Influence of different barrier types on the use of landscapes by forest-dwelling caribou (*Rangifer tarandus caribou*)

Project proposal for an MSc student
Deadline for applications: 27 March 2009

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Roads and traffic affect the movement behavior of many wildlife animals. Relevant mechanisms include long-distance avoidance due to noise and smell, road surface avoidance due to lack of cover, avoidance of vehicles, and difficulties of physically moving across the built structure, e.g., up the embankment of roads or over fences and median barriers (Jaeger et al. 2005). For example, Laurian et al. (2008) found that moose (*Alces alces*) crossed highways 16 times less often than expected by chance and forest roads 10 times less often. These authors also found a positive relationship between home-range size and the proportion of road axes they contained. Preliminary results suggest that fragmentation of forested boreal landscapes may influence strongly the habitat use of forest-dwelling caribou, an endangered ecotype closely associated to undisturbed coniferous forests (St-Laurent, *unpubl. data*) which is listed as a Canadian threatened species and as a vulnerable species under the Québec Act Respecting Threatened or Vulnerable Species. Landscape configuration already appeared to have an effect on caribou habitat selection by interfering with the avoidance of clearcuts and the selection of mature forest remnants (Hins et al. *in press*).

The landscape metric of effective mesh size (m_{eff}) is a convenient measure of the degree of landscape fragmentation (Jaeger 2000, Jaeger et al. 2008). It is useful to quantify the patterns created by the fragmenting elements in the landscape. The definition is based on the probability that any two points in the landscape are connected and directly relates to functional connectivity which has been defined as "the degree to which the landscape facilitates or impedes movement among resource patches" (Taylor et al. 1993). A selection of a set of specific fragmenting elements defines a so-called "fragmentation geometry". We are interested in the question of how the various patterns of fragmentation affect the movement behaviour and home range sizes of forest-dwelling caribou (*Rangifer tarandus caribou*), and which fragmentation geometries are most influential on their use of space. To analyze the relative importance of different elements fragmenting the landscape in the view of this species, we will analyze the correlation between several parameters characterizing the species' movement behavior and a variety of fragmentation geometries. The model selection will be based on the AIC (Akaike's Information Criterion; Burnham and Anderson 1998) and other criteria, and the modeling will also apply variance partitioning. We will use existing telemetry data of caribou from Saguenay and Lake St. Jean regions that have been collected by UQAR and MRNF since 2004. This GPS telemetry dataset consists of ~50 caribous monitored for at least one year between March 2004 and March 2009. We will calculate m_{eff} within the home ranges of individuals and relate it to home range size and other movement indices like movement rate or core area size. We will then compare a series of candidate models that include different fragmentation geometries; for example,

major forest roads only, major forest roads + secondary forest roads, major forest roads + secondary forest roads + trails, major forest roads + secondary forest roads + trails + old clearcuts, major forest roads + secondary forest roads + trails + old clearcuts + regenerating stands + recent barriers, etc.

This MSc is funded with about 17,000$ per year (34k$ in total).

This project will be co-supervised by Dr. J. Jaeger and Dr. M.-H. St-Laurent.

Please send your application to Dr. J. Jaeger or Dr. M.-H. St-Laurent.

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References

Burnham, K.P., D.R. Anderson. 1998. *Model selection and inference*. Springer, New York, etc.

Courtois R., A. Lavoie and C. Seuthé. 2002. La télédétection sur la trace des caribous forestiers. Quebec: Ministère des Ressources Naturelles. URL: http://www.quebecgeographique.gouv.qc.ca/approfondir/bibliotheque/geoinfo/pdf/juin02.pdf .

Dussault, C., M. Poulin, R. Courtois, and J. -P. Ouellet. 2006. Temporal and spatial distribution of moose-vehicle accidents in the Laurentides Wildlife Reserve, Québec, Canada. *Wildlife Biology* 12(4):415-425.

Dussault, C., J. -P. Ouellet, C. Laurian, R. Courtois, M. Poulin, and L. Breton. 2007. Moose movement rates along highways and crossing probability models. *Journal of Wildlife Management* 71(7):2338-2345.

Hins, C., J.-P. Ouellet, C. Dussault, and M.-H. St-Laurent. 2008. Habitat selection by forest-dwelling caribou in managed boreal forest of eastern Canada: evidence of a landscape configuration effect. *Forest Ecology and Management* (*in press*).

Jaeger, J.A.G. 2000. Landscape division, splitting index, and effective mesh size: New measures of landscape fragmentation. *Landscape ecology* 15(2): 115-130.

Jaeger, J.A.G., Bowman, J., Brennan, J., Fahrig, L., Bert, D., Bouchard, J., Charbonneau, N., Frank, K., Gruber, B., Tluk von Toschanowitz, K. (2005): Predicting when animal populations are at risk from roads: an interactive model of road avoidance behavior. *Ecological Modelling* 185: 329-348.

Jaeger, J.A.G., Bertiller, R., Schwick, C., Müller, K., Steinmeier, C., Ewald, K.C., Ghazoul, J. 2008. Implementing landscape fragmentation as an indicator in the Swiss Monitoring System of Sustainable Development (MONET). *Journal of Environmental Management* 88: 737-751.

Laurian, C., Dussault, C., Ouellet, J.-P., Courtois, R., Poulin, M., Breton, L. 2008. Behavior of moose relative to a road network. *Journal of Wildlife Management* 72(7): 1550-1557.

Lefort S., R. Courtois, M. Poulin, L. Breton and and A. Sebbane. 2006. Sélection d'habitat du caribou forestier de Charlevoix d'après la télémétrie GPS Saison 2004-2005. Québec. Ministère des Ressources naturelles et de la Faune and Ministère des Transports du Québec. URL: http://bibnum2.banq.qc.ca/pgq/2007/3249586.pdf.

Taylor, P.D., Fahrig, L., Henein, K., Merriam, G., 1993. Connectivity is a vital element of landscape structure. *Oikos* 68: 571–573.