THE EXCHANGE:

Sharing Knowledge, Inspiring Solutions

2025
EDITION 13

ARCKP

Alberta Regional Caribou Knowledge Partnership

Connecting Alberta's forest sector and policy makers to accessible and relevant scientific information is key to advancing woodland caribou conservation efforts across the province. To facilitate this, the Alberta Regional Caribou Knowledge Partnership (ARCKP) provides regular knowledge exchange, keeping our partners and stakeholders up to date on the research and information they need to make important forest management and policy decisions.

Credit: Mercer Peace River Pulp Ltd.

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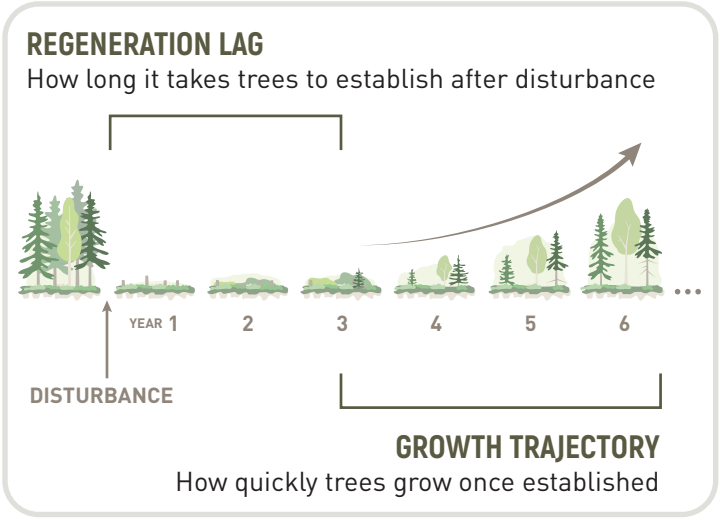
Understanding seismic line recovery through regeneration lags and growth trajectories

Tens of thousands of kilometers of seismic lines crisscross north-eastern Alberta. These disturbances contribute to declines in threatened woodland caribou by increasing movement efficiency of wolves, making restoration essential. However, seismic line restoration can cost $12,000 to $15,000 per km, making active restoration very expensive. In addition, active restoration treatments require re-disturbing lines, potentially resetting regeneration and impacting other ecosystem functions and processes. To strategically plan and properly allocate seismic line restoration efforts, it is vital to understand which lines will benefit the most from active treatment, and where it is best to leave lines to recover passively.

Untangling the Potential of Passive Recovery

Research has shown that tree regeneration on seismic lines is influenced by many factors, including the availability of light, nutrients, seeds, and moisture (influenced by the width and orientation of seismic lines, height of adjacent forest canopy, and microtopography) and additional line disturbances like wildfires or human use. However, little is known about the impact of **regeneration lags** (when trees establish after disturbance) and **growth trajectories** (how quickly trees grow once established), including how these processes interact to influence forest recovery rates.



Study area

Between 2016 and 2022, naturally regenerating trees on 344 seismic lines with minimal human disturbance were sampled. These sites were chosen from a 42 200 km^2 area extending across the Athabasca oil sands region of north-eastern Alberta. Four boreal forest types were sampled, including xeric upland forests, mesic upland forests, transitional forests, and peatland forests.

Dominant tree species on seismic lines included:

