ARCKP
Alberta Regional Caribou Knowledge Partnership

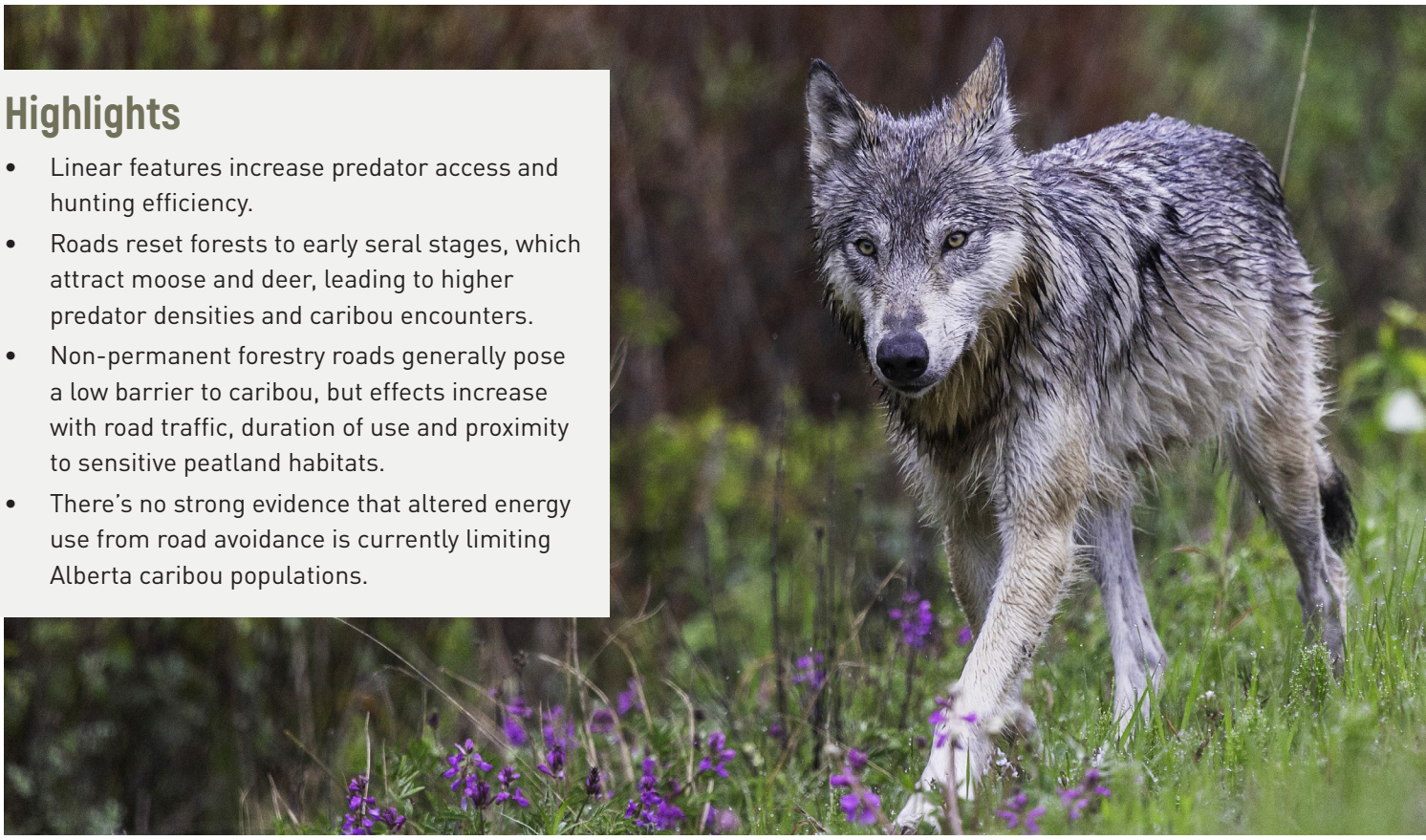
Process drivers and effects of forestry roads on woodland caribou

