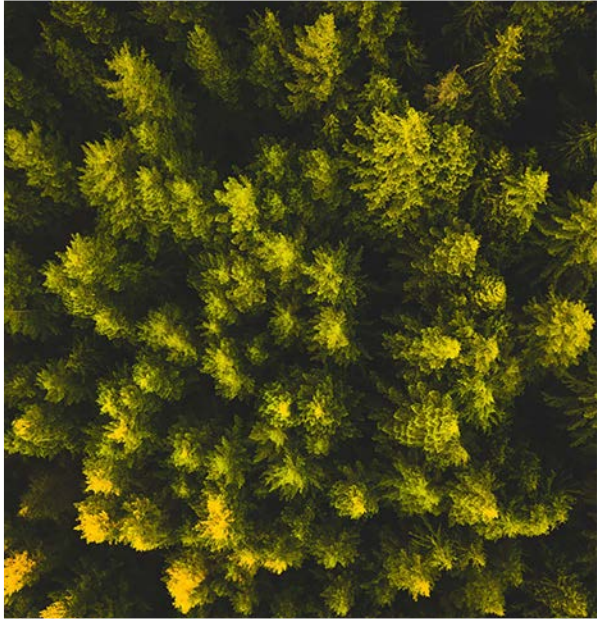

ALBERTA BIODIVERSITY CONSERVATION CHAIRS

FINAL REPORT 2018

UNIVERSITY OF ALBERTA

Stan Boutin | Scott Nielsen | Erin Bayne

CONTENTS

BACKGROUND TO THE FINAL REPORT

The Alberta Biodiversity Conservation (ABC) Chairs program (2013-2018) was a multi-stakeholder, applied research initiative focused on conservation and management of biodiversity within the oil sands regions of Alberta (primarily around in situ developments). There were four integrated research themes which included:

1. Rare and endangered species monitoring and conservation.
2. Cause and effect assessment of biodiversity change for effective management.
3. Improving monitoring, modeling and management of biodiversity for land use planning.
4. Integrated restoration: from sites to landscapes.

This report compiles one-page summaries for some of the key projects completed through the ABC Chairs program. We chose to profile up to ten projects per researcher to showcase the results of the Chairs program, while also keeping the volume of content accessible for partners. Each project summary has been developed to clearly address: Why the project was important, How it was delivered, and What the key findings were.

ACKNOWLEDGEMENTS

Thank you to the Alberta Biodiversity Conservation Chairs funding partners:

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ALBERTA INNOVATES

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ABC CHAIRS PROGRAM - RESEARCH LEADS

Dr. Stan Boutin is a Professor of Population Ecology and Alberta Biodiversity Conservation Chair in the Department of Biological Sciences at the University of Alberta. He is the scientific co-director of the Alberta Biodiversity Monitoring Institute (ABMI) and a Fellow of the Royal Society of Canada. His research focuses on providing decision-makers with the information and tools necessary to make ecologically-informed land use decisions.

Dr. Scott Nielsen is an Associate Professor of Conservation Biology and Alberta Biodiversity Conservation Chair in the Department of Renewable Resources at the University of Alberta. In 2008 he founded the Applied Conservation Ecology Lab and currently leads a research team examining the responses of biodiversity to forestry and energy development and the effectiveness of mitigation/restoration actions.

Dr. Erin Bayne is a Professor of Conservation Biology in the Department of Biological Sciences at the University of Alberta. His research focuses on understanding the cumulative ecological impacts of human activities on biodiversity. His lab works closely with government, industry, and conservation organizations to facilitate better conservation decision making. Erin is also the director of the Bioacoustic Unit which is working to develop new tools for effective monitoring of rare species.

EXECUTIVE SUMMARY

The Alberta Biodiversity Research Chairs (ABC) Program was operational from 2013-2018 with the focus of fast-tracking biodiversity science in the oil sands region by providing funding and support for on-the-ground research. The program was designed to help discover opportunities for minimizing environmental effects of human development across Canada's boreal forest. It was also designed to look at ways to rapidly and effectively remove or mitigate effects on biodiversity when they occur during development.

The ABC Chairs program resulted in several key achievements. A summary of some of these achievements is provided here. Summaries have been grouped by research lead for clarity.

Research Lead: Dr. Stan Boutin

Stan Boutin led a program to understand the role of industrial development on the population viability of important wildlife species. A core focus of his program was understanding how woodland caribou and their predators respond to linear features within landscapes of northern Alberta and northeastern British Columbia. This included understanding how predators and woodland caribou respond to linear features, how changes to ecological processes translate into population level impacts on woodland caribou, and how restoration success can be clearly defined. His team also focused on developing an approach for the prioritization of seismic lines for restoration within Alberta's oil sands region. Finally, his team considered how a changing climate might impact when and where it makes sense to focus on conservation of woodland caribou.

The key studies highlighted in this report include:

- The caribou data portal for facilitating collaboration
- Planning restoration to maximize woodland caribou return on investment
- Caribou population trajectories under a range of restoration scenarios
- Criteria for assessing functional restoration of linear features
- Nowhere to Hide: linear features invite predators into caribou calving grounds
- Return on investment of safe havens as a caribou recovery strategy
- Trailing edge conservation and woodland caribou
- Identifying woodland caribou calving habitat
- Human footprint, habitat, wolves, and boreal caribou population growth rates

Research Lead: Dr. Scott Nielsen

Scott Nielsen led a program focused on understanding development impacts and mitigation opportunities for a range of boreal species. Rare plants were a core focus and his team's work included the mapping of rare species habitats in northeastern Alberta, testing translocation success for rare plants, and understanding important habitats for fruiting shrubs. His team also developed techniques for using Unmanned Aerial Vehicles (UAVs) to map important habitat for biodiversity and informing predictive tools for aiding development planning. Finally, his team focused

on understanding how seismic lines affect a range of key species, such as butterflies and invasive species. His team then paired this with studies of how fire might influence seismic line recovery and how UAVs can be used to monitor vegetation recovery on restored seismic lines.

The key studies highlighted in this report include:

- Responses in butterflies to seismic lines, well pads, and roads
- Rare plant populations near human footprint have higher extirpation rates
- Fire as a seismic line restoration tool
- A place-based understanding and mapping of fruiting shrubs
- Seismic lines may spread invasive plant seeds
- Using LiDAR-derived data to predict patterns of plant diversity
- Testing rare plant translocation success
- Rare plants of the Lower Athabasca oil sands region
- Understanding when and where roads block water flow and responses to the plant community
- UAVs and monitoring of vegetation recovery on seismic lines

Research Lead: Dr. Erin Bayne

Erin Bayne led a program focused on understanding how development and cumulative effects influence a range of species in northeastern Alberta. Several of his team's studies focused on how bird species respond to oil sands development and forest harvesting. His team then looked at ways that existing data about bird species can be used to map their probability of occurrence within future development areas. His team also focused on developing new technologies for autonomously recording bird species in the field and training computers to automatically identify key bird species. These studies have the potential to dramatically improve the efficiency of current field survey methods for a range of species including: birds, owls and amphibians.

The key studies highlighted in this report include:

- New model predicts Canadian toad habitat
- Risk to Yellow Rails from oilsands mining—habitat and preliminary trends
- Understory protection harvesting supports bird communities more similar to unharvested forest
- Songbird communities are resilient to wildfire in the northern boreal forest
- Can a computer recognize a bird song?
- Local-scale boreal bird models don't scale up well to individual landscapes
- Moose populations appear stable but avoid human features
- Industrial noise does not strongly affect owls in northeastern Alberta
- Songbird communities recover as reclaimed well sites regenerate
- Using sound level from autonomous recording units to provide more accurate distance—and thereby density—estimates

STAN BOUTIN

THE CARIBOU DATA PORTAL FOR FACILITATING COLLABORATION

Project Led By: Regional Industry Caribou Collaboration

WHY IS THIS PROJECT IMPORTANT?

Woodland caribou recovery represents a significant planning challenge. Dozens of companies may operate within one caribou range, and coordinating land-use and restoration planning is essential. Without a way to share knowledge between different companies, operations of one company could unintentionally interfere with the restoration efforts of another. Approaching caribou recovery collaboratively is, therefore, critical to ensure conservation resources are used efficiently.

The Regional Industry Caribou Collaboration (RICC) is a group of companies that have chosen to coordinate their efforts on research, habitat restoration, and land management. They recognized a need to create a centralized source of information to better facilitate their collaboration and data sharing.

HOW WAS THE STUDY COMPLETED?

RICC developed a password-protected web portal that is home to the data used or generated by RICC projects. RICC members conducting caribou research or land-use planning can easily locate and utilize data from the portal.

WHAT WERE THE CORE FINDINGS?

The web portal has supported habitat restoration by making key data easily accessible. Examples of data included on the portal are:

- Detailed inventory of linear features
- Predator telemetry
- Industrial project boundaries
- Land-use planning boundaries under the Lower Athabasca Regional Plan (LARP)
- Provincial Protected Areas
- Planned habitat restoration areas
- Government of Alberta caribou home range data

Using this collaborative data sharing approach, RICC has initiated several significant projects, including: 1) defining ecological criteria for habitat restoration; 2) predator radio telemetry collaring; 3) the prioritization of linear features for restoration; and 4) coordinating habitat restoration among companies.

PLANNING RESTORATION TO MAXIMIZE WOODLAND CARIBOU RETURN ON INVESTMENT

Research Led By: Alberta Biodiversity Monitoring Institute and Stan Boutin

WHY IS THIS STUDY IMPORTANT?

Woodland caribou are threatened in Alberta and are declining by up to 16% per year. To ensure that woodland caribou populations remain viable, the Federal Recovery Strategy has mandated that 65% of caribou ranges be undisturbed. Most herds in Alberta remain well below this threshold, and significant restoration efforts will be needed in coming years to meet the mandate.

Seismic lines allow predators to travel more efficiently and provide access into woodland caribou habitat. Having been implicated in caribou declines, they are a prime target for restoration efforts. However, restoring seismic lines is a costly and time-consuming process, and over 100,000 km of seismic lines have been cut across Alberta's oil sands area. Restoring seismic lines in a single caribou range could cost hundreds of millions of dollars. Prioritizing which seismic lines should be restored within this working landscape is key to ensuring efficient caribou recovery.

HOW WAS THE STUDY COMPLETED?

We simulated the outcome of different restoration strategies to find out which approach gives the best "bang" for our "buck." We used several factors to classify the suitability of a given township for seismic line restoration. First was the degree of human disturbance on the landscape. This tells us how much undisturbed habitat would be gained if all the seismic lines were restored. The next factor was the density of seismic lines. Townships with more seismic lines will take longer and be more expensive to restore. Finally, we considered the potential economic value of the area. This allows us to pull restoration efforts away from areas likely to be developed in the near future.

Using these factors, we ranked townships into five categories of restoration priority.

WHAT WERE THE CORE FINDINGS?

We found that for four of the five caribou ranges in Alberta's oil sands area, all seismic lines need to be restored to meet the federal mandate, regardless of prioritization category.

When other human disturbances like well pads and forestry cut blocks are included for restoration, all five caribou ranges could reach the federal mandate when only the three highest priority zones were restored.

Using our approach, the dollars spent on habitat restoration in caribou ranges can be stretched up to three times further. Therefore, this work will help ensure that caribou restoration efforts receive the best possible return-on-investment.

CARIBOU POPULATION TRAJECTORIES UNDER A RANGE OF RESTORATION SCENARIOS

Research Led By: Robert Serrouya and Stan Boutin

WHY IS THIS STUDY IMPORTANT?

Linear features (e.g., roads, pipelines, and seismic lines) form extensive networks in parts of Canada's boreal forest, and they have been implicated in declines of threatened woodland caribou. Recent research has revealed that linear features alter the dynamics between woodland caribou and their predators in several key ways:

1. Linear features offer straight, clear paths to predators on which they can move unimpeded. This allows wolves to move 2-3 times faster, thereby increasing their hunting efficiency.

2. Linear features allow predators access into peatlands that normally serve as refugia for woodland caribou. By increasing the spatial overlap of predators and prey, it is difficult for caribou to avoid encounters with predators.

Restoring linear features in woodland caribou habitat could cost hundreds of millions of dollars. Understanding which forms of restoration will be effective is critical information for managers and land-use planners, so we modeled the ways linear feature restoration could affect caribou populations.

HOW WAS THE STUDY COMPLETED?

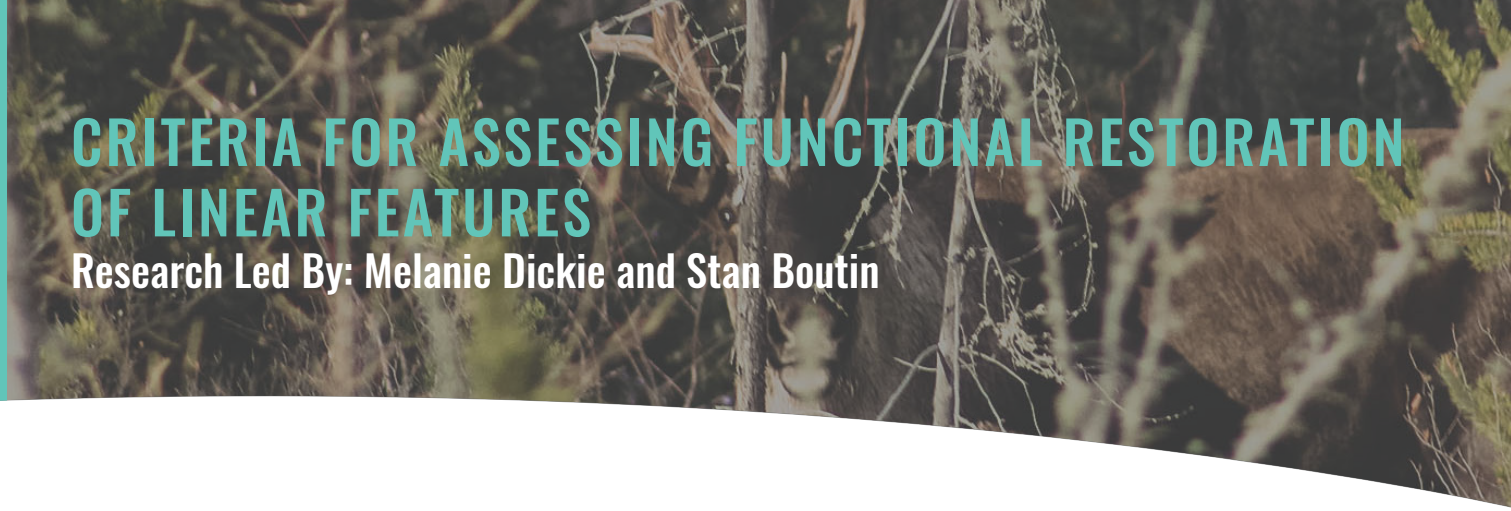
Using data on wolf speed and spatial overlap with caribou, we have modeled the hunting advantage afforded to wolves by linear features. From this, we predicted the expected densities of wolves, moose, and woodland caribou under different restoration scenarios: the current landscape conditions (existing linear feature density), when only seismic lines are restored (partial restoration), and when all linear features are restored (complete restoration).

WHAT WERE THE CORE FINDINGS?

The analysis is still ongoing, but preliminary findings indicate that spatial overlap between wolves and caribou is the most important factor boosting wolf hunting efficiency. Linear features that provide wolf access into caribou refugia (such as peatlands) should be the highest priority for restoration.

While the increased speed afforded to wolves by linear features was a less important factor compared to spatial overlap, restoring linear features in a way that reduces both spatial overlap and movement efficiency had the greatest benefit to caribou.

Overall, restoration of linear features could have a substantial effect on woodland caribou. Model predictions indicate that current linear feature densities suppress the number of woodland caribou that can coexist on the landscape by 43%. Restoration of all linear features as opposed to just seismic lines will have the greatest benefit.



CRITERIA FOR ASSESSING FUNCTIONAL RESTORATION OF LINEAR FEATURES

Research Led By: Melanie Dickie and Stan Boutin

WHY IS THIS STUDY IMPORTANT?

Seismic lines have been shown to provide predators of woodland caribou with a clear path of travel through the landscape. This allows wolves to move 2-3 times faster, increasing their hunting efficiency. Current federal recovery criteria define seismic lines as restored when they are no longer visible using Landsat satellite imagery, but vegetation on seismic lines may impede wolf movement long before these levels of regeneration are achieved.

Because wolves use seismic lines to increase their travel speed and hunting efficiency, it may be more appropriate to designate lines as "restored" when the regenerated vegetation is tall enough that wolves no longer gain an advantage. Making restoration criteria relevant to the implications for woodland caribou (i.e., when wolf speed is reduced) will help managers better allocate restoration dollars.

HOW WAS THE STUDY COMPLETED?

We compared wolf movement on seismic lines and in undisturbed forest. Twenty-two wolves from six packs were tracked using GPS collars. To determine the height of vegetation growing on the seismic lines, we used LiDAR data. We analyzed both wolf selection for seismic lines as well as their travelling speed when on seismic lines.

WHAT WERE THE CORE FINDINGS?

Once vegetation height reaches 50 cm, wolves travel considerably slower, but taller vegetation is required to reduce wolf speed to levels comparable to the surrounding forest.

If 50 cm were used as the threshold for restoration criteria, 13% of the existing seismic lines in the study area would be considered "restored." Further restoration efforts could then be more effectively directed towards the remaining seismic lines that have not yet reached 50 cm of regrowth.

NOWHERE TO HIDE: LINEAR FEATURES INVITE PREDATORS INTO CARIBOU CALVING GROUNDS

Research Led By: Craig DeMars and Stan Boutin

WHY IS THIS STUDY IMPORTANT?

Predators and prey have adapted over millenia to use their landscape to their advantage. The long-term stability of predator-prey systems relies on the availability and effectiveness of refugia – places where prey can avoid their predators and find temporary safety. Alterations to the landscape may compromise the effectiveness of prey refugia, with consequences to populations of rare or threatened species.

Within boreal forests, threatened woodland caribou have traditionally used peatlands as refugia to avoid predators, such as wolves and bears. However, linear features such as seismic lines and roads may be compromising this strategy by altering the spatial behaviour of woodland caribou and their predators.

HOW WAS THE STUDY COMPLETED?

To find out whether linear features are compromising woodland caribou refugia, we collected data on caribou and their predators during the calving season. We studied six boreal caribou ranges in British Columbia with an average linear feature density of 4.04 km/km². Fifty-six female caribou, 23 wolves, and 19 black bears were tracked with GPS collars. We then examined their response to linear features at two spatial scales. At the fine scale, we assessed how linear features influenced each species' habitat selection between successive GPS locations. At the large scale, we assessed how each species responded to variation in linear feature density within their home ranges.

WHAT WERE THE CORE FINDINGS?

At the fine scale, female caribou generally avoided linear features. Wolves selected strongly for linear features in peatlands and avoided peatlands that lacked linear features. Bears showed a similar, though less strong, effect. At the large scale, female caribou generally selected areas with lower linear feature density, but completely avoiding exposure was not possible. Wolves and bears showed weak avoidance for higher linear feature density in peatlands, possibly due to predators only requiring a few lines to effectively search an area or because of ongoing human activity.

Female caribou with calves tended to avoid linear features but could not avoid them completely because of the extensive network of linear features within their ranges. Female response toward linear features also had potential demographic effects as females that used linear features more, also had higher probability of calf mortality. By increasing the spatial overlap between predators and woodland caribou, linear features reduced the effectiveness of peatlands as a refugia for woodland caribou. Mitigation efforts should focus on limiting or restoring linear features that lead into and occur within peatlands.

RETURN ON INVESTMENT OF SAFE HAVENS AS A CARIBOU RECOVERY STRATEGY

Research Led By: Stan Boutin and Rob Serrouya

WHY IS THIS STUDY IMPORTANT?

Many woodland caribou herds in Alberta face extirpation in the next 10–20 years if aggressive conservation steps are not taken. In response to targets set by the federal government's Recovery Strategy for Woodland Caribou, a range of potential conservation techniques have been identified for possible implementation in Alberta. However, the relative costs and benefits of these techniques must be assessed to determine the combination of strategies with the greatest likelihood of success.

HOW WAS THE STUDY COMPLETED?

We performed a 15-year simulation of caribou populations under several possible scenarios: Business As Usual, Linear Restoration, Linear Deactivation, Maternity Pens, and Predator Fencing. We also estimated the probable costs of each scenario.

WHAT WERE THE CORE FINDINGS?

Our simulation saw the steepest declines in caribou populations under the Business As Usual Scenario (only 20% of the starting population remained after 15 years), Linear Restoration (20% of the population remained after 15 years), and Linear Deactivation (40% of the population remained after 15 years). Key characteristics that limited the effectiveness of these techniques included slower implementation timelines and the time lag before regenerating vegetation could grow tall enough to affect predator movement.