95%
Of xeric upland forest sites had Jack pine

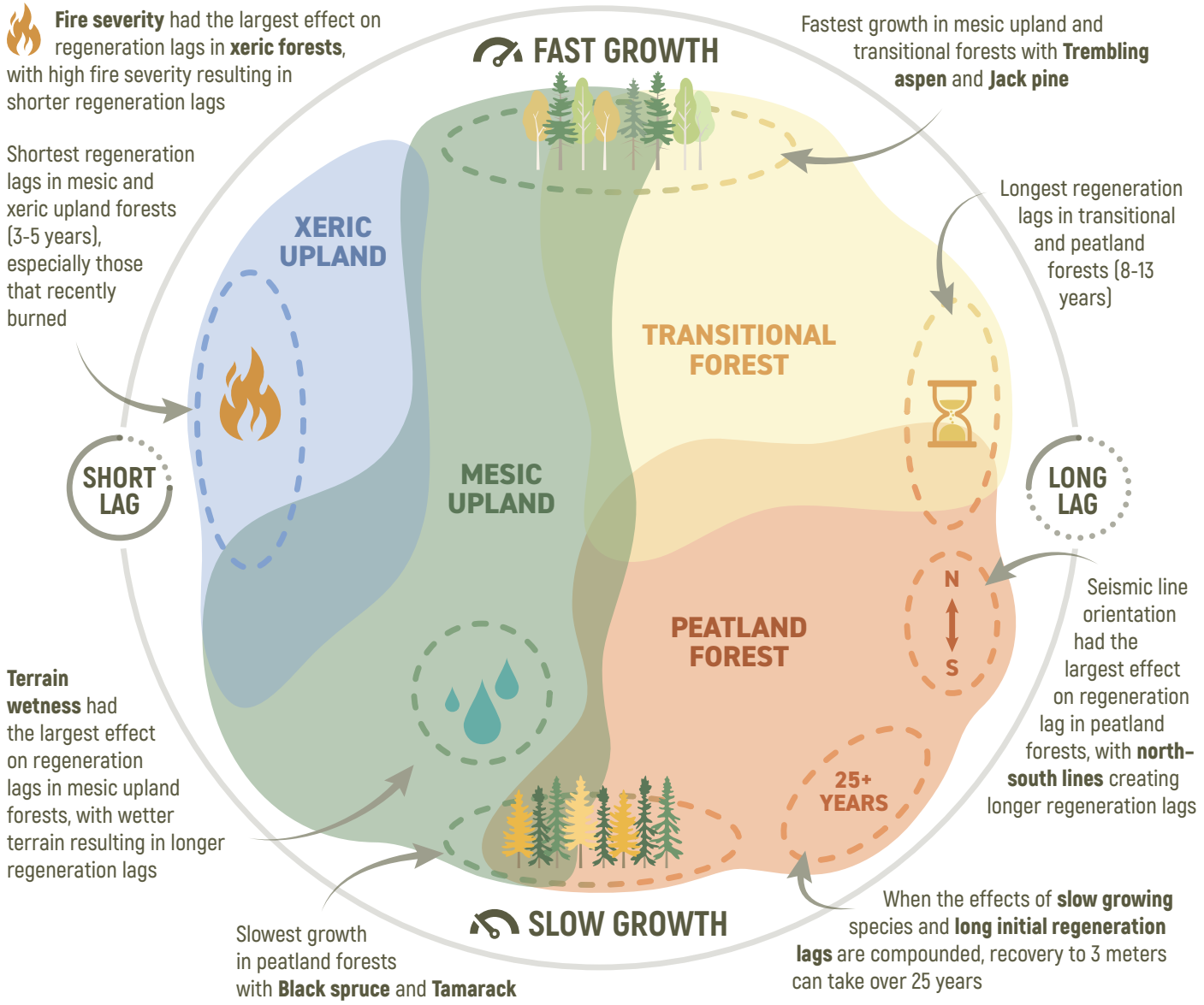
87%
Of peatland forest sites had Black Spruce

63%
Of transitional forest sites had Black Spruce

79%
Of mesic upland forest sites had Trembling aspen

Passive recovery on seismic lines is slower in boreal wetland forests, suggesting that active treatment could be most beneficial at these sites

Forest recovery rates are influenced by the interaction between regeneration lags and growth trajectories. Both lags and growth rates vary depending on **forest type**, **dominant tree species**, **disturbance type**, and **site characteristics**.



What does this mean for restoration planning?

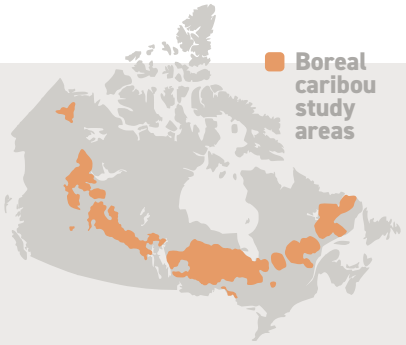
This research can be used to help guide the allocation of limited resources during restoration planning. When planning seismic line recovery in boreal forests, it is important to consider forest type and the impacts of re-disturbance. In general, this work found that seismic lines in boreal upland forests can often be left to recover without intervention especially if re-disturbance is limited or regeneration is stimulated by wildfire. In contrast, peatland and transitional forests may benefit from active restoration treatments, especially with the aim of reducing regeneration lags.

