



HOKKAIDO UNIVERSITY

Title	CLASSIFICATION AND BIOLOGY OF JAPANESE INSECTIVORA (MAMMALIA) : II. Biological Aspects
Author(s)	Abe, Hisashi
Citation	Journal of the Faculty of Agriculture, Hokkaido University, 55(4), 429-458
Issue Date	1968-05
Doc URL	https://hdl.handle.net/2115/12830
Type	departmental bulletin paper
File Information	55(4)_p429-458.pdf



CLASSIFICATION AND BIOLOGY OF JAPANESE INSECTIVORA (MAMMALIA)

II. Biological Aspects

Hisashi ABE

(Natural History Museum, Faculty of Agriculture
Hokkaido University, Sapporo)

Received December 6, 1967

As a continuation of the first paper of this work (1) dealing with the variation and classification of the Japanese insectivores, the present paper comprises the ecological accounts of their habitat, food habits, population structure and reproductive activity. The material and method are accordingly the same as in the former paper.

(1) *Sorex unguiculatus* DOBSON and *Sorex caecutiens saevus* THOMAS

Habitat. *Sorex unguiculatus* (big-clawed shrew) is common in grassy meadows and shrublands ranging from lowlands to low mountain regions; it is less abundant in woods of mature forest type with little undergrowth.

Sorex caecutiens saevus (ezo shinto shrew) is most abundant in the shrublands and the woods of mountain regions (Table 1). In the woods it is not so abundant as in the shrublands, but still distinctly predominates over the big-clawed shrew. The ezo shinto shrew is scarcely seen in grassy meadows where the big-clawed shrew is dominant.

TABLE 1. Differences of occurrence between the two species
of *Sorex* in various vegetations

Type of vegetation	<i>S. unguiculatus</i>	<i>S. caecutiens saevus</i>
Forests	18.4 %	81.6 %
Bushes (Shrubs>Grasses)	26.2	73.8
Bushes (Shrubs<Grasses)	75.8	24.2
Grasses	96.0	4.0

In areas where the forest has been removed, either by logging or by fire, the land is revegetated by shrubs, young trees, sasa bamboos, and herbs. In such areas shrews are usually very abundant; the big-clawed shrew is rather

abundant in the bushes having a rich understory of grasses, while the ezo shinto shrew is more common in bushes in which young trees and sasa bamboos are dominant. In moderate brushes suitable for both the species, it was never seen that the two species lived together in numbers. If one species was abundant, the other was present only in small numbers or was absent. This suggests the existence of some interspecific intolerance between the two species.

The habitat of the shrews is usually rich in ground litter, providing shelter and hunting areas. This is also the same as regards certain wild mice. The ezo shinto shrew associates occasionally with forest-dwelling mice, such as *Apodemus argenteus* TEMMINCK, and the big-clawed shrew with *Clethrionomys rufocanus bedfordiae* (THOMAS), which also inhabits mainly shrublands and grassy meadows.

Although both species of shrews are inhabitants of subterranean runways, the ezo shinto shrew is not a digger. On the other hand, the big-clawed shrew appears to be a semidigger. This may be demonstrated by their food habits and morphological characters; i.e., the former has a relatively long tail, large hind feet, longer ears, small hands and claws, and feeds much on spiders, whereas the latter has a relatively short tail, small hind feet, short ears, very large hands with long claws, and feeds much on earthworms. From these facts, the big-clawed shrew appears to be more modified morphologically for a fossorial existence than does the ezo shinto shrew. Abundant occurrence of this semifossorial shrew, *S. unguiculatus*, in the grass fields and shrublands of Hokkaido may be caused partly by the absence of fossorial mammals such as moles and shrew-moles which are more robust and prefer a habitat similar to that of this shrew.

After the thawing of snow in spring, often are found many small holes on the surface of ground in the big-clawed shrew's range. The holes, measuring about 2.5 cm in diameter and 3 to 5 cm in depth, seem to have been dug by the big-clawed shrew for hunting food, and around them are small piles of earth containing the remains of insects and snails, probably eaten by the shrews. In the range of the ezo shinto shrew, no such holes are found; if any holes are made, they probably be obscured because of the heavily littered habitat.

Food habits. Stomachs and alimentary tracts of 66 big-clawed shrews and 117 ezo shinto shrews collected in all seasons were examined. In the big-clawed shrews, insects make up more than one-half of the food, and next in abundance are earthworms, centipedes, root stocks, seeds, molluscs, and arachnids (Table 2). The insects identified comprise two orders: Coleoptera and Lepidoptera. The large bulk and frequency of earthworms and the small

TABLE 2. Stomach contents of 66 individuals of
Sorex unguiculatus

		Percentage by bulk	Percentage by occurrence
I.	Insecta	59.2	
	a. Coleoptera	2.5	7.6
	b. Lepidoptera	2.3	3.0
	c. Undetermined	54.4	68.2
II.	Arachnida	1.4	9.1
III.	Chilopoda		
	Geophilus	5.7	16.7
IV.	Gastropoda	2.2	10.6
V.	Chaetopoda		
	Lumbricomorpha	22.5	40.9
VI.	Undetermined		
	(animals)	2.9	3.0
VII.	Hair	0.0	1.5
VIII.	Plants		
	Seeds	2.8	3.0
	Root stocks	2.9	3.0
	Dead grasses	0.2	9.1
IX.	Sand	0.2	1.5

percentage of spiders are distinctly different from what have been found in the ezo shinto shrew. In the latter, almost all of the stomachs contain insects, which compose by bulk the largest share of food. Next in order of abundance by bulk are arachnids, centipedes, seeds, molluscs, earthworms, crustaceans, and millipedes (Table 3). This composition of stomach contents is very characteristic in that there is a large percentage of arachnids contrasted with a small percentage of earthworms, compared with the food of the big-clawed shrew. This difference in food habits is significant, for the respective tendencies are evident even in individuals of both species obtained in the same habitat during the same season. This has probably resulted from the different habits of the two species; namely, it indicates more fossorial activity of the big-clawed shrew.

The proportion of vegetable matter by bulk is very small in the two species, and these data well conform to many other reports on the related but different species of *Sorex* (3, 4).

It has been said that shrews prey on wild mice, but the author strongly

TABLE 3. Stomach contents of 117 individuals of
Sorex caecutiens saevus

		Percentage by bulk	Percentage by occurrence
I.	Insecta	65.3	
	a. Coleoptera	0.3	1.7
	b. Diptera	0.6	1.7
	c. Lepidoptera	1.2	1.7
	d. Undetermined	63.2	88.0
II.	Arachnida	19.9	35.9
III.	Chilopoda		
	Geophilus	10.8	25.6
IV.	Gastropoda	0.8	1.7
V.	Crustacea		
	Isopoda	0.3	0.9
VI.	Chaetopoda		
	Lumbricomorpha	0.5	2.6
VII.	Undetermined (animals)	0.2	0.9
VIII.	Hair	0.1	0.9
IX.	Plants		
	Seeds	2.0	3.4
	Dead grasses	0.2	0.9

doubts whether the shrews concerned prey on healthy wild mice under natural conditions. To elucidate this question, a small red-backed vole, *Clethrionomys rutilus mikado*, was placed in a cage with seven big-clawed shrews, and they were kept alive for two days. During this period nothing appeared to happen to any of these animals. Although captive shrews devour the carcasses of mice, they probably do not kill healthy mice. The absence of remains of any other mammal in the stomachs also suggests that these shrews do not prey naturally on small mammals.

