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# Stomach Contents of the Mole, *Talpa europaea* Linnaeus, 1758 from Southern Poland*

[With 10 Figs. & 10 Tables]

A total of 604 stomachs of moles from grasslands of Kraków and its environs and from mountainous regions were examined. The weight of the stomach contents of moles collected at the same locality does not undergo any major fluctuations (with the exception of the breeding season). Remarkable differences in this respect were observed in specimens derived from different habitats. Earthworms constituted the main component of the mole diet (82.7 — 100% of the stomachs contained them), especially in the spring and autumn. Insects were represented in thest omachs, above all, by larvae of *Tipula sp.* and wireworms. Cockchafer larvae were noted in 19.4% of the stomachs. Ants were eaten by moles in masses in areas inhabited by them. The occurrence of slugs in the stomach contents was dependent on the habitat and topical humidity conditions. The presence of stomach stones was related to the habitat and the sex and age of specimens. The occurrence of stones is supposed to influence the mortality in moles. Heavy infection of moles with nematodes was also conditioned by the habitat and sex.



* This paper is a part of the series "Studies on the Biology and Ecology of the Mole (*Talpa europaea* L.) in Poland".

## I. INTRODUCTION

The diet of the mole *Talpa europaea* Linnaeus, 1758 is the basic problem in the studies on this animal. Though a large number of papers have dealt with this subject, there is still need for extensive research covering a full year's period and various habitats. The most exhaustive works so far published in this field are those by Hauchecorne (1927), Schaerffenberg (1940), Grigorev (1957) and Godfrey & Crowcroft (1960). The works of other authors, as White (1914), Sachtleben (1925), Folitarek (1932), Baškirov & Žarkov (1934), Kuzjakin (1935), Larkin (1948), Godet (1951) and Borodulina (1953), are concerned with analyses of the food of moles from various habitats but for the most part from short periods of time.

Most investigators regard the mole as an animal of great nutritional demands, the daily value of which exceeds 100 per cent of its body weight. However, the studies made recently in England by Hawkins & Jewell (1962) show that in the mole the cal./g. body weight value falls within the same limits as in rodents. The opinions on the method of obtaining food and on food preference in this species are also controversial.

The purpose of the present work is to analyse the composition of the food of moles inhabiting meadows and pastures. It has been carried out under the scheme of studies on the economic importance of this species (Kawecki, 1957). The material collected made it possible to find differences in the composition of the food of moles from various seasons, years and habitats.

## II. MATERIAL AND METHODS

A total of 614 mole stomachs were analysed. Out of this number, 581 stomachs were derived from moles collected in the grasslands of Kraków, mainly from 3 localities: Błonia — a pasture with a firm substratum, Łęg — a peat pasture, and Dr. Jordan's Park — park meadows. The remaining 33 specimens were obtained from moles caught in the Sądecki Beskid Mts. and in Hala Smytnia in the Tatra Mts.

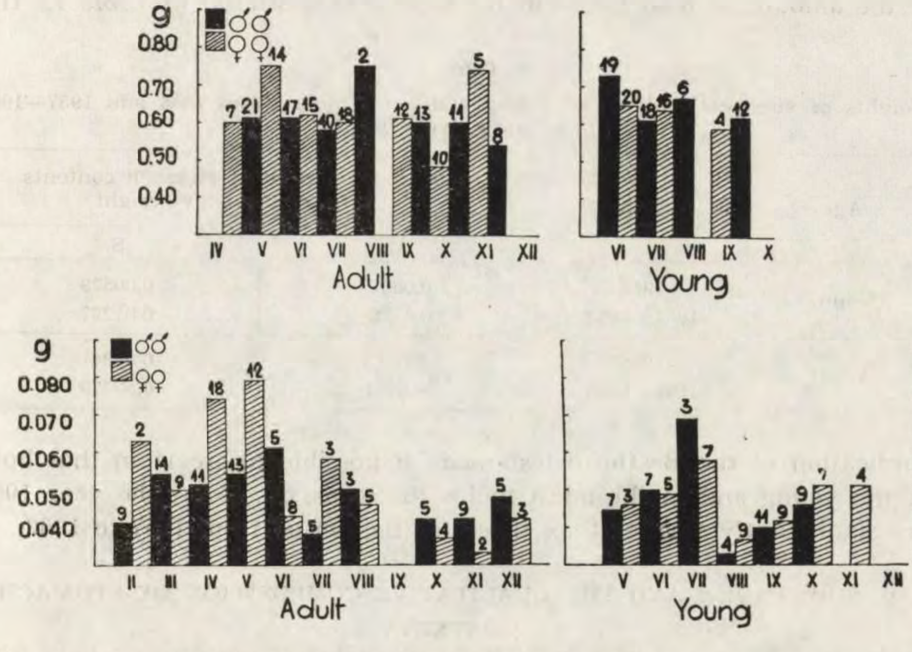
Moles, live-trapped in the field, were injected 0.5 cu. cm. of 3% formaline by means of a pipette introduced into the oesophagus, immediately after killing. This was done to stop the diggestive processes without any delay. All the specimens were dissected in the laboratory. The stomachs removed were weighed together with their contents and placed in 3% formalin. Before analysis the stomachs were strained out from the formalin and kept in a covered jar to prevent drying. After weighing, each stomach was cut open along its greater curve and the contents were removed to a Petri dish. The empty stomach was rinsed and weighed again and the weight of the contents was calculated from the difference obtained by subtraction, taking into account the amount of formalin introduced into the stomach. The weights of plant remains, stomach stones and nematodes were subtracted.

Water was poured over the contents in the Petri dish and next the aggregations of food were loosened with the tip of a pincette, strained by means of a plankton net stretched over a jar and rinsed with water. Then the contents of the stomach were placed again in water in a Petri dish and subjected to qualitative and quantitative examination under the binocular microscope. The constituent elements were sorted in groups (earthworms, slugs), counted, and weighed to an accuracy of 0.1 g. whenever it was possible. Besides, the fragments of earthworms and remains of insects were counted. These last estimations were made on the basis of the number of abdomens found, which was especially true of the larvae of the *Tipulidae* and imagines of the *Formicidae*, and the number of other fragments, e.g., mandibles of cockchafer larvae or pincers of *Forficula sp.*

Plant remains, if present in fairly large amounts, and stomach stones were weighed. The weight of the sediment was calculated indirectly from the difference between the weight of all the contents and that of the constituent elements. The number of the fragments of earthworms occurring in the stomach contents was established by counting. Some difficulties encountered here were caused by the varied lengths of these fragments. Most of the fragments fell within limits of 1—1.5 cm., that is, did not exceed the length of a bite cut off by the mole.

## III. WEIGHTS OF STOMACH CONTENTS IN PARTICULAR MONTHS AND SEASONS

The data presented in Fig. 1 and 2 show the mean amounts of the stomach contents in g. per g. body weight in particular months and




Figs. 1 and 2. Weights of the stomach contents of adult and young moles in the materials from 1956 and 1957—1962, in g. per g. body weight.

localities. In 1958 the quantity of stomach contents in moles (derived chiefly from Błonia) underwent but a slight fluctuation (Fig. 1). Only in May the quantity of stomach contents found in the lactating females was considerably larger than that in the other months. As to the males, the difference in August is not significant, because it includes only

2 stomachs. In November a large amount of food eaten was found in 5 specimens. In young moles the situation was analogous. The differences between particular months are small both in males and in females. It is interesting that the amounts of contents in the stomachs of the young were the same as in adult moles.

On the other hand, remarkable differences in the amount of stomach contents occurred in the material from 1957—1962. In the spring the females had considerably more contents in the stomach than the males. In this group, pregnancy and lactation are clearly reflected in the diagram. In some lactating females the weight of the stomach contents forms 20% of the body weight of the animal. In males the amount of food in the stomachs increases in the spring up to the end of June, then it begins to decline. It is interesting that an analogous pattern is observed in young moles (Fig. 2).

