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Habitat Use by American Marten in Temagami, Ontario: Preliminary Implications for the Marten Habitat Suitability Model and Management Guidelines

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Introduction

The loss and degradation of forests have caused a reduction in the historical range of American marten (*Martes americana*) in portions of North America, and have lead to local population declines in this species. Agriculture, human settlement, logging, and unregulated trapping have caused its extirpation in Prince Edward Island and southern New England (Ray 2000). Clearcut logging, which is still widely practiced throughout the range of American marten, has resulted in decreased marten population densities due to lower reproductive success, increased mortality, and expansion of home range sizes (Thompson 1994; Thompson and Colgan 1994, Potvin et al. 2000, Payer and Harrison 2003). Several authors suggest that marten populations may decline precipitously at levels of habitat fragmentation exceeding 20-40% (Thompson and Harestad 1994; Chapin et al. 1998, Hargis et al. 1999, Potvin et al. 2000). The conversion of mature and old-growth forests to young even-aged forests in Newfoundland has led to the endangered status of marten (Species at Risk 2003). The loss and degradation of forest habitat in the Temagami-Algonquin region of central Ontario have created barriers to ecological connectivity in some areas and have likely also caused declines in marten populations. In response to this habitat fragmentation and degradation, Ancient Forest Exploration & Research (AFER) has proposed two ecological corridors linking Algonquin Park to Lady Evelyn-Smoothwater Park (Quinby and Lee 2002). The American marten was chosen as a focal species for corridor design because it is (1) a "provincially featured species", (2) an indicator of mature and old-growth conditions, and (3) an umbrella for other forest species requiring late successional forest habitat (Watt et al. 1996).

Guidelines developed by the Ontario Ministry of Natural Resources (OMNR) for the provision of marten habitat are applied to timber management planning in the Temagami Forest Management Unit (TFMU). These guidelines require that at least 10% of the management unit be maintained in core areas of 30-50 km^2 composed of forests exceeding 80 years of age with a conifer composition exceeding 40% and a canopy closure exceeding 50% (Watt et al. 1996). These criteria are based on studies indicating that the greater abundance of taller trees, snags, and downed woody debris (logs, stumps, root mats) found in older forests create vertical and horizontal structure that provide more resting and denning sites (Buskirk et al. 1989; Chapin et al. 1997), subnivean access to prey (Sherbourne and Bissonette 1994), runways through the forest (Francis and Stephenson 1972), and vertical escape routes from terrestrial predators (Hodgman et al. 1997). In addition, higher rates of prey capture have been observed in older forests (Thompson and Colgan 1994). Coniferous forest composition is thought to be important in maintaining thermal cover during winter (Buskirk and Powell 1994) and a closed canopy provides overhead cover from avian predators (Hargis and McCullough 1984). However, the studies used to develop these marten habitat criteria were not conducted in the TFMU, and regionally-specific information is confined to studies conducted in Algonquin Park, which is south of the TFMU and in the Boreal Forest Region of Ontario, which is north of the TFMU.

Because relationships between mammals and their habitat vary from one region to another, studies should be conducted to identify regionally-specific associations (Ray 2000). In fact, recent studies from Maine and Quebec have documented that marten will use a wide variety of forest types and successional stages where adequate structural habitat features are present (Payer and Harrison 2000, Potvin et al. 2000, Payer and Harrison 2003). Thus, the objective of this study was to characterize marten habitat in the TFMU and to compare the results to predictions made by the OMNR's marten habitat suitability model. Refinement of this model could be a vital tool for identifying key marten habitat for inclusion in the proposed wildlife corridors.

Methods

Marten occurrence was sampled at ten sites within the Rabbit Lake Watershed, Temagami, Ontario from June to August 2003. The watershed area was stratified into site types according to logging history, successional stage, and overstory composition. Logged forests were identified according to the decade in which they were harvested, ranging from 1960 to 2000, and one site from each decade was sampled. Primary forests were stratified into mature conifer (80+ yrs), mature deciduous (60+ yrs), and old-growth (121+ yrs.) forests. One site from each of the mature forest types and three old-growth sites were sampled. Marten presence was assessed at each of the ten sites using rectangular arrays of six track plate boxes baited with chicken (Zielinski and Kucera 1995), each separated by 500 m placed within site type patches large enough to contain an entire array. The suitability of habitat at each track box was predicted using the Ontario Marten Habitat Suitability Model (OWHAMTool Ver 4.0) for the GLSL Forest Region (Naylor et al. 1999) and Forest Resource Inventory (FRI) stand data for each track box location. This model rates forest stands according to Forest Ecosystem Classification (FEC) site type (Chambers et al. 1997), successional stage (pre-sapling, sapling, immature, mature, and old-growth), and canopy closure derived from FRI data. FEC types represent consistent combinations of vegetation and site conditions and are rated by the model as "unsuitable", "used", or "preferred". This rating is based on the thermal value of conifer cover and a downed woody debris index value for each FEC type (Naylor et al. 1994). Mature and old-growth forest successional stages are rated highest, and canopy closure between 40 and 70% is considered ideal. The predicted suitability of marten habitat for each stand at each track plate location was compared to our marten detection assessment for each stand.

Results and Discussion

Marten were detected at 7 of 10 sites and at 23 of 60 track boxes, including track boxes in two deciduous FEC ecosites (17 and 27), which are currently rated as unsuitable by the OMNR marten habitat suitability model (Table 1).