The average weight of daily food was 18 grams for a captive young big-clawed shrew weighing 11 grams. This is more than one and half times of its body weight.

Population structure. In early spring, when the breeding activity does not yet begin, populations of these shrews are composed of members of a single age-class, namely the over-wintered adults born in the previous year. Its

TABLE 4. Seasonal variation in the population structure in the two species of *Sorex*

Month		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<i>Sorex unguiculatus</i>	a. Young	0	0	0	0	11	19	15	97	16	62	2	0
	b. Subadult	9	12	10	32	2	2	0	1	1	0	0	0
	c. Adult	0	0	0	0	12	14	5	18	4	6	1	0
	Per cent of subadult & adult	100	100	100	100	56.0	45.7	25.0	16.4	23.8	8.8	?	0
<i>Sorex caecutiens saevus</i>	a. Young	0	0	0	0	0	1	9	53	41	58	17	2
	b. Subadult	19	4	11	2	3	1	0	0	0	0	0	0
	c. Adult	0	0	0	0	1	4	1	7	1	3	1	0
	Per cent of subadult & adult	100	100	100	100	100	83.3	10.0	11.7	2.4	4.9	5.6	0

simple structure changes into two sharply different age classes in late spring when new young are born, and this condition exists till November.

As the trapping method and the number of trap nights were varied from month to month, the numbers of shrews belonging to the same age classes presented in Table 4 are not comparable by month; but it is reasonable to compare the numbers of adults with those of immatures obtained in the same month. This is, therefore, shown by the proportion of the adults to the total in a month. In this table the percentage of adult big-clawed shrews decreases gradually from May toward October, while that of adult ezo shinto shrews decreases suddenly in July. The population turnover is completed by late fall.

Probably 18 months for the big-clawed shrew and 17 months for the ezo shinto shrew are maximum life spans in Hokkaido; the mean life span, however, must be much less. Most commonly it probably approximates 12 months. There is no evidence that any individual lived through more than two winters. CLOTHIER (2), RUDD (9), and JAMESON (6) reported similar results in their works on American shrews.

In the young and adults obtained before July, the sex ratios indicate approximately 1 : 1 in respective species. After August, however, the ratio of old adults is distinctly changed and the males decrease to only about 14 per cent in the big-clawed shrew and to about 18 per cent in the ezo shinto shrew (Table 5). These data suggest that the males have a shorter life expectancy than the females.

TABLE 5. Sex ratios by age class of the two species of *Sorex* (in per cent)

Age class	a		b (Jan.-Apr.)		b+c (May-Jul.)		c (after Aug.)	
	♂	♀	♂	♀	♂	♀	♂	♀
<i>S. unguiculatus</i>	42.6	57.4	57.1	42.9	48.5	51.5	13.8	86.2
<i>S. caecutiens saevus</i>	57.8	42.2	48.2	51.8	44.4	55.6	18.2	81.8

Reproductive activity. Monthly changes in length of the linearly extended uterine horns and in length of testis in animals of both species are represented in Figs. 1 and 2. These variations are well synchronized with the change of body weight except in the case of the testis of the ezo shinto shrew, which increases one month earlier than the occurrence of change in body weight.

In the big-clawed shrew the length of uterine horns and the size of testis of immatures vary little from May to February, but increase suddenly toward maturity in March. There is also a similar variation in the ezo shinto shrew,

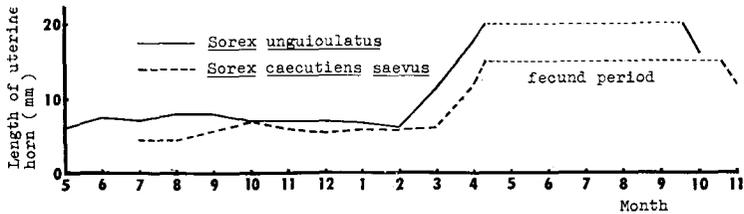


Fig. 1. Monthly changes in length of uterine horns of *Sorex unguiculatus* and *Sorex caecutiens saevus*.



Fig. 2. Monthly changes in length of testes of *Sorex unguiculatus* and *Sorex caecutiens saevus*.

but the variation of the uterine horn length occurs one month later than is the case with the big-clawed shrew. As stated above, the ezo shinto shrew usually inhabits the forested areas in which snow remains later in spring than it does in grass fields. This may be a reason for the delayed development of the female's reproductive organs.

Females may become fecund when the uterine horns have developed to a little more than 17 mm in length in the big-clawed shrew and about 15 mm in the ezo shinto shrew.

The earliest evidence of pregnancy was found in a female of the big-clawed shrew obtained on April 17, 1957, and in that of the ezo shinto shrew obtained on May 9, 1957, while the latest evidence was in specimens obtained on September 10, 1955, and on October 5, 1955, respectively. On the other hand, it was May 28, 1956, and May 30, 1957, when the earliest young of the big-clawed shrew appeared in the trap line (tumble-in tray) in Sapporo, and on July 11, 1956, for the ezo shinto shrew at Ashibetsu. From the above-

mentioned changes in reproductive tracts and body weight, it appears that young *ezo shinto* shrews may leave the nest somewhat earlier than this date would indicate, although the number obtained in spring was too few to make this point clear.

Thirty-one gravid females of the big-clawed shrew and eight such females of the *ezo shinto* shrew contained embryos large enough to be counted accurately; the number of embryos varied from 3 to 7 with a mean of 5.7 in the former and 4 to 8 with a mean of 7 in the latter. CLOTHIER (2) reported that he recorded from 1 to 8 embryos in *Sorex vagrans* in Montana. The big-clawed shrew appears to have more embryos per female in June and July than in other months during the breeding season (Table 6).

TABLE 6. The litter size of the two species of *Sorex*

Month	<i>Sorex unguiculatus</i>		<i>Sorex caecutiens saevus</i>	
	Litter size	Average	Litter size	Average
Apr.	4, 4, 5, 5, 5, 5, 5	4.7		
May	5, 5, 6, 6, 6	5.6		
Jun.	6, 6, 6	6.0	8	8.0
Jul.	6, 6, 6, 7, 7	6.4		
Aug.	3, 5, 6, 6, 6, 6, 6	5.4	8, 8	8.8
Sep.	3, 4, 6, 6	4.8	7, 8, 8	7.7
Oct.			4, 6	5.0
Total average		5.4		7.1

Without any exception, all the pregnant females examined were the individuals born in the previous year, and there was no evidence that the individuals trapped in the year when they were born took part in reproductive activity.