A comparison of the year 1956 with the 1957—1962 period in respect of the amount of food found in the stomachs is offered in Table 1. The

**Table 1.**

Weights of stomach contents of young and adult moles from 1956 and 1957—1962 in g. per g. body weight.

| Age | Year | Annual mean weight of stomach contents in g. per g. body weight | |
|---|---|---|---|
| | | M | S |
| Young | 1956<br>1957—1962 | 0.0607<br>0.0538 | 0.00579<br>0.01297 |
| Adult | 1956<br>1957—1962 | 0.0625<br>0.0461 | 0 0424<br>0.00779 |

application of the Bastlette test made it possible to ascertain that both in the young and in the adult moles the variances $s^2$ for the year 1956 are significantly smaller than those for the period from 1957 to 1962.

## IV. SOIL FAUNA AND THE QUALITATIVE COMPOSITION OF STOMACH CONTENTS

Analyses of the stomach contents ought to provide the answer to the question whether the mole eats everything that it comes across. If so, the stomach contents should reflect the composition of the soil fauna. Otherwise, it would give evidence of a food preference in these animals. Schaerffenberg (1940) supposed that the stomach contents of moles do not coincide with the composition of the soil fauna, but Godet (1951) found that they do.

My analyses of the soil fauna of Błonia (pasture), Dr. Jordan's Park (meadow) and Łęg (peat pasture) (Table 2) indicate that earthworms formed 85.6% of the soil macrofauna in the whole sample from Błonia, to a depth of 30 cm. As the depth increased, the number of earthworms became smaller. No insects were present deeper than 20 cm. below the surface. Most of the macrofauna (earthworms and arthropods) aggregated in the rhizosphere, 5 cm. in thickness. Here, the insects constituted 15% of the soil fauna against 3% in the other layers. In Dr. Jordan's Park the earthworms formed 80% of the soil macrofauna to a depth of 30 cm.,

**Table 2.**
The analyses of the soil fauna from Błonia, Dr. Jordan's Park and Łęg.

| Depth in cm | | Błonia | | | Dr Jordan's Park | | | Łęg | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | per m² | Min. | Max. | per m² | Min. | Max. | per m² |
| 0—5 | Earthworms | 2 | 39 | 325 | 1 | 20 | 232 | 4 | 17 | 288 |
| | Cockchafer larvae | 1 | 3 | 20 | 1 | 2 | 19 | 1 | 1 | 6.2 |
| | Wireworms | 1 | 3 | 15 | 1 | 2 | 9.4 | 1 | 6 | 37.5 |
| | Other insects | 1 | 4 | 22 | 1 | 3 | 25 | — | — | — |
| | Myriapods | — | — | — | 1 | 1 | 3.1 | — | — | — |
| 5—10 | Earthworms | 1 | 12 | 125 | 1 | 19 | 131 | 2 | 3 | 66.6 |
| | Cockchafer larvae | 1 | 1 | 2 | — | — | — | — | — | — |
| | Wireworms | 2 | 2 | 5 | — | — | — | — | — | — |
| | Other insects | — | — | — | 1 | 4 | 15.6 | — | — | — |
| | Myriapods | — | — | — | 2 | 2 | 6.2 | — | — | — |
| 10—20 | Earthworms | 1 | 11 | 75 | 1 | 4 | 50 | 1 | 10 | 83.3 |
| | Cockchafer larvae | — | — | — | 1 | 1 | 4.2 | 1 | 1 | 8.3 |
| | Wireworms | 1 | 1 | 1.5 | — | — | — | — | — | — |
| | Other insects | 1 | 1 | 1.5 | — | — | — | — | — | — |
| | Myriapods | — | — | — | — | — | — | — | — | — |
| 20—30 | Earthworms | 1 | 9 | 15 | 1 | 1 | 8.3 | — | — | — |
| | Cockchafer larvae | 1 | 1 | 1.5 | 1 | 1 | 4.1 | — | — | — |
| | Wireworms | — | — | — | — | — | — | — | — | — |
| | Other insects | — | — | — | 1 | 1 | 4.1 | — | — | — |
| | Myriapods | — | — | — | 1 | 1 | 8.3 | — | — | — |

whereas the contribution of insects was 20% to a depth of 5 cm., 14.3% to 10 cm., and 8% to 20 cm. In Łęg the proportion of earthworms in the whole sample reached 90% of the soil macrofauna, and to a depth of 5 cm. it was 87%.

A direct comparison of the results of soil analyses with the stomach contents was not possible. Nevertheless, it is instructive to compare the results of a weight analysis of earthworms and insects from stomachs

**Table 3.**
The percentage of mole stomachs containing particular food components.

| Month | | Dr. Jordan's Park, Błonie, Łęg | | | | | | | | | | | Total | Tatry Mts. & Beskid Sądecki VI—IX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | | |
| Earthworms | | 100 | 100 | 100 | 100 | 82.7 | 91.6 | 100 | 100 | 100 | 100 | 100 | 97.6 | 100 |
| Earthworm cocoons | | 27.2 | 22.2 | 16.6 | 33 | 10.6 | 33 | 26 | 46.3 | 47 | 42.1 | 54.5 | 30 | 38.7 |
| Snail | | — | 5.5 | 5.6 | 6.8 | 13.2 | 10 | 6 | 14.6 | 8 | 10.5 | — | 9.4 | 13.3 |
| *Coleoptera* | Imagines | — | 11.1 | 25 | 16 | 15.6 | 23 | 14.3 | 14.6 | 18.3 | 29 | — | 18.4 | 15.7 |
| | Wireworms | 9 | 16.6 | 50.1 | 27.3 | 19 | 23 | 14.3 | 36.6 | 40.8 | 50 | 18.1 | 28 | 35 |
| | Cockchafer larvae | 9 | 33.2 | 14 | 34.1 | 7.4 | 7 | 17.1 | 24.4 | 45 | 31.6 | 9 | 19.4 | 4.4 |
| | *Curculio* larvae | — | 11.1 | 11 | 8 | 3.3 | 7 | 3.2 | 22 | 2.0 | 2.6 | — | 6.6 | 3.3 |
| | *Carabus, Staphylinus* larvae | 27.2 | 22.2 | 33.4 | 33 | 14 | 8 | 8.6 | 14.6 | 30.6 | 34.2 | 36.2 | 20.3 | 14 |
| *Diptera* | | — | 22.2 | 70 | 53.4 | 45 | 59.2 | 20 | 9.7 | 18.3 | 47.3 | 27 | 42.5 | 30.3 |
| *Lepidoptera* | | 9 | 5.5 | 39 | 16 | 9 | 9 | 17.2 | 19.5 | 32.6 | 15.8 | 18.1 | 15.6 | 4.7 |
| *Hymenoptera* | Larvae | — | — | 2.8 | 2.3 | 27 | 60 | 6 | 2.4 | — | — | — | 20.3 | 4.4 |
| | Imagines | — | — | 8.3 | 8 | 26 | 42 | 23 | 22 | 22.4 | 15.8 | 36.2 | 23.6 | 6.6 |
| *Orthoptera* | | — | — | — | — | — | 0.8 | — | — | 2 | — | — | 0.3 | — |
| *Dermaptera* | | — | — | — | — | — | 0.8 | 8.6 | 2.4 | 4 | — | — | 1.2 | — |
| Unidentified arthropods | | — | 5.5 | 5.6 | 5.7 | 2.4 | — | 6 | 4.8 | 2 | 5.2 | — | 3.1 | 4.4 |
| Pupae | | — | 16.6 | 2.8 | 4.5 | 8 | 10 | 20 | — | 2 | — | — | 6.8 | 6.9 |
| Myriapods | | — | 22.4 | 40 | 26 | 9 | 24.4 | 40 | 44 | 32.6 | 23.5 | 9 | 24.8 | 20.6 |
| Vertebrates | | — | — | — | — | — | 1.5 | — | 2.4 | — | — | — | 0.36 | — |
| N | | 11 | 18 | 37 | 88 | 122 | 131 | 35 | 41 | 49 | 38 | 11 | 581 | 33 |

with the corresponding data obtained for the soil fauna. The mean weight of insects in the mole stomachs formed 14.4% of the contents. The weight of earthworms and the remaining animals (slugs) amounted to 86.5% of the contents, which more or less agrees with the data from the soil

