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Title	Stomach contents of <i>Mogera wogura wogura</i> (TEMMINCK) collected in the Hanno City, Saitama Prefecture, Japan. Part I
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Stomach contents of *Mogera wogura wogura* (TEMMINCK) collected in the Hanno City, Saitama Prefecture, Japan. Part I

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ABSTRACT. Stomach contents of *Mogera wogura wogura* were studied based on 125 specimens trapped at the Hanno Golf Course, Hanno City, Saitama Prefecture. The contents were sorted into the following food items: animal matters, vegetable matters and others. Number of stomachs containing each food item was given for four seasonal periods, spring(March to May), summer(June to August), autumn(September to November) and winter(December to February).

The results obtained were as follows: Insects and earthworms were the main foods of the moles. The occurrence rate of Formicidae(adult) was the highest and Scarabaeidae (larvae) was the second. The number of stomachs containing the larvae of Scarabaeidae was found in winter and spring in plenty, but that of the adults was seen in summer and autumn, and that of the hairs of *M.w.wogura* as a mass was often found in winter and spring. Namely, because these seasons were breeding seasons of the moles they seemed to fight with each other. And hairs found thin in each stomachs in summer and autumn seemed to be swallowed in case of grooming. All vegetable matters were found as fibers in the stomachs in summer. Sand and soil were found in most of the stomachs. They seemed to be swallowed with other foods, moreover they might have come out of the intestines of earthworms.

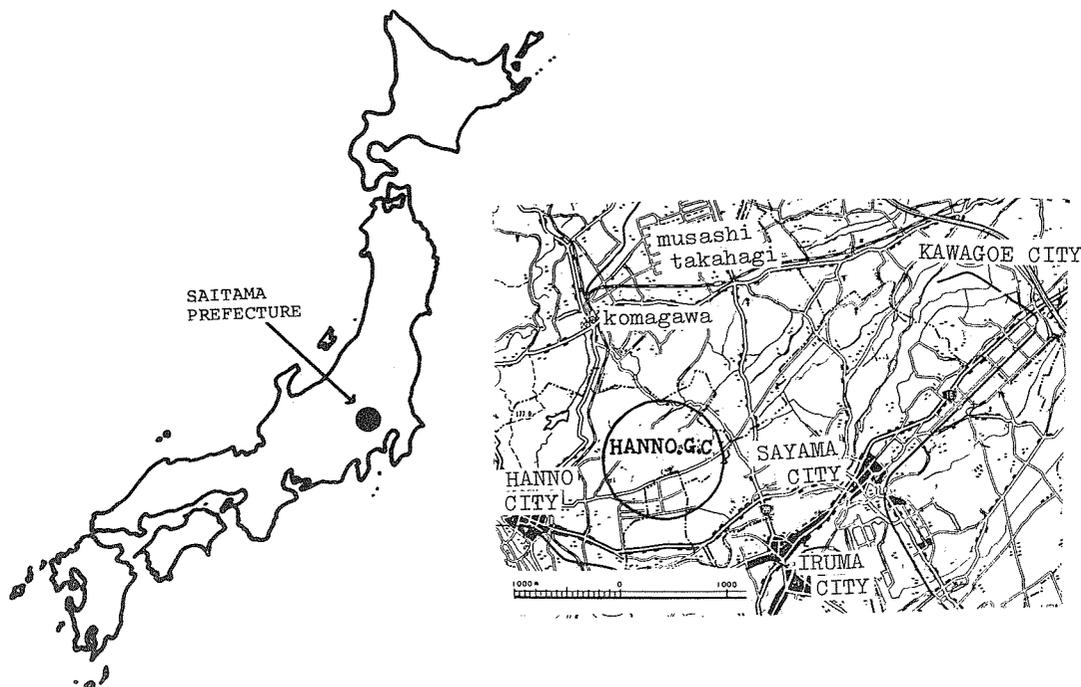


Fig. 1 The study area

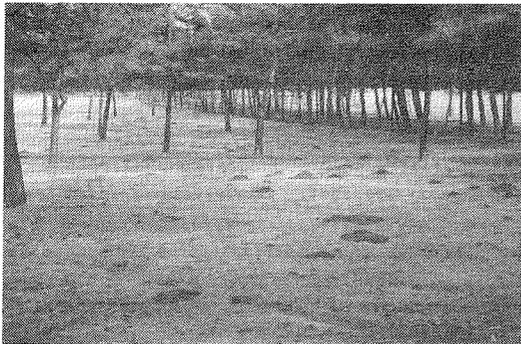


Fig. 2 Habitat of the moles collected.
Many mole-mounds are seen on the lawn
under the *Pinus densiflora*

