A C T A   T H E R I O L O G I C A

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Activity of Some Small Mammals in the Field

[With 3 Tables & 5 Figs.]

A method was developed to record trap captures automatically by means of a dot recorder. According to the grid or trap-line method, only one cable was required in every trap line to indicate and record place and time of each capture in snap traps and live traps in the field. These facilities made it possible to release animals immediately after capture in live traps and to avoid bias to them. Some data on activity patterns of marked individuals and of whole populations of the field vole (*Microtus agrestis* L.) and some species associated with it could be gathered. The rate of capture and recapture was increased in linear regression with the weekly quantity of precipitation. The activity of the voles changed from nighttime in summer to daytime in winter. The captures were confined to few hours *a.m.* and *p.m.* on clear days in the cold season. Males of the vole were more trap prone than females and older males more than younger stages. The activity shifted from night to daylight with increased weight.

I. INTRODUCTION

Field studies of mice are often very time-consuming, especially in the case of low trapability and population density or if the species are sensitive in live-trapping programmes *e.g.*, *Sorex* sp. as it is pointed out by Crowcroft (1957) and Michielsen (1966). In many cases it becomes necessary to visit and control the traps within short periods, even at nighttime.

These difficulties often cause a qualification in the studies intended, what mostly results in a reduction of the test area or the number of traps. When applying *CMR* method (Dice, 1938) or the standard minimum method (Ryszkowski *et al.* 1966 and Gębczyńska, 1966), I at first could not prevent losses of animals and traps. Some of the traps were displaced with the prey by foxes or others failed to be discovered in the undergrowth, especially when the grass and plants are swept down after stormy, rainy or snowy weather. Up to the present such difficulties were mainly overcome *e.g.* by a clear arrangement of the traps in a grid (Dice, 1938; Stickel, 1948), by the use of reflecting markers (Lewis, 1967) or population censusing by means of remote sensing of the animals (Marten, 1972). Taking this into account, I at first connected all traps in a trap line by means of a long flexible and bright colored cable. This enabled me to discover all traps, even at night or during/after rain- and snowfall. The few cables arranged in parallel order provided in addition a quick and simple means of orientation, measuring and division of the test area.

It was quite obvious that these thin cables should be used in order to control all traps automatically by means of an indicating and recording device. Such a recorder was built and placed in a small meteorological

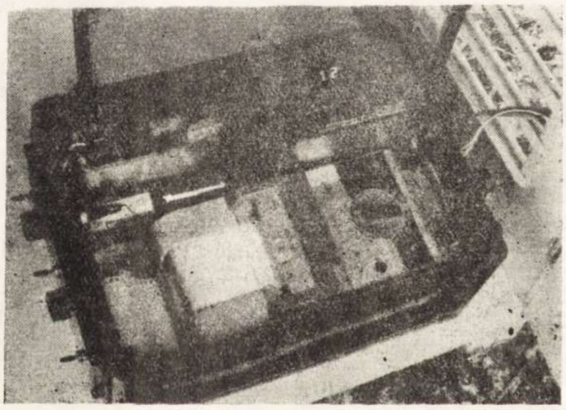

Fig. 1. The recording device inside of a meteorological shed. The 12. trap line is checked in that moment.

shed (Fig. 1) or used in a field lab in the center of the test area were it could reached easily. A look at the recorder gave informations on as to whether, were and at what time a trap had been closed. And then the only task was to inspect the indicated trap(s) in order to fetch the trapped animal. This was advantageous especially at night when the weather was bad. Some further advantages were a.o. that the biotope in the test area was no longer detiorated by various inspections or that the animals remained undisturbed.

Stress and mortality in live traps (see Corke, 1967) could be reduced, so that the rate of recapture was very high. The short period of time additionally spent for the installation of this trap system, which by the way could be done when the weather was fine, seemed worth the trouble because various inspections now became superfluous. This was most advantageous in adverse weather.

The automatical recording of trap captures also provided some data on the surface activity of some species; a first general survey is given below.

