

Damage by Rodents and Prediction for Their Occurrence in Japan

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Kinds of rodents

Rodents are a group of animals which belong to the family of Muridae, Rodentia and Mammalia. Muridae is classified into two sub-families, Murinae and Microtinae, and 17 species and 32 subspecies of rodents belonging to eight genera are known to be rampant in Japan.

The representative members of them are as follows:

Murinae

- 1) Kumanezumi (*Rattus rattus*): house rat, black rat
- 2) Dobunezumi (*R. norvegicus*): Norway rat, brown rat
- 3) Hatsukanezumi (*Mus musculus*): Japanese house mouse
- 4) Akanezumi (*Apodemus speciosus*): Japanese field mouse
- 5) Ezoakanezumi (*A. ainu*)
- 6) Himenezumi (*A. argenteus*): long-tailed wood mouse
- 7) Kayanezumi (*Micromys minutus*)

Microtinae

- 8) Hatanezumi (*Microtus montebelli*): Japanese meadow mouse
- 9) Sumisunezumi (*Eothenomys smithii*): Smith's Vole
- 10) Kayanezumi (*E. kageus*)
- 11) Yachinezumi (*Clethrionomys andersoni*)
- 12) Ezoyachinezumi (*C. rufocanus bedfordiae*)

Among these species the ones which actually

cause great damage to agricultural and forest products are rather small in number. For instance: 2) *Rattus norvegicus* is a species which is found in every part of the country and rages in both fields (in spring, summer and autumn) and houses (in winter); 8) *Microtus montebelli* is not distributed in Shikoku and is also rare in Hokkaido. However, it damages field crops severely in the other districts; 4) *Apodemus speciosus* lives in upland fields and adjacent woods, and does, next to *M. montebelli*, the greatest damage; 3) *Mus musculus* is often seen in upland fields on the outskirts of cities; 12) *Clethrionomys rufocanus bedfordiae* is distributed only in Hokkaido and causes the greatest damage to forests there; in Shikoku 9) *Eothenomys smithii* is active in place of 8) *M. montebelli* which is not distributed there.

Rodent damage

An outbreak of rodents is unusual and covers a comparatively narrow area mainly in forests, being rare in fields.

But once it occurs, as a result of an abnormal increase in population density, they eat away every kind of edible matter and cause heavy damage.

In the case of ordinary occurrence the damage is local and does not bring crops to nought, though a few loss is found in every place.

1) Rodents in forests

In forests, rodents attack roots of tree in

the areas where the snow is light, while they gnaw trunks of trees in the areas where the snow is heavy.

They eat away the cortex of roots together with small roots, leaving stick-shaped main roots, and gnaw the bark of trees in the shape of a ring about 1–2 cm wide round the trunk, severely damaging the tree.

The damage is generally done in a period from late autumn to spring, but it seems to have no relation to the season in the case of an outbreak.

In many cases, rodents attack Japanese larches in Hokkaido and Japanese cypresses, pines and Japanese cedars in Honshu, Shikoku and Kyushu.

It is said that there is little damage in a forest when the population density of rodents is not more than 10 per ha, and damage is observed in Japanese cypresses when the density reaches 20 per ha, spreading to pines, larches and Japanese cedars when the density increases to 30, 40 and 50 or more, respectively.

2) Rodents in fields

The commonest rodent in fields is 8) *Microtus montebelli* and 2) *Rattus norvegicus* is also counted among the commonest ones in some areas. In fields near mountains damage is done by 4) *Apodemus speciosus* as well as the species mentioned above. The control of rodents is not necessary when the population density is not more than two to three per ha, but it is necessary if the density becomes greater.

There are various kinds of crops which show seasonal changes in fields. Damage done by rodents to field crops, therefore, is variable and different in nature from that of forests.

When the cases of great damage are examined seasonally, it is noticed that rodents migrate, seeking food, as follows:

Spring (March to May)—Damage is observed in stems and leaves of wheat and barley in the beginning of this period; potatoes, newly planted seedlings of vegetable

fruits, young buds of pulse and miscellaneous cereals, and bulbs in the ground in the middle of the period; rice seedlings in nurseries, sweet potato cuttings and germinated seeds of upland rice in the last part of the period.

Summer (June to August)—Damage is frequently done to newly planted rice seedlings, soybeans planted on levees of paddy fields and potatoes. But the damage is not concentric and rather inconspicuous because there are many kinds of crops in the fields.

Autumn (September to November)—This is the harvesting season and rodents cause great damage to the crops. Rice plants in ear, especially those in early culture are concentrically attacked.

Loss is also great in pulse, potatoes, miscellaneous cereals, root vegetables and especially sweet potatoes.

In late autumn when most crops have been harvested and food for rodents decreased in fields, they eat away young buds of wheat and barley and seeds sowed in the soil.

Winter (December to February)—Owing to the lack of food in fields, the attack of rodents extends to stems and leaves of wheat, barley, rape, stored sweet potatoes, harvested rice and miscellaneous cereals. And rodents living in the fields of rice and other annual crops invade orchards, mulberry fields and meadows to seek food.

When the snowy season comes and the fields are under snow for a long period, they are active in the earth and begin to eat away roots and trunks of these perennial plants as in forests.

