

## Occurrence and activity of American martens *Martes americana* in relation to roads and other routes

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In order to clarify the relationship between American martens *Martes americana* (Turton, 1806), and roads in boreal forests, we tested the effect of distance from road on marten habitat use by comparing the frequency of occurrence, and the number of, marten snow tracks in 27 pairs of 300 and 400 m transect segments perpendicular to access roads, and corresponding segments 800 or 1000 m away from the road, for a total of four spatial analyses. The number of black spruce *Picea mariana*, stems was generally lower near roads ( $-94.0 < T_s < -63.0$ ,  $p < 0.05$ ), but otherwise forest composition generally did not differ significantly between road and forest segments. Depending on the spatial scale, 11 – 14 road and 15 – 18 forest (out of 27) segments had marten tracks, but the difference was not statistically significant (Fisher's exact test,  $p > 0.05$ ). In all analyses, marten tracks were significantly fewer near roads (Wilcoxon test:  $-74.0 < T_s < -62.0$ ,  $p < 0.01$ ) than away from roads. In segments with tracks, track density was significantly lower near roads than away from roads in three of four spatial analyses ( $-3.3 < T_s < -2.9$ ,  $p < 0.01$ ). The findings suggest that snow track samples near roads can detect marten occurrence, but do not reflect the clumping pattern observed away from roads. Habitat selection studies using tracks should consider the possible effect of roads on marten movement patterns.

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### Introduction

With growing interest in the conservation of biodiversity in man-modified environments, effect of edges in heterogeneous habitats has been the focus of several recent ecological studies (Jokimäki and Huhta 1996, Garcia *et al.* 1998, Gardner 1998, Hansson 1998, Kuitunen *et al.* 1998, Stevens and Husband 1998). Knowledge of edge effects aid management authorities in planning timber harvest and wildlife conservation (Darveau *et al.* 1997), in particular indicator species (Niemi *et al.* 1997) such as the marten in northern Ontario (Watt *et al.* 1996). Martens are known to avoid open areas, but evidence for their use or avoidance of edges is somewhat contradictory. Buskirk and Powell (1994) hypothesized that edge preference or avoidance by martens is a function of particular habitat values within the edge. Martens also are known to use marginally suitable forested areas

as travel corridors (Potvin and Breton 1997). Evidence of how martens use forest edges habitats is scarce and no study has yet considered marten movement patterns specifically in relation to road corridors. Yet, it is not uncommon to find marten habitat studies where sampling occurred in proximity of a road system.

The objective of this study was to examine the effect of road proximity on the movement patterns of martens. Here we compare the occurrence (presence-absence) of marten tracks and the number of marten tracks near and away from active access routes (including seasonal snowmobile trails) in northern Ontario boreal forest. Because of the low road density of roads and trails and relatively low traffic in northern boreal forest, we predicted that marten track distribution near roads would not differ from that found in core of the forest matrix.

