ACA grants in biodiversity

# biennial report 2006/2007

Alberta Conservation Association

The Alberta Conservation Association, in concert with the three premier research universities in Alberta, continue to support and highlight the best of the best graduate student researchers in Western Canada. The Grants in Biodiversity program supports our understanding of biodiversity, dynamics of species and habitats in the rapidly developing province of Alberta, and the role of scientific management of our resources.

This grant program benefits Alberta and Canada in many ways but one legacy effect not commonly seen is the recruitment and fostering of expertise that ends up in resource management positions. This year our program administrator Margaret Foxcroft and I polled the supervisors of ACA Grants in Biodiversity from the previous decade. We asked where the student recipients of ACA funds eventually ended up and what they thought of our awards program.

We learned that the following numbers of students went on these positions:

| | |
|---|---|
| Consulting/private industry - | 31 |
| Further graduate education - | 26 |
| University instruction/professorial - | 23 |
| Federal environmental/biological - | 24 |
| Alberta Government - | 17 |
| Alberta Conservation Association - | 4 |

**Margaret Foxcroft**

**Lee Foote**

We received back many supportive comments and we include some quotes below:

"Program is extremely valuable…it gives Alberta researchers a distinct advantage".

"I am not aware of any ecologically oriented program of similar impact."

"One of the most valuable things ACA does. Bang for the buck (Biological work per dollar invested) is astronomical compared to anything else ACA does."

I remain delighted to be part of such a worthwhile and direct contribution to maintaining the quality of Alberta's environment. This work is the essence of environmental stewardship as supported by hunters and anglers, showing again that they are the cornerstones of conservation.

We thank the 100+ anonymous reviewers who volunteer each year and our dedicated Academic Adjudicators. Outgoing after 3 years of adjudication service are Drs. Cindy Paszkowski and Darren Bender. Great job!

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

**Final Reports**
of students funded
2004 and 2005
**2 to 45**

**Progress Reports**
of students funded
2006
**46 to 50**

# Final Reports

# Cryptic Avian Diversification along Mountain Gradients

Heather Bears
University of British Columbia, PhD
Dr. K. Martin, Supervisor

**Wetern Canada's mountain habitats vary altitudinally**

Forty percent of the terrestrial planet is mountainous, yet little is known about how elevation shapes the phenotypes of birds. With increasing elevation, populations experience very different conditions that could select for different traits in species over a short spatial scale. Heather studied Dark-eyed Juncos, breeding at the extremes of their elevation range in Jasper National Park (1000 and 2000 m) to determine how elevation shapes the form and function of birds. She also collected chicks from each elevation and raised them in a common environment where environmental influences were controlled, and only genetic or early developmental differences would persist. In wild populations, high-elevation birds became reproductively active >6 weeks later than low-elevation birds, and only produced half the number of broods per year as low-elevation birds. However, when birds were raised in a common environment and induced to breed by photoperiod increases, high-elevation birds became reproductively active earlier than low-elevation birds. Her results suggest that selection and environmental influences on bird reproduction oppose one another with breeding elevation. In the wild, the effects of the environment win out over selection, and later breeding is observed. When the influence of the environment was removed however, selection occurred in the opposite direction. Results suggest that elevation gradients can promote avian reproductive diversification in an unexpected manner. ■

# Soil Invertebrate Diversity Associated with Root Zones of Boreal Plants

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

For organisms that live in the soil, the root zone (rhizosphere) of plants provides both structure and food. The structure comes from the roots' physical presence in the soil, helping to break up soil particles and provide pockets in which organisms can live. Food for soil invertebrates comes from the sugars exuded from the roots themselves. Different plant species can exude different compounds, and so each plant species can have specific bacteria associated with them. Danica investigated whether this would also translate into specific invertebrates being associated with specific plants. She took soil cores from four common boreal plants (fireweed, bedstraw, vetch, and anemone) at intervals over the summer and extracted the mites, nematodes and springtails from the samples. This showed that the invertebrates did not show specificity to the plants, but they did show a seasonal trend with greater numbers and diversity later in the summer. Danica also examined how changes in these root exudates could affect the organisms in the root zones. Above- and below-ground herbivory has been shown to increase the amount of sugars exuded, so she tested for any increase in the abundance of the other organism by setting up a greenhouse experiment with clipped (root and leaf herbivory) and un-clipped (root herbivory only) plants. She found root herbivory did lead to an increase in the number of invertebrates. ■

**Recording data in the Meanook forest**

# Elevated Mortality of Residual Trees

## Following Variable Retention Harvesting

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

There has been a shift in forest management objectives to incorporate ecological, economic and social benefits, rather than just wood production. Variable retention (VR) harvesting is a forest management practice designed to closely resemble the structural outcomes of natural disturbance (i.e. fire). The practice involves the preservation of large, mature trees in dispersed or aggregated patterns throughout forest cutovers. VR is assumed to sustain ecosystem functions and biological diversity by maintaining an array of tree sizes, ages, species, and forest conditions through to the next rotation. Thus, VR harvesting has been widely promoted and adopted from expert opinion as a management technique in boreal and temperate forest ecosystems in the past decade. Many details around how to best implement the ideas of VR are still unclear. Increased mortality of residual trees after forests have been cleared around them is a concern. Objectives of this study were to quantify the mortality rates of white spruce, trembling aspen, balsam poplar and paper birch residuals in boreal mixedwood cutovers in west-central Alberta. Mortality rates in VR plots were 2.5- to 4-fold greater than in control plots for all species. Poplar and birch showed additional signs of stress, including leaf wilting and dieback. Spruce responded positively to increased evaporative demand after VR. Species susceptibility to atmospheric moisture-stress due to increased evaportive demand can be ranked as: poplar > birch > spruce. Ultimately, the knowledge from this research may be used by land managers to improve sustainable forest management practices, by providing guidelines of the most desirable species composition for retention. ■

**Calling Lake residual tree die-back**

# Sexual Selection and Speciation in a Warbler Hybrid Zone

Alan T. Brelsford
University of British Columbia, Ph.D.
Dr. Darren Irwin, Supervisor

Ice sheets separated North America's boreal forests into separate eastern and western regions repeatedly during the Pleistocene. This separation allowed populations of many forest birds to evolve independently for tens or hundreds of thousands of years. Many of these recently diverged eastern and western forms now interbreed in Alberta, and studying patterns of gene flow between them can help us to understand the early stages of species formation.

Alan studied changes in colour pattern, body shape, song, and genetic markers across the hybrid zone between Myrtle and Audubon's warblers. Results indicate that sexual selection on colour pattern, potentially important for mating success, may have played a larger role than adaptation to different habitats or food sources in promoting divergence between the two forms. Colour traits show evidence of mixing only in a 180-kilometre zone along the Rocky Mountains, while body shape traits (which are usually indicative of feeding behaviour or habitat) mix across a zone several hundred kilometers wide.

The two forms are genetically very similar, but Alan identified two regions of the genome that show strong differences. This raises the possibility of identifying genes responsible for differences between two populations early in the process of becoming separate species. A deeper understanding of this hybrid zone reinforces the idea that genetic diversity within species is an important component of biodiversity, serving as raw material for the evolution of new species. ■

**Drawing a blood sample from a hybrid warbler**

# Peace River Grassland Butterflies:

## Conservation and Systematics

Sean M. Bromilow
University of Alberta, M. Sc.
Dr. Felix Sperling, Supervisor

Six to nine thousand years ago, climate changes led to the isolation of a grassland ecosystem – including a number of butterfly species – in the Peace River region of Alberta and British Columbia. Since then, the grassland butterflies have evolved without any contact with southern representatives of their species. Much of the native grassland of the Peace River region has been converted to agricultural production, leaving only small remnants of native butterfly populations. Sean sequenced DNA from numerous Peace River butterflies and compared it with sequences from specimens of the same species collected in southern grasslands. He have found that all of the Peace River populations exhibit some level of genetic divergence from their southern counterparts. When he sequenced closely related butterflies with a continuous distribution (across Alberta), he found that most of these butterflies exhibit very little variation across the province. Interestingly, one species shows major population structuring, and may in fact represent another previously unknown Peace River isolate. While it is early in the process of speciation, it is clear that the Peace River butterflies are distinct and unique. They warrant concerted conservation efforts, especially in light of the ongoing degradation of our northern grasslands. ■

