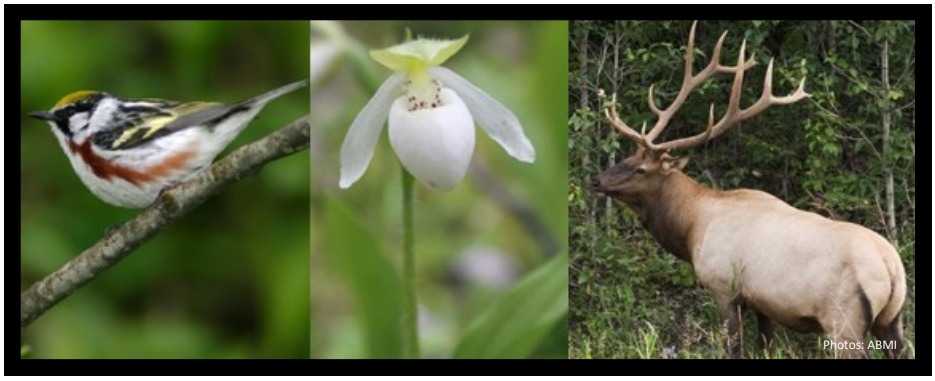
# Biodiversity Management and Climate Change Adaptation

**2012-2013 Year-end Report**




## OVERVIEW

"Biodiversity" describes the variation present among living organisms, including diversity within and among species and the ecosystems they reside in. Biodiversity has significant intrinsic and aesthetic value to Albertans, but it also supports the production of ecosystem services, such as water purification and forest productivity. Increasingly, climate change is being recognized as a threat to biodiversity globally, federally and in Alberta. That the effects of climate change on biodiversity will have implications for the provision of ecosystem services is prompting natural resource managers to consider climate change adaptation strategies in management plans. Because the relationships between climate and biodiversity are still unclear, policies for successful adaptation to future climate change are poorly defined.

The Biodiversity Management and Climate Change Adaptation Project is spearheaded by the Alberta Biodiversity Monitoring Institute with collaborators from the University of Alberta and the Miistakis Institute. The goal of the project is to develop essential knowledge and tools to support the management of Alberta's biodiversity and ensure successful adaptation to a changing climate. Investment in a climate change adaptation program will help avoid costly and ineffective crisis-driven biodiversity management actions, while maintaining biodiversity and its value to Albertans into the future.

*Our goal is to develop essential knowledge and tools to support the management of Alberta's biodiversity in a changing climate*

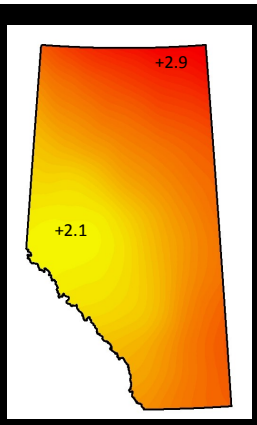
**This project focuses on four objectives:**

1. **Predicting the impacts of climate change on Alberta's native species and ecosystems**
2. **Predicting invasive species responses to climate change**
3. **Assessing strategies to support climate sensitive species-at-risk**
4. **Developing and evaluating adaptation policy and tools to manage biodiversity in a changing climate**

In the first year of the project, we have focused on three initiatives outlined in this report: predicting the effects of climate change on native species and ecosystems, strategies to support climate sensitive species, and climate change adaptation action plans for communities.

## YEAR ONE HIGHLIGHTS

- Completed initial assessments of the vulnerability of more than 125 of Alberta's native species to climate change
- Predicted changes to distributions of many of Alberta's songbirds and rare plants with climate change
- Mapped and described the climatic changes predicted to occur within Alberta's Natural Subregions as well as the potential ecological responses to these changes
- Initiated a resiliency-based action planning strategy to support climate change adaptation by local communities
- Identified extreme rainfall as key driver of nest success of the Burrowing Owl
- Launched a field program examining the consequences of extreme weather on Ferruginous Hawks
- Commenced field trials examining the fitness of plant species, such as Northern blazing star, planted outside their current climate conditions



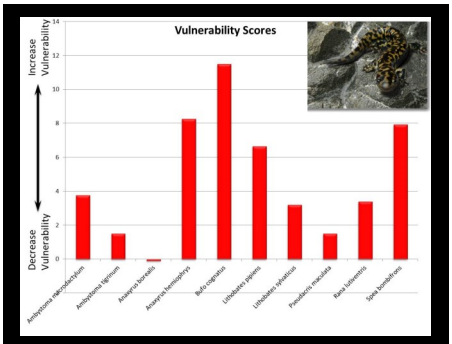

Predicted change in mean annual temperature (°C) in Alberta from the present to 2050, based on a downscaled average of 15 global circulation models (GCMs) and the A2 emissions scenario.