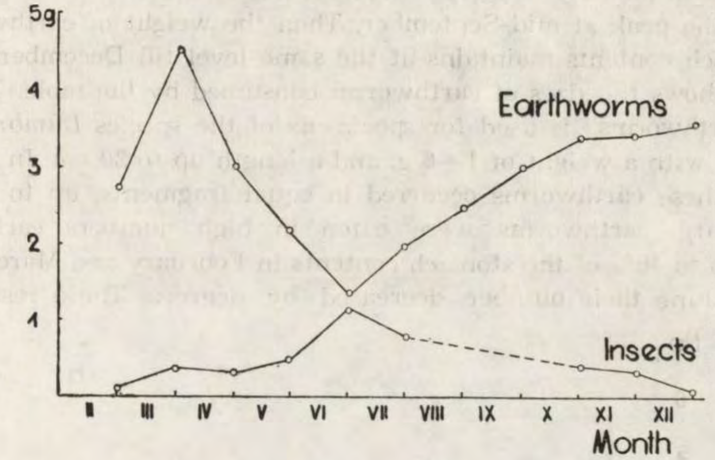



Fig. 3. Weights of earthworms and insects (in grams) in the food of moles in the 1956—1962 period.

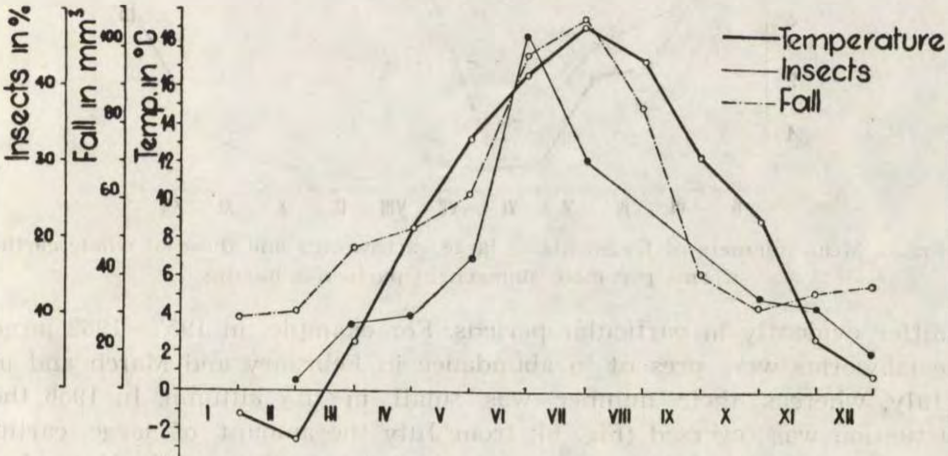



Fig. 4. The occurrence of insects in the mole diet in dependence on temperature and humidity.

analyses. The basic food of moles in pastures and meadows consists of earthworms, which were present in 97.6% of the stomachs (Table 3). Earthworms occurred in 100% of the stomachs throughout the year except for June and July. This was also true of the materials collected in the Tatra Mts. and in the valley of the River Poprad near Stary Sącz

(Table 3). The weight of earthworms eaten by moles shows some seasonal changes (Fig. 3). Moles eat the most earthworms in the spring (about 4.5 g. in March). The greatest fall in the amount of earthworms in the stomachs takes place in the May—July period, next this amount increases gradually tc reach the peak at mid-September. Then the weight of earthworms in the stomach contents maintains at the same level till December (Fig. 4).

Fig. 5 shows the sizes of earthworms consumed by the mole. The term "large earthworms" is used for specimens of the species *Lumbricus terrestris* L., with a weight of 1—6 g. and a length up to 20 cm. In the mole stomach these earthworms occurred in equal fragments, up to 3 cm. in length. Large earthworms were eaten in high numbers early in the spring (up to 40% of the stomach contents in February and March). From April to June their number decreased by degrees. These results may

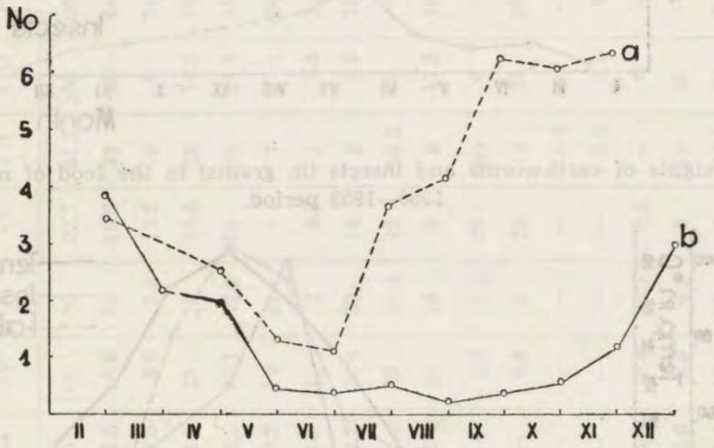



Fig. 5. Mean numbers of fragments of large earthworms and those of whole earthworms per mole stomach in particular months.

differ evidently in particular periods. For example, in 1957—1962 large earthworms were present in abundance in February and March and in July, whereas their number was small in the autumn. In 1956 the situation was reversed (Fig. 6); from July the amount of large earthworms in the diet of the mole increased gradually and in November reached 32.2% of the stomach contents.

The foregoing facts are undoubtedly associated with the humidity and temperature of the soil. Early in the spring earthworms dwell in the superficial layer of soil, which is more heated at that time. For example, 50—100 large specimens of earthworms *Lumbricus terrestris* L. were counted in 1 sq. m. of the 10-cm-thick superficial layer of soil on 25.3. 1960. They made 100—300 g. of food per 1 sq. m. These earthworms, still relatively sluggish, could readily be captured by the mole.

The phenomenon of storing earthworms — they used to be found hoarded in the vicinity of the winter nest of the mole (S k o c z e ń, 1961) — is connected with the occurrence of large earthworms. However, as can be seen from the diagram (Fig. 6), large earthworms were absent from the stomachs of moles from the period (1957—1962) when food-stores were found, but they occurred in the stomach contents in 1956. The first of these facts is evidently associated with the mole's food preference for small earthworms, and the other is probably due to the drought that took place in July 1956. The drought undoubtedly exerted influence on the reproduction of earthworms and, as a result, caused the lack of small specimens. Consequently, in the autumn the moles were dependent in food on the large earthworms coming from the deeper layers of soil.