Sutheimer, C.M., Filicetti, A.T., Viliani, L. and Nielsen, S.E. (2025), Regeneration lags and growth trajectories influence passive seismic line recovery in western North American boreal forests. Restor Ecol, 33: e14353. https://doi.org/10.1111/rec.14353

Conserving Canada's woodland caribou: Is habitat restoration enough?

Boreal woodland caribou have been declining across Canada for decades. Habitat disturbance is widely viewed as the primary cause of these declines due to its effects on vegetation and predator–prey dynamics. As a result, caribou recovery strategies typically aim to limit disturbance to no more than 35% of critical habitat.

However, multiple factors may play a role in caribou declines, and while calf recruitment tends to decline as disturbance increases, this trend is not universal. Some populations decline in areas with minimal disturbance, while others remain stable despite high disturbance. Untangling the reason behind these differences highlights one of the challenges with observational data. Unlike controlled experiments, observational data lack a true baseline or "control," making it impossible to know how caribou would have fared in the absence of disturbance. Would they have thrived, remained stable, or declined for other reasons?



Looking at causation rather than observation tells a broader story

To explore this more deeply, Steve Wilson (2025) asked not just whether disturbance is associated with decline, but whether it causes it. Using caribou demographic data (1997–2017) and habitat disturbance data (current to 2015), he calculated **three types of causation** for two disturbance models.

Necessary causation (PN): the probability that disturbance factors were necessary for declines to have occurred, although other factors might have also been required.

Sufficient causation (PS): the probability that disturbance factors alone were sufficient to cause a decline, but that other factors may also cause declines.

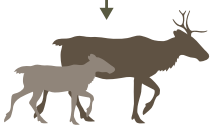
Causal attribution (PNS): the probability that disturbance factors were both necessary ***and*** sufficient for declines to have occurred (PN and PS combined).

Disturbance Models:

GROUPED MODEL
(Looks at disturbance types together)

HABITAT DISTURBANCE
Anthropogenic features identifiable on 1:50 000 imagery (+ 500 m buffer) and burned areas < 40 years old

CAUSATION
PNS = 18%



CALF RECRUITMENT

UNGROUPED MODEL
(Looks at each disturbance type separately)

HARVEST BLOCKS

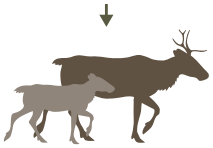
PNS = 20%

LINEAR FEATURE DENSITY

PNS = 26%

PRIMARY PRODUCTIVITY

PNS = 30%



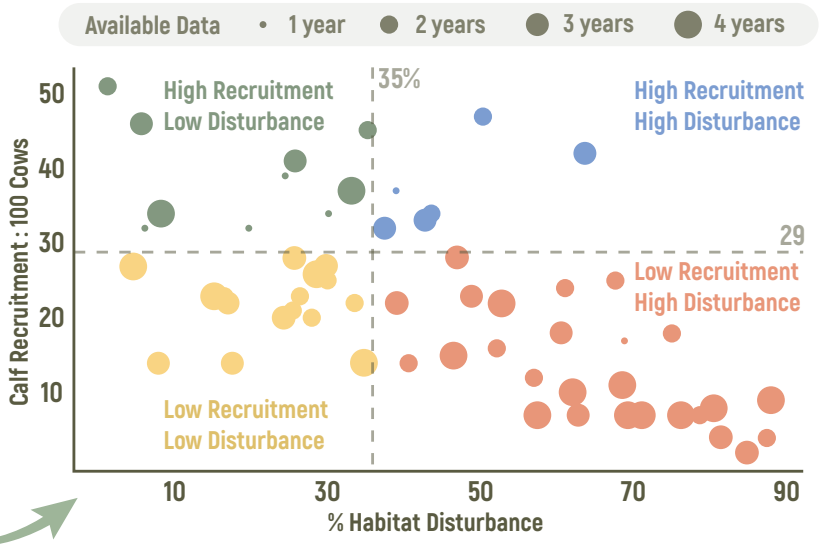
CALF RECRUITMENT

Wildfire was removed from the ungrouped model since areas recently burned by wildfire did not have significant causation. However, this may change as climate change continues to increase the frequency of extreme fire behavior.

