prairies to explain how species have adapted to these two habitats, and to determine how functional diversity is related to species diversity and to environmental conditionss. During 2003 and 2004, Steven measured plant community structure and environmental conditions at grassland sites in the northern fescue and dry mixedgrass ecoregions of Alberta. He also measured leaf and root morphology and physiology, seed mass, and phenology. Northern fescue grasslands had higher species and functional diversity than mixedgrass grasslands. This study also provides a large database of plant species functional traits useful for conservation and restoration efforts. ■

Ball cactus and other native plants in a mixedgrass grassland

Foraging Behaviour of Wild Rufous Hummingbirds

Mark E. Klassen
University of Lethbridge, M.Sc.
Dr. T. Andrew Hurly, Supervisor

Male rufous hummingbirds establish breeding territories throughout the Rocky Mountains during May and June and fill a significant role as pollinators. Mark Klassen investigated foraging preferences of Rufous Hummingbirds. Foraging preferences are influenced by the mean and variability of nectar volume demonstrating that hummingbirds are risk-sensitive foragers. Mark tested model predictions that when foraging returns are low or foraging costs are high (high threat of starvation) hummingbirds should prefer the constant nectar option. When foraging returns are high or foraging costs are low (low threat of starvation) hummingbirds should prefer the variable nectar option. Wild hummingbirds were presented a choice of three artificial flower types that shared a common mean nectar volume but had either a nil, moderate or high level of variability. In poor environments the birds preferred nil variability; in rich environments they opted for the low variable option. In a second experiment Mark investigated the effect of foraging cost on preferences for variable volumes by manipulating corolla length. When the cost of foraging was low (short corolla), hummingbirds preferred the low and high variable options. Studying the foraging behaviour of hummingbirds will improve our understanding of factors influencing the evolution of plant-pollinator systems. ■

Male rufous hummingbird foraging from an artificial inflorescence

Competition and Community Structure in a Rough Fescue Grassland

Eric G. Lamb
University of Alberta, Ph.D.
Dr. James F. Cahill, Supervisor

An *Artemisia frigida* individual in a root exclusion tube

Eric Lamb is a PhD student studying the role of interspecific competition in structuring species abundance and diversity patterns in a native rough fescue grassland community at Kinsella, Alberta. Competition may cause severe reductions in the growth of individual plants, but a major question in ecology is whether these effects on individuals have consequences for the larger plant community. Eric evaluated the role of competition using the rough fescue communities by examining changes in relative competitive ability of a species through its lifetime; the relative competitive ability of species along environmental gradients; and fertilization effects on competitive abilities and community change. Eric's models suggest that a species' relative dominance rank in the community should affect how competitive ability changes through a plants lifespan. Results show that the competitive ability of a plant is highly contingent on the environmental context of that plant, suggesting that the current view of competitive ability as an inflexible species trait needs to be revised. A close match between change in relative competitive ability and change in abundance when nitrogen is added will provide a test of a major ecological question: whether or not competition is the underlying mechanism driving the changes in community structure that follow resource addition. Finally, the effects of changes in water and nitrogen availability on this rare community is important, as human impacts are likely to affect patterns of precipitation patterns and nitrogen deposition. ■

Role of River Valley Landscape in Ecology of Prairie Bats

Cori L. Lausen
University of Calgary, PhD.
Dr. Robert M.R. Barclay, Supervisor

Alberta hosts five species of non-migratory prairie bats including the little brown, big brown, western small-footed, western long-eared, and long-legged bats. All of these species roost in rock crevices of river valleys though two of these species will roost in buildings also. Cori will test the hypothesis that these "house bats," because of their generalized roosting habits, may be able to move across the prairie landscape more easily than those requiring rock-crevice roosts. This project has three main objectives: first she must locate where rock-roosting bats hibernate in the prairies; secondly, she will describe the characteristics of rock crevice roosts required by maternity colonies of prairie bats; and finally, she will examine prairie bat dispersal by comparing patterns of genetic relatedness within and between bats nesting in different river systems. Cori has described rock crevice roosts for pregnant and lactating western small-footed bats, a species of special concern in Alberta and Canada. Unlike big brown and long-eared bats in rock-crevices, the small-footed bats do not select different roosts between pregnancy and lactation; they roost individually or in small groups low to the ground under rocks and in erosion holes tunneled into solidified mudstone. She also discovered bats overwintering in the Dinosaur Provincial Park area; the first known natural prairie hibernation area in Alberta. Cori is currently genotyping bats from two sites on each of the Red Deer, South Saskatchewan, Milk and Missouri River valleys. ■

