THE EXCHANGE:

Sharing Knowledge, Inspiring Solutions

2025
EDITION 14

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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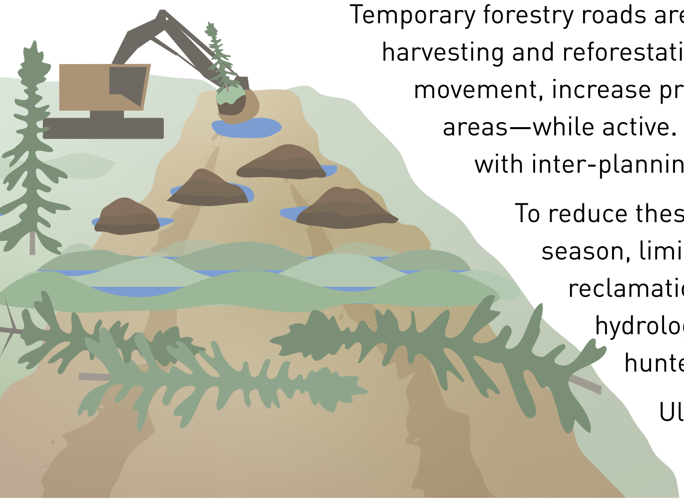
ARCKP funded project

Effects of temporary forestry roads on caribou

Forestry roads are essential for accessing harvest areas, but their presence can have lasting impacts on woodland caribou. Temporary or non-permanent roads, though designed for short-term use, can fragment habitat, increase predator access, and disrupt caribou movement.

The ARCKP has recently developed a special series of four research briefing notes, summarized below, to help forest managers support caribou conservation and sustainable forestry through informed road planning, design, and reclamation. Each note provides practical insights into how temporary forestry roads affect woodland caribou and outlines strategies to reduce those impacts.

#1 Understanding and reducing potential effects of temporary forestry roads on caribou



Temporary forestry roads are a routine part of forest operations, providing short-term access for harvesting and reforestation. Though eventually reclaimed, these roads can disrupt caribou movement, increase predator access, and degrade habitat—especially in sensitive peatland areas—while active. The type and duration of road use influence the severity of impacts, with inter-planning unit roads posing the greatest risk.

To reduce these effects, planners should avoid road use during caribou calving season, limit construction in peatlands, and apply low-impact building and reclamation techniques. Practices such as blocking roads after use, preserving hydrology, and planning for rapid reforestation are key. Maintaining some hunter access may also help manage predator populations.

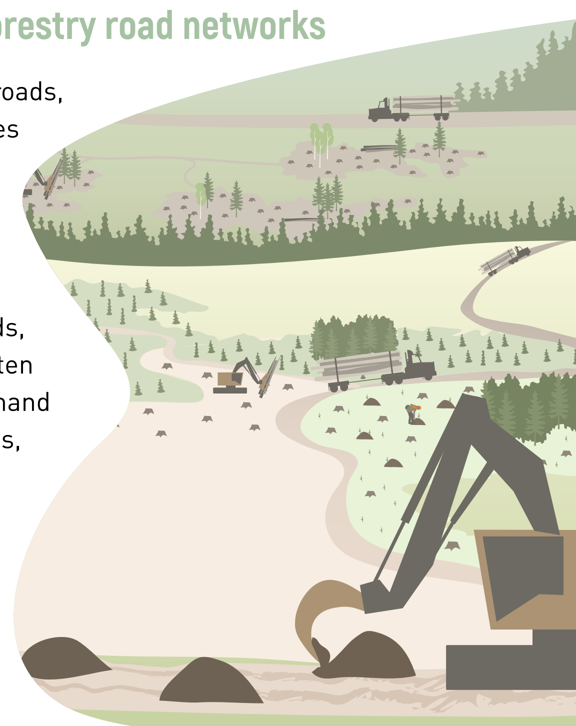
Ultimately, thoughtful road design and timely reclamation can minimize long-term disturbance, support caribou recovery, and maintain operational efficiency.

#2 Multi-pass vs. aggregated harvest systems: Comparing forestry road networks

Forest harvest systems influence the extent and impact of temporary forestry roads, which in turn affect caribou habitat. Conventional multi-pass harvesting involves repeated entries into small areas over decades, leading to prolonged road use and disturbance. In contrast, aggregated harvest systems concentrate activity into larger areas completed in a single pass, reducing road reuse and long-term disruption.