**Sean in Cottonwood Park,Lethbridge**

# Habitat Use of the Western Toad

Constance L. Browne
University of Alberta, Ph.D.
Dr. Cynthia Paszkowski, Supervisor
Dr. Lee Foote, Supervisor

The western toad is a species at risk and habitat protection is needed for its recovery; however, the habitat requirements are poorly understood. Connie Browne's objectives were to investigate the habitat use and movements of western toads in Alberta throughout the breeding, foraging, and hibernation periods. Connie used radio-telemetry, and 1-2 g transmitters were attached to toads using a waist belt. Toads were radio-tracked at Elk Island National Park (2004), at a nearby pasture site in the Aspen Parkland (2004, 2006), and at a site influenced by energy and forestry industries in the Boreal region near Lac La Biche (2005). A total of 116 toads were captured during the spring and summer and 50 of these were followed to their hibernation sites in October. Data analysis is currently underway for habitat use during the breeding and foraging season. This was the first Canadian study to locate and describe hibernation sites of western toads. For hibernacula, western toads selected pre-existing tunnels such as natural crevasses, muskrat tunnels, beaver lodges, red-squirrel middens, cavities in peat hummocks, cavities under spruce trees, and decayed root channels. Toads moved an average of 731 m from their breeding pond to reach their hibernation site (range = 146 m – 1674 m, n = 34). Sixty-eight percent of toads tracked to hibernation were in communal hibernacula. These data suggest that either hibernation sites are limited for this species in Alberta or there are advantages to aggregating for hibernation. Therefore, it's important that managers consider both aquatic and terrestrial habitat to protect toad populations. ■

**Radio tracking western toads to their hibernation sites**

# The Evolutionary Origins of a Rare Alpine Plant

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

***Erigeron trifidus* is restricted to three disjunct alpine regions of the Alberta Rocky Mountains and is a designated rare plant in the province**

Systematic relationships among the flowering Fleabanes of the *Erigeron* species are obscure due to complex geographical distribution patterns, hybridization and the existence of a wide variety of reproductive strategies. *Erigeron trifidus* was originally treated as a variety of *E. compositus* until 1983, where, based on morphological, cytological and habitat differences, it was proposed that *E. trifidus* be treated as a distinct species and that it had arisen via hybridization between *E. compositus* and *E. lanatus*. Jennifer Burke used molecular markers to investigate the evolutionary history of *E. trifidus* by addressing two main questions: 1) Is the current hypothesis of the origin of the species supported by molecular data? 2) Is the current distribution pattern for *E. trifidus* the result of a single hybridization event or multiple hybridization events? She examined northern populations (Jasper National Park, Mountain Park and Wilmore Wilderness Area) that support the hybridization hypothesis. Evidence points to a single hybridization event followed by post origin migration. This pattern of molecular diversity was absent in populations collected at Ram Mountain and at Waterton Lakes National Park thereby supporting a north/south geographic split of *E. trifidus* populations. In Waterton Lakes National Park, populations of *E. trifidus* are thought to be the product of local hybridization but the identity of the putative parents remains uncertain. ■

# Endangered Alberta Sage-Grouse:

## Genetic Diversity Analysis

Krista L. Bush
University of Alberta, M.Sc.
Dr. Cindy Paszkowski, Supervisor
Dr. Dave Coltman, Supervisor

Sage-Grouse (*Centrocercus urophasianus*) populations in Alberta have declined by over 60% in the last 30 years. The purpose of this research is to analyze the genetic structure of this species in relation to adjacent populations in Saskatchewan and northern Montana by: (1) examining population and sub-population boundaries of northern Sage-Grouse, (2) determining the effects of anthropogenic habitat fragmentation (conversion of native land to crops, pasture and oil and gas industrial sites) on the genetic structure of Alberta populations and testing for barriers to gene flow, and (3) evaluating evidence for inbreeding at the population level. Krista found that Sage-Grouse north of the Missouri river form a single population that exhibits isolation by distance (leks that are geographically close are also genetically close and as distance increases, genetic relatedness decreases). Sage-Grouse in Alberta, and the population as a whole, have high genetic diversity indicating that there are high levels of gene flow. There is little genetic differentiation between the three geographic regions in the population, but they are all significant demonstrating that some barriers to gene flow exist and some regions are becoming isolated. Krista's results will be used to examine possible reasons for the population decline and aid with future management decisions, such as translocation of birds from Montana. ■

**Male Sage-Grouse return to specific dancing grounds each year**

# Bryophyte Diversity
## in Harvested Northern Mixedwood Forests

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

Bryophytes (mosses and liverworts) constitute an important component of the plant diversity in northern mixedwood boreal forests, and provide a wide variety of ecosystem functions from caribou food to carbon sequestration. Understanding the response of bryophytes to industrial forest harvesting is of critical management and conservation concern, as harvesting activities in the mixedwood Region of west-central Canada may have long-term implications for bryophyte species persistence and community composition over large areas. Richard's study objectives are to describe the mechanisms driving the response and reassembly of bryophytes after different intensities of forest harvest in an experimental landscape. His research examined the effects of residual forest structure after harvest on bryophyte occurrence, diversity and species groupings. Richard has also experimented with factors affecting the germination of bryophyte spores naturally found in the upper mineral soil horizons. These "diaspore banks" may be a key to forest floor recolonization after disturbances that expose mineral soil. Bryophyte diaspore banks appear species-rich and affected by light intensity and soil properties. Richard aims to outline the factors driving bryophyte diversity after logging, and to provide guidelines to assist decision-makers in the development of sustainable forest management strategies. ■

**Richard surveying for bryophytes beneath a fallen tree**

# Movement and Paternity of American Redstarts

## in an Agricultural Landscape

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

Breeding-territory boundaries of Alberta's songbirds may be more permeable than once thought. In many species, sneaky males leave their territories and enter other territories to seek copulations with extra-pair females (i.e. females other than their social mate) to increase the number of young they sire in the landscape. Off-territory movements may be facilitated or impeded by features of the landscape. Habitat loss and fragmentation should reduce connectivity thereby impeding these off-territory movements. James radio-tracked twenty-four American Redstarts during the 2003 and 2004 breeding seasons in an agricultural landscape near Meanook, Alberta. Males left their territories as frequently as twice an hour, spent up to 50% of their time off-territory, and entered territories up to 3 km away. Older, experienced males who bred in large woodlots with high local densities of breeding pairs invested in off-territory movement to the greatest degree. Off-territory movement frequency was not related to the breeding stage of the social mate, but most male movements were directed to territories of fertile females. James also found that 33% and 10% of chicks in 2003 and 2004, respectively, were extra-pair conceptions. Current analyses will enable the identification of fathers of each chick and will reveal whether moving males succeeded in siring more young. If habitat quality for American Redstarts is influenced by access to extra-pair mates, then birds may choose not to settle in habitats that do not support high densities of breeding pairs, or in landscapes that are not conducive to movement. ■

**James radio-tracking a male Redstart in breeding habitat**

# Cavity Users in Mixedwood Boreal Forests

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

Vertebrates that excavate cavities play key functional roles in the ecosystem by creating cavities used by non-excavating avian and mammalian species. Several Alberta woodpecker species may be keystone excavators, providing the majority of cavities used by other species. New approaches to timber harvest attempt to reduce harvest impacts on wildlife by retaining live and dead trees singly or in patches across harvested areas. Hilary is identifying keystone cavity excavators and evaluating community changes associated with timber harvest through comparisons of patterns of cavity excavation and use in intact (unharvested) and harvested mixedwood boreal landscapes of Alberta and Saskatchewan. Preliminary analysis of 124 cavities excavated by 9 species suggests Northern Flickers are keystone excavators in both landscapes. In the intact landscapes, cavities of Yellow-bellied Sapsuckers, Northern Flickers and Pileated Woodpeckers were reused by Red Squirrels, Northern Flying Squirrels, and Bufflehead. In the harvested landscape, cavities of Sapsuckers, Flickers, and Hairy Woodpeckers were reused by Red Squirrels, Northern Flying Squirrels, and American Kestrels. Preliminary cavity tree selection analysis identifies the number of false tinder fungal conks as the most important discriminating characteristic of Yellow-bellied Sapsucker and Northern Flicker cavity trees. Given current threats to boreal forests from resource development, information on the effects of alternative harvest approaches is critical. Biodiversity monitoring can be facilitated using keystone excavators as indicators, and information from cavity tree selection can be incorporated into management guidelines. ■