In contrast, scenarios that created safe havens for caribou—Maternity Pens and Predator Fences— resulted in much healthier caribou populations. Maternity Pens resulted in 80% of the starting population remaining by year 15 and Predator Fences resulted in a 20% increase in the population within 15 years. According to our simulation, herds in northeastern Alberta could be stabilized given protection of 50% of females from each herd.

When expected costs for each technique were considered, the cost per individual caribou favored Maternity Pens and Predator Fences by an order of magnitude.

In our simulation, Maternity Pens and a Predator Fence were the most cost-effective options for caribou recovery, particularly in the short-term. However, uncertainties persist regarding survival of calves after release and the carrying capacity within a fenced enclosure. While Linear Restoration and Linear Deactivation are required by the Federal Recovery Strategy and are important for long-term caribou recovery, a multi-pronged approach that combines a suite of techniques is ideal for addressing caribou recovery across different time scales.

TRAILING EDGE CONSERVATION AND WOODLAND CARIBOU

Research Led By: Sophie Gilbert, Kate Broadley, Darcy Doran-Myers, Amanda Droghini, Jess Haines, Anni Hämäläinen, Clayton Lamb, Eric Neilson, Stan Boutin

WHY IS THIS STUDY IMPORTANT?

As climate change progresses, habitats characterized by particular climatic conditions will shift geographically. At the "leading-edge" of these shifting habitats, locations that were previously unsuitable for a given species may open up for colonization, while at the "trailing-edge," locations that previously supported the species will become unsuitable. Populations of Threatened and Endangered species at the trailing-edge will find themselves in progressively unsuitable habitat with little or no potential for them to become self-sustaining. Attempts by managers to restore habitats to previous conditions are likely to be foiled by these changing climatic conditions.

Woodland caribou may be one example of this conundrum. Some woodland caribou herds may now be living on the trailing edge because climatic conditions now favour expanding deer populations which lead to wolf densities that are incompatible with caribou populations. These populations may never become self-sustaining despite aggressive restoration and range planning efforts.

As more resources are dedicated to increasingly challenged southern populations, fewer resources are available for those populations inside the new climate envelope. A change in conservation policy is needed to reflect the reality that some populations of Threatened and Endangered species on the trailing edge will never be self-sustaining.

HOW WAS THE STUDY COMPLETED?

We developed a decision framework to serve as a basis for deciding which populations should be let go, and which should receive other interventions.

WHAT WERE THE CORE FINDINGS?

For woodland caribou, a more adaptive approach than the current status quo may involve shifting resources from struggling southern populations to the northern populations. While habitat restoration efforts in southern regions are likely to be insufficient on their own due to climate change, northern populations stand to benefit from habitat restoration. As management of southern herds at the trailing-edge is dialed back, conservation efforts can be focused on herds in habitats supported by the current and future climate.

Of course, the decision to reduce conservation efforts and allow a trailing-edge population to decline should be restricted to specific circumstances. First, it must be ensured that the cause of their current decline is due to climate change and not some other factor. It must also be established that the population is not critically important to the survival of the species – for example, if there is only one population left. If a critically important population is stranded in an unsuitable climate, then the options are either intensive, prolonged management in situ (e.g., perpetual predator control with no plan to scale back), or relocation to a more suitable area.

IDENTIFYING WOODLAND CARIBOU CALVING HABITAT

Research Led By: Craig DeMars and Stan Boutin

WHY IS THIS STUDY IMPORTANT?

Threatened woodland caribou have experienced sharp declines and represent a significant conservation challenge. Human disturbances on the landscape have given caribou predators an advantage, and young calves are particularly vulnerable. Low rates of calf survival are a key factor contributing to overall population declines, making the protection of caribou calving areas a priority. However, few conservation efforts target woodland caribou calving habitat, as discriminating these areas from the overall landscape has been very difficult.

We sought to identify important habitat types for calving woodland caribou at scales relevant to management. This could help efforts to limit human activity in calving habitats and more efficiently allocate restoration dollars.

HOW WAS THE STUDY COMPLETED?

Individuals may select habitats differently, so we developed an individual-based model. Using data from 46 female caribou fitted with GPS collars, we compared how they selected habitat depending on several factors. Key comparisons included calving vs non-calving seasons, barren females vs females that had calves, and females before and after losing a calf. We also assessed whether females primarily selected calving areas to reduce encounters with predators or to increase access to better forage.

WHAT WERE THE CORE FINDINGS?

Females with calves avoided upland deciduous forests, lakeshore habitats, and areas with high human disturbance. These areas are likely frequented by wolves, indicating that predation risk is the dominant factor driving selection of calving habitat.

While caribou use mostly lichen-rich bogs in winter, females shifted to nutrient-poor fens during the calving season, which have a higher abundance of sedges and shrubs. This may help female caribou meet nutritional demands of nursing during the calving season, while limiting exposure to predators as much as possible.

Nutrient-poor fens are important calving habitat for woodland caribou, allowing them to meet nutritional needs while minimizing exposure to predators. These habitats should be prioritized for restoration of human disturbances like linear features so that females can adequately spread out in these areas during calving season.

HUMAN FOOTPRINT, HABITAT, WOLVES, AND BOREAL CARIBOU POPULATION GROWTH RATES

Research Led By: Rob Serrouya, Harry van Oort, Craig DeMars, Stan Boutin

WHY IS THIS STUDY IMPORTANT?

Woodland caribou are declining rapidly in much of their range. Apparent competition is the prevailing hypothesis for the proximate cause of caribou declines. Human disturbances are hypothesized to increase the abundance of moose and deer which boost predator populations. This in turn puts more pressure on caribou populations through incidental predation. However, other factors may play a role in these relationships, such as climate change, fire, weather, and landscape attributes.

Understanding the degree to which human footprint is responsible for caribou declines will help guide conservation dollars and plan restoration more effectively. We embarked on a project to evaluate how caribou populations respond to landscape attributes, ungulate abundance, and wolf abundance.

HOW WAS THE STUDY COMPLETED?

So far, we have surveyed 6 large areas (4000-5000 km²) in the Northwest Territories, Alberta and BC. We performed aerial census counts within each area, flying transects in winter to detect wolf packs by tracks left in the snow. We used pre-existing datasets for estimates of moose density, caribou population growth rates, human footprint, and land-cover type.

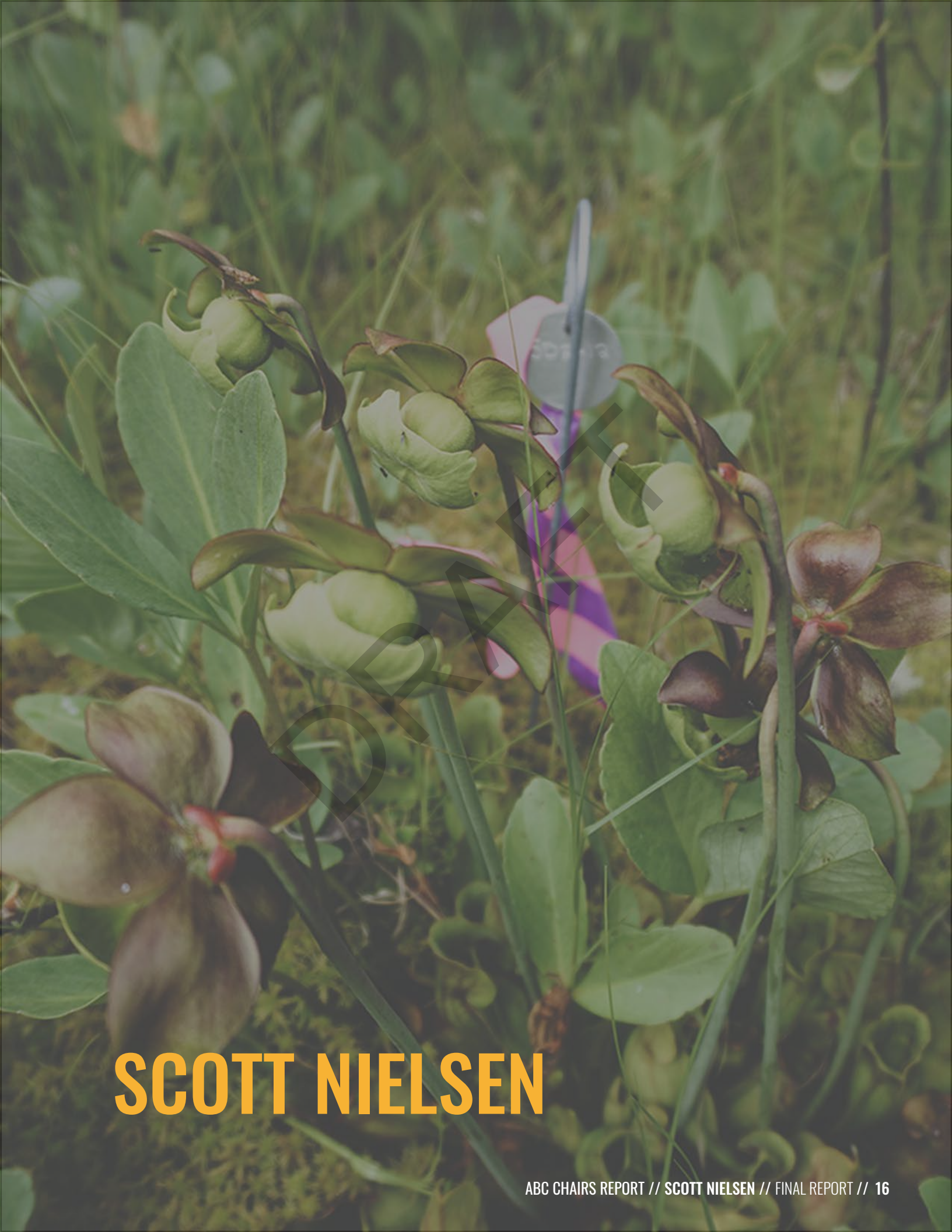
WHAT WERE THE CORE FINDINGS?

In our pilot analysis, we found that as wolf density increased caribou population growth rates decreased.

Greater human footprint was associated with greater wolf densities and lower caribou growth rates.

This preliminary analysis has succeeded in directly relating human footprint to caribou growth rates and provides explicit support for the apparent competition hypothesis. These findings will facilitate more detailed investigations once additional data are collected and more sites are surveyed.

As more areas are surveyed, we will be able to determine the relative magnitude of importance between human footprint and other landscape attributes.



SCOTT NIELSEN

SEISMIC LINES AND BUTTERFLIES

Research Led By: Federico Riva, John Acorn, Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Seismic lines are widespread in Alberta's boreal forests, and their impacts on wildlife have been a topic of great interest. Low-impact seismic lines are narrower and often have a more winding path than standard seismic lines. They are, therefore, thought to cause less disturbance to wildlife communities.

As oil sands companies test and adopt new practices to reduce their environmental footprint, it is important to evaluate the outcomes of these practices and confirm whether their objectives are being realized. Past studies have looked at mammal and bird responses to low-impact seismic, but not those of smaller organisms like insects. This study aimed to help fill the gap and determine whether butterflies are sensitive to the gaps created by low-impact seismic lines and other disturbances.

HOW WAS THE STUDY COMPLETED?

In 2015 through 2017, we assessed population responses of butterflies to in situ oil sands footprints and examined permeability of the landscape to butterfly movements from seismic lines versus control forests. We surveyed 10- to 15-year-old open disturbances in treed peatlands within the Wood Buffalo region, including conventional seismic lines (9 m wide), low-impact seismic lines (3 m wide), well pads (60 m by 60 m), and road sides. We also surveyed butterflies in mature (>80-year-old) forests for comparison.

WHAT WERE THE CORE FINDINGS?

The effect of in situ exploration on butterflies was clearly reduced on low-impact lines. These lines remained shaded with the butterfly community similar to the undisturbed forest.

In contrast, road sides, well pads, and conventional seismic lines all provoked a strong change in the butterfly community. These open areas contained many more plants and species on which adults and caterpillars can feed.

These findings demonstrate the potential benefits of low-impact seismic over conventional seismic and expand our understanding to include smaller species that are typically overlooked.

Future studies of in situ oil sands footprint would benefit from comparisons to fire and harvesting to better understand the relative magnitude of these disturbances on the landscape.

RARE PLANT POPULATIONS NEAR HUMAN FOOTPRINT HAVE HIGHER EXTIRPATION RATES

Research Led By: Jacqueline Dennett, Monica Kohler, Dan Farr, Scott Nielsen.

WHY IS THIS STUDY IMPORTANT?

Rare vascular plants are vulnerable to extirpation, particularly in heavily-disturbed regions. In order to conserve and manage them effectively, it is necessary to understand their conservation status. However, species data (maintained by the Alberta Conservation Information Management System) can include records of populations which have become extirpated since they were last recorded.

This is of particular concern given that many population records of rare plants are collected during pre-disturbance assessments on oil and gas leases—i.e., these records were collected shortly before a planned disturbance which may have affected or extirpated the population. This has the potential to inflate records and make some rare species appear more secure than they truly are.

There is also an important knowledge gap regarding the extent of footprint adjacent to rare plant records and the relationship between population extirpation and oil and gas development.

HOW WAS THE STUDY COMPLETED?

First, we used remote-sensing-derived imagery to determine the amount and type of footprint in proximity to 209 rare plant records within the oil sands area. Second, we visited 62 populations between 2016 and 2017 to determine whether the recorded populations were still present or if they had been extirpated.

WHAT WERE THE CORE FINDINGS?

Estimates of human footprint – derived from remote sensing imagery – around the 209 rare vascular plant populations suggests that while populations of rare species are commonly within 100–500 m of human footprint, disturbance intensity is most often low. In addition, populations on lease areas had a higher proportion of surrounding oil and gas related footprint than off-lease populations, where populations on in-situ leases generally had greater amounts of surrounding footprint than those on mining leases.

Contrary to our expectations, similar rates of population extirpation were observed between on- and off-lease areas and between in-situ and mining leases. Some species may be promoted by soft oil and gas related features, while others, such as orchids, are more difficult to monitor and their responses to disturbance may be less favourable.

Revisitation standards (i.e., setting criteria for monitoring rare species over time) for assessing the status of rare plant populations within oil and gas leases are recommended, particularly revisitation of populations which are reported to be small, or of species which are more likely to be sensitive to disturbance. By collecting data following disturbances, it will be possible to more accurately track population trends of rare plant species and their conservation status.

FIRE: A SEISMIC RESTORATION TOOL?

Research Led By: Angelo Filicetti and Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Seismic lines are an important disturbance legacy in Alberta. They affect key wildlife like woodland caribou by fragmenting forests and regeneration has historically been poor, especially on treed peatlands and dry upland forests.

Fire is another key disturbance in western boreal forests. Unlike seismic lines, fire typically provokes rapid regeneration by fire-adapted species like jack pine. If fires promote regeneration that resembles the growth in adjacent stands, it could have major implications for seismic line restoration planning. We investigated whether fire could improve seismic line recovery in upland jack pine forests.

HOW WAS THE STUDY COMPLETED?

We examined seismic lines that burned five years earlier during the Richardson Fire, approximately 115 km north of Fort McMurray. A total of 70 paired plots have been completed. Tree densities were measured along seismic lines and 25 m into the adjacent forest for comparison. Tree cores and tree heights were also measured to determine stand age.

WHAT WERE THE CORE FINDINGS?

Five years after a wildfire, jack pine regeneration on upland seismic lines was twice as high as regeneration in the adjacent burned forest.

The challenge of recovering legacy seismic lines is considerable, and our findings suggest that regeneration is kick-started on certain sites following high-severity fire.

Passive recovery may be a strategy for poorly-recovering lines that have a high probability of burning. Prescribed burns may also be a powerful restoration tool on upland jack pine sites. These findings could result in significant cost savings while still contributing to woodland caribou recovery over the long term.

A PLACE-BASED UNDERSTANDING OF FRUITING SHRUBS

Research Led By: Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Fruiting shrubs are highly valued by Indigenous communities and are a food source for key wildlife in the boreal. Despite their value, there are significant gaps in our knowledge regarding the location and fruit production of fruiting shrubs in the Lower Athabasca region. These gaps result in under-representation in land use planning decisions and environmental impact assessments. Our aim was to develop predictive maps to help identify important areas of fruiting shrubs, thus supporting land use planning, seed/fruit collection, and management and mitigation actions.

HOW WAS THE STUDY COMPLETED?

We collected data on 21 different fruiting species from a total of 845 plots in the Lower Athabasca region. We determined which habitat factors were associated with each species and used this information to predict their distribution and productivity across the area. Maps based on landcover type, soil type, topography, and climatic factors had good to very good accuracy.

WHAT WERE THE CORE FINDINGS?

We determined which habitat factors are most associated with fruiting shrubs and successfully predicted the location and productivity of these species in the oil sands region of Alberta to support their management.

The most important areas for fruit production were the east slope of the Birch Mountains, the Athabasca Plain, parts of the east side of Stony Mountain, and the Lake-land/Sand River areas.

In general, areas with greater terrain variability were an important predictor for fruiting shrubs, though xeric-adapted species were associated with the Athabasca plain.

These maps (available at www.ace-lab.org/atlas/shrubs) will allow communities, land-use planners, and scientists to identify important areas for berry picking and facilitate greater inclusion into decision-making.

These maps can also be used to identify ideal sites for conducting experiments aimed at increasing berry production (e.g., tree thinning, identifying sites for seed collection, or assessing impacts of future developments).

SEISMIC LINES MAY SPREAD INVASIVE PLANT SEEDS

Research Led By: David Roberts and Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Habitat fragmentation can have profound effects on ecosystems, and seismic lines may be a key source of this fragmentation in Alberta's boreal areas. To date, most studies have focused on assessing vegetation recovery and the resulting impacts on key wildlife species like woodland caribou and wolves. However, the vast networks of seismic lines in Alberta's boreal forests may also function as seed dispersal corridors, offering fewer obstructions and greater wind speeds.

Understanding the potential role of seismic lines as seed dispersal corridors will enable more accurate environmental impact assessments and could inform what mitigation techniques are necessary to restore seismic lines.

HOW WAS THE STUDY COMPLETED?

We experimentally tested the effect of seismic lines on seed dispersal by releasing cattail seeds as proxies for wind-dispersed invasive plants both in forested areas and on adjacent seismic lines (whose width ranged from 5.3 to 8 m). We performed a total of twelve seed release tests in an area near Ellscott in northern Alberta.

WHAT WERE THE CORE FINDINGS?

We found that wind speeds were seven times faster on seismic lines compared to adjacent forests. The median distance reached by wind-borne seeds is almost three times farther, and the maximum distance four times farther, on a seismic line compared to the undisturbed forest.

Seismic lines may facilitate rapid expansion of invasive plants where sites are suitable. Land-use planners should consider the potential effect of seismic lines on wind-borne seeds if invasive plants are present in the area.

Seismic lines may also aid in the northward advancement of native species to help mitigate against the impacts of climate change, but this depends largely on wind direction and seismic line orientation.

Future work should investigate the relative importance of wind speed versus physical barriers, such as trees and tall shrubs, in regards to slowing seed dispersal. Studies on seed establishment would also help better understand the magnitude of seismic line impacts, which we are now studying.

LIDAR-DERIVED DATA: A NEW TOOL FOR PREDICTING PATTERNS OF PLANT DIVERSITY

Research Led By: Lingfeng Mao, Jacqueline Dennett, Christopher Bater, Piotr Tompaski, Nicholas Coops, Dan Farr, Monica Kohler, Barry White, John Stadt, and Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Threats to biodiversity continue to be an important conservation topic in landscapes with high rates of human disturbance, particularly under a changing climate. Biodiversity itself is, however, difficult to measure across large scales—presenting a challenge to biodiversity monitoring across large regions. Large-scale, cost-effective monitoring tools that can be linked to biodiversity measures would, therefore, be an asset for understanding and managing biodiversity at larger scales.

Recent advances in LiDAR technology have made it possible to more effectively measure the structure and complexity of vegetation across large areas—variables which previously could only be collected at local scales in the field. The potential of these metrics to explain patterns of plant diversity, and to assess factors which may be affecting these patterns, has received limited attention.

HOW WAS THE STUDY COMPLETED?