Aggregated harvesting may reduce the number and duration of temporary roads, allowing for earlier reclamation and improved habitat continuity. However, it often requires stronger main roads, which can increase short-term impacts and demand more robust reclamation. Modeling suggests potential road footprint reductions, though results vary by landscape.

Regardless of harvest system, consistent best practices in road planning, construction, and reclamation are essential—especially in sensitive areas like peatlands. Integrating modeling insights, prioritizing early reclamation, and collaborating with Indigenous communities can help align forest operations with caribou recovery goals.



#3 Improving forestry road network planning and design under aggregated harvest systems for caribou outcomes

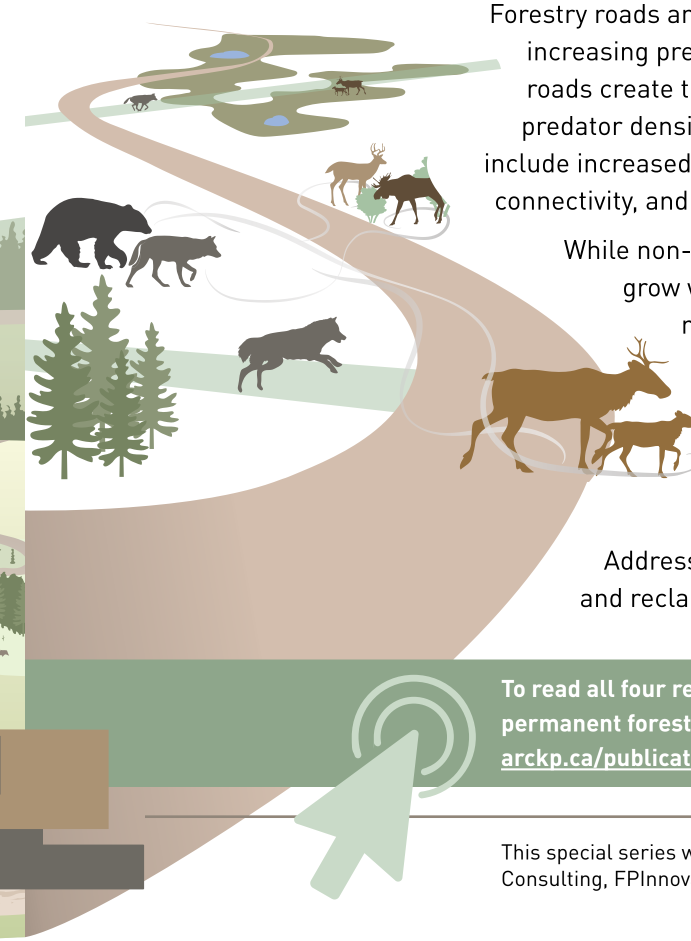
Careful planning and design of temporary forestry roads are key to minimizing long-term impacts on caribou habitat, especially in sensitive peatland areas. While aggregated harvest systems may reduce road density, both conventional and aggregated approaches require thoughtful road placement and construction.

Avoiding peatland crossings is critical, as these areas are vital caribou refuge and are difficult to restore. When crossings are necessary, low-impact techniques—like island hopping, preserving topography, and maintaining hydrology—can reduce damage and support faster reclamation.

Strategic use of in-block roads can limit reliance on high-standard inter-block roads, which are more costly and slower to reclaim. Seasonal timing also matters—winter roads are preferred but increasingly constrained, while summer roads often require more intensive restoration.

To improve outcomes, future efforts should focus on better planning tools, standardized practices, reclamation research, and collaboration with Indigenous communities to support shared stewardship and long-term habitat resilience.

#4 Process drivers and effects of forestry roads on woodland caribou



Forestry roads and other linear features contribute to woodland caribou decline by increasing predator access, fragmenting habitat, and disrupting movement. These roads create travel corridors for wolves and attract moose and deer, elevating predator densities. Key drivers associated with non-permanent forestry roads include increased predation, human-caused mortality, disrupted movement, barriers to connectivity, and altered energy use from road avoidance.

While non-permanent forestry roads pose a relatively low barrier, their effects grow with traffic volume, duration, and proximity to sensitive peatlands. High road densities and unmanaged access can reduce caribou survival. Mitigation strategies include avoiding roads through peatlands, prompt reclamation, and maintaining controlled hunter access to manage prey populations. Collaboration with Indigenous communities and monitoring recreational use are also vital for sustainable access and habitat stewardship.

Addressing these key drivers is essential for guiding responsible road planning and reclamation that supports long-term caribou recovery.