Habitat disturbance is important, but it's not the only factor in caribou declines

In the grouped model, the author found a 54% probability that high habitat disturbance (exceeding the 35% disturbance threshold) is sufficient alone to cause low caribou recruitment and a 21% probability that it was necessary. The probability that high habitat disturbance is both necessary and sufficient to cause declines was only 18%. **This means that although habitat disturbance can impact caribou, the current habitat recovery objective on its own has a low probability of successfully stabilizing populations.**

Causation is low because despite the overall declining trend in areas with high habitat disturbance, there are also instances of **population decline in low disturbance areas** and **stable populations in high disturbance areas**. These contrary circumstances suggest there are other factors at play.



Causation probabilities are sensitive to the thresholds used to calculate them. For example, both linear features and harvest blocks are incompatible with stable caribou populations (PS = 100%) above certain thresholds. Caribou will decline if:

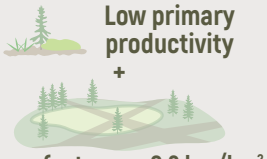
Linear feature densities exceed 0.2 km/km²

or

Harvest blocks are more than 10% of a range's area

High primary productivity (EVI > 3500) alone has a 94% probability of being sufficient to cause caribou declines and has a PNS of 30%. In addition, disturbances are more likely to contribute to declines on landscapes with low primary productivity than high productivity.

High primary productivity
+
Linear features > 0.2 km/km²
Harvest blocks > 10%
↓
PNS: 3%



Low primary productivity
+
Linear features > 0.2 km/km²
Harvest blocks > 10%
↓
PNS: 55%

What does this mean for caribou recovery strategies?

Reducing habitat disturbance below 35% is the main goal of recovery strategies but the author suggests it is it is unlikely to be sufficient to stabilize caribou populations. Causation analysis suggests habitat disturbance, while important, may not be the only driver of decline. Habitat restoration may not always lead to recovery if other unaddressed factors are at play. Other factors could include variation or shifts in forage supply, diseases, parasites, hunter harvest, displacement, or climate change impacts. To ensure the success of caribou recovery efforts, the author suggests that broader factors must be identified and integrated into restoration planning.

Wilson, Steven F. 2025. "Causal Attribution from Retrospective Data in Canada's Woodland Caribou System." Ecological Applications 35(3): e70022. https://doi.org/10.1002/eap.70022

ARCKP funded project

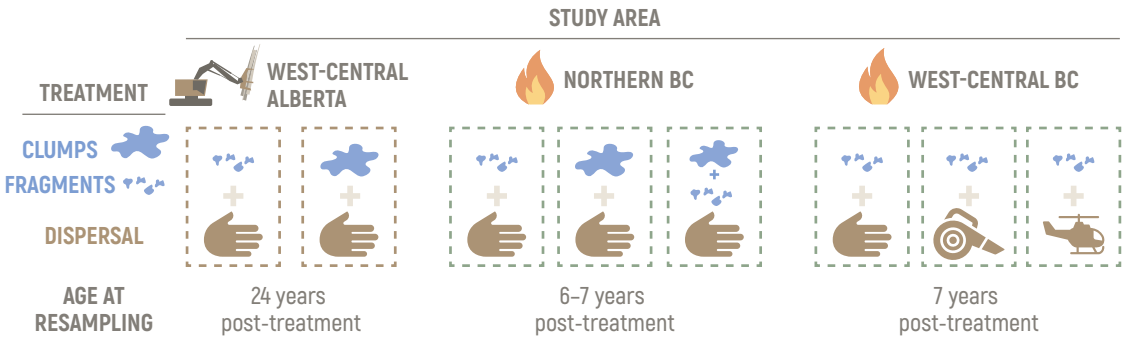
Historical trials confirm feasibility of lichen transplantation

Lichen transplantation is a restoration technique with potential to rapidly re-establish terrestrial lichen cover on disturbed sites. Without intervention, lichens typically take 40 years or more to re-establish on disturbed sites due to their slow growth and dispersal rates. Given terrestrial lichens' relative importance for caribou as a winter food source, techniques that more quickly restore lichen cover may provide conservation benefits.