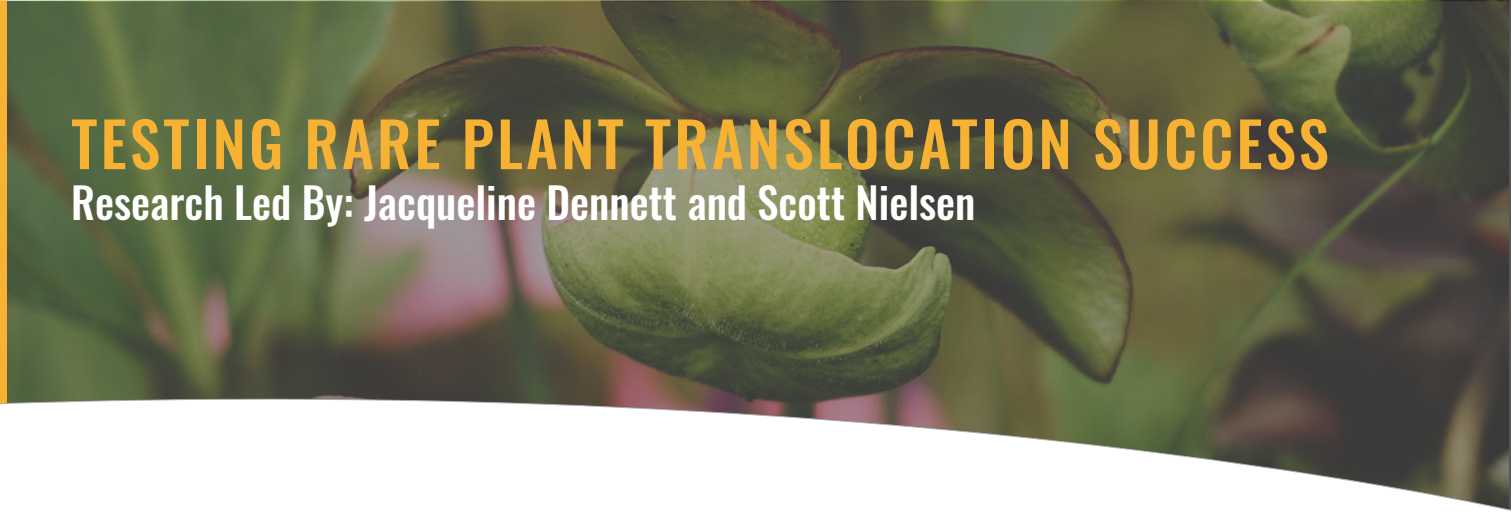
We tested the relationships between plant diversity data collected in the field, climate data, and LiDAR-derived vegetation structure data, depth to water, and terrain variability. This allowed us to assess the threats posed by oil sands developments to plant biodiversity hotspots. We also analyzed species richness inside and outside of woodland caribou ranges to evaluate whether woodland caribou conservation plans will protect plant biodiversity hotspots.

WHAT WERE THE CORE FINDINGS?

While LiDAR-derived variables only partly explained patterns in plant diversity, they show promise for indirectly monitoring plant biodiversity across regional scales. Climate and LiDAR-derived measures of vegetation structure, slope, and depth to water were moderately effective at explaining local patterns in native plant species richness. Overall, canopy height and mean annual precipitation were the best predictors of plant richness with the exception of graminoids (grasses and sedges). Older, productive forests were associated with high species richness, with the exception of grasses and sedges, which were most species-rich in open habitats.

Comparisons between on- and off-lease areas within the studied region generally showed higher richness on-lease, suggesting that many oil sands leases are located in areas with moderate to high plant species richness. However, leases further north and at lower elevations had higher plant richness. Analyses of plant richness inside and outside of woodland caribou ranges suggest that plans to protect caribou will likely do little to protect vascular plant biodiversity hotspots.

Our findings suggested that LiDAR-derived data may be used during pre-planning on leases by highlighting target areas of potentially high plant diversity and selecting areas for proposed developments that would have the least impact.



TESTING RARE PLANT TRANSLOCATION SUCCESS

Research Led By: Jacqueline Dennett and Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Mitigation efforts are expensive and time-consuming, so it is critical to ensure that approved mitigation practices are effective. Translocation is one mitigation technique that has seen mixed success in the past. When new human developments encounter rare plants, translocation involves moving the plants to another area within their natural range in an effort to conserve them.

While upland species are known to have poor survival rates after translocation, little is known about the response of peatland species to this technique. This study sought to fill this knowledge gap to inform conservation strategies for rare plants within peatlands.

Understanding the effectiveness of translocations will help planners choose the most appropriate mitigation technique for a given situation.

HOW WAS THE STUDY COMPLETED?

We conducted experimental translocations of two peatland species in the Oil Sands Region of Alberta. For each species, 70 plants were removed from each of three donor sites. Of these, 20 were immediately replanted at the donor site to act as a control, while the remaining plants were distributed across three recipient sites. Initial transplanting occurred in 2014 and follow-up monitoring of survival, growth, and reproduction was conducted annually from 2015 - 2017.

WHAT WERE THE CORE FINDINGS?

Translocation of peatland species appeared successful in the short-term, with higher survival than was previously observed for plants on drier sites in other studies. Transplants survived and grew equally well across varied recipient sites, suggesting that recipient site selection does not need to be guided by vegetation similarity for the species considered.

Although survival was high, growth and reproduction decreased in the years following translocation. However, their growth and reproduction appeared to approach normal rates over time.

While peatland species may survive the translocation process, changes to growth and reproduction could reduce their ability to colonize new areas. Translocations should remain a last-resort option used only when habitat is being totally destroyed (i.e., peat is being stripped).

When using translocations, individuals should consider the importance of the number of plants being transplanted together, current knowledge of the species being transplanted, and the capacity for long-term monitoring.

When translocation is used as a mitigation technique, long-term monitoring will be key to ensuring the success of future generations and the efficacy of this strategy.

RARE PLANTS OF THE LOWER ATHABASCA OIL SANDS REGION

Research Led By: Scott Nielsen and Jacqueline Dennett

WHY IS THIS STUDY IMPORTANT?

Rare plants represent a conundrum. Rare species require effort to protect, but some species ranked as rare have simply been under-sampled and are in fact more frequently encountered than would be expected. Learning more about rare plants is critical to understanding the impact of in situ oil sands development, but they are habitat-specific and cryptic in nature. This means they are often missed by standard monitoring programs, making the finding and management of rare plants a challenge.

We identified environmental factors associated with rare plants, then used that information to map rare plant habitat in the Lower Athabasca region of Alberta. Our aim was to develop a more efficient sampling approach and map rare plant habitat across the region. Such information can assist with understanding and mitigating the effects of in situ oil sands developments.

HOW WAS THE STUDY COMPLETED?

We mapped areas of the Lower Athabasca region where we expected rare plants to be, then sampled these areas more frequently. We searched 602 unique 50 x 50 m sites in the Lower Athabasca region for rare plants. Using an adaptive sampling approach proved an effective way to detect rare plants, with some species being encountered more frequently than expected given their conservation status. We identified environmental factors associated with rare plants, then used that information to map rare plant habitat in the Lower Athabasca region.

WHAT WERE THE CORE FINDINGS?

Vegetation height structure and land cover type were the most important indicators of rare plant habitat, demonstrating the utility of using remote sensing methods like LiDAR.

Maps produced from this model are being used for the provincial Biodiversity Management Framework, are guiding more efficient sampling for rare plants during pre-disturbance assessments, and are informing mitigation strategies. Industry partners can now more effectively avoid important rare plant habitat and minimize their impact on these species. Maps are available for download from the Alberta Species Conservation Atlas: http://www.ace-lab.org/asca-rare-plants

Our sampling efforts also helped contribute new information towards a re-evaluation of the conservation status rankings of rare plant species. Under the updated rankings, dry, sandy pine forests are the habitat type most likely to include rare plants.

UNDERSTANDING WHEN AND WHERE ROADS BLOCK WATER FLOW

Research Led By: Caitlin Willier and Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Roads are well-known for disrupting water flow through peatlands. When water is blocked by a road, the downstream side dries up and becomes more forested, while the upstream side floods, becoming more open. However, this flooding pattern is not always consistent, with different responses observed in similar peatlands or even along stretches of a single road.

Because peatlands of the same type can show very different responses to roads, simple wetland classification types (e.g., bog vs fen) are not enough to determine where this is likely to occur. This study examined the role of additional factors, including landscape position and substrate texture, on flooding responses as indicated by changes in tree canopy.

HOW WAS THE STUDY COMPLETED?

This study was conducted in the Boreal Plains of northeast Alberta. A total of 100 fens and bogs were selected and their vegetation cover was mapped using LiDAR data. Random locations within each wetland that were up to 250 metres from a road were selected and their substrate texture was determined using Surficial Geology of Alberta data. Vegetation and peat substrate conditions were also determined through field surveys. This information was used to determine which factors are most associated with road-based flooding.

WHAT WERE THE CORE FINDINGS?

Substrate texture was strongly linked to flooding. Coarser substrates like sand and gravel allowed vertical water flow under the road, preventing flooding. In contrast, fine clay-like substrates impeded water flow causing flooding on one side of the road and drying on the other.

Contrary to our expectations, both bogs and fens were susceptible to flooding depending on their landscape position.

Understanding underlying substrates can help in evaluating the sensitivity of peatlands to roads. Where road building is unavoidable, mitigation methods that promote the gradual movement of water beneath the road surface (such as multiple culverts along the length of the road) are needed.

UAVS AND MONITORING OF VEGETATION RECOVERY ON SEISMIC LINES

Research Led by: Tobias Tan and Scott Nielsen

WHY IS THIS STUDY IMPORTANT?

Reclamation is not only important for ensuring ecological recovery after resource extraction, but is often a legal requirement of industry operators. While long-term monitoring is essential for assessing the effectiveness of reclamation, there is no standard strategy for conducting such programs in Alberta. Monitoring projects on seismic lines have typically consisted of vegetation and soil surveys, but these are expensive to conduct in the field. A more rapid, cost-efficient method for conducting site assessments would greatly benefit monitoring programs and help improve the reclamation process.

We tested the capacity of unmanned aerial vehicles (UAVs) to provide useful photographic data for site assessments.

HOW WAS THE STUDY COMPLETED?

The accuracy of the UAV data was initially validated using a single aspen-mixedwood site. Target objects and trees were hand-measured before deployment of the UAV. We then surveyed the site with the UAV and compared estimates of key parameters derived from UAV data and traditional field methods.

After validating UAVs as an accurate survey tool, we surveyed seismic lines in the Cumulative Environmental Management Association (CEMA) and McClelland Lake study areas. UAVs were flown over 150 m X 140 m plots with each plot taking only 12-14 minutes to survey. From the UAV data, we generated forest structure point clouds, a type of 3D map generated from overlapping photographs. From these point clouds, we estimated vegetation height on the seismic lines.

We then used the UAV data to determine how wildfire and line type (3D vs 2D) affect seismic line regeneration, as well as to explore the applications of this technology to the monitoring of in situ disturbances in northern Alberta.

WHAT WERE THE CORE FINDINGS?

The consistency and accuracy of the UAV data were found comparable or superior to estimates derived from traditional field methods.

Using UAVs, we found that 3D seismic lines had taller regenerating vegetation than 2D seismic lines of similar age.

Fire also encouraged faster regeneration, as seismic lines burned by the Richardson fire in 2011 had greater vegetation height compared to unburnt lines.

This work highlights the potential value of UAVs to provide accurate monitoring data and improve the cost-efficiencies and speed of ecological recovery monitoring programs.

ERIN BAYNE

NEW MODEL PREDICTS CANADIAN TOAD HABITAT

Research Led By: Natasha Annich, Erin Bayne and Cindy Paszkowski

WHY IS THIS STUDY IMPORTANT?

The Canadian Toad, one of the few amphibian species that lives in the boreal forest, has been declining since the mid-1980s. It is a nocturnal, patchily-distributed species which makes it difficult to locate. In Alberta, survey data for this species of concern are so limited that we are unable to determine its habitat requirements, population sizes, or its regional distribution.

The Canadian Toad is most often reported in northeastern Alberta, raising concerns that extensive land-use and human footprint in this region may pose a threat to their already-declining populations. Essential steps to understanding how land managers may mitigate their impacts to this species include determining habitat preferences and assessing the relative impact of industrial footprint on populations.

HOW WAS THE STUDY COMPLETED?

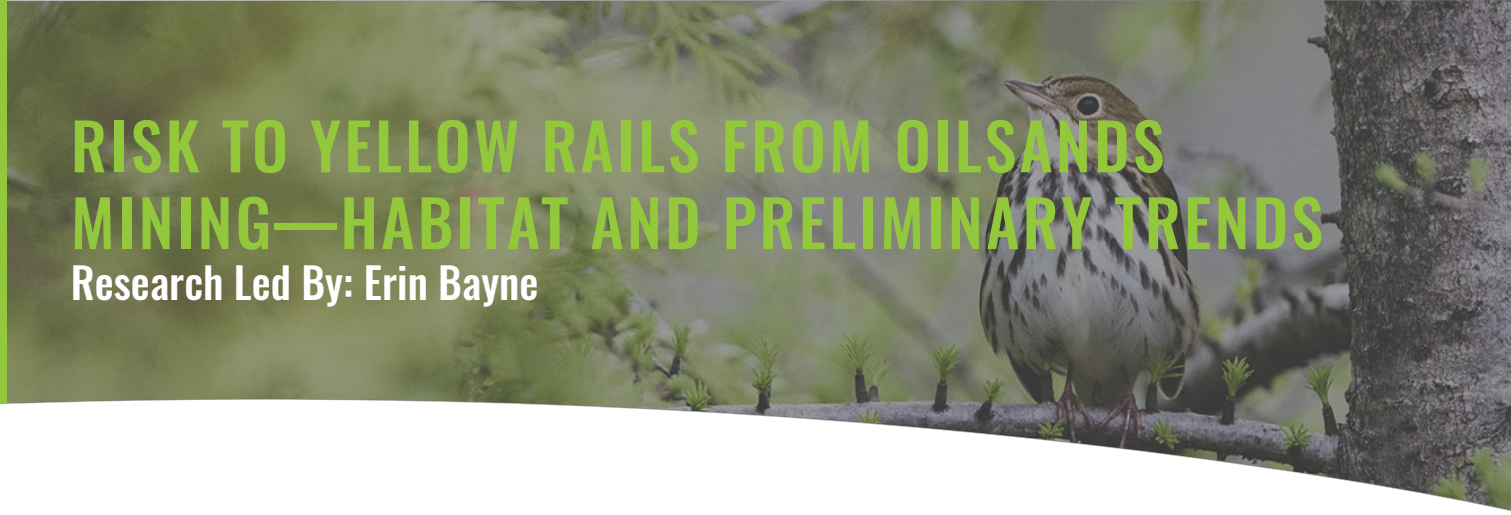
We surveyed Canadian Toads in the Lower Athabasca Planning Region from 2012–2015 using autonomous recording units, which allowed us to survey during their most active hours (10:00 PM–4:00 AM). We then used computer-automated recognizers to identify Canadian Toad vocalizations.

Local habitat data were collected at stations with and without Canadian Toad detections. Larger-scale information on habitat classes, vegetation density, elevation, soil, and human disturbance were also collected using spatial layers including Ducks Unlimited Canada's Enhanced Wetland Classification.

WHAT WERE THE CORE FINDINGS?

Canadian Toads were detected at 142 of the 666 stations we surveyed. At each of these stations, toads were typically detected in low abundance or only a single individual was detected. Toads were detected most frequently in fens (63%) and upland habitat (22%). LiDAR-derived data were most effective at predicting Canadian Toad use of the landscape by identifying combinations of habitat features (e.g., edge habitats between uplands and wetlands) that were more likely to be used. Toads were also predicted to have higher habitat use near linear features used by motor vehicles and near open water.

While the high use of habitats next to roads may have been a sampling artifact, it seems more likely that the combination of short vegetation, open water pooling along roads, and loose and coarse soils may provide a suite of ideal habitat features for toads. This finding raises concern of mortality of Canadian Toads crossing these roads. The model developed for this study can now be used as a tool for locating potential Canadian Toad breeding locations within the Lower Athabasca Planning area. However, caution is warranted when considering use of the model in other ecoregions or in areas with habitat features which were not surveyed in this study (e.g., <3m deep productive lakes).



RISK TO YELLOW RAILS FROM OILSANDS MINING—HABITAT AND PRELIMINARY TRENDS

Research Led By: Erin Bayne

WHY IS THIS STUDY IMPORTANT?

The Yellow Rail is a federally designated species of Special Concern, yet accounts of its declines are mainly anecdotal and its habitat use within areas in Alberta has not been mapped. These knowledge gaps have limited the ability of land managers and industry to mitigate their effects on this species or to evaluate the effectiveness of their actions.

Remote sensing products have potential for more efficiently predicting the extent and locations of Yellow Rail habitats at large scales. Predictive tools based on this information will allow managers to more effectively anticipate and mitigate risk to this species of concern. Additionally, it is important to better understand where Yellow Rails currently live within undisturbed, developed, and planned development areas.

HOW WAS THE STUDY COMPLETED?

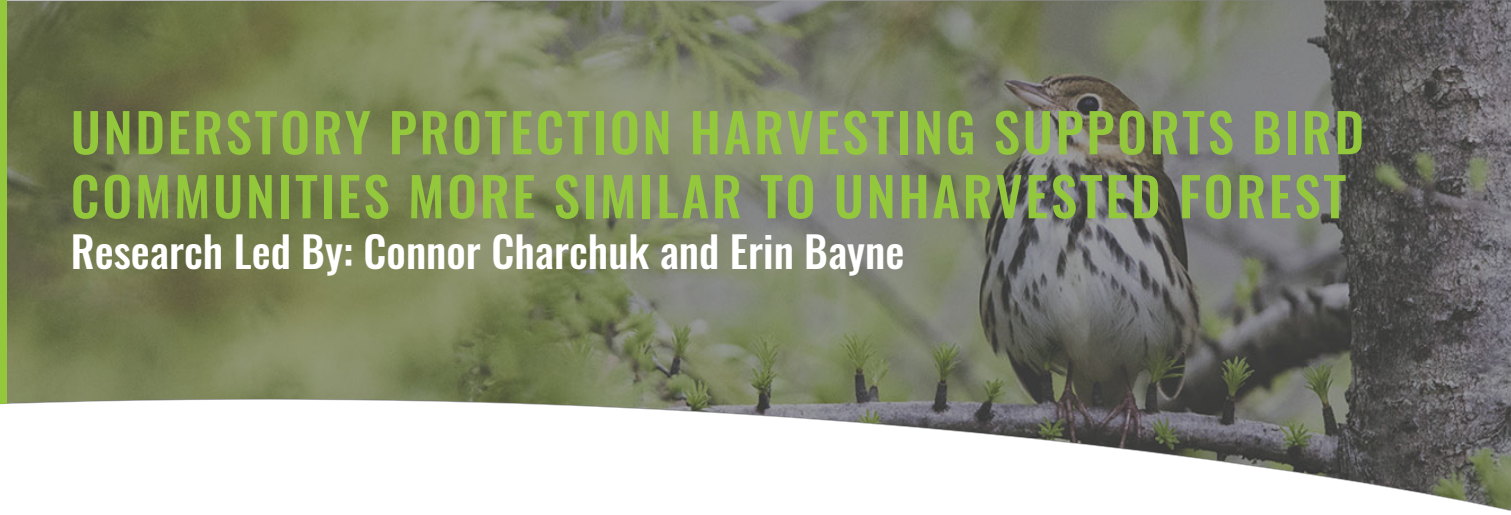
We undertook two studies to better understand Yellow Rail habitats and occupancy within the Lower Athabasca planning region. First, we combined four spatial land-cover products to create a map that predicts the relative importance of different habitat conditions for Yellow Rail. This map was overlaid with planned and proposed projects to evaluate the degree of risk to important Yellow Rail habitats. Second, we surveyed nearly 4,000 locations from 2013–present using autonomous recording units to evaluate Yellow Rail occurrence relative to distance from planned and proposed oil sands mine areas.

WHAT WERE THE CORE FINDINGS?

Habitat maps produced using land-cover products determined that 12,700 ha of modelled high-importance Yellow Rail habitat is at risk from planned oil sands mines. This area represents only ~2.5% of available habitat within the mapped habitat areas in the Lower Athabasca planning region. Additionally, Yellow Rail occurrences tracked over time in the same locations found a slight but non-significant decline. This rate of decline was similar whether the habitat was near to or far from an oil sands mine.

These initial results suggest that Yellow Rails are not as rare as previously thought and that current mining activities have not caused them to decline more steeply than in the Lower Athabasca planning region overall.

However, simulations have shown significant declines of Yellow Rails if proposed mines were developed. As part of this monitoring program, we are continuing to collect information to aid in reclamation planning and we are assessing potential management options for sites where consistent Yellow Rail use was observed.