CCEMC Core funding for this project is provided by the Climate Change and Emissions Management Corporation

# EFFECTS OF CLIMATE CHANGE ON NATIVE SPECIES AND ECOSYSTEMS

## Species Vulnerability Assessments

The purple pitcher plant is predicted to be vulnerable to climate change in Alberta. Photo: L. Shackleton




Preliminary assessments of Alberta amphibians indicate that vulnerability varies substantially among species. The Great Plains toad (*Bufo cognatus*), Canadian toad (*Anaxyrus hemiophrys*), and the plains spadefoot toad (*Spea bombifrons*) are the most vulnerable. Inset: Tiger salamander (*Ambystoma tigrinum*) is less vulnerable. Photo: Alberta Environment and Sustainable Resource Development

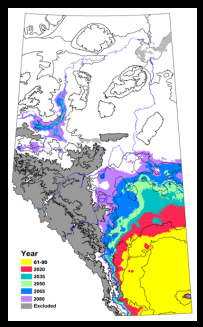
A species' vulnerability to climate change depends on the magnitude of climate change throughout its range and on how sensitive that species is to such changes. We have evaluated the vulnerability to climate change of more than 125 of Alberta's native species using a vulnerability index developed by NatureServe (natureserve.org). Our analysis includes species from a broad range of taxonomic groups and from all natural and land management regions of the province.

These assessments provide insight into patterns of species vulnerability associated with geography, taxonomy or "at risk" status. They are also providing species-specific information relevant to provincial species assessments and recovery plans. An initial assessment framework and a review of possible tools is provided in our report *Framework for assessing the vulnerability of Alberta's biodiversity to climate change.* Our Year 1 progress report provides a recent update on our methods, the set of species assessed so far and preliminary results.

This project, combined with the outcomes of the species and ecosystem distribution modelling, will support prioritization of Alberta's native species according to climate change vulnerability.

## Ecosystems

The distribution of Alberta's regional ecosystems, such as grasslands, parkland and boreal forests, depends in large part on climate. We have developed models that link the current distribution of Alberta's ecosystems to current climate and have used these models to map the potential future distribution of ecosystems as climate changes. These predictions could provide support to regional planning initiatives, including provincial parks planning, and are particularly relevant for policies and plans that are currently based on fixed ecological benchmarks.

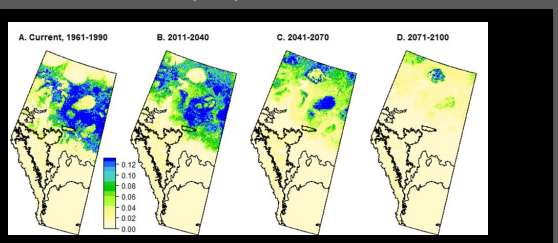



Predicted change in the distribution of the grassland natural region with climate change.

Our report *Alberta's ecosystems: past, present and future* considers how the current distributions of Alberta's Natural Subregions are related to climatic conditions. It describes how the distributions of these regions may shift in response to climate change and highlights some of the uncertainty inherent in these predictions.

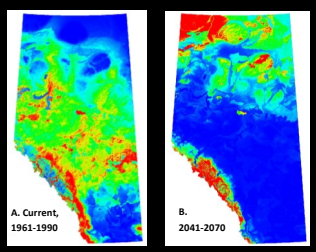
## Species Distribution Models

We are developing species distribution models for many Alberta birds and rare plants that predict where species are expected to be found based on variables like current and future climate, soil conditions, vegetation and land use. These models describe predicted species abundances and whether a species' preferred climate is likely to persist in Alberta in the future. We can use these models to identify regions of the province that may represent climate refugia, areas that could support current species assemblages in the future.




Predicted current and future density of bay-breasted warbler. Darker blue represents a higher predicted density. There is a notable reduction in the predicted density of this species. Climate data: 19 GCM average, A2 emissions scenario. (*Stralberg et al., in prep.*)

Our report *Scientific support for assessing the vulnerability of Alberta's biodiversity to climate change* outlines our approach to species distribution modelling and the implications of these models for species' vulnerabilities to climate change. Our report *Modeling avifaunal responses to climate change across Alberta's Natural Regions* provides detailed predictions for 84 species of boreal birds.




Predicted current and future distributions of early coralroot. Warm colours indicate areas of higher habitat suitability for this orchid. There is a distinct shift in suitable habitat northward, and to higher elevations. Climate data: UKMO HADGEM, A2 emissions scenario. (*Stolar and Nielsen, in prep.*) Photo: M. Klüber

Distribution maps and additional information on species distribution modelling are available online at borealbirds.ca and ace-lab.org/asca.

# COMMUNITY CLIMATE CHANGE ADAPTATION ACTION PLANS

Climate Change Science → Implications for Community → Action Plan

As the climate changes, Alberta's communities will be required to make decisions that encourage adaptation to the new climate conditions. Alberta currently lacks a framework for local governments and communities to address climate change; supporting the development of community-based climate change adaptation action plans will enable communities to move forward. We are also developing a decision support toolkit that will help communities identify adaptation strategies that satisfy their goals while maintaining biodiversity-related ecosystem services.

In Year 1, we have reviewed possible tools for local adaptation to climate change in Alberta, and proposed an action plan process and a mapping and visualization toolkit structure that will be pursued during the next two years of the project. This action plan process and toolkit will enable community decision-makers to interpret relevant climate change science, understand the implications for biodiversity and ecosystem services in their communities, and identify opportunities for adaptation, both within and beyond planning processes already in place.