Is lichen transplantation a feasible technique over the long term? **This ARCKP-funded project revisited three historical trials — one harvest and two burns — to evaluate lichen persistence over 6-24 years**. For results from a greenhouse trial conducted as part of this project, see *The Exchange* #12. Results from a hydroseeding trial will be reported in the next issue.

The trials and the treatments tested

Three historical lichen transplantation trials in Alberta and BC



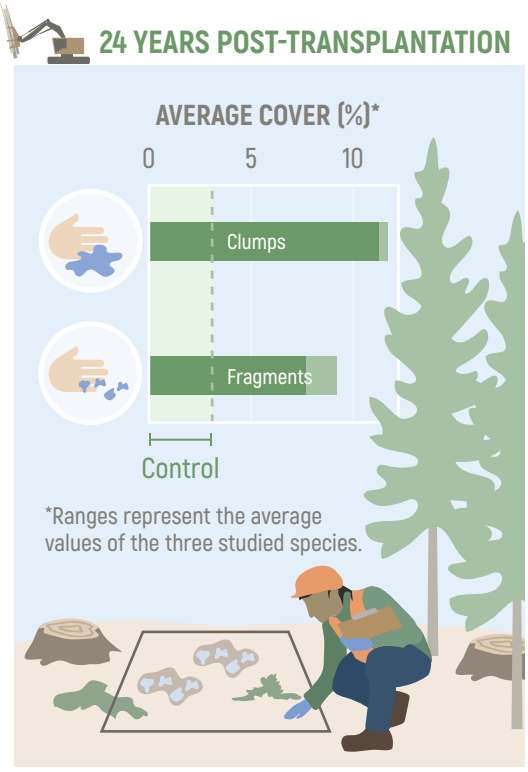
Transplantation increased lichen cover in harvest areas

After 24 years, transplanted plots in harvest areas had substantially higher lichen cover than the controls. This was true whether lichens were hand-transplanted as clumps or evenly scattered as fragments.

This findings from this trial suggest that transplanted lichen are resilient over the longer term, including lichens that had been crushed and spread (a more cost-effective approach than carefully transporting and placing clumps).

Additional implications from this study include:

- The three species trialled — *C. arbuscula* ssp. *mitis, C. rangiferina*, and *C. uncialis* — all performed well, suggesting they are good candidates for transplantation.
- Transplanted lichens did not disperse very far (<50 cm) from their original plots during the study period.
- Overall cover was slightly higher in areas with lower slopes, suggesting steep microsites may not be suitable for transplantation.



Transplanted lichens increased cover in burned forests

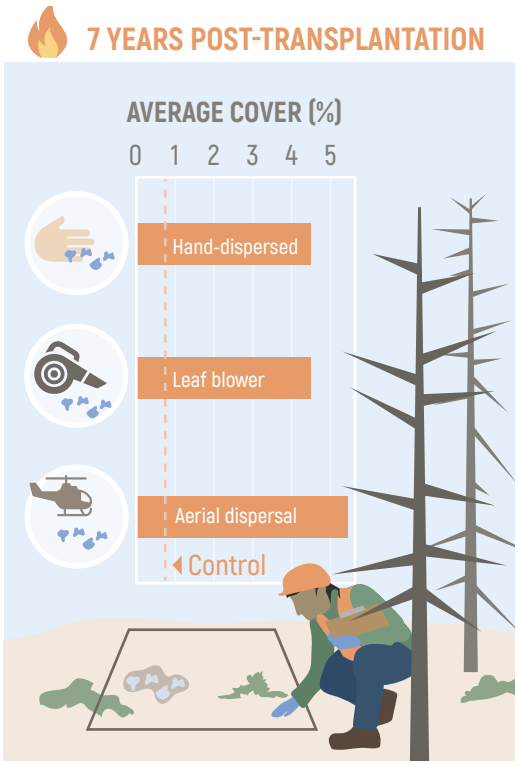
Transplantation increased lichen cover in burned plots in west-central BC, six years after transplantation. Notably, average cover was similar regardless of dispersal method. This resilience to dispersal method suggests that transplantation may be tailored to lower-cost options (manual or leaf-blower dispersal) or scaled up to treat large areas (aerial dispersal), as needed.