Temporary forestry road effects #4

Forestry roads and other linear features can alter predator-prey dynamics, fragment critical habitat and disrupt how caribou move across the landscape. These changes trigger a series of underlying mechanisms, known as "drivers", that directly contribute to woodland caribou population decline. This note focuses on five key drivers associated with non-permanent forestry roads:[1]

1. **Increased predation:** Roads change how caribou and predators move across the landscape, leading to more predator encounters.
2. **Direct human-caused mortality:** Caribou can face greater risks of poaching or vehicle collisions due to increased access.
3. **Disrupted movement:** Roads can affect how caribou use and travel through their habitat.
4. **Barriers to connectivity:** Roads can block movement between caribou populations.
5. **Altered energy use:** Avoiding disturbed areas can force caribou to expend more energy.

The primary way forestry roads contribute to caribou population decline is by facilitating increased predation by wolves through the travel corridors these linear features create.

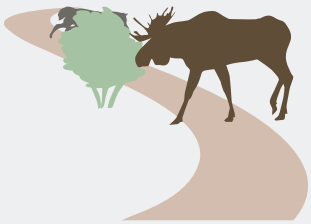
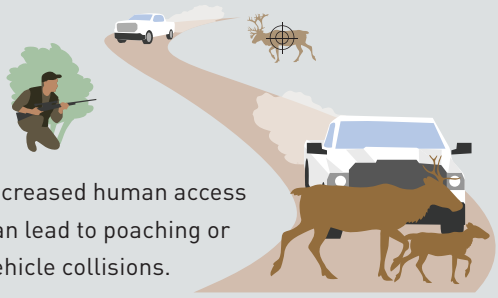
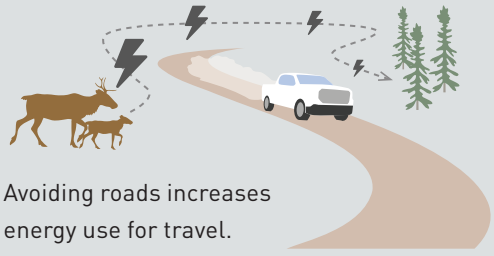


Highlights

- Linear features increase predator access and hunting efficiency.
- Roads reset forests to early seral stages, which attract moose and deer, leading to higher predator densities and caribou encounters.
- Non-permanent forestry roads generally pose a low barrier to caribou, but effects increase with road traffic, duration of use and proximity to sensitive peatland habitats.
- There's no strong evidence that altered energy use from road avoidance is currently limiting Alberta caribou populations.

[1] The findings reported in this note are based on literature review and interviews with forest industry staff.