As may be seen in Table 6 and Fig. 1, there is an appreciable discrepancy between the breeding periods of the big-clawed shrew and the *ezo shinto* shrew; i. e., that of the latter begins slightly later in spring and lasts longer toward fall.

Post-partum mating was described in several species of shrews. HAMILTON (5) stated that *Sorex fumeus* mates post-partum; CLOTHIER (2) presented evidence that *S. vagrans* also did so. Although the author has not been able to obtain evidence for post-partum mating in the *ezo shinto* shrew, some old females of the big-clawed shrew probably had the second litter as a result of such mating, as shown by the nipples exhibiting evidence of recent suckling

in old adult females containing embryos and also by the uteri having both embryos and indistinct placental scars suggesting the first pregnancy.

The nests wholly constructed by the animals themselves have not yet been found in the field. The author buried, on May 3, 1957, three wooden nest boxes in the stands of trees adjacent to a pasture ground in Sapporo. These nest boxes, with a runway toward ground surface, were buried at 15 to 20 cm underground. On May 6 and May 10, two of the three boxes were used by big-clawed shrews, and shallow dish-like nests were made with dried grasses. On May 13, six additional nest boxes were buried in the same area. Although nests were made subsequently in several of the boxes buried, no young were found. When the boxes were examined on September 14, six of them contained the nests of big-clawed shrews. Of these, three consisted of a ball of dried broad leaves of trees, each ball about 11 cm in diameter and with a definite cavity; two others made of grasses and broad leaves were shallow, dish-like in shape and the last one made of grasses was bowl-like in shape, about 10 cm in outer diameter, 4.5 cm in inner diameter, and 3 cm in depth. In two of the nests there were wings of a kind of dragonfly which probably had been brought in and eaten by the shrews.

(2) *Sorex minutus gracillimus* THOMAS

In the woods and shrublands of Hokkaido, this shrew is also widely distributed, but its population density is usually very small as compared with the preceding two species. This shrew occasionally associates with the small red-backed vole, *Clethrionomys rutilus mikado* (THOMAS), which is less numerous in Hokkaido than the large red-backed vole. Other habits of this species are almost unknown.

(3) *Sorex minutissimus hawkeri* THOMAS

This species is found only from the revegetated shrubland of Nijibetsu, Kushiro Prov., Hokkaido. The colony of this species has an extremely limited range in the shrubland and abuts on the ranges of *Sorex caecutiens saevus*, *S. unguiculatus*, *Clethrionomys rufocanus bedfordiae*, and *Apodemus argenteus*. On account of its extremely small size this species must be more inferior ecologically than the other species of *Sorex* in Hokkaido. Habits are not known.

(4) *Sorex hosonoi* IMAIZUMI

This species occurs in Honshû and is nearly related to the preceding species. Its habitat is confined to the alpine meadow and shrub of the high mountain regions of central Honshû and is situated on an elevation higher

than that of *S. caecutiens shinto*. At Karasawa of Mt. Hodaka in Nagano Pref., however, *S. hosonoi* meets *S. caecutiens shinto* at the level of 2000 m in altitude.

Although the stomach contents of this species have not been examined, it is thought that its food habits may be similar to those of *S. caecutiens shinto*.

(5) *Crocidura* group

Since *Crocidura dsinezumi*, *C. horsfieldi watasei*, and *C. suaveolens shantungensis* inhabit similar habitats, in spite of the difference (v. i.) in their geographical distribution, these three species are grouped for convenience.

Habitat. These shrews are most abundant in shrubs of stream sides, retaining walls of river banks, and revegetated slopes at the foot of hills. Usually these shrews are unable to live far from water, and all the specimens trapped were taken in moist bushes or in dry bushes close to water.

Altitudinally these shrews range from near sea level to low mountain regions less than about 1000 m in altitude.

Geographically *C. dsinezumi* ranges from Yaku Island to Hokkaido, but the population is very sparse in both the southern and northern localities. The distributions of *C. horsfieldi* and *C. suaveolens* in Japan are restricted to Amami Islands and Tsushima, respectively. The former is the most abundant shrew in Amami-Ōshima. The author once collected forty specimens of this species in the brush of a river bank which expanded only about one hectare. *C. suaveolens shantungensis* is a relatively rare resident in Tsushima. This species segregates in habitat from *Urotrichus talpoides*, but coexists with *Apodemus speciosus* and *Micromys minutus*.

Food habits. Forty-four stomachs of *C. dsinezumi* and forty stomachs of *C. horsfieldi* were examined in the present study. According to the data gathered, these two kinds of shrews subsist mainly on many kinds of insects and spiders which constitute a major share of their diets. In addition to these items, centipedes and crustaceans are also taken by both species. The dead grasses and rootlets found might have been swallowed with other foods inadvertently (Tables 7 and 8).

Four stomachs of *C. suaveolens* were examined; of these, one contained insects, two others, spiders, and the last, starchy paste.

Population structure. The population of *C. dsinezumi* is composed of two age classes, old and young, during the late spring and summer, but in winter and early spring it becomes a simpler structure consisting of subadults. No evidence has been found of the fact that this shrew can survive a second

TABLE 7. Stomach contents of 44 individuals of *Crocidura dsinezumi*

	Percentage by bulk	Percentage by occurrence
I. Insecta	68.3	
a. Coleoptera		
Carabidae (adults)	4.4	4.5
Chrysomelidae (adults)	2.3	2.2
Undetermined	8.4	11.4
b. Lepidoptera (adults)	1.1	2.2
c. Hymenoptera		
Formicidae (adults)	0.2	2.2
d. Undetermined	51.9	68.2
II. Arachnida	22.0	36.4
III. Chilopoda		
Geophilus	4.8	20.5
IV. Crustacea		
Isopoda	1.8	2.2
V. Gastropoda	1.8	2.2
VI. Oligochaeta		
Lumbricomorpha	1.0	2.2
VII. Plants		
Grasses	0.2	2.2

winter.

In forty-one individuals of *C. horsfieldi* obtained in Amami-Ôshima during December, one was an old adult, the other two were relatively young individuals, and the rest, subadults.

Five specimens of *C. suaveolens shantungensis*, consisting of one young, three subadults and one old adult were obtained in Tsushima during December.

The sex ratios of *C. dsinezumi* varied with advancing age; i. e., females to males—young 46:54; subadults 38:62; adults 30:70. In the subadults of *C. horsfieldi watasei*, it was 45:55.