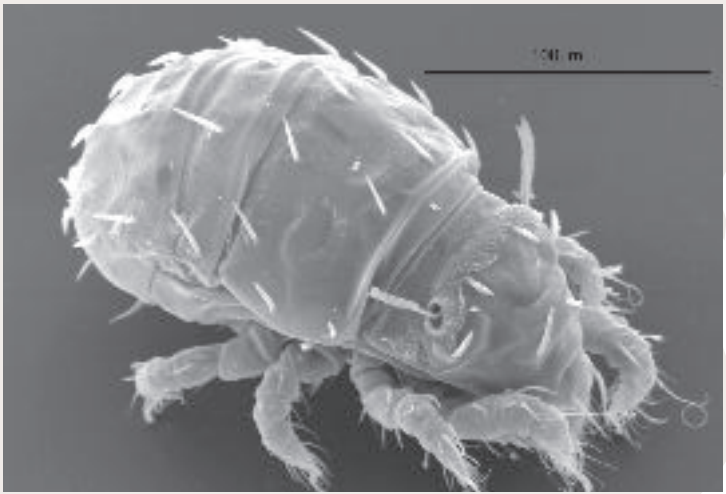
Cori radiotracking bats in southern Alberta

Forest Harvesting Effects on Forest Floor Microarthropods

in Alberta's Boreal Mixed-woods

Zoë Lindo
University of Calgary, M.Sc.
Dr. Suzanne Visser, Supervisor

Forest floors teem with an abundance of invertebrate taxa that few humans ever see. Microarthropods (mites and springtails) are the main constituents of the forest floor fauna, are functionally important components of forest ecosystems, and contribute significantly to overall forest biodiversity. They are important in maintaining forest system processes as they catalyse decomposition and regulate microbial populations, thereby influencing carbon, nitrogen and phosphorous availability. Little is known about the forest floor microarthropods in Canadian boreal forests and the impact of harvesting practices on these populations, but reductions in forest floor microarthropod abundance or changes to the microarthropod community structure may affect nutrient cycles in the forest floor. Zoë Lindo's research examined the effects of partial and clear-cut harvesting on soil microarthropod abundance and community structure in the mixed-wood boreal forest. As part of the EMEND project, she sought relationships between microarthropod abundance and other forest floor variables affected by harvesting. Results show that total microarthropod abundance was reduced up to 50% in clear-cut sites, while partial-cut sites had less of an impact on these populations. Microarthropod abundance was best correlated with microbial biomass and fine roots, and negatively correlated with compaction of the forest floor, which suggested that decreases in microarthropod abundance were related to decreases in food and habitat. ■



Oribatid mite from the EMEND site in northern Alberta

A Process Approach for Predicting Tree Mortality Following Surface Fire

Sean T. Michaletz
University of Calgary, M.Sc.
Dr. Edward A. Johnson, Supervisor

Even forest fires that burn close to the ground can damage plant tissues. Sean Michaletz produced heat-transfer models to predict death of various tree tissues that encounter the heat plume above fires burning on the ground surface. The models indicate that stem mortality is controlled by bark thickness and water content while branch and bud mortality is more dependent on their diameter, water content, and foliage architecture. A logarithmic relationship exists between plume temperature and time to mortality. Models were validated using samples from four tree species at the Kananaskis Field Stations in the eastern range of the Canadian Rocky Mountains. Simulations across a range of surface fire intensities predicted the minimum tree height required for stem survival as well as the minimum branch and diameter required for crown survival. ■

Sean measuring aspen crown characteristics

Spatial Dynamics of Wolves in Relation to Woodland Caribou Decline

Lalenia M. Neufeld
University of Alberta, M.Sc.
Dr. Fiona Schmiegelow, Supervisor