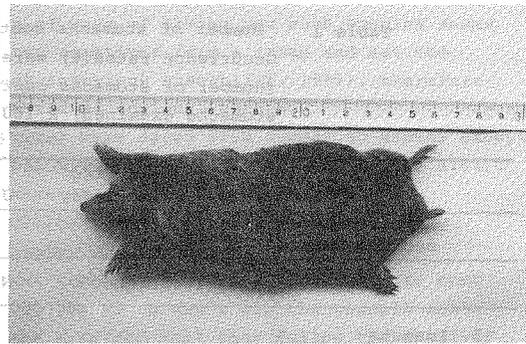


Fig. 3 *Mogera wogura wogura*

Introduction

Several papers on the variation of the food habits were published on *Mogera wogura wogura* (TEMMINCK) from wild populations in Japan (ABE, 1965, 1968, 1971; TEZUKA, 1962; NAORA, 1975). But the reports of the seasonal changes and geographical variations of the food habits are very rare, therefore the authors have carried out the analysis of the stomach contents of *M.w.wogura* collected in the Hanno Golf Courses from 1978 to 1979.

The present purpose of this paper is to describe the seasonal changes (four seasons) of the stomach contents in the Japanese field mole *M.w.wogura*.

Materials and Methods

The stomach contents of *M.w.wogura* were studied based on 125 specimens trapped at the Hanno Golf Club, Ashikariba, Hanno City, Saitama Prefecture. The specimens were captured by mole-traps from February in 1978 to January in 1979. The study area (Fig.1), the golf courses were covered with lawn, and mole-traps were laid on the mole burrows which seemed to be main tunnels and were retrieved the next day.

The study area is 90 hectare. About 9000 *Pinus densiflora* which are 20 - 30cm in diameter grow in the courses and around them, and yet *Cryptomeria japonica*, *Chamaecyparis obtusa*, etc grow too. The golf courses have many undulations, and have many shades by *P.densiflora*. *M.w.wogura* tunnels under the tree in summer, while in winter in a warm place. Their main tunnels are distributed in the earth near the surface where their foods are very rich, and especially they tended to tunnel to a damp ground, for example, the shade of the tree (Fig.2).

After collecting the moles, their stomachs were castrated and they were preserved in 70 % alcohol. The stomach contents of *M.w.wogura* were got into petri-dishes and they were classified into animal matters, vegetable matters (root and stem) and others by stereoscopic microscope. The occurrence rate of the stomach contents was shown by percentage.

Results and Discussions

The results of analysis of the contents of 125 stomachs of *M.w.wogura* were shown in Table 1. As indicated in Table 1, the foods of the moles consisted of insects, millipedes, spiders, worms, hairs, sand, soil and vegetable matters. As far as the items are concerned, the insects and the earthworms which are subterranean or soil animals occupied the main food of the mole, and vegetable matters were little found.

The details are as follows.

Table 1 Number of stomachs containing each food item.
Occurrence rates(%) were calculated by following formula:
(number of stomachs containing each food item/number of
stomachs examined) x 100

Seasons	Spring Mar.-May		Summer Jun.-Aug.		Autumn Sep.-Nov.		Winter Dec.-Feb.		Total	
Number of stomachs examined	22		31		45		27		125	
Species	No.	%	No.	%	No.	%	No.	%	No.	%
I. Insecta										
a. Coleoptera										
Carabidae(adults)			1	3.2	2	4.4	3	11.1	6	4.8
" (larvae)			3	9.7	2	4.4	2	7.4	7	5.6
Scarabaeidae(adults)	3	13.6	11	35.5	8	17.8	8	29.6	30	24.0
" (larvae)	17	77.3	15	48.4	18	40.0	17	63.0	57	45.6
Undetermined	6	27.3	13	41.9	11	24.4	3	11.1	33	26.4
b. Orthoptera										
Gryllotalpidae							1	3.7	1	0.8
Tettigoriidae					1	2.2			1	0.8
c. Diptera										
Undetermined			2	6.5	1	2.2	1	3.7	4	3.2
d. Hymenoptera										
Formicidae(adults)	8	36.4	12	38.7	20	44.4	21	77.8	61	48.8
" (pupae)			3	9.7					3	2.4
" (larvae)	1	4.5			1	2.2	1	3.7	3	2.4
Undetermined					2	4.4	1	3.7	3	2.4
e. Undetermined	6	27.3	6	19.4	12	26.7	4	14.8	28	22.4
II. Chilopoda	9	40.9	13	41.9	1	2.2	1	3.7	24	19.2
III. Arachnida			1	3.2	1	2.2			2	1.6
IV. Oligochaeta	7	31.8	1	3.2	2	4.4	8	29.6	18	14.4
V. Hair	12	54.5	2	6.5	4	8.9	11	40.7	29	23.2
VI. Plants(fiber)	1	4.5	13	41.9	2	4.4	4	14.8	20	16.0
VII. Sand and Soil	21	95.5	30	96.8	43	95.6	26	96.3	120	96.0

1. Animal matters.

Of the insects, Scarabaeidae(larvae and adults) and Formicidae were very much favored and these occurrence rates were much higher than the others, moreover they seemed to occupy the major part of the diet.