Reproductive activity. Three gravid females of *C. dsinezumi* containing 3, 3, and 4 embryos, respectively, were taken in Kawashima Town, Tokushima Pref., and Kagoshima City during April. Moreover, two adults with suckling young were caught in June, one from Zendôji Town, Fukuoka Pref., and the other from Mt. Takanawa, Ehime Pref. Adult males had relatively large testes

TABLE 8. Stomach contents of 40 individuals of *Crocidura horsfieldi watasei*

	Percentage by bulk	Percentage by occurrence
I. Insecta	87.8	
a. Coleoptera (adults)	5.8	25.0
" (larvae)	4.4	7.5
b. Hymenoptera (adults)	1.3	7.5
c. Diptera (adults)	2.8	17.5
d. Plecoptera	0.8	2.5
e. Neuroptera	2.5	2.5
f. Orthoptera	3.8	7.5
g. Lepidoptera (larvae)	11.7	22.5
h. Hemiptera (adults)	2.5	7.5
i. Undetermined	52.2	75.0
II. Arachnida	9.6	32.5
III. Chilopoda		
Geophilus	0.2	5.0
IV. Crustacea		
Isopoda	0.7	5.0
V. Plants		
Dead grasses	1.5	10.0
VI. Sand	0.5	2.5

from April to September; testes measured at their maximum 5.5 mm × 4.5 mm.

On the breeding habits of the other two species the author has too little data to permit discussion in this study.

(6) *Suncus murinus* LINNAEUS

The musk shrew is not native to Japan. It was recorded in an old literature (1713) that the musk shrew had invaded Kagoshima and Nagasaki of Kyûshû probably by ships coming from China or the Riu Kiu Islands (8).

Notwithstanding its relatively long habitation in Japan, the musk shrew has not expanded its range after introduction, and its present distribution in Japan is restricted to almost the same range as it was in the early time of its invasion.

Habitat. This shrew usually lives under the floor of houses, in sewers, and along riversides, all of which are the same kinds of habitats as those of the wide-spread *Rattus norvegicus*. Moreover, the food habits are also very

similar to those of the Norway rat; namely, the same kinds of animals which are eaten by the shrew constitute also the major part of the diet of the rat. For these reasons, one suspects that there may be an antagonistic relationship between these two animals. One habitat, therefore, is never occupied by both the species, but is inhabited exclusively by one or the other. Since the rat, on the other hand, is more robust as compared with the shrew, it seems plausible that the rat is stronger in competition with the latter when the two species happen to meet on new range or on the original range of the rat. Therefore, the main reason the musk shrew could not have enlarged its distribution appears to be due to the existence of a rival species, so far as is indicated by the facts known at present.

Food habits. Examination of seven stomachs of the musk shrew collected in May indicated that insects comprise the larger share of its food. Leeches also were found in one of the stomachs (Table 9).

TABLE 9. Stomach contents of 7 individuals of
Suncus murinus

	Percentage by bulk	Percentage by occurrence
I. Insecta	73.6	
a. Coleoptera (adults)	3.6	14.3
b. Diptera (adults)	2.9	14.3
" (larvae)	5.0	14.3
c. Orthoptera	7.1	14.3
d. Lepidoptera (adults)	11.4	28.6
" (larvae)	43.6	71.4
II. Hirudinea	8.6	14.3
III. Undetermined (animals)	14.3	14.3
IV. Hair	3.6	14.3

Population structure is not known.

Reproductive activity. In the present work the author collected 6 adult females, 7 adult males and 3 immatures in Kagoshima City during the third and fourth week of May. Of the 6 adult females, 3 were gravid, containing 6, 6 and 4 embryos, respectively; one was lactating, and the uteri of the other two were swollen though no visible embryos were contained therein. Three immatures seemed to be the members of the same litter and to be sucklings. The adult males had relatively large testes which measured at their maximum 9 mm × 5.5 mm. This species appeared in May to be active in its reproduction.

(7) *Chimarrogale platycephala* TEMMINCK

The water shrew usually ranges from the foot of mountain to the level of about 1500 m. Since this shrew is well specialized for swimming and feeds mainly on aquatic insects and small fish, it is unable to exist far from the stream. The shrew usually inhabit the sides along clear streams and the basin of water-falls in mountain regions. It is well known that this shrew is active throughout the day. The author also observed in broad day light a water shrew feeding in a small stream of Hikosan, Fukuoka Pref.

Food habits. Nine stomachs were examined and three of them contained remains of small fish. However, remains of aquatic insects constitute the major share of the diet.

Population structure and reproductive activity are little known.

(8) *Dymecodon pilirostris* TRUE

Habitat. The distribution of this shrew-mole is confined to relatively high mountain regions usually situated upwards of the range of *Urotrichus talpoides*. The shrew-mole is most common in areas grown to bushes, to shrubs with much undergrowth or duff layer, and to grass fields, whereas woods of a climax type with poor undergrowth are rarely invaded by this animal. The shrew-mole sometimes inhabits rocky ground covered with mosses or grasses. Though it is relatively common on high mountains, its population density is usually not so high as in the lower resident, *Urotrichus talpoides*. It is a subterranean resident but often appears on the ground surface as *U. talpoides* does.

In the habitat of this shrew-mole *Apodemus argenteus*, *Clethrionomys andersoni*, and *Sorex caecutiens shinto* were also collected.

Food habits. No study so far has been available on the food habits of this shrew-mole. Thirty-five stomachs were examined in the present work and the stomach contents were generally similar to those of *U. talpoides* and consisted of insects, earthworms, centipedes, arachnids, and crustaceans, in the order of percentage by bulk (Table 10).

Population structure. *D. pilirostris* has three age classes in its population: young, adult, and old adult (Table 11). Since the proportion of old adults (age class c in Table 11) to the total members of the population is very small, it appears to be certain that the age class d corresponding to the old adults of *Mogera* and *Urotrichus* is deficient in the population of this species.

The sex ratio appeared to change with advancing age, but it is thought necessary to collect more data before any decisive conclusion is made in this regard.

Reproductive activity. *D. pilirostris* is similar in breeding habits to *U.*

TABLE 10. Stomach contents of 35 individuals of *Dymecodon pilirostris*

		Percentage by bulk	Percentage by occurrence
I.	Insecta	58.9	
	a. Coleoptera		
	Carabidae (adults)	0.7	5.7
	" (larvae)	0.6	2.9
	Curculionidae	2.0	8.6
	Undetermined (adults)	0.7	11.4
	(larvae)	5.6	8.6
	b. Diptera		
	Tipulidae	2.9	2.9
	Muscidae (adults)	3.3	8.6
	" (larvae)	0.2	5.7
	c. Undetermined	42.9	71.4
II.	Arachnida	4.6	14.3
III.	Crustacea		
	Isopoda	0.1	2.9
IV.	Chilopoda		
	Geophilus	8.9	45.7
V.	Oligochaeta		
	Lumbricomorpha	27.5	57.1

TABLE 11. The sex ratio and age structure of *Dymecodon pilirostris*

Age class*	Sex ratio				Age structure	
	No.	♂ %	No.	♀ %	Total no.	%
a-1)	8	42.1	11	57.9	19	51.4
a-2)						
b	8	53.3	7	46.7	15	40.5
c	1	33.3	2	66.7	3	8.1
d	0	—	0	—	0	—

* Cf. p. 194 of Abe, 1967.

talpoides, and its mating occurs in early spring.