Table 1. Marten detections at track plate boxes by FEC ecosite type

FEC Type	FEC Description	Predicted Suitability	No. of Track Boxes	No. of Track Boxes with Detections
11	Pw-Pr	preferred	5	2
12	Pr	used	6	1
13	Pj-Pw-Pr	used	5	0
15	Pj	used	5	0
16	Sb-P	preferred	3	2
17	Po-Bw	unsuitable	5	4
18	Po-Bw-Sw-B	preferred	4	4
20	Pw-Pr-Sw-Bw-Pot	preferred	6	4
21	Ce-Pw-Bw-Sw	preferred	12	3
22	Ce-OCo	preferred	3	0
27	Mh-Bw-Po-Pw	unsuitable	2	2
33	Ce-OCo	preferred	3	0
34	Ce-LoHa	preferred	1	1
Total			60	23

Definitions: Pw- White Pine, Pr –Red Pine, Pj – Jack Pine, Sb- Black Spruce, Sw – White Spruce, Po – Poplar, Bw – White Birch, B – Balsam fir, Pot – Trembling Aspen, Ce – Cedar, Mh – Sugar maple, OCo – other conifer, LoHa – Lowland Hardwood

Ecosite 17 is dominated by white birch and poplar, and detections for this ecosite occurred at two track boxes in a mature, unharvested shoreline reserve at the 1990's logged site and at two track boxes placed in a mature stand and in an immature stand at the mature hardwood site. Ecosite 27 is dominated by sugar maple and white birch, and detections for this ecosite occurred in a mature stand and in a sapling stage stand at the 1970's logged site. Six marten detections occurred in stands rated by the model as "unsuitable", eight in stands rated as "used", and nine in stands rated as "preferred" (Table 2). The proportion of track boxes with detections

Table 2. Marten detections by habitat suitability index rating accounting for FEC type, successional stage, and canopy closure

Habitat Suitability	No. Track Boxes	No. Track Boxes with Detections	Proportion with detections (%)
0 – unsuitable	18	6	33.3
1 – used	22	8	36.4
2 – preferred	20	9	45.0
Total	60	23	38.3

was not significantly different among marten habitat suitability categories (X^2 = 0.602, d.f. = 2, P = 0.740). A greater proportion of track plates placed in deciduous mixedwood and deciduous forest types had marten detections relative to those placed in coniferous and conifer mixedwood forest types (Table 3), however, the sample size is too low to evaluate the statistical significance of this finding.

Table 3. Marten detections by forest type based on Forest Resource Inventory species composition

Forest Type	No. of Track Boxes	No. of Track Boxes with Detections	Proportion with Detections (%)
Coniferous (>75% conifer)	22	3	13.6
Conifer Mixedwood (50-75% conifer)	17	4	23.5
Deciduous Mixedwood (25-50% conifer)	12	8	66.7
Deciduous (<25% conifer)	9	8	88.9
Total	60	23	38.3

The results from this first field season suggest that features contributing to habitat suitability for marten may be present in a wider variety of FEC ecosites than predicted by the OMNR marten habitat suitability model. This indicates that some FEC ecosite types that provide suitable habitat for marten may be ignored in planning for the provision of marten habitat. The association of marten with deciduous FEC ecosite types suggests that conifer composition may be a poor predictor of marten habitat use. Our results are consistent with studies in Quebec and Maine indicating that marten use deciduous forest types (Potvin et al. 2000; Payer and Harrison 2003), but our results are inconsistent with observations from boreal Ontario and Algonquin Park where marten preferred conifer-dominated forests (Thompson 1994; Francis and Stephenson 1972). Payer and Harrison (2003) suggested that selection for mixedwood and deciduous stands by marten in Maine may be related to higher prey populations - red-backed voles (*Clethrionomys gapperi*) and deer mice (*Peromyscus maniculatus*) - in these forest types (Lachowski 1997, Fuller 1999), which in turn may be related to the structural habitat features present within these stands.

Detections at the 1970's logged site included track boxes placed in regenerating and young forest stands, which are rated as unsuitable and used, respectively, by the OMNR model. Despite the younger age of these stands, they had large volumes of coarse woody debris similar to volumes recorded at the three old-growth sites due to large diameter logs left behind following logging. The downed woody debris index that is incorporated into the habitat suitability model is based on surveys of downed woody debris in mature stands of each FEC ecosite type and thus does not account for variations in forest structure in stands younger than the mature stage. The mature hardwood site, which had the greatest number of detections, lacked the amount of coarse woody debris that was observed at younger deciduous stands in the 1970's logged site. However, this site did have greater conifer understory density, which may offset limited overhead cover under a deciduous canopy in leaf-off condition. Detections in the shoreline reserve at the 1990's logged site occurred in mature deciduous stands that lacked both the coarse woody debris observed at the 1970's logged site and the conifer understory observed at the mature hardwood site. The presence of marten in this shoreline reserve may represent use as a travel corridor from one suitable habitat to another. While all deciduous and deciduous mixedwood stands provided high overhead cover in summer, winter suitability of these forest types when foliage is absent is likely reduced.

In conclusion, our preliminary results indicate that further examination of the validity of the OMNR's marten habitat suitability model is warranted. For the 2004 field season, we will increase our sample size to determine whether marten are consistently associated with deciduous and deciduous mixedwood FEC ecosite types. Recent findings that structure may be a stronger stand-level determinant of habitat suitability than species composition indicate that a valid habitat suitability model might incorporate a more accurate measure of forest structure (e.g., coarse woody debris). However, it has been suggested that marten habitat selection may be dominated by factors operating at the home-range scale and higher (Carroll et al. 1999, Ray 2000). The current marten habitat suitability model and guidelines are designed for landscape-level forest management. Thus, an investigation of the relationships between marten presence and the configuration of forest types at different spatial scales will provide a landscape-level evaluation of the model, will help to refine the current marten habitat suitability model, and will be useful for designing a functional ecological corridor for populations of American marten and other species with similar habitat requirements.

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