The rate of Formicidae(adult) was 36.4%(8 stomachs of 22) in spring, 38.7%(12 of 31) in summer, 44.4%(20 of 45) in autumn, 77.8%(21 of 27) in winter and 48.5%(61 in 125) through a year, and the rate was the highest of that of all the insects through the four seasons. It was found that the moles ate more small-sized *Crematogaster laboriosa* and *Tetramorium caespitum* than large-sized *Formica japonica*(Formicidae) and occasionally there were some moles which took 40-50 individuals in the stomachs, moreover in case of Formicidae, it was found that moles ate several tens of individuals which gathered together and they took pupae and larvae as well as adults.

The adult of Scarabaeidae was 13.6-35.5%, and 24.0% through a year, and larvae was 40.0-77.0%. Its rate was the second next to Formicidae, especially moles ate the larvae, and the rate was 77.3%(17 of 22) in spring, 48.4%(15 of 31) in summer, 40.0%(18 of 45) in autumn, 63.0%(17 of 27) in winter and 45.6%(57 of 125) through a year. After all moles took the larvae in winter and spring, and the adults in summer and autumn though the proportions between the larvae and adults vary to a great extent according to each mole.

Insects of Scarabaeidae have various kinds of ways of living and each species seems to injure the vegetable matters. Because they sometimes form a group and eat the useful vegetations, they seemed to be a great injurious insect (IGA, 1955), therefore moles seemed to be very useful animal to get rid of noxious insects.

The larvae and adults of Carabidae (Coleoptera) were eaten from summer to winter except spring, and the occurrence rate through a year was very low (adults 4.8%, larvae 5.6%). Other undetermined insects of Coleoptera were 11.1-41.9% through a year.

Because Tettigoniidae (Orthoptera) and Arachnida rarely live in the ground, they seemed to be eaten when moles appeared from under the ground.

One *Gryllotalpa africana* (Gryllotalpidae) was eaten in winter, authors suppose that a mole happened to meet him in the tunnel, because moles don't dig the tunnels and search for their diet recklessly but they take a method that they follow the smell of eatable insects which came into the tunnels from the ground, patrolling in the ready-made tunnels (IMAZUMI et al 1970).

The occurrence rate of Diptera (larvae) was 6.5% in summer and 2.2% in winter which was very low.

The rate of other undetermined insects was 14.8-27.3%. The rate of Chilopoda was much higher in spring and summer (40.9 and 41.9%) than in autumn and winter (2.2-3.7%). Sometimes millipedes (*Thereuonema hilgendorfi*) were found in the contents.

The rate of Oligochaeta (earthworms) was 31.3% in spring and 29.6% in winter, and oligochaeta were eaten in plenty. Though authors didn't fix the quantity of stomach contents, most part of their stomach was occupied by lots of earthworms. Therefore, earthworms seem to be one of the most favorite foods of *M.w.vogura*, and yet the rate was 3.2% in summer and 4.4% in winter which was very low.

Hairs (*M.w.vogura*) was 40.7% in winter and 54.5% in spring which was rather high, but it was 6.5% in summer and 8.9% in autumn. *M.w.vogura* usually lives alone in the tunnels (ABE, 1971), but in breeding season, a few male moles live in the females tunnels, therefore an example that moles feed on each other was reported by TEZUKA in 1962. Hairs were found thin in each stomach but sometimes they seem to remain in it as a mass, therefore it can be said that hairs were not eaten as a diet but that they seemed to be swallowed in case of grooming. ASAH (1967) reported the same matter in the stomach contents of *Callosciurus caniceps taiwanensis*, and judging from that the hairs as a mass of *M.w.vogura* were found in the stomachs in spring (March to May), they seemed to be swallowed when they fought with each other in their breeding season.

2. Vegetable matters.

Judging from the all vegetable matters were found as fibers without chlorophyll, roots or stems of plants were considered to be eaten by the moles. The occurrence rate was 41.9% (13 of 31) in summer and 4-15% in other seasons. Because lawn grows rapidly in summer, the occurrence rate was very high in summer. In other words, they seemed to eat vegetable matters because lawn grows rapidly and roots and stems were very soft with a lot of water in them, or because moles needed much food for their child care and they ate inadvertently with the other foods.

ABE (1965) reported that the vegetable matters which seemed to be eaten positively were only seeds, and the quantity was little, but we did not find the seeds of plants in the stomach contents.

