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Experiments on Microhabitat Preference of Polecats

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The microhabitat selection of two hand-reared polecats, *Mustela putorius* Linnaeus, 1758, was investigated in an experimental outdoor enclosure. The animals showed a finely-scaled preference for densely structured microhabitats even within a habitat offering cover (oak forest). Experimental modifications of the vegetation cover resulted in significant changes of microhabitat use. Given the choice of dense vegetation, and bare ground with complete sight cover from above, the polecats preferred bare ground. The origin and function of the described microhabitat preference are discussed, using the experimental results and literature. It is hypothized that (1) a preference for sight cover is innate to polecats and (2) this is an adaptation to anuran microhabitat use, or to predation pressure.

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1. INTRODUCTION

Information from several authors suggests a preference of polecats for habitats providing cover (*e.g.* Usinger, 1931; Goethe, 1940; Hainard, 1948; Harter, 1959). A preference for habitats providing cover, *e.g.* forests, could be shown on a large scale using radio-telemetry (Weber, 1989b) and was already mentioned by Herrenschmidt (1982). However, there is only anecdotal information available on microhabitat use.

Observing radio-tracked polecats revealed a strong attachment of these animals to densely structured habitats (Weber, 1987, 1989b). Although the animals were, surprisingly, not very shy towards the observer and other people, direct sightings were rare occurrences. Active polecats literally dived into and across dense vegetation, heaps of leaf litter or twigs. Even at distances of a few metres, exact locations of polecats were usually only possible by observing the movements of plants, or by listening to the many noises of the animals. However, the radio-tracking study did not allow the selection of densely structured microhabitats to be quanitified, as the availability

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of such places could not be precisely evaluated. An analysis on a larger scale has at least shown that wild polecats avoided open habitat types like agricultural areas (Weber, 1989b).

The aim of the present study was to test the finely-scaled preference of polecats for densely structured microhabitats even within habitats offering cover (*e.g.*, forests), and to investigate the extent, the constancy and dependence on individual experience of this preference.

2. METHODS

2.1. The Experimental Enclosure

All experiments presented in this paper were conducted in an outdoor enclosure at Reinach near Basle (Switzerland). An area of 10×20 m was fenced in, at the edge of a deciduous forest at a place regularly used by wild polecats (Weber, 1987). On two sides, the enclosure was surrounded by old trees (mainly oaks); on the other sides, and inside the fence, the vegetation consisted of a wet meadow in the first successional stages of spontaneous re-afforestation.

One half of the enclosure was only opened to the polecats when an experiment was being conducted. The part where they normally lived was bare of cover, except for the den, a heap of twigs and some sedges by a small pond which provided drinking water. Growing vegetation was regularly cut until the first two experiments were concluded. Thus, the ground of the enclosure consisted of patches of short grass and bare soil with some dry leaves.

2.2. The Polecats

For the experiments (conducted from July 1985 to April 1986) three polecats were hand-reared in summer 1984. According to the dealer who supplied them, these animals were the two sons and the daughter of a female caught in the wild some weeks before parturition in the Harz mountains (Germany).

I obtained these polecats when they were about seven weeks old and reared them for three months with the closest possible contact with man. They were then released into the enclosure. At this time, they were scarcely tolerant of being carried by people, but showed no obvious fear towards observers. Except when they were sleeping, they approached immediately on being called or whistled to, and begged for food. They then climbed upon me and wildly bit shoes, hands and clothes. This tameness towards me was retained until the end of the experiments. However, they became increasingly shy towards other persons, whom they finally approached only when hungry, to beg for food.

All three polecats escaped in October 1984. After three days, I found the two males in the forest, from where they followed me willingly back to the enclosure. Unfortunately, the female was not found, so all experiments were conducted with the two brothers "Harpo" and "Groucho". With the exception of the three-day escape, the polecats had no contact with dense vegetation until the experiments started. Except during experiment 3, the polecats were always given their food at sites without cover.

