## Research

# From local adaptation to geographical variation: pine marten response to food abundance and climatic conditions

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#### Abstract

Understanding the relative contributions of extrinsic and intrinsic processes, in explaining population regulation and limitation, are basic questions in ecology. Here I report on how a solitary carnivore (the pine marten) changes its behaviour in response to environmental variation, and how this variation affects the population dynamics of this predator, by analyzing the marten population at a local scale and throughout their geographical range. In Białowieża Forest, martens showed a functional response to fluctuations in rodent numbers. During the climatically harshest period, the marten diet was composed of a greater amount of larger prey, and the food niche breadth was wider. Martens also markedly changed their mode of use of the home range in response to environmental variation. Daily movement distances and daily range declined with increasing rodent abundance or decreasing ambient temperature. Spacing pattern, however, was very stable with strong territorial behaviour. Density was very high and changes in population size were density-dependent and prey-dependent. The combination of these factors regulated marten density at a stable level. Martens reduced competition between the sexes by partitioning their food niche, which arose as a result of variation in the behaviour of males and females.

At a larger geographical scale, marten diets showed a very clear latitudinal pattern in 4 types of main food items, resulting in an increasing food niche breadth and prey size along a south-north gradient. The bank vole and large prey were important components of marten diet throughout Europe. There was also a geographical gradient in marten mobility and home range size. Daily movement distance of pine martens in winter increased significantly from south to north in relation to winter severity (from 2 km at 41°N to 8 km at 68°N). Throughout the pine marten geographical range, the mean population density in winter varied from 0.1 to 8.9 martens/10 km<sup>2</sup>, and was negatively related to winter severity (which becomes a limiting factor). Marten body size decreased from south to north (opposite to Bergmann rule) and was negatively related to prey size. The behavioural response to environmental variation was similar at both local and geographical scales. However, with increasing winter severity towards the north, martens increased their daily movement, while at a local scale they reduced movement with decreasing ambient temperature. This comparison highlights the joint influence of food, climate and demographic factors in shaping the processes of population regulation and limitation.

#### Key words

Pine marten, Martes martes, population regulation and limitation, solitary carnivores, behavioural ecology.