Woodland caribou in Canada have been the focus of many conservation initiatives and research programs over the past twenty years. Lalenia Neufeld studied the Little Smoky caribou herd in west-central Alberta. This non-migratory herd is the most rapidly declining caribou population in the province and they inhabit a dynamic landscape, increasingly influenced by timber harvesting, oil and gas development, and recreation. Causes of caribou decline are not clear; however, predation by wolves is suspected to play a large role. Lalenia's research examined wolf/caribou habitat-selection and overlap to help identify wolf response to the many seismic lines in the region. Seismic lines are thought to facilitate wolf movement, thereby compromising caribou anti-predator strategies by increasing wolf/caribou encounter rates. Lalenia fitted 17 caribou and 16 wolves from five packs with telemetry collars. Data on animal locations, vegetation, physical habitat characteristics, alternate prey species distributions, and industrial features, are currently being used to model habitat-selection by caribou and wolves. To examine wolf response to seismic lines Lalenia evaluated line-blocking as a way to reduce predator mobility. Preliminary movement results suggest that wolves are 62% less likely to use areas where line-blocking has occurred. However, line-blocking by tree-felling does not appear to influence use of linear features, as measured by remote cameras. ■

Bull caribou of the Little Smoky herd photographed with a remote camera

The Influence of Northern Pike on Wood Frog Tadpole Populations

Kirsten C. Norris
University of Alberta, M.Sc.
Dr. Cindy Paszkowski, Supervisor

Kirsten measuring a Northern Pike

Wood frogs and northern pike are two species common to the boreal ecosystem. Wood frogs typically breed in small, temporary, fishless ponds, however, recent periods of drought and dryness have limited the numbers of these ponds and forced wood frogs to select fish-inhabited waterbodies for breeding. While small-bodied fish populations have a negative impact on wood frog tadpole populations, little is known about the impact of large bodied-fish, such as northern pike. Amphibian monitoring has been ongoing at three boreal Alberta lakes since 1995. Northern pike densities in these lakes have varied widely between years because of winter kill events. Kirsten has found a slight trend toward higher numbers of wood frogs emerging from these lakes during the summer following a winterkill, when northern pike numbers are low. Using experimental ponds stocked with both northern pike and wood frog tadpoles, Kirsten attempted to measure the effect, if any, that northern pike have on wood frog tadpole populations and she found that northern pike appear to have a negative impact on the behaviour and activity of tadpoles, as well as the number of tadpoles metamorphosing and emerging from the fish-inhabited ponds. Her findings contribute to the development of management plans in Alberta lakes that will promote sportfish populations while conserving co-existing amphibian populations. ■

Relative Effects of

Introduced Trout and Minnows on Long-toed Salamanders

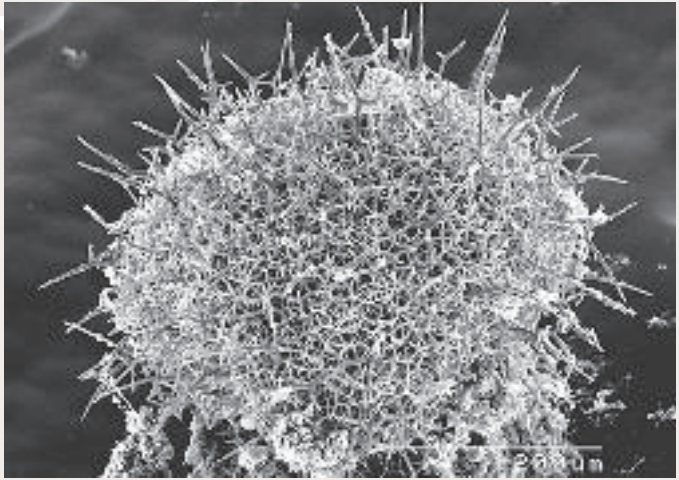
Kimberly J. Pearson
University of Lethbridge, M.Sc.
Dr. Cameron Goater, Supervisor