2.3. The Experiments

The 10×10 m compartment of the enclosure which was normally inaccessible to the polecats served as an experimental arena. Within this arena, 81 1-m-squares were marked in a way that allowed the position of a polecat to be attributed to an individual square from the observation site. A strip of 50 cm along the surrounding fences was not marked, and not treated as part of the arena.

The vegetation of the experimental enclosure was similar to that of a clearcutting several years old, and consisted of a 50 to 70 cm high thicket, with mainly bramble (*Rubus* sp.), raspberry (*Rubus idaeus*) and blackthorn (*Prunus spinosa*), with which several grasses (*Carex silvatica, Luzula pilosa, Deschampsia caespitosa, Poa trivialis* and others) and herbs were mixed. The thicket was difficult for man to enter and provided complete sight cover for polecats from the outside. This type of vegetation will be referred to as "vegetation cover" or "cover" in this paper. In the squares described as "coverless" or "bare", all plants and other structures were completely removed, so that the soil was either bare, or covered with a number of leaf rosettes and the typical leaf-litter of oak forests.

Observations were made mostly at dawn or at night and only when the polecats showed spontaneous activity. The entrance of the experimental arena was opened, so that the animals could decide whether to enter it or not. In the arena, the position of each polecat was recorded at 30 second-intervals. If an animal happened to be on the boundary between two squares, it was recorded in the square where it had its forefeet. When in areas with vegetation cover, the polecats were detected by plant movements. However, in some cases of doubt, only the position "cover" was recorded, if the position of the animal could not be attributed to a single square. No positions were recorded when the polecats were within the 50 cm-strips along the fence, or while they were eating.

All statistical treatment of the data was performed according to Mühlenberg (1976).

3. RESULTS

3.1. The First Experiment

Before allowing the polecats to enter the experimental enclosure for the first time, the vegetation cover was removed from 40 squares. After the entrance was opened, the animals hesitated to enter for several minutes, and then timidly and cautiously started their first excursion. Some minutes later, their fear had gone and they began to rummage around in the whole arena. On the following evenings, they entered the area without signs of fear. As in the later experiments the polecats were allowed to stay inside the experimental enclosure, as long as they did not try to store food or to dig holes there.

336 of the total 455 records were from squares with vegetation cover. The preference for squares with cover is significant for both individuals ("Harpo" chi-square=41.36; $p<0.001$; "Groucho": chi-square= =52.69; $p<0.001$). Squares without cover were predominantly used near the entrance, where the polecats sometimes stopped to watch

before continuing to enter the areas with cover. Additionally, such squares had to be crossed when entering the experimental enclosure.

3.2. The Second Experiment

For the second experiment, the distribution of vegetation cover was changed (Fig. 1). Especially some squares near the entrance, which had been intensively used during the first experiment, were made coverless. On other squares, vegetation was allowed to grow and shrubs were planted. The distribution of 136 following records ("Harpo" 39, "Groucho" 97) shows as in the first experiment a significant avoidance of coverless squares ("Harpo": chi-square=24.34; $p<0.001$. "Groucho": chi-square=60.87; $p<0.001$).

Squares which were cleared after the first experiment were used less than those with conserved cover ("Harpo" chi-square=24.31, $p<$ <0.001; "Groucho" chi-square=8.82, $p<0.005$). Of the squares which were without cover during the first experiment, those with newly established cover were preferred to those which remained bare ("Harpo" chi-square=5.61, $p<0.02$; "Groucho" chi-square=26.77, $p<0.001$).