UNDERSTORY PROTECTION HARVESTING SUPPORTS BIRD COMMUNITIES MORE SIMILAR TO UNHARVESTED FOREST

Research Led By: Connor Charchuk and Erin Bayne

WHY IS THIS STUDY IMPORTANT?

Many species of songbirds are vulnerable to traditional forest harvesting approaches. Traditional harvesting affects habitat quality by removing large-diameter trees and snags (used by many species for nesting, foraging, and roosting) and simplifying the structure of the regenerating stand. These alterations to habitat quality are of concern to managers committed to sustainably managing wildlife habitat quality under species-at-risk legislation and certification programs.

Understory protection harvesting is a recent approach to improve softwood timber yields within mixedwood forests. The approach focuses on harvesting the overstory hardwood trees while protecting the understory spruce trees. The spruce trees are then released from competition, accelerating their growth. Understory protection is increasingly used by forest managers yet its effect on bird diversity has not been studied.

HOW WAS THE STUDY COMPLETED?

We compared songbird communities in understory protection harvest blocks, traditional harvest blocks (5% retention), and unharvested forest. To understand the effects of stand regeneration, we surveyed harvest blocks that were 0–12 years postharvest (understory protection) and 0–22 years postharvest (traditional harvest).

WHAT WERE THE CORE FINDINGS?

Bird communities in stands with understory protection were intermediate between those in traditional harvest blocks and unharvested forest. Understory protection stands were used by early-seral specialists that are often found in traditional harvests as well as mature forest species that are not typically found in harvested areas. This is of particular value given that many of the steepest-declining species in the boreal forest are associated with older forests.

The fact that bird communities within understory protection stands quickly (within 10–12 years) converged to resemble those in the unharvested forest is striking. This contrasts strongly with traditional harvesting, which can take up to 75 years before the songbird community converges with the unharvested forest. Understory protection harvesting has potential to provide habitat to mature forest bird species on landscapes subject to deforestation and/or forest harvesting where old forest habitats are limiting.

SONGBIRD COMMUNITIES ARE RESILIENT TO WILDFIRE IN THE NORTHERN BOREAL FOREST

Research Led By: Michelle Knaggs and Erin Bayne

WHY IS THIS STUDY IMPORTANT?

Wildfire is the major natural disturbance in the western boreal forest, shaping the landscape by creating a mosaic of forest patches of different ages. When a forest burns, its habitat value for different songbird communities changes, and this change is affected by burn severity and the amount of time that passes after the fire.

The boreal forest is expected to experience increasingly frequent, severe, and large wildfires under a changing climate. This increase in wildfires is expected to significantly affect the amount of forest habitat available to birds, particularly in northern regions subject to less intense fire suppression efforts. Given that overall songbird abundance in the western boreal forest is declining, it is essential to understand how well songbird communities recover following wildfires. This information will help managers assess wildfire's potential impacts on breeding songbird populations, particularly species at risk.

HOW WAS THE STUDY COMPLETED?

We surveyed songbirds in mixed-severity burned forest stands in the Northwest Territories in upland and peatland habitats. These stands ranged in age from one to >50 years postfire, allowing us to evaluate the rate of songbird community change over time since the fire.

We surveyed birds in-person using the point count method at 777 sampling stations. We compared songbird communities in burned stands of varying ages to communities in control stands (i.e., forests >50 years postfire). We also compared functional diversity; a decrease in functional diversity would suggest that the community became more dominated by species sharing specific traits (e.g., members of a single feeding or nesting guild).

WHAT WERE THE CORE FINDINGS?

As forests recovered from fire, the greatest number of species was detected in 11- to 30-year postfire stands. Interestingly, we did not detect a change in functional diversity, nor was there a distinct shift in species composition over time since fire. The only detected difference was lower functional diversity in 1-year postfire peatlands than in the >50 year controls.

Or results indicate that songbird communities in northern boreal forests are highly resilient to the current wildfire regime. However, predicted climate change effects include forest composition shifts and/or failure of forests to regenerate following repeated fires. Our results may, therefore, not apply under these future conditions. The data from this research will be used to support Environment and Climate Change Canada's mandate to "conserve and protect migratory birds and their habitat from major threats". It will also be used as baseline data for a proposed National Wildlife Area.

CAN A COMPUTER RECOGNIZE BIRD SONGS?

Research Led By: Elly Knight and Erin Bayne

WHY IS THIS STUDY IMPORTANT?

Bird monitoring is an important component of many conservation and management programs, but traditional bird survey methods (e.g., point counts) are labour-intensive, subject to human error, and limited by manpower availability. In recent years, autonomous recording units have gained popularity as a tool to efficiently survey large areas. Their advantages include the ability to easily conduct repeated surveys at any time of day or year, and researchers also have a permanent record of the survey—which can be used to reduce observer bias or re-analyzed for other focal species or objectives.

A key challenge of using autonomous recording units is the time required to manually process hundreds of hours of audio to record individual species detections. Automated species recognition is a growing field that seeks to reduce this drain on researcher time by training computers to recognize individual species by their songs.

However, no standardized protocol has yet been established for developing or evaluating these recognition programs, making it difficult to determine or compare the quality of species detection data they produce.

HOW WAS THE STUDY COMPLETED?

First, we conducted a literature review to assess how recognizers are currently evaluated, how researchers have reported recognizer performance, and the range of metrics used.

Second, we constructed four recognizers using freely-available recognizer development programs and one state-of-the-art custom recognizer program. We tested them using recordings containing vocalizations by Common Nighthawks—a Threatened species under the Species at Risk Act, whose activity at dusk makes it an ideal candidate for improved data collection using autonomous recording units. We compared each recognizer's results against the results of a human listening to the recordings.

WHAT WERE THE CORE FINDINGS?

From the results of our literature review and existing best practices, we compiled six general recommendations for ecologists using automated acoustic recognition in their research. These steps, if applied, can help ensure that only high-quality data collected using properly-validated recognizers are used in support of management decisions.

Overall, the recognizers we tested were effective at determining Common Nighthawk presence and absence as well as its call rate. However, occupancy estimates using these data were consistently lower than those obtained from human listening for four of the five recognizers. If more robust practices and reporting methods are followed, autonomous recording units and processing using recognizer software holds promise for monitoring the Common Nighthawk, a species with a distinctive and simple call. Further research following our recommendations is needed to understand whether computers hold equal promise for the monitoring of songbirds with complex songs and/or in environments with variable levels of ambient noise.

LOCAL-SCALE BOREAL BIRD MODELS DON'T SCALE UP WELL TO INDIVIDUAL LANDSCAPES

Research Led By: Lionel Leston, Erin Bayne, Lisa Mahon, Péter Sólymos, Jeff Ball, Jim Schieck, Fiona Schmiegelow, and Samantha Song

WHY IS THIS STUDY IMPORTANT?

Overlapping footprints by oil and gas disturbances, forestry, and associated infrastructure present a challenge to land managers in the western boreal forest. The effects of these cumulative disturbances on biodiversity have mostly been studied at local scales or through qualitative studies.

If local-scale models of industry impacts to wildlife can be used to accurately predict abundance within larger individual landscapes, this information could be more effectively used to forecast changes to populations and set conservation priorities accordingly. However, this method must be tested to determine its efficacy. We tested this method using birds, a taxon for which large datasets exist and which is of high conservation priority.

HOW WAS THE STUDY COMPLETED?

We used bird data from the boreal forest of Alberta and the Northwest Territories, to test how well local-scale models can be scaled up to generate landscape-level abundance predictions. These bird data were collected by the Boreal Avian Modelling project from studies conducted from 1993–2013.

From these data, we modelled the effects of vegetation, forestry and energy sector disturbances on birds. We then validated the results against landscape-scale bird data collected by the Alberta Biodiversity Monitoring Institute.

WHAT WERE THE CORE FINDINGS?

For most of the 47 species in our dataset, local-scale models were adequate at predicting whether a species was present in ny given landscapes. However, local-scale models were not effective at predicting the actual number of birds in an individual landscape.

Our results suggest that local-scale models, when applied to larger landscapes, may not be effective for making operational decisions (e.g., exactly how many Canada Warblers are in this sub-township planning unit?). This was particularly true for rare species of concern. We were, however, able to rank landscapes in order of higher to lower bird density and predict average bird abundance quite accurately. This suggests that local-scale models are reasonable for predicting the average number of birds in landscapes with similar levels of cumulative effects.

Notably, models that included forestry and oil and gas effects (i.e., cumulative effects) did not substantially improve prediction accuracy. This is not to say that cumulative effects did not have an impact on bird species. Rather, this implies that our models would have very high uncertainty if used to predict whether a cumulative effects threshold has been surpassed in an area and whether this will in turn negatively affect bird abundances. Actual abundance estimates (generated from on-the-ground surveys), rather than the predicted values from our models, may be more effective in answering this question by directly estimating density in the area of interest.

MOOSE POPULATIONS APPEAR STABLE BUT AVOID HUMAN FEATURES

Research Led By: Eric Neilson, Erin Bayne, and Stan Boutin

WHY IS THIS STUDY IMPORTANT?

The effects of extensive natural resource development on mammal populations within Alberta's Lower Athabasca Region is of key interest to land managers, Indigenous communities, industry, and the general public. Improved monitoring of mammals and other taxa in this region is also a high priority that will allow managers to make more informed decisions that will minimize impacts to species of concern.

Moose are among the species of concern within the Lower Athabasca Region. They are well-adapted to habitats in the boreal forest and are considered an indicator of ecological health in Alberta's boreal forest. Moose are an important hunting species for Indigenous and recreational hunters and have shown mixed responses to human disturbances. For these reasons, we selected moose as case study to evaluate the state of knowledge on the effects of oil and gas disturbance on mammals in the Lower Athabasca

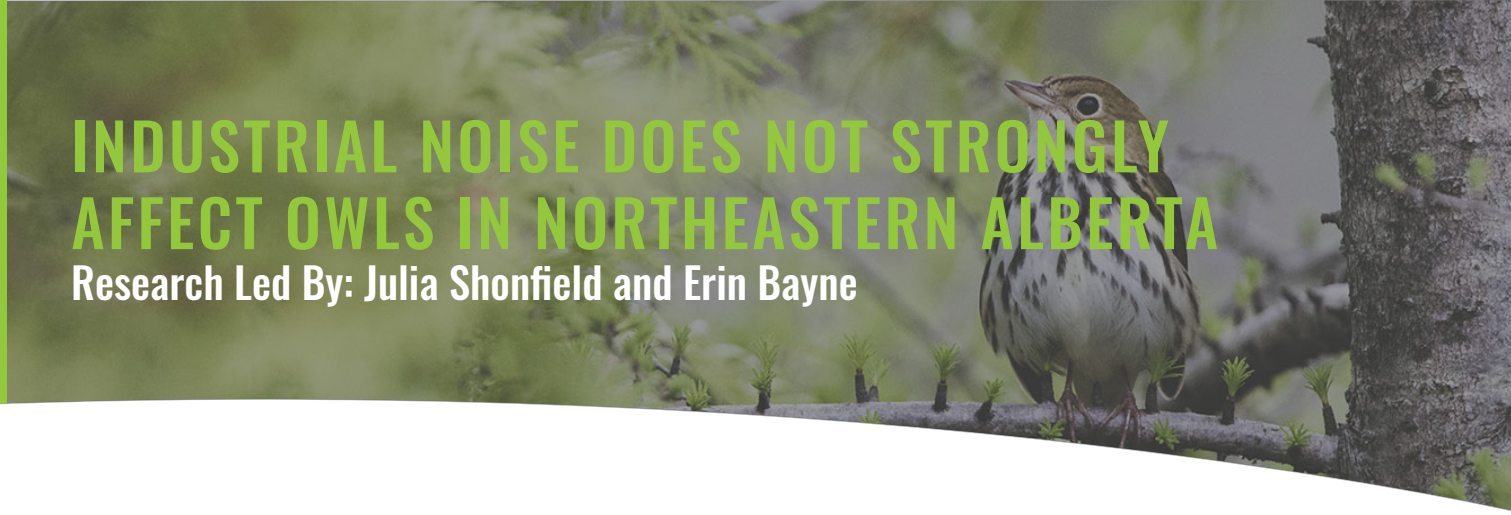
HOW WAS THE STUDY COMPLETED?

We reviewed scientific literature and technical reports to determine the current state of understanding of the relationship between human activity and moose in the Lower Athabasca Region. Using the information within these documents, we estimated moose density, population trends, population demographics, distribution, and behaviour.

WHAT WERE THE CORE FINDINGS?

Moose have been well-studied in the Lower Athabasca Region and they have shown relatively stable densities with no directional trend observed since 1993, the first year for which we had density data. Likewise, population growth demographics did not demonstrate any change over time. Twenty-four per cent of the documents we reviewed reported moose selection or avoidance relative to human disturbance; selection varied with season and the overall trend was avoidance of human features.

Despite the body of research on moose in northeastern Alberta, the general avoidance of human features by moose suggest that further local-scale research is needed to conclusively determine whether human disturbance has had a negative effect on moose populations.



INDUSTRIAL NOISE DOES NOT STRONGLY AFFECT OWLS IN NORTHEASTERN ALBERTA

Research Led By: Julia Shonfield and Erin Bayne

WHY IS THIS STUDY IMPORTANT?

Energy development affects wildlife in several ways, including not only industrial footprints but also chronic noise from vehicles, construction, and noise from facilities. To accurately predict the environmental effects of industrial noise, and take appropriate mitigation measures if necessary, it is important to understand its impacts on various wildlife species.

Owls are generally considered vulnerable to noise due to their reliance on calls to attract mates and on sensitive hearing to locate prey. However, owl distribution around noisy infrastructure has not been well-studied. The effects of these developments and associated traffic are, therefore, poorly understood.

HOW WAS THE STUDY COMPLETED?

We studied Great Horned Owls, Boreal Owls, and Barred Owls to determine whether they avoided industrial areas with chronic noise (i.e., compressor stations and roads) within the Lower Athabasca Planning Region. We surveyed owls using autonomous recording units at 72 256-ha sites, with 5–6 units deployed in the forest surrounding the noise source. Among these owls, one species (the Barred Owl) is provincially listed as Sensitive, but all owls are important top predators within many ecosystems.

WHAT WERE THE CORE FINDINGS?

We found that owls showed no response to noise from industrial facilities or traffic and were equally likely to occupy sites affected by these noise sources. This may be because noise was much quieter near the edges of chronic noise sites, to the point that it was almost inaudible in some recordings—making it unlikely to have been loud enough to affect owls' ability to hear or be heard.

At the home range scale (256 ha), owls did not appear to avoid noise sources, however it is possible they were responding to noise by using habitat differently within a site. At many sites, owls were only detected by a single recording station, raising the possibility that noise prevented them from using the entire site. We also found that Barred Owl use declined as the amount of human disturbance—and resulting loss of forest cover—increased.

It is important to note, however, that changes in occupancy are not the sole measure of noise effects. We recommend additional research to determine if chronic industrial noise has other negative effects, for example on pairing success or reproductive rates. However, this early research indicates that industrial noise in the boreal forest may have less of an effect on owls than previously expected.

SONGBIRD COMMUNITIES RECOVER AS RECLAIMED WELLSITES REGENERATE

Research Led By: Scott Wilson and Erin Bayne

WHY IS THIS STUDY IMPORTANT?

The extent and intensity of oil and gas development in parts of the western boreal forest have raised concerns that this industrial footprint may be partially responsible for bird population declines in the area. Among this development footprint are hundreds of thousands of one-hectare wellsites. While decommissioned wellsites have been subject to reclamation for decades, the target for "successful reclamation" has evolved. More recent standards for "success" require equivalent land capability rather than simply a return of vegetation cover.

As reclamation obligations are held to a higher ecological standard, it becomes important to determine whether and to what extent reclaimed wellsites are providing habitat to boreal birds.

HOW WAS THE STUDY COMPLETED?

We collected bird data at one-hectare wellsites ranging in age from 13–49 years since development and 7–49 years since a reclamation certificate was issued. We compared these results against data from mature forest sites.

We collected bird data using autonomous recording units deployed at each site. We also tested a leading-edge technique by which an array of recording units is used to estimate the locations of individual birds (in this case, Ovenbirds). This technique allowed us to more accurately model the effects of energy infrastructure on Ovenbirds.

WHAT WERE THE CORE FINDINGS?

We detected 35 species in total and of these, 16 species were only detected at mature forest sites. Another six species were only detected at wellsites, including species that are typically considered early-seral species. As canopy cover increased on regenerating wellsites, bird communities became more similar to those of mature forest, indicating a trajectory of recovery on reclaimed sites. Further, location tracking of Ovenbirds revealed that they sang from reclaimed wellsites and edges more frequently as the canopy cover of the regenerating wellsite increased.

Our results indicate that reclamation practices on wellsites facilitate their use by songbird communities provided they resulted in an increase in canopy cover. The successful implementation of an acoustic array to estimate the locations of singing birds provides 1) a potential alternative to labour-intensive point count surveys, and 2) the ability to estimate locations more accurately than observers in the field.

USING SOUND LEVEL FROM AUTONOMOUS RECORDING UNITS TO PROVIDE MORE ACCURATE DISTANCE—AND THEREBY DENSITY—ESTIMATES

Research Led By: Daniel Yip, Elly Knight, Elène Haave-Audet, Scott Wilson, Connor Charchuk, Chris Scott, Péter Sólymos, and Erin Bayne

WHY IS THIS STUDY IMPORTANT?

Imperfect detection rates, and variability in detection rates among observers, species, and field conditions, make it very difficult to accurately estimate bird abundances. This can lead to systematic under-estimation of densities of hard-to-detect birds, or over-estimation of bird densities in habitats where their songs travel farther and are heard more clearly.

Several field and statistical methods have been developed to try to reduce these inaccuracies, including a modelling strategy that uses the estimated distance of each detected bird from the observer. Distance estimation in the field, even by trained observers, is highly subjective when relying entirely on auditory cues like a bird's song. If arrays of autonomous recording units can be used to accurately detect birds and estimate their distances, this will make more accurate density predictions possible. In addition, these surveys will be able to capitalize on the reduced manpower and increased flexibility of autonomous recording units.

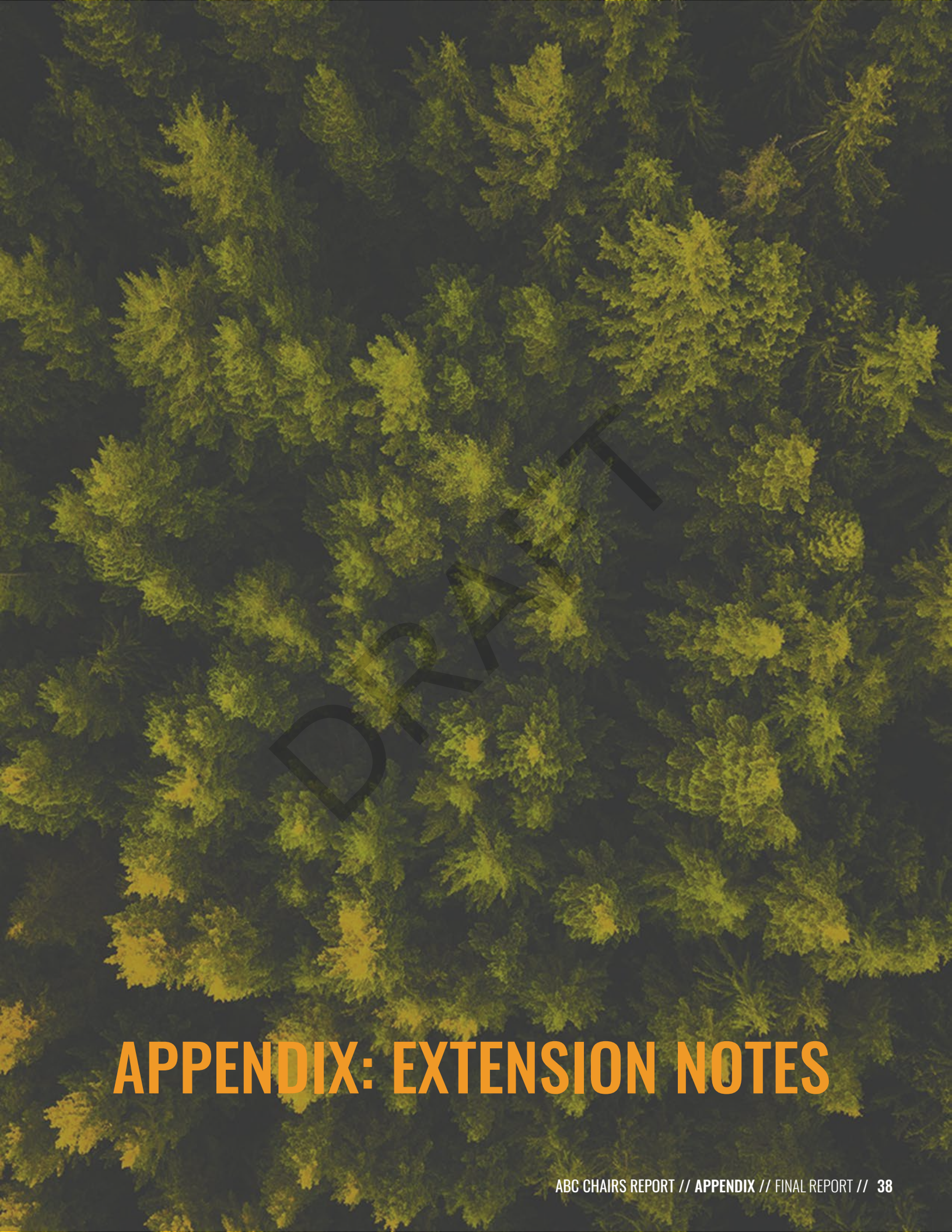
HOW WAS THE STUDY COMPLETED?

