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BEHAVIOURAL RESPONSE OF FOREST RODENTS AGAINST TRAP AND BAIT

BEHAWIORALNA REAKCJA GRYZONI LEŚNYCH NA PUŁAPKĘ I PRZYNĘTĘ

Two types of movements of rodents and their reactions to wooden traps and pitfalls were observed by means of noctovisor and directly during a day. The penetration of trapping devices by these animals does not occur in a mechanical manner but is preceded by apparent interest in the trap. Some rodents may escape from pitfalls by running of the walls. This has been confirmed by repeated disappearance of the bait from pitfalls (65% of cases on the average). Wet walls or small amount of water on the bottom make the escape very difficult or impossible. The consumption of two types of bait was compared: bread fried in oil represents a more atractive bait than oat grains.

I. INTRODUCTION

Various types of traps are employed for the capture of small mammals: live-traps, snap-traps, conical or cylindrical pitfalls sunk into the ground (Pucek, 1964). The type of trap, its location and the employed bait (food placed in a trap not always functions as bait) exert an effect on the efficiency of trapping and its selectivity which depends, moreover, on a sea son (Kratochvil & Gaisler, 1964; Neal & Cook, 1969; Pucek, 1969, and others).

Our investigations were aimed at understanding the reaction of rodents to the type of trap and bait, and at collecting the observations of animal behaviour in such situations. For this purpose we employed the equipment and methods utilized in earlier studies (Andrzejewski & Olszewski, 1963a,b; Olszewski, 1963), as well as some unpublished observations from that period. The noctovisor was used for night observations of two rodent species: *Apodemus flavicollis* (Melchior, 1834) and *Clethrionomys glareolus* (Schreber, 1870) on account of joint appearance of these animals at night. The observations during a day were limited only to *C. glareolus* which is active in this period (cf., *e. g.* Buchalczyk, 1964). The investigations were carried out in the Białowieża National Park, in section 399.

II. DIRECT OBSERVATIONS

1. Two types of movements of epigeic rodents could be distinguished on the basis of noctovision and daily observations, both recent and carried out earlier.

a) Displacement, or covering some distance to reach certain place or to escape from certain point, for example after meeting other individuals. This type of movement is also common during collection of food reserves. The observed movements took place in most cases along sections of straight lines of the length not exceeding 10 m. *A. flavicollis* used most often for this purpose natural hollows, or moved independently of them by making »jumps« up to 2 m long. *C. glareolus* behaved in a similar manner employing hollows (mainly in day), moving by fast running with small jumps, about 0.5 m long.

b) Penetration, or scanning the terrain and food seeking. An animal searches in burrows, in ground and tree-trunk hollows, scatters the litter and acquaints with new objects in the area. The penetration may be continued for around 20 min. without break, particularly when is carried out by a single individual without meeting other animals. The area penetrated during this time may reach up to 20 m^2. In some cases joint penetration of two individuals, or a mother with young voles, could be observed. The individuals of *A. flavicollis* use more time for such penetration and are more active. Similar more or less random movements through the range were observed in *Microtus agrestis* (Linnaeus, 1761) by Shillito (1963). Voles reacted to any new objects, different from those previously experienced and confirms old ones.

We were not able to ascertain whether during the penetration the rodents reacted to eventual scent marks felt by other individuals. On the basis of investigations with laboratory mice (Kałkowski, 1968) it may be expected, however, that wild-living rodents are also able to follow the scent marks. Turček (1960) reported some interesting observations supporting this idea. He found that individuals of *A. flavicollis* were trapped more often into traps containing previously individuals of the same species. The same was true of *C. glareolus*. This fact might indicate not only the ecological isolation but also eventual recognition of scent marks of individuals of the same species, or avoidance of other species.

2. Reaction to live-traps. The first acquaintance of a rodent with the trap remains in a close relationship to the above-mentioned types of movement. The main problem depends on that whether the trap is on the way of the animal or within the penetrated area. Finding the trap is accidental. The trap does not belong to objects attracting the animal attention from a larger distance. When it is placed some 20 cm from the hollow used as a permanent route of rodents they usually do not pay any attention to it.

When a rodent encounters a live-trap (or other trap, or any new object) it does not show any sing of alarm. This reaction is probably due to the immobility of the object, since the element of movement constitutes one of the most important stimuli (Nikolskij, 1970). The animal makes acquaintance with the trap by inspecting it from outside and inside. This may be compared to »exploratory behaviour« — the term employed by Montgomery (1955) and Montgomery & Monkran (1955; cited after Nikolskij, 1970). After these cognitive activities are completed the animal often stays on the trap and treats it similarly to an uprooted tree. For investigating the behaviour of rodents we used either traps not set for trapping or operated by remote control.

