Monitoring Method 1

GPS Collars

Radio and GPS collars may be the most important monitoring technology developed in the last 50 years. They provide us with almost endless amounts of data.

The use of the collars does require that animals be captured and fitted with a tracking device. As such, some people have expressed concerns that collars may impact the health of the animals. Current systems are being refined and alternatives are being explored.

While the technology can be expensive, the costs of GPS tracking have historically been cheaper than other options.

Collars can be used to monitor movement, behaviour, health, and environmental context. Researchers can use data from a number of disciplines to better understand the factors that impact caribou throughout the year.

Many collars used today weigh 0.8 kg, much less than older collars, which weighed well over 1 kg.

Collars help us identitfy peak calving times and locations, which improve the efficiency and effectiveness of surveys.

Collaring Process

Nets launched from helicopters are generally used to catch caribou for the collaring process. This does entail some risk of injury or death for the caribou but it is considered to be less stressfull and less likely to harm the caribou when compared to other forms of immobilization.

Once the caribou are caught in the net, they are blindfolded to relieve stress, hobbled, and their heart rate is monitored to ensure it goes down to a normal level. A collar is quickly placed on the animal, some health-related observations are recorded (this may include biological samples such as blood or hair) before the animal is released as quickly as possible.

The complete report can be found at:
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GPS collars have been shown to be effective tools for monitoring of caribou.

GPS collars are the cheapest proven method for monitoring the movement of caribou. The data collected through the use of collars significantly reduces the cost of caribou population surveys.

Monitoring Method | 2

Remote Sensing

The advantages of remote sensing include the ability to collect information over large areas; to characterize natural features or physical objects on the ground; to observe surface areas and objects on a systematic basis and monitor their changes over time; and the ability to integrate this data with other information to aid in decision making.

High resolution remote sensing images can be used to detect individual animals. Most of the research to date applies these technologies to larger animals that are easily spotted and are not spread over a large range. It is possible that they could be used to monitor caribou as the the technology is improved with paired with artificial intelligence systems, which are used in the analysis of remote sensing data.

Spotting Individual Animals

Individual animals have been successfully spotted using remote sensing systems but animal detection over large areas has, until recently, only been successful when there is a high contrast between the landscape and the animals, and even then there were a significant number of errors, which required the researchers to manually confirm each sighting.

With the rapid development of computer-supported image recognition, it is possible to count large animals in aerial photos within 1% of expert counts with less processing time, demonstrating that the combination of remote sensing and deep learning techniques can enable automatic/semiautomatic, accurate, inexpensive, and efficient animal surveys.

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Remote sensing can help us understand changes in species movements by looking at shifts in land use and changes in the availability of forage which may impact migrations.

It can also be used to help design better protected areas, looking more comprehensively at how to manage land inside and outside protected areas in order to better achieve conservation goals.

Data from satellites can help us understand caribou distribution and abundance.

Remote sensing has been shown to be effective at smaller scales but may not function as reliably at the scales needed for monitoring caribou.

The cost of remote sensing data covering the range of a barren-ground caribou herd is decreasing but is still expensive.

Monitoring Method | 4

Fecal Sampling

Caribou fecal samples are used as a source of DNA for the study of population demographics.

Collection of pellet samples takes place when snow is present to allow for tracking and location of caribou cratering areas and to obtain good quality DNA. Samples can be collected in conjunction with local community-based monitoring projects. This field work can be labour intensive and may require expensive air charters but the relatively high cost of collecting the samples may be offset by the rich health and population data produced.

On top of the DNA data that is collected through fecal sampling, the pellets can provide valuable information on the winter diet of barren-ground caribou. The winter forage quality can affect adult survival, timing of birth and calf survival.

Fecal samples have also been used to determine sex-specific characteristics, pregnancy rates, group composition, and measures of physiological and nutritional stress.

Fecal samples can provide a wealth of data about caribou populations.

Collecting fecal samples can be labour intensive and may require expensive air charters.

Challenges and Feasibility

While this methodology has been effective for monitoring smaller populations, the feasibility of scaling this methodology up to barren-ground caribou still needs to be assessed. It is possible that there is an upper limit for reliably estimating large populations and, as such, it may not work for large migratory caribou herds.

Fecal sampling may offer a whole new way of understanding caribou populations but it takes a long time to process the samples. As such, data may not be provided with the immediacy that decision makers require.

Fecal sample surveys can be very expensive as they often require a survey flight with a fixed-wing aircraft for spoting caribou locations followed by a helicopter flight to aquire samples.