Two species with different song characteristics and behaviours, Ovenbirds and Common Nighthawks, were recorded from known locations using acoustic arrays. We then trained a computer recognizer to automatically detect each species and quantify the relative sound level of each call, which was subsequently verified.

WHAT WERE THE CORE FINDINGS?

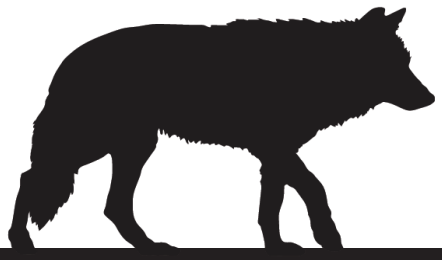
Relative sound level was found to be a reliable predictor of a singing bird's distance from an autonomous recording unit, provided researchers first establish a reliable relationship between relative sound level and distance. This finding shows promise for further use and accuracy of bird density estimates using autonomous recording units, particularly as it provided more accurate distance estimates than human observers in the field.

As techniques for improving the effectiveness of autonomous recording units and processing software (recognizers) become more sophisticated and successful, the potential applications for large-scale monitoring programs become more promising. Deployment of automated recording units is generally less time-consuming than field observations, and it may improve data accuracy compared with human distance estimation in the field, which has high error rates and variability.



APPENDIX: EXTENSION NOTES

Nowhere to hide: linear features invite predators into caribou calving grounds



Predators and prey have adapted over millenia to use their landscape to their advantage. The long-term stability of predator-prey systems relies on the availability and effectiveness of refugia - places where prey can avoid their predators and find temporary safety[1]. Alterations to the landscape may compromise the effectiveness of prey refugia, with consequences to populations of rare or threatened species[2,3].

Within boreal forests, threatened woodland caribou have traditionally used peatlands as refugia to avoid predators, such as wolves and bears. However, linear features such as seismic lines and roads may be compromising this strategy by altering the spatial behaviour of caribou and their predators.

This study

To find out whether linear features are compromising caribou refugia, we collected data on caribou and their predators during the calving season. We studied six boreal caribou ranges in British Columbia with an average linear feature density of 4.04 km/km2. Fifty-six female caribou, 23 wolves, and 19 black bears were tracked with GPS collars. We then exmined their response to linear features at two spatial scales. At the fine scale, we assessed how linear features influenced each species' habitat selection between successive GPS locations. At the large scale, we assessed how each species responded to variation in linear feature density within their home ranges.

Our findings

Female caribou with calves tended to avoid linear features but could not avoid them completely because of the extensive network of linear features within their ranges. Female response toward linear features also had potential demographic effects as females that used linear features more, also had higher probability of calf mortality.

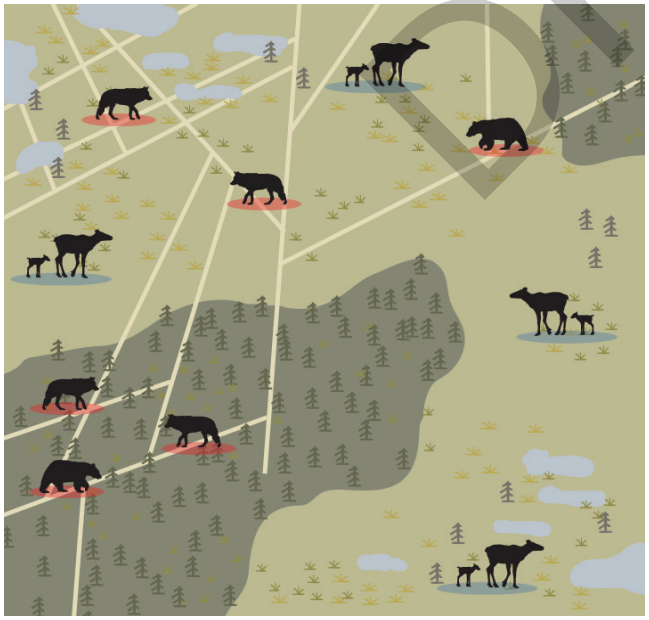


Fig 1. At the fine scale, female caribou generally avoided linear features. Wolves selected strongly for linear features in peatlands and avoided peatlands that lacked linear features. Bears showed a similar, though less strong, effect.

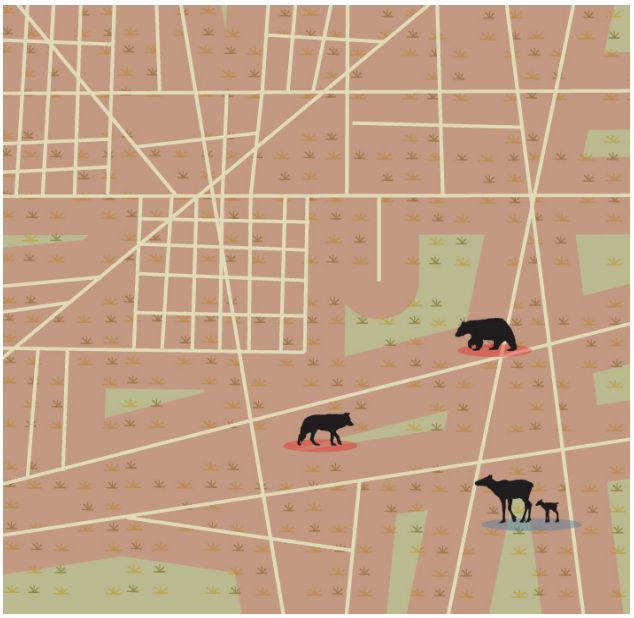


Fig 2. At the large scale, female caribou generally selected areas with lower linear feature density, but completely avoiding exposure was not possible. Wolves and bears showed weak avoidance for higher linear feature density in peatlands, possibly due to predators only requiring a few lines to effectively search an area or because of ongoing human activity.

So what?

By increasing the spatial overlap between predators and woodland caribou, linear features reduced the effectiveness of peatlands as a refugia for woodland caribou. Mitigation efforts should focus on limiting or restoring linear features that lead into and occur within peatlands.

We found that not only did predators select linear features in all landcover types, but linear features facilitated movement into and out of peatlands, which are traditionally refugia for caribou. Prey can sometimes cope with changing predation risk by altering their behaviour, and female caribou appeared to demonstrate some flexibility in their habitat use by avoiding linear features during calving. However, the extensive nature of linear feature development in peatlands meant caribou could not escape them completely. For now, linear features appear to have provided predators a leg-up over their prey.

Woodland caribou recovery is a shared responsibility of all energy sector operators. Recovery will require a collaborative, range-wide approach, involving multiple management actions. The Chair will work to continue to define recovery and develop alternative criteria for restoration.

Project supporters

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www.nserc-crsng.gc.ca

DeMars, C. A., Boutin, S. (2018). Nowhere to hide: Effects of linear features on predator-prey dynamics in a large mammal system. Journal of Animal Ecology, 87(1), 274-284

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Restoring caribou habitat: When should seismic lines be taken off the books?

Woodland caribou populations in Alberta are declining by up to 16% per year[1] and their recovery represents a significant conservation challenge, both provincially and nationally.

Declines are driven by increased predation, primarily from wolves and bears, resulting from habitat alteration through human land-use and a changing climate. Recovery will require a combination of actions, including habitat restoration and protection, and predator management through culling or the creation of safe havens. The Federal Recovery Strategy mandates that 65% of caribou ranges be undisturbed for populations to remain viable.[2] Most Alberta herds are well below this threshold.

Seismic lines improve wolf hunting efficiency and are a target for restoration

MSc student Melanie Dickie tracked wolf movements using GPS collars that obtained a location every 5 minutes. She found that wolves select linear features, such as seismic lines, for travel (Fig. 1a), and move 2–3 times faster on them (Fig. 1b).[3] Distance travelled by wolves increased by up to 54% every hour they spent on linear features. This may increase their search rate, and ultimately result in higher kill rates of caribou. 'Low-impact' seismic lines were not selected by wolves for travel and did not increase movement rates.

Wolves are 2–3X faster on seismic lines

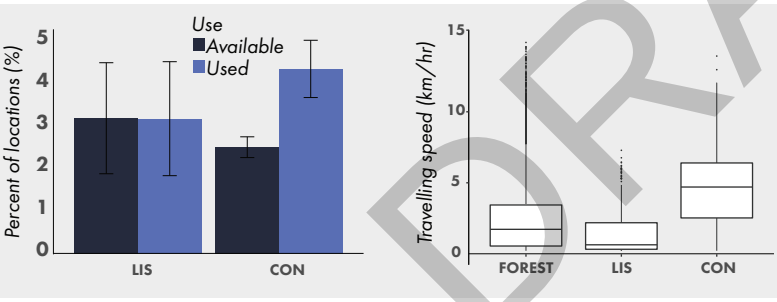

Fig. 1 (a) Wolves used conventional seismic lines (CON) more than they were available, meaning they select them for travel. Low-impact seismic lines (LIS) were not selected; (b) Median wolf travel speed (km/h) was faster on conventional seismic lines than low-impact seismic lines in summer. Undisturbed forest is included for comparison.

The Federal Recovery Strategy defines disturbed caribou habitat as any human-caused change that is visible using Landsat satellite imagery. Seismic lines fall into this category, and because tree seedlings grow slowly, the lines remain visible from space for decades. With over 100,000 km of seismic lines in caribou habitat in Alberta's Oil Sands Area,[4] they are an obvious focus for restoration. With an estimated restoration cost of $10,000 per km, the question is, when should restored lines be taken off the books?

When is a line recovered?

The "visible from space" definition of disturbance means that restoration today will not produce measurable improvements in caribou habitat for years. However, if wolves use seismic lines to increase their travel speed and hunting efficiency, it may be more appropriate to consider when lines regenerate enough vegetation to slow, and eventually stop, wolves from using them preferentially.

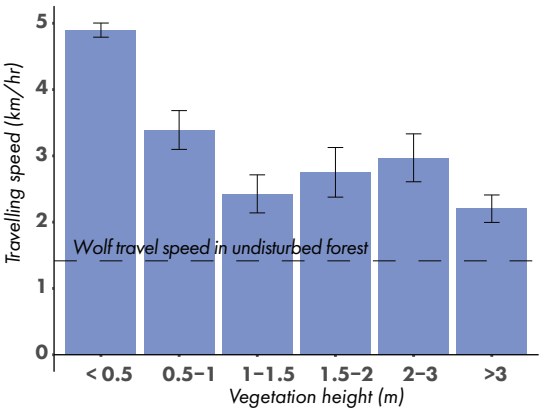

Fig.2 Wolf travel speed on seismic lines in the summer, in upland forests. Once vegetation height reaches 50 cm, wolf travel speed is considerably reduced.

So what?

By developing a definition of recovery for seismic lines based on a functional understanding of how vegetation influences wolf movement, the process of effective recovery could be much shorter than under current definitions.

Lines with vegetation already exceeding 50 cm would be considered "restored," providing an immediate bump in undisturbed habitat. For example, in Dickie's study area, 13% of lines had already reached the 50-cm height threshold, reducing the cost and timelines required for caribou ranges to meet federal disturbance targets by decades. While more research is needed to determine exactly when wolves begin to treat seismic lines the same as natural forest, Dickie's work suggests an intriguing new paradigm for seismic line restoration, at least with respect to woodland caribou.

Woodland caribou recovery is a shared responsibility of all energy sector operators. Recovery will require a collaborative, range-wide approach, involving multiple management actions. The Chair will work to continue to define recovery and develop alternative criteria for restoration.

Project supporters

This work was made possible through the Alberta Biodiversity Conservation Chair (Dr. Stan Boutin) and collaborations with the Caribou Monitoring Unit of the Alberta Biodiversity Monitoring Institute and the Regional Industry Caribou Collaboration.

Dr. Stan Boutin
https://tinyurl.com/StanBoutin

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http://www.abmi.ca

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[1]Hervieux, D. et al. Widespread declines in woodland caribou (*Rangifer tarandus caribou*) continue in Alberta. Can. J. Zool. 91, 872–882 (2012).

[2]Environment Canada. Recovery strategy for the woodland caribou, boreal population (*Rangifer tarandus caribou*) in Canada (2012).

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[4]ABMI. Prioritizing zones for caribou habitat restoration in the COSIA area. Prepared for Canada's Oil Sands Innovation Alliance (2016).

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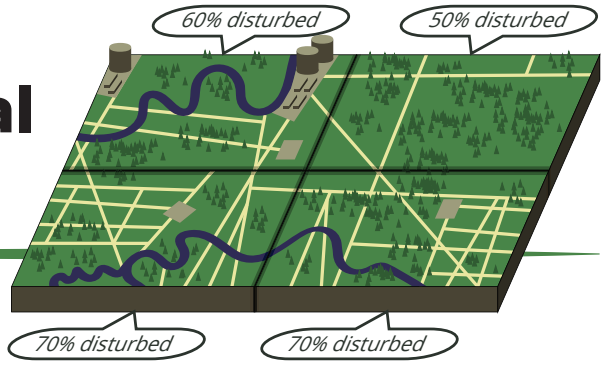
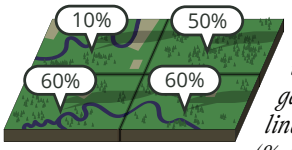
*Wolf and caribou graphics created by Kate Broadley.

Prioritizing zones for habitat restoration in boreal woodland caribou range



In a working landscape, how do we prioritize restoration to get the best "bang" for our "buck?"

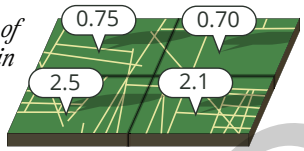
Woodland caribou populations in Alberta are declining by up to 16% per year[1] and their recovery represents a significant conservation challenge, both provincially and nationally. Declines are driven by increased predation, primarily from wolves and bears, resulting from habitat alteration through human land-use and a changing climate. Recovery will require a combination of actions, including habitat restoration and protection, and predator management through culling or the creation of safe havens. The Federal Recovery Strategy mandates that 65% of caribou ranges be undisturbed for populations to remain viable.[2] Most Alberta herds are well below this threshold.

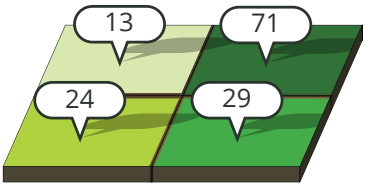


BANG: *How much undisturbed habitat is gained if all seismic lines are restored? (% disturbed - % disturbed if restored)*

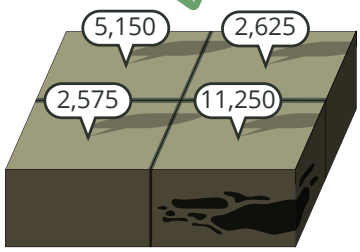
How do we prioritize habitat restoration?

BUCK: *The density of seismic lines that are in each township. (km/km²)*





*We divide to get the "**bang-for-buck**" Higher "bang-for-buck" = higher priority.*



Lastly, priority rankings are adjusted relative to their resource value ($MM CDN). This pulls restoration efforts away from areas likely to be developed in the near future.

Over 100,000 km of seismic lines have been cut across Alberta's Oil Sands Area.[3] Though habitat restoration is already taking place, it is costly,[4] time consuming, and difficult to implement across lease boundaries. Where and when restoration should occur has been identified as an important planning exercise for caribou recovery.

We addressed this question by simulating outcomes of various restoration strategies. First, we classified suitability for restoration using criteria such as the degree of human disturbance,[5] seismic line density, and projected economic potential. Then we ranked townships into 5 categories of restoration priority. As per the Federal Recovery Strategy, we applied a 500-m buffer around all human disturbances and considered the area within them disturbed. Thus, restoring seismic lines that are further apart gains more "undisturbed" habitat than areas with lines that are close together.

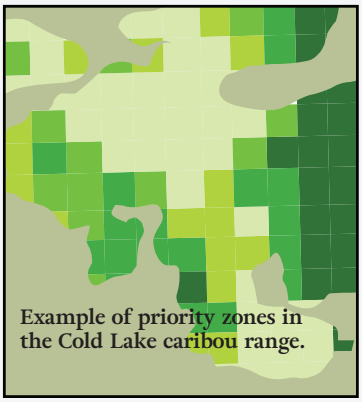
All done!

Areas are prioritized such that restoration efforts are most efficient.

priority level:

high **low**

From our simulation, we found that for four of the five caribou ranges in Alberta's Oil Sands Area to reach federal disturbance targets, every seismic line had to be restored, regardless of priority zone. When additional 'semi-permanent' human footprint features, such as well pads and forestry cut blocks, were also simulated as restored, all five caribou ranges reached federal targets when only the 3 highest priority zones were restored.[6]



Example of priority zones in the Cold Lake caribou range.

RESTORATION PRIORITY

HIGH LOW

The highest priority zones are typically in areas with low seismic line density and low potential for future development; restoring these areas leads to the greatest gain in undisturbed habitat for the lowest cost.

So what?

Restoring seismic lines in a single caribou range could cost hundreds of millions.[3] By prioritizing areas that maximize the gain in undisturbed habitat per dollar spent, or return in investment, our analyses suggest those dollars can be stretched up to three times further.[3,7] Results are already being acted on, but prioritization must continue if federal disturbance targets for caribou are to be met expediently. For more information on available priority zones for the Cold Lake, East Side and West Side Athabasca River, Richardson, and Red Earth caribou ranges, contact the Alberta Biodiversity Monitoring Institute.

Woodland caribou recovery is a shared responsibility of all energy sector operators. Recovery will require a collaborative, range-wide approach, involving multiple management actions. The Chair will work to continue to define recovery and develop alternative criteria for restoration.

Project supporters

Canada's Oil Sands Innovation Alliance partnered with the ABMI's Caribou Monitoring Unit to prioritize areas for habitat restoration. The Alberta Biodiversity Conservation Chair program (Dr. Stan Boutin) has been integral to the development of this work.

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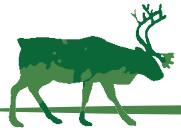

[1]Hervieux, D. et al. Widespread declines in woodland caribou (*Rangifer tarandus caribou*) continue in Alberta. Can. J. Zool. 91, 872–882 (2012).
[2]Environment Canada. Recovery strategy for the woodland caribou, boreal population (*Rangifer tarandus caribou*) in Canada (2012).
[3]ABMI. Prioritizing zones for caribou habitat restoration in the COSIA area: Version 2.0. Prepared for Canada's Oil Sands Innovation Alliance (2017).
[4]The cost of developing priority areas for restoration is only a small fraction of the cost of restoring seismic lines across caribou range (estimated at $10,000/km).
[5]Human disturbance values were calibrated to those in the Federal Recovery Strategy, allowing a more direct comparison to the lower resolution Landsat data used to create federal disturbance targets.
[6]Results account for human disturbances only; another analysis included burned areas and human disturbance together.
[7]Restoring all seismic lines in the highest priority zone of the Cold Lake caribou range will result in a gain that is 3-fold higher than restoring a similar amount of seismic lines in the fourth highest priority zone (i.e., 11.4% vs. 3.9%).
*Infographic on P1 and illustrations created by Kate Broadley.

When to let go? Conservation at the trailing-edge

Trailing behind

As climate change progresses, habitats characterized by particular climatic conditions will shift geographically. At the "leading-edge" of these shifting habitats, locations that were previously unsuitable for a given species may open up for colonization, while at the "trailing-edge," locations that previously supported the species will become unsuitable.

Populations of Threatened and Endangered species at the trailing-edge will find themselves in progressively unsuitable habitat with little or no potential for them to become self-sustaining. Attempts by managers to restore habitats to previous conditions are likely to be foiled by these changing climatic conditions.