### Material and methods

The study site was an 1,100-km<sup>2</sup> area south of Timmins (48°30'N, 81°00'W; Fig. 1) where U-shaped transects (Fig. 1 inset) were sampled for vegetation and marten tracks during February and March 1994. For the purpose of the present study, a sub-sample of twenty-seven transects averaging 2.4 km (range 1.9–3.1 km) in length were selected that were large enough to include a forest transect, that were at least 1 km away from the nearest transect, and where vegetation survey was available. Chosen transects were located off six of 10 logging roads, two hydro-electric power lines, and provincial highway 144, where widths varied approximately between 20 m and 50 m. Logging roads remain open and active throughout the year (mostly commercial hauling during working days) while power lines are used as seasonal snowmobile trails and all-terrain vehicles for recreational and other (eg trapping) purposes. Forest attributes were measured in 10 m radius plots every 100 m along a segment. Forest cover characteristics included total stand height (ie summation of highest height in each plot) and the number of stems of black spruce *Picea mariana*, white spruce *P. glauca*, balsam fir *Abies balsamea*, jack pine *Pinus banksiana*, eastern cedar *Thuja occidentalis*, all conifers, poplar (*Populus* spp.), birch (*Betula* spp.) and all deciduous trees that fit a BAF2 prism (Grenier and Du Sablon 1993). Structural characteristics included number of stumps, fallen logs > 10 cm diameter at breast height (DBH), and other structures (eg boulders). Differences in the number of marten tracks and tree stems between pairs of road and forest 300- and 400-m transect segments were tested using Wilcoxon signed-rank test (hereafter  $T_s$ ) with JMP 3.0. (SAS 1995). Road and forest segments were extracted from the original transect, hence pairs of road and forest segments were sampled on the same day. Segment lengths were chosen at 300 and 400 m to reflect reasonable portions of marten home range sizes, to minimize zero values in samples, and to reduce the effect of recent logging near roads. We chose to test two different road-forest intervals: 800 m or 1000 m. Four length/interval segment combinations were thus tested: (a) 300 m long / 800 m interval; (b) 300 m long / 1000 m interval; (c) 400 m long / 800 m interval and (d) 400 m long / 1000 m interval (hereafter 300/800, 300/1000, 400/800 and 400/1000 respectively). Differences in the frequency of occurrence of marten tracks in road vs. forest segments were tested using Fisher's exact test.

### Results

Most analyses (ie segment length-interval combinations) indicated that forest cover near roads did not differ from that found away from roads. Black spruce were significantly fewer near roads at three levels of analysis ( $-94.0 < T_s < -63.0$ ,  $p < 0.05$ ), but the number of conifer stems were not. Deciduous trees were significantly