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Monitoring Method | 3

Drones (UAV)

Drones, or Unmanned Aerial Vehicles (UAVs), can provide remote sensing data similar to that which comes from other systems (airplanes, helicopters and satellites).

UAV technologies have significantly advanced and are becoming increasingly more available and affordable, making them cost-effective option over traditional aerial surveys.

Despite the benefits of UAV systems, there are some issues, such as the extensive amount of work needed to analyze the data collected. This can negate any convenience or time savings compared to traditional survey methods. Additonally, most current UAV systems are limited in range and cannot effectively cover study areas as large as what are currently used for monitoring caribou.

Smaller quadcopter drones may be used in some instances but they are very limited in range and flight time.

The term “drone” can refer many things. While most people picture a quadcopter, larger fixed-wing drones are more likely to be used in surveys that cover large study areas.

The Future of UAVs

UAVs tend to be limited in range but there is some potential for longer or even indefinite flight times with lighter-than-air vehicles with onboard solar chargers.

Currently, gas-powered fixed-wing UAVs, can have flying times up to 8 hours. These UAVs may provide a level of flexibility that is not achievable through satellite-basedremote sensing.

This technology will likely replace the traditionally aerial survey that is currently used for caribou population surveys in the future.

UAVs have been shown to be effective at smaller scales but do not yet have the range needed for monitoring large caribou ranges.

Large fixed-wing UAVs can cost millions of dollars. Over its lifetime this may be cheaper than the equvialent cost of the aerial surveys it would be replacing.

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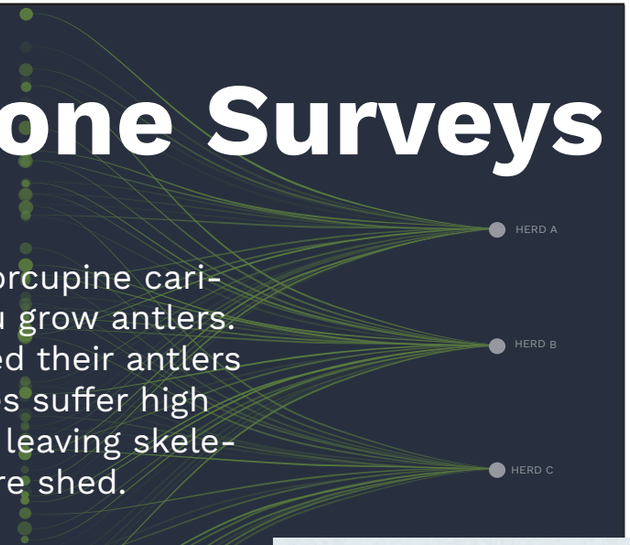
Monitoring Method 5

Antler & Bone Surveys

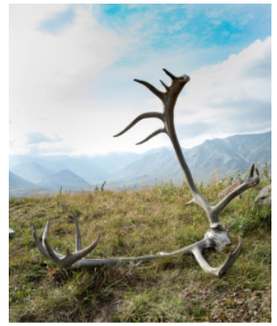


Antler shed and bone surveys have been utilized in the Porcupine caribou herd's calving grounds. Both male and female caribou grow antlers. Bulls shed them after the rut, while pregnant females shed their antlers a day or two after giving birth. Additionally, newborn calves suffer high mortality rates in the first couple of days after birth, thus leaving skeletal remains in the same areas where the female antlers are shed.

These antlers and newborn skeletal remains offer a unique biological signal for understanding calving activity. These types of surveys are able to provide historical data, as bones and antlers may be preserved for millennia in the cold conditions common to the calving grounds.

As with the fecal sampling technique this type of survey is labour intensive and may be too expensive in areas where monitors require expensive charter flights to access the calving grounds.

DNA can be collected from antlers and bones that are found on the land. DNA samples can be used to show changes in the caribou population over long periods of time as the antlers may accumulate over thousands of years on the land.



This method of sampling is non-invasive, so it does not cause any stress to the caribou.

Challenges and Feasibility

While this methodology has been effective for monitoring smaller, discrete populations, the feasibility of scaling this methodology up to barren-ground caribou still needs to be assessed. It is possible that there is an upper limit for reliably estimating large populations and, as such, it may not work for large migratory caribou herds.

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This survey method won't replace the current methods for monitoring caribou but may be used in conjuction with some of the newer methods to provide a more robust understanding of the caribou population.

These surveys can be very expensive as they often require a large ground survey on caribou calving grounds. These calving grounds are generally in remote locations that are expensive to access.