A challenge for caribou

Woodland caribou may be one example of this conundrum. Some woodland caribou herds may now be living on the trailing edge because climatic conditions now favour expanding deer populations which lead to wolf densities that are incompatible with caribou populations. These populations may never become self-sustaining despite aggressive restoration and range planning efforts.

As more resources are dedicated to increasingly challenged southern populations, fewer resources are available for those populations inside the new climate envelope.

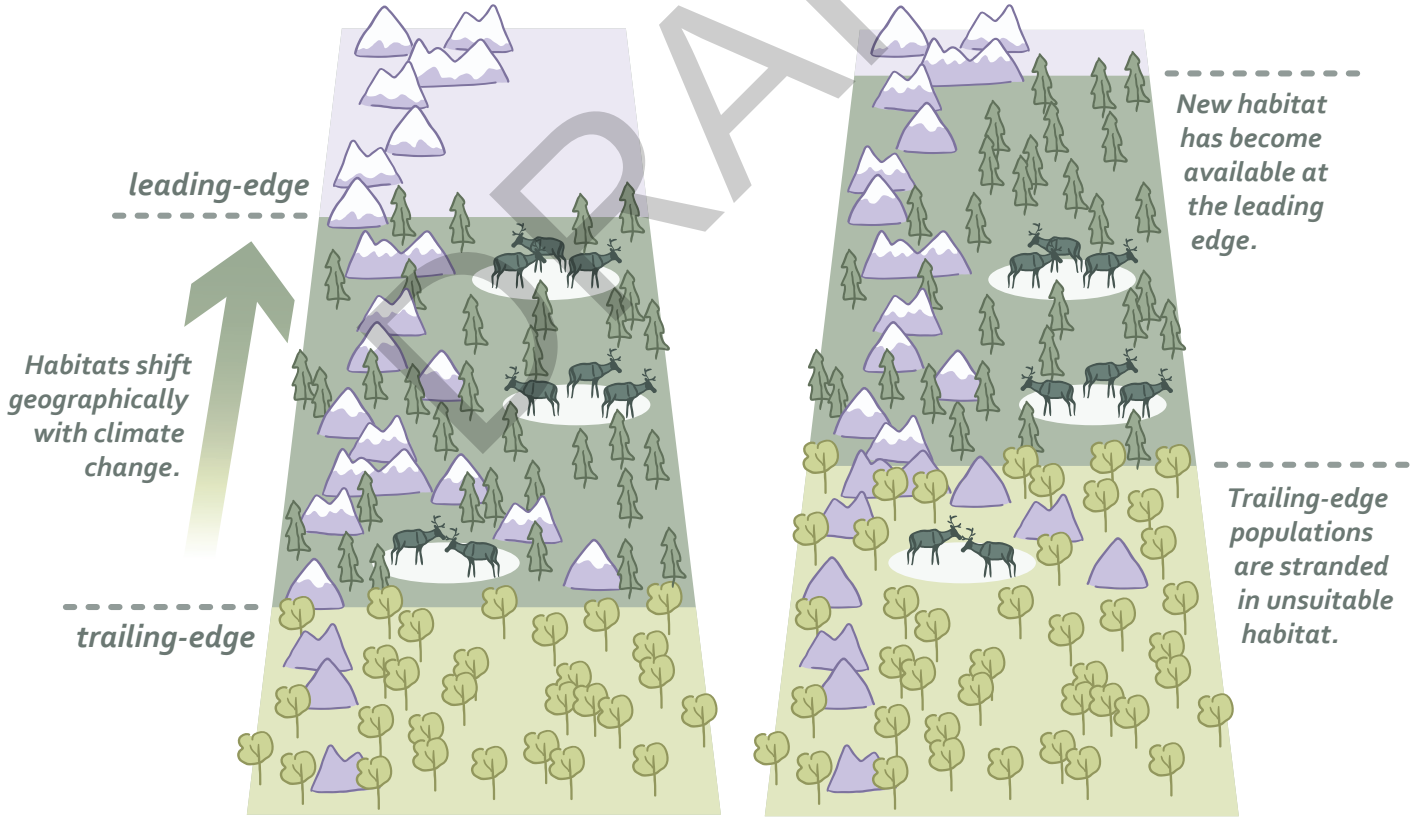

Fig 1. In the northern hemisphere, climate change is causing habitats to shift northward. At the leading-edge, new habitat may become available to certain species. At the trailing-edge, however, some populations may be stranded in unsuitable habitat that can no longer support their needs. How should such populations be managed?

Trailing behind

Conservation policy in Canada must become adaptive in order to meet the challenges of climate change. Current policies are "location" focused making them ill-equipped to help Threatened and Endangered species when suitable habitat shifts away from that location. Under current frameworks, populations on the trailing edge will receive the majority of conservation resources despite the low potential for them to ever become self-sustaining. This leaves few funds to assist more progressive efforts to help populations still living in their typical habitat.

For woodland caribou, a more adaptive approach may involve shifting of resources from struggling southern populations to the northern populations. While habitat restoration efforts in southern regions are likely to be insufficient on their own due to climate change, northern populations stand to benefit from habitat restoration. As management of southern herds at the trailing-edge are dialed back, conservation efforts can be focused on herds in habitats supported by the current and future climate.

A case-specific tool

Of course, the decision to reduce conservation efforts and allow a trailing-edge population to decline should be restricted to specific circumstances. First, it must be ensured that the cause of their current decline is due to climate change and not some other factor. It must also be established that the population is not critically important to the survival of the species - for example, if there is only one population left. If a critically important population is stranded in an unsuitable climate, then the options are either intensive, prolonged management *in situ* (e.g. perpetual predator control with no plan to scale back), or relocation to a more suitable area.

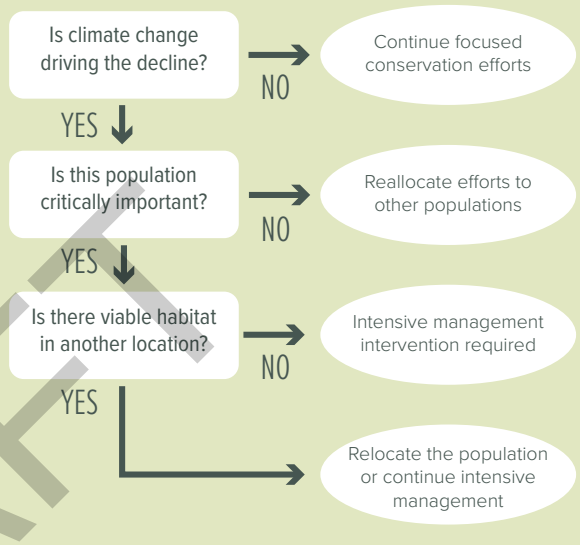

Fig 2. This decision framework forms a basis for deciding which populations should be let go, and which should receive other interventions.

Conservation policy needs to change to reflect the reality that some populations of Threatened and Endangered species on the trailing edge will never be self-sustaining. Conservation efforts that disregard this situation are likely to be costly and provide little return on investment.

Project sponsors and collaborators

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Gilbert, S. L., Broadley, K., Doran-Myers, D., Droghini, A., Haines, J. A., Hämäläinen, A., Lamb, C. T., Neilson, E. W., Boutin, S. (2018) Trailing-edge triage for effective biodiversity conservation in changing climates.

APPLIED CONSERVATION ECOLOGY LAB

Low-impact holds true for butterflies

Research led by F. Riva, J. Acorn, and S. Nielsen

Summary

- Low-impact seismic has been adopted for oil sands exploration in Alberta, but its effect on small organisms like insects is poorly understood.
- Compared to undisturbed treed peatlands, butterflies were not impacted by low-impact seismic lines, while conventional seismic lines, well pads, and roadsides had very different communities.
- These findings support the effectiveness of low-impact seismic lines for reducing the effects of human footprint on butterfly communities, filling an important knowledge gap on the sensitivity of small species to these features.

Why this study?

As oil sands companies test and adopt new practices to reduce their environmental footprint, it is important to evaluate the outcomes of these practices and confirm whether their objectives are being realized.

Past studies have looked at mammal and bird responses to low-impact seismic, but not those of smaller creatures like insects. We asked: are butterflies sensitive to the gaps created by low-impact seismic lines and other disturbances?

How was it done?

We surveyed 10- to 15-year-old open disturbances in treed peatlands within the Wood Buffalo region:

- Conventional seismic lines (9 m wide)
- Low-impact seismic lines (3 m wide)
- Well pads (60 m by 60 m)
- Road sides

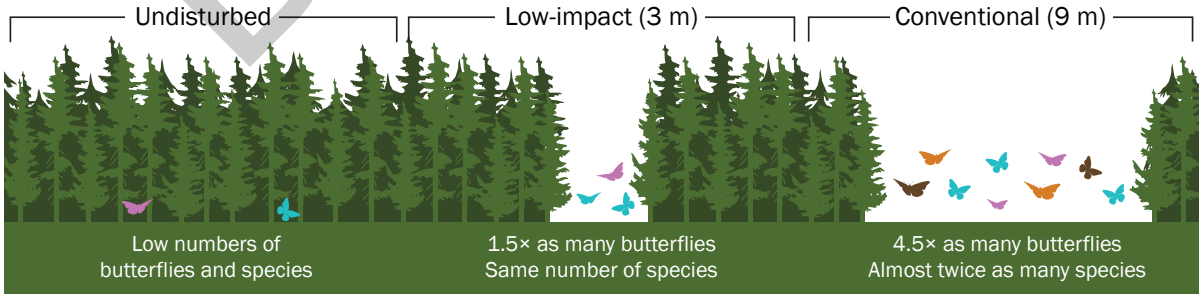
We also surveyed butterflies in mature (>80-year-old) forest for comparison.

Putting low-impact to the test

The impact of in situ exploration on butterflies was clearly reduced on low-impact lines. These lines remained shady and closed, and butterfly communities were similar to undisturbed forest.

In contrast, road sides, well pads, and conventional seismic lines all provoked a strong change in the butterfly community. These open areas contained many more plants and species on which adults and caterpillars can feed.

The low-impact seismic lines were most similar to undisturbed forest, while conventional lines were significantly different.



Key implications

- These findings demonstrate the reduced footprint placed on ecological communities by low-impact seismic, and expand our understanding to include smaller species that are typically overlooked.
- Future studies of in situ oil sands footprint would benefit from comparisons to fire and harvesting to better understand the relative magnitude of these disturbances on the landscape.

Partners and Funders

- COSIA
- Alberta Innovates - Energy & Environment Solutions
- Alberta Agriculture and Forestry
- Land Reclamation International Graduate School via NSERC-CREATE
- NSERC-CRD

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APPLIED CONSERVATION ECOLOGY LAB

Fire: A Seismic Restoration Tool?

Research led by A. Filicetti and S. Nielsen

Summary

- Wildfire is an important natural disturbance in Alberta's boreal forest, but it is unclear how it affects the recovery of existing disturbance footprints like seismic lines.
- Five years after a wildfire, Jack pine regeneration on upland seismic lines was twice as high as regeneration inside the forest.
- These results support the possibility of wildfire as a tool for passive recovery of seismic lines on upland Jack pine sites by promoting dense seedling regeneration along lines.

When disturbances overlap

Seismic lines are an important disturbance legacy in Alberta. They affect key wildlife like caribou by fragmenting forests, and regeneration has historically been poor, especially on treed peatlands and dry upland forests.

Fire is another key disturbance in western boreal forests. Unlike seismic lines, fire typically provokes rapid regeneration by fire-adapted species like Jack pine. Could fire improve seismic line recovery in upland Jack pine forests?

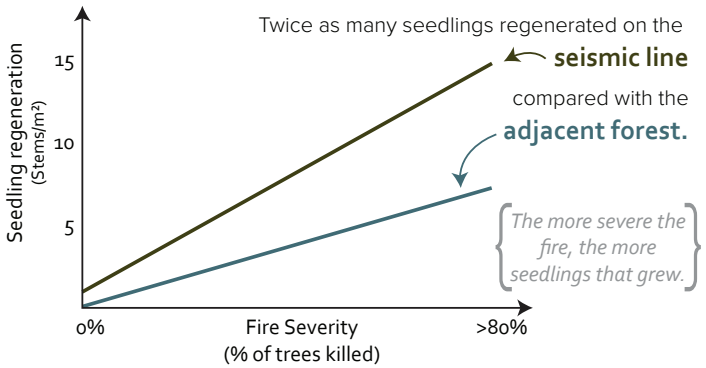
Walking the line

We examined seismic lines that burned five years earlier during the Richardson Fire, approximately 115 km north of Fort McMurray. Tree densities were measured along seismic lines and 25 m into the adjacent forest for comparison.

Fire gave recovery a boost

Jack pine regeneration on recently-burned seismic lines was very high. Twice as many seedlings were growing on seismic lines as in the adjacent forest. Regeneration also increased with fire severity: seedling densities peaked at nearly 15 stems/m^2 on lines in stands where the fire killed >80% of trees.

Jack pine seedlings regenerating on a burned seismic line. Photo by S. Nielsen.



Key implications

- The challenge of recovering legacy seismic lines is considerable, and our findings suggest that regeneration is kick-started on certain sites following high-severity fire.
- Passive recovery may be a strong option on poorly-recovering lines that have a high probability of burning. Prescribed burns may also be a powerful restoration tool on upland Jack pine sites.

Partners and Funders

- NSERC-CRD
- Boreal Ecosystem Recovery and Assessment (BERA) project:
  - ConocoPhillips
  - Cenovus Energy
  - Alberta Pacific Forest Industries

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Putting rare plants on the map

Research led by S. Nielsen and J. Dennett

Summary

- Learning more about rare plants is critical to understanding the impact of in-situ development, but they are often missed by standard monitoring programs.
- We surveyed rare plants in 602 sites across the Lower Athabasca to identify environmental factors associated with rare plants and used that information to map rare plant habitat across the Lower Athabasca.

Finding a Needle in a Haystack

Rare plants are often habitat-specific and cryptic in nature. This makes finding rare plants and managing their populations a challenge, including understanding and mitigating the effects of in situ developments.

Our aim was to develop a more efficient sampling approach and map rare plant habitat across the region.

Mapping the Unknown

We mapped areas of Lower Athabasca region where we expected rare plants to live, then sampled these areas more frequently. This alternative to random sampling results in a more efficient search for rare species, with potentially big cost savings.

We searched 602 unique 50 x 50 m sites in the Lower Athabasca region for rare plants.

Using an adaptive sampling approach proved an effective way to detect rare plants, with some species being encountered more frequently than expected given their conservation status.

We identified environmental factors associated with rare plants, then used that information to map rare plant habitat in the Lower Athabasca.

Our most up-to-date map showing rare plant habitat in the Lower Athabasca.

Key Implications

- Vegetation height structure and land cover type were the most important indicators of rare plant habitat, demonstrating the utility of using remote sensing methods like LiDAR.
- Maps produced from this model are being used for the provincial Biodiversity Management Framework, as well as guiding more efficient sampling for rare plants during pre-disturbance assessments and informing mitigation strategies.
- Industry partners can now more effectively avoid important rare plant habitat and minimize their impact on these species. Maps are available for download from the Alberta Species Conservation Atlas: http://www.ace-lab.org/asca-rare-plants

Partners and Funders

- Alberta Environmental Monitoring and Science Division
- Alberta Agriculture and Forestry
- Alberta Innovates
- NSERC-CRD and CGS-M
- COSIA
- ABMI
- Alberta Conservation Association
- Ducks Unlimited

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APPLIED CONSERVATION ECOLOGY LAB

Interpreting the rankings of rare plants

Research led by S. Nielsen and J. Dennett

Summary

- Rare plants represent a conundrum. Rare species require effort to protect, but some species ranked as rare have simply been under-sampled, and are in fact more frequently encountered than would be expected.
- Our work helped contribute information for the re-evaluation of the ranking of the conservation status of rare plant species in the oil sands region. Specifically, we examined what these changes in species status ranking mean for on-the-ground operations and regional land-use planning.

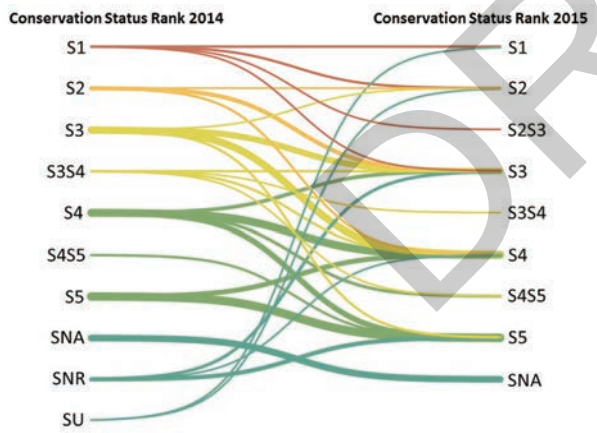
Rare, or just rarely sampled?

Rare plants are difficult to survey effectively, and it's often difficult to know their true population status. Our data, combined with other provincial data, contributed information towards a re-evaluation of the conservation status of rare plant species in 2015. We then used these rankings to compare habitat types associated with species of different conservation status to determine how they might impact on-the-ground surveys for rare plants.

The rankings undergo a re-evaluation

Several wetlands species from primarily fens occurred at higher frequencies than their original conservation status would suggest, being reclassified accordingly. Other species that were previously unranked due to a lack of information (SNR and SU) were assigned a new ranking, including some of high conservation rank (S1-S2).

With these key species being reclassified, the rarest status categories (S1 and S2) are no longer dominated by plants associated with fens. In fact, it is now clear that dry, sandy pine forests are the most likely areas to include rare species and thus where greater sampling efforts are needed to confirm rarity.



New information reclassified species both out of, and into, the rarest conservation status categories (S1 and S2).

2012-2014 rankings

***Fen** was the habitat type considered most likely to contain rare plants under the old rankings.*

2015 rankings

***Sandy pine forests** are most likely to contain rare plants under the revised rankings although we suggest some species are likely more common thus requiring greater sampling effort.*

Key Implications

- Dry, sandy pine forests are the habitat type most likely to include rare plants.
- This work provides more accurate information to industry and government partners and allows them to more easily detect and mitigate their impact on rare plant species
- This new information on rankings has informed models to help predict where rare plants might occur, and to drive more efficient sampling (See Note #3, October 2017)

Partners and Funders

- ABMI
- Alberta Environmental Monitoring and Science Division (OSM)
- Alberta Agriculture and Forestry
- Alberta Innovates
- NSERC-CRD and CGS-M
- COSIA
- Alberta Conservation Association
- Ducks Unlimited

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A place-based understanding of fruiting shrubs

Research led by Scott Nielsen

Summary

- Fruiting shrubs are highly valued by Indigenous communities and are a food source for key wildlife in the boreal. Despite their value, large knowledge gaps exist about the distribution and production of these species.
- We determined which habitat factors are most associated with fruiting shrubs and predicted the location and productivity of these species in the oil sands region of Alberta to support their management.

Knowledge gaps on an important resource

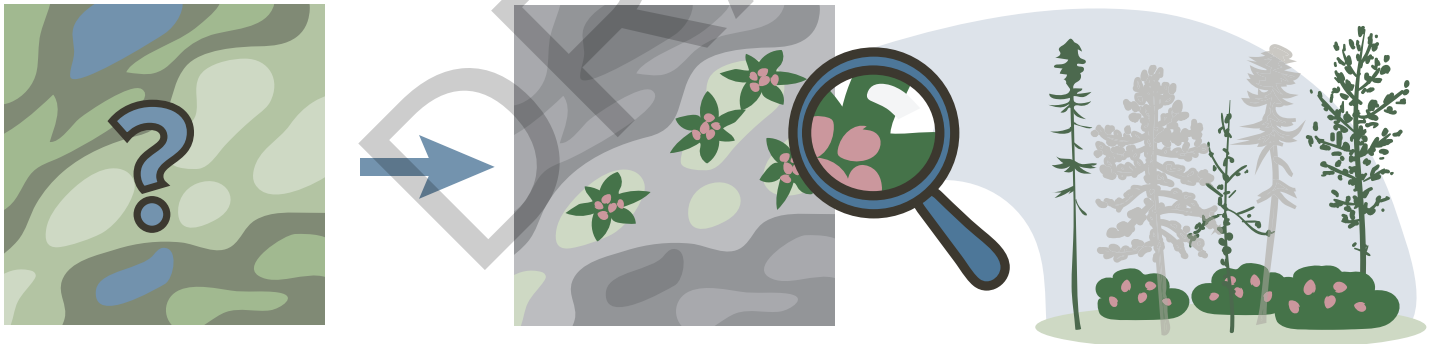
There are significant gaps in our knowledge regarding the location and fruit production of fruiting shrubs in the Lower Athabasca region. These gaps result in under-representation in land use planning decisions and environmental impact assessments. Our aim was to develop predictive maps to help identify important areas of fruiting shrubs, thus supporting land use planning, seed/fruit collections, and management and mitigation actions.