### 1. The Occurrence of Whole Earthworms in Stomachs

Whole earthworms occurred in the stomachs almost entirely undamaged. This was not the case with large earthworms. The maximum length of earthworms swallowed whole was 8 cm. The largest numbers of such earthworms were eaten in cool seasons, i.e., in spring and autumn (Fig. 5). This is certainly connected, with the fact that in these

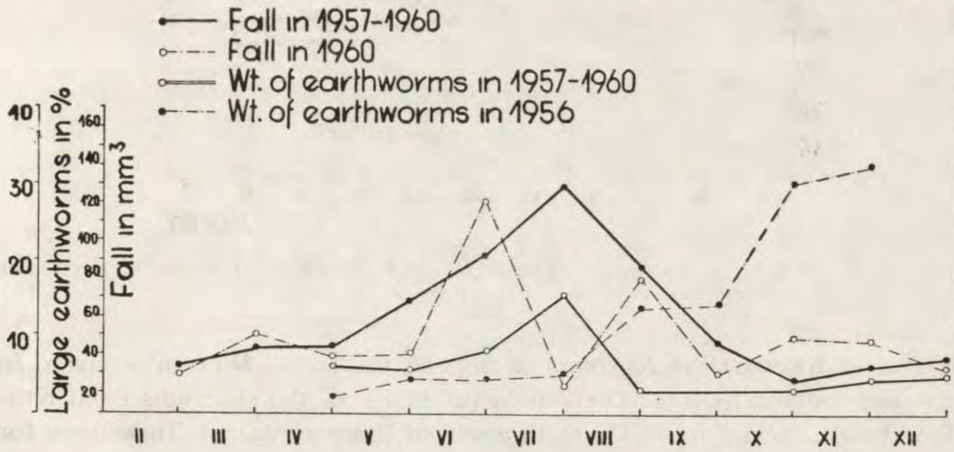



Fig. 6. The quantities of large earthworms in the diet of moles in dependence on rainfall.

seasons earthworms contain the least earth in their alimentary canals, which is also indicated by the diagram showing the amount of sediment in the stomach contents in the particular months of the year (Fig. 7). In the extreme cases the number of earthworms per stomach reached 24 specimens (female No. 306 of 5.3.1960 and a male of 14.4.1958).

### 2. The Occurrence of Earthworm Cocoons

In 1957—1962 the number of mole stomachs containing earthworm cocoons was very variable and in the February—August period ranged from 17 to 25% of the total. This figure increased evidently to reach 30—50% in the autumn months. Similar results were obtained in 1956. In the autumn of this year about 50% of the stomachs contained earthworm cocoons. Young moles did not consume cocoons.

### 3. Insects in the Diet of the Mole

The percentage of insects is inversely proportional to that of earthworms (Fig. 3). In the cold season, insects occur in the diet of the mole in slight quantities. As the soil becomes warmer, the number of insects in the stomach contents increases (Figs. 3 and 4). The remarkable increase in June and July was due to the large number of ants eaten by the mole (Table 3). The coefficient of correlation ($r$) between the weight of earthworms ($x$) and that of insects ($y$) equals $-0.718$ and is significant ($P = 0.01$). This relation is expressed by the regression equation $y = 1.302 - 0.292\,x$.

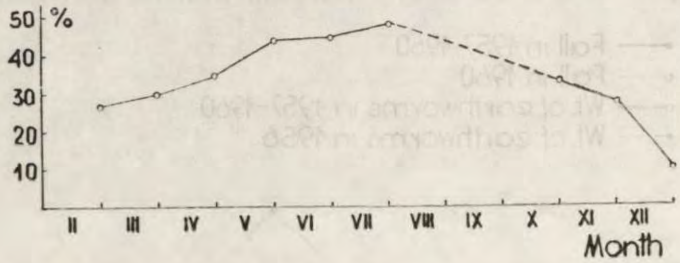



Fig. 7. Proportions of sediment in the stomach contents of moles in particular months.

Out of the particular groups of insects, the larval *Diptera* occurred in the mole stomachs most frequently (in 42.5% of the stomachs from Kraków localities and in 30.3% of those from the mountains). They were for the most part larvae of the *Tipulidae*, which sometimes abounded in the rhizosphere of the meadows and pastures. These harmful larvae destroy the root system of grasses. Their mass occurrence is signalized by the yellow coloration of large patches of the lawn (F r a n z, 1950). The length of the specimens found ranged from 0.5 to 2 cm. The larval *Bibionidae* (especially *Dilophus sp.)* were also present in the mole stomachs. Owing to their thick integument they were generally eaten whole, and hence they were easily recognized. Other larvae of the *Diptera* were found rather occasionally. Imagines of the *Diptera* were also only sporadically present in the stomach contents. Fragments of imagines of *Tipula sp.* and wings of the *Muscidae* occurred in a few specimens.

The second richest group of insects in the stomach contents included the larval *Coleoptera*, of which the wireworms were present in 28% of the stomachs. Soil analyses showed them to be fairly numerous, particularly in Dr. Jordan's Park (Table 2). Larvae of *Athous sp.*, *Agriotes sp.*, *Corymbites sp.* and *Selastosomus sp.* were the most frequent prey in this group. In the mountainous regions wireworms were found in 35% of the stomachs.

**Table 4.**

The composition of the stomach contents of moles from areas inhabited by ants.

| Date | Sex | Weight in g. | Age group | Weight of contents | Weight of earth-worms | Fragments of earth-worms | Ants | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | ima-gines | larvae |
| 17. 6. 1956 | ♂ | 76.5 | II | 5.60 | — | — | 12 | 340 |
| | ♂ | 91.3 | II | 6.67 | 0.43 | 5 | 17 | 141 |
| 19. 6. 1956 | ♂ | 75.0 | IV | 4.04 | — | — | 3 | 161 |
| | ♀ | 52.5 | 0 | 2.20 | — | — | — | 189 |
| 26. 6. 1956 | ♀ | 58.4 | 0 | 4.67 | 0.81 | 41 | 78 | 132 |
| | ♀ | 69.0 | II | 5.08 | 0.89 | 7 | 11 | 306 |
| | ♂ | 86.0 | III | 5.23 | 0.08 | 3 | 9 | 319 |
| 27. 6. 1956 | ♂ | 76.0 | III | 7.64 | 0.29 | 9 | — | 786 |
| | ♀ | 71.3 | II | 2.25 | 0.08 | 2 | — | 288 |
| 30. 6. 1956 | ♀ | 57.0 | I | 3.50 | 0.13 | 2 | — | 344 |
| 7. 7. 1956 | ♂ | 93.0 | — | 7.80 | 1.36 | 28 | 2 | 750 |
| 9. 7. 1956 | ♂ | 79 0 | I | 3 61 | — | — | 3 | 400 |
| 12. 7. 1956 | ♂ | 92.5 | III | 7.66 | 0.50 | 25 | 113 | 1,070 |
| 14. 7. 1956 | ♀ | 69.0 | IV | 5.25 | 0.38 | 11 | 9 | 600 |
| 20. 7. 1956 | ♀ | 64.5 | II | 5.10 | 0.82 | 19 | 20 | 1,117 |
| | ♂ | 85.8 | — | 5.88 | 0.60 | 18 | 20 | 790 |
| 26. 7. 1956 | ♂ | 87.5 | I | 4.98 | 0.80 | 10 | 12 | 942 |
| | ♂ | 82.9 | II | 5.28 | 0.45 | 14 | 21 | 408 |

Larvae of the *Melolonthidae* (cockchafer larvae) were fairly often consumed (present in 19.4% of the stomachs from the Kraków region and in 4.4% of those from the mountains) (Table 3). They pointed to the mole's food preference for small or at most medium-sized cockchafer larvae, which prevailed in all the stomachs, whereas the large larvae occurred only sporadically.

Pupae of the *Melolonthidae* were found in scarcely a few cases, for the most part in the stomachs of moles from Dr. Jordan's Park. Their armours were bitten into so small pieces that it was difficult to determine the number of the specimens. Remains of imagines of *Melolontha sp.* or *Amphimallus solstitialis* were also encountered occasionally.

Of the remaining larvae of the *Coleoptera* the *Carabidae* were predominant. The larval *Curculionidae* were also fairly numerous, but I failed to identify them down to species. It should be emphasized that in this group, as well as in the case of ants, some larvae did not exceed 5 mm. in length, and yet they had been spotted by the mole.