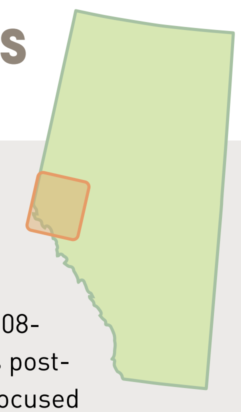
To read all four research briefing notes in the Special Series: Reducing the effects of non-permanent forestry roads on woodland caribou in Alberta, visit the ARCKP website: arckp.ca/publications/project-reports

This special series was made possible through the technical contributions of Circle T Consulting, FPInnovations, and Solstice Environmental Management.

Caribou and moose show varying responses to pine beetle outbreaks

Climate change has fueled increasingly frequent insect outbreaks across western Alberta, with mountain pine beetle infestations spreading rapidly. Land managers have responded with interventions including accelerated pine harvest, salvage logging, and prescribed burns to protect communities and minimize economic damage. Yet the effects of both beetle infestations and these management responses on wildlife remain poorly understood.

Pine beetle outbreaks fundamentally alter forest structure. As infestations thin the canopy, they may trigger lichen declines that can manifest in the following 3–15 years (depending on local conditions). Meanwhile, increased light penetration can stimulate understory vegetation growth, enhancing both its abundance and diversity. For woodland caribou and moose — which depend heavily on lichens and understory plants — these habitat transformations might alter landscape use.

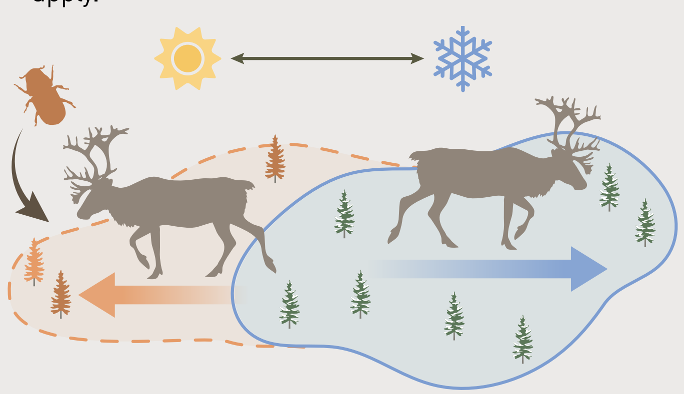


Study Design

Researchers analyzed habitat selection using GPS collar data from 2008-2010 (three to five years post-infestation). The study focused on two caribou populations in west-central Alberta (Little Smoky and Redrock-Prairie Creek) and an overlapping moose population.

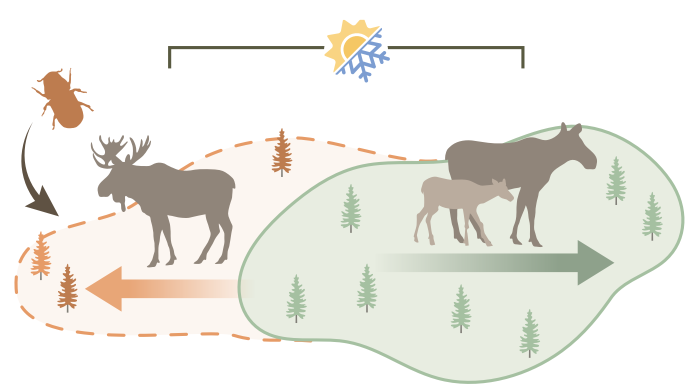
Caribou have a seasonally variable response to pine-beetle disturbance

Both caribou populations avoided pine beetle-disturbed areas during winter but selected for these same areas in summer. While the drivers of this pattern remain unclear, winter avoidance may stem from several factors: declining lichen availability as a food source, deeper snow accumulation beneath thinned canopies that hampers movement, or heightened predation risk due to altered forest structure and apparent competition dynamics. Summer selection may reflect seasonal shifts to consuming vascular plants. It may also be that factors driving winter avoidance no longer apply.



