Boreal Wolverine: A Focal Species for Land Use Planning in Ontario's Northern Boreal Forest

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Participation by **The Wolverine Foundation, Inc.** in the **"Ontario Boreal Wolverine Project"**
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Ontario's Lands For Life process and the Ontario Forest Accord have resulted in an increase in land reserved as protected areas where timber extraction is not permitted. As a result, forest products companies are likely to intensify post-harvest silviculture activities to increase fibre yields on remaining lands in Ontario, and also look north of 51º for additional forest resources. Moreover, several of the 28 northern First Nations communities have expressed interest in initiating forest management within their traditional use areas. Such actions are reflected in the Northern Boreal Initiative (NBI) and increased interest in intensive forest management. More intensive forest management and the northward expansion of forestry activities give rise to new management concerns and issues, some of which are novel to Ontario's resource managers. A prime example of this is the management of the wolverine (*Gulo gulo*) in northwestern Ontario, a species that has been determined as Threatened by the Committee on the Status of Species At Risk in Ontario (COSSARO) and is listed as "Special Concern" by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC) within Canada at large. In the past, little if any attention was paid to this wide-ranging carnivore because harvests were generally low and they occurred primarily north of current forest management activities (Dawson 2000).

The wolverine is a medium-sized carnivore with a circumpolar distribution within the tundra, boreal, and mountain regions of North America and Eurasia. Wolverines have large home ranges, low reproductive potential, and are more ecologically similar to large carnivores than other species of similar size (Weaver *et al.* 1996). Populations throughout the range are generally associated with remote wilderness areas, and are considered to be sensitive to human development, especially with respect to selection of denning sites (Banci 1994). The biological and ecological characteristics of wolverine result in low population resiliency that means wolverine populations are slow to recover from disturbance (Banci and Proulx 1999; Weaver *et al.* 1996). Wolverines have been suggested as potential focal species for conservation purposes along with lynx, grizzly bear and fisher (Carroll *et al.* 2001).

Lowland boreal forests characteristic of central and eastern Canada are possibly low quality habitats for wolverines, and may carry the lowest density and least resilient populations of this species in the country. Wolverine are federally listed as Endangered in Québec & Labrador by COSEWIC (Dauphine 1989) and there is some question as to whether viable populations still remain, as there have been no confirmed specimens since the early 1980's. As such, Ontario is currently responsible for the most easterly viable population in North America. Along with the new Threatened status in Ontario, there is a legal requirement that a recovery strategy and action plan be prepared within 2 years of listing. The major gap in strategy development is the lack of basic ecological data on the species in the Ontario context (Dawson 2000). There have been no ecological studies conducted on wolverines east of the Rockies or south of the Yukon/NWT/Nunavut in Canada. Moreover, all studies of the species have taken place in habitats characterized by great topographic diversity (Hornocker and Hash 1981, Magoun 1985, Gardner 1985, Whitman *et al.* 1986, Banci 1987, Copeland 1996, Landa *et al.* 1997, Krebs and Lewis 1999, Lofroth *et al.* 2000, Vangen *et al.* 2001), where wolverines utilize alpine and subalpine areas as refugia or den/maternal sites (Magoun and Copeland 1998). Ontario wolverine habitat provides a stark contrast (low elevation forest and tundra interlaced with peat lowlands). Therefore, habitat requirements identified from other studies cannot necessarily be used to construct habitat models for Ontario. The draft wolverine recovery plan for Québec and Labrador (Wolverine Recovery Team 1996) identified the acquisition of wolverine data through scientific studies as the first major element in the recovery strategy, and also listed development and implementation of population management and monitoring methods as key items.

