# Caribou and Wind Turbines (Kivalliq Region)

An Overview of Available Information

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Reindeer at Storheia Wind Farm, Norway

Photo Credit: Getty Images/Heiko Junge

#### What information is readily available?

Not a lot specifically on caribou and wind turbines!

#### But considerable amount of info on disturbances

#### SOURCES

- Peer-reviewed papers
- Other information
  - Traditional knowledge, meeting reports, newsletters, news media, interviews, reports, government publications, etc.)

#### SEARCH RESULTS

- Annotated Bibliography (peer-reviewed sources)
- Annotated List (for other)

#### **ORGANIZATION (each document)**

- 1 Caribou and Wind Turbines
- 2 Caribou and Power Lines
- 3 Caribou and Roads
- 4 Caribou and Cumulative Effects Including Mining
- 5 Traditional Knowledge of Caribou and Disturbances
- 6 Caribou in the Kivalliq
- 7 Recommendations for Minimizing Disturbance to Caribou

### Effects of Disturbances on Caribou/Reindeer

Block, delay or deflect movements

Fragmentation of herd

Reduced high-quality grazing (affecting lactation, body weight, and reproduction)

Increased predation

ZOI **Zone of Influence: the** distance at which caribou change their behaviour, habitat selection and distribution relative to disturbance. This changes with season, herd composition, insect and climate conditions, water sources, etc.

Stages of Wind Turbine Projects

- Planning and Siting
  - Winter Roads
  - Activity, Vehicles
  - Noise
  - Dust
- Construction
  - Roads
  - Activity, Vehicles
  - Noise (could include blasting)
  - Power Lines
  - Dust
- Operation and Maintenance
  - Operational noise
  - Power lines
  - Roads
  - Low-flying aircraft (monitoring)
- Decommissioning
  - Roads,
  - Activity, Vehicles
  - Noise
  - Dust

How disturbances affect caribou behaviour



- Semi-domesticated reindeer have similar avoidance patterns of large-scale avoidance as wild Rangifer (strength of their response may differ) (Northwest Territories Wildlife Service, 1979)
- <u>But</u> Scandinavian studies may not be fully relevant to the situation in NU. Scandinavian reindeer, many of whom are herded, are not as harassed by predators as caribou here, and have had several generations to get used to the turbines (Campbell, 2022)
- Migratory animals are more likely to be alarmed at items on their route than sedentary ones (Campbell, 2022)
- Scale is important. Groups of animals tend to avoid disturbances far away but locally, individuals may not show much disturbance if in good feeding area (Cameron et al., 1992)
- Effect of a disturbance depends on it
  - presenting a physical barrier
  - "seeming" to be a physical barrier (even if not)
  - altering landscape in a way which appears threatening (Northwest Territories Wildlife Service, 1979)
- Caribou and reindeer usually avoid human activity more than a constructed disturbance (Wasser at al., 2011)
- On regional scale, reindeer may avoid infrastructure, but this may not be true locally (Skarin and Alam, 2017)
- Large groups of animals are more likely to have an avoidance reaction to an obstruction than single ones or small groups. Females and calves are especially avoidant of infrastructure during spring and summer, reducing later in summer (Johnson et al., 2019)
- Yearlings and adult males seem less sensitive to human-made disturbances (Nellemann and Cameron, 1998), especially during insect season (Wolfe et al, 2000)
- During times of insect harassment, caribou are more likely to cross roads and obstructions (Prichard et al., 2020)
- In rutting season, or in fall migration, caribou are less sensitive to disturbances (Leblond et al., 2011)

Photo credit: Hidehiro Otake https://www.ontario.ca/page/woodland-caribou-conservation-plan

1 MW Turbines planned for Baker Lake, Arviat and Rankin Inlet.





#### Caribou in Kivalliq (Rangifer Tarandus Groenlandicus)

-Vital to Indigenous peoples and to ecosystem

-Both Beverly and Qamanirjuac herds have decreased in numbers in last decade



Maps: Kivalliq Ecological Land Classification Map Atlas https://www.gov.nu.ca/fr/node/21752