Introduced fish can cause amphibian population declines. Sport fish and small-bodied baitfish have been introduced into most of Alberta's waterbodies. Kimberly Pearson examined the effects of introduced trout and minnows on the distribution, demography and behaviour of larval long-toed salamanders through a combination of field surveys and artificial pond and laboratory experiments. In the field, Kimberly found salamander distribution was strongly limited by the presence of trout at 27 low-elevation (<1500 m) and 32 high-elevation (≥1500 m) ponds and lakes in southwestern Alberta. In an outdoor artificial pond experiment, salamander survival was significantly reduced in ponds containing trout or minnows. Surprisingly, larvae exposed to minnows were 28-65% smaller than larvae in control ponds, suggesting indirect effects such as interspecific competition. Laboratory studies confirmed that trout preyed directly on salamander hatchlings and larvae, whereas minnows injured hatchlings but did not consume them. In a series of laboratory behaviour trials, salamander larvae spent significantly more time within a refuge when exposed to minnows, but showed no behavioural response to trout. This confirmed Kimberly's earlier expectation that long-toed salamanders lack specific behavioural responses to trout, but respond generally to disturbances within the water column. Thus, direct predation and a lack of larval antipredator behaviour are among the likely mechanisms responsible for the observed distributions of trout and long-toed salamanders. Minnows reduced growth and survival of salamanders, perhaps more so than trout, through mechanisms such as competition and behavioural alteration. These results may be used to make management decisions regarding the conservation of the long-toed salamander and other amphibians in Alberta. ■

Long-toed Salamander Habitat

Diversity and Ecology of Some Decomposer Fungi from a Bog

Adrianne V. Rice
University of Alberta, Ph. D.
Dr. Randolph S. Currah, Supervisor



Scanning Electron Micrograph of *Gymnostellatospora appendiculata*

Bogs support a thick, mattress-like layer of sphagnum moss that accumulates faster than it decomposes. This imbalance between primary productivity and decomposition is a result of the acidic and polyphenolic nature of sphagnum detritus and the flooded, low-oxygen environment below ground. Adrianne Rice tested the role of fungi in decomposing resistant residues of sphagnum by planting blocks of material similar to sphagnum in bogs. These blocks were bait for degrader fungi and once infested, could be removed and cultured in the laboratory. Most degraders were from a poorly studied group called the Myxotrichales fungi and several appear to be species new to science. Adrianne's research is particularly relevant because the peat accumulated in bogs serves as a carbon sink and the decomposition of sphagnum has serious climate change implications for Canada's carbon budget. These little known fungi may be playing a large role in bog ecology. ■

An experimental analysis of

forest fragmentation's effects on parasitoid movement

David Z. Roth
University of Alberta, M.Sc.
Dr. Jens Roland, Supervisor

David examined forest insects

Forest fragmentation is one of the primary disturbances threatening forests worldwide, resulting in loss of habitat and decreased connectivity for forest-dwelling animals. Of particular interest to the boreal forests of North America is the interaction between insect species and their natural enemies. The forest tent caterpillar (*Malacosoma disstria*) is one of the primary pest species found within Alberta's boreal forests. Tent caterpillar outbreaks last longer in fragmented forest, possibly because fragmentation limits movement of natural enemies such as parasitoids and viruses. If large forest clearings inhibit parasitoid movement, fragmentation may decouple parasitoids from their hosts, resulting in outbreaks lasting longer and occurring more frequently. To examine forest fragmentation changes on parasitoid movement David Roth experimentally transplanted forest tent caterpillar egg masses to elevate caterpillar densities over two years in both continuous forest, and in isolated forest fragments. Caterpillars were collected from both landscape types, and parasitoids were reared and identified. Interestingly, parasitism was generally found to be higher in forest fragments, going against his initial hypothesis. This suggests that the fine-scale fragmentation of his experimental sites (100 - 400m clearings) did not negatively impact parasitoid movement; if there is an effect of clearing on parasitoid movement, it is occurring at larger spatial scales. All experimentally created outbreaks were suppressed by a combination of generalist predation, parasitism, and harsh weather, resulting in no long term impact to the study area. ■