Other management implications from these studies include:

- *C. arbuscula* ssp. *mitis* was the most common species in treatment plots, suggesting it is a strong candidate for transplantation into burned sites.
- Highest potential for lichen restoration on dry, sandy, low-nutrient sites with low to moderate slopes.

Transplanted lichens are healthy

Visual assessments and lab testing found that transplanted lichens are healthy, with no significant differences between treatments, suggesting they do well once established.



Implications: Historical trials confirm feasibility of lichen transplantation

Together, the findings of these three historical trials suggest that transplanted lichens survive well over time, they remain healthy once established, and they significantly increase cover compared with natural recovery.

The similar results across trials regardless of dispersal method suggest that lichens are generally resilient to transplantation. Notably, **broadcasted fragments performed as well as hand-dispersed fragments or clumps**. The success of broadcasted fragments supports the feasibility of larger-scale programs, as broadcasting is more cost-effective than collecting, transporting and carefully transplanting intact clumps.

Additional recommendations drawn from these studies include:

- Transplanted fragments should be spread widely across sites to help increase overall cover and reduce competition with each other. While specific microsite recommendations did not emerge from the studies, transplants may be more successful on lower slopes.
- Transplantation may provide the greatest benefit on burned sites, where there was almost no natural re-establishment (compared with harvest areas, where some natural re-establishment was observed).
- While lichen sourcing was not studied in these trials, it is broadly recommended to source lichens for transplantation from nearby sites with similar habitat conditions.

Wang, D., R.S. Kong, M. Schulz, J.-M. Sobze. (2025). Examining the feasibility of terrestrial lichen transplantation and seeding technology for woodland caribou habitat restoration. Prepared for: Alberta Regional Caribou Knowledge Partnership (ARCKP). NAIT Boreal Research Institute and Portage College.

Kranrod K., Anderson E. 2001. Terrestrial lichen enhancement of second-growth stands in west-central Alberta. Weldwood of Canada Limited.

Rapai S.B., Mccoll D., Mcmullin R.T. 2017. Examining the role of terrestrial lichen transplants in restoring woodland caribou winter habitat. The Forestry Chronicle, 93(3): 204-212.

Ronalds I. 2018. Tweedsmuir lichen restoration trial year 1 report. Skeena Region, Ministry of Forests, Lands, Natural Resource Operations, and Rural Development.

WHAT IS THE ARCKP?

Who we are, and what we do

Woodland caribou are a cultural and ecological icon of Alberta's Boreal forests. However, they are also a threatened species, and represent a significant conservation challenge. In response to this challenge, and to the additional challenge of managing woodland caribou across different ecosystems, the Government of Alberta and the province's forest sector formed the Alberta Regional Caribou Knowledge Partnership (ARCKP). Together, we are committed to finding on-the-ground solutions that balance forestry activities with woodland caribou conservation.

The ARCKP is an association of fRI Research and funded by the Forest Resource Improvement Association of Alberta (FRIAA) through the support of forestry companies in Alberta. Together, these partners contribute over $1 million per year to address region-specific knowledge gaps in woodland caribou ecology.

fRI Research
Informing Land & Resource Management

ARCKP
Alberta Regional Caribou Knowledge Partnership

$1M / YEAR

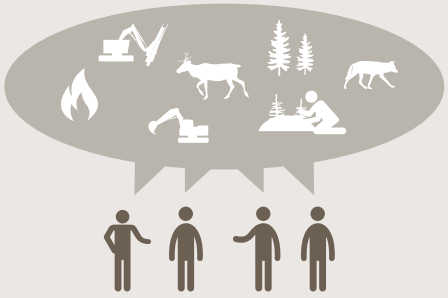
Forest Resource Improvement Association of Alberta (FRIAA)

Twelve Forestry Companies

Alberta Government

OUR VISION

A collaboration promoting self-sustaining caribou populations and a viable forest sector.



OUR MISSION

We support the development and sharing of innovative tools, techniques, strategies and understandable scientific knowledge to enhance sustainable forest management and caribou recovery efforts.

Have questions about the ARCKP?
Contact our network coordinator at ARCKP@fuseconsulting.ca or visit arckp.ca.

The ARCKP is funded by the Forest Resource Improvement Association of Alberta

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