Searching for shrubs

We collected data on 21 different fruiting species from a total of 845 plots. We determined which habitat factors were associated witheach species and used this information to predict their distribution and productivity across the Lower Athabasca. Maps based on landcover type, soil type, topography, and climatic factors had good to very good accuracy.

A fruitful effort

The most important areas for fruit production were the east slope of the Birch Mountains, the Athabasca Plain, parts of the east side of Stony Mountain, and the Lakeland/Sand River areas. In general, areas with greater terrain variability were an important predictor for fruiting shrubs, though xeric-adapted species were associated with the Athabasca plain.



We examined 845 plots to determine what habitat factors were associated with fruiting shrubs. Using these habitat factors, we accurately predicted the location of fruiting shrub habitat across the region.

These maps can be used among other things to identify ideal sites for conducting experiments aimed at increasing berry production (e.g. tree thinning, identifying sites for seed collection, or assessing impacts of future developments).

Key implications

- These maps (available at www.ace-lab.org/atlas/shrubs) will be shared with the Traditional Knowledge Working Group allowing communities, land-use planners, and scientists to identify important areas for berry picking and facilitate greater inclusion into decision-making.
- Next steps include identifying sites for testing methods to increase berry production. Tree thinning, for example, may promote production in areas with abundant shrubs but low fruit production due to forest succession (canopy closure).

Partners and Funders

- CEMA
- ABMI
- Ducks Unlimited Canada
- COSIA (ABC Chairs)
- Alberta Innovates
- Alberta Agriculture & Forestry
- NSERC-CRD

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DEPARTMENT OF RENEWABLE RESOURCES

APPLIED CONSERVATION ECOLOGY LAB

Testing rare plant translocations

Research led by Jacqueline Dennett and Scott Nielsen

Summary

- When new human developments encounter rare plants, these plants may be relocated to another area within their natural range in an effort to conserve them (i.e. translocation). We tested the success of this technique on two rare peatland plant species, *Sarracenia purpurea* and *Carex oligosperma*.
- Translocation of peatland species appeared successful in the short-term, with higher survival than was previously observed for plants on drier sites.
- When translocation is used as a mitigation technique, long-term monitoring will be key to ensuring the success of future generations and the efficacy of this strategy.

A method for mitigation?

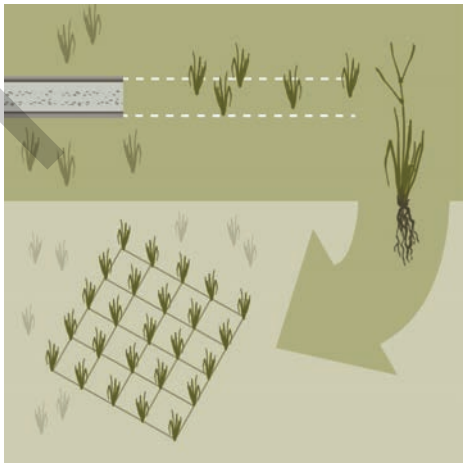
Translocations are a technique used to conserve rare plant species that are likely to be impacted by human development. While upland species are known to have poor survival rates after translocation, little is known about the response of peatland species to this technique. This study sought to fill this knowledge gap to inform conservation strategies for rare plants within peatlands.

Moving and monitoring

We conducted experimental translocations of two peatland species in the Oil Sands Region of Alberta. For each species, 70 plants were removed from each of three donor sites. Of these, 20 were immediately replanted at the donor site to act as a control, while the remaining plants were distributed across three recipient sites. Initial transplanting occurred in 2014 and follow-up monitoring of survival, growth, and reproduction has been conducted in the years since.

A survival success, but at the cost of health

Translocation of peatland species was considered successful. Survival rates were high compared to past research that looked at translocation of plants within drier landcover types. Although survival was high for peatland species, growth and reproduction decreased in the years following translocation. Their growth and reproduction does, however, appear to be approaching normal rates over time.



Translocation involves removing plants facing imminent destruction (e.g. in the path of a future road), and replanting them elsewhere within their native range.

Key implications

- While peatland species may survive the translocation process, changes to growth and reproduction could reduce their ability to colonize new areas.
- Translocations should remain a last-resort option used only when habitat is being totally destroyed, i.e. peat is being stripped.
- When using translocation, consider the importance of the number of plants being transplanted together, matching recipient and source habitats, and the capacity for long-term monitoring.
- Monitoring is essential to determine the success of this technique and the establishment of new generations.

Plants showed reduced growth and seed production in the years immediately following translocation.

Partners and Funders

- Alberta Environmental Monitoring and Science Division
- Alberta Agriculture and Forestry
- Alberta Innovates
- NSERC-CRD and CGS-M
- COSIA
- ABMI
- Alberta Conservation Association

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Why did the water cross under the road?

Research led by Caitlin Willier and Scott Nielsen

Summary

- Roads built through peatlands can cause flooding by blocking water flow, but simple wetland classification types (e.g. bog vs fen) are not enough to determine where this is likely to occur. Peatlands of the same type can show very different responses to roads. This study examined the role of additional factors, including landscape position and substrate texture, on flooding responses as indicated by changes in tree canopy.
- Both bogs and fens were susceptible to flooding, with bogs showing the greatest differences in headwater regions. The underlying substrates were a major factor, with coarser substrates like sand and gravel preventing flooding by permitting water to flow under the road.

The damming effects of roads

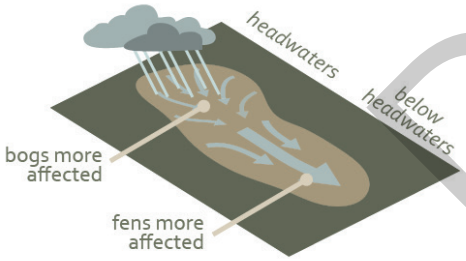
Roads are well-known for disrupting water flow through peatlands. When water is blocked by a road, the downstream side dries up and becomes more forested, while the upstream side floods, becoming more open. However, this flooding pattern is not always consistent, with different responses observed in similar peatlands or even along stretches of a single road. We examined a suite of factors to more precisely determine when roads are likely to cause flooding.

Bogs can get bogged down

While water in bogs is commonly classified as stagnant, we were surprised to find that both bogs and fens are impacted by roads. Bogs located in drier headwater regions were impacted the most, perhaps because headwater species are less adapted to handle prolonged flooding. In contrast, fens showed greater differences in areas below the headwaters.

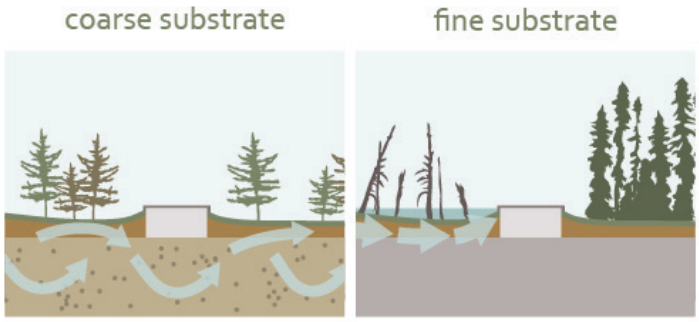
Going below the surface

The largest factor for determining flooding was the underlying substrate of the peatland. Water flowed more easily when the road was built over a substrate like sand or gravel. When the road was built over a fine substrate like clay, water flow was restricted to the surface of the peatland and was not able to pass under the road.



Landscape position determines where peatlands are most affected by roads.

Coarse substrates allow water to flow vertically under the road whereas fine substrates block water and increase propensity for flooding.



Key implications

- Substrate texture was strongly linked to flooding. Coarser substrates like sand and gravel allow vertical water flow under the road, preventing flooding. In contrast, fine clay-like substrates impede water flow causing flooding on one side of the road and drying on the other.
- Contrary to our expectations, both bogs and fens were susceptible to flooding depending on their landscape position. One simple tool for understanding sensitivity of peatlands to roads is the underlying substrate. Where road building is unavoidable, mitigation methods that promote the gradual movement of water beneath the road surface (such as multiple culverts along the length of the road) are needed.

Partners and Funders

- COSIA
- Alberta Innovates
- Alberta Agriculture & Forestry
- NSERC-CRD

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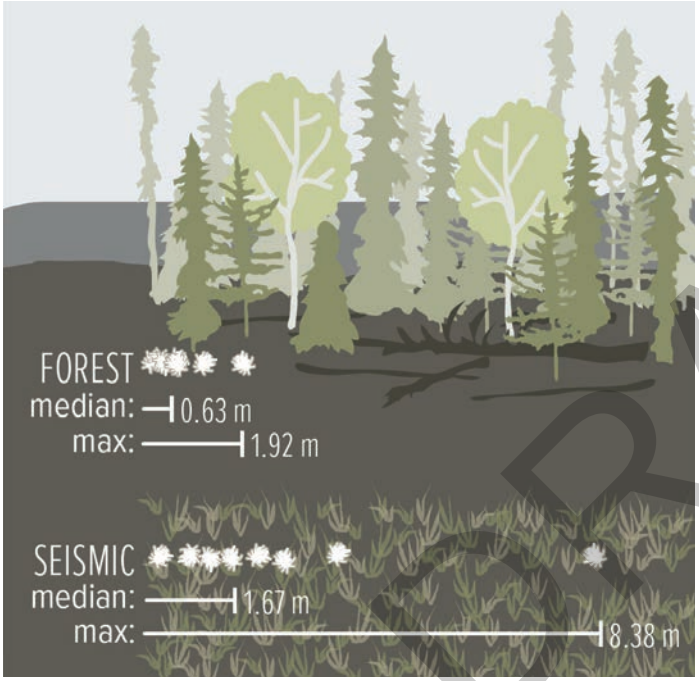
APPLIED CONSERVATION ECOLOGY LAB

Seismic lines may spread seeds

Research led by David Roberts and Scott Nielsen

Summary

- Seismic lines have received significant attention in Alberta's boreal forest, but their potential role as seed dispersal corridors for native and invasive plants is unknown. Here we investigated how seismic lines affect the distance travelled by wind-borne seeds.
- The median distance reached by wind-borne seeds is almost three times farther, and the maximum distance four times farther, on a seismic line compared to the undisturbed forest.



Seeds released on seismic lines were blown up to four times farther than the seeds released in forested areas.

A corridor for more?

Habitat fragmentation can have profound effects on ecosystems, and seismic lines may be a key source of this fragmentation in Alberta's boreal areas. To date, most studies have focused on assessing vegetation recovery and the resulting impacts on key wildlife species like woodland caribou and wolves. However, the vast networks of seismic lines in Alberta's boreal forests may also function as seed dispersal corridors, offering fewer obstructions and greater wind speeds.

We experimentally tested the effect of seismic lines on seed dispersal by releasing cattail seeds as proxies for wind dispersed invasive plants both in forested areas and on adjacent seismic lines (whose width ranged from 5.3 to 8 m).

Of wind and weeds

Wind speeds were seven times faster on seismic lines compared to adjacent forests. Median dispersal distances were nearly three times farther for seeds released on a seismic line compared to those released in the nearby forest. Effects were even stronger for the maximum dispersal distances, with the farthest traveling seeds drifting four times farther when on a seismic line.

Key implications

- Seismic lines may facilitate rapid expansion of invasive plants where sites are suitable. Land-use planners should consider the potential effect of seismic lines on wind-borne seeds if invasive plants are present in the area.
- Seismic lines may also aid in the northward advancement of native species to help mitigate against the impacts of climate change, but this depends largely on wind direction and seismic line orientation.
- Future work should investigate the relative importance of wind speed vs physical barriers, such as trees and tall shrubs, in regards to slowing seed dispersal. Studies on seed establishment would also help better understand the magnitude of seismic line impacts, which we are now studying.

Partners and Funders

- COSIA
- Alberta Innovates
- Alberta Agriculture & Forestry
- NSERC (CRD)

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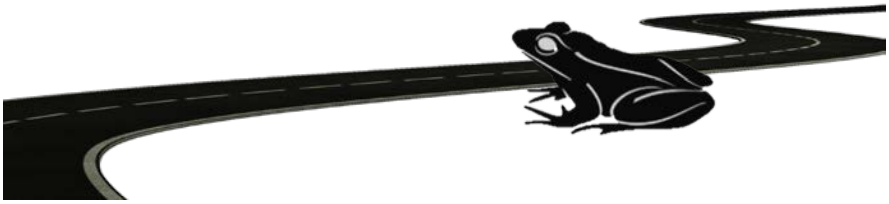
Natasha Annich, MSc, University of Alberta – April 11, 2018

Do boreal chorus frogs think F250s are predators?



Introduction: If you have ever walked near a wetland where frogs are calling, you will find they stop calling when you get close. This behavior is a defence against predators that use sound to find frogs. How frogs "know you are coming" is the noise we make when walking and vibrations of our footsteps. Increased numbers of trucks and cars cause a lot of noise and vibration in Alberta's boreal forest. As male frogs call to attract females, anything that disturbs calling behavior has the potential to negative affect frog populations. This could lead to local extinctions in otherwise suitable wetlands simply because they are close to noisy areas.

Objective: See if boreal chorus frogs stop calling when trucks pass & assess if distance to & density of roads influences the # of frogs.

Methods: We used data from autonomous recording units located throughout boreal Alberta that were located close to versus far from various road types. We modelled how distance to road, road density, and traffic noise influenced relative abundance and calling behaviour of boreal chorus frogs. A computer recognizer was created to find recordings when vehicles passed by calling boreal chorus frogs to see when frogs "shut up".

Results: Abundance of frogs is measured using an index based on how loud a group of frogs is (known as a chorus). The "chorus" of boreal chorus frogs was louder near most road types than in areas far from roads, suggesting more individuals near roads. This may be caused by pooling of water in ditches, which can create suitable breeding habitat for the boreal chorus frog. When we looked at the calling behavior a minute before and a minute after a truck went by, we found no evidence the intensity of the chorus changed.

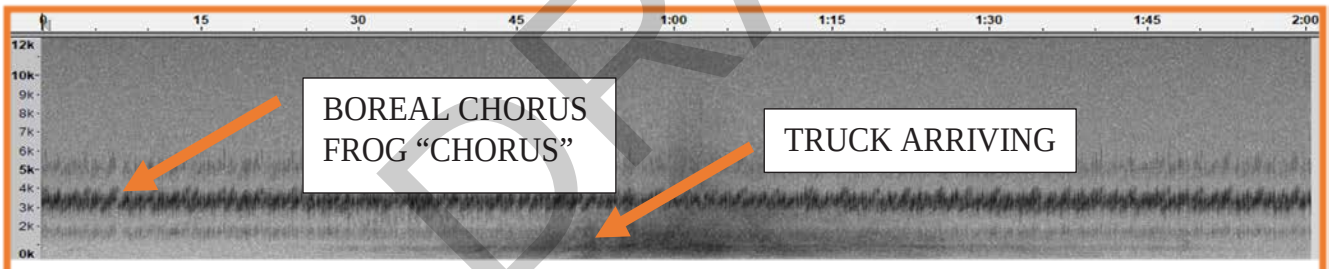


Fig. 1 – Spectrograms including boreal chorus frogs (*Pseudacris maculata*) calling in full chorus during a vehicle passage. x-axis = time (s); y-axis = frequency (kHz). Boreal chorus frog calls are 3 kHz – 4 kHz from 0:00 min to 2:00 min. Maximum frequency vehicle event occurs at 0:50 min to 1:10 min, and is between 0 kHz – 2 kHz.

Implications:

- Does not look like F250s are seen as predators by boreal chorus frogs! Seems like males are able to attract females to wetlands near roads and may use roadside ditches as breeding habitat.
- While seemingly good news, there may be a downside. Frogs move overland from breeding to wintering sites. Thus, there is a good chance the frog will cross the road. This may increase road mortality.
- Research is needed to determine how often frogs cross roads, when they do it, and whether or not large numbers are killed to assess risk to frog populations in the region. Limiting travel or reducing speeds during key amphibian movement times should be evaluated if areas with high mortality are observed.

Project funding: National Science and Engineering Research Council, Devon Energy Canada, the Northern Scientific Training Program, the University of Alberta North program, the Alberta Biodiversity Monitoring Institute, the Alberta Conservation Association, Oilsands Monitoring Program, and Alberta Environment and Parks' Environmental Monitoring and Science Division.

Changes in boreal forest birds over a 23-year period in regenerating cutblocks

Lionel Leston, Erin Bayne, and Fiona Schmiegelow

Forest harvesting for lumber and pulp increases the amount of younger forest on the landscape. For some species, young forest is essential habitat, while for other species, forest harvesting causes temporary habitat loss.

How long harvested areas are suitable for early seral species and when species associated with older forests return is key to effective forest & wildlife management.

Research Question:

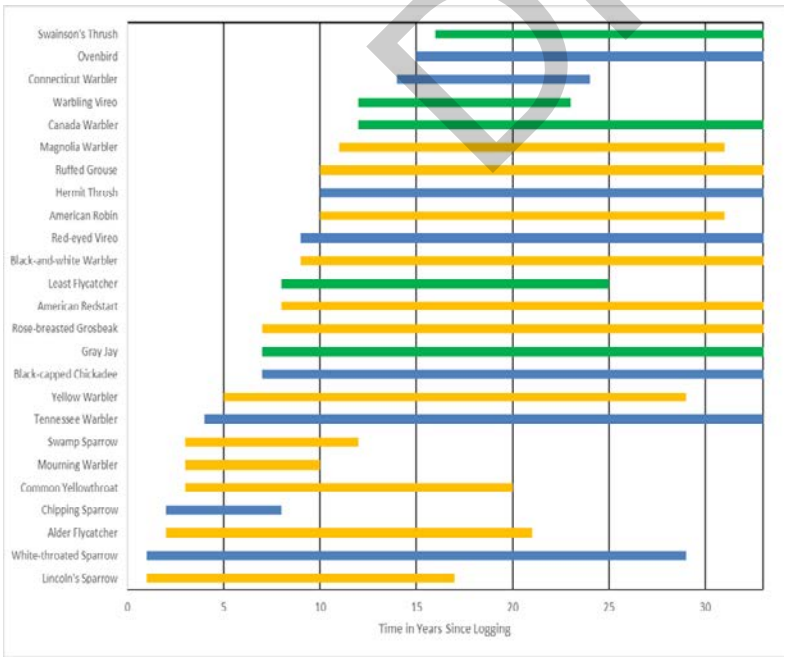
When after harvest do different boreal birds regularly use regenerating cutblocks?

We used 23 years of point count data (1994-2016) from the Calling Lake Forest Fragmentation Study[1] at three types of sites:

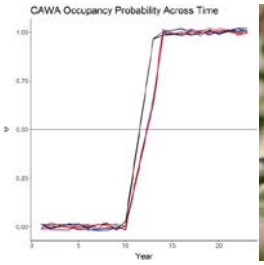
1. Cutblocks harvested in 1984 – treated to enhance conifer survival
2. Cutblocks harvested in 1994 – no treatment, natural regeneration
3. Control sites – unharvested forest > 80 years old in 1994

Occupancy models were used to predict when (#years after harvest occurred) species were likely to be present at point counts within each type of site.

8 of 21 "old growth species" used harvested areas by 2016, while 11 of 16 "early-seral species" declined or disappeared over time. A number of generalist species showed interesting patterns of change related to regional density and climatic conditions occurring on both the breeding and wintering grounds.



Coloured bars indicate when species are likely to reoccupy cutblocks after harvest: species of open lands, younger forests (yellow), older forests only (green), and species that use many forest ages as habitat (blue).



Canada Warbler, a Species at Risk, was first observed at Calling Lake around 2004. They arrived in unharvested forest first (black), but also settled in harvested areas in 2005. However, density of Canada Warbler is far lower in harvested areas than older forest.

Take-home message:

75% of 51 species present in the original forest used regenerating cutblocks by 2016.

Species that did not use cutblocks are associated with mixedwoods (Brown Creeper, Black-throated Green Warbler, Bay-breasted Warbler) suggesting a lack of white spruce in these cutblocks may limit reuse by these species within the period of recovery we measured.

bioacoustic unit

The Utility of Using Recognizers for Owl Acoustic Surveys

Julia Shonfield, PhD Candidate

Autonomous recording units (ARUs) have numerous practical benefits for conducting acoustic owl surveys: ARUs can be set up during the day and scheduled to record at night, and can be left out for long periods. Methods for owl monitoring often include broadcasting owl calls, but this can affect owl behaviour. ARUs are a less biased method to survey owls, but processing large numbers of recordings from ARUs is time consuming. Recognizers could help to make processing recordings more efficient and manageable, but how effective are they for owls?