Favoured by caribou in summer

Avoided by caribou in winter



Pine beetle-disturbed areas **favoured by male moose** in both seasons

Pine beetle-disturbed areas **avoided by female moose** in both seasons

Moose have a sex-specific response to pine-beetle disturbance

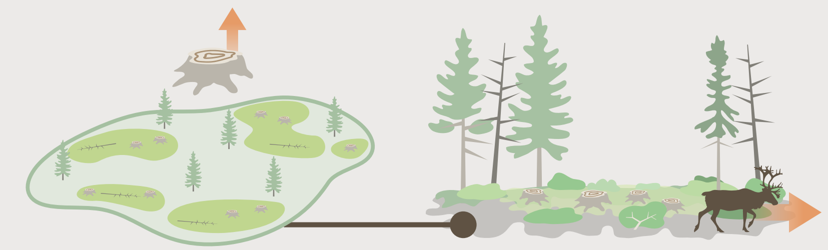
Male and female moose responded to beetle infestations in different ways but the mechanisms driving the observed response are unknown. They likely reflect differences in ecological needs, body size, and reproductive status. Female moose with calves prioritize forage quality and may seek alternative habitats such as riparian areas over beetle affected areas. Deep snow in beetle-infested areas during winter poses challenges for calves attempting to navigate the landscape. Male moose, by contrast, prioritize forage quantity over quality, potentially capitalizing on new vegetation in beetle affected areas while being less impeded by deep snow.

Responses to timber harvest and fire were complex

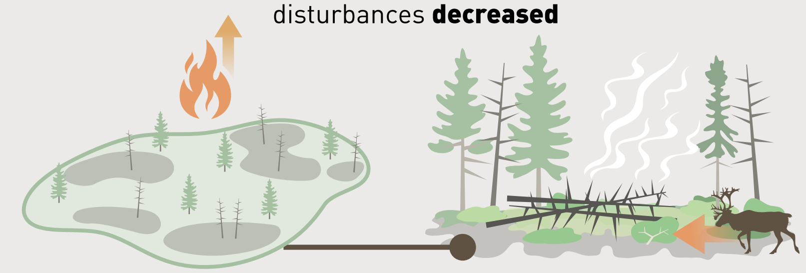
Redrock-Prairie Creek (central mountain) caribou avoided areas with higher timber harvest and fire densities, likely due to increased mortality risk and reduced lichen availability. Their avoidance of timber harvest areas intensified as harvest activities expanded across their home ranges. Interestingly, they showed reduced avoidance of burned areas as fire became more prevalent, possibly reflecting inability to avoid disturbances within constrained home ranges.

Little Smoky (boreal) caribou also generally avoided harvested and burned areas, though their response depended on overall disturbance levels and fire disturbance was rare across home ranges. As disturbance increased, caribou showed greater selection for disturbed areas. Although, with nearly 90% of the Little Smoky range already disturbed at the time of study, avoiding disturbed areas may have become infeasible.

For central mountain caribou, as timber harvest areas **increased**, avoidance of harvested areas **increased**



As fire disturbed areas **increased**, avoidance of fire disturbances **decreased**



Female moose selected areas with higher fire density, exploiting forage opportunities in burned areas. In contrast, **male moose** avoided burned areas, potentially because their larger body size makes thermoregulation challenging in open, burned summer landscapes.

Implications for Conservation and Management

Pine beetle disturbances appear to degrade winter habitat for caribou and female moose while simultaneously creating favorable conditions for male moose. For caribou, avoidance of infestations compounds human-caused habitat loss, further shrinking available range. Caribou responses to timber harvest and prescribed burns proved complex and often negative. However, Little Smoky caribou did show a small positive response to fire in summer where burning remained limited, suggesting potential value in exploring alternative approaches to beetle management such as small-scale prescribed burning, Indigenous fire stewardship practices, or targeted single-tree cut-and-burn strategies.

As climate-driven disturbances intensify, understanding nuanced wildlife responses becomes critical for reconciling economic forestry objectives with conservation needs. Effective management requires strategies that account for the species-specific, sex-specific, and seasonally variable ways that wildlife navigate increasingly disturbed landscapes.

Griffin, L. L., L. Finnegan, J. Duval, S. Ciuti, V. Morera-Pujol, H. Li, and A. C. Burton. 2025. Vulnerable caribou and moose populations display varying responses to mountain pine beetle outbreaks and management. Journal of Wildlife Management 89:e70065. https://doi.org/10.1002/jwmg.70065