When the food (usually under the form of oat grains) was left in a permanently open trap, the rodents, after localizing the trap in their area, visited it repeatedly using the same way in most cases. Usually *A. flavicollis* consumed the food inside the trap, while *C. glareolus* collected there single oat grains but always consumed them outside. In some cases a second individual approached the trap where already stayed one animal. As a rule the second animal retreated after seeing the place occupied. Interesting data on a similar subject were reported by Kalinowska (1971). The phenomenon of accustoming rodents to live-traps is well known. After certain time the adaptation reaches constant level or even decreases (Trojan & Wojciechowska, 1967).

Tanaka (1963), analysing the captures of marked and non-marked individuals of various rodent species and sub-species, distinguished three types of response against trap, linking them with the degree of shyness of the population. He observed the predominance of second captures of marked individuals, or equal trapping of marked and non--marked individuals (*Apodemus, Peromyscus, Microtus, Clethrionomys* and *Eothonomys*). This may indicate fast learning and considerable interest in the trap. The opposite reaction, predominance of non-marked individuals (populations of *Rattus* from inhabited area), suggests increased shyness and caution of animals, with simultaneous trend of exploration of new areas. Our direct observations of the two studied species of forest rodents confirm the data of Tanaka (1963) on fast learning these animals and on constant visiting the same traps.

3. Reaction to pitfalls (cones and cylinders). Two conical pitfalls used for standard trapping of *Micromammalia* were sunk into the ground in the vicinity of an uprooted tree often frequented by rodents (Olszewski, 1968). When moving on this uprooted tree the animals did not pay attention to the pitfalls but encountered them accidentally during penetration of the terrain. Both *A. flavicollis* and *C. glareolus* showed a similar behaviour. They cautiously looked inside and retreated, or slowly descended to the interior, at first by hanging on hind legs with subsequent slipping down. Then they investigated all objects present in the trap and attempted to get away. When the walls of the tin cone are dry, fully efficient individuals of *A. flavicollis* and majority of large *C. glareolus* may escape by fast running on the steep cone wall. With deeper cones, or those having walls wet, the attempts are not successful. The rodents gradually loose strength, rub sore feet and in effect they remain in the pitfall. Smaller and younger animals, or weaker individuals may enter the first encountered cone and remain there. The escape from cylinders is possible by direct jumping out. Majority of individuals of *C. glareolus* and small *A. flavicollis* are not able to leave such trap. This is confirmed by morphological differences in

samples of *A. flavicollis* deriving from pitfalls and live-traps (A d a m c z e w s k a, 1959).

It was found that often the animals enter the pitfalls containing water on the bottom which makes their escape impossible. They investigate also the pitfalls devoid of any food or other interesting objects. This may be related to the fact that in natural conditions most of the burrows are easily accessible to these rodents and they have no difficulties with leaving them. Shaded burrows are often used as places of staying or shelter for these rodents so they do not show any fear in penetrating such places.

Table 1

Trapping of *Micromammalia* and bait consumption in conical pitfalls. Boldface figures indicates alive animals released after trapping.

1965 Oct.	*S. minutus*	*S. araneus*	*C. glareolus*	*A. flavicollis*	*M. nivalis*	Total	Bait not consumed with simultaneous capture of an animal	Bait consumption	
								N	%
19			5			5	4		
20			**3***	2		5	2	45	90
21		1	1			2	1	18	36
22	1		1			2		28	56
23								35	70
24				1		1		24	48
25		1	1	**1**		3	1	33	66
26			1			1		41	82
27			2		**1**	3		37	74
28								33	66
29				1		1			
30			2			2			
Total	1	2	16	5	1	25	8	Avg. 65	

* Only two alive voles released.

It is impossible to establish whether in some cases forest rodents or other *Micromammalia* fall into sunk pitfalls quite by accident, on the same principle as balls on the billiard table. Our observations indicate however, that this is certainly the case of some invertebrates, among others *Carabidae*.

III. EXPERIMENTS ON THE BAIT CONSUMPTION IN CONICAL PITFALLS

In order to confirm direct and noctovision observations on free entering and escape from pitfalls the following experiment was carried out. Fifty metal cones, 40 cm deep, were sunk in the ground in 3 m distance from each other in straight line. A lump of oil-fried bread was placed in each cone. The pitfalls were inspected daily to record trapped mammals and consumed food. Altogether 25 individuals of *Micromammalia* (Table 1), mostly dead, were found in the cones. Alive individuals were set free on the spot (3 individuals of *C. glareolus*, 1 *A. flavicollis* and 1 *Mustela nivalis* Linnaeus, 1776). Consumed, damaged or wet bait was replaced by the fresh one.

The, eating away of food from the pitfalls varied from day to day between 36 and 90%, with mean 65% (Table 1). In eight cases the bait remained not consumed despite the capture of a rodent in the pitfall. During the first two days 6 such cases were recorded.

Table 2

Percentage of baits consumed from paper plates on two control lines.