Polyploidy and Speciation in Fireweed in the Canadian Rockies

Holly A. Sabara
University of Guelph, Ph.D.
Dr. Brian Husband, Supervisor

Polyploidy, or the presence of more than two sets of chromosomes, is a common occurrence in flowering plants, and can cause rapid speciation. Polyploid plants arise spontaneously and generally have different morphologies, life histories and ecologies than their diploid counterparts, resulting in strong barriers that reduce mating between the two forms of the plant. In the Canadian Rockies, fireweed (*Chamerion angustifolium*) shows variable chromosome numbers and provides an ideal system to study the importance of polyploidy as a speciation mechanism. In mixed-ploidy populations, theory predicts that matings between the diploids and tetraploids will be impossible; however, hybrids are found in natural populations. PhD student Holly Sabara examined the role of pollinators in limiting the frequency of matings between diploids and tetraploid plants growing side-by-side. In three mixed-ploidy fireweed populations in Kananaskis and Banff she observed the foraging behaviour of 142 pollinators, recording the frequency of flights between plants of the same ploidy and between plants of differing ploidy. Bumble bees were the most common visitors to fireweed, comprising 86% of the total visits. Bees tended to favour tetraploid plants over diploids as they had significantly larger flower sizes and numbers of open flowers. In total, 74% of all bee flights occurred between plants of the same ploidy, decreasing the opportunity for hybrid matings. In conclusion, our research provides the most comprehensive study of the role of pollinator behaviour in naturally coexisting diploid and tetraploid populations and clearly demonstrates the importance of pollinators in maintaining species boundaries between diploid and tetraploid fireweed. ■

A bumble bee visiting a fireweed flower in Banff National Park, Alberta

Woodland Caribou Habitat Selection

During Winter and Along Migratory Routes

D. Joanne Saher
University of Alberta, M.Sc.
Dr. Fiona Schmiegelow, Supervisor

Joanne laying out a vegetation sampling plot on the Narraway caribou winter range

Special management of the threatened woodland caribou is required to ensure habitat needs are met. Many caribou distributions are heavily influenced by resource extraction and development activities. Maintenance of connectivity between summer and winter ranges has received little attention in woodland caribou conservation. Joanne Saher assessed habitat selection pattern during the winter and spring migratory periods for caribou in the Narraway range of west-central Alberta. She used multiple spatial scales and resource selection functions (RSFs) to define patterns. In winter, caribou selected habitat patches with high area to perimeter ratios, low terrain ruggedness, forest stands with a larger component of black spruce and greater abundance of terrestrial lichens (*Cladina mitis*). Migratory movements indicated that caribou migration was punctuated; caribou traveled for some distance (movement phase) followed by a pause (resting/foraging phase). The RSFs indicated that caribou traveled through areas that were less rugged and closer to water than random and that resting/foraging sites were associated with older forests that had a greater pine component, and were further from water than randomly available locations. Models for both the spring migratory and winter periods were applied to the landscape using a geographic information system, providing managers with a spatial interpretation of areas of relative importance to caribou during these two annual stages. RSF models are important tools that can assist in land use and conservation planning. ■

Regeneration of Boreal Moss Communities after Fire and its Implications

Michael John Simpson
University of Alberta, Ph.D.
Dr. M.R.T. Dale, Supervisor

Mosses are among the first plants to colonise burned ground after a forest fire. In surveys within the boundaries of the Chisholm fire in north-central Alberta, we found that common weedy species, such as fire moss (*Ceratodon purpureus*), proliferate on burned soil. Graduate student John Simpson's data suggest that fire moss colonies might provide a good environment for the establishment of at least six other plant species in this habitat. In surveys of older spruce forests he found at least 15 plant species, all different from those present after fire. These results match those of other studies, and show that the forest's biodiversity can increase with time as well as with space. Species that were common before the fire might be rare in the first few post-fire years because they cannot spread on burned substrates. Where fragments of Schreber's moss (*Pleurozium schreberi*) were sown on organic humus typical of older spruce stands, they produced the filaments from which they might establish new colonies. Fragments sown on burned mineral soil, however, had not produced any colonies and more experiments are planned to clarify this discrepancy. Mosses in old stands can form mats several inches thick and John has found living moss fragments buried in these mats positioned to re-grow after fires. These moss mats may also serve as a trap for tamarack seeds that reduces their germination, thereby influencing future forest landscapes. ■