Ontario's wolverine population appears to be concentrated in northwestern Ontario, roughly from Red Lake – Sioux Lookout north to Fort Severn – Peawanuck (Dawson 2000). This is a critical time in the future of wolverines along the southern portion of wolverine range in Ontario because timber harvest activities currently occur in the Red Lake area and are proposed to proceed further north as part of the NBI. In addition, the agreed first step in the process of planning for timber harvest (NBI 2001) requires the identification of protected areas. There are also plans in place to increase mineral and natural gas exploration within current wolverine range. Wolverines are sensitive to human disturbance and development (Weaver *et al.* 1996), and current activities make this a compelling time to learn more about wolverine ecology in Ontario and the relationship between wolverine habitat use, forest management, protected areas, and other human activities. We have the rare opportunity to ensure that planning for future protected areas, forest management, and other extraction activities in the NBI area are carried out in an ecologically sensitive manner that will ensure the persistence of occupied wolverine range rather than a further northward recession.

The proposed study is unlikely to resolve all issues regarding wolverine habitat and resource development in Ontario, but because there is such a tremendous need for any information regarding wolverine in light of impending development pressures within their range, even preliminary results stand to be of great use in helping to guide recovery and land use planning efforts both within and outside the province. In addition, we hope to use the results of this project as leverage for additional funding and research development. The wolverine is a very difficult species to work with because of its naturally low densities and wide-ranging movements and the remoteness of core habitats. Significant advances in understanding wolverine ecology have been made possible only with the recent development of satellite telemetry technology. We view the proposed project as providing the foundation for future research on wolverines in lowland boreal forest habitats of eastern North America, just as the first radio-telemetry study of wolverines in Montana (Hornocker and Hash 1981) spurred additional research on this species in mountainous western states and provinces.

PARTNERSHIPS

The following partners are participating in the Boreal Wolverine research project.

- **The Wolverine Foundation, Inc. (TWF)** (Project Leader): Dr. Audrey Magoun, Director
- **Ontario Ministry of Natural Resources (OMNR):** Neil Dawson - Wildlife Assessment Program Leader, Northwest Region; Catherine Lipsett-Moore - Species At Risk Biologist, Northwest Region
- **Ontario Parks:** Dr. Geoff Lipsett-Moore, Zone Ecologist, Northwest Zone.
- **Wildlife Conservation Society (WCS)/University of Toronto:** Dr. Justina C. Ray, Associate Conservation Zoologist, North America & Global Carnivore Programs, WCS; Adjunct Professor, Faculty of Forestry, University of Toronto.

STUDY OBJECTIVES

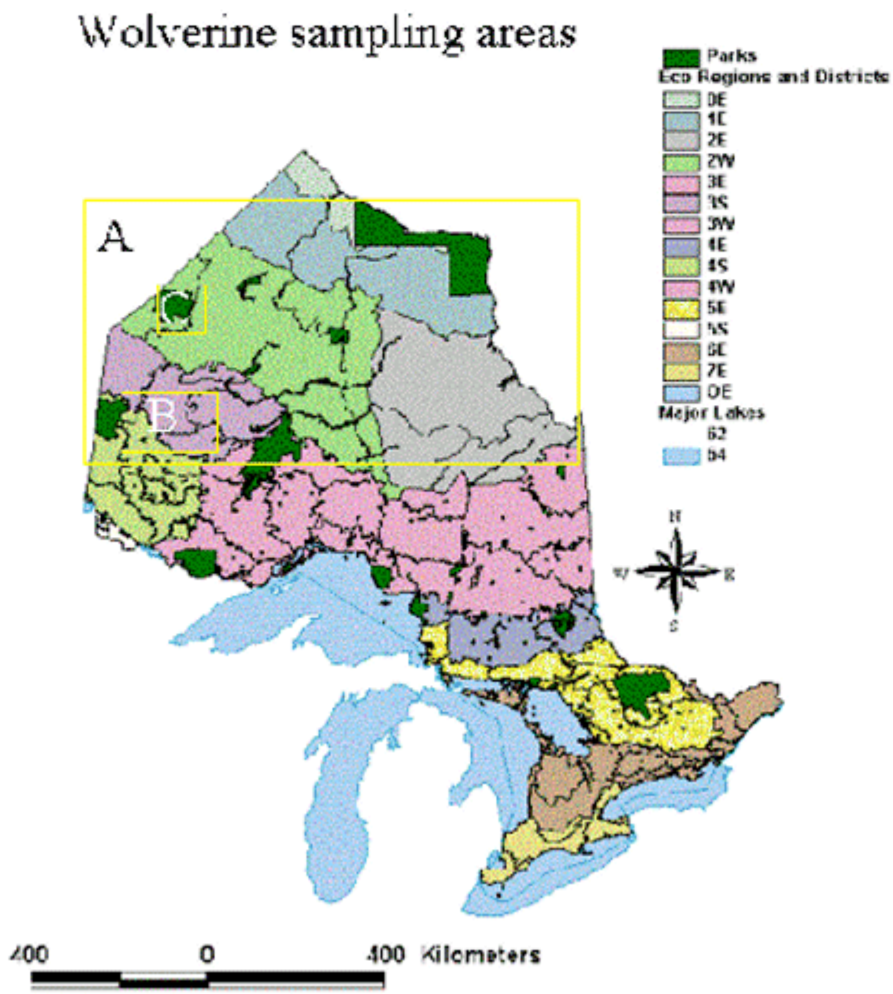
A. Refine our knowledge of wolverine distribution and habitat in Ontario;
B. Develop a first-generation spatial habitat model for wolverines in northwestern Ontario;
C. Test the feasibility of using satellite/VHF collars to document home range, movements, habitat selection, and residency status of wolverines in low elevation boreal forests;
D. Develop and test tools for inventory and monitoring of wolverine populations in