**Northern Flickers are important creators of tree cavities in Alberta**

# Silica and Algal Communities in Lac la Biche, Alberta

Angela M. Crowe
University of Alberta, M.Sc.
Dr. David Schindler, Supervisor

In freshwater lakes, nutrient input from sewage and agricultural runoff can enhance algal production. Increased production yields an increase in dissolved silica uptake by diatoms in the water column, which can result in silica depletion. Siliceous algal species such as diatoms may be replaced by non-siliceous species such as blue-green algae, which contribute to taste and odour problems and decrease the recreational value of the lake. Angela tested the hypothesis that historical nutrient input to Lac la Biche, Alberta resulted in long-term silica decline. She further proposed that the onset of blue-green algal blooms under high nutrient conditions could be delayed by supplementing 3000L bags suspended in Lac la Biche with dissolved silica. She found that there is currently no evidence of long-term, historical silica depletion in Lac la Biche. However, experiments demonstrated that silica concentrations declined seasonally in ambient silica bags, in some cases to below values where silica limitation was expected. Silica addition significantly lowered total phytoplankton biomass, and resulted in increased proportions of diatoms and decreased proportions of blue-green algae. Angela concluded that concentrations of dissolved silica can significantly alter the structure and biomass of phytoplankton communities. Futher, while long-term silica depletion is not presently occuring in Lac la Biche, with continued nutrient loading and anticipated declining inflows associated with climate change, silica depletion may be an issue of increasing concern in the near future. ■

**Sampling experimental bags deployed in Lac la Biche, AB for phytoplankton communities**

# Ecology of Arctic and Alpine Fungi in Glacial Forefields

Melissa J. Day
University of Alberta, Ph.D.
Dr. Randolph Currah, Supervisor

**Some of the world's newest habitats exist at the receding edge of glaciers**

Mosses in the forefield of Saskatchewan Glacier, Banff National Park grow between the rocks, forming an organic grout that represents the first soil in the area. Decay of these mosses, rich in lignin or lignin-like compounds, is an important factor in soil formation after deglaciation. This grout is also an ideal habitat for fungi, especially those species typically associated with mosses or involved in decomposition and the influx of nutrients to the developing soil. Melissa's work focuses on determining which fungal species live in the moss grout and what their roles are in the environment. Fungal isolates were obtained from moss gametophytes and vascular plant roots collected from the Saskatchewan Glacier floodplain. These isolates include representatives from genera known for forming benign (*Cryptosporiopsis radicicola, Leptodontidium orchidicola*), mutually beneficial (*Epulorhiza sp.*), and pathogenic (*Trichothecium roseum, Embellisia sp.*) relationships with plants. Known decomposers (*Pseudocladosporium hachijoensis, Arthrinium sp., Scopulariopsis sp., Coprinellus sp.*) as well as species with unknown roles in these habitats (*black meristematic fungi, Tetracoccosporium sp.*) were also recovered. Experiments will be conducted to determine if these fungi are capable of colonising living mosses and decomposing dead moss gametophytes. These tests will aid in determining what roles the fungi fill and if they contribute to soil development in these recently deglaciated areas. ■

# Double-Crested Cormorant Diets on Boreal Lakes:

## Implications for Food Web Structure and Fisheries Management

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

Knowledge of the direct and indirect effects of apex predators in lake ecosystems is essential to managing fisheries and maintaining water quality. Trophic interactions between waterbird, fish and invertebrate species can significantly influence lake ecosystem properties. Suzanne Earle has been examining these interactions which remain a critical challenge in predicting ecological dynamics and effectively managing boreal lakes. To determine if population increases of the Double-Crested Cormorant are influencing ecosystem dynamics and trophic structure, Suzanne used a combination of conventional diet, and stable isotope analyses on lake communities in the Lac La Biche area of north-central Alberta. Analysis of regurgitation samples collected from bird colonies during 2003 and 2004 nesting seasons revealed a dominance of small bodied (55 – 80 mm) fishes including yellow perch, sticklebacks and spottail shiner. Yellow perch was the most frequently captured species and comprised the largest percent biomass in cormorant diet. Prey composition is likely a reflection of prey availability within the lake since netting data also yielded many juvenile yellow perch in Lac La Biche, the main foraging site. Isotopic ratios of $^{15}N$ and $^{13}C$ were consistent with the prey items identified by conventional diet analysis. Suzanne has found cormorants to occupy a similar trophic level to predatory fish including walleye and northern pike. This research, which explores the role of cormorants along with fish and aquatic invertebrates, may contribute to new management strategies essential for changing current ecosystem states of many large boreal lakes. ■

**Juvenile cormorants forming a creche on a nesting colony in Lac La Biche**

# Ecology and Physiology of a Ground-Dwelling Prairie Bat

Jeffery C. Gruver
University of Calgary, Ph.D.
Dr. Robert Barclay, Supervisor

During summer in Canada, bats spend up to 18 hours each day in well-hidden roosts without access to food or water. Pregnant and lactating bats generally select warmer roosts than non-reproductive counterparts, a strategy that increases the odds that young will survive hibernation, but may incur substantial water loss. Therefore, bats rearing young in Alberta's arid prairies may face trade-offs between annual reproductive success and daily water balance. Jeff's research focuses on the physiological responses of long-eared bats (*Myotis evotis*) to conditions in their roosts. He used two distinct but complementary approaches to investigate these questions: field observation and laboratory experiments. Working along the Red Deer River near Drumheller, Jeff used small radio-transmitters attached to bats to locate 273 roosts over three summers and he documented bats roosting in small erosion tunnels in mudstone. Though the bats switched roosts often (about every other day), they roosted within small, well-defined areas and some remained loyal to specific areas from year to year. In the laboratory, Jeff measured water loss and metabolic rate for 236 bats over two summers and confirmed that water loss increased with metabolic rate. Jeff is currently working to integrate these findings with those from field observations. His work will provide insight into where and why bats choose to roost and will aid conservation of these unique and ecologically beneficial mammals. ■

**Long-eared bat with radio-transmitter preparing for flight**

# Industrial Noise Disturbance and Forest Songbirds

Lucas D. Habib
University of Alberta, M.Sc.
Dr. Erin Bayne , Supervisor
Dr. Stan Boutin, Supervisor

Alberta's boreal forest is being rapidly encroached upon by energy development. While much research has been conducted on the physical effects of this development, other, more subtle effects have been less studied. Lucas Habib is looking at whether increased chronic noise disturbance from energy facilities is affecting boreal songbirds. A density assessment indicated that total bird density is reduced as background noise increases, and that some species appear to be more sensitive than others. Lucas measured mating success of male birds. Constant background noise may affect song transmission and increase song attenuation, and consequently, females in noisy areas may not be able to hear singing males as well. At control sites, 92% of males successfully paired with females, compared to 77% at compressor stations. This implies that noise does lead to reduced mating success. There were also significantly more first-year breeders at compressor stations, implying that older birds may be forcing the young birds into the less-desirable (noisy) territories. Lucas also tested whether or not birds sing at higher frequencies in areas of high background noise so their songs can be heard more clearly. From recordings Lucas found that Swainson's Thrush was able to raise the minimum frequency of its song to be heard above the background noise. ■

**Lucas holding an Ovenbird**

# 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

Theresa examined the habitat associations of an uncommon warbler in Alberta's woodlands. Increased forestry activity in Alberta has reduced the amount of habitat on the landscape, and increased the amount of forest edge in relation to interior forest. The Calling Lake Fragmentation Study was established in 1993 to look at the effects of fragmentation on the boreal songbird community by comparing abundance levels of birds in continuous control forest to isolated forest patches. Surveys have been ongoing for 12 years, with population-level surveys conducted in 2003 and 2004 on the Black-throated Green Warbler, as it showed an initial decline in forest fragments relative to unharvested controls. Territory delineation, patterns of vegetation use, and behavioural observations were used to seek causal mechanism for this decline. A total of 39 territories were mapped, and 28 nests were located in 2003-04. Results suggest changes in habitat structure between treatments over time do not explain recent declines. No difference in reproductive status was detected between the unharvested controls and the forest fragments, suggesting pairing success and predation rates are consistent across treatments. However, both edge avoidance and area effects were apparent in the forest fragments, reducing the functional amount of habitat available for this species on the landscape. Individuals preferred deciduous-dominated, older mixedwood forest (120 years), with a minimum of 10% white spruce component to the overstory. Such stands are at risk due to current forestry practices in Alberta, yet innovative forest management strategies involving mixedwood management, aggregated harvest, and integrated landscape management, could significantly contribute to maintaining suitable habitat for this species. ■