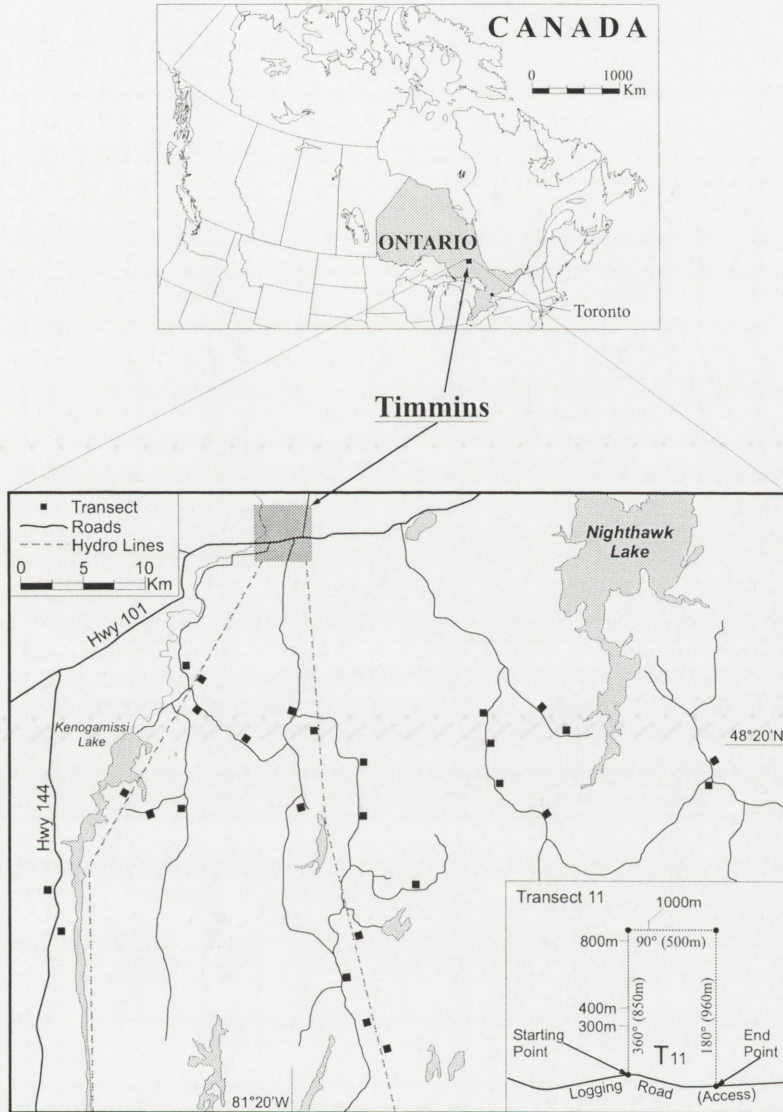


Fig. 1. Layout of logging roads, hydro-electric power lines and 27 snowtracking transects in a 1100 km<sup>2</sup> study area south of Timmins, Ontario. Inset: Bearings, distances and intervals on Transect 11.

fewer on road segments in one (400/1000 m level) analysis ( $T_s = -77.0$ ,  $p < 0.05$ ). There were no significant differences in the density of shrubs, stumps, logs and other structural characteristics between road and forest segments ( $-62.0 < T_s < 49.5$ ;  $p > 0.05$ ). Stand height was lower in the forest than on road segments only at the 300/800 m level ( $T_s = -83.0$ ,  $p < 0.05$ ) (Table 1).

Table 1. Average number of marten tracks and stems (> 10 cm DBH) ( $\pm$  1 SE) of 300 and 400 m transects and intervals of 800 m and 1000 m. Matching letters within column indicate significant differences.

Treat- ment	Marten tracks	Number of stems							Decid- uous	Total	Stand height (m)	Structure		
		Conifers						Stumps				Logs	Other	
		Black spruce	White spruce	Balsam fir	Jack pine	Cedar	Total							
Segment length (300 m)														
Road	0.5(0.1) <sup>ab</sup>	5.7(0.9) <sup>ab</sup>	1.3(0.5)	4.3(0.9)	4.8(2.2)	1.8(1.0)	17.8(1.9)	7.7(1.9)	26.2(2.7)	31.1(2.3) <sup>a</sup>	10.0(1.2)	7.7(1.0)	1.1(0.8)	
Interval (800 m)														
Forest	3.1(0.7) <sup>a</sup>	11.7(2.2) <sup>a</sup>	1.0(0.3)	2.8(0.6)	4.0(2.1)	0.6(0.3)	20.1(2.7)	10.6(2.4)	30.9(2.9)	35.8(2.5) <sup>a</sup>	12.8(1.5)	9.2(1.3)	0.8(0.7)	
Interval (1000 m)														
Forest	2.4(0.7) <sup>b</sup>	11.5(2.2) <sup>b</sup>	1.2(0.4)	2.7(0.6)	2.4(1.2)	2.0(0.6)	19.9(2.6)	11.4(2.4)	31.4(3.0)	34.3(2.2)	12.3(1.5)	9.0(1.4)	1.4(0.6)	
Segment length (400 m)														
Road	0.9(0.2) <sup>cd</sup>	9.7(1.6) <sup>c</sup>	1.7(0.7)	5.1(1.0)	6.6(2.9)	3.7(1.6)	26.8(2.5)	9.5(2.3) <sup>a</sup>	36.9(3.2)	41.8(2.9)	13.6(1.5)	11.3(1.4)	1.3(0.8)	
Interval (800 m)														
Forest	3.3(0.8) <sup>c</sup>	15.1(2.7) <sup>c</sup>	1.5(0.5)	3.8(0.8)	3.7(2.0)	2.1(0.6)	26.3(3.3)	14.6(3.1)	41.0(3.6)	46.1(3.2)	15.6(1.8)	12.2(1.7)	1.7(0.8)	
Interval (1000 m)														
Forest	3.0(0.8) <sup>d</sup>	11.7(1.8)	1.8(0.5)	4.0(0.8)	3.2(1.7)	4.3(1.6)	25.0(2.2)	14.0(2.4) <sup>a</sup>	39.3(2.5)	44.8(2.5)	14.4(1.5)	12.1(2.0)	1.9(0.6)	