Lichen hydroseeding: A proof of concept with mixed results

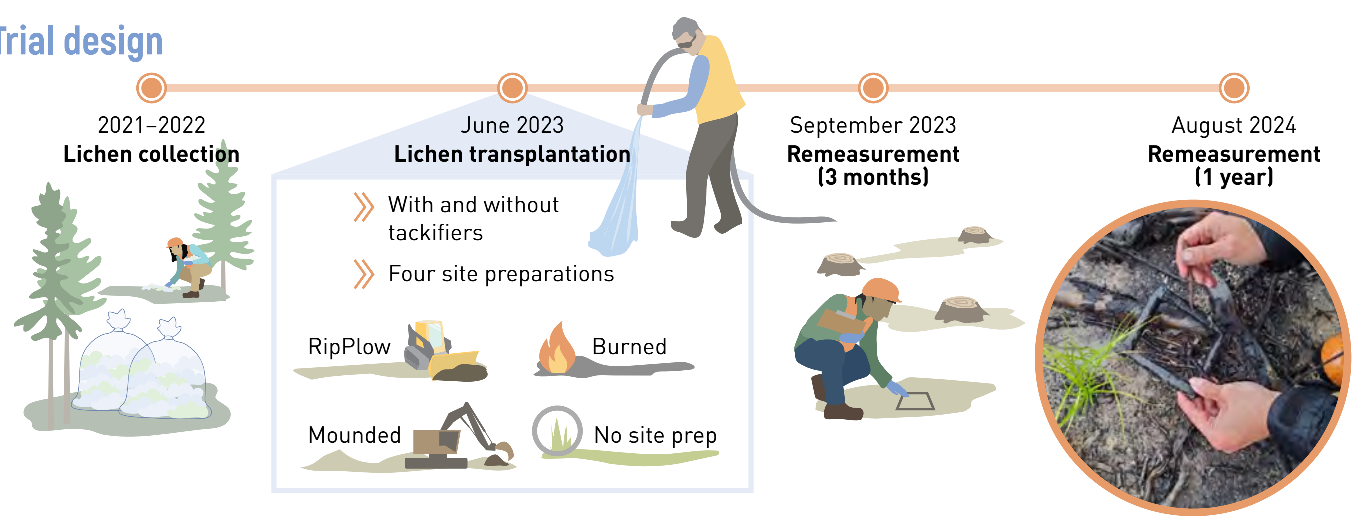
One of the strategies being explored for caribou conservation is whether and how forestry companies may restore caribou habitat in harvested (or burned) areas by transplanting reindeer lichen, an important winter food. A large, ARCKP-funded project has explored the operational feasibility and efficacy of this strategy through field and greenhouse trials and revisiting historical trials, with promising results.

However, the costs per hectare of transplanting lichen remains high. Hand application is very time consuming and requires stand access, with estimated costs ranging from $920–4,600/ha. Aerial application, while much faster and suitable for remote areas, is even more expensive at approximately $125,000/ha. In this study, the research team explored the **viability of hydroseeding for cost-effectively transplanting lichens across large areas.**

What is hydroseeding?

Hydroseeding, also called hydraulic seeding, is a technique for spraying a solution of water and seeds across large areas. Hydroseeding solutions often include "tackifiers," sticky substances that help the seeds adhere to the ground. The use of hydroseeding to distribute lichen fragments has not been previously tested.

Trial design



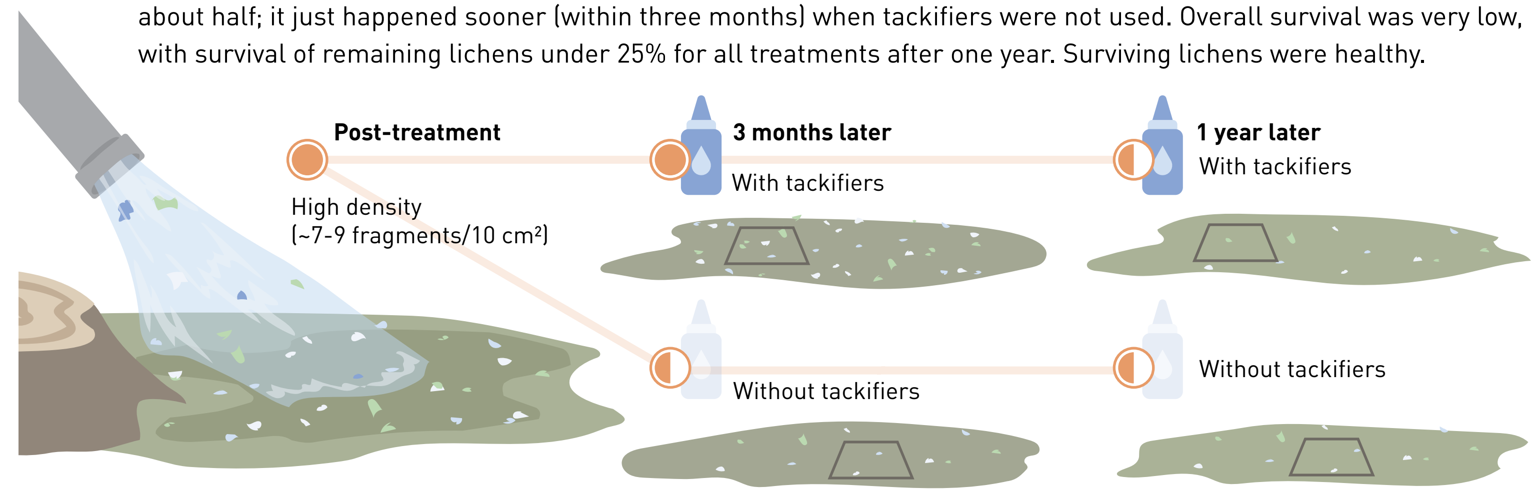
What worked: Lichens can be sprayed from a hydroseeder