**Theresa conducting a point count survey of bird abundance**

# Co-Existence and Habitat Use by Alder and Willow Flycatchers

Sarah D. Hechtenthal
University of Calgary, M.Sc.
Dr. M. Ross. Lein, Supervisor

Species with similar ecology and behaviour frequently use different habitats as a result of competition for resources as Sarah Hechtenthal observed in five of the seven species of *Empidonax* flycatchers that breed in Alberta. The other two species, the Willow Flycatcher and the Alder Flycatcher, are extremely similar in all aspects of their ecology, including habitat use, and this may explain why their breeding ranges overlap only narrowly. These two species have recently come into contact in southwestern Alberta, and can be found breeding on adjacent territories at some sites. Sarah examined habitat use by Willow and Alder flycatchers in this area of contact to investigate the mechanisms and possible consequences of co-existence between these two similar species. Her preliminary results indicate that the two species select very similar micro habitats until the other species arrive and breed nearby whereupon there are clear and significant differences in habitat use, with the Willow Flycatchers shifting their territories to much wetter habitats. This shift suggests that competition may play an important role in shaping the distribution of these species in Alberta. This is an important finding in light of the uncertain population status of the Willow Flycatcher in Alberta and indicates that competition with Alder Flycatchers may be a limiting factor for this species. ■

**Sarah and Willow Flycatcher nestling**

# Parasitic Nasal Mites of Birds

Wayne Knee
University of Alberta, M. Sc.
Dr. Heather Proctor, Supervisor

Birds host a variety of symbiotic animals. Next to lice, the most species-rich group is mites (Arachnida: Acari). Some mites are benign, like feather mites, while others feed on blood or tissues and may damage the host. Among the latter are the avian nasal mites, which have a broad global distribution. These mites occur predominately in the nasal cavities where feeding may cause trauma to the nasal epithelium. Variation in distribution and prevalence among hosts may be a function of geographical location and host phylogenetic history. To explore such ideas, good data on host-mite relationships are required; however, birds of many geographic regions, including Canada, have not been surveyed for nasal mites. Wayne has surveyed nasal mites associated with Canadian birds, focusing on hosts from Alberta and Manitoba. In Alberta, 449 individual birds have been examined for nasal mites, representing 16 orders and 154 species. To date from Alberta and Manitoba Wayne has collected 55 species of nasal mites and has also recorded numerous novel host-mite species records. He has also described five new species of nasal mites and has created the first computer-based interactive key to nasal mite species of Canada. The first step to determining the potential role of these mites in avian disease is to uncover their diversity in Canada. ■

**Collecting birds and bird heads at the Alberta Fish and Wildlife Forensic Laboratory**

# Belowground Soil Fungi Effects on Aboveground Insects

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

The roots of most plant species are colonized by soil fungi known as arbuscular mycorrhizal fungi. These fungi help their host plant forage for soil nutrients in exchange for carbohydrates that the plant produces during photosynthesis. Because these fungi alter their host plant's carbon and nutrient economies, these belowground fungi can have important indirect effects on the suite of harmful and beneficial aboveground insects that interact with the host plant. Robert Laird studied this type of belowground-aboveground interaction, focusing on the native annual sunflower as a study species in the badlands of Dinosaur Provincial Park, Alberta. Robert found a variety of positive and negative indirect effects of belowground fungi on aboveground insects, mediated by changes to their shared host plant. For example, he determined that arbuscular mycorrhizal fungi can alter their host sunflower plants in such a way as to make them more nutritious for specialist sunflower beetles. Robert's research emphasizes the need to integrate the historically separate sub-disciplines of belowground and aboveground ecology. ■

**Sunflower beetles indirectly benefited when their host plants were colonized by arbuscular mycorrhizal soil fungi**

# Pioneer Behaviour in the Mountain Pine Beetle

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

The mountain pine beetle is a native forest insect that has reached outbreak levels in British Columbia and Alberta. Mountain pine beetles attack and kill pine trees. Pine trees, however, have well developed defences that can repel or kill attacking insects. Mountain pine beetles overcome these defences by attacking in groups. Each group is initiated by a female known as the "pioneer". Because they attack first, pioneers suffer higher mortality than joiners. Since pioneering is a dangerous activity (relative to joining), why should a beetle ever become a pioneer?

This project identified factors that predispose individuals to becoming pioneers. Tanya also investigated factors that influence the success of pioneer attacks. Experiments were conducted in Kootenay, Yoho and Banff national parks during the summers of 2003 -2005. She found that pioneers who successfully started aggregations didn't have more offspring then joiners, refuting the hypothesis that there is a benefit to pioneering. Small beetles were more likely to become pioneers than were large beetles, thereby supporting the hypothesis that pioneering occurs when beetles run out of energy for continued dispersal. Small beetles were more likely to recruit others if they were in trees with low resin levels, while large beetles were more likely to recruit in trees with high resin defences. Beetle survival was higher for beetles implanted later in the season. Taken together, these results show that the spread of aggregations to new trees and new areas is dependent on beetle, tree and environmental/ seasonal factors. ■

**Tanya measuring mountain pine beetle infestation potential**

# Interactions Between Vireo Species in Alberta

Scott F. Lovell
University of Calgary, Ph.D.
Dr. M. Ross Lein, Supervisor

A major consequence of Pleistocene glaciations of North America was the splitting of ranges of many animal and plant species into isolated segments in ice-free refugia. These disjunct populations subsequently diverged significant genetic differences while in isolation. After the glaciers receded, many of these populations came into secondary contact, and demonstrate various stages of the speciation process, with some having reached partial, but not complete, reproductive isolation. This phenomenon is especially apparent along the front range of the Rocky Mountains in Alberta, where boreal coniferous forests meet montane coniferous forests. Studies of these populations in secondary contact present an opportunity to test major ideas in evolutionary biology. The objective of Scott's study is to examine geographic variation in song, plumage, and DNA within members of two pairs of sister taxa in secondary contact, Blue-headed Vireo (*Vireo solitarius*) and Cassin's Vireo (*V. cassinii*), and eastern and western subspecies of the Warbling Vireo (*V. gilvus*) and both the individual and population level. Over the past two field seasons, Scott found and focused his research on locations in the province where these taxa came into contact. Eastern and Western Warbling Vireos are coming into contact northwest of Edmonton, near Barrhead. Blue-headed and Cassin's Vireos are coming into contact along the Forestry Trunk Road, near the Clearwater River. His results will further our understanding of the speciation process, and the evolutionary history shaping the biota of Alberta. ■

**Close up of Blue-headed Vireo (left two birds), two individuals from the contact zone (two birds in the middle) and Cassin's Vireo (right two birds)**

# Breeding Shorebird Habitat in Alberta's Prairie Grasslands

Christa L. MacNevin
University of Calgary, M.Sc.
Dr. Darren J. Bender, Supervisor

**Christa examined shorebird presence and absence in relation to habitat conditions**

Alberta's prairie shorebirds have experienced significant population declines in recent years. Christa's research focus was to use satellite imagery to determine if habitat features at the landscape-level could be combined with existing counts of shorebirds to create a predictive habitat model for breeding shorebirds of southeastern Alberta. Key habitat features in her model included: high proportions of wetland and grassland, high densities of roads, low ground brightness, low distances to other intact grassland containing wetlands, and high diversities of habitat types within 5 km of each shorebird count. To explore the validity of the model, sites predicted by the model to have high or medium probability of breeding shorebird use, but not previously surveyed (i.e., gaps), were sampled in the summer of 2005. An additional 2260 observations of individual breeding shorebirds were obtained over 860 new count locations that were all at least 400 m from a road. This new shorebird count data matched the original predictive model well. The refined habitat model was similar to the original, but no longer included high densities of roads. This research identifies potentially critical habitat features for breeding shorebirds and provides a valuable tool to aid in long-term monitoring and habitat management for prairie shorebirds. ■