Three adult males taken on Mt. Sazareo and Mt. Shimokabuto, Ehime Pref., in April had very large testes which measured 8 mm × 6 mm, 8.5 mm ×

5.5 mm. and 9.5 mm × 5.5 mm, respectively, whereas one adult female obtained from the former locality in the same month contained 3 embryos. No immature was trapped in this month. In Kamikôchi and Senjôgadake, Nagano Pref., however, many immatures were obtained in July, and the testes of adult males were in the process of regression, the size ranging from 2.5 mm × 1.3 mm to 7.5 mm × 5 mm.

(9) *Urotrichus talpoides* TEMMINCK

Habitat. *Urotrichus talpoides* is a resident of areas grown to shrubs and bushes in low mountain regions. The upper boundary line of the distribution usually coincides with that of deciduous forests. The population of this shrew-mole, however, is most prominent at lower elevation and gradually decreases toward the boundary zone at higher elevation where this species often meets, if it occurs, another shrew-mole, *Dymecodon pilirostris*.

On Mt. Hakkoda, *U. talpoides* comes in contact with *D. pilirostris* at the level of 800–900 m in altitude in deciduous forest. The author collected many specimens of *U. talpoides* at Konashidaira (1500 m), Kamikôchi, Nagano Pref., within deciduous forest and also *D. pilirostris* at Yokoo (1600 m), the upper but near locality of the same hydrographic basin in which the former species resides. On Mt. Shimokabuto, Niihama City, and on Mt. Sazareo, Iyomishima City, Shikoku, *D. pilirostris* extends farther downwards and meets *U. talpoides* only at an altitude of 900 m, in a typical deciduous forest zone. From these facts it may be seen that the upper boundary line of the distribution of *U. talpoides* is not settled only by the forest type but rather probably by the ecological interaction between the two shrew-moles or among the small mammals living in the same habitat. Similar conclusion was also given by TOKUDA (11).

This shrew-mole is most abundant along moist stream sides, in revegetated edges along pathways, or under bushes which have a thick duff layer on the floor. It also inhabits rocky or gravelly grounds which are covered with mosses or grasses. The shrew-mole is able to live in areas of dry woods, or even on logged-off or burned-over lands, but here it is not so abundant as in damp ravines.

Since *U. talpoides* is not so well specialized for digging as the large mole, *Mogera*, the former apparently often emerges from the subterranean burrows to the ground surface and hunts for food. This is evinced by the fact that the shrew-mole is easily obtained by snap traps set on the ground surface.

The shrew-mole occasionally associates with other small mammals such as *Microtus montebelli*, *Apodemus argenteus*, *Apodemus speciosus*, and *Sorex*

caecutiens shinto in their respective habitats.

Food habit. The food habits of *Urotrichus* were studied by THOMAS (10) and KISHIDA (7) who examined a few specimens of this species and recorded earthworms, insects, spiders, and rootlets as its stomach contents.

The author examined 290 specimens of this species which were taken in various vegetations of many districts of Honshû, Shikoku, and Kyûshû (Table 12).

TABLE 12. Stomach contents of 290 individuals of
Urotrichus talpoides

		Percentage by bulk	Percentage by occurrence
I.	Insecta	50.8	
	a. Coleoptera		
	Carabidae (adults)	1.2	5.5
	" (larvae)	1.2	3.1
	Coccinellidae (adults)	0.1	0.3
	Chrysomelidae (adults)	0.01	0.3
	Helotidae (larvae)	0.1	0.3
	Scarabaeidae (larvae)	1.0	2.4
	Curculionidae (larvae)	0.5	1.7
	Elateridae (larvae)	0.4	3.4
	Undetermined (adults)	2.5	9.0
	" (larvae)	1.6	7.6
	b. Diptera		
	Tipulidae (larvae)	0.3	1.7
	Muscidae (adults)	0.5	3.8
	" (larvae)	0.6	6.6
	c. Hymenoptera		
	Formicidae (adults)	0.2	1.4
	" (larvae)	0.2	1.0
	d. Hemiptera (adults)	0.1	1.0
	e. Orthoptera	0.1	0.3
	f. Lepidoptera (larvae)	5.1	11.7
	g. Mecoptera		
	Panorpidae (adults)	0.5	1.0
	h. Undetermined	34.6	63.8
II.	Arachnida	1.8	5.5
III.	Chilopoda		

(continued)

	Geophilus	6.2	43.1
IV.	Crustacea		
	Isopoda	0.1	0.7
V.	Gastropoda	0.5	1.0
VI.	Oligochaeta		
	Lumbricomorpha	31.7	72.8
	" (eggs)	0.3	2.1
VII.	Nematoda	0.03	0.7
VIII.	Undetermined (animals)	0.7	13.8
IX.	Hair	0.3	2.1
X.	Plants		
	Seeds	5.6	12.4
	Fruits	0.1	0.7
	Rootlets	1.3	2.1
	Dead grasses	0.2	4.5
XI.	Sand & soil	0.6	2.8

Many kinds of insect larvae, centipedes, earthworms, and seeds constituted the primary food in these specimens. As shown in the table the kinds of insects eaten by this shrew-mole are qualitatively unlike those of the mole, *Mogera*, apparently because of the difference in habitat and habits; namely, the former species feeds more frequently on insect larvae of the forests, whereas the mole prefers the insect larvae living in more moist grass fields and also aquatic insects.

The kinds of the earthworms eaten by the shrew-mole are also different from those eaten by the mole. The diet of *U. talpoides* consists partly of smaller types inhabiting the carpet of leaves and loose humus, while that of *Mogera spp.* usually consists of larger ones inhabiting deep soil.

Although the percentage of seeds of weeds, berries, and rhizomes is relatively low, such foods may constitute an important part of the diet. Dead grasses and sand, on the other hand, seem to be ingested inadvertently.

Population structure. The population of *U. talpoides* is composed of four age classes in the season from spring to fall (Table 13). The frequency of old adults (age class d) in the population is very low as compared with that of *Mogera kobae* (Table 18). This suggests that the shrew-moles surviving through the third winter are extremely few in number; the major portion of these old adults appears to die out usually by the summer of the fourth

TABLE 13. The sex ratio and age structure of *Urotrichus talpoides*

Age class	Sex ratio				Age structure			
	♂		♀		♂	♀	Total no.	%
	No.	%	No.	%	%	%		
a-1) a-2)	57	41.6	80	58.4	19.4	27.2	137	46.6
b	45	51.1	43	48.9	15.3	14.6	88	29.9
c	27	45.0	33	55.0	9.2	11.2	60	20.4
d	4	44.4	5	55.5	1.3	1.7	9	3.1

year, and there is no evidence of the shrew-mole's surviving through the fourth winter. In winter and early spring, therefore, the population usually consists of three age classes, a, b, and c.