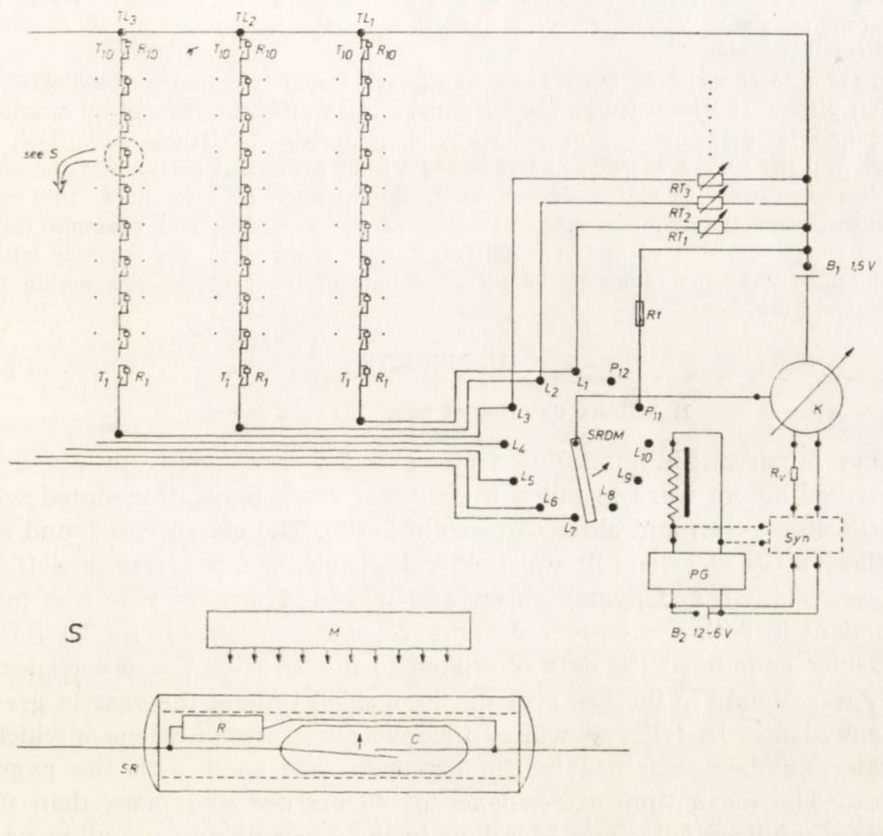

Fig. 2. Circuit of the recording system.

B_1 = battery for measurement, B_2 = batteries for power supply, K = compensator (dot grapher), $L_1 \ldots L_{10}$ = contacts corresponding to trap lines. P_{11} = contact for test circuit, P_{12} = contact switching over to subsequent *SRDMs* when more than 10 trap lines are required, *PG* = pulse generator, $R_1 \ldots R_{10}$ = resistors of different graduate values (300 to 3000 Ohms according to standard *E* 12) inside of a switching element (*S*), $T_1 \ldots T_{10}$ = resistors in shunt circuits, *Rv* = resistor or fuse, *SRDM* = stepping relay drive mechanism, *Syn* = element which synchronizes pulses of the generator (*PG*), drive and dotting of the grapher. *S* = switching element mounted on top resp. behind trap door interchangeable in fuse carriers. *C* = Mini—Reed contact, *M* = magnet bar, *R* = resistor (see $R_1 \ldots R_{10}$). *SR* = synthetic resin fixing the contact and resistor inside of a polyamid or aluminium tube.

II. MATERIAL AND METHOD

A small gasthighted magnet contact connected parallel to a resistor of ten varying graduated values (200—700 Ohms) was mounted onto each trap of a trap line interchangeable in a fuse carrier. The ten switching elements (Fig. 2 S) of each trap line were joined via a separate channel of a dot recorder to a testing current resource. Whenever a trap closed the matched resistor was cut out by means of the magnetic contact and the current transmitted to the recorder was increased according to the selected resistance value. It was possible to distinguish very clearly ten different resistance values, corresponding to ten traps in a trap line on the scale of a small recorder.

In order to check some hundred of traps, each tested trap line was indicated by digital display and recorded on the chart paper as a different channel by means of stepping relay drive mechanisms moved by exact time-base voltage.