# Genetic Variability of Mountain Goats

Julien Mainguy
Université Laval, Ph.D.
Dr. Steeve D. Côté , Supervisor
Dr. David W. Coltman, Supervisor

Julien Mainguy's research used molecular tools and field observations to examine which male characteristics are important for reproductive success in mountain goats from a marked population at Caw Ridge, west-central Alberta. Behavioural observations conducted over three breeding seasons revealed that males must reach at least four years of age to successfully form consort pairs with females. Interestingly, old males were observed in consort pairs with old and more productive females more often than with younger females. Males that had a greater body mass for their age also allocated more time to reproductive activities and reached higher social rank than lighter individuals. Paternity analyses conducted with DNA markers showed that most kids were sired by dominant males aged six years or more, whereas many males never sired a kid. The analysis of the DNA markers used to infer paternities also showed that mountain goats exhibit very little genetic variability compared to other ungulates. In addition, the study of a gene playing a central role in disease resistance among three different populations revealed very low diversity, suggesting that inbreeding might occur in some populations due to limited connectivity between them. Overall, this study provides valuable insights on the reproductive ecology and the genetic status of mountain goats that will prove useful in their management and conservation. ■

**An 8-year-old male (left) in consort pair with an 11-year-old female (right) during the rut, November 2006, Caw Ridge, Alberta.**

# The values of burned and old-growth forests to woodpeckers

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

Three-toed and Black-backed woodpeckers are among the birds most vulnerable to intensified management of Canada's northern forests. The two habitats with which they are most associated, recently burned and old-growth forests, are expected to become increasingly rare with current harvesting and salvage-logging practices. Both woodpeckers show characteristic irruptions following fire, suggesting that periodic burns may be essential for maintaining populations. To test this hypothesis, Shawna is: 1) comparing abundance and distribution measures of these woodpeckers in burned and unburned forest, and 2) developing computer models to see how populations may respond to different future forest harvesting and fire regimes. She monitored the densities, nest success and number of chicks fledged by 60 woodpecker pairs within the 2003 Syncline Ridge Burn in Jasper National Park and in old-growth, conifer forests in the Park and near Hinton, AB. For three-toed woodpeckers these measures were surprisingly similar between habitats (~1.5 pairs/km2, with >80% producing 1 chick), suggesting that both burns and old-growth are valuable habitat for this species. Not surprisingly, black-backed woodpeckers (a strong post-fire specialist) were found breeding only in burned sites, however even here their densities (~1.5 pairs/km2) and breeding success (~60%) were lower than expected. Preliminary survival estimates are reasonably high (72% of birds banded in 2004 remained in 2005), and data from coming years will allow comparison between species and habitats. Combining these and other data with computer models help show how much and how frequently burns and old-growth must occur on the landscape to maintain these woodpecker populations. ■

**Male Black-backed Woodpecker in a nest cavity in the Syncline Ridge Burn**

# Bot Fly Parasitism of Ord's Kangaroo Rat in Alberta

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

**Sandra capturing an Ord's kangaroo rat**

The Alberta population of the endangered Ord's kangaroo rat is parasitized by larvae of the bot fly. The bot fly is not considered to be a natural parasite of the kangaroo rat because kangaroo rat populations outside of Canada are not infected, despite the bot flies presence. Limited evidence suggests that kangaroo rats living along roads are more susceptible to bot fly parasitism than those living in natural habitats. In Alberta, a large proportion of the kangaroo rat population lives along gravel and sandy roads, in addition to natural habitats such as sand dunes. Sandra Robertson's main objective was to investigate whether bot fly parasitism rates were higher in road habitat compared to natural habitat. Her second objective was to examine possible effects of bot fly parasitism on body mass, reproduction, and survival. The results revealed that bot fly average parasitism rates were significantly higher for kangaroo rats inhabiting roadsides than those in natural habitats. However, infection rates were variable at individual natural sites, and infection rates at some natural sites were as high as roads. Parasitism by bot fly larvae did not have an effect on the body mass of kangaroo rats. A lower proportion of parasitized females were in breeding condition compared to nonparasitized females, but parasitism did not reduce the proportion of males in breeding condition. The results from this study indicate that parasitism by bot fly larvae does not significantly reduce survival of kangaroo rats. It is likely that the productive growing season and very mild winter helped to reduced mortality. ■

# Hybridization of Native and Introduced Trout

Michael D. Robinson
University of Lethbridge, M.Sc.
Dr. Joseph Rasmussen, Supervisor

The introduction of rainbow trout has been identified as a main factor in the extinction, extirpation and genetic alteration of multiple cutthroat subpopulations, namely the westslope cutthroat trout. Hybridization studies commonly report an elevational gradient of rainbow trout dominating low elevation, pure cutthroat populations in higher reaches, with an intermediate elevation zone of hybrid dominance. Understanding this segregation may be useful when developing conservative management approaches for the protection of remaining pure cutthroat populations. The purpose of Michael's study was to describe the distribution of hybridization throughout the upper Oldman River basin in southern Alberta and determine the roles of life-history strategies (growth and survival rates), behaviour (habitat preference and competition), migratory barriers and physiology in the development of this gradient. This study confirmed the typical elevational gradient found in other study areas. On average, rainbow trout were found to be a faster growing but shorter-lived species with a higher aerobic metabolic rate than westslope cutthroat; hybrids were found to be intermediate in all aspects. For rainbows, an implication of this type of life-history strategy is a higher energetic requirement that demands more food availability. Furthermore, it requires rainbow trout to be more competitive to secure enough food to satisfy this accelerated life-cycle. As stream productivity is known to increase in a downstream fashion, it seems likely that the elevational gradient is the result of a combination of life-history strategy and behavioural differences.■

**Stream speed and food availability may affect native and introduced trout differently**

# Barred Owls in Alberta's Agricultural Landscape

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

Barred Owls are associated with mature forest and are common in Alberta's relatively undisturbed old forest habitats. However, they also breed in the agricultural woodlots of north-central Alberta. The objectives of this radio tracking study were to determine the demographic response of Barred Owls to changes in forest cover and landscape configuration, and to assess what forest characteristics they are selecting within their territories during the breeding season. In territories with intermediate levels of forest cover, 50-75% cover, Barred Owls fledged more young, had higher rates of depredation, and bred less consistently from year to year. Therefore, preliminary results suggest that areas of moderate forest cover may act as an ecological trap in the agricultural landscapes of Alberta. Sixty-four percent of territories changed in their territory status (pair, unpaired individual, no owls) between 2004 and 2005, and 33 percent of radio-tagged barred owls were killed by avian predators in winter. This suggests that winter predation is the primary cause of mortality in this population. The survival and reproductive status of 22 adult owls will be followed throughout the spring of 2006 to further examine how landscape levels of forest cover may affect mortality, territory occupancy and productivity for this species.■

**Michael measures the wing cord length of a Northern Barred Owl**

# Grassland Tiger-moths:
## Biogeography and Taxonomy

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

**Xeric dunes in Alberta offer a diversity of moth habitats**

Tiger-moths of the genus *Grammia* are colourful, mid-sized moths, and at least 13 species occur in Alberta - more than any other Canadian province. Most are grassland specialists, and some inhabit only very dry biomes such as sand dunes and badlands. Several tiger-moth species occur as geographically limited populations in the province, such as the Peace River grasslands and the Wainwright sand dune complex. The taxonomy (species status and affinities to other named species) and geographic extent of at least three tiger-moths have conservation implications in Alberta, since they occur only in the Peace River canyon, parkland sand dunes, or the southernmost dry grasslands. The objectives of Chris' research were to clarify the species affinities of Alberta *Grammia* species with restricted distribution and habitat requirements, through comparison of these populations to other named populations across the species' range, using molecular, structural, and ecological traits of tiger-moths. Initial results show that Peace River populations are derived from southern grassland populations, despite being closer in appearance to montane Rocky Mountain populations. Several rare species occur in the Wainwright dune complex, including one unnamed species and another that occurs nowhere else in the province. ■