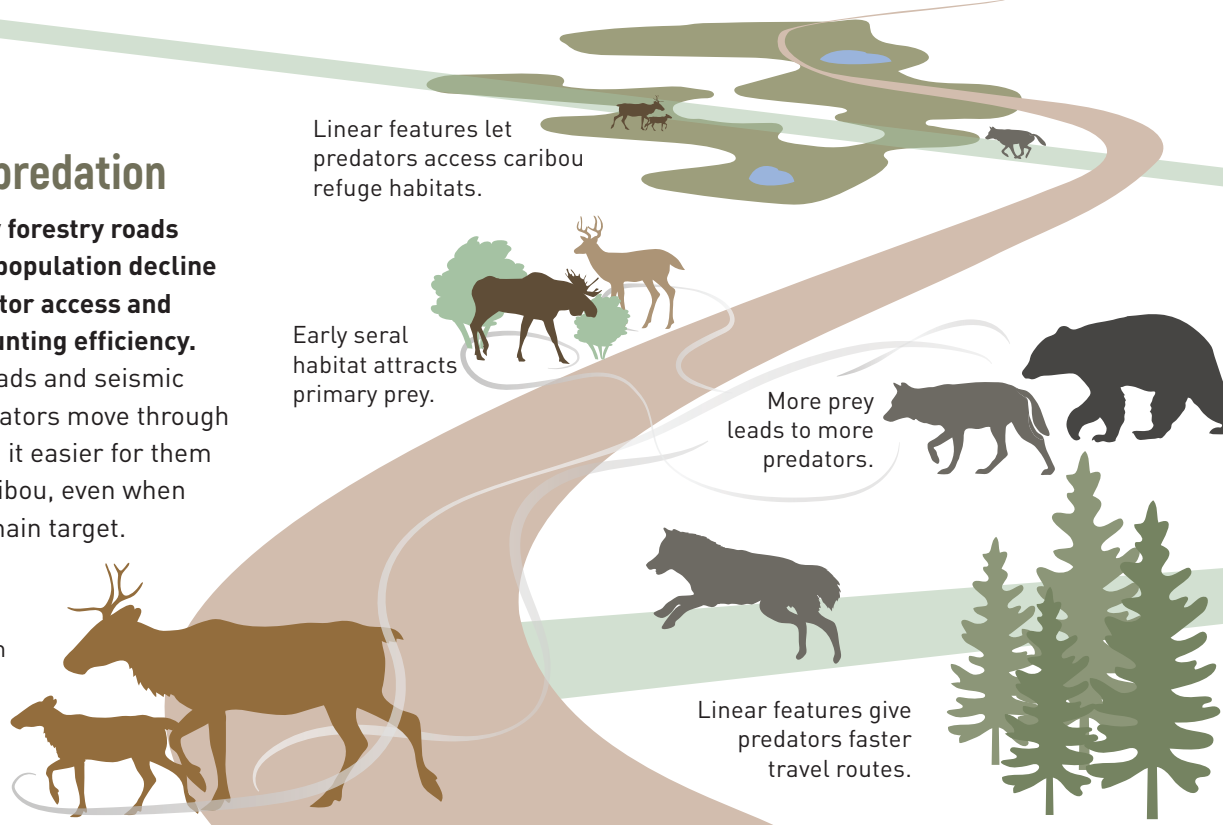
How forestry roads affect caribou: key drivers, underlying mechanisms and examples

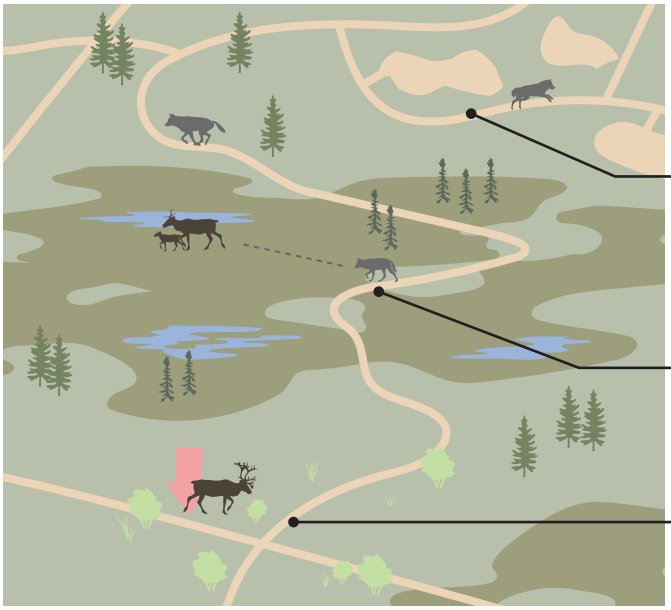
Driver	Mechanism	Examples
 **Increased Predation (Key Driver)**	**Roads improve predator travel and hunting efficiency and support primary prey expansion.** 	• **Wolves use roads to move faster and access caribou refuge habitats.** • **Moose and deer are attracted to the early seral vegetation along roads.**
 **Direct Mortality**	 Increased human access can lead to poaching or vehicle collisions.	• Caribou are more vulnerable to poaching where access is unmanaged. • Caribou are more vulnerable to vehicle collisions in areas with increased traffic.
 **Disrupted Movement & Habitat Connectivity**	 Roads interfere with seasonal movement between herds and access to key habitats.	• Caribou avoid areas with high traffic. • Movement between herds may be restricted in late winter.
 **Altered Energy Use**	 Avoiding roads increases energy use for travel.	• Caribou may need to detour around roads, leading to energy loss.