eastern boreal forest habitats;

E. Develop interim management guidelines and recommendations for maintaining or expanding wolverine populations in northwestern Ontario in areas of timber harvest or potential timber harvest;
F. Establish an action plan for more detailed studies on wolverine ecology, status and distribution, habitat use, and impacts of timber harvest and other activities on wolverines in eastern Canada.

STUDY AREA

The study will be conducted in northwestern Ontario. The study area is divided into 3 units: Study Area A: (Extensive Area) a broad area that extends from Ear Falls (south of Red Lake) to Fort Severn, and from the border with Manitoba to James Bay. Aerial track surveys conducted in this area will consist of long transect lines designed to detect wolverine tracks over large areas. Study Area B: (Intensive Area) is a southern subunit of the study area which will be used to compare several survey techniques conducted simultaneously in logged and unlogged habitats in the Red Lake area. Within this area, four survey blocks, each approximately 2,500 km^2, will be delineated. Study Area C: (Intensive Area) is a northern subunit of the study area centered on Opasquia Provincial Park that will address the sampling of unrepresented stratum, while also acting as a "control site" (see Wolverine Sampling Areas Map).



METHODS

Several distinct data sets of wolverine occurrences will be collected during the course of this study for use in complementary analyses (see below) and will be combined with recent historical data (since 1980) collected by Dawson (2000): 1) statistically independent locations from satellite-collared individuals (satellite locations); 2) spatially explicit observations from presence/absence surveys using aerial track surveys, camera traps, and hair snares (survey locations); and 3) locations of sightings, roadkills, and trap-line returns (opportunistic locations). As described below, satellite and survey locations will be used to derive the habitat models. Sample size will consist of the total number of locations obtained. We estimate that 50-100 sample locations will be adequate to derive a robust first generation model. Results from the first year's efforts will determine sampling intensity in the second year. The allocation of sampling methods and effort will be assigned to maximize the cost effectiveness and efficiency of the project.

Pre-stratification - The study area will be pre-stratified using a range of biotic and abiotic factors that span broad environmental gradients; these will likely include, but are not limited to, snow cover, soil fertility, and broad vegetation classes. These strata will be mapped across the study area using GIS and all existing presence/absence data will be overlain to define un-represented strata.