Research Objective:

Test the utility of using computer recognizers to detect owls.

- I built recognizers for Barred owls, Boreal owls, and Great Horned owls, and scanned all recordings collected at 238 ARU locations in 2014 (over 84,000 recordings!).
- We compared results from the recognizers to results from listening to a subset of the recordings (4, 10-min recordings from each location).
- Human observers checked all results from the recognizers.

Table 1 – Results of the recognizers and comparison of ARU locations where the target owl was missed

Recognizer	Recognizer results (total no. hits)	% of hits of target owl species	Time to check results (min)	Locations missed by recognizer	Locations missed from listening
Barred Owl	10,361	2.7%	384	3	31
Boreal Owl	6,932	99%	693	24	16
Great Horned Owl	3,069	72%	256	3	107

Checking all recognizer results took 30 hrs, this was efficient and took substantially less time than listening (174 hrs). The Barred owl and Great Horned owl recognizer performed well and detected these owls at quite a few more locations than from listening. The Boreal owl recognizer was very precise (99% of all recognizer hits were Boreal owl calls), but did not perform as well and missed this species in a number of locations where we detected them from listening.

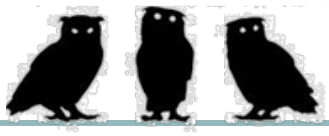
Project funding by: National Science and Engineering Research Council, the Northern Scientific Training Program, the University of Alberta North program, the Alberta Conservation Association, the Environmental Monitoring Committee of the Lower Athabasca, Nexen Energy, and the Oil Sands Monitoring program operated jointly by Alberta Environment and Parks and Environment and Climate Change Canada.

Take-home message:

Given the low detection rates of owls by listening to recordings, using recognizers is likely to be highly useful for monitoring owls. Similar patterns have been observed for other rare & wide ranging species.

bioacoustic unit

How Does Industrial Noise Affect Owls in Northeastern Alberta?



Julia Shonfield, PhD Candidate

Energy development creates several types of disturbance that can impact wildlife, including the physical footprint of the infrastructure and the chronic noise from facilities.

Chronic noise sources can pose problems for animals that communicate vocally because the noise can mask important signals[1,2]. Owls, for example, use vocalizations to attract mates and defend territories, and hunt by listening to sounds made by prey. Chronic noise has been shown to negatively affect owl hunting success and ability to detect prey[3,4].

Barred Owls are listed as 'Sensitive' in Alberta, other owls are not listed but are important as top predators.

Research Question:

Do owls avoid industrial areas with chronic noise?

I used autonomous recordings units to survey owls at three types of sites:

1. Chronic noise sites – with a compressor station
2. Intermittent noise sites – with a road bisecting the site
3. No noise sites – with no traffic noise or industrial noise

I processed the recordings using recognizers to detect the calls of Barred owls, Great Horned owls and Boreal owls.
I found that the occupancy of all three owl species were not different between the three noise categories (Fig. 1).

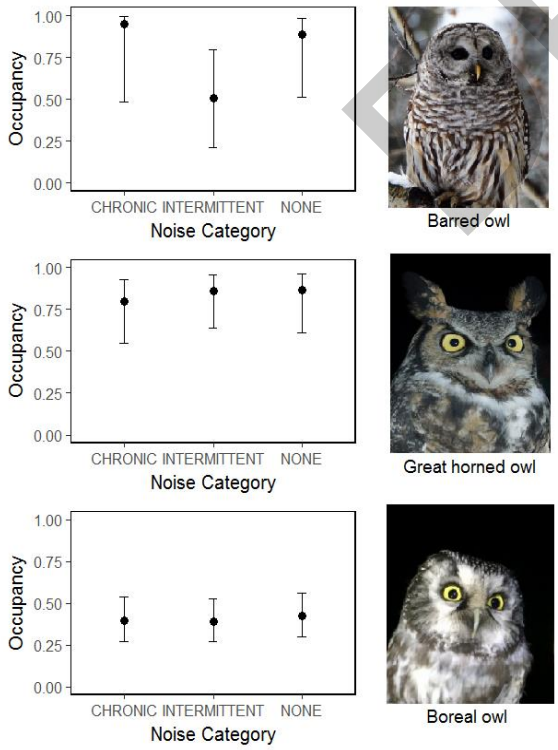


Fig. 1 – Occupancy model predictions for all three owl species for the three noise categories of sites surveyed (72 sites). Error bars are 95% confidence intervals.

Take-home message:

My results suggest the effect of industrial noise on owls is minimal, and unlikely to result in a population change.

Project funding by: National Science and Engineering Research Council, the Northern Scientific Training Program, the University of Alberta North program, the Alberta Conservation Association, the Environmental Monitoring Committee of the Lower Athabasca, Nexen Energy, and the Oil Sands Monitoring program operated jointly by Alberta Environment and Parks and Environment and Climate Change Canada.

[1]Brumm & Slabbekoorn. 2005. *Adv. Study Behav.* **35**: 151–209.
[2]Barber *et al*. 2010. *Trends Ecol. Evol.* **25**: 180–189.
[3]Mason *et al*. 2016. *Biol. Conserv.* **199**: 29–32.
[4]Senzaki *et al*. 2016. *Sci. Rep.* **6**: 30602.

For more details, see the full article at the link below:

Shonfield & Bayne. 2017. *Avian Conservation and Ecology* 12(2):13. https://doi.org/10.5751/ACE-01042-120213

bioacoustic unit

The Impact of Industrial Noise on Small Mammal Abundance and Activity

Julia Shonfield, PhD Candidate

Research on the effects of human-caused noise has focused on species that rely primarily on vocal communication (e.g. songbirds, squirrels, frogs, and bats)[1,2]. Many species of small mammals (e.g. mice and voles) rely primarily on olfactory communication (i.e. scent). Small mammals are unlikely to be directly impacted by noise but could be indirectly impacted through predation. They could be more vulnerable to predators if they are distracted by the noise[3], or noisy areas could be a refuge if predators avoid these areas.

Small mammals are important components of ecosystems, as prey, predators and seed dispersers.

Research Question:

Does industrial noise impact small mammal abundance and activity?

I live-trapped small mammals using Longworth traps with 64 traps per site, set up in 8 x 8 grids. Trapping was done for 4 nights per site, at 14 sites in 2014 and 23 sites in 2015. There were 3 types of sites:

1. Chronic noise sites – trapping grid adjacent to a clearing with a compressor station
2. Intermittent noise sites –trapping grid adjacent to a road
3. No noise sites – trapping grid adjacent to a clearing with no industrial/traffic noise

I caught 7 species, but deer mice and red-backed voles were the most numerous. The abundance of these two species, as well as all rodents, did not differ between the 3 types of sites (Fig. 1).

I calculated maximum distance moved for individuals caught at least twice, as a measure of activity, and this also did not differ between the 3 types of sites.

Take-home message:

Small mammal abundance and activity do not appear to be strongly impacted by industrial noise.

A red-backed vole (*Myodes gapperi*)

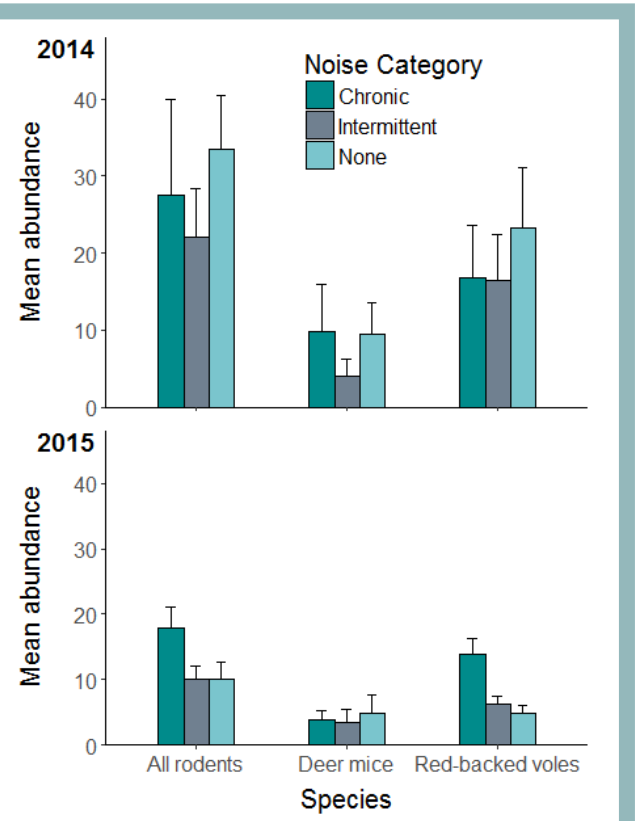


Fig. 1 – Small mammal mean abundance (no. individuals) across noise categories in 2014 (top) and 2015 (bottom).

Project funding by: National Science and Engineering Research Council, the Northern Scientific Training Program, the University of Alberta North program, the Alberta Conservation Association, the Environmental Monitoring Committee of the Lower Athabasca, Nexen Energy, and the Oil Sands Monitoring program operated jointly by Alberta Environment and Parks and Environment and Climate Change Canada.

[1]Luther & Gentry. 2013. *Behav*. **150:** 1045–1068.
[2]Shannon *et al.* 2016. *Biol. Rev.* **91**: 982–1005.
[3]Chan *et al.* 2010. *Biol. Lett.* **6**: 458–461.

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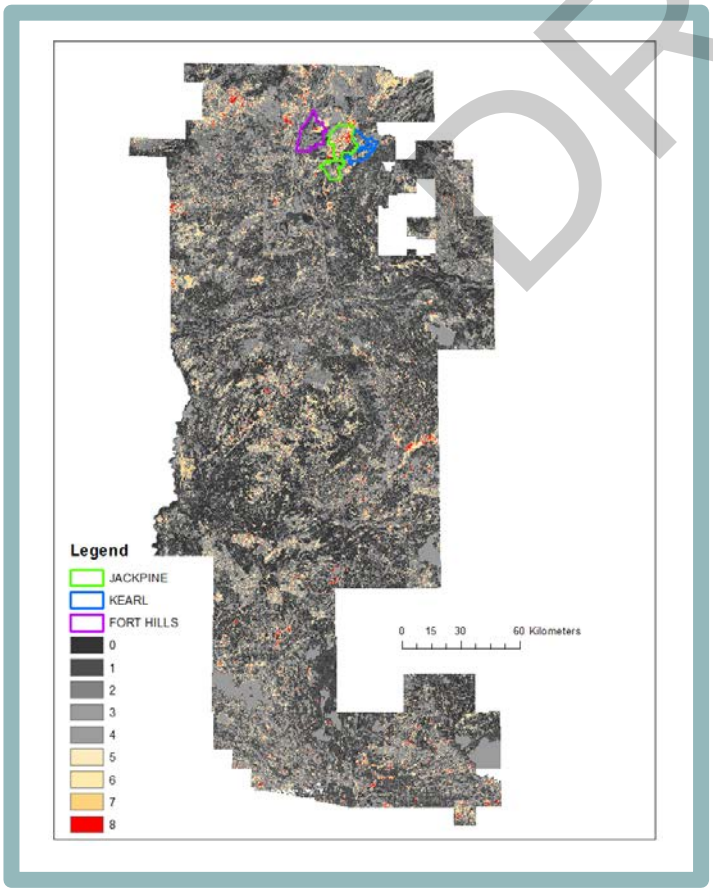
Risk to Yellow Rails from oilsands mining

Dr. Erin Bayne – Professor – University of Alberta.
January 18, 2018.

Objective:
Assess potential impacts of oilsands mining on habitat availability for the Yellow Rail, a federally listed species of concern.

Introduction: The Yellow Rail (YERA) is a small marsh bird found in grassy wetlands in the boreal forest. Despite a growing understanding of the vegetation & water conditions used by YERA, there have been no previous attempts to map their habitat selection. Current remote sensing products for the oilsands region vary in their categorization of the water & vegetation conditions where YERA exist. This has made estimation of risk from oilsands mining and other forms of human & natural disturbance difficult in the past.



Methods : We created a novel fusion approach to integrate information from four land-cover products to make an improved map that predicts the relative importance of different habitat conditions for YERA. Each area was assigned a score between 0 to 8.

An importance score of 8 indicates all land-cover products agree YERA select that habitat. A value of 0 indicates all land-cover products agree YERA avoid that habitat. Values from 1 to 7 indicate the land-cover products do not all agree whether YERA select, avoid, or are neutral to a particular habitat. Scores 5 to 8 include 85% of known YERA locations in the oilsands region. Current & proposed mine development plans were overlaid with the YERA habitat importance map to assess risk of habitat loss.

Results: The area in hectares for each YERA importance score are on page 2. Numbers in brackets are the predicted # of locations (~21 ha area sampled by an autonomous recording unit - ARU) where YERA might occur based on habitat conditions. Where we know the YERA to occur is labelled **Known Risk**.

Results (cont.):
12,700 hectares of category 5 to 8 habitat has been or could be lost to the oilsands mines shown in the map on page 1. This represents ~2.53% of available habitat in the mapped portion of the Lower Athabasca planning region.

An absolute population estimate is not possible with this model as we used presence data to build the habitat model & presence/absence data to compute modelled risk. YERA are estimated to occur at 4,416 locations in total & 3,360 locations in importance scores 5 to 8. Of the 203 locations where YERA are known to occur, 70 are within current or proposed footprint of the 3 mines shown in the map on page 1.

YERA Score	Fort Hills	Kearl	Jackpine Expansion	Regional Habitat Availability
0	2,476 (0)	1,499 (0)	900 (0)	758,689 (0)
1	3,335 (0)	2,556 (0)	3,344 (0)	1,289,994 (68)
2	5,391 (2)	2,425 (1)	3,715 (2)	893,530 (364)
3	3,764 (2)	2,409 (1)	4,355 (2)	768,965 (418)
4	1,195 (0)	1,225 (0)	3,019 (1)	610,017 (206)
5	447 (2)	679 (3)	2,498 (11)	228,682 (970)
6	551 (4)	731 (5)	2,710 (19)	169,619 (1176)
7	387 (3)	499 (4)	2,331 (21)	66,669 (595)
8	188 (3)	198 (3)	1,482 (24)	37,741 (619)
Modelled Risk	17,733 (17)	12,221 (18)	24,354 (80)	4,823,905 (4,416)
Known Risk	22	13	35	203

Take-home messages:

- The YERA is not as rare as thought. They have been observed in 18 large wetland complexes outside the mineable area & are predicted to occur in other locations.
- The mineable area contains a large amount of YERA habitat, both within & adjacent to proposed mine developments. Continued monitoring of YERA is needed to ensure compliance with EPEA[1] conditions in vegetated areas adjacent to mine boundaries.
- The fusion model identifies new locations where the species could occur. More locations should be surveyed to gain greater confidence in population estimates. Many locations are small patches of habitat that were not identifiable by previous mapping approaches & may not be suitable. Determining minimum patch sizes used by YERA is a monitoring priority.
- Large wetland complexes exist in remote locations within the modelled study area & outside. Areas not included in the habitat importance map that are likely to have YERA include the Peace-Athabasca Delta near Wood Buffalo National Park & Cold Lake Air Weapons range. Access constraints for monitoring & lack of land-cover products prevent the maps from being extrapolated to these potentially important areas.
- The risk to YERA in northeastern Alberta from oilsands mines varies based on whether known or modelled risk are used to assess impact (2.5% of modelled vs. 34.5% of observed YERA). Explicit statements from regulators about the area of concern are required to determine if this degree of loss exceeds desired thresholds. Proposed mine development is unlikely to remove 34.5% of the actual YERA in the study area. Only 1.7% of the total study area & 3.6% of YERA importance scores 5 to 8 have been surveyed by ARUs.
- As part of the monitoring program, information on local vegetation conditions & water levels have been tracked to provide information that will be used by industry to aid in reclamation planning for the YERA at the end of the mining cycle.

Acknowledgments: The YERA is monitored in Alberta's mineable oilsands region by a collaboration between the Bioacoustic Unit, Suncor – Fort Hills, Imperial - Kearl, Canadian Natural Resources, and the regional Oilsands Monitoring program. This work is part of conditions put in place by the Alberta Environmental Protection and Enhancement Act (EPEA) [1]. See //bioacoustic.abmi.ca/ for more details. Photo Credits: https://commons.wikimedia.org/wiki/File:Yellow_Rail & Bioacoustic Unit.

bioacoustic unit

Preliminary trends for Yellow Rail in LAPR

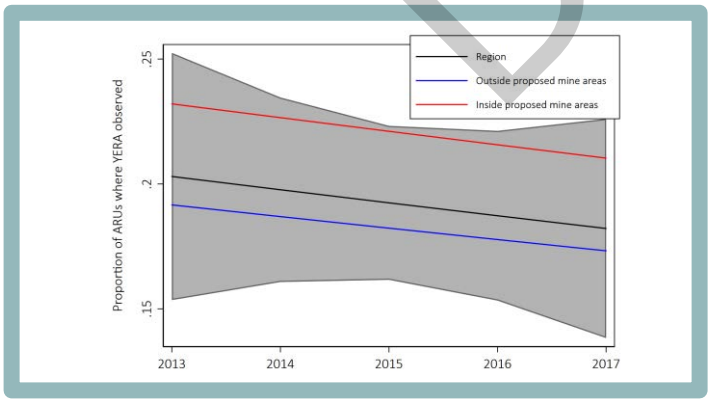
Dr. Erin Bayne – Professor – University of Alberta. January 18, 2018.

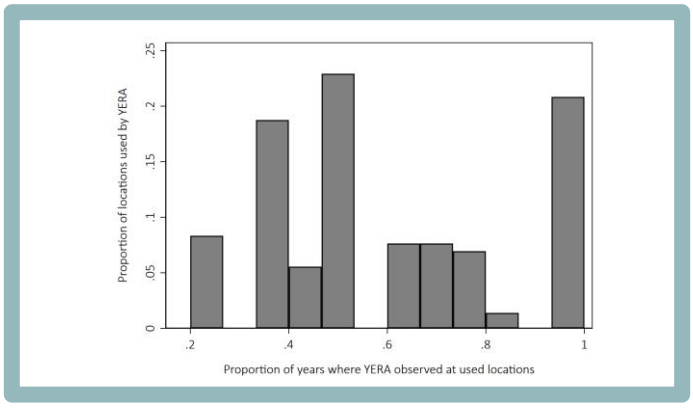
Introduction: The Yellow Rail (YERA), a species of concern in Canada, is found in grassy wetlands of the boreal forest that are relatively common near Alberta's oilsands mines. Habitat models created for a section of the Lower Athabasca planning region (LAPR), suggest YERA may lose 2.5% of their habitat to future mine development. Evaluating how potential loss of habitat in the future will effect YERA requires a good understanding of current population size & trends at meaningful spatial extents. Formal trend estimates do not exist for YERA in Canada, although anecdotal reports suggest local declines. Of particular importance in Alberta, is how YERA populations are changing in suitable habitat close to versus far from oilsands mines.

Is YERA occurrence close versus far from oilsands mines changing at the same rate?

Methods: Since 2013, we have surveyed for YERA at almost 4000 locations in the Lower Athabasca planning region (LAPR) using autonomous recording units (ARU). When a YERA is found at a site (area of ~ 80 hectares), we redeploy 4 to 5 ARUs in subsequent years. A total 414 ARUs have been deployed at the same sites in multiple years (44% for 2 years, 32% for 3 years, 14% for 4 years, and 10% for 5 years). Controlling for # of recordings, time of day, & time of year, a cross-sectional time-series analysis was used to determine change in YERA occurrence close (inside proposed mine expansion areas) vs. far (areas outside mineable region).

Results: The occurrence of YERA showed a slight, but non-significant decline (grey area in left panel indicates 95% CI in regional trend). The rate of decline is similar close vs. far from mines. Whether a location is used every year varied, with 21% of ARUs having YERA every year & 67% having YERA more than half the time. Variation between years is the same close vs. far from mines. Future work will examine trends in occupancy & density.





Take-home messages:

- Current mining activities have not caused change in YERA at rates any higher than observed in LAPR overall.
- Some sites are used more consistently. Currently assessing why & evaluating potential management options.
- Simulations shows significant declines in YERA would be observed in LAPR if proposed mines were developed.
- We are assessing if mitigation monitoring adjacent to future mine edges will have sufficient statistical power to detect edge effects in suitable habitat caused by activities within the mines per se(i.e. water draw down, deposition).

Acknowledgments: The YERA is monitored by the Bioacoustic Unit, Suncor – Fort Hills, Imperial - Kearl, Canadian Natural Resources, and the regional Oilsands Monitoring program. See //bioacoustic.abmi.ca/ for details.