Michael conducting species surveys in the field

Can Ants Protect Plants? Ants, Yuccas and Moths

Rebecca S. Snell
University of Calgary, M.Sc.
Dr. John F. Addicott, Supervisor

By attacking herbivores and protecting vegetative and reproductive structures, aggressive ants can defend plants. However, if ants attack beneficial visitors, such as pollinators, they may impose a severe cost to their host plant. Rebecca Snell studied these dynamics on insects using Yucca plants. Yuccas have a variety of visitors, some of which are beneficial and some are harmful. Ants that commonly forage on yucca buds, fruit, and aphid honeydew, may influence the interactions between yuccas and three species of moths: 1) Yucca moths (*Tegeticula yuccasella*) – Female yucca moths pollinate and oviposit in the flowers, where some seeds are consumed by offspring. 2) Cheaters (*T. corruptrix*) – arrive later in the season, after pollination has already occurred and lay their eggs directly into the developing fruit where their offspring consume yucca seeds. 3) Prodoxus (*Prodoxus quinquepunctellus*) – These moths also don't pollinate yucca flowers, but their larva consume stem tissue. Yuccas may benefit if ants lower herbivory from cheaters and Prodoxus. However, ants could have negative effects by eating buds and flowers, or by preventing yucca moths from pollinating. Rebecca conducted exclosure experiments and recorded species presence and abundance on individual yuccas and measured the reproductive success of yuccas and moths by species. The net result of ants was positive for yuccas. Ant-damaged buds had no impact on fruit production as yuccas retain less than 10% of the flowers to mature as fruit and the yuccas were able to selectively drop ant-damaged flowers. Ants had a strong negative effect on cheaters and Prodoxus. By reducing cheater larvae in the fruit, ants indirectly caused a 25% increase in the number of viable seeds per fruit. ■

Ant species tending aphids on a Yucca bud

Beaver Ponds as Habitat for Amphibians:

The Older the Better

Cameron E. Stevens
University of Alberta, Ph.D.
Dr. Cindy Paszkowski, Supervisor

The frogs and toads of Canada's boreal forest are adapted to survive cold climates. Cam Stevens examined habitat, population and larval performance patterns for breeding wood frogs on beaver ponds in the boreal foothills. Ponds varied in successional stage; older ponds had reduced canopy cover due to extensive flooding and foraging by beaver. The abundance of breeding wood frogs on beaver ponds appears to be primarily determined by canopy cover and pond age. Cam tested the prediction that wood frogs select older ponds due to better larval environments (e.g., warm water) provided by their more open canopy. Pond age and a food supplementation (rabbit chow) also affected larval growth and development. Food effects were larger in old versus new ponds where the water was 4˚C warmer and had 3-times as much dissolved oxygen. Forest management strategies and regulations that protect beaver habitat and populations may also ensure healthy amphibian populations through their effects on enhancing the longevity of beaver colonies and the persistence of old ponds on the landscape. ■

Cam and Liam Dunn preparing field enclosures in the boreal foothills near Lodgepole, Alberta

Impact of Forest Fragmentation on Resident Bird Abundance in an Agricultural Region of Alberta

Trisha L. Swift
University of Alberta, Ph.D.
Dr. Susan Hannon, Supervisor

Habitat loss may be a global threat to biodiversity, but how much habitat is required? Do wildlife populations decline in direct linear proportion to habitat loss or are there critical levels or thresholds of habitat below which populations suddenly start to decline more rapidly than they did above that amount of habitat? Trisha Swift investigated how the abundance of resident (year-round) songbirds and woodpeckers changed along a gradient of forest cover, ranging from 0.6 % to 89 %, in a series of 100 ha landscapes in the Beaverhills region of Alberta. Six of eight forest specialists showed evidence of a critical threshold-like response, decreasing more rapidly with forest loss below a certain amount of forest cover (10%-40%, depending on the species). Trisha's findings imply that resident songbirds and woodpeckers are sensitive to moderate to severe levels of forest loss. If the prevalence of critical threshold responses to habitat loss is true of birds or wildlife in general, this has important implications for conservation and wildlife monitoring. A species that has appeared stable despite progressive losses in habitat may decline rapidly once habitat loss exceeds some critical amount. If such responses are not anticipated, such rapid changes in a species' status may preclude effective conservation measures. ■

The Black-capped Chickadee is a year-round resident in Alberta

Progress Reports

Soil Invertebrate Diversity Associated with Root Zones of Boreal Plants

Danica L. Belter
University of Alberta, M.Sc.
Dr. Heather Proctor, Supervisor

Danica tested whether specific invertebrates, like this soil velvet mite, were associated with specific plants in the boreal forest.