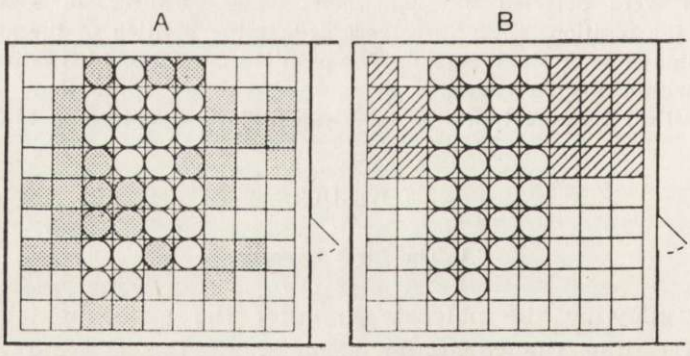

Fig. 1. The experimental arena in the second and third (A), and the fourth (B) microhabitat choice experiment. Areas with vegetation cover with circles, areas with plastic foil hatched. Shading indicates squares on which the structure was changed after the first experiment.

3.3. The Third Experiment

After the second experiment, the polecats were fed for 20 days in the experimental enclosure only. The distribution of the vegetation cover was not changed. About 50 food items (mainly laboratory mice cut in quarters) were distributed equally in a way that none was nearer than one metre to squares with cover. The items were covered with leaf-litter. The polecats were then allowed to enter. Within a few days, they became accustomed to this kind of feeding: after the entrance had been opened, they began searching with excitement and high speed on the bare ground. Each food item found was immediately stored in a hiding-place in the vegetation cover of the experimental arena, in the den, or in the heap of twigs. After about ten minutes, all food had usually been found, and the polecats began to feed in their hiding-places. If after the meal they did not leave the experimental enclosure by themselves, they were chased out and the entrance was closed.

After this training period, the use of different squares within the experimental enclosure was recorded for a third time (N=103); the distribution of cover was not changed. For these observations, no food was distributed, but the polecats were let in hungry. Now, the polecats used the squares without cover somewhat more intensively than during the second experiment (pooled data of both polecats: chi-square= 4.13; $p<0.05$; for individuals not significant). This was mainly during the first few minutes, when they rapidly searched for food on the patches without cover. However, they soon continued to move around mainly within cover, which resulted in a remaining overall preference for areas providing vegetation cover ("Harpo": chi-square=14.91; $p<0.001$; "Groucho": chi-square=21.35; $p<0.001$).

3.4. The Fourth Experiment

For the last series of observations, the existing distribution of vegetation cover was retained. Two bare areas were covered with a black plastic foil 30 to 40 cm above the ground (Fig. 1). This material is normally used for mulching in commercial vegetable plantations. The ground under this foil was swept as clean as possible, but I could not avoid some leaf-litter being brought in by the wind and later by the polecats. For this cover I selected two areas which the polecats had especially avoided during the previous experiment (13 records compared with 27 on other coverless squares). The distribution of records during the following observation periods is given in Tab. 1.

The areas covered with plastic were used most intensively and preferred to both those with vegetation cover and those without cover (Tabl. 2). The figure for the former is statistically not significant for "Groucho" which is probably due to a lack of records from this animal. By this time, he had almost lost all interest in the experimental enclosure and entered mainly to search for an opportunity to escape along the fence.

Within the area which had been without cover during the previous

Table 1

Results of the fourth microhabitat choice experiment

	Microhabitat offer (1 m squares)		Records of polecats					
			"Harpo"		"Groucho"		Total	
	N	%	N	%	N	%	N	%
Coverless	32	39.5	20	27.8	7	22.6	27	26.2
Vegetation cover	30	37.0	25	34.7	12	38.7	37	35.9
Plastic foil	19	23.5	27	37.5	12	38.7	39	37.9
Total	81	100.0	72	100.0	31	100.0	103	100.0

Table 2

Chi-square-tests on microhabitat preference in the fourth microhabitat choice experiment.

Compared microhabitats	"Harpo"		"Groucho"		Both polecats	
	χ^2	p	χ^2	p	χ^2	p
Plastic foil vs. coverless	8.22	<0.01	5.65	<0.02	13.44	<0.001
Plastic foil vs. vegetation cover	3.74	<0.04	1.28	>0.20	5.00	<0.03
Plastic foil vs. both other	7.89	<0.01	3.96	<0.05	11.83	<0.001

experiment, the distribution of records changed significantly for both polecats, after the installation of the plastic roof. ("Harpo" chi-square= $=4.85$, $p<0.05$; "Groucho" chi-square$=2.63$, $p<0.12$; pooled data chi--square$=7.05$; $p<0.01$).