Sex ratio is roughly 1 : 1 throughout the life span.

Reproductive activity. Mating probably occurs during the last week in February and the first week in March in southern warm localities, but about in April and even in May in colder localities. Usually, only one litter is produced each year.

The testes of the adult male become gradually enlarged in early spring and measure at their maximum about 7 mm × 5 mm. In warm Tsushima, however, half of the adult males examined already had relatively large testes measuring about 5 mm × 3.2 mm as early as the second week in December, and the rest had smaller testes but were in the process of development. The testes of all adult males from Oki Island also were found to be already enlarged as early as the first week in December.

After the breeding season, the testes decrease in size from June until late fall and measure at their minimum about 2.7 mm × 1.5 mm. The variation in

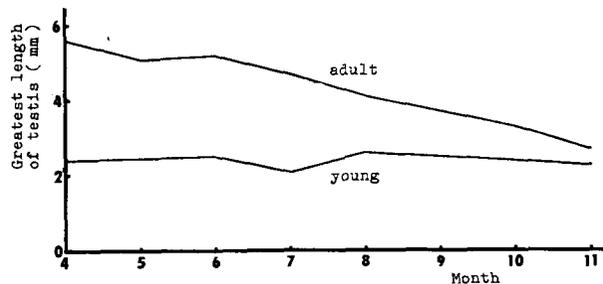


Fig. 3. Monthly changes in length of testis of *Urotrichus talpoides*. Adult: "b, c and d" stages of age; young: "a-1 and a-2" stages of age..

size from April to November is shown in Fig. 3. The testes of the young develop little until the next spring.

Seven adult females containing embryos were obtained; the number of embryos per female ranged from 2 to 4 with an average of 3.1.

In Kagoshima City the majority of the animals trapped had finished breeding activity by the last week in April and many immatures were trapped at this time. At Mt. Sazareo and Mt. Shimokabuto, Ehime Pref., breeding activity was at its height during the month of April, but immatures had not yet grown enough to be trapped. Specimens taken on the mountain side of Hikosan, Fukuoka Pref., during the second week in June consisted of newly born immatures and adults; one of the females still contained 2 embryos. After July no female containing embryos was trapped in any locality, by this time the reproductive organs of females having regressed.

The gestation period, breeding nest, and other points are not known.

(10) *Euroscaptor mizura* GÜNTHER

Habitat. The Mizura mole usually inhabits the coniferous forest of relatively high mountain regions in Honshû. Generally the coniferous climax forest has little undergrowth except mosses, and the populations of soil animals in the forest are also very small as compared with those of grass fields at lower elevations. Consequently the mole is very sparse in population even in its

TABLE 14. Stomach contents of 3 individuals
of *Euroscaptor mizura*

		Percentage by bulk
I.	Insecta	66.7
	a. Coleoptera	
	Carabidae (larvae)	10.0
	Undetermined (adults)	3.3
	" (larvae)	6.7
	b. Diptera (larvae)	1.7
	c. Undetermined	45.0
II.	Chilopoda	
	Geophilus	10.0
III.	Oligochaeta	
	Lumbricomorpha	21.0
IV.	Hirudinea	
	Drobdella	2.3

apparently best habitat.

Food habits. The author examined only three stomachs of moles obtained in the woods of the North and South Japanese Alps, Nagano Pref. The stomach contents had a similarity to those of *Mogera*, though the percentage of insects by bulk was larger than in the latter (Table 14).

Concerning the population structure and the breeding habits there are no available data.

(11) *Mogera wogura* group

Inasmuch as the three species of moles, *Mogera wogura*, *M. kobae*, and *M. tokudae*, are similar to each other in general life form, they are grouped together here for convenience.

Habitat. The moles range from near sea level to mountain regions of about 1000 m in altitude, but rarely to the alpine meadows of relatively high mountains; namely, *M. wogura* ranges to the top (1955 m) of Mt. Tsurugi, Tokushima Pref. They are usually most abundant in the low flat fields with deep soil having a fine texture and sufficient moisture. In Japan the fields are mostly cultivated and a major part of them is occupied by paddy fields with high moisture. In such fields the moles most densely populate the ridges separating the stretches of paddy fields, river banks, the sides of irrigation ditches, and pasture lands, probably because of the high yield of invertebrates for food. As is apparent from these facts, another important factor closely related to the former for the existence of moles in a given territory is ample soil moisture.

Although the moles are highly specialized for digging, they can scarcely dig in dry, baked soils. However, they may be found in soil of the same type if it has relatively high moisture. Extremely cohesive soil, even if moist, is also often uninhabited by moles because of the difficulty of digging and of the scarcity of invertebrate life suitable for food. A good example of such a condition is seen on Iki Island having moist soil, situated between Tsushima and Kyûshû Islands. Although the latter two islands yield moles (*M. kobae*), the former is uninhabited by any moles, probably because of its extremely cohesive soil. Another example is seen in Maezawa Town, Iwate Pref., where *M. wogura* occurs. The soil texture around the town is so cohesive that the mole is very scarce. Moreover, the habitat of moles in this locality is confined only to the sides of irrigation ditches and of rivers with relatively loose soil.

Very rocky or gravelly soil is also rarely occupied by moles. Extremely rocky ground, bare rocky mountain slopes, and rocky gorges may be barriers to the distribution of moles. For example, there is a small terrace facing to

the Kiso River at Tôgyoku, Agematsu Town, Nagano Pref. The terrace was occupied by *M. wogura* in the summer of 1959, but both upper and lower sides of it were inhabited by the predominant newcomer, *M. kobeae*. The barrier by which the latter species could not invade the territory of the weaker *M. wogura* might have been the rocky walls situated on both sides of the terrace.

Forested lands with sparse undergrowth are also not so suitable as habitat for the moles as are grass fields. Therefore, mountain regions covered with woods are usually sparsely inhabited by moles. Even if moles are to be found in the forest, their range of habitat is restricted to the sides of paths around which the trees have been cut over and where bushes grow in many cases.

The burrows of the moles usually extend in the surface soil less than 50 cm deep. There are two kinds of burrows; the one with smoother and well-packed side walls is frequently utilized as the trunk for going to the hunting ground and the other has loose and less well-defined side walls, suggesting rare use.

A single tunnel system is principally occupied by one mole. In early breeding season, however, the tunnel system occupied by a female is frequently visited by several males but not by any other females.

The moles associate occasionally with other small mammals that use the tunnels as their common runways. The following are the mammals trapped in mole tunnels where moles had been taken: *Microtus montebelli*, *Apodemus speciosus*, and *Urotrichus talpoides*.

Trapping records indicate no apparent nocturnal or diurnal periods of the activity of moles. They were collected irrespective of the time of day, though it is probable that individual moles may exhibit a rhythm of active feeding and resting periods. On rainy days, on the other hand, moles become more active than on fine, hot days. This activity results in greater yields from the trap line.