See Note #1 in this series for a table outlining the magnitude and duration of forestry road effects on caribou by driver and road type.

Increased predation

The primary way forestry roads contribute to caribou population decline is by increasing predator access and improving predator hunting efficiency. Linear features like roads and seismic lines change how predators move through the landscape, making it easier for them to find and prey on caribou, even when caribou are not their main target.





Predators are more successful in landscapes with dense road networks. Caribou mortality increases not only with the amount of disturbance, but also with how roads and harvest areas are arranged:

- High road densities are especially harmful when they cover large areas. While roads may benefit caribou for movement or foraging at small scales, broad-scale road networks reduce caribou survival.
- Peatlands no longer function as refuges from predators. Linear features allow predators to access peatland areas more easily and hunt more effectively.
- More edge habitat means fewer caribou. Caribou survival and herd persistence are lower in areas with high densities of linear disturbances.

Direct mortality

Roads increase human access, which can directly contribute to caribou mortality through poaching or vehicle collisions.

- **Non-permanent forestry roads pose a relatively low risk** of vehicle collisions, with few incidents reported on lower-class inter-block roads (class 4 and 5).
- **Poaching risk may still increase** in areas with higher human access, particularly if access is not actively managed or limited.

Disrupted movement and habitat connectivity

Forestry roads can affect how caribou move across the landscape. Roads with moderate to high traffic (i.e., 780 or more vehicles per day) may begin to interrupt seasonal movement, particularly in late winter. Recreational ATV and snowmobile use can further reduce caribou habitat use even when access is gated.

Non-permanent forestry roads generally do not interrupt caribou movement, but their effect increases with traffic levels and duration of use.

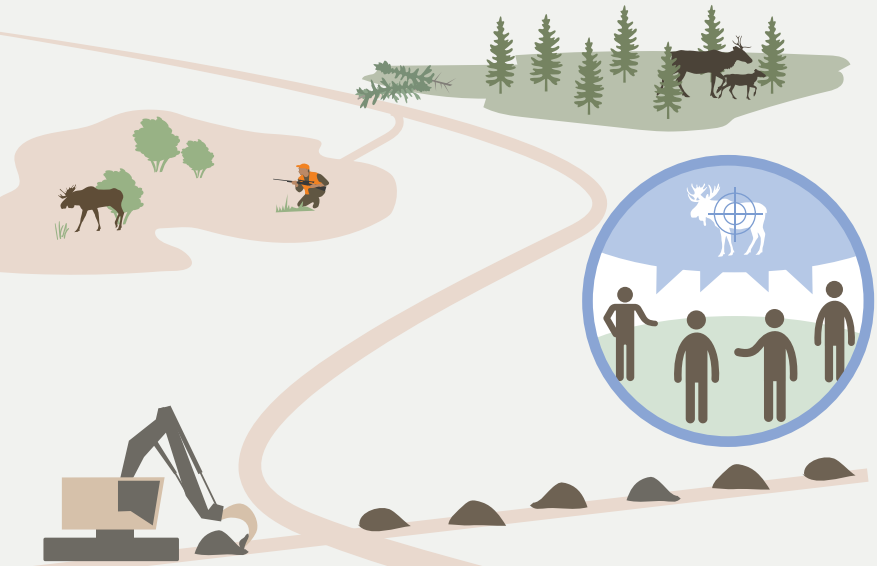
Habitat degradation is another process linked to disturbance from roads. In peatlands especially, roads can disrupt drainage, leading to vegetation changes such as tree dieback. These changes can affect the quality of habitat resources like food and cover.

Altered energy use

Caribou may avoid roads and other linear features, which can lead to longer and less efficient travel between habitats. This additional energy use could affect caribou health, survival or reproduction. However, **there is no strong evidence that altered energy use due to road avoidance is currently a limiting factor for Alberta caribou populations**.

