



Dissertation

Ingunn Ims Vistnes (b. 1974) successfully defended her dissertation "Impacts of human development and activity on reindeer and caribou habitat use" for the Doctor philosophiae degree at the Norwegian University of Life Sciences, Ås, Norway, April 17-18 2008.

Opponents were associate professor James A. Schaefer, Trent University, Canada, Dr. Anne Loison, Université de Savoie, France, and associate professor Øystein Holand, Norwegian University of Life Sciences, Norway.

Ingunn Ims Vistnes completed her master (Cand. agric.) in 1999 at the Norwegian University of Life Sciences (formerly Agricultural University of Norway) with the thesis "Avoidance of cabins and power transmission lines by semi-domestic reindeer during calving", supervised by Dr. Christian Nellemann, Norwegian Institute of Nature Research (NINA). She was an exchange student at University of Alaska Fairbanks in 1996-1997. Ingunn Ims Vistnes has worked as a researcher based in Alta, Northern Norway since 1999, being involved in a wide range of large and small projects focussing on interactions between reindeer and human development. She is employed at the research institute Norut Alta – Áltá, currently working with reindeer husbandry in relation to petroleum development, mining, and climate change.

Thesis

Vistnes, I. I. 2008. **Impacts of human development and activity on reindeer and caribou habitat use.** Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences, Ås, Norway. – *Doctor philosophiae thesis* 2008:1. 407pp.

Her thesis was based on the following ten papers:

Vistnes, I., & Nellemann, C. 2001. Avoidance of cabins, roads, and power lines by reindeer during calving. – *Journal of Wildlife Management* 65: 915-925.

Nellemann, C., Vistnes, I., Jordhøy, P., & Strand, O. 2001. Winter distribution of wild reindeer in relation to power lines, roads and resorts. – *Biological Conservation* 101: 351-360.

Vistnes, I., Nellemann, C., Jordhøy, P., & Strand, O. 2001. Wild reindeer: impacts of progressive infrastructure development on distribution and range use. – *Polar Biology* 24: 531-537.

Vistnes, I., Nellemann, C., Jordhøy, P., & Strand, O. 2004. Effects of infrastructure on migration and range use of wild reindeer. – *Journal of Wildlife Management* 68: 101-108.

Vistnes, I. I., & Nellemann, C. 2008. Reindeer winter grazing in alpine tundra: Impacts on ridge community composition in Norway. – *Arctic, Antarctic, and Alpine Research* 40: 215-224.

Nellemann, C., Vistnes, I., Jordhøy, P., Strand, O., & Newton, A. 2003. Progressive impact of piecemeal infrastructure development on wild reindeer. – *Biological Conservation* 113: 307-317.

Vistnes, I. I., Nellemann, C., Jordhøy, P., & Støen, O. G. Summer distribution of wild reindeer in relation to human activity and insect stress. Submitted.

Nellemann, C., Vistnes, I. I., Jordhøy, P., Støen, O. G., Kaltenborn, B. P., Hanssen, E., & Helgesen, R. Effects of tourist resorts and trail regulation on distribution of wild reindeer in winter. Submitted.

Joly, K., Nellemann, C., & Vistnes, I. 2006. A reevaluation of caribou distribution near an oilfield road on Alaska's North Slope. – *Wildlife Society Bulletin* 34: 866-869.

Vistnes, I., & Nellemann, C. 2008. The matter of spatial and temporal scales: a review of reindeer and caribou response to human activity. – *Polar Biology* 31: 399-407.

Abstract. Man and *Rangifer* have interacted in a predator-prey relationship since the Late Pleistocene. In order to hunt and trap reindeer and caribou (*Rangifer tarandus* spp.), man built structures such as bow stands and stone fences, directing *Rangifer* in particular directions. In modern times, infrastructure such as roads, railways, power lines, pipelines, and settlements has fragmented reindeer and caribou habitat and led to extensive habitat loss. This thesis investigates regional-scale effects of human development and activity on *Rangifer* range use, as local-scale behavioral studies may seriously underestimate negative impacts of human disturbance on reindeer and caribou. Aerial and ground surveys of reindeer and caribou were used along with ground surveys of vegetation, snow conditions and terrain. Reindeer (*R. t. tarandus*) and caribou (*R. t. granti*) were found to avoid disturbance sources, the degree of avoidance typically being a 50-95% reduction in animal density in areas within 2-5 km from the source of disturbance, and ranging from virtually no effect to a 95% reduction in density out to 15 km. The extent of avoidance depends upon a number of factors. Disturbance sources such as tourist resorts and major roads induced greater avoidance responses than power lines and closed roads. Areas with higher densities of disturbance sources or large tourist resorts induced greater avoidance responses than areas with lower disturbance or smaller tourist resorts. Females with calves were more sensitive to human disturbance than males and yearlings. Avoidance was documented in all seasons investigated (spring, summer and winter). In summer, however, *Rangifer* was also found to avoid areas with insect harassment, and showed increased tolerance for areas close to human disturbance if this provided the only insect relief habitat available. Infrastructure such as parallel power lines or power lines in combination with roads could also be perceived as semi-permeable barriers which *Rangifer* crossed significantly less than expected, leading to very low use of parts of the grazing range. Avoidance behavior led to increased animal densities in areas outside the avoided zones if habitat was limited, which in turn likely led to

increased competition and reduced forage availability per animal. The first infrastructure development in an area appeared to have the greatest avoidance effect on reindeer and caribou but further development induced increased avoidance until a certain threshold was reached at which point reindeer and caribou left the area providing that other areas were available. If such abandonment was not possible, it appeared likely that increased stress and higher densities of animals in the least disturbed parts of the range negatively affected body condition and calf production over time. Avoidance was detected even for 90-100 year old infrastructures, indicating little or no habituation to infrastructure.

Habitat loss within reindeer and caribou habitat will indeed continue. This study shows that impacts may be mitigated by concentrating disturbance sources, avoiding barrier effects through choice of infrastructure location, relocating critical disturbance sources such as tourist trails and cabins, and seasonal regulation of traffic. At the metapopulation scale, however, mitigation measures do not seem sufficient to secure *Rangifer* habitat. In addition, climate change will likely lead to an increased need for flexibility and robustness in *Rangifer*. This will require sufficient habitat and functional migration corridors. As long as we hunt reindeer and caribou, they are unlikely to habituate to human presence. By encroaching on *Rangifer* habitat, we furthermore seriously reduce their resilience and capability of coping with natural and man-made changes, and thus their opportunity to survive in the long term.

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