# Pronghorn Habitat Selection on CFB Suffield, Alberta

Tobin Seagel
University of Calgary, MEDes
Dr. Cormack Gates, Supervisor

The pronghorn antelope is a useful biodiversity indicator for native grassland ecosystem management at the landscape scale. This indigenous grassland obligate ranges widely, and differentially uses anthropogenic and native land cover types in each season. Tobin's project evaluated the influence of natural and anthropogenic variables on the distribution of pronghorn on CFB Suffield and the Suffield National Wildlife Area in summer and winter, and provided recommendations for beneficial land management practices for sustaining healthy pronghorn populations. Given the strong relationships observed between the probabilities of occurrence of pronghorn to native prairie cover, this project contributes knowledge supporting conservation of Alberta's native grasslands. Seasonal habitat selection models were developed for summer and winter. Two summer habitat selection models were developed using independent data (aerial survey and GPS locations of individuals). Pronghorn used the landscape differently in summer and winter. For example, pronghorn seasonally differ in their response to some anthropogenic features, such as stronger negative selection against the large 2003 burns in the winter versus summer. The project was part of a collaborative initiative between private industry, academia, government agencies and the Alberta Conservation Association and it was part of the larger Northern Sagebrush Steppe Conservation inititive. ■

**Alberta supports the world's northernmost pronghorn populations**

# Caribou, Lichens, and Fire

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

**Landon uses some creative tactics to access vegetation plot sites across the Red Deer River**

Woodland caribou populations in Jasper and Banff National Parks are small and declining. Absence of recent fire may have detrimentally affected terrestrial (ground-borne) lichens, the main forage of caribou in Alberta. Landon examined the winter preferences for forested habitat by woodland caribou in Jasper and Banff National Parks to examine whether the lack of wildfires over the past century may have contributed to a decline in caribou habitat quality. Landon used models that evaluated how the age of forests, topography, and stand structure might explain relationships among caribou, lichens, and fire history. At a landscape scale, he found caribou preferred old forest (> 75 years) in landscapes that burned less frequently, whereas the abundance of *Cladonia* spp. (a terrestrial lichen) was the most significant attractant for caribou at a foraging level. Landon then created predictive models for terrestrial and arboreal (tree-borne) lichens. The model for *Cladonia* showed that sufficient lichen abundance to attract caribou only occurred after 75 years. Similarly, the abundance of arboreal lichens also required the presence of older trees (>150yrs), but abundant arboreal lichens could potentially be retained following low-severity fires. Rather than suffering from a lack of fire, it appears that caribou habitat in Jasper and Banff National Parks would be negatively affected for at least 75 years following either wild or prescribed fires. ■

# Pronghorn Population Dynamics

Katherine A. Sheriff
University of Calgary, MEDes
Dr. Cormack Gates, Supervisor

**Pronghorn on Canadian Forces Base Suffield**

The Grasslands Natural Region of Alberta is the most threatened ecosystem in the province and provides habitat for a diverse native fauna, including 75% of Alberta's 'species at risk'. The pronghorn antelope (*Antilocapra americana*) remains abundant. It is an obligate grassland species and is the most representative large mammal on Alberta's prairies. The pronghorn is highly valued as big game species and as a charismatic icon of the prairie ecosystem. However, they are sensitive to land use and are susceptible to dramatic population fluctuations caused by extreme winter severity. Katherine examined pronghorn population dynamics and density distributions, including temporal and spatial variation in landscape composition, forage productivity, climate, and coyote predation. Population data from annual surveys were available from the Alberta Fish and Wildlife Division. Range productivity was analyzed and showed forage productivity as driven by moisture availability, was a key determinant of fawn production. Winter severity had a significant influence on population rates of increase. The extent of native prairie cover had a profound positive influence on the pronghorn density and influenced density-dependency in fawn production and rate of increase. A system dynamics population model was developed representing environmental and management factors influencing pronghorn population dynamics in Alberta. The model was based on empirical relationships, supplemented with information from published literature. The model identified key uncertainties for future research. Recommendations are offered for evaluating and improving current inventory and management programs. ■

# Fungal Effects on a Rough Fescue Grassland

Bryon H. Shore
University of Alberta, M.Sc.
Dr. James F. Cahill, Jr., Supervisor

Arbuscular mycorrhizal fungi (AMF) form symbioses with the roots of most vascular plant species. Colonized plants provide AMF with carbon, and in turn benefit from increased nutrient and water uptake. AMF may be mutualistic, parasitic, or have no net effect on their plant hosts depending on the species involved and environmental conditions. The role of AMF in structuring Alberta's endangered rough fescue grasslands, remains poorly understood. Bryon applied fungicide to small plots in a rough fescue grassland community in east-central Alberta to suppress AMF. He applied neighbour removal and defoliation treatments to plains rough fescue (*Festuca hallii*) individuals within these plots to determine the effects of AMF suppression on fescue competitive ability and defoliation response. A parallel growth chamber experiment using intact soil cores from this community was performed to determine the effects of AMF suppression on the competitive abilities of fescue seedlings. Bryon also examined changes in plant community composition driven by AMF suppression. Bryon's results indicated that while plains rough fescue was commonly infected with AMF, effects of the symbiosis on competitive ability were negligible for all ages. Following defoliation, however, AMF shifted from being mutualists under low productivity conditions to parasitic under high productivity conditions. The effects of AMF may therefore not be apparent unless additional interactions are applied. At the community level, only a small number of minimally and un-colonized species increased their cover when AMF were suppressed, suggesting that AMF colonization improves the competitive abilities of most species in this system equally. ■

**Fescue seedling grown in an intact soil core**

# Predation and Life-History of the Fathead Minnow

Deborah R. Silver
University of Alberta, M.Sc.
Dr. Bill Tonn, Supervisor
Dr. Cindy Paszkowski, Supervisor

Small lakes in northern Alberta are typically dominated either by small-bodied "forage fishes" or larger piscivorous fishes, but not both. In a few lakes, however, a mixed assemblage exists that includes northern pike and fathead minnow. Co-existing with pike may lead to differences in life-histories of minnow populations relative to predator-free habitats. Deborah examined if and how predation shapes minnow life-history by comparing characteristics of minnows from lakes where pike did and did not occur. Minnows in pike-free lakes were significantly larger and had a longer spawning season with a later peak, yet produced fewer nests than in lakes with pike. To examine if these differences would persist in a common environment, Deborah stocked minnows from two lakes (with and without pike) into divided ponds and collected data on reproductive activity from each experimental population. Despite the absence of pike, minnows from the pike-free lake continued to have a longer spawning season with a later peak, and produced fewer nests than the minnows from the lake with pike. Nests from the pike-free population were defended more often by the males and had higher rates of hatching. At the summer's end, hatchlings from the pike-free population were smaller than those from the population originally with pike. The minnows did not adapt to the common environment within one season, indicating a genetic component to these life-history traits. Because changing climatic conditions may alter the distribution of piscivorous fish, it is important to understand how well prey species can respond to changing predatory pressures. ■

**Deborah with the catch-of-the -day**

# Bird Populations in Edmonton, Alberta

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

Human populations are concentrating in urban areas. In developed countries, cities are growing much faster in area than in population size. As a consequence urbanization is a major cause of habitat loss and fragmentation and if they are to survive, native wildlife has to adapt to this altered environment. While many authors have already studied bird populations in residential areas, only a few have investigated the effect of nearby "natural" habitat on birds of urban streets. The structure of the city of Edmonton around a bisecting parkland (i.e. River Valley System), offered an ideal scenario to simultaneously evaluate the effect of local and landscape features on the bird community in Edmonton neighbourhoods. In winter and spring 2004, birds were surveyed in thirty six 30-ha sites located around Edmonton that varied in distance to forest and local characteristics (e.g., vegetation, feeders and cats). Redundancy Analyses were used to assess the relative effect of local habitat vs. landscape structure on the overall bird community and generalized linear models to analyze factors influencing individual resident species in winter and spring. In both analyses, stand-level variables seem to be better predictors of bird abundance than landscape composition. Number of coniferous trees, tall deciduous trees, and feeding stations were the most important variables, whereas distance to forest or agricultural areas, traffic levels, and cat and dog abundance were not predictors of abundance. ■