The *Hymenoptera* come third in quantity as a component of the diet of moles from the Kraków localities. The mole has not been regarded hitherto as an ant-eating animal. However, large numbers of ant cocoons and pupae were found in the stomachs which made up my material (Table 4). In particular cases they exceed 1000 specimens per stomach. The moles with such quantities of ants in their stomachs were caught in some definite places of a pasture abounding in ant-hills of *Formica sp.* These large numbers of ants were found in the stomachs of both young and old moles.

The imagines of ants appeared only in a relatively low percentage of specimens (in 5% in July 1956). Table 3 suggests that moles are not concerned with imaginal ants, which get into their alimentary canals rather occasionally, for instance, when they eat out the cocoons. In the stomachs of moles from the mountainous regions ants were encountered only sporadically (Table 3).

The *Lepidoptera* were represented chiefly by the noctuid larvae of the genus *Agrozis* (Table 3), but these were of relatively little importance, especially in so far as the moles from the mountainous localities are concerned.

Of the *Myriapoda*, the remains of *Lithobius sp.* were found in only one mole and some fragments of the *Diplopoda* in a few cases. A remarkable percentage of the stomachs contained fragments of *Geophilus sp.* (Table 3).

### 4. Slugs

Only slugs of the genera *Limax* and *Agriolimax* were met with. There is an evident correlation between the rainfall and the proportion of the stomachs containing slugs (Fig. 8). In 1956, June had a heavy rainfall (on the average 120.2 cu. mm.), July was conspicuously dry (mean rainfall — 26.7 cu. mm.) and August was also deficient in humidity. Out of the 43 stomachs examined in May only one contained slugs, but they were present in 16.8% of the 95 stomachs taken in June. These stomachs turned out to belong exclusively to young moles. The moles probably obtained slugs during their inspections of the surface of the area. In

July slugs were ascertained in 12 (11%) out of the 110 stomachs examined. Fifty per cent of them were stomachs of adult moles. No slugs were observed in the 12 stomachs collected in August, but in September they occurred in 6 (14.63%) out of the 41 stomachs. Extremely large quantities of slugs were encountered in a young male caught on 16 April, 1956. Its stomach contained 56 small slugs, up to 1 cm. in length. They were the only food found in the stomach (3.81 g.). On the next day 24 fragments of earthworms and 17 small slugs were counted in the stomach of another young male, which weighed 53.7 g.

In the mountainous regions slugs were eaten by a considerable percentage of the moles (13.3%). Four captive moles ate slugs sporadically and reluctantly. The occurrence of slugs in materials of other authors is presented in Table 5.

### 5. Vertebrates

Remains of the common vole *Microtus arvalis* (P a l l.) were found in the stomach contents of two moles. In the first case they were fragments

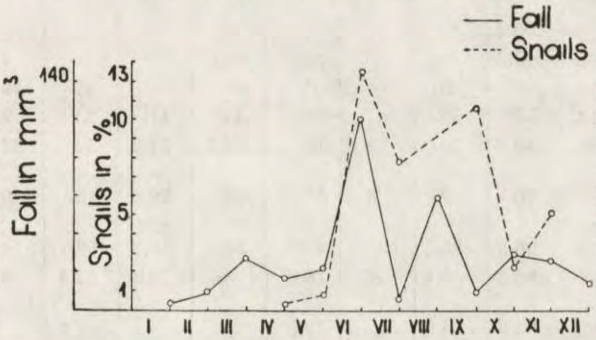



Fig. 8. The occurrence of slugs in the food of moles in dependence on humidity.

of a nestling vole (foot with digits, fragments of skin) encountered in a young female caught in Błonia on 9 July, 1956. In the second case, fragments of the skin with hair occurred in the stomach of a male from Dr. Jordan's Park (11 Sept., 1958). In another stomach there were fragments of a cartilage and tendons of a newborn mouse.

## V. STOMACH STONES

Balls of loose or compact plant fragments mixed with mole hair and parts of arthropodal armours were present in some stomachs. The ball material was also interlaced with bristles of earthworms, packed up with sand and other mineral components of soil and imbued with digested food. In addition, it occurred in the form of hard compact stones with polished walls (Fig. 9) and a colour ranging mostly from pink to brown. In some stomachs such stones were numerous.

For example, 8 stones, weighing 4.74 g. all together, were removed from the stomach of an old male (age group III) caught in Dr. Jordan's Park in 1956. The nutritional contents of the stomach, including the sediment, weighed 4 g. in this specimen. In an old female from he same locality (caught on 30. May, 1956, body weight — 94 g.) 4 stones with a global weight of 3.4 g. were found in the stomach. The weight of the stomach contents was 4.25 g. The stones measured from 0.5 to 3 cm. They were ovoid in shape, sometimes entirely round (Fig. 9).

**Table 5.**

The percentage of mole stomachs containing particular groups of food components, according to other authors.

| Authors | *Lumbricidae* | *Myriapoda* | *Mollusca* | *Coleoptera* | | | | *Hymenoptera* | *Diptera* | *Lepidoptera* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Imagines | Larvae | | | | | |
| | | | | | Cockchafer larvae | Wireworms | Other | | | |
| Tauber, 1924 | 100 | 12 | 2 | 6 | — | — | 14 | — | 6 | 4 |
| Dyche, 1908 | 43.2 | — | — | 22.7 | 22.8 | — | — | 7.6 | — | — |
| Scheffer, 1919 | 49 | 25 | — | 67 | 64 | — | 25 | 19 | — | — |
| White, 1914 | 92 | 50 | 5 | 26 | 38 | 41 | 20 | 2 | 87 | 39 |
| Sachtleben, 1926 | 40 | 70 | — | 16 | 74.2 | 64.2 | 32 | 21 | 10 | 22 |
| Hauchecorne, 1927 | 89 | 2 | 5 | 37 | 39 | 39.5 | 15 | 9 | 35 | 17.5 |
| Schaerffenberg, 1940 | 96.3 | 35.5 | 19 | 40.7 | 28.3 | 51.7 | 58.7 | 14.3 | 42.6 | 14.3 |
| Grigoriev, 1957 | 98.6 | 8.4 | — | 16.6 | — | 73.4 | 22.4 | 8.4 | — | 3.2 |
| Crowcroft & Godfrey, 1960 | [1]) 93.8 | 14.8 | 2.3 | 19.5 | | | 84.4 | | | |
| Skoczeń, 1965 | [2]) 91.4 | 3.1 | 0 0 | 45.3 | | | 85.9 | | | |
| | [3]) 97.6 | 24.8 | 9.4 | 18.4 | 19.4 | 28 | 26.9 | 20.3 | 42.5 | 15.6 |

[1]) arable field; [2]) pasture; [3]) pastures and meadows.

Percentage occurrence of moles with stomach stones is as a rule consistent with the quantities of large earthworms and those eaten whole in the particular months of the year (Fig. 5). In the spring and autumn the numbers of moles with stomach stones are the largest. No doubt, this great proportion of moles with stones in their stomachs subsists throughout the winter.

Formation of stones is to some degree dependent on the occurrence of moults. Fig. 10 shows the percentages of moles with stomach stones in particular months in comparison with the progress of the moults. These two phenomena appear to be related to each other. The maximum number of stones was noted during the spring and autumn moults.

In no lower degree the occurrence of stomach stones is associated with the numbers of earthworms eaten whole by moles, as will be seen from a comparison of Figs. 10 and 5.

The occurrence of stomach stones depends also on the type of the habitat, especially on the plant cover (Table 6). Stomach stones occurred


Fig. 9. The distribution of stones in the mole stomach.
1. Fresh stone, 2. Intermediate stone, 3. Mineralized stone.

