American marten responses to roads and clearcuts in a boreal forest: a snow-tracking study

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Introduction

- Large-scale forestry: boreal landscapes filled with roads and clearcuts.
- In Canada alone : 15,000 km of new forestry roads built annually and 10,000 km² of forest harvested annually.
- Species distribution patterns may be affected by gaps in the forest cover, but underlying mechanisms are unknown most of the time.
- Indeed, animal foraging and other movements may be modified by an influence zone possibly caused by:
  - Differences between vegetation structure near forestry roads and clearcut edges
  - Supposed differences in prey abundance near edges
  - Movement conduit effect (moving alongside obstacles)
- We asked whether and how American marten (*Martes americana*) respond to forest edges adjoining roads and clearcuts.

Methods

- 81 km of marten tracks followed by snowshoe over 3 winters (2004, 2005, 2008).
- Track locations recorded with high-resolution Trimble GeoExplorer GPS receivers.
- Movement paths filtered by observer speed to discard erroneous GPS locations (Figure 2).
- Each track reduced to 10, 20 and 40 m equidistant points (steps).
- Track angles relative to edge calculated for each step (Figure 3).
- Linear regression for each track (n = 80):
  angle = *f*(log[distance], approach [or not], log[distance]*approach
- Meta-analysis of regression coefficients, weighted by inverse variance of estimates.

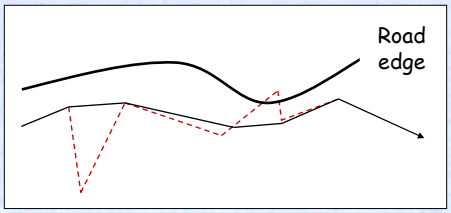


Figure 2: Dotted line = Raw GPS data; solid line = filtered by observer speed (max = 1 m/s).

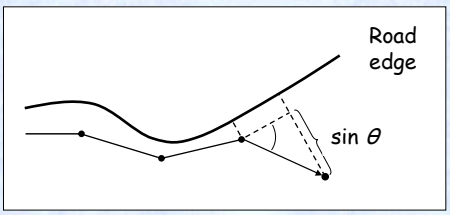


Figure 3: Measurement of movement in relation to road/clearcut edge. The sine of each step relative to the nearest edge was obtained from lines linking each equidistant point to the nearest point on an edge, and the length of each segment (adapted from Desrochers & Fortin, 2000).

Study area

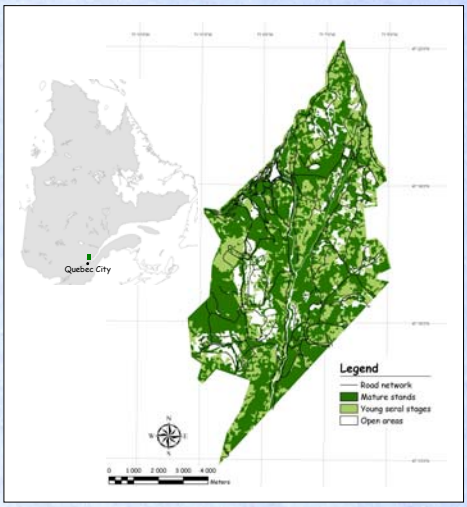
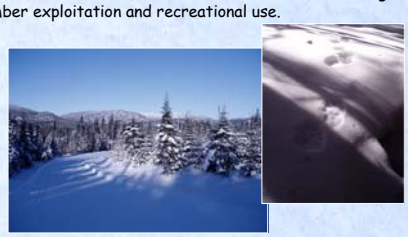


Figure 1: Location of the Montmorency Research Forest (in December 2007), a boreal forest mosaic managed for timber exploitation and recreational use.



Results

Table 1: Relationship between marten track angle, distance to edge, and whether martens approach or move away from road/clearcut edges. Mean regression estimates, followed by their S.E.

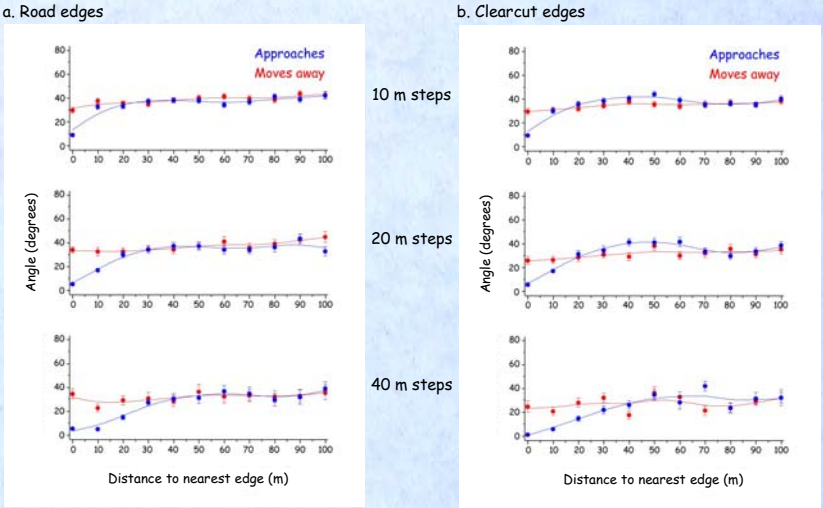
a. Road edges

	Step length		
	10m	20m	40m
log[distance]	5.28 ± 1.15 (P < 0.0001) *n = 60*	9.53 ± 1.59 (P < 0.0001) *n = 60*	10.67 ± 2.65 (P = 0.0002) *n = 53*
log[distance]*approach	-3.43 ± 1.38 (P = 0.02) *n = 54*	-8.38 ± 1.91 (P < 0.0001) *n = 46*	-7.07 ± 3.31 (P = 0.04) *n = 38*

b. Clearcut edges

	Step length		
	10m	20m	40m
log[distance]	5.45 ± 1.41 (P = 0.0003) *n = 52*	7.40 ± 1.85 (P = 0.0002) *n = 51*	13.27 ± 2.29 (P < 0.0001) *n = 48*
log[distance]*approach	-4.21 ± 1.55 (P = 0.009) *n = 50*	-6.04 ± 2.49 (P = 0.02) *n = 44*	-11.93 ± 3.54 (P = 0.002) *n = 33*

Figure 4: Relationship between marten track angle relative to edge, distance to edge, and whether martens approach or move away from road/clearcut edges.



Conclusions

- Marten moving towards forest edges tended to move increasingly parallel to them (Figure 4).
- No evidence of differences in responses to clearcut vs. road edges.
- Gaps as narrow as forestry roads may induce marten to 'channel' their movements along man-made forest edges.
- ~30% of the mature forest in the study area was <30 m away from an edge, suggesting that edges have a substantial effect on overall marten movements.

Acknowledgements

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