All trap lines were checked and recorded within a rotation period and therefore the captures were recorded depended on the number of trap lines, the cycle frequency and the adjusted paper feeding of the recorder. The example stated below shows *e.g.* that 30 lines (= 300 traps) were checked by the recorder within 15 minutes. Thus the range of the recorded time of the captures was within this cycle of 15 min.

III. RESULTS

1. Activity Patterns of Some Trapped Species

One hundred Sherman live traps and 200 snap traps prepared as described before were installed in two test areas both afforestated with fir (*Picea excelsa*) and alder (*Alnus glutinosa*). The six species found a.o. in these areas were as follows: field vole, bank vole, yellownecked field-mouse, common and pygmy shrew and weasel. The field vole was most abundant in both areas covered first of all by *Calamagrostis* sp. Therefore a greater amount of the data is related to this species. The other species only were found in the test area during a short time of the year in greater abundance. In fall and winter field vole was the only one of which a greater number remained in the test area associated with the pygmy shrew. The mean time of residence of 45 marked and more than five times recaptured voles was 43.9 days in the mean (males: $n=26$, $m=41.7$ days, $s=\pm 26.5$ days; females: $n=19$, $m=47.0$, $s=\pm 22.3$ days).

Fig. 3 and Table 1 gives general information on the surface activity of some species according to the captures recorded in its order of succession. The field vole was polyphasic active and in summer the night-time was prefered. The activity scheme of the total population seemed to be equilibrated because, as it could be observed in the lab as well, the individuals made short rests only and their activity cycles were overlapping. A minimum of snap trap and live trap captures was observed about 2 hours *p.m.* in the summer, especially on days with high temperatures. The surface activity was confined in winter, however, to a few hours in the late morning and in early afternoon (see also Fig. 4). Such a shift in the circadian activity of field vole could also be observed in the laboratory (Erkinaro, 1961, 1969). The efficacy of sprays or poisoned baits used for control of this harmful species was limited in winter in some cases (Diercks & Junker, 1958, Bäumler, 1973). This fact may

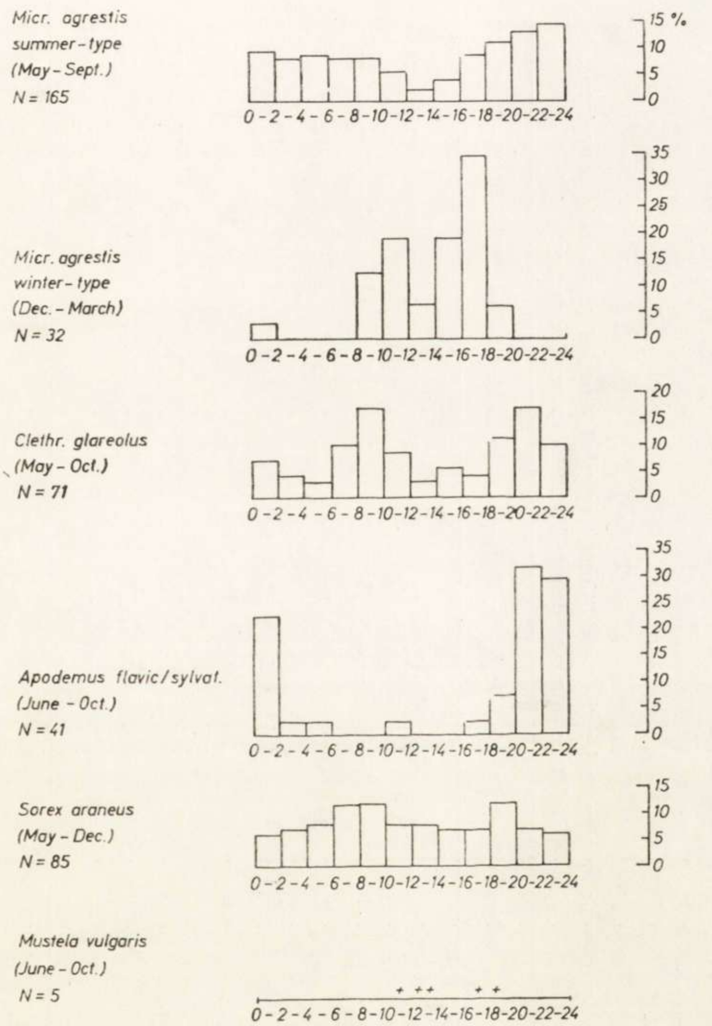

Fig. 3. Circadian patterns of recorded times of captures in snap traps (see Table 1).

also be caused indirectly by restriction of surface activity of this species in winter.