**Zulima doing winter bird surveys**

# Predation on Ord's Kangaroo Rats

Andrew C. Teucher
University of Calgary, M.Sc.
Dr. Darren Bender, Supervisor

**Ord's kangaroo rat is a rare nocturnal mammal in Alberta**

Ord's kangaroo rats are nocturnal rodents that live in the Middle Sand Hills of south-eastern Alberta. They are also listed as a provincially endangered species. Their natural habitat is actively eroding sand dunes, but recent declines of their natural habitat have been observed. The edges of sandy roads and fireguards are available as alternative habitat, but the quality of this habitat is unknown. All kangaroo rats are at risk of predation by many predator species, the most common being owls, coyotes, badgers, and snakes. Andrew hypothesized that kangaroo rats living along road and fireguard edges would face higher predation risk than kangaroo rats in natural sand dune habitats, because predators often use linear features such as roads as movement pathways. To test this hypothesis Andrew monitored night-time predator traffic in human-altered habitats (roads and fireguards), as well as natural sand dune habitats using infrared remote video cameras. Coyotes and owls were the only predators observed. He found that roads and fireguards had significantly higher total numbers of predators than dunes (an 89% difference). Increased predation risk for kangaroo rats inhabiting roads and fireguards lowers the quality of these habitats; therefore these human-altered habitats should not be deemed substitutable for disappearing natural habitat. ■

# Songbirds in an Urban Landscape

Marie A. Tremblay
University of Alberta, Ph.D.
Dr. Colleen Cassady St.Clair, Supervisor

Urbanization is widely regarded as a major threat to biological diversity worldwide. Yet, biological conservation in urban landscapes has received relatively little attention by ecologists compared to that in more natural systems. Marie's research investigates how habitat loss, alteration, and fragmentation caused by urban development and transportation corridors affect the movements, distribution, and abundance of forest songbirds within the rapidly urbanizing landscape of Calgary. Early results from bird surveys suggest that local habitat factors, such as the amount of tree cover and the size of the habitat patch, have a greater effect on the diversity of urban bird communities than landscape-level attributes like proximity to a forested natural area. In addition to surveys, Marie used taped recordings of bird calls to lure birds across possible small-scale barriers to movement (like roads and railways) and thus, assess the relative permeability of such features to bird movements. These experiments showed that as the gap in vegetation increased, the likelihood of crossing sharply decreased, particularly as the gap exceeded 30 to 50 m. Marie is also using homing experiments to measure the ability of birds to move across larger scale features such as multi-lane expressways and neighbourhoods of different ages and densities. A major goal of this study is to generate planning strategies aimed at preserving or enhancing avian biodiversity within urban landscapes in North America and elsewhere in the world. ■

**A yellow warbler receives coloured leg bands for individual marking in a permeability experiment**

# Plant Communities in Boreal Saline Wetlands

Marsha J. Trites
University of Alberta, Ph.D.
Dr. Suzanne Bayley, Supervisor

Marsha Trites is studying saline wetlands in boreal Alberta. Naturally saline wetlands are uncommon features in the boreal and often contain plant species considered regionally or provincially rare. Landscapes reclaimed after oil sands mining will be saline, therefore, understanding which environmental factors control plant community composition, diversity and productivity in naturally saline boreal wetlands will help in the design of constructed wetlands in reclaimed oil sands landscapes. Marsha surveyed 17 natural wetlands in central and northern Alberta and plant communities in 10 constructed wetlands on or near oil sands leases in Fort McMurray. She measured nutrients, pH, water level, soil moisture and organic content within each vegetation community. Plant communities contained 1 to 16 species and there was no difference in the number of species in constructed wetland plant communities compared to those found in natural wetlands. Salinity and water depth were important determinants of dominant species identity at each wetland. Highly productive species, such as Broadleaf Cattail and Water Sedge, were found in areas that had deeper water with lower salinity. Less productive species, such as Seaside Arrowgrass and Prairie Bulrush, are more common in drier, high salinity areas. Water depth and pH may be predictors of the number of species present at each wetland. Generally, plant communities were more diverse when water was shallow and when pH was neutral or slightly acidic. ■

**Marsh Trites' saline study sites at Elk Island National Park were dominated by the plant Seaside Arrowgrass**

# Plains Garter Snakes in Southern Alberta

Krysia N. Tuttle
University of Victoria, M.Sc.
Dr. Patrick T, Supervisor

Variation in critical resources has been shown to affect the habitat use and seasonal movements of many species, especially animals whose ranges extend into the temperate zone, where certain resources may be only seasonally available. Due to the life-histories of garter snakes, summer and winter habitats have been outlined as important for the persistence of their sub-populations. In Alberta, Krysia found plains garter snakes to be strongly wetland-associated species during the summer months. Marshes and surrounding grassland habitats provided prey, vegetative cover for protection from predators, and basking and cooling sites required for thermoregulation. In the winter, snakes relied upon den sites in terrestrial habitat for survival. Results from radiotelemetry indicated that snakes selected habitats for optimal thermoregulation and foraging opportunities; such as south-facing grassland hillsides with cover, near marshes. Snakes also appeared to avoid sites in direct contact with water or sites with a high percentage of forest-associated vegetation. Plains garter snakes did not communally den at this study site, although they did migrate from summer foraging areas to winter sites, where they spent up to eight months in mammal burrows. The plains garter snake can be considered an umbrella species with respect to its use of habitat at the aquatic-terrestrial interface. Thus, protection of garter snake habitat will have potential for multi-species benefits, by expanding the boundaries of wetland habitat to include surrounding terrestrial areas. ■

**Garter snakes in Alberta rely on wetlands and the burrows of small mammals**

# Genome Duplication And Adaptation

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

There are still many questions about the rate and mode of evolution in plants and animals. Sara's research focuses on understanding the genomic basis of adaptation and geographic range expansion. Genome duplication may facilitate these processes, but this has not been experimentally tested. Our native wildflower, fireweed (*Chamerion angustifolium*), exists in two forms, a diploid with 36 chromosomes and a tetraploid with 72. The diploid is the tetraploid's ancestor and grows at higher latitudes and elevations. This suggests that genome duplication may have facilitated a range shift. To understand fireweed's distribution, Sara designed a reciprocal transplant study to determine whether the diploid and tetraploid forms are locally adapted. If so, diploid and tetraploid forms should have higher survival and reproductive rates within their native range. Sara established nine plots across an elevational gradient in the Rocky Mountain parks of Alberta and measured the growth and survival of seedlings transplanted into these plots in 2004 and 2005. Significantly more diploids planted in 2005 survived at high elevations than tetraploids. This suggests that diploids are better adapted to high elevations than tetraploids, as expected. However, Sara found no difference in survival at low elevation. The ability of diploid seedlings to survive as well as tetraploid seedlings, at low elevation, may indicate that genome duplication did not facilitate range shift in fireweed, or that fitness differences emerge after the seedling stage. Additional observations will be important for determining conclusively how increase in genome size affects new species and regulates biodiversity. ■


**Moving fireweed plants to new habitats is a way of empirically testing their life history characteristics**

# Endophytes of Aspen Roots in Central Alberta

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

Trembling aspen is ecologically and commercially one of the most important tree species in Alberta's boreal forest. Observations of wood decay, dieback and reduced growth in aspen forests in the Canadian Prairie Provinces emphasize the need for more detailed studies of the mycota, especially the dark septate endophytes (DSE), associated with this species. DSE are dematiaceous fungi that form inconspicuous infections within tissue of healthy plants for all or nearly all their life cycle. The hyphae of DSE grow over the root surface and into the root tissues. DSE may be either parasitic or symbiotic. A survey was made in central Alberta of DSE in 5-7-year-old aspen seedlings. They were abundant and taxonomically diverse. Isolates of *Cryptosporiopsis*, a coelomycete genus affiliated with *Pezicula* (Helotiales), comprised one large group of isolates. *C. ericacea* and *C. radicicola* were identified according to the morphological characteristics and ITS sequences. *Phialocephala fortinii*-like species comprise a second large group. Resynthesis work shows that both *Cryptosporiopsis* and *Phialocephala fortinii*-like species can grow within the roots of seedlings without causing detectable levels of necrosis or growth retardation and may serve as beneficial associates of aspen. ■