Sampling - Aerial surveys will sample remote stratum, particularly less dense vegetation classes, although a subset of dense classes with associated open lake systems will also be sampled to compare with the other survey techniques. Camera trapping and hair snagging stations will be constrained to sampling dense vegetation types in Study Areas B and C. Camera traps and hair snagging stations will be deployed in ground accessible areas in Area B and by aircraft in Area C. The total number of hair snagging stations will depend on the amount of time it takes to set out and maintain the stations, but we estimate at least 100 stations in Area B and 25 - 50 in Area C. Live trapping will occur in ground accessible areas in Area B and capture sites will be incorporated into the sampling framework. Point locations obtained from aerial surveys and telemetry data will be analyzed for independence (Swihart and Slade 1985) and only statistically independent locations will be incorporated into spatial habitat models. In addition, covariates will be developed to account for differences in survey effort and method.

Telemetry - Wolverines will be captured in baited log-cabin style traps (Copeland *et al.* 1995), immobilized, weighed and measured, and ear-tagged; tissue samples from earplugs will be saved for DNA analyses. The wolverines will be fitted with satellite/VHF radio-collars and released. Primary collar monitoring will be through the ARGOS satellite system. If reproductive-age females are captured, the VHF unit can be used to locate potential natal den sites. The VHF unit will also be used to recover the collar, which is designed with a drop-off feature. They can also be used to periodically test the accuracy of satellite locations.

Camera Trapping - Initial surveys in the Red Lake area and other studies (Foresman and Pearson 1998, Kucera *et al.* 1995) have shown that wolverines can be detected using this technique. TrailMaster 1500 transmitters and receivers combined with the TM-35 camera kit will be established within accessible portions (vehicle or snowmobile) of Area B. Cameras will be placed near riparian areas at roughly 10 km intervals and baited with road-killed moose or deer. Sites will be visited every 14 days to check batteries and film and to freshen the bait. Cameras will be set from January to April inclusive. When a wolverine has been detected at a given site the camera will be taken down and moved to a new site to increase area coverage. A total of 30 initial camera-trap stations will be established each field season. Data on "captures" of wolverine and other carnivores will be used in the modeling phase of the project. Information will be collected on location and local habitat features (see below) for each station regardless of whether wolverines are detected.

Hair-snagging - Methods for gathering wolverine hairs are being developed by Jeff Copeland with the U.S. Forest Service. This methodology will be used for gathering hair samples from wolverines. Information will be collected on location, lure, characteristics of the scent station, and local habitat features for each station regardless of whether hairs are snagged.

Aerial Track Surveys - Pilots from Alaska with extensive experience tracking wolverines from the air using slow-flying, fixed-wing aircraft will be used to conduct aerial track surveys in a 2-week period during the February-April period. The aerial track surveys will be conducted on two levels of intensity:

1) Extensive - Approximately 1500 km of transects will be selected based on pre-stratification (see below), biological, logistical, and safety considerations. The flight paths for this survey will be standard transects, sampling pre-identified stratum. Observations outside the pre-set transects will also be collected as incidental records. The transect lines will also span the area from highest wolverine harvest density in the north to the lowest in the southern part of Area A (Dawson 2000). GPS coordinates of all wolverine tracks crossed along the survey route will be recorded as well as habitat features in the vicinity; tracks or visual sightings of other species will be noted.

2) Intensive - Intensive searches for wolverine tracks will be made in each survey block in Area B by flying a pattern that will result in all areas of the unit falling within 5 km of a flight path. The level of searching is well within the conservative approach recommended by Zielinski *et al.* (1995). The exact flight path is at the discretion of the pilot and will depend on forest density, topographic features, number of lakes and waterways, and presence of other animal tracks. GPS coordinates of all wolverine tracks at the point where they were detected will be recorded as well as habitat features in the vicinity.

