

NWT Environmental

Research Bulletin (NERB)



NWT Cumulative Impact Monitoring Program (NWT CIMP)

A source of environmental monitoring and research in the NWT. The program coordinates, conducts and funds the collection, analysis and reporting of information related to environmental conditions in the NWT.

NWT Environmental Research Bulletin (NERB)

A series of brief plain language summaries of various environmental research findings in the Northwest Territories. If you're conducting environmental research in the NWT, consider sharing your information with northern residents in a bulletin. These research summaries are also of use to northern resource decision-makers.

Caribou, Mining Operations and the “Zone of Influence”

The “Zone of Influence” (ZOI) refers to the distance at which caribou change their behaviour due to the influence of an industrial development such as a mine. Observations by researchers and NWT community members suggest there are several environmental changes related to mining activities that might contribute to the ZOI, including visual disturbances, noise and air emissions. This study explored methods to measure these changes at the Ekati diamond mine in the hopes of gaining a better understanding of the causes of the ZOI.

Why is this research important?

Measuring the ZOI is important because it can be used to track the impacts to caribou of avoiding industrial development. Several studies have estimated the size of the ZOI of mining operations in the Bathurst caribou summer range using aerial survey or satellite collar data; however, little is known about what causes the ZOI. Knowing the causes of the ZOI is important so we can develop ways to reduce its size. The first step in understanding the causes of the ZOI is to be able to measure the environmental changes caused by mining activities we suspect may play a key role. This study focuses on measuring the distance that dust (and other particulate emissions), noise and visual disturbance can be detected from the Ekati mine.

What did we do?

In the NWT CIMP-funded project, titled “**Satellite Monitoring for Assessing Resource Development’s Impact on Bathurst Caribou (SMART)**”, we focused on choosing and reviewing possible methods for measuring the Zone of Disturbance (ZOD) of dust, noise and visible mining activity. Environmental changes that have a zone of disturbance that is less than or equal to the zone of influence are likely to play a role in causing the zone of influence. Near the Ekati mine, visual observations and digital photos were used to record the visibility of mining activities at different distances. Recordings of noise levels at various distances were used as well as measurements of particulate emissions, such as dust. The results were then brought together with other data to measure the zone of these disturbances.



An example of a digital photograph used for quantifying the visibility of a truck on a mining road. The photo was taken 90 m from the Misery Pit Road - 3 km - on August 15, 2015. (Credit: W. Chen)

What did we find?

- The Zone of Visual Disturbance (ZOVD) can be measured using a method that relates the distance measurement with the likelihood of a caribou seeing the disturbance.
- The Zone of Dust Disturbance (ZODD) from a mining road can be measured using soil pH measurements taken at increasing distances from a mining road. We found that soil pH near mining roads is strongly alkaline (pH 9) and then decreases with distance to become slightly acidic (pH 5), which is normal in this region.
- Using this soil pH gradient method, we measured the ZODD to be $1,760 \pm 469$ metres from the Misery Road, $1,220 \pm 290$ metres from the Sable Road, and $1,080 \pm 278$ metres from the Fox Road. The difference in these extents may be related to the amount of traffic, as indicated by road use history.
- Challenges were encountered in determining the Zone of Noise Disturbance related to wind-induced recording noise and the ability of caribou to hear higher frequencies than a human. Further work is required to develop an appropriate way to measure noise disturbance.

What does this mean?

It appears that the soil pH gradient method can be used to measure the Zone of Dust Disturbance. Similarly, the likelihood of sighting method seems feasible for monitoring the Zone of Visual Disturbance. However, these are preliminary results and further work is needed.

What's next?

- Develop maps of particulate emissions around the Ekati diamond mine since 2000 using remote sensing data and field measurements. These maps will be compared with the ZOI to see if there are any correlations.
- Continue working on how to best measure the Zone of Noise Disturbance from various mining operations.
- Collect and add more observations (in the 1-5 kilometre range) to reduce the uncertainties in the estimates of ZOVD and ZODD. Digital photos using cameras with an ultraviolet band will be taken.



(Credit: C. Lee, Dominion Diamond Ekati Corporation)

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What do the different Zones mean?

The **Zone of Influence (ZOI)** is the distance at which caribou change their behaviour, habitat selection and distribution relative to disturbance (Boulanger et al., 2012).

The **Zone of Disturbance (ZOD)** is the maximum distance or area a disturbance can reach. The disturbances can be visual, noise or air pollution.

The **Zone of Visual Disturbance (ZOVD)** is the maximum distance caribou can clearly see the vehicles driving on a mining road or the buildings and the elevated waste piles in a camp.

The **Zone of Noise Disturbance (ZOND)** is the maximum distance caribou might hear the noise caused by mining operations.

The **Zone of Dust Disturbance (ZODD)** is the maximum distance dust (or $PM_{2.5}$) from mining operations can reach.

What are ‘particulate emissions’?

Particulate emissions are a complex mixture of extremely small particles and liquid droplets that get into the air. They can include things like dust, pollen, soot and smoke. $PM_{2.5}$ refers to particles that are smaller than 0.0025 mm.

Recommended reading

Boulanger, J., K.G. Poole, A. Gunn, and J. Wierzchowski, 2012. Estimating the zone of influence of industrial developments on wildlife: a migratory caribou *Rangifer tarandus groenlandicus* and diamond mine case study. *Wildlife Biology*, 18(2):164-179. 2012.

Hu, X., L. A. Waller, A. Lyapustin, Y. Wang, and Y. Liu, 2014. 10-year spatial and temporal trends of $PM_{2.5}$ concentrations in the southeastern US estimated using high-resolution satellite data. *Atmospheric Chemistry and Physics*, 14: 6301-6314.

Mackenzie, R., P. Dryneck, B. Pea, J. Dryneck, W. Quitte, B. Football, R. Judas, J. Smallgeese, J. Judas, J. Kodzin, 2013. Cumulative Impacts on the Bathurst Caribou Herd: A Tłı̨chǫ Traditional Knowledge Study, Research and Monitoring Program, Tłı̨chǫ Government.