**DSE in root cells of aspen seedlings (orange arrows)**

# Wolf Pregnancy Rates in Alberta

Nathan F. Webb
University of Alberta, Ph.D.
Dr. Evelyn H. Merrill, Supervisor

Recent work from Alaska has indicated that wolf packs subject to harvest by humans may have higher instances of secondary reproduction (breeding by multiple females within a single pack) than previously believed. Nathan evaluated the use of hormone levels from scats as a non-invasive method to determine pregnancy rates in wolves, and conducted a preliminary assessment of whether multiple pregnancies were associated with increased harvest intensity. Scat collected from pregnant captive wolves was used to create a "benchmark" progesterone concentration that could be used to indicate pregnancy of wild wolves from feces collected between 15 March – 15 April in 2004 and 2005. Due to high variability among samples, low sample sizes and no samples from non-pregnant individuals from captive animals, our selection of a criterion value for pregnancy remains tentative at best. Nevertheless, Nathan believes statistical refinement of predicting the probability of pregnancy based on hormone levels in scat remains feasible with a larger sample of captive pregnant and non-pregnant wolves for comparison. In contrast, identification of individual wild wolves from DNA in scats seems more limiting at this time. Results of Nathan's study were not adequate to assess the effects of wolf harvest on pregnancy rates. While a larger sample of scats may improve the probability of detecting pregnancy, given the recommended sampling intensity of >50 samples/pack and assuming approximate $80CAD/sample for DNA analysis and $25CAD/sample for hormone analysis, this equates a total cost of $5250CAD per pack not including collection costs. Nonetheless, if feasible, this approach is likely to be more economical than catching wolves. ■

**Wolf pups at the den of the Radial Lake Pack**

# Northern Flying Squirrels in the Alberta Foothills

Matthew Wheatley
University of Victoria, Ph.D.
Dr. Karl Larsen, Supervisor

Contemporary forest management changes the amount and configuration of suitable habitat types across landscapes, and affects the movement and distribution of forest-dwelling animals. A species' response to this change depends on its movement abilities and how it perceives the spatial grain and extent inherent within landscape structure. The scale of this perception should be different between settled adults and dispersing juvenile animals: adults responding to local small-scale structure, and dispersing juveniles perceiving large-scale structure as they explore new territory while leaving home. The relative differences (and subsequent importance) of scale between these two life history stages are not well known. Matthew is studying the movement ecology of northern flying squirrels, a primary prey item for nocturnal predators and a key dispersal agent of underground fungi that benefit tree growth. Using radio-tracking techniques in a commercially logged forest, Matthew is investigating the spatial correlates of flying squirrel movement for both adult and juvenile squirrels. After three field seasons, Matthew has intensively followed over 60 animals among 17 study areas near Hinton, Alberta, adjacent to varying-aged regenerating forest. Results have revealed unanticipated habitat associations such as relatively extensive use of bog areas by reproductive adults, and use of residual tree patches facilitating among-patch movement in recently harvested areas. Flying squirrels will both forage and nest in regenerating forest roughly 20-years post-harvest if adjacent to certain habitat types. This information assists landscape planners to maintain key forest vertebrates in managed areas. ■

**A juvenile flying squirrel that was radio-collared and monitored through dispersal**

# Progress Reports

## Edge Effects on the Nesting Success of Boreal Forest Songbirds

Jeffrey R. Ball
University of Alberta, Ph.D.
Dr. Erin Bayne, Supervisor

Jeffrey relates detailed nesting study results to songbird position in the forest.

**Swainson's thrush monitored by video camera checking nest contents**

## Salinity and Water Clarity in Shallow Prairie Lakes

Heather M. Boyd
University of Calgary, Ph.D.
Dr. Leland J. Jackson, Supervisor

Heather is examining factors that influence turbidity in prairie lakes.

**A sediment core that Heather extracted from one of her study lakes in southern Alberta**

## Factors Controlling the Ecosystem State of Alberta's Shallow Lakes

Danielle Cobbaert
University of Alberta, Ph.D.
Dr. Suzanne Bayley, Supervisor

Danielle is studying environmental changes that affect aquatic plants.

**Danielle sampling shallow lakes in northern Alberta**

## Diet Influence on Small Mammal Response to Linear Features

Amy F. Darling
University of Alberta, M.Sc.
Dr. Erin Bayne, Supervisor

Understanding how roads, pipelines and cutlines affect small mammals may help managers minimize forest disturbances.

***Peromyscus maniculatus* held by Amy Darling**

## The Ecology and Biodiversity of Fungi Growing on Mosses

Marie L. Davey
University of Alberta, Ph.D.
Dr. Randolph Currah, Supervisor

Marie is examining the hidden role of fungal infection on Alberta mosses

**Light micrograph of a moss rhizoid infected by the pathogenic fungus *Phoma herbarum***

## The Influence of Fish on Waterfowl Diversity and Abundance

Ceitlynn A. Epners
University of Alberta, M.Sc.
Dr. Suzanne Bayley, Supervisor
Dr. William Tonn, Supervisor

Ceitlynn studies the ways fish and waterfowl share or compete for food supplies

**Ceitlynn opens a minnow trap**

## Ecotoxicology of Common Loons and Ospreys in the Rocky Mountains

Sarah I. Lord
University of Alberta, M.Sc.
Dr. David Schindler, Supervisor
Dr. Gordon Court, Supervisor

Ospreys may serve as contaminant indicators in Alberta

**Attaching satellite transmitter to adult female osprey in Drayton Valley, Alberta**

## Plant Foraging Behaviour in a Native Alberta Grassland

Gordon G. McNickle
University of Alberta, Ph.D.
Dr. James F. Cahill, Supervisor
Dr. Michael K. Deyholos, Supervisor

Alberta's native grasslands have shrunk in the face of agriculture and there is much to learn if we are to demonstrate their value.

**Gord McNickle sampling native Alberta grasslands for his research**

## Population Genetics and Chronic Wasting Disease Spread in Mule Deer

Stephanie M. Nakada
University of Alberta, M.Sc.
Dr. David Coltman, Supervisor

Stephanie is addressing the features that aid or inhibit the spread of CWD, a fatal disease of wild deer.

**Stephanie Nakada sampling muscle tissue for population genetic analysis**

## Implications of Bighorn Male-Male Relationships

Graeme O. Pelchat
University of Calgary, M.Sc.
Dr. Kathreen Ruckstuhl, Supervisor

Graeme's work helps identify dominance and breeding factors in bighorn sheep.

**Rams interacting during the 2005 rut**

## Evolutionary Consequences of Trophy Hunting in Bighorn Sheep

Jocelyn Poissant
University of Alberta, Ph.D.
Dr. David Coltman, Supervisor

Jocelyn's work builds on earlier questions of the effects of removing specific sheep from the population.

**Anaesthetized bighorn ram being measured**

## Mountain Pine Beetle Dispersal in Host and Non-host Forest Habitats

Tyler G. Reid
University of Calgary, M.Sc.
Dr. Mary Reid, Supervisor

Tyler is examining the spread of this extremely important insect in Alberta.

**Mountain pine beetles marked with one of four flourescent powders**

## Competition Between Rough Fescue and Kentucky Bluegrass

Steven C. Tannas
University of Alberta, M.Sc.
Dr. Edward W. Bork, Supervisor

Stephen is an award winning range student who is examining two species of agronomically important range plants.

**Watering plots to determine the impact of increased soil moisture on competition**

## Effects of Climate Change on Mountain Lake Food Webs

Paul Weidman
University of Alberta, Ph.D. Candidate
Dr. David Schindler, Supervisor
Dr. Rolf Vinebrooke, Supervisor

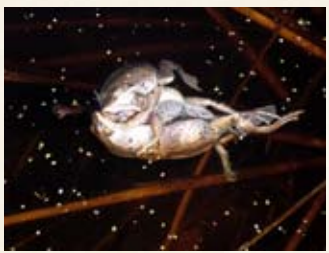
Paul works in the extreme environments of alpine lakes.

**Sampling on Geraldine Headwater Lake, Jasper National Park**

## The effects of nutrient enrichment on tadpole growth and survival

Arthur V Whiting
University of Alberta, Ph.D.
Dr. Cynthia Paszkowski, Supervisor

Arthur's examination of tadpole growth is highly relevant to land use practices.



**Breeding anurans**

# 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 www.biology.ualberta.ca/biodiversity/ for exact deadline.

**For more information please contact:**

Margaret Foxcroft, Program Administrator
ACA Grants in Biodiversity
Department of Biological Sciences
CW 405, Biological Sciences Building,
University of Alberta, T6G 2E9
Phone: (780) 492-7059
Email: m.foxcroft@ualberta.ca

Dr. Lee Foote, Program Director
Department of Renewable Resources
University of Alberta
Edmonton, Alberta T6G 2H1
Phone: (780) 492-4020
Email: Lee.Foote@ualberta.ca

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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