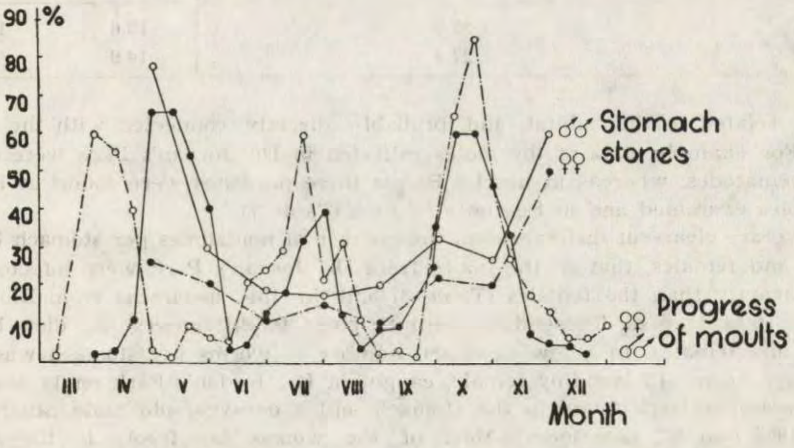



Fig. 10. Seasonal variations in the proportion of moles with stomach stones, compared with the progress of moults.

more frequently in the moles from the localities with more exuberant vegetation (Dr. Jordan's Park) than in those from the pastural areas (Błonia, Łęg). In addition, the differences between the habitats have an effect on the number of stones per stomach. In the moles from Dr. Jordan's Park the number of stones per stomach was larger than in those from the remaining localities.

There is a close relation between the presence of stones in the stomach and the age of the moles. In old moles (age groups III and IV) stomach stones were present in 36.1% of the specimens, whereas for the remaining groups this value came to 23.6%. The stomach stones of old moles were compact and mostly mineralized. Their number per stomach was larger. For example, out of the 9 moles with stones collected in April in the years 1956—1962, 6 were old specimens, their numbers of stones per stomach being 2—3. These data seem to indicate that stomach stones exert some influence on the mortality of old moles.

## VI. NEMATODES

In my material nematodes were noted in relatively large numbers. Identifications carried out by Mr. S. Stanuszek showed that nearly all of them represented one species, *Spirura talpae* (Gmelin, 1790), and only in a few cases there were members of *Mermis sp.* The intensity of infection of the mole with nematodes is closely related to the habitat and probably directly connected with the kind of food. For example, 65% of the moles collected in Dr. Jordan's Park were infected with nematodes, whereas in nearby Błonia these parasites were found in 15.7% of the moles examined and in Łęg only in 2.4% (Table 7).

**Table 6.**

The percentage of moles with stones in the stomach in particular habitats.

| Sex | Dr. Jordan's Park | Błonia | Łęg |
|---|---|---|---|
| ♂♂ | 37.7 | 18.6 | 15.0 |
| ♀♀ | 27.3 | 14.9 | 3.6 |

There are clear-cut differences in the number of nematodes per stomach between males and females, that is, the males from Dr. Jordan's Park were infected much more heavily than the females (Table 8) and in the specimens from Błonia this relation was reverse. These data seem to point to differences in diet between males and females. In a few cases the number of worms per stomach was extraordinary. In an old lactating female, caught in Dr. Jordan's Park on 19 May, 1958, 237 nematodes were found in the stomach and a one-year-old male caught on 21 May, 1965 had 402 nematodes. Most of the worms lay freely in the stomach contents, some of them were attached to the cardia.

Nematodes encysted in the outer walls of the stomach were observed in 7 moles (4 males and 3 females) of the Kraków series in the summer and autumn of 1956. All the moles from the Tatra Mts. but one had a few larvae encysted in the outer walls of the stomach each. No such cysts were seen in the other parts of the alimentary canal, except for one specimen, in which a cyst was found in the mesentery of the stomach.

## VII. DISCUSSION

Injection of formalin into the stomachs of moles soon after their being killed turned out to be useful. As a result, well fixed stomach contents

Table 7.
The infection of moles with nematodes in particular habitats.

| Months | | II | III | IV | V | VI | VII | VIII | IX | X | XI | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dr. Jordan's Park:** | | | | | | | | | | | | |
| Number of stomachs examined | ♂ | | 2 | 4 | 14 | 8 | 6 | 7 | 7 | 9 | 1 | 62 |
| | ♀ | | 2 | 7 | 4 | 8 | 7 | 8 | 7 | 14 | 6 | 63 |
| Number of stomachs with nematodes | ♂ | | 1 | 3 | 6 | 5 | 5 | 6 | 6 | 8 | 1 | 41 |
| | ♀ | | 2 | 4 | 3 | 3 | 5 | 6 | 5 | 10 | 2 | 40 |
| Number of nematodes in stomachs | ♂ | | 63 | 53 | 635 | 168 | 287 | 110 | 360 | 152 | 87 | M 46.7 |
| | ♀ | | 48 | 133 | 277 | 55 | 119 | 28 | 100 | 289 | 29 | M 27.0 |
| Minimum | | | 7 | 5 | 6 | 3 | 2 | 1 | 3 | 6 | 1 | |
| Maximum | | | 63 | 83 | 402 | 100 | 224 | 48 | 118 | 85 | 87 | |
| **Błonie:** | | | | | | | | | | | | |
| Number of stomachs examined | ♂ | 5 | 6 | 6 | 29 | 51 | 65 | 9 | 9 | 10 | 4 | 194 |
| | ♀ | 1 | 5 | 11 | 28 | 46 | 48 | 11 | 18 | 6 | 2 | 176 |
| Number of stomachs with nematodes | ♂ | | | 1 | 4 | 2 | 10 | 2 | 4 | 2 | 2 | 27 |
| | ♀ | | 3 | 2 | 2 | 7 | 7 | 1 | 5 | 2 | 2 | 31 |
| Number of nematodes in stomachs | ♂ | | | 2 | 9 | 5 | 22 | 2 | 5 | 5 | 100 | M 5.7 |
| | ♀ | | 51 | 6 | 4 | 106 | 11 | 2 | 84 | 51 | 12 | M 10.6 |
| Minimum | | | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | |
| Maximum | | | 43 | 5 | 2 | 4 | 5 | 2 | 46 | 39 | 10 | |
| **Łęg:** | | | | | | | | | | | | |
| Number of stomachs examined | ♂ | 10 | 7 | 2 | 2 | | 2 | | | 9 | 12 | 44 |
| | ♀ | 10 | 1 | 7 | 4 | 1 | 1 | | | 8 | 7 | 39 |
| Number of stomachs with nematodes | ♂ | — | — | — | — | — | — | | | 1 | — | 1 |
| | ♀ | — | — | — | — | — | — | | | 1 | — | 1 |
| Number of nematodes in stomachs | ♂ | — | — | — | — | — | — | | | 7 | — | M 0.16 |
| | ♀ | — | — | — | — | — | — | | | 2 | — | M 0.05 |

and stomachs themselves were obtained, which is of vital importance to the exactness of results. The stomach contens of trapped moles, especially in warm seasons, were in the state of considerably more advanced decay.

The purposefulness of weighing food components is a controversial point in stomach analyses. F o l i t a r e k (1932) and G o d f r e y &

Crowcroft (1960) weighed them. The results of weighing must be relative to some extent, because the organisms which make up the stomach contents are in different stages of decay. It is not unimportant either that different organisms and tissues show an ununiform increase or decrease in weight after the fixation in formalin. Moreover, the differences in the weight of stomach contents are undoubtedly connected with changes in the proportional qualitative composition of the mole's food. However, the relative value of weight results is, above all, due to the soil content of the alimentary canals of earthworms. According to Lawrence & Millar (1945), it forms 25—45% of the body weight of an earthworm. It is almost impossible to clean the stomach contents of the soil which they contain. After rinsing with water their weight dropped by about 30%, but coarse grains of sand were still found on the plankton net.