MODELING AND ANALYSIS

Initial Characterization of Wolverine Habitat ("Expert Derived Model") - Before undertaking the modeling exercise, wolverine researchers from North America and Eurasia will be asked to describe important features of wolverine habitat in their study areas. This information will be synthesized and commonalities identified. We will then construct a preliminary decision-tree (Starfield 1991) designed to identify habitat features that are likely to be important to wolverines in Ontario. The simple decision-tree will be applicable to any ecoregion or subregion and will be designed to answer the question "Is this area good wolverine habitat?" The decision-tree will then be sent to the same researchers for a critique of its validity and suggested revisions. This exercise will help us to identify explicit, key variables that should be included in our spatial habitat model, highlight areas where information on wolverine life history requirements is lacking, and refine and focus our research efforts.

Empirical Wolverine Habitat Model - We will construct empirically-derived predicted wolverine distributional models by first relating species occurrence data to both local and landscape-level categories (mapped layers) using multiple logistic regression techniques to determine those variables most strongly associated with the presence of wolverine (see Carroll *et al.* 1999; 2001; Mladenoff *et al.* 1995; Burnham and Anderson

1998). This will be followed by forward stepwise Generalized Additive Modeling (GAM's) to help construct the final model with the best fit to the data. This approach was used extensively in Australia, for example, to derive144 habitat models for priority fauna species (RACAC 1999). Further exploratory analyses will be conducted by testing single habitat predictor variables for significance (Spearman's Rank Correlation; Carroll *et al.*1999).

Landscape-level mapped layers are likely to include: 1) Abiotic factors – (snow cover in April, monthly maximum temperature, monthly minimum temperature, annual average precipitation; terrain variables such as digital elevation model (DEM), topographic indices, ruggedness indices; surficial geology/soil fertility variables); 2) Biotic factors – (vegetation [Landcover 28], fire history, indices defining the distribution of other species such as caribou, moose, other furbearers); and 3) Human-impacts - (road density, human population density, settlements, outfitters, forest management history, and other human impact variables).

To grapple with varying assumptions and resolution characteristics of the wolverine data sets, we will derive appropriate covariates and construct separate logistic regression models for each data set. With survey location data, we will compare habitat features at points where wolverines were confirmed present with locations within independent sampling units from the same surveys where they were absent. We will compare associated habitat features against pre-determined random points in the study area using trapline and opportunistic data. We will also model landscape and local-level habitat variables separately. Sample sizes for significance will be corrected for spatial auto-correlation (Cliford *et al.* 1989). We plan to validate the model results using points from available datasets (i.e., trapping returns and/or occurrence data) from other central Canadian provinces with similar wolverine habitat by correlating predicted habitat values and number of occurrences per unit area (Carroll *et al.* 2001).

Project Dates: The project is slated to begin August 15, 2002 with completion of fieldwork by March 31, 2004. Final reports and manuscripts for publication will be completed by December 31, 2004.

Tangible Deliverables and Target Dates:

- Progress Report (5/31/03)
- Broad-scale distribution map for wolverine in Ontario (3/31/04)
- Report on methodologies for studying wolverines in lowland boreal forests (3/30/04)
- First-generation spatial habitat model for wolverines in northwestern Ontario (5/30/04)
- Final Report (6/30/04)
- Interim management guidelines for wolverine habitat, particularly in relation to forestry activities, recommendations for maintaining or expanding wolverine populations in northwestern Ontario, and relevance to wolverine population management and recovery in other jurisdictions with similar habitat (9/31/04)

- Action Plan for more detailed studies on wolverine ecology, status and distribution, and impacts of timber harvest and other activities on wolverines in eastern Canada (10/31/04)
- Manuscripts submitted for publication (12/31/04)

**** Related publication:**

Magoun, A. J., J. C. Ray, D. S. Johnson, P. Valkenburg, F. N. Dawson, and J. Bowman. 2007. Modeling Wolverine Occurrence Using Aerial Surveys of Tracks in Snow. Journal of Wildlife Management. 71(7):2221-2229.

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Ontario Wolverine Project Report - July, 2004
Ontario Wolverine Project Report Appendix - July, 2004
Capture Updates
MAY, 2003 PROGRESS REPORT
YEAR 1 STATUS REPORT
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