Practical Implications

To reduce the effects of key drivers of caribou decline linked to forestry roads, consider:



- **Leaving access open to hunters** in appropriate areas to help manage moose and deer populations and reduce predator-caribou encounters.
- **Developing collaborative access and hunting programs** with Indigenous communities that support sustainable prey and predator management in caribou ranges.
- **Focusing on road reclamation** to limit long-term predator travel corridors and reduce caribou encounter rates. *See Note #1 in this series for specific reclamation practices.*
- **Avoiding roads through peatlands wherever possible**. Roads can enable predator access into sensitive caribou habitat, and they can alter hydrology and vegetation in ways that degrade habitat quality. *See Note #3 in this series for additional considerations related to peatland road planning.*

Implications Summary

- Leave strategic access to hunters
- Collaborate with Indigenous communities (access, hunting)
- Focus on road reclamation
- Avoid roads through peatlands

Future considerations

- **Maintaining hunter access** on select roads to support moose and wolf management during early recovery phases and create opportunities for collaboration with Indigenous partners.
- **Monitor high-use access roads** for vehicle-related risks, especially during sensitive periods. *See Note #1 in this series for guidance around seasonal timing and mitigation strategies.*
- **Track recreational use and unauthorized access** (e.g., ATVs, snowmobiles) to better understand traffic on forestry roads that may deter caribou use or increase risk of habitat fragmentation.

Further reading

The following resources provide additional context and evidence for the key drivers of caribou decline discussed in this note.

ABMI. 2011. Assessing the influence of industrial development on caribou (Rangifer tarandus) in the Lower Athabasca Planning Region of Alberta.

Bentham, P., Dickie, M. and Wilson, S. 2022. Boreal caribou ecological model technical report (DRAFT).

Dickie, M., et al. 2016. Faster and farther: Wolf movement on linear features and implications for hunting behaviour. Journal of Applied Ecology.

Dickie, M. et al. 2017. Evaluating functional recovery of habitat for threatened woodland caribou. Ecosphere.

Dickie, M., et al. Evaluating the impact of caribou habitat restoration on predator and prey movement. Conservation Biology.

ECCC. 2020. Amended recovery strategy for caribou (*Rangifer tarandus caribou*), boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138 pp.

Golder Associates. 2015. State of the science. 2014 update (biology, impact pathways, and next steps; Alberta and British Columbia). Submitted to the Canadian Association of Petroleum Producers Species Management Committee.

James, A.R.C. 1999. Effects of industrial development on the predator-prey relationship between wolves and caribou in northeastern Alberta. Ph.D. Thesis, University of Alberta.

James, A.R.C and Stuart-Smith, A.K. 2000. Distribution of caribou and wolves in relation to linear corridors. Journal of Wildlife Management.

James, A.R.C. et al. 2004. Spatial separation of caribou from moose and its relation to predation by wolves. Journal of Wildlife Management.

Latham, A., Latham, M. and Boyce, M. 2011a. Habitat selection and spatial relationships of black bears (*Ursus americanus*) with woodland caribou (*Rangifer tarandus caribou*) in northeastern Alberta. Canadian Journal of Zoology.

Latham, A. et al. 2011b. Movement responses by wolves to industrial linear features and their effect on woodland caribou in northeast Alberta. Ecological Applications.

Mumma, M. et al. 2019. Functional responses to anthropogenic linear features in a complex predator-multi-prey system. Landscape Ecology.

Nagy, J.A. 2011. Use of Space by Caribou in Northern Canada. Ph.D. Thesis, University of Alberta.

Serrouya, R. et al. 2021. Trophic consequences of terrestrial eutrophication for a threatened ungulate. Proceedings of the Royal Society B: Biological Sciences.

Tigner, J., Bayne E. and Boutin, S. 2014. Black bear use of seismic lines in northern Canada. The Journal of Wildlife Management.

Tracz, B., et al. 2010. Annual and monthly range fidelity of female boreal woodland caribou in response to petroleum development.

Willier, C.N. et al. 2022. The extent and magnitude of edge effects on woody vegetation in road-bisected treed peatlands in boreal Alberta, Canada. Ecohydrology.

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