# Arthropods preferred as food by *Sorex cinereus* (masked shrew) and *Peromyscus maniculatus* (deer mouse) : an experimental approach

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*Summary.* – Traditional cafeteria trials were conducted to determine food preference rankings of *Sorex cinereus* (masked shrew) and *Peromyscus maniculatus* (deer mouse). Results showed that *S. cinereus* preferred flies, lepidopteran larvae and spiders whereas *P. maniculatus* selected lepidopteran larvae and spiders. Both species avoided ants, had similar ranking of food preferences, and shifted to alternative prey when the abundance of preferred prey decreased.

*Résumé.* – Des expériences classiques de cafeteria ont permis de déterminer l'ordre des préférences alimentaires de *Sorex cinereus* et de *Peromyscus maniculatus*. Les résultats obtenus montrent que *S. cinereus* préfère les mouches, les chenilles et les araignées, tandis que *P. maniculatus* choisit les chenilles et les araignées. Les deux espèces, qui évitent les fourmis, ont montré des préférences alimentaires comparables et ont modifié leur choix lorsque leurs proies préférées devenaient moins abondantes.

## INTRODUCTION

*Sorex cinereus* (masked shrew) and *Peromyscus maniculatus* (deer mouse) are widely distributed throughout the boreal forest in North America. In northern Ontario, Canada, *S. cinereus* may be found at all successional stages of pure and mixed forests, but it is more common in medium-age and old-grown plantations. *Peromyscus maniculatus* is an early successional species, abundant in clearcuts and recent plantations (Naylor and Bendell 1983).

Diet of *S. cinereus* was described in several localities. It is a generalist insectivore that feeds almost exclusively on arthropods (e.g., Hamilton 1930, 1941 ; Whitaker and Mumford 1972 ; Whitaker and French 1984). A previous experiment conducted under natural conditions in northern Ontario, showed that *S. cinereus* prefers spiders and lepidopteran larvae as food, shifting to alternative prey when the abundance of lepidopte-

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ran larvae decreased (Bellocq *et al.* 1992). This voracious predator weighs 4.6 g (mean weight of adults, Innes *et al.* 1990) and has a minimum oxygen consumption of 7.9 ml $O_2$ $g^{-1}$ $h^{-1}$ (Buckner 1964).

*Peromyscus maniculatus* is omnivorous, but seeds and arthropods represent the major source of food (e.g., Jameson 1952 ; Williams 1959 ; Whitaker 1966 ; Hahus and Smith 1990). Its mean weight is 19.9 g and the basal metabolic rate (2.06 ml $O_2$ $g^{-1}$ $h^{-1)}$ is higher than that of most other species of the genus (MacMillen and Garland 1989). Food preferences of *P. maniculatus* have been explored using different kinds of seeds (e.g. Drickamer 1970, Tardif and Gray 1978, Reichman and Fay 1983), but essentially no information is available on preferred arthropods.

In this study, we present the food preference ranking of *S. cinereus* and *P. maniculatus*, based on the results obtained on trials performed offering different kinds of arthropods under conditions of equal availability of food items and simultaneous encounters between predator and prey.

## MATERIALS AND METHODS

Animals for the experiments were live trapped in jack pine plantations near Gogama, Ontario (47°31'N and 81°40'S), during the summer of 1992. Shrews were captured in a 25-year-old stand using pitfall traps (plastic pots, 30 cm height, 20 cm diameter) containing approximately 5 cm of pine needles and inserted flush with the ground. Mice were caught in a 3-year-old stand using longworth traps baited with peanut butter. All animals were released after the experiment.

Because *S. cinereus* shows high mortality in life traps (e.g. Getz 1961), traps were checked twice daily. High metabolic rate, leading to starvation, was suggested as the primary factor affecting survival of shrews in life traps (Pearson 1947), even when traps are checked often. Attempts to keep the shrews on pretrial diet in captivity also resulted in high mortality likely due to excessive stress. Consequently, experiments were conducted immediately after capture with shrews presumably starving. In contrast, *P. maniculatus* were exposed to peanut butter *ad-libitum* for at least 5 hours prior to the experiment.