The three species of the moles retain the same ecological niche within their respective distributions, but *M. kobeae* and *M. tokudae* appear to be ecologically dominant to *M. wogura*. However, the ecological relationship between the former two species has not been explored at all because of their far separate distribution.

Food habits. Analyses were made of the contents of 226 stomachs of *M. kobeae*, 150 stomachs of *M. wogura*, and 23 stomachs of *M. tokudae*, all of which had been collected from many localities in various months of the year.

As indicated in Tables 15, 16, and 17, the foods of the moles consist of

TABLE 15. Stomach contents of 226 individuals
of *Mogera kobae*

	Percentage by bulk	Percentage by occurrence
I. Insecta	43.0	
a. Coleoptera		
Carabidae (adults)	3.2	22.6
" (larvae)	2.0	21.2
Scarabaeidae (larvae)	8.9	23.5
Chrysomelidae (larvae)	0.4	2.2
Elateridae (larvae)	0.5	9.7
Undetermined (adults)	2.7	10.6
" (larvae)	1.9	11.1
b. Orthoptera		
Gryllotalpidae	5.5	12.8
c. Diptera		
Tipulidae (larvae)	0.3	4.9
Tabanidae (larvae)	1.1	4.9
Muscidae (larvae)	1.4	11.5
d. Lepidoptera (larvae)	4.5	23.5
e. Hymenoptera		
Formicidae	1.0	6.2
f. Dermaptera		
Forficulidae	0.0	0.4
g. Undetermined	9.6	25.7
II. Diplopoda	0.3	1.8
III. Chilopoda		
Geophilomorpha	0.8	15.9
Scolopendromorpha	0.4	0.9
IV. Arachnida	0.04	0.9
V. Crustacea		
Amphipoda	0.00	0.4
VI. Oligochaeta	31.6	65.5
" (eggs)	0.8	8.8
VII. Hirudinea		
Drobdella	1.7	6.2
VIII. Gastropoda	0.1	1.3
IX. Amphibia		

(Continued)

	<i>Rana</i> spp.	1.9	3.5
X.	Mammalia		
	<i>Mogera</i>	0.1	0.4
XI.	Hair	1.4	8.0
XII.	Undetermined (animals)	2.5	6.6
XIII.	Plants		
	Seeds	9.3	25.2
	Fruits	0.3	0.4
	Dead grasses	2.9	23.5
	Undetermined	0.8	2.7
XIV.	Soil	1.5	8.0

insects, millipedes, centipedes, spiders, worms, slugs, leeches, frogs, and various seeds. Of these items the insects and the earthworms constitute the two major parts of the diet in each species, though the proportions between the two items vary to a great extent with the kind of mole.

Of the insects, Scarabaeidae (larvae), Gryllotalpidae (nymphs and adults), and Lepidoptera (larvae) are most favored. Some of the insects represent the families of economic importance; namely, among the beetles the Scarabaeidae and Elateridae, among the flies Muscidae, and Gryllotalpidae in the mole-cricket. As the frog remains were found only from the stomachs of moles obtained in winter, they might have been eaten by the moles while in hibernation. The dead grass and sand appear to be eaten inadvertently with the other foods, but soil might have come out of the intestines of earthworms. The seeds of plants seem to be a principal diet.

Population structure. The population of the moles usually consists of four cohorts of members, each with different age: the young in the year of their birth, the young adults born in the previous year, the adults born two years previously, and the old adults born three years before. The general age structures in the populations of two species of the moles are shown in Tables 18 and 19. It is clearly recognized from these data that the frequencies of the members of each age class in the population gradually decrease with advancing age.

Taking up the seasonal change of age structure, however, this situation is seen to be slightly different. Namely, the structure with four age classes is maintained from early summer to fall, but it changes in fall to a simpler one with three age classes, because of the death of old adults. Subsequently

TABLE 16. Stomach contents of 150 individuals
of *Mogera wogura*

	Percentage by bulk	Percentage by occurrence
I. Insecta	39.8	
a. Coleoptera		
Carabidae (adults)	2.6	14.7
" (larvae)	1.6	14.0
Scarabaeidae (larvae)	4.9	15.3
Elateridae (larvae)	1.2	12.7
Dytiscidae (larvae)	0.9	4.0
Undetermined (adults)	0.9	3.3
" (larvae)	1.6	4.7
b. Orthoptera		
Gryllotalpidae	8.8	22.7
c. Diptera		
Tipulidae (larvae)	1.4	12.7
Tabanidae (larvae)	1.6	11.3
Muscidae (larvae)	0.8	12.0
d. Lepidoptera (larvae)	4.5	21.3
e. Hymenoptera		
Formicidae	1.7	8.0
f. Undetermined	7.3	28.7
II. Arachnida	0.00	1.3
III. Chilopoda		
Geophilomorpha	0.01	10.6
IV. Oligochaeta	44.5	78.0
" (eggs)	0.7	14.0
V. Hirudinea	1.4	6.0
VI. Amphibia		
<i>Rana</i> spp.	0.00	0.6
VII. Hair	0.7	8.0
VIII. Undetermined	1.2	2.7
IX. Plants		
Seeds	3.1	8.0
Dead grass	4.9	16.6
Undetermined	1.2	2.7
X. Sand & soil	1.5	7.3

TABLE 17. Stomach contents of 23 individuals
of *Mogera tokudae*

	Percentage by bulk	Percentage by occurrence
I. Insecta	21.6	
a. Coleoptera		
Carabidae (adults)	1.5	8.7
" (larvae)	0.3	13.0
Scarabaeidae (larvae)	1.1	4.3
Elateridae (larvae)	0.8	8.7
Undetermined (adults)	0.00	4.3
" (larvae)	0.00	8.7
b. Orthoptera		
Gryllotalpidae	9.6	47.8
c. Diptera		
Tipulidae (larvae)	0.5	13.0
Tabanidae (larvae)	1.1	4.3
Muscidae (larvae)	2.0	26.0
d. Lepidoptera (larvae)	3.6	30.0
e. Hymenoptera		
Formicidae	1.1	8.7
f. Undetermined	0.00	4.3
II. Chilopoda		
Geophilomorpha	0.4	17.4
III. Oligochaeta	75.2	100.0
" (eggs)	0.00	4.3
IV. Hirudinea		
Drobdella	0.4	8.7
V. Hair	0.2	4.3
VI. Plants		
Seeds	0.2	4.3
Dead grasses	1.0	17.4
VII. Sand	0.7	4.3

TABLE 18. The sex ratio and age structure of *Mogera kobeeae*

Age class	Sex ratio				Age structure			
	♂		♀		♂	♀	Total no.	%
No.	%	No.	%	%	%			
a	53	59.6	36	40.4	23.1	15.7	89	38.9
b	45	58.4	32	41.6	19.7	14.0	77	33.6
c	24	52.2	22	47.8	10.5	9.6	46	20.1
d	11	64.7	6	35.3	4.8	2.6	17	7.4

TABLE 19. The sex ratio and age structure of *Mogera wogura*

Age class	Sex ratio				Age structure			
	♂		♀		♂	♀	Total no.	%
No.	%	No.	%	%	%			
a	39	54.2	33	45.8	23.3	19.7	72	43.0
b	31	57.4	23	42.6	18.6	13.8	54	32.4
c	16	45.7	19	54.3	9.6	11.4	35	21.0
d	1	16.7	5	83.3	0.6	3.0	6	3.6

this situation continues until the next late spring, when new young are born. The old adults probably die out by fall and none of them survives through the fourth winter.