The occurrence of marten tracks did not differ significantly between road segments and segments away from the roads ( $-19.5 < T_s < -9.0$ ,  $p > 0.05$ ). At the 300/800 and the 300/1000 m scale, 11 road and 18 forest segments had marten tracks. In the 400 m analysis, 14 road segments had marten tracks and 18 forest segments had tracks at 800 m spacing; at 1,000 m spacing, 15 forest segments had tracks. The consistently high number of segments without tracks throughout the sample suggested clumping of tracks.

At any scale of analysis, martens left on average significantly fewer tracks on road than on forest segments ( $-74.0 < T_s < -62.0$ ,  $p < 0.01$ ; Table 1). To further analyze clumping of tracks, track counts were compared among transects with tracks only. At the 300 m scale, martens left 14 tracks on 11 road segments (avg: 4.2 tracks/km) and 84 and 66 tracks on 18 and 15 forest segments (avg: 15.6 and 14.7 tracks/km at 800 and 1000 m intervals respectively) and both road-forest comparisons showed significant differences ( $T_s = -2.9$  and  $-3.3$  respectively,  $p < 0.01$ ). At the 400 m scale, martens left 25 tracks on 14 road segments (avg: 4.5 tracks/km), and 89 and 80 tracks on 18 and 15 forest segments (avg: 12.4 and 13.3 tracks/km at 800 and 1000 m intervals respectively), although only the latter comparison (ie 400 m at 1000 m interval) was significant ( $T_s = -2.9$ ,  $p < 0.01$ ).

## Discussion

This study revealed that martens were as likely to be detected near roads as away from roads. In many Crown Land areas in northern Ontario, secondary roads are developed for logging purposes and hence, residential development is limited and road densities are relatively low. Trappers and wildlife biologists commonly restrict sampling to roadsides because of difficult access to the forest core. Our results show that marten tracks can be found near roads (at least in the first 300 m) and thus support the use of road transects for detection surveys (*sensu* Zielinski and Kucera 1995).

The analysis of track density, on the other hand, showed that tracks were relatively more clumped within forest segments, which suggests different marten movement patterns, and therefore different habitat use by martens near roads. Martens are solitary and territorial (Strickland and Douglas 1987); hence, more tracks in the forest interior is more likely an indication that martens were more active away from than near roads than it is an indication of the presence of more individuals in the forest segments. Vegetation characteristics were apparently not related to this pattern, but results indicated that the number of black spruce was lower near roads. In the study area, black spruce proliferated mostly in mesic environments, and roads likely were set on higher and drier areas or near harvestable stands. Hence, shorter forest stands in 300/800 m segments were likely lowlands and bogs between established roads.

Martens may have been less active near roads because of sub-optimal black spruce cover, but more likely traffic. The observed response of martens the specific

difference in habitat noted here cannot be imputable to, as some studies suggested that martens will select for a variety of conifer assemblages (D'Eon and Watt 1994). Also, movement patterns of martens may be different in areas of higher road/traffic densities (Reijnen *et al.* 1997). This must be considered, especially when a measure of habitat use is sought.

The spatial analysis indicated little statistical variation in marten detectability, clumping of tracks and vegetation attributes, with a 100-m scale change. Hence, detectability of martens and vegetation characterization were not sensitive to a 100-m scale variation, which suggests that this level of resolution is insignificant relative to marten home ranges sizes (Buskirk and McDonald 1989). On the other hand, it has been suggested that transects used for marten habitat studies be 1 km or more (Thompson *et al.* 1989). However, in order to reveal the possible effect of roads on marten movements, a relatively short distance was chosen at a scale where possibly a given marten would detect, and respond to, the proximity of roads within its home range. Hence, this study examined the response of martens to road at a stand-scale level rather than at the landscape level.

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