The most promising outcome of this trial was that lichen fragments were compatible with the hydroseeder. Fragments were mixed with water in the tank and were sprayed through the nozzle without clogging it. An initial review immediately after application found that lichen material was evenly distributed across treatment plots.

What didn't work: Hydroseeded lichens had poor overall density and survival

While initial treatments were successful, follow-up monitoring revealed that many of the lichen fragments died or otherwise "dispersed" (e.g., were blown or washed out of the plot).

Tackifiers did not affect performance — they simply delayed outcomes. In both treatments, lichen density declined by about half; it just happened sooner (within three months) when tackifiers were not used. Overall survival was very low, with survival of remaining lichens under 25% for all treatments after one year. Surviving lichens were healthy.



What about the site preparation treatments?

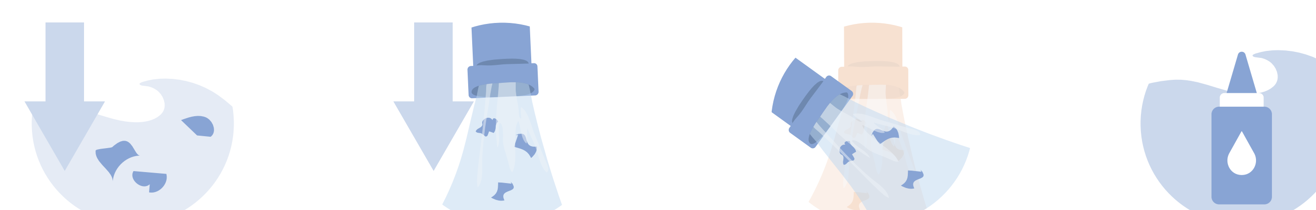
Lichen density and survival were highly variable and treatment differences could not be statistically tested. However, all treatments performed poorly overall, suggesting other factors affected lichen performance more than site preparation method.

Management implication: Feasibility will depend on achieving better outcomes for lichen

While the successful deployment of lichen fragments via hydroseeder is a positive outcome of this trial, lichen density and survival must be improved before the technique could be considered operationally.

Potential reasons for poor survival may include the time lichens spent submerged in water and physical damage from the process (e.g., agitation in the tank and impact with the ground during spraying). Researchers informally observed that lichen fragments got smaller the longer they spent in the tank, suggesting they were breaking down further.

Potential process improvements based on these observations could be explored in further trials to learn whether they improve lichen outcomes. These changes include:



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.

WHAT IS THE ARCKP?

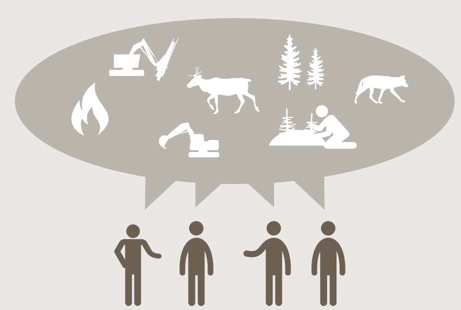
Who we are, and what we do

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.

Initiated in 2020, 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 have contributed over $1 million per year to address region-specific knowledge gaps in woodland caribou ecology.

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

Current ARCKP Partners

ANC Timber Ltd. · Tolko · Weyerhaeuser · Northland · Alberta Pacific Forest Industries Inc. · Mercer peace river · Canfor · West Fraser · Vanderwell Contractors (1971) Ltd.

ARCKP — Alberta Regional Caribou Knowledge Partnership

For more information or to contact the ARCKP, visit arckp.ca

An Association of fRI Research