Males usually predominate in sex ratio over females, except for the "c and d" classes of *M. wogura*. However, it is not evident whether the predominance has resulted from the difference in the activity between the sexes or from the real difference in the sex ratio.

Reproductive activity. Moles usually produce one litter a year. This observation is based on three types of evidence: testis size, condition of the female reproductive organs, and field observation.

Generally the breeding season differs, more or less, from one locality to another. Since the present survey covers from the warm Tane and Yaku Islands to snowy Niigata and Aomori Prefs., Honshū, the breeding seasons of the moles may be much different according to localities. However, the general pattern of breeding activity is probably similar in almost all localities.

In *M. kobeeae*, the testes along with the accessory organs of males become greatly enlarged in early spring. The variation in size from April to the next January is shown in Fig. 4. In adult males containing three age

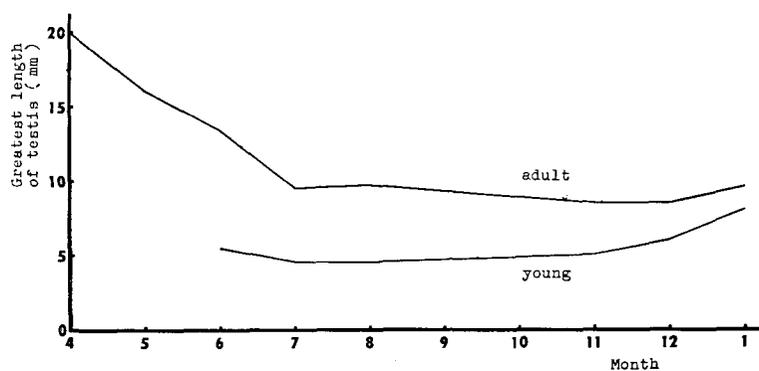


Fig. 4. Monthly changes in length of testis of *Mogera kobae*.
 Adult: "b, c and d" stages of age; young: "a" stage
 of age.

classes, the testes are largest in spring and decrease in size from then until mid-summer. The shrunken testes of late summer develop very little until the next breeding season, but they are distinctly larger in average than those of the young. Generally the testes of older adults shrink less than do those of younger adults. Accordingly the absolute size of shrunken testes of older adults is slightly greater than that of younger adults.

Reproductive organs of the young, males and females, gradually develop toward the breeding season of the next year, but in the year of their birth such organs never develop to the full size as seen during the time of breeding activity.

As shown in Table 20, four females of *M. kobae* containing embryos (3 to 5) were trapped in late April and early May in Kagoshima and Tane, both of which are situated in the warmest region of Japan. April and May are probably the height of the breeding season in those localities, but in more northern or colder localities breeding may occur later. For example, a female obtained from the mountain side (700m in alt.) of Hikosan, Fukuoka Pref., had 3 embryos as late as June 13, though another one trapped at the same locality on the same date had 4 placental scars on the uterine horns. Moreover, four females obtained from Zendôji Town, Fukuoka Pref., in early June had already given birth to young and had placental scars on the uterine horns. At the same time four young moles which were born during the season were trapped at the same locality.

After late June no female was found to contain embryos, but placental scars were seen in many adult females.

These observations suggest that mating after the last week of June must

TABLE 20. Data on the reproductive activity of adult female *Mogera kobae* and on newly born young during spring and summer.

Female or young	No.	Locality	Date
Gravid females	2	Kagoshima C.	Apr. 21-28, '59
	2	Tane Id., Kagoshima	May 3-11, '59
	1	Hikosan, Fukuoka	Jun. 13, '59
Females with large and vascular uteri	1	Kagoshima C.	Apr. 22, '59
	1	Zendôji T., Fukuoka	Jun. 3, '59
	1	Hikosan, Fukuoka	Jun. 14, '59
	1	Togouchi T., Hiroshima	Jun. 18, '59
	1	Akoichi T., Hiroshima	Jun. 27, '59
	1	Ôkuwa V., Nagano	Aug. 7, '59
Females of which the reproductive activity was over	2	Togouchi T., Hiroshima	Jun. 18-23, '59
	2	Akoichi T., Hiroshima	Jun. 29-30, '59
	1	Hase V., Nagano	Jul. 20, '59
	1	Chiyo V., Nagano	Jul. 27, '59
	1	Ôkuwa V., Nagano	Aug. 7, '59
	1	Shiojiri C., Nagano	Aug. 24, '59
Females with placental scars	4	Zendôji T., Fukuoka	May 30-Jun. 6, '59
	1	Hikosan, Fukuoka	Jun. 13, '59
	4	Yomikaki V., Nagano	Aug. 1-5, '59
	1	Shiojiri C., Nagano	Aug. 23, '59
Newly born young	1	Zendôji T., Fukuoka	Jun. 5, '59
	2	Togouchi T., Hiroshima	Jun. 19, '59
	5	Akoichi T., Hiroshima	Jun. 28-Jul. 1, '59
	5	Chiyo V., Nagano	Jul. 26-27, '59
	3	Yomikaki V., Nagano	Aug. 1-4, '59
	6	Ôkuwa V., Nagano	Aug. 6-14, '59

rarely or never occur.

Calculating from the numbers of placental scars and embryos, the average litter size is 4.2 with the range from 3 to 6 in *M. kobae*, 3.6 with the range from 2 to 6 in *M. wogura*, and 3 with the range from 2 to 6 in *M. tokudae*.

On the gestation period and the breeding nest nothing has been observed.

Literature

1. ABE, H. 1967. J. Fac. Agr. Hokkaido Univ. 55 (3): 191.
2. CLOTHIER, R. R. 1955. J. Mamm. 36: 214.
3. HAMILTON, W. J. Jr. 1930. J. Mamm. 11: 26.
4. ————— 1941. *Ibid.* 22: 250.
5. ————— 1949. *Ibid.* 30: 257.
6. JAMESON, E. W. Jr. 1955. J. Mamm. 36: 339.
7. KISHIDA, K. 1924. Honyûdôbutsu-zukai (Illustrated Japanese mammals). Tokyo In Jap.
8. ————— 1924. Zool. Mag. Tokyo. 36: 156. In Jap.
9. RUDD, R. L. 1955. J. Mamm. 36: 323.
10. THOMAS, O. 1906. Proc. Zool. Soc. London 331.
11. TOKUDA, M. 1953. Ecol. Rev. 13: 129.