The bank vole had longer rest periods, this could also be observed in the laboratory. Compared with field vole, this species prefered more

Table 1

Activity of some species under field conditions; recorded times of captures in snap traps. Boldface numbers denote highest capture frequency.

Hours	0—2	2—4	4—6	6—8	8—10	10—12	12—14	14—16	16—18	18—20	20—22	22—24	Total
Species and season:													
Microtus agrestis (May—September)	16	13	14	13	13	9	3	7	14	18	21	**24**	165
Microtus agrestis (December—March)	1	—	—	—	4	6	2	6	**11**	2	—	—	32
Clethr. glareolus (May—October)	**5**	**3**	2	7	**12**	6	2	3	4	8	**12**	7	71
Apod. flav./sylvat. (June—October)	**9**	1	1	—	—	1	—	—	1	3	**13**	12	41
Sorex araneus (May—December)	5	6	**7**	**10**	**10**	7	7	6	6	**10**	6	5	85
Sorex minutus (November—March)	3	—	—	—	—	1	—	—	1	2	—	—	7
Neomys anomalus (June—October)	—	—	—	2	—	—	—	—	1	—	—	—	3
Mustela nivalis (June—October)	—	—	—	—	—	1	2	—	1	1	—	—	5

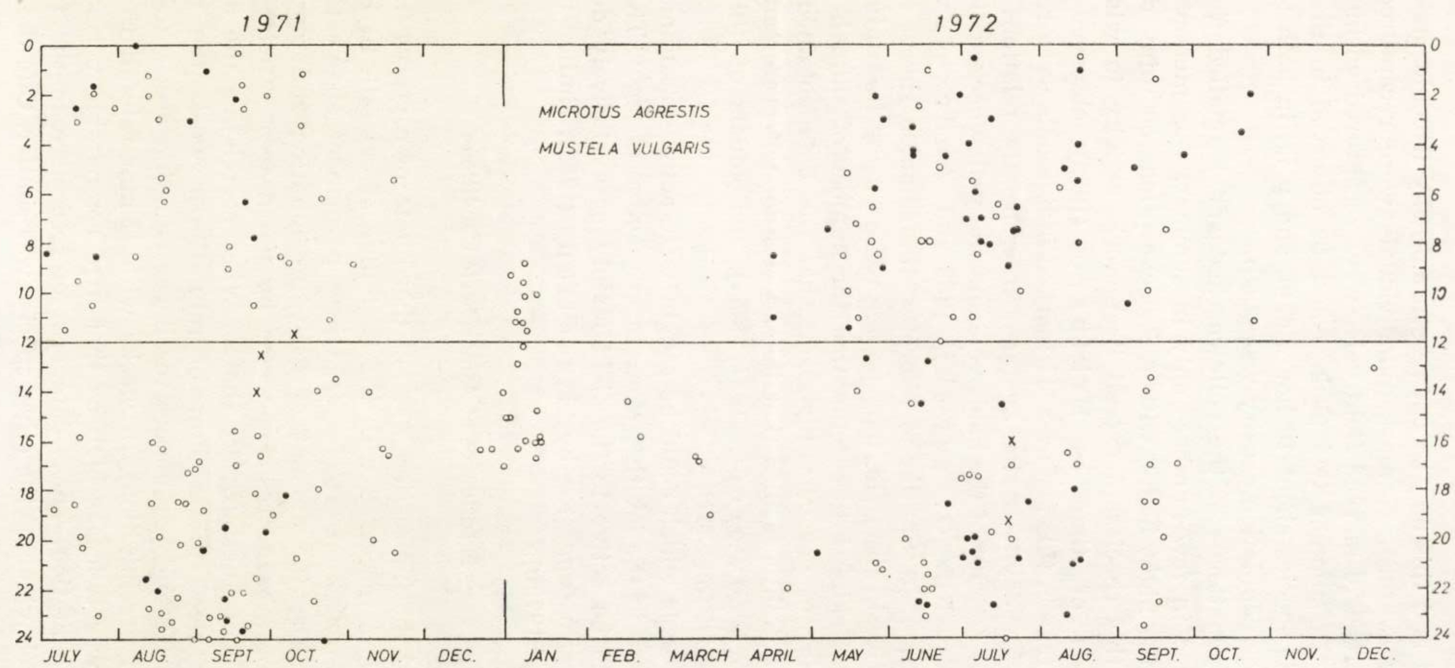

Fig. 4. Circadian dispersion of snap trap captures in different seasons.