**Table 8.**

The infection of moles with nematodes in the same habitat.

| Locality and year | | Infected moles in per cent | | Mean number of nematodes per stomach (only infected moles) | |
|---|---|---|---|---|---|
| | | ♂♂ | ♀♀ | ♂♂ | ♀♀ |
| Dr. Jordan's Park, | 1956 | 82.1 | 60.6 | 80.0 | 36.8 |
| | 1957—1962 | 62.0 | 69.0 | 9.0 | 11.8 |
| Błonia, | 1956 | 13.0 | 18.1 | 7.0 | 8.1 |
| | 1957—1962 | 11.4 | 16.3 | 3.0 | 16.4 |

Lunt & Jacobson (1944) think that the soil present in the alimentary canals of earthworms may be of nutritional importance. It is very rich in nitrogen and contains more organic components than the soil in which the earthworms have lived.

The relation of the weight of food eaten to the body weight of the moles is instructive, in spite of the approximate character of estimations, for the following reasons: a) The differences in the weights of the stomach contents of the moles caught in Błonia in 1956 are slight, which points to their uniform feeding activity. This uniformity of the results may be connected with the method of catching, because in that period all the moles were caught by hand and, consequently, while they were searching for food. b) The year 1956 was much differentiated in respect of rainfall, which, however, was not reflected in the quantities of food in the mole stomachs. c) The great differences in amounts of the stomach contents in the 1957—1962 period may have been caused by the methods of catching (by hand and in traps) and, above all, by the fact that the moles were derived from different habitats (Błonia, Dr. Jordan's Park, Łęg).

Practically all the authors (Hauchecorne, 1927; Folitarek, 1932; Baškirov & Žarkov, 1934; Schaerffenberg, 1940, and others) remark that the presence of particular groups of food in the mole stomach is closely related to the degree of digestibility of the components and also to the lingering of indigestible remains, e.g., fragments of armours of insects, in the stomach. The studies on the rate of transport of food through the alimentary canal of rodents show that the rates of passage of particular components vary and depend on the kind of food. In addition, a marked fall in the rate of transport was observed for the last 10% of the component (Kostelecka-Myrcha & Myrcha, 1964a, b).

As both Kriszat & Ferrari (1933) and Spiridonova (1949) pointed out and as can be seen from the stomach contents themselves, insects are digested more easily than earthworms. On the other hand, slugs are considerably more resistive to digestive juices.

The investigators who studied the diet of the mole (Hauchecorne, 1927; Schaerffenberg, 1940; Baškirov & Zarkov, 1934; Grigorev, 1957, Godfrey & Crowcroft, 1960, and others) counted the organisms found in the stomachs. Earthworms used to be estimated by the number of head or tail fragments of these animals. This estimation, as well as all the others, is not exact, because earthworms, especially in summer, are not consumed whole. Moles do not, as a rule, eat the posterior parts of annelids, excessively loaded with soil. Numerous fragments of uneaten earthworms left at the exits of mole tunnels were observed many a time, particularly so in May.

As to Godets method (1951), consisting in an immediate analysis of the stomach contents of moles in the field combined with an analysis of the composition of the soil fauna, an objection may be raised in connection with the mass escape of earthworms from the digging mole, which was frequently observed. For example, in the autumn of 1962 I collected 18 earthworms running away from a mole in an area 70 cm. long in a damp meadow at Łęg. Once, in Błonia, I also observed the retreat of beetles of the genus *Corymbites* to the tops of grasses, where they waited till the threatening danger was over. In these and the like cases the composition of the soil fauna obtained from an analysis did not agree with the actual state.

There is a controversy concerning the consumption of large cockchafer larvae by moles. According to some authors, moles do not eat large grubs (Hauchecorne, 1927); other investigators, e.g., Schaerffenberg (1940), are of the opinion that they are included in the diet of the mole. Observation of captive moles (Skoczeń, 1957) shows that the factor which makes large cockchafer larvae repellent to the mole is their fat. Moles are not physiologically adapted to large amounts of fat in their food. All the moles which were fed pork in captivity developed a hepatic insufficiency and hypertrophic gall-bladder.

The presence of cockchafer larvae in the stomach contents of a mole is readily recognized by a large amount of fat on the surface of water in the Petri dish. None the less, Grigorev (1957) reports that in the Gomel region, which was pestered with cockchafers, their larvae occurred in 90% of the stomachs.

A new aspect of the economic importance of the mole is associated with the mass occurrence of ants in its stomach. Ants are regarded as an undesirable element in fields and meadows (Klapp, 1962). On the one hand, the mole, with its tunnels and hills, brings about favourable conditions for ants to settle. On the other hand, feeding on ants it reduces their populations in grasslands. A secondary aspect of this fact is the mole's ability to eat out as small forms as, e.g., ant eggs, up to 2 mm. long.

Baškirov & Žarkov (1934) explain the frequent occurrence of remains of *Geophilus sp.* in the mole stomach by a special preference for this food. Soil analyses of the samples from Błonia did not reveal the presence of this species, and in Dr. Jordan's Park it was encountered only occasionally (Table 2). However, in the stomachs of moles from these localities it occurs in large numbers. Owing perhaps to active ways of life, this species is a particularly frequent faunal element in the tunnels of moles. Besides other myriapods, especially diplopods, *Geophilus sp.* is a permanent inhabitant of the winter nests of moles. This is probably responsible for the fact that in Schaerffenberg's (1940) material the largest numbers of myriapods were found in the autumn and winter months.

The proportion of slugs in the mole food was different in materials of different authors (Table 5). The results of Schaerffenberg (1940) suggest a close relation between the presence of slugs in the mole stomach and the habitat. The proportion of slugs in the stomach contents was considerably higher in the specimens from meadows and pastures than in those from arable areas and gardens. The results of Godfrey & Crowcroft (1960) are, however, quite opposite (Table 5). In addition to the habitat, there is undoubtedly another factor that comes into play in this respect. As will be seen from my results, this factor is the actual humidity conditions.

There are only sporadic records on vertebrates in the diet of the mole (Blasius, 1857; Adams, 1903; Löns, 1914 after Schaerffenberg, 1940; Hauchecorne, 1927). Only in one case did Baškirov & Žarkov (1934) find the forelegs of a young frog in their abundant material. Grulich (1959) encountered skins left after consumed mice and voles in the winter nests of the mole. Some interesting information is given by Larkin (1948), who found a paw of a nestling mole in the contents of a stomach. This would indicate the existence of cannibalism, especially with respect to nestling moles.

**Table 9.**

The caloric value of some components of the mole diet (after Hawkins & Jewell, 1962)

| Kind of food | Water content | Dry matter | Kcal/g moist matter | Kcal/g dry matter |
|---|---|---|---|---|
| Ant larvae | 68 | 32 | 2.0 | 6.2 |
| *Tenebrio molitor*, larvae | 60 | 40 | 2.4 | 6.1 |
| Various insects | 75 | 25 | 1.5 | 5.8 |
| Earthworms | 83 | 17 | 0.8 | 4.6 |
| One-day-old mice | 84 | 16 | 0.8 | 4.8 |

**Table 10.**

Daily food requirements of the mole according to different authors.

| Author | Sex & weight | Food eaten in % of body weight or in g. | Kind of food |
|---|---|---|---|
| Kriszat & Ferrari, 1933 | — | 50 % | beef |
| Baškirov & Žarkov, 1934 | — | 20—60 g | natural food |
| Schaerffenberg, 1940 | — | 100 % | natural food |
| Loginov, 1949 | ♂ 64.9 | 30—40 g | natural food |
| | ♀ 60.0 | 30—40 g | natural food |
| | ♂ 85.0 | 150 g | natural food |
| Grigorev, 1957 | ♂ 79.2 | 78 g | natural food |
| | ♀ 100.0 | 80 g | meat |
| Skoczeń, 1957 | ♂♂ | 50 % | meat |
| | ♀♀ | 100 % | natural food |
| Godfrey & Crowcroft, 1960 | ♂♂+♀♀ | 40—50 % | natural food |
| Hawkins & Jewell, 1962 | ♂♂+♀♀ | 40 % | natural food |

Bite-marks observed frequntly on the skins of *Arvicola terrestris* (Linnaeus, 1758) and the remains of (skin and gonads) discovered in the winter nest chamber of a mole at Łęg in April 1958 give evidence of the aggressiveness of moles in relation to the vertebrates occurring in their territories.

