THIRD INTERIM PROGRESS REPORT

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AN ENERGETICS-BASED HABITAT MODEL FOR MARTEN IN WESTERN NEWFOUNDLAND

A RESEARCH COMPONENT OF THE MODEL FORESTRY PROGRAM IN WESTERN NEWFOUNDLAND

PREPARED FOR

THE MANAGEMENT COMMITTEE
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INTRODUCTION

The Western Newfoundland Model Forest program represents a vision of the future of Canadian forest management, where all resources and concerns will be considered during forest planning. Identifying the resources of concern is the easy part. However, addressing competing concerns (to the satisfaction of all) provides a much more significant challenge. Our project will provide a means to meet one of the most demanding challenges in western Newfoundland.

Conserving the Newfoundland marten (*Martes americana atrata*) appears to conflict directly with timber resource objectives. Previous research within the area encompassed by the Model Forest has shown that Newfoundland marten prefer large tracts of old forest with a contiguous tree canopy. This suggests rather emphatically that martens cannot flourish in a harvested landscape. However, the Model Forest is charged with providing timber products and ensuring marten survival. Our contribution to the Model Forest will be a distinctive habitat model that will at last provide a quantitative means for evaluating management plans respective to both timber and marten needs.

We have chosen an energetic approach for our model to reflect the marten's morphology and the distinctive living conditions of western Newfoundland. To survive, each marten must balance energy costs demanded by the environment, principally cold stress, as well as extract energy from the environment in the form of food. We intend to determine to what extent energy balance governs marten behavior, particularly in reference to marten habitat. The first step is to determine how much energy marten's need under controlled environmental conditions, and then see how these conditions relate to "real" habitats in western Newfoundland. This information will then be incorporated into a landscape-level model.

OBJECTIVES AND ACCOMPLISHMENTS

We had two principal objectives for the period from October 1, 1993 to January 31, 1994. We have continued to refine the conceptual framework for the inner workings of the model and how it would be used in forest practice. We have also commenced laboratory experiments to investigate marten energy needs in controlled conditions, which provide the foundation for the model.

The October 1 progress report illustrated our model's conceptual basis and practical application. The model relates individual marten energetic needs to actual landscapes by means of a "smart marten," a tool for evaluating points in a landscape one at a time. Landscape-level parameters such as dispersal then combine with the energetic landscape to provide a final picture of marten habitat suitability.

We have since refined our understanding of the data necessary to construct such a model. Existing published data on marten energetic needs under controlled conditions suffer from insufficient sample size and conflicting results. Furthermore, these works have each considered only one season, whereas marten live in a highly seasonal environment.

We have been actively engaged in developing a complete picture of marten energetic needs in a variety of environmental conditions and as a function of season.

Two distinct experiments are needed to evaluate marten seasonal energetic needs. The most basic of energetic measurements is basal metabolic rate (BMR), the amount of energy needed by a marten in resting condition. Because even resting marten experience a variety of environmental conditions in the wild, we have conducted our experiments to examine metabolic response to temperature (MRT).

We conducted summer trials from late July to early August, 1993. The rate of oxygen consumption (VO_2), which reflects the rate of respiration (and therefore metabolism), was measured using open-circuit respirometry. Fractional excurrent oxygen levels were measured using an Ametek S-3A oxygen analyzer. Standard Metabolic Rate (SMR) and Metabolic Response to Temperature (MRT) were measured from 0800 to 2100 hours, to reflect the active period of marten in summer. For summer MRT, marten were exposed to 25 C, 20 C, 15 C, 10 C, 5 C, 0 C, and -5 C temperatures. Individual animals were exposed to three of these temperatures for one hour each, allowing 15 minutes equilibration once a stable temperature had been reached. Metabolic rates were determined as the mean VO_2 over the entire hour. The DataCan computer program was used to monitor output.

We conducted fall trials while our marten were changing from summer to winter pelage, in mid-October. For fall MRT, marten were exposed to 20 C, 15 C, 10 C, 5 C, 0 C, -5 C, -10 C, and -15 C temperatures. Results from both summer and fall trials were both encouraging and curious. Our captive marten quickly adapted to the test chamber, and therefore provided results compatible with wild marten resting in familiar densites. Our summer lower critical temperature (LCT), the temperature below which metabolic thermogenesis (shivering and fat metabolism) begins, was close to 15 C, which is similar to that reported by Buskirk *et al.* (1989) but far below the 29 C reported by Worthen and Kilgore (1981). These studies, however, reported winter LCT, not summer LCT. Furthermore, our LCT for the fall trials was nearly identical to that for summer, despite obvious changes in pelage condition. These results support the hypothesis that winter is the most energetically limiting season for marten.

The Near Future

Because energetics seem to be most limiting for marten in winter, our ongoing winter trials are the most crucial to the habitat model. During November and December we received considerable financial cooperation from the Utah State University Ecology Center, which allowed us to construct an environmental chamber capable of holding the -25 C temperatures needed for winter trials. Furthermore, because our artificial dens and cages did not provide adequate thermal insulation, we moved our captive marten into a controlled winter environment.

We have already begun our examination of BMR and MRT for winter-acclimated marten, using 20 C, 15 C, 10 C, 5 C, 0 C, -5 C, -10 C, -15 C, -20 C, and -25 C temperatures.

However, because marten are highly active, resting metabolism alone is clearly not enough to construct a good energetics model. Consequently, we constructed a marten-sized treadmill for measuring the effect of activity on metabolism and thermoregulation. We have taken several weeks to acclimate the martens to the treadmill, with good results. Treadmill speed will approximate three activity levels common to martens: 1) crawl, which simulates very low activity, 2) medium, which simulates typical foraging speed, and 3) high, which simulates active pursuit or escape. Each marten will run for 10 minutes for all three speeds and 20 C, 15 C, 10 C, 5 C, 0 C, -5 C, -10 C, -15 C, and -20 C temperatures. This information will allow us to assess the hypothesis that marten make up for poor morphological adaptations for cold by being active. Furthermore, once we have examined the daily activity patterns (relative to environmental conditions) of marten in Newfoundland, we can use this information to piece together daily energy budgets respective to habitat- the basis for our habitat suitability model.