Monitoring Method 6

Traditional Knowledge
and community-based monitoring

Data from community-based monitoring programs can remarkably improve the knowledge of the wildlife which sustain our communities. Community-based monitoring programs (CBMPs) draw on both traditional and western scientific approaches. The programs provide opportunities for contributing and analyzing observations and identifying monitoring priorities. Co-production approaches draw on local knowledge systems and scientific methods to develop novel questions and interpret data based on multiple ways of knowing.

It has been repeatedly shown that local knowledge holders can provide high-quality data on the health and status of wildlife. Status decisions can be made in years where there is limited, or no scientific data presented for some of the monitoring criteria. It is certainly possible that TEK could provide the bulk of the direct observations for the monitoring criteria.

The key to acquiring good TK is the development of strong relationships. These take time to develop and require mutual trust and understanding. Long term monitoring programs foster trust between researchers and knowledge holders by providing them opportunities to collaborate.

Traditional Knowledge can provide high-quality data on the status of caribou.

How can TK be used to monitor caribou?

CBMPs provide opportunities for contributing and analyzing data, as well as identifying monitoring priorities. Drawing on local knowledge systems and scientific methods help to develop new questions and interpret data based on multiple ways of knowing.

In some cases habitat models developed with the local knowledge holders performed better than models developed solely from scientific observations.

TK and community-based monitoring have been shown to be feasible, but there are still significant challenges involved in fitting community observations into frameworks that tend towards a reliance on scientific observations.

The current challenge lies in the inconsistent funding of these programs and the ongoing need to improve how community-based knowledge is used in the management process.

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Other Technologies

The methodologies selected for investigation in the report were chosen based on the potential for use with barrenground caribou and the interests of the stakeholders that were inteviewed in the early stages of the project.

There were plenty of other technologies that have some potential for helping is monitor caribou that weren't incuded in the report. These include new and emerging technologies that could be used in the future, as well as tried and true systems that are used in other contexts that haven't been shown to work at the scale needed for the barrenground caribou. These are some examples of technologies that piqued our interest but weren't included in the report.

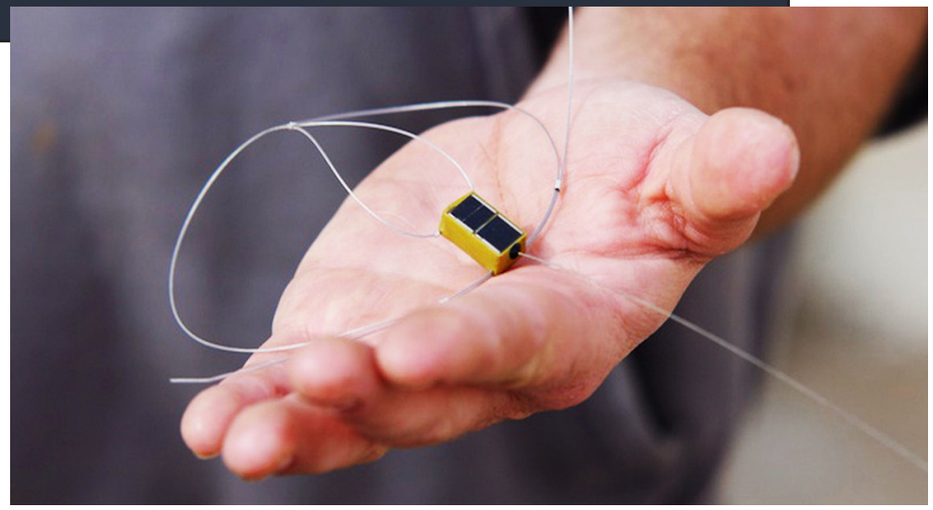
Audio and Image Recording Units

These units may have some potential uses for monitoring caribou but they require a lot of resources to deploy and to analyse the data produced.

Current methodologies using these units don't address enough of the ACCWMs monitoring criteria to consider these a potential replacement for GPS collars.

Small GPS Tracking Units

Micro-GPS trackers, such as the ones that are used for monitoring small birds, currently only have batteries that last a small fraction of the time that standard caribou collars last. Also, these units are quite vulnerable to the temperatures experienced by caribou.



Additionally, the small batterieries limit the amount of transmitable data and the manner in which it is transmited.

The short battery life and fragility of the units would mean that more caribou would need to be tagged in order to collect similar amounts of movement data as is currently collected via GPS collars.

Geo-Fencing

Geofencing is a location based technology enabling many different researchers to accurately track when an animal has entered or exited the virtual geofence.

Researchers place a virtual geo-fence around a particular boundary and when the animal travels across that boundary, an alert is sent to the researcher. This can provide valuable data, including migration timing and herd fidelity.

As this technology requires the animals to carry a transmittor, it was not considered as a replacement for GPS collars.

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