There are hardly any more controversial problems than that of the quantity of food eaten daily by the mole (Table 9, 10). It is an undisputable fact that on the first day of captivity moles eat more than in the later period. Hard work (Skoczeń, 1958) brings about a much greater demand for food than that observed normally in captivity.

For the proper estimation of the nutrition of the mole in the course of the year, it is worth while to quote the data (Hawkins & Jewell, 1962) concerning the caloric values of particular food components (Table 9). These data and those on the weights of particular foods eaten (Fig. 3) make it possible to state that the caloric value of moles' food, with the exception of lactating females, keeps at the same level throughout the year. The period of the greatest depression in the amount of earthworms in the stomach contents coincides with an increase in the amount of insects.

Stomach stones in moles were recorded by various authors (Hauchecorne, 1927; Baškirov & Žarkov, 1934; Schaerffenberg, 1940). Similar formations are also met with in ruminants, e.g., in the chamois (Kowalski, 1955). According to Baškirov & Žarkov (1934) new stones form more readily in males, whereas the females have more stones fully formed. Albini (1910, after Schaerffenberg, 1940) believed that moles drop their stones in the same manner as owls do. Hauchecorne (1927) did not exclude this possibility. On the other hand, Baškirov & Žarkov (1934) claimed that in females the stones undergo a loosening and removal. I infer from my observations that unmineralized stones are subject to attrition in the stomach. This is suggested by the brown coloration of the contents of the stomachs with stones and the characteristic worn surfaces of stones. In water such contents formed a dark suspension of crushed plant fragments.

As to the intensity of infection of moles with nematodes, the females from Byelorussia were, according to Grigorev (1953), infected with worms twice as heavily as the males. These data would indicate that there are differences in diet between males and females. Grigorev (*l. c.*) also states that earthworms transfer nematodes of the genus *Capillaria*.

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## TREŚĆ ŻOŁĄDKÓW KRETA, *TALPA EUROPAEA* LINNAEUS, 1758, Z POLSKI POŁUDNIOWEJ

### Streszczenie

Przebadano 581 żołądków kreta z terenów zielonych Krakowa (pastwisko o twardym podłożu, pastwisko torfowiskowe, łąki parkowe), oraz 33 żołądki kretów z terenów górskich.

W materiale z r. 1956 (prawie wyłącznie z jednego biotopu) różnice w ilości pokarmu w poszczególnych miesiącach tak u kretów młodych jak i dorosłych są minimalne, mimo panującej w lipcu ostrej suszy. Natomiast w latach 1957—62 widać znaczne różnice w ciężarze treści w poszczególnych miesiącach. W okresie wiosny różnice wiążą się z rozrodem, w miesiącach następnych zaś prawdopodobnie z charakterem biotopu (Ryc. 1, 2, Tab. 1).

Głównym pokarmem kreta w wyżej wymienionych biotopach są dżdżownice (od 82,7—100% żołądków, w terenach górskich w 100% żołądków), (Tab. 3). Najwięcej dżdżownic (przeważnie dużych i średnich całych), zjadają krety w okresie wiosny i jesieni (ryc. 3, 5). Kokony dżdżownic zjadane są najliczniej jesienią (42—54,5% żołądków).

Tabela 3 wskazuje, że z owadów głównym pokarmem kretów w terenach krakowskich były *Tipulidae* (42% żołądków), następnie drutowce (28% żołądków). W terenach górskich pierwsze miejsce zajmowały drutowce. Z pozostałych larw *Coleoptera* notowane były larwy *Carabidae, Staphylinidae, Curculionidae*. Pędraki, przeważnie średniej wielkości, notowane były z terenów krakowskich w 19,4% żołądków, natomiast w żołądkach kretów górskich tylko w 4,4%. *Hymenoptera*, występowały w dużej liczbie żołądków, szczególnie z terenów krakowskich (larwy w 20,3%, imagines w 23,6%). Dotyczyło to głównie mrówek (*Formicidae*). W pojedyńczych żołądkach występowały one masowo (1117 kokonów i 113 imagines). Kre-

ty z tą zawartością żołądków odławiane były w terenie zamieszkałym przez mrówki. W żołądkach kretów z terenów górskich mrówki występowały w znikomej ilości. Poczwarki owadów reprezentowane były głównie przez *Melolonthidae*. Z wijów występował w przeważającej mierze *Geophilus sp.* (w 24% żołądków z terenów krakowskich i 20,6% z terenów górskich (Tab. 3).

Ślimaki w żołądkach kretów z terenów krakowskich występowały w 9,4%, natomiast u kretów z terenów górskich w 13.3% (Tab. 3). Ich obecność w treści żołądków związana była z rodzajem biotopu oraz aktualnymi warunkami wilgotności (Ryc. 8). Zjadane one były głównie przez krety młode penetrujące po powierzchni terenu a w biotopach górskich, również przez krety stare. Maksymalna liczba ślimaków w jednym żołądku wynosiła 56 sztuk (3,81 g). Z kręgowców na uwagę zasługują znalezione fragmenty mięśni młodej myszy i skóry z sierścią polnika (w 3 żołądkach).

Występowanie kamyków w żołądkach kretów związane jest z płcią, biotopem i wiekiem okazów (Tabela 6). Samce z Parku dr Jordana posiadały kamyki u 37,7%, natomiast samice u 27,3% osobników. U samców z Błoń kamyki występowały w 18,6%, natomiast u samic w 14,9% okazów. W Łęgu kamyki znaleziono w żołądkach 15% samców i 3,6% samic. Kamyki żołądkowe występują częściej u kretów z terenów łąkowych niż z terenów pastwiskowych. U kretów starych kamyki występowały u 36,1% osobników, podczas gdy u pozostałych grup wiekowych u 23.6% osobników. W obecności kamyków żołądkowych zaznaczały się wyraźne różnice sezonowe. Krety z okresu wiosennego i jesiennego posiadały je w większym procencie niż w pozostałych sezonach. W okresie linki wiosennej i jesiennej kamyki żołądkowe powstają częściej (Ryc. 10).

Zarażenie nicieniami wykazywało różnice związane z płcią i biotopami (Tabela 7). Najintensywniej zarażone były krety z terenów parkowych w 65%, z Błoń w 15,7%, a z Łęgu tylko w 2,5%. Występowały różnice w intensywności zarażenia w poszczególnych latach (Tabela 8). Fakty te wydają się być związane z różnicami w odżywianiu się kretów w tym samym biotopie jak również z pewną wybiórczością pokarmową zwierząt. Fauna nicieni w żołądkach reprezentowana była wyłącznie przez jeden gatunek *Spirura talpae* (G m e l i n, 1790). Maksymalne liczby nicieni w jednym żołądku wynosiły u samicy karmiącej 237 sztuk, oraz u samca jednorocznego 402 sztuki.