TEZUKA (1962) experimentally gave them some sliced sweet potatoes and white potatoes, but they never ate the potatoes at all, and the moles were brought up in the breeding box with straw for more than one year, but they didn't eat them at all. The results of TEZUKA's experiment showed that the moles didn't eat any vegetable matters. NAORA (1975) also obtained the same results.

3 Others contents

Soil and sand were found in more than 95% stomachs and the occurrence rate was 96.0%(120 of 125). Sand and soil appeared in the stomachs in plenty, especially when earthworms were eaten, therefore most of the soil and sand might have come out of the intestines of earthworms or they seemed to be swallowed with other foods.

As mentioned above, the insects and the earthworms constituted the two major parts of the diet at the occurrence rate in the stomach contents, and because the quantity of these items occupied the major part of stomach contents, these items seemed to be the main food of the moles. ABE(1971) also obtained the same results, namely ABE(1968) reported that most of the stomachs investigated were occupied with the insects and earthworms and percentage by bulk was 39.8% as to insects and 44.5% as to earthworms as a result of the investigation of 150 stomachs of *M.w. wogura* which had been collected from many localities in summer and autumn of the year in Japan, and the occurrence rate of the earthworms was 78% but the rate was 3.9% in the Hanno Golf Course at the same seasons, and it was much lower than the rate of ABE.

The occurrence rate of the Gryllotalpidae(larvae and adults) was 22.7% and the percentage by bulk was 8.8%(ABE 1968) but the rate in Hanno-City was only 3.7% which was found in the stomach contents of a mole. while Dyticidae, Elateridae, Mucidae, Tipulidae, Tabanidae, Muscidae, Lepidoptera and Hirudinae were found in the stomach contents of the moles investigated by ABE(1968), but all of them were not found in the stomach of the moles of Hanno Golf Course. Moreover, ABE(1968) reported that the insects and earthworms constituted the most parts of the stomach contents, and Scarabaeidae and Gryllotalpidae among the insects were eaten in plenty, and as the frog remains were found only in the stomachs of the moles obtained in winter, they might have been eaten during hibernation by the moles.

TEZUKA(1962) reported that the most favorite foods of moles was larvae of Scarabaeidae, and earthworms were eaten too, but moles ate insects rather than earthworms in summer and autumn. The same tendency was seen in the moles of Hanno Golf Course. Moreover TEZUKA reported that the moles ate the fibers and frog by choice. ABE reported that the shrew moles have a tendency to eat the seeds of plants in autumn. At any rate, main foods of the moles must be animal matters.

The high-ranked occurrence rates from the first to the third of the stomach contents of the moles(*M.k.kobeae*, *M.w.wogura* and *M.kobeae tokudae*) which were investigated by ABE were as follows:

Mogera kobeae kobeae: Oligochaeta(65.5%)-Seeds of plants(25.2%)-Dead grasses of plants, Lepidoptera, Scarabaeidae(23.5%).

Mogera wogura wogura: Oligochaeta(78.0%)-Gryllotalpidae(22.7%)-Lepidoptera(21.3%)

Mogera kobeae tokudae: Oligochaeta(100.0%)-Gryllotalpidae (47.8%)-Lepidoptera (30.0%) while the rate of *M.w.wogura* of Hanno Golf Course was as follows, Formicidae(48.8%)-Larvae of Scarabaeidae(45.5%)-Adults of Scarabaeidae(24.0%).

The differences of the occurrence rate of the stomach contents can not be compared because there is no report on the geographical changes.

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摘 要

埼玉県飯能市で採集されたアズマモグラの胃内容物, 第1報

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埼玉県飯能市の飯能ゴルフ場において採集した 125 個体のアズマモグラの胃内容物を調査した。

1. アズマモグラの主要食物は昆虫類と貧毛類であった。
2. 昆虫類のうち出現頻度は、アリ科の成虫が最も大きく、次にコガネムシ科の幼虫であった。
3. コガネムシ科の幼虫を含む胃は冬と春に、また成虫を含む胃は夏と秋によく認められた。
4. 貧毛類を含む胃は冬と春によく認められたが、夏と秋にはあまり認められなかった。
5. アズマモグラの毛を含む胃は、とくに冬と春によく認められ、しかもかたまりとして存在していた。この時期は本種の繁殖期にあたるため、モグラどおしの闘争があったと考えられた。そして夏と秋には、わずかの毛が少数の胃内に認められたのみで、グルーミング等によって呑みこまれたものと考えられた。
6. 植物質は、胃内にあっては全て繊維状を呈しており、これを含む胃は夏期に多くみられた。
7. 大部分の胃内には土砂が認められたが、これは他の食物とともに不意に呑みこまれたと思われるが、土砂の一部はミミズの消化管内のものも含まれていると考えられた。