Soft and cuddly; a soil velvet mite

Insights into the Evolutionary Origins of *Erigeron trifidus*

Jennifer Burke
University of Lethbridge, M.Sc.
Dr. John Bain, Supervisor

Jennifer uses molecular markers to estimate the amount of genetic variation and hybridization in *Erigeron trifidus* plants in Alberta.

***Erigeron trifidus* is a putative hybrid and is considered rare in the province of Alberta.**

Residual Tree Mortality as a Limit to Success of Green-Tree Retention

Kevin D. Bladon
University of Alberta, Ph.D.
Dr. Uldis Silins, Supervisor
Dr. Victor J. Lieffers, Supervisor

Kevin is examining the survival factors of unharvested trees left after timber harvesting operations.

Calling Lake residual tree die-back

Bryophyte Diversity in Response to Harvesting of Northern Mixedwood Forests

Richard T. Caners
University of Alberta, Ph.D.
Dr. Ellen Macdonald, Supervisor
Dr. René Belland, Supervisor

The effects of changing forest structure on bryophytes (mosses, liverworts, and hornworts) is the focus of Richard's research in northwest Alberta.

Substrates such as decayed stumps provide important habitat for many mosses and liverworts

Off-territory Movements of American Redstarts in an Agricultural Landscape

James L. Churchill
University of Alberta, M.Sc.
Dr. Susan Hannon, Supervisor

James' research will test the paternity of fledgling male American Redstarts to see if territorial males have temporarily moved offsite to breed with females other than their mates.

A second-year male American Redstart

Double-Crested Cormorant Diet on Boreal Lakes:

Implications for Food Web Structure and Fisheries Management

Suzanne N. Earle
University of Alberta, M.Sc.
Dr. Cynthia Paszkowski, Supervisor

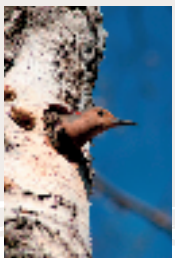
Suzanne Earle uses foraging and diet studies to define the effects of fish-eating cormorants on Lac LaBiche, Alberta's fishery resource.

A juvenile Double-crested Cormorant on a Lac La Biche colony

Cavity Users in Intact and Harvested Mixedwood Boreal Forest

Hilary A. Cooke
University of Alberta, Ph.D.
Dr. Susan Hannon, Supervisor

By examining the importance of tree cavities, Hilary Cooke hopes to better explain the value of residual forest structure on wildlife populations.



Northern Flickers are more common in harvested than intact forest landscapes

Declines in the Black-throated Green Warbler: from Pattern to Process

Theresa A. Hannah
University of Alberta, M.Sc.
Dr. Fiona K.A. Schmiegelow, Supervisor

By examining the changes in territory sizes of nesting birds Theresa Hannah will draw inferences about the role of forest fragmentation on biodiversity in Alberta's mixedwood forest.

Theresa conducting a point count survey of bird abundance

Indirect Effects and Emergent Properties of Multiple, Simultaneous Mutualisms

Robert A. Laird
University of Calgary, Ph.D.
Dr. John F. Addicott, Supervisor

Robert Laird is examining how various organisms, such as beneficial root fungi and ants, cooperate with common sunflowers, and how multiple cooperators also interact with each other indirectly.

Ants foraging for extra-floral nectar

Population Demographics of Three-toed and Black-backed Woodpeckers in Burned and Unburned Forests

Shawna Pelech
University of Alberta, Ph.D.
Dr. Stan Boutin, Supervisor

Shawna Pelech is measuring the importance of burned and old-growth forests for maintaining populations of American Three-toed and Black-backed Woodpeckers.

Recent burns provide productive habitat for Three-toed Woodpeckers

Pioneer Behaviour in the Mountain Pine Beetle

Tanya M. Latty
University of Calgary, Ph.D.
Dr. Mary Reid, Supervisor

Tanya Latty's research focuses on the cues, survival and pioneering behaviour of mountain pine beetle in their attacks on Alberta's lodgepole pine stands.

Tanya measuring the Diameter at breast height of an experimental tree

The Impact of Anthropogenic Habitat on Bot Fly Parasitism of Ord's Kangaroo Rat in Alberta

Sandra E. Robertson
University of Calgary, M.Sc.
Dr. Darren Bender, Supervisor

Sandra is attempting to determine if Alberta's endangered Ord's kangaroo rat populations are being more heavily parasitized by flies as a result of proximity to human structures such as roads.