4. DISCUSSION

4.1. Innate Microhabitat Preference?

In the present study, the whole experimental enclosure consisted of microhabitats which occur in forests; even bare patches were covered with some leaf-litter and lay beneath the canopy of old oaks. The result of the first microhabitat-choice experiment suggests an avoidance of even small areas without vegetation cover laying near dense vegetation. Such a differentiated view of microhabitat preferences cannot be established on the basis of radio-tracking data. The second experiment showed that dense vegetation was indeed the attractive quality of microhabitat patches, as (1) the complete removal of vegetation in certain squares was answered by avoiding such squares, and (2) the creation of vegetation cover on previously bare ground produced a more intensive use of the relevant areas. The fourth experiment has revealed that the preferred microhabitat quality is not primarily vegetation, but cover in the sense of shelter from sight.

Habitat preferences can be innate, imprinted, or created or modified by individual learning and by tradition (*e.g.* Patridge, 1981). As the experimental polecats were hand-reared in an environment with almost no vegetation or other cover, in which they later had to live (with the exception of the short experiments), any habituation to, or imprinting on, the dense vegetation subsequently preferred during the experiments was not possible. Individual experience would have resulted in a preference for bare ground, especially as food was available only there. The third experiment has shown that the polecats were able to learn to search their food on coverless sites, but that overall microhabitat choice was only slightly changed by this experience.

The observations of Goethe (1940) already support the idea of an innate preference for cover in polecats. He describes the positive excitement of his hand-reared polecats released by "being-in-something" and "being-under-something". A probable morphological adaptation to densely structured microhabitats is reported by Heymach (1964): Polecats have, relatively, the shortest legs of all Central European mustelids.

I hypothize, therefore, that polecats prefer, within habitats, the microhabitats with shelter from sight, and that this is an innate microhabitat preference. Its probable functions are discussed below.

4.2. Microhabitats and Foraging

Optimal selection of habitats can be affected by food availability. This is one of the best known fields in behavioural ecology (*e.g.* Krebs, 1981; Huntingford, 1984; for more recent literature see Stephens *et al.*, 1986). An animal should search for food at those places where the net energy intake is highest. For a predator, prey density and hunting success are the most important factors affecting net energy intake.

Outside human buildings, polecats in Switzerland feed mainly on frogs (*Rana temporaria*) and toads (*Bufo bufo*). Mice, voles and shrews are of minor importance (Weber, 1989b; Labhardt, 1980). From other countries, however, these are described as staple foods (Goethe, 1939; Kratochvil, 1952; Danilov & Rusakov, 1969; Rzebik-Kowalska, 1972; Brugge, 1977).

Different densities according to microhabitat differences are well known for most ground-living rodents of Central Europe (*e.g.* Geuse, 1985; Kikkawa, 1964; Miller, 1958; Montgomery, 1978; Niethammer & Krapp, 1982). Of these, the only species with a preference for dense vegetation is *Microtus agrestis.* To a lesser extent this is also the case with *Clethrionomys glareolus,* which however is reported to avoid densely vegetated clear-cuttings. Both *Apodemus*-species, *Microtus arvalis* and *Arvicola terrestris* prefer microhabitas with relatively bare ground. All species mentioned are eaten by polecats. Experiments have shown that a structured microhabitat handicaps rodent-hunting polecats (Weber, 1989b). Once detected and attacked, both mice and voles more easily ecaped in a simulated thicket than on bare ground.

Neither distribution of rodents nor rodent-hunting efficiency of polecats correlate with the microhabitat preference of polecats. I therefore conclude that this preference cannot be considered to be an adaptation to rodent-hunting.