# Wind Turbines



- North American info lacking (despite Alaska having numerous turbines)
  - · Canada: Literature on disturbances exists but none was found specifically on wind turbines
  - Existing Large Northern wind turbines near caribou:
    - Diavik Mine NWT (4 @ 2.3 MW s) no impacts noted by Diavik monitoring (Boa-Antwi, 2021)
    - Raglan Mine QC (2@ 3 MW ) no info found in my search
- Scandinavia-Info is for semi-domesticated reindeer (migratory).
  - Sami herders say sight and sound of turbines scare their reindeer, who may scatter and lose good quality forage areas (Kater et al., 2021)
  - Scientific research studies showed various results.
    - Effects from wind farm depend on farm size (Helldin et al., 2012)
    - Reindeer in enclosures had no negative effects from nearby turbine-noise did not bother them (Flydal et al., 2004)
    - Colman et al. (2012) showed "no barrier effect" from nearby windpower plant in Norway
    - Reindeer avoided a wind farm during construction, reducing their movement within 2 km of development by 75% (Skarin et al., 2015)
    - Another study found that reindeer may "temporarily avoid wind farms" during construction (Helldin et al., 2012)
    - A further study noted that the operational phase of small wind farm had stronger (negative) effect on reindeer than the construction (due to operational noise?) (Skarin et al., 2018)
    - Skarin and Alam (2017) noted increased habitat use at a wind farm during operation (perhaps being on migratory route), but suggested "overall avoidance" of wind farms during operation
    - Reindeer shifted home range when turbines visible (versus obscured by landscape) (Skarin et al., 2018)
    - Researchers suggested turbines may have less negative effect if built in areas of poor habitat (at least for reindeer) (Colman et al, 2012)
    - Calving caribou tend to avoid wind farms (Norway) (Prichard et al., 2020)

### **Power Lines**



- Noise: Caribou hear power line corona noise above 250 Hz (high voltage lines) (Flydal et al., 2010)
- UV corona effect: Caribou see into UV range and probably see lines at night as bright, possibly flashing, lights (Carrington, 2014)
- Electromagnetic: No evidence of electromagnetic effects (Manitoba Hydro, 2010)
- Physical Corridor: Where cleared rights-of-way make predator (e.g., wolf) travel easier, caribou travel further away than normal (James and Stuart-Smith, 2000)

#### Some studies exist from Norway

- A study of wild and domestic reindeer in enclosures near power lines showed no disturbance (or minor compared to the human effect!) (Flydal et al., 2009)
- Some studies showed little evidence of behavioural disturbance of wild reindeer under power lines (Bartzke et al., 2014) yet others showed they preferred to stay at least 4 km away (this may be due to human activity along lines) (Løsnes, 2016)
- Canadian report from Manitoba Hydro, 2010
  - Found no ill effects of power lines on animal/plant health, productivity, or behaviour
  - Recommends care at siting lines near water crossings

Photo Credit: David Latham https://www.researchgate.net/publication/275524181\_Impacts\_of\_Utility\_and\_Other\_Industrial\_Linear\_Corridors\_on\_Wildlife

### Roads



- Overall, studies show caribou prefer to avoid roads (even if no traffic, the "linear feature itself" and the height of road are deterrents) (DeMars and Boutin, 2017)
- Volume and type of traffic affect response (NWT Wildlife Service, 1979)
- Late winter movement and spring migration shows greatest effects as caribou speed is greater (Dyer et al., 2002)
- Several Canadian Studies exist at northern mines (Ekati, Meadowbank, Meliadine, etc.). Zones of influence ranged from 5 km to over 50 km (during road construction) (Boulanger et al., 2021)
- Alaska study at Red Dog Mine site showed some animals walked an extra 100 miles to avoid crossing...slow crossers had to speed up to catch up...some animals never crossed (Wilson et al., 2016)
- Seismic lines do not appear to hamper movement (Dyer et al., 2002)
- Elders note that the behaviour of leaders has large impact on herd road (and water) crossing behaviour (Rosen and News, 2016).

Photo Credit: Hart River Woodland Caribou Herd https://www.gettyimages.ca/detail/photo/hart-river-woodland-caribou-herd-yukon-dempster-royalty-freeimage/982118272?adppopup=true

# Cumulative Effects



- Adding a turbine within a community or minesite which already has an effect (Zone of Influence) on caribou will have less negative effect than placing a turbine in a location away from the existing development (Campbell, 2022)
- Complex/hard to separate disturbance effects from natural variation in caribou behaviour and land use (Adamczewski et al., 2008)
- Caribou and reindeer are more likely to adapt or habituate to disturbances if they are resident (and not passing through on migration) (NWT Wildlife Services, 1979)
- Caribou will spend more time near (within a few kilometres) of mines or disturbances during summer, fall and winter, but not during calving or past-calving (Poole et al., 2021)
- Female caribou are particularly leery of disturbances and stay further away all the time than males, but especially during calving. In North Slope Alaska, as development grew, female caribou moved calving areas inland (Nellemann and Cameron, 1998)
- As animals deflect or avoid, grazing pressure can increase outside the zone of influence (Vistnes and Nellemann, 2001)
- Dustfall from construction or mines is added deterrent (Wek'èezhìu Renewable Resources Board, 2017)