Ecosystem services, like rangeland production, will be affected by climate change. Climate change adaptation action plans can support communities to identify strategies that benefit biodiversity–related ecosystem services. Photo: M. Kohler

# SPECIES-SPECIFIC INTERVENTIONS

## Assisted Migration

Some plant species in Alberta may be unable to disperse sufficient distances to alter their ranges in response to a changing climate. We are testing the utility of translocating these plants to areas where the climate is predicted to become more favourable in the future. Translocations to the north of the current range allow us to test the fitness (survival and potential reproduction) of a plant in a region where climate may become more suitable in the future. Translocations to the south of allow us to examine plant fitness under projected future climate conditions for the current range. These field trials will help determine whether assisted migration could be used as a large-scale intervention for a dispersal-limited plant species.

Northern blazing star (*Liatris ligulistylis*), one of two species currently being used in assisted migration trials. Photo: S. Nielsen


Initial population location (star) and trans-plant locations for Northern blazing star trials. Inset: Experimental planting layout. Photo: S. Nielsen

If assisted migration of a plant species is deemed feasible, what is the best way to ensure seed germination in the new locations? We are testing a variety of seed delivery systems that could be used to enhance germination success in the context of assisted migration.

Our interim report *Status of field work on assisted migration of rare, range-restricted plants* provides an update on the field work performed so far and the rationale behind the study design and species selection.

## Grassland Birds

The nesting success of two rare Alberta grassland birds, the Burrowing Owl and Ferruginous Hawk, is diminished by extreme weather events like extreme rainfall and wind, which are expected to become more frequent as climate changes.

*Our research that identifies extreme rainfall as a key driver of Burrowing Owl nest success has been submitted for publication in the Journal of Applied Ecology*

We are working to associate patterns in weather and climate variables with hawk behaviours that may influence reproductive success or survival. To do so, we are using portable weather stations placed close to hawk nests.

Weather stations monitor environmental variables near Ferruginous Hawk nests. Photo: R. Fisher

In addition, we are testing whether targeted interventions such as supplemental feeding of chicks and weatherproofing vulnerable nests can improve nesting success, which may ultimately promote persistence of these species in their current ranges if extreme weather events become more common.

# PROJECT TEAM

The Biodiversity Management and Climate Change Adaptation project is coordinated by the Alberta Biodiversity Monitoring Institute (ABMI), with collaborators from the Miistakis Institute and the University of Alberta. The project receives its core funding from the Climate Change and Emissions Management (CCEMC) Corporation, with additional support provided through collaborators and related projects. The project's Steering Committee, comprised of representatives of Government of Alberta departments, provides project direction, reviews project outcomes, and fosters connections with government and non-government representatives that have responsibility, capacity, and interest in the adaptation of biodiversity management in Alberta to climate change.

The project team is:

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|---|---|
| **Erin Bayne** | *University of Alberta* |
| **Shauna-Lee Chai** | *ABMI* |
| **Greg Chernoff** | *Miistakis Institute* |
| **Dan Farr** | *ABMI* |
| **Ryan Fisher** | *University of Alberta* |
| **Guy Greenaway** | *Miistakis Institute* |
| **Jeff Lane** | *University of Alberta* |
| **Tracy Lee** | *Miistakis Institute* |
| **Tara Narwani** | *ABMI* |
| **Scott Nielsen** | *University of Alberta* |
| **Amy Nixon** | *ABMI* |
| **Ken Sanderson** | *Miistakis Institute* |
| **Rick Schneider** | *Consultant, ABMI* |
| **Chris Shank** | *Consultant, ABMI* |
| **Diana Stralberg** | *University of Alberta* |
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# COMING UP...

In upcoming years of the project we will be considering the interface between climate change science and biodiversity management practices and policy at the provincial scale. Because biodiversity management in Alberta occurs at two primary scales, the species level and the regional level, we are investigating both.

**At the species level, we are considering:**

- The relative vulnerability of Alberta's species to climate change
- The viability of current management objectives in a changing climate
- Potential solutions to the challenges of species management in a changing climate

**At the regional level, we are considering:**

- The management of parks and protected areas in a changing climate
- The implications of climate change for the management of biodiversity on the working landscape
- The implications of climate change for the decoupling of communities and ecosystems

**We are also pursuing two additional sub-projects in support of our objectives:**

- A risk assessment of the response of invasive plant species to climate change in Alberta with a view to prioritizing particular species or regions of the province for targeted management
- Experimental translocations of Columbian ground squirrels between low– and high-elevation populations to determine the potential for adaptive change in date of emergence from hibernation and the feasibility of assisted migration along an elevation gradient for this species

*Please visit our website to view the reports highlighted in this newsletter as they become available: www.biodiversityandclimate.abmi.ca*


Photo: M. Kohler


## Support

Core funding for this project is provided by the Climate Change and Emissions Management Corporation

Additional support is provided by funders of related projects

Alberta Upstream Petroleum Research Fund (AUPRF)