Data on microhabitat distribution of European toads and frogs are rare. *Bufo bufo* may have a strong preference for forests (Heusser, 1967) and there, like *Rana temporaria,* prefer microhabitats with weed thickets (Blab, 1978). Outside woodland, *Rana temporaria* can also reach considerable densities in meadows (Loman, 1978). The problem for anuran-hunting polecats is in finding and not in catching (Gossow, 1970; Herter & Herter, 1953; Goethe, 1940; Weber, 1989b). How frog-finding efficiency of polecats might be influenced by microhabitat structure is not known.

For the anuran prey segment, a correlation between prey density and polecat microhabitat selection may thus exist. However, as long as the influence of microhabitat structure on the efficiency of anuran--finding in polecats is not known, it is not clear if the microhabitat preference of polecats can be explained as an adaptation to hunting frogs and toads.

4.3. Microhabitats and Predator Avoidance

The adaptive value of avoiding predators is classic (Darwin, 1859). Polecats are exposed to several predators. Polecat remains were found in the diets of wolf (*Canis lupus*), wildcat (*Felis silvestris*), golden eagle (*Aquila chrysaëtos.*) and eagle owl (*Bubo bubo*) (Herter, 1959). Amores (1980) found polecat remains in a stone marten (*Martes foina*) dropping. A kit of one of my radio-tracked polecats was killed by a cat (*Felis catus*). An adult radio-tracked polecat male was killed by a dog, another eaten and possibly also killed by a fox (*Vulpes vulpes*) (Weber, 1987). A further one was beaten to death by forestry workers. Compared with other carnivores, killing polecats in this way is easy, since they cannot run very fast and do not climb. In Friesland, beating wild polecats to death is therefore a popular sport (Broekhuizen, pers. comm.).

Most of these predators need visual contact to attack successfully. Additionally, they may be prevented by thickets from approaching or grasping polecats (*e.g.* eagle owl, man, dog). It is therefore obvious that the microhabitat selection of polecats reduces the risk of predation. This is also emphasized by different, habitat-specific locomotion: where invisible, polecats sometimes rummage around, even in daytime, only some metres away from people, whereas bare areas are usually crossed with marten-like leaps at high speed (pers. obs.).

Data on microhabitat-specific predation rates of polecats which would be needed to measure the adaptive value of the habitat preference are not available and are diffcult to obtain; being predated on is a rare event and polecats rarely leave vegetation cover. Compared with the anuran-hunting hypothesis, the predation avoiding hypothesis is somewhat supported by the result of experiment four, which reveals cover from sight and not vegetation as the attractive quality of microhabitats preferred by polecats.

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EKSPERYMENTALNE BADANIA NAD WYBIÓRCZOŚCIĄ MIKROŚRODOWISKOWĄ TCHÓRZY

Streszczenie

W warunkach zagrody (Ryc. 1) badano wybór mikrośrodowisk przez dwa wychowane przez autora tchórze, *Mustela putorius* Linnaeus, 1758.

Zwierzęta wykazywały wyraźną preferencję do gęstej pokrywy roślinnej nawet w środowisku zapewniającym ukrycie (las dębowy). Eksperymentalne zmiany pokrywy roślinnej powodowały istotną zmianę użytkowania mikrośrodowisk przez tchórze. Z dwu mikrośrodowisk: gęstej roślinności i nagiego podłoża ale całkowicie zasłoniętego od góry, tchórze preferowały drugi wariant (Tabele 1 i 2). Pochodzenie i funkcje obserwowanych preferencji mikrośrodowiskowych dyskutowane są w świetle wyników eksperymentów oraz danych z literatury. Autor sugeruje, że (1) preferowanie miejsc z pokrywą roślinną dającą ukrycie od góry jest u tchórzy wrodzone i (2) jest to przystosowanie do preferencji mikrośrodowiskowych płazów, głównych ofiar tchórzy lub do unikania drapieżnictwa.