qualified food and this may be one reason a.o. why it could make longer rests. On the average, 24 marked individuals were recaptured within 2.6 days, whereas 76 marked field voles were recaptured within 1.5 days in the mean. In summer two peaks could be observed in the activity scheme of this species about 10 hours *a. m.* and *p. m.* in both test areas when a greater population density was given.

The activity patterns of the yellownecked and longtailed fieldmouse, which occurred in few numbers only in summer, was monophasic and restricted to the night hours, with a few exceptions on rainy days. The tendency of this species to extend its motoric activity in winter over larger periods of time as Erkinaro (1970) observed in the lab, was also true in this test area. 11 marked individuals were recaptured here within 5.1 days on the average. Interspecific relations possibly influenced the activity of the bank vole and the yellownecked fieldmouse as it is suggested by Olszewski, 1963 and Andrzejewski & Olszewski, 1963. Similar to *Microtus*, the common shrew was polyphasically active in the field, may be one reason being its continual food requirements. Taking into account that the number of animals captured in the area is not yet very high and that the data obtained are not evaluated in detail, it seemed that this species did not prefer any special daytime (see Crowcroft, 1954, 1957). Individuals of this species were not marked for *CMR*.

All five weasels which could be caught were active in summer during the day, though in the lab they were mostly active at night. This species thus seems to be active in the field mainly or exclusively during the day as it is also suggested by Brodman (1952), similar to ermine (Bäumler, 1973b).

2. Influence of Atmospheric Conditions

In the field the impression was got that quota of captures in life and snap traps were increased with the beginning of rainfall. In Fig. 5 the number of captures on a test area, where permanent observations were made, as well as the amount of daily precipitation and temperatures (daily total or average resp.) assessed by the nearest official meteorological station in Augsburg are shown. When correlating the number of captures per week to the sum of rainfall per week the regression coefficient is 0.6 and parameters for linear equation are: y (captures) $=$ $3.4 + 0.3$ (mm precipitation). In weeks with 11 mm rainfall the number of captures was twice as high as that in a comparable period of time with no precipitation. These data are referred here to the field vole, though the behaviour of the other species was similar. One the one hand