1965 Oct.	Line *A*		Line *B*	
	Bread	Oats	Bread	Oats
24		44	100	
25	100			84
26		62	100	
27	98			86

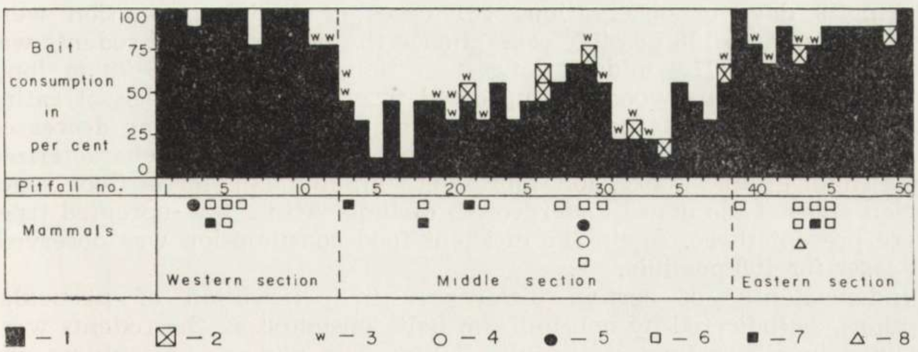

Fig. 1. Bait consumption and captures of *Micromammalia*.

1 — Total bait consumption, 2 — Partially consumed, 3 — Not consumed wet, 4 — *Sorex minutus*, 5 — *Sorex araneus*, 6 — *Clethrionomys glareolus*, 7 — *Apodemus flavicollis*, 8 — *Mustela nivalis*.

In the first day of trapping (19 Oct. 1965) only 30 pitfalls were set and 5 *C. glareolus* were captured (all dead). This day should be treated as a preliminary trial and thus has not been taken into account for calculating the percentage of food consumption during next 9 days (Fig. 1 and Table 1). A certain decrease of eating away of the bait was observed during 1—2 days after trapping a few rodents. For example in result of trapping 2 *A. flavicollis* and 1 *C. glareolus* dead (20 Oct.) in subsequent days food consumption decreased from 90 to 36 and 56%.

In the fifth day of the experiment cubes of fried bread and hulled oat grains were placed separately on paper plates in two parallel lines, 20 m from the line of cone pitfalls. The bait was changed during 4 days according to the scheme in Table 2. The purpose of the experiment was to establish the differences in the eating away of food on these bait lines. The consumed food was replaced daily.

It was found that rodents promptly accustom themselves to places where food is always present. Bread fried in oil was found to be more attractive than oats. It was always completely consumed independently of the trap line in which it was placed. Oat was consumed in 44—86% (Table 2). The comparison of attractivity of the two types of bait for the whole experiment and jointly for both lines indicates that the difference is statistically significant when compared by χ^2 test ($P<.01$).

The possibility of eating away the bait by birds cannot be excluded but our observations carried out by many years suggest that this is without significance for the obtained results.

The studied fragment of the forest belonged to the *Tilio carpinetum complex* Traczyk 1962, and may be regarded as regional modification of *Querco-Carpinetum medioeuropaeum* Tüxen 1936 (Traczyk, 1963). The distribution of forest floor vegetation on the experimental plot was not uniform and this fact may be responsible for different penetration of the terrain by the rodents. The western section of the line of cones, around 36 m long, run through the dense undergrowth of young maples (Fig. 1). A few uprooted trees were also present there. During 9 days of observations 101 cases of food consumption were recorded against 108 possible cases, hence the penetration of rodents was relatively high. The middle, longest section of cones line, 78 m long, was devoid of brushwood and uprooted trees. There 100 cases of eating away food against 234 possible cases were recorded indicating decreased penetration of rodents. The eastern section (36 m long) was characterized by a slight ground depression, more wet soil, abundant forest floor vegetation and not too dense undergrowth of lime. Also a few uprooted trees were present there. Again the efficient food consumption was observed: 93 cases for 108 possible.

Independently of certain differences in penetration of particular sections, as indicated by non-uniform bait consumption, the rodents were trapped in all sections of the pitfall line. The number of captures and cases of food consumption were the smallest in the middle, least penetrated section.

IV. GENERAL REMARKS

The rodents encounter traps accidentally but penetrate the pitfalls and live-traps in purpose. An increased efficiency of trapping may be achieved by using the most attractive bait, suitable type of traps (*e. g.* deep cones), and carrying the trapping in area which, due to specific conditions, is more often penetrated by rodents. The conditions include the presence of uprooted trees, dense undergrowth and forest floor vegetation. The results of presented experiments indicate that in cases of the employment of various types of traps and baits the specific reaction of rodents should be taken into consideration. The possibility of selective action of traps and bait, depending moreover on local conditions and time of trapping must be also analysed in order to avoid too far fetched conclusions concerning for example such parameters as species composition or age and numbers of animals in the population.

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