To conduct the trial, each animal was set in a plastic container (32 cm diameter, 45 cm high). Arthropods for the experiment were collected by sweep net from low shrubs and herbs of the forests. Arthropods were killed just before each trial to ensure they were fresh, and put all together in a Petri dish (0.9 cm height, 9 cm diameter) into the pail.

Traditional cafeteria trials were conducted offering simultaneously the same number (10 individuals) of different kinds of foods : lepidopteran larvae, moths (lepidopteran adults), bugs (Hemiptera), spiders (Araneae), beetles (Coleoptera), flies (Diptera), ants (Hymenoptera), and rice. Food was not replaced as it was consumed, and water was provided *ad-libitum*. The remaining arthropods and seeds were counted regularly every one to two minutes until all food was eaten or until the animal refused to eat more. The trial was replicated with 11 *S. cinereus* and 12 *P. maniculatus* (1 juvenile male, 3 adult males, 6 juvenile females, and 2 adult females). Sex of the shrews was not possible to determine from external morphology.

Rodgers' (1990) method was used to obtain the preference indices and to rank food preferences. This method appears to be the best for cafeteria experiments when prey are not replaced as they are consumed (Krebs 1989). It takes into account individual variations through the total proportion of foods consumed and the rate at which they are consumed. The method gives standardized preference indices based on the area under the curves of cumulative proportion of food eaten as a function of the time. The index values vary between 1 and 0. Based on the preference indices, a food preference ranking was assigned to each individual and mean preference indices and standard errors were calculated. Spearman's coefficient was used to correlate food preference rankings between *S. cinereus* and *P. maniculatus*.