# Traditional Knowledge



- Workshops and consultations with elders can inform development
- At a workshop on the Bathurst Herd, participants noted how caribou moved from the area around mines and even relocate to North Saskatchewan to avoid the "line" of developments north of Yellowknife (Government of the Northwest Territories, 2016)
- Elders in Rankin Inlet noted that caribou avoided Rankin Inlet Nickel mine at first (during blasting) but some came back. They noted caribou decrease (an continued avoidance) of Meliadine mine (Tartak et al., 2019)
- Elders in several communities commented that the caribou leaders (or "vanguard" animals) were important in determining herd responsescrossing water, changing routes if disturbance found, or choosing location to overwinter (Kendrick et al., 2010)
- Elders said that females usually led the spring migration but there was little agreement about who led the fall migration (Padilla, 2010)
- Łutsël K'e Dene noted the Ekati mine had "screwed" up migration patterns, and allowed non-Indigenous hunters better access. They also noted caribou injured their legs crossing mine roads (Parlee et al., 2018)



- Proposed Nunavut Land Use Plan recommends protection of calving areas, post calving areas, and caribou key access corridors from
  - a) oil and gas exploration and production; (b) mineral exploration and production; (c) quarries; (d)
    hydro-electrical and related infrastructure; (e) wind turbines for electrical generation that are over 15 m in height and related infrastructure; and (f) linear infrastructure.
  - All uses at sites must stop during certain date ranges depending on herd, for example, Beverly Herd:

June 6 to July 8, during calving (Draft Nunavut Land Use Plan, 2021)

Kivalliq Inuit Association (KIA) would prefer "mobile" conservation measures instead of the Draft Plan's Limited Use areas. They support seasonal restrictions on core calving areas (which they wish to be remapped) and some Limited Use areas around seasonal crossings (Kivalliq Inuit Association, 2021)

Siting



- Suggest a "mock-up" study with temporary towers before the main installation is sited and built to note effect on caribou (and other wildlife) (Campbell, 2022)
- Each case is different-monitoring "before-after-control-impact" (BACI) is highly recommended (Gartmann et al., 2016)
- Use traditional and local knowledge
- Place temporary roads and camps out of sight of caribou if possible, and away from forage (Wasser et al., 2011)
- Choose locations which do not present resistance to movement (Gartman et al., 2016)
- Place turbines where they are least visible to caribou (Wasser et al., 2011)
- Use the fewest turbines possible (Gartman et al., 2016)
- Curtailment (of construction, operation or maintenance) during migration, calving, or times when a certain number of animals are present (Gartman et al., 2016)

Photo Credit: Rob Monteith https://sd-windenergy.com/wind-turbine-news-events/sd-wind-turbines-power-new-arctic-research/

Construction



- Plan construction when animals are not there (Gartman et al., 2016)
- Roads, foundations, and power lines will be built before or concurrently with the turbines consider these disturbances too (access to water, need to cross road or pipeline, traffic velocities and quantity, etc.) (May et al., 2017)
- Restrict activity or movements during times or seasons where sensitivity is greater (Gartman et al., 2016)
- Limit the spread of human activity outside the area (Gartman et al., 2016)
- Minimize number of roads and the traffic on them (Wasser, 2011)
- Minimize type and frequency of noise that most bothers caribou (Flydal et al., 2010).
- Noise studies on various wildlife for the Mackenzie gas pipeline showed that caribou response varies with "season, the type of stimuli, and the sex and age class, group size, and previous experience of the animals", with spring being the season of most sensitivity. Researchers found that caribou can be "reasonably tolerant of human activities" (AMEC Americas, 2005).
- ...And Decommissioning-similar to construction phase

Photo Credit: Aeolus Wind Turbine LLC https://www.windturbinestar.com/wind-turbine-construction.html

# Operation and Maintenance



- Curtailment of operation or activities when caribou present or passing through (Gartman et al., 2016)
- Minimizing aircraft flights for monitoring of power lines and other infrastructure (Manitoba Hydro, 2010). Avoid low-flying aircraft (Calef et al, 1976)
- Contain activity to immediate area

# Conclusion



- Vital to protect the caribou from disruptive development
- Consultation .. And more consultation!
- May have to compromise siting from absolute best for wind speed to accommodate wildlife
- Since there is little "hard" information about wind turbines and their effect on caribou it is important to be careful and flexible when planning an installation (Gartman et al., 2016)
- Consider the "accessory" disturbances and effects-seasonal, yearly, noise, dust, vehicles, people, insects, climate change, etc.
- A prior study (mock-up) of turbine effect on caribou is suggested (Campbell, 2022)
- If a turbine is built, a "case" study of before, during, and after would be extremely useful for mitigation purposes and future projects:
  - consistent and accepted definitions and study methods
  - regional and local scale,
  - multi-year, multi-season,
  - analyzed for cumulative effects

Photo Credit: Peter Mather https://cpawsyukon.org/porcupine-caribou/

# Thank you!



Photo Credit: Bruno Croft GNWT https://wwf.ca/stories/13-caribou-facts-herds-risk-disappearing/

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