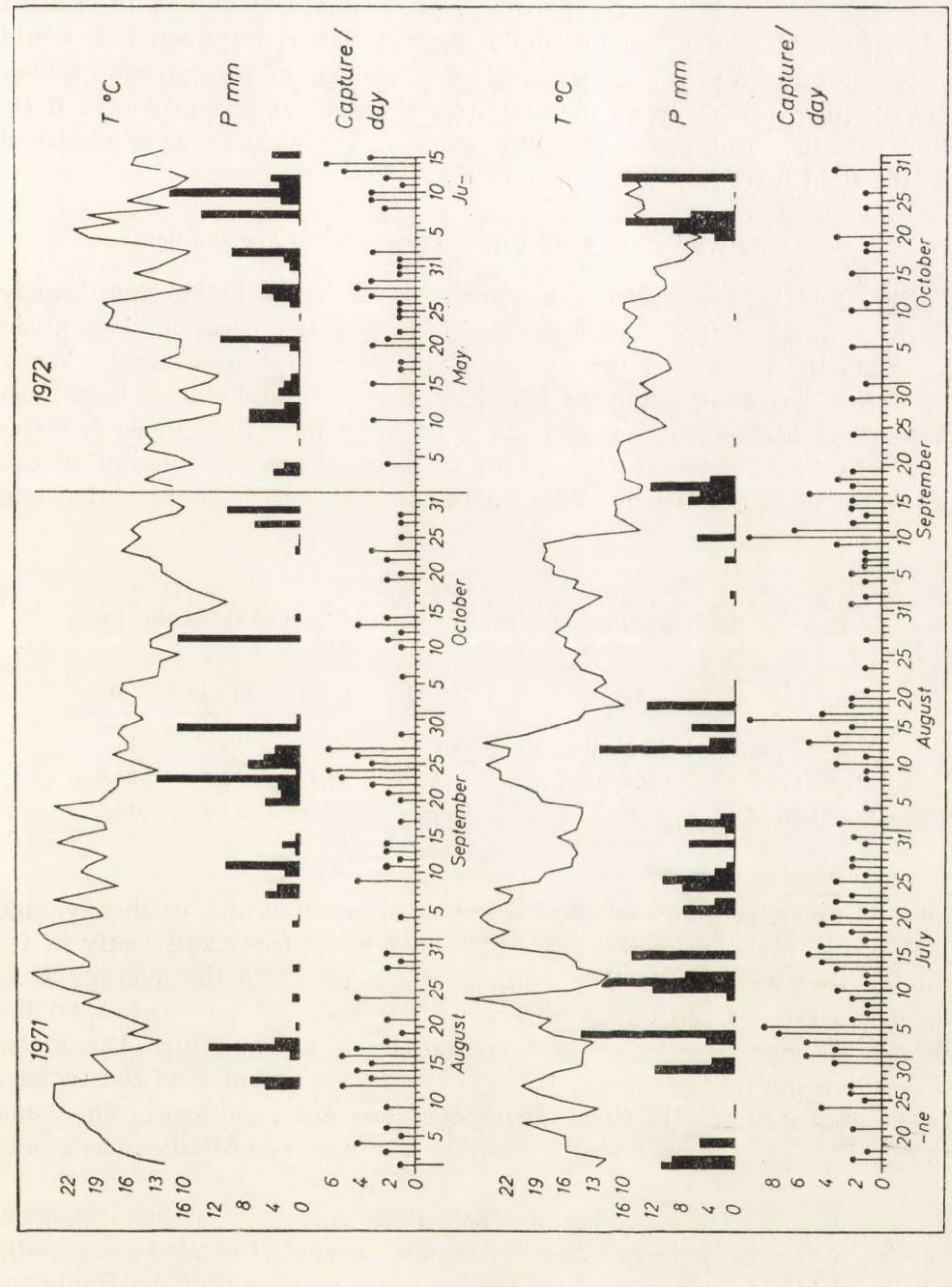

Fig. 5. The amount of daily snap trap captures in relation to temperatures and precipitation.

the increased activity during rainy weather may be due to intensified search for food in order to supply their energy requirements. It could however also be possible that the higher amount of precipitation drives the small mammals in an increasing number out of less protected nests and galleries. But peaks of rising numbers of captures were observed in the field just often it began to rain.

3. Activity of the Field Vole in Correlation to Age and Sex

The field vole was represented on the test areas in an significantly greater number than the other species; thus the occasion was given to study the activity of this species in the field more thoroughly. When recaptures are analysed in the following, only those individuals have been taken into account that were recaptured more than five times. A difference in the activity patterns of both sexes could not be made out, as can be seen by Fig. 4. But on the whole the males were more active and

Table 2

Frequency of recaptures of different weight groups of both sexes of the field vole.

Weight group, gramms	10—20	20—30	30—40	40
No. of marked individuals	7	23	15	16
Mean interval of recapture, hr	47.9	43.4	33.8	25.9
Standard deviation, ±	28.0	35.1	25.9	18.6

almost twice as many of them were recaptured. While in the average 47 marked males were retrapped after 30.2 hours ($s = \pm 20.4$), only 22 females, that were marked as well, were recaptured in the average after 59.9 hours ($s = \pm 22.7$). This difference is proved by the t — test on the 5% level and significant. The average time during which the males stayed on the test area was 41.7 days ($s = \pm 26.6$) and that of the females 47.0 days ($s = \pm 23.3$). These differences are not significant. The bank vole *e.g.* — males and females together — was present in the mean only 28.2 days ($s = \pm 30.4$).