Ord's kangaroo with a bot fly larva parasite

Effects of Forest Loss and Great Horned Owls on Barred Owls

Michael S. Russell
University of Alberta, M.Sc.
Dr. Susan Hannon, Supervisor

Michael will examine if Great-horned Owls predate Barred Owls more frequently in fragmented forest habitats than in intact mature forests.

Wing measurements being taken on a captured owl

Fire Management and Woodland Caribou Conservation in Jasper and Banff National Parks

Landon K. Shepherd
University of Alberta, M.Sc.
Dr. Fiona Schmiegelow, Supervisor
Dr. Ellen MacDonald, Supervisor

Landon is testing the preference of Alberta's woodland caribou for burned versus un-burned forest types to better describe the effects of fire suppression and prescribed burns on this species.

Laying out a vegetation plot to examine stand structure and vegetation cover

Biogeography and Taxonomy of Grassland Tiger-moths

B. Christian Schmidt
University of Alberta, Ph.D.
Dr. Felix Sperling, Supervisor

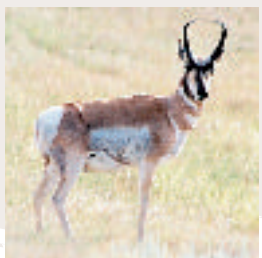
Chris is using modern techniques of molecular, structural, and ecological traits to examine the linkage of several Tiger-moth species to their selected habitat types.

Sand dunes such as this one provide important habitat for a number of Grammia tiger-moths

Modeling Pronghorn Antelope Population Dynamics in Southern Alberta

Katherine A. Sheriff
University of Calgary, M.E.Des.
Dr. C. Cormack Gates, Supervisor

Katherine's graduate work examines the range productivity and its effects on the success of pronghorn in Alberta's grassland natural region.

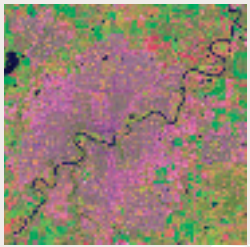


Pronghorn buck near Medicine Hat

Distribution of Bird Populations in an Urban Environment, Edmonton, Alberta

Zulima Tablado Almela
University of Alberta, M.Sc.
Dr. Susan Hannon, Supervisor

Tablado Almela is using a landscape level approach to explain urban bird wintering habitat selection.

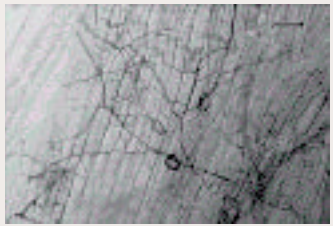


Digital Image of the City of Edmonton

The Taxonomic Diversity of Dark Septate Endophytes in the Roots of Aspen in Central Alberta

Wei Wang
University of Alberta, Ph.D.
Dr. Randolph S. Currah, Supervisor

Wei Wang studies root fungi called "endophytes", the types of endophytes trembling aspen support, and their effects on plant success.



Dark septate endophytes in root cells of aspen

The Role of Genome Duplication in Adaptation

Sara L. Wagner
University of Guelph, Ph.D.
Dr. Brian Husband

If chromosome number affects the growth habit or survival rates of Alberta's showy fireweed then Sara Wagner's research should be able to demonstrate how the plant's success is linked to their actual genetic structure.

Fortress Mountain in late August

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 fund graduate students and Post Doctoral Fellows. 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.biology.ualberta.ca/biodiversity/) 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 and postdoctoral fellows 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 and postdoctoral fellows doing work in Alberta. Applicants must be associated with a university, either as graduate students enrolled in a graduate program or as postdoctoral fellows (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 generally in the first week of November of each fall. Check our website for exact deadline.

For more information please contact:

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The ACA Grants in Biodiversity invites proposals from graduate student or post-doctoral fellows 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.

Program goals are to:

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

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

Biodiversity Grants:
www.biology.ualberta.ca/biodiversity/

Alberta Cooperative Conservation Research Unit:
www.accru.rr.ualberta.ca

Alberta Conservation Association:
www.ab-conservation.com