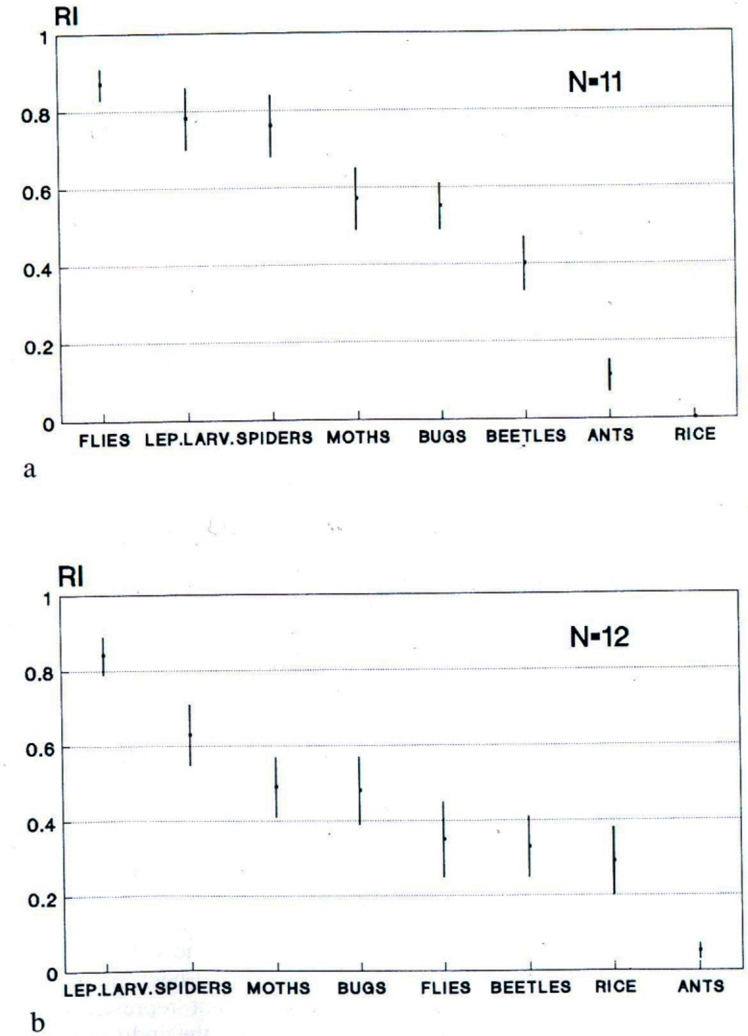


Fig. 1. – Rodger's indices (RI, mean ± 1 SE) and ranking of arthropods (and rice) preferred as food by (a) *Sorex cinereus* and (b) *Peromyscus maniculatus*.

## RESULTS AND DISCUSSION

*Sorex cinereus* preferred arthropods over rice when both types of foods were equally available. None of the shrews ate rice during the trials, but it is possible that other seeds were more palatable to shrews than rice. Diet of *S. cinereus* generally do not include seeds during summer neither in our study area (Bellocq *et al.* 1992, Bellocq *et al.* in press) nor in other areas (e.g., Whitaker and French 1984), although a shift in the diet from insects in the spring-summer to seeds in the fall-winter has been reported (Criddle 1973).

Based on mean Rodgers' index values, flies, lepidopteran larvae, and spiders were preferred prey of *S. cinereus* whereas ants were avoided (Fig. 1*a*). Flies would be preferred over other arthropods if they were equally available, however, under natural field conditions, lepidopteran larvae and spiders were selected over flies (Bellocq *et al.* 1992). Because of differences in vertical distribution and ability to escape from mammalian predators, the vulnerability of flies to shrew predation in the wild is lower than that of epigean spiders and larvae. Some species of flies, however, pupate on the ground and the adults spend a few hours at ground level before flying, thus being exposed to a high predation risk.

*Peromyscus maniculatus* preferred lepidopteran larvae and spiders and avoided ants (Fig. 1*b*). Lepidopteran larvae was the primary food (15 %) found in stomachs of *P. maniculatus* in Indiana during the summer (Whitaker 1966), but no reference to the availability of food was provided.

*Sorex cinereus* and *P. maniculatus* had similar food preference rankings ($r_s = 0.738$, $P < 0.05$). The main difference between both predator species was the ranking assigned to flies. In general, mice are more adapted to eat hard food than shrews because of differences in anatomical adaptations and handling capability. For instance, *P. maniculatus* usually ate beetles completely during the experiments, whereas *S. cinereus* ate the abdomens discarding heads and elytra.

Individual variations and their role in population biology were widely reviewed by Lomnicki (1988). Diet and prey selection of small mammals may differ with sexual maturation and social behaviour. Adult *S. cinereus* were reported to eat a lower proportion of lepidopteran larvae and a higher proportion of spiders than juveniles (Bellocq *et al.* 1992). Feeding diversity was greater in immigrants than in resident *P. leucopus* (Tardif and Gray 1978).

When the abundance of preferred prey decreased, these predators used alternative prey showing that *S. cinereus* and *P. maniculatus* might show a sigmoidal functional response to the abundance of preferred arthropods. Holling (1959) and Buckner (1966) showed strong evidence of numerical and functional responses of *S. cinereus* and *P. maniculatus* to changes in the abundance of larch sawfly *(Pristiphora erichsonii)*. Bellocq *et al.* (in press) suggested possible numerical response and showed functional response of *S. cinereus* to the abundance of lepidopteran larvae.

Prey selection depends on the abundance, distribution, and vulnerability of alternative prey. The average ranking of food preferences presented here, pretend to approach that of the population. Although these experiments do not represent the conditions under which predators usually find their prey, they show the individual variations in food preference ranking that could be expected, and the kind of arthropods that would be exposed to a high risk of predation by *S. cinereus* and *P. maniculatus*.



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