In many cases the age had a considerable influence on the frequency of recaptures as well as on the circadian dispersion of captures, especially with regard to the males of field vole. Table 2 shows that the frequency of recaptures rose with increasing age or weight. The average time of recaptures of mammals smaller than 20 g was 47.9 hours. But with the beginning of full maturity the surface activity was increasing and the mean interval per recapture fell to 25.9 hours at the mean. As to the females, differences dependent on age were not so obvious.

The distribution of captures during the day and night showed differences as well which were due to age. Table 3 contents the relation of captures of voles belonging to different age groups or weight classes resp. which were made with life and snap traps during the day and at night. The juveniles of both sexes developed chiefly night activity, whereas the activity of older individuals shifted mainly to the day time.

IV. DISCUSSION

The results which were found especially the shifting of activity of males with increased age to light seems obviously in complex connection with the habits of this species.

Table 3

Captures at night and day of different age resp. weight groups of males and females of the field vole.
L = life trap captures, S = snap trap captures.

Weight group, g	Males								Females							
	10—20		20—30		30—40		<40		10—20		20—30		30—40		<40	
	L	S	L	S	L	S	L	S	L	S	L	S	L	S	L	S
(Re)captures	23	12	71	34	41	14	54	9	15	7	40	22	28	8	5	9
At night	9	4	26	11	9	2	8	2	5	3	8	7	5	1	0	5
At day	14	8	45	23	32	12	46	7	10	4	33	15	23	7	5	4
Day/Night	1.5	2.0	1.7	2.1	3.6	6.0	5.7	3.5	2.0	1.3	4.1	2.1	4.6	7.0		0.8
Day/Night $L+S$ total	1.69		1.84		4.00		5.30		1.75		3.20		5.00		1.80	

Anxious and frightened voles usually retreat into dark. Voles of younger stages have presumable not yet lost their anxiety and at the beginning they only seldom dare to appear on the surface during the day. On the other hand, voles of greater weight become increasingly sensitive to low temperatures. Previous tests with life traps have demonstrated that the voles were able to stand cold nights in life traps (see Corke, 1967) best just before the beginning of their sexual maturity, *viz.* when they had a weight of about 20 g and at this stage they mainly wintered. At atmospheric changes to low temperatures the heaviest voles always disappeared first and the average weight of the population decreased. Voles are generally small under severe conditions. It can thus be assumed that, with increasing weight and dominance, the surface activity of older individuals is restricted mainly to the warm hours of the day. They stand low surface temperatures at night not very well, especially during cloudless weather. In addition to the natural anxiety of the juveniles there is the pressure of competition with dominating adults which try to drive them out of their territory and which are active mainly at daytime. This fact could also restrict the activity of the young voles to nighttime. It thus seems that similar to the interspecific competition of voles (Andrzejewski & Olszewski, 1963) the intraspecific competition between age groups could have an influence on the activity patterns of the field vole.

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AKTYWNOŚĆ KILKU GATUNKÓW DROBNYCH SSAKÓW W TERENIE

Streszczenie

Opracowano metodę automatycznego rejestrowania momentów łapania się ssaków w pułapki. Zastosowanie układu analogowo-dyskretnego (Ryc. 1, 2) do kontroli czujników rozmieszczonych w terenie pozwoliło zbierać dane z całych powierzchni odłownych, przy użyciu niewielkiej ilości linii przesyłkowych. Metoda pozwala także na uwolnienie zwierzęcia z pułapki bezpośrednio po jego złapaniu się.

Zebrano dane o wzorcu aktywności znakowanych osobników a także całej populacji nornika burego, *Microtus agrestis*. Poza tym uzyskano informacje o aktywności innych gatunków małych ssaków (Tabela 1), (Ryc. 3). Zaobserwowano, że wzrost ilości opadów zwiększa liniowo łowność (Ryc. 5). Aktywność norników zmienia się z nocnej w lecie na dzienną w okresie zimy, kiedy to gatunek ten łowi się w ciągu kilku godzin dnia (Ryc. 4). Samce nornika wyraźniej unikają pułapek niż samice a stare samce są bardziej ostrożne niż młode (Tabela 3). Poza tym zaobserwowano, że osobniki cięższe stają się nieco bardziej aktywne w ciągu dnia, przesuwając jakby swoją ruchliwość z okresu nocy (Tabela 2).