

To Eat and Not to Be Eaten

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The pine marten can capture prey from 3 grams up to 4 kilos. The problem lies in choosing the right prey, and in avoiding becoming prey itself

Bergmann's rule states that mammals and birds are larger in northern latitudes than in southern latitudes. The explanation of this phenomenon is based on heat conservation. Larger bodies reduce heat loss in cooler areas, leading to increased survival. The pine marten *Martes martes* is widely distributed in Europe, and the winters in large parts of their geographical range are severe, with temperatures below 0°C. However, the pine marten is one of the few species which does not follow Bergman's rule: smaller martens inhabit northern Europe, while larger ones inhabit southern Europe. Their larger body size in southern Europe might result from the larger prey present there. Can the size of prey explain variation in the size of pine martens within their geographical range?

Have some squirrel, please

As an opportunist predator, pine martens change their diet composition depending on their geographical

location. Within their geographical range, martens hunt prey ranging in weight from as much as 4 kg (hares), down to as little as 3 g (such as shrews). Throughout Europe, however, pine martens mainly hunt small mammals, which constitute their main winter food in the temperate zone. Plant material (mainly fruits) and insects are more important food items in southern Europe, with their proportion in marten diets decreasing towards the north. The contribution of birds, medium-size mammals (squirrels and hares) and ungulate carcasses in martens' winter diet increases as their geographical range moves from southern to northern European latitudes. The higher share of birds is due to increased consumption of large birds, such as black or willow grouse. This comparison shows that martens generally hunt bigger prey in northern than in southern regions. In the south, therefore, larger martens eat smaller prey, whereas in the north, smaller martens hunt bigger prey.

Why are martens smaller in northern latitudes? One explanation might lie in their behavior. Martens are active 13 h per day when ambient temperatures are 25°C. To reduce energy loss and exposure to low temperatures, martens curtail their activity to 2 h in temperatures of -20°C. Similarly, they reduce daily movements to only 1 km per day when temperatures are -25°C. During these short time periods, martens increase their foraging efficiency by hunting bigger prey during the harsher northern winters. Compared to larger martens, smaller individuals have lower food requirements, allowing them to reduce

The pine marten proves it can cope with wide spectrum of temperatures and food sources



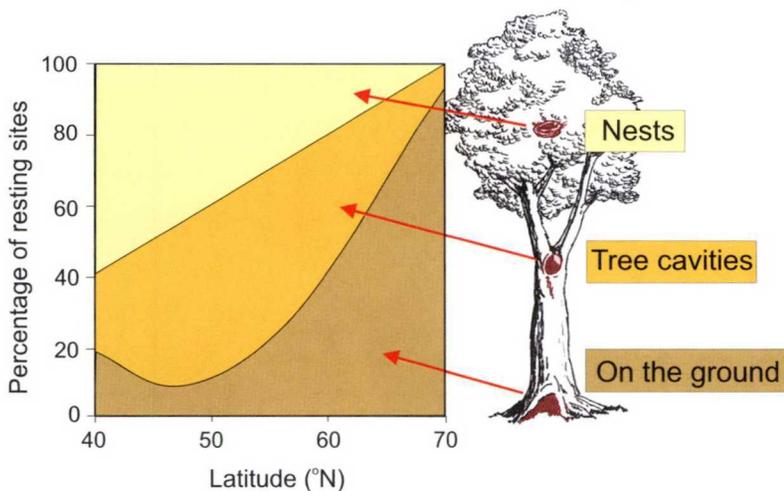
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their activity by eating bigger prey. Such behavior enables smaller martens to remain at resting sites longer, and minimizes their energy expenditures in lower temperatures. Thus, the marten's adaptation to cold climates probably involves reducing their exposure time to low temperatures and a diet functional response (behavioral adaptation), rather than an increase in body size (morphological adaptation).

Burrow or bird nest?

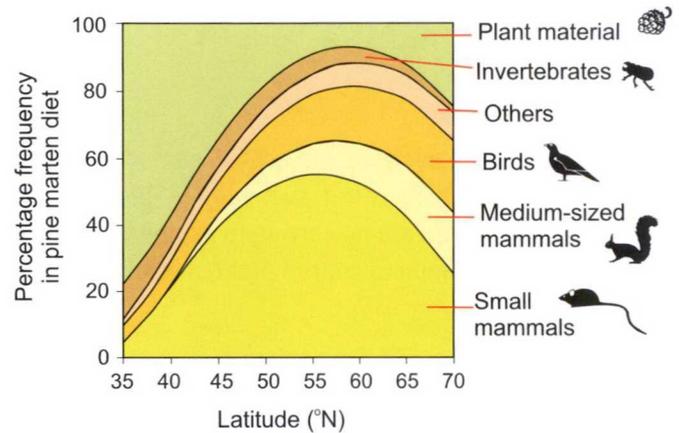
The reduction of exposure time to low temperatures may be possible only when animals can hide in resting sites, where martens curl around each other whilst sleeping and resting. Resting sites need to be dry and well insulated, in addition to being inaccessible to predators. Temperature measurements taken in three types of resting sites showed that cavities and burrows under the snow were warmer than cavities higher in trees, which, in turn, have been shown to be warmer than nests among tree branches. In southern Europe, where climatic conditions are mild, martens most often rest in nests. Resting places at ground level or in dens are seldom used. In temperate deciduous forests, when winters are severe, most resting places used by martens are located in holes (67% of resting sites), followed by squirrel and bird nests (26%). In northern coniferous forests, pine martens are in winter frequently found resting at ground level under the snow, under fallen logs, or in burrows (90%). When resting in coniferous trees, martens use nests, especially squirrel drays, and more rarely holes. This is not surprising as it is rare to find cavities in coniferous forests, due to the low number of deciduous trees and woodpecker species as compared to deciduous forests.

As resting sites at ground level are less safe than in the tree canopy, martens are more susceptible to predation there. Therefore, in northern areas where martens



Model of latitudinal variation in resting site choice by pine martens in Europe

need to rest on the ground due to severe winters and the lack of cavities, predators may regulate their numbers. Indeed, when the red fox density in Scandinavia decreased in the 1980s, the marten density increased 5 times, decreasing again in the 1990s following the recovery of the red fox population. Food competition between these two predators does not affect the increase in mar-



Model of latitudinal variation in winter diets of pine marten in Europe, based on empirical data
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ten density. If just one in 18 foxes were to kill one marten per year, this would be enough to prevent the marten population from increasing. In the northern part of the marten's range, foxes and other predators could limit the marten population due to the lack of safe arboreal resting sites.

The pine marten's adaptation to harsh, northern winters does not involve increasing its body size, but rather reducing its activity during colder days – hereby forcing martens to hunt bigger prey and choose better insulated resting places, either at or below ground level. However, these locations are less safe and expose martens to predation. Therefore, marten survival within the great variety of forest habitats and climatic conditions of Europe is a trade-off between finding large prey (to eat) and escaping from predation (not to be eaten).

Further reading:

- Zalewski A. (2000). Factors affecting the duration of activity by pine martens (*Martes martes*) in the Białowieża National Park, Poland. *Journal of Zoology*, 251: 439-447.
- Zalewski A. (2004). Geographical and seasonal variation in food habits and prey size of the European pine marten *Martes martes*. In: Harrison D. J., Fuller A. K. & Proulx G. (ed). *Martens and fishers (Martes) in human-altered environments: an international perspective*.
- Zalewski A., Iędrzejewski W., Iędrzejewska B. (2004). Mobility and home range use by pine martens *Martes martes* in Poland's primeval forest. *Ecoscience* 11 (1).