The population density of rodents and the rate of damage in crops, which suffer comparatively frequent damages, at the harvesting season are shown in Table 1, and changes in the rate of damage during the cultivation period are indicated in Table 2.

In these tables it is seen that rodents changing their target with the growth of plants, attack various kinds of crops and cause the greatest loss in the harvesting season.

In paddy fields the damage is conspicuous at

Table 1. Population density of rodent and the rate of damage caused by them

Crop	Place	Time of examination	Species and population density (per 10 a) of rodents		Rate of damage (%)	
Rice	Honjo-shi, Akita Pref.	September 1965	R. n.	5	2.3	
		September 1966	R. n.	13	6.9	
Sweet potato	Uwakai-mura, Ehime Pref.	October 1965	R. n.	18	29.0	
		November 1965	R. n.	6	15.0	
	Tsushima-machi, Ehime Pref.	December 1965	A. s.	10	21.0	
		October 1966	R. n.	12	16.0	
Burdock	Obuse-machi, Nagano Pref.	November 1965	M. m.	12	17.7	
Potato	"	July 1966	M. m.	6	2.5-4.8	
Peanut	Yachimata-machi, Chiba Pref.	July 1965	A. s. M. u.	4	70 (plants)	
		October 1966	A. s.	5	31 (plants)	
Tulip	Hikawa-machi, Shimane Pref.	March 1967	M. m. A. s.	10	2.1-3.2	
Vegetables in mixed culture	Ohara-machi, Shimane Pref.	February 1967	M. m.	20	Carrot	81.3
					Chinese cabbage	53.3
					Spinach	49.1
					Radish	9.3

R.n.: *Rattus norvegicus*
A.s.: *Apodemus speciosus*

M.m.: *Microtus montebelli*
M.mu.: *Mus musculus*

Table 2. Changes in the rate of damage during the cultivation period (1967)

Crop	Place and stage of crops		Rate of damage (%)
Rice	Nagano Pref.	August - Booting	4.4
		October - Maturing	3.3
		November - Harvest	9.7
	Akita Pref.	June - Tillering	0.6
		September - Maturing	9.0
Peanut	Chiba Pref.	June - Germinating	0
		August - Flowering	0
		October - Harvest	24-29 (plants)
Sweet potato	Ehime Pref.	July - Transplanting	0
		August - Enlarging	5
		November - Harvest	12-18

both the early and last stages of the growing period. 2) *Rattus norvegicus* has its nest in a grassy place or at a bank near a rice field and invades the field at night.

At the early stage, the rats mainly eat rice seeds sowed in nurseries, but their invasion is

prevented to some extent because of the small size of rice plants which can not sufficiently cover the invaders and the filling of the field with water.

When rice plants grow to a sufficiently large size to cover rodents, they come in the inner

part of the field. It seems that they are protected by the rice plants from natural enemies.

When water is drained away near the heading period of rice plants, they can freely attack the field where rice is nearing the ripening stage. They at first eat away the rice in the central part of a field. This is a distinctive feature of damage caused by 2) *Rattus norvegicus*.

8) *Microtus montebelli* makes its nest at a levee of a rice field. Therefore, they easily come in the field. The damage done at the early stage is compensated by the vigorous growth of rice plants to some extent but at the last stage the compensation becomes little, and consequently the damage increases. And when harvested rice is dried on levees, it is concentrically attacked by them as a good target.

In sweet potato fields, the amount of plants eaten away by rodents also gradually increases with the plant growth and the damage reaches the maximum in the harvesting season.

When harvested sweet potatoes are stored in the ground, the place becomes the target of their attack and the rate of damage sometimes reaches to 80 to 100 per cent.

Rodents like peanuts and do striking damage to the crop, as in the cases of sweet potato and rice, in the harvesting season and at the time when the harvested crop is dried by piling up in a place of the field.

In meadows which have grass throughout the year the population density of 8) *Microtus montebelli* is often so high as to be 90 per 10 a, and the yield decreases to half if no measures are taken to control them.

Especially in winter they eat away roots of grass under snow and kill the grass until the early spring when the snow melts, causing a large amount of damage.

In orchards and mulberry plantations dam-

age by rodents is also slight in spring and summer because there is much food in other fields but in late autumn rodents come in to seek food and voraciously eat away roots and trunks of these trees, causing their death.

Prediction for the occurrence of rodents

To prevent damage by rodents, it is needless to say that we must take carefully planned measures on the basis of the prediction for the occurrence of them which are in practice for a fairly long time in the forests of Hokkaido.

Since forests sustain the damage mainly in a period from late autumn to winter, the population density of rodents in the area is examined in June, August and October and the population in future is estimated from these surveys to make a plan to control them.

In this case, the mark-and-release method is mainly used for the determination of the population density. The catching and killing method is also adopted sometimes for the purpose.

The predicting method for the occurrence of rodents in fields has not yet been established. It has been made clear that each crop is concentrically attacked by rodents in the harvesting season as mentioned above, but for the control of rodents, we must know the population size and their living places of them in the area.

These surveys, however, are difficult in fields as compared with forests, because there are various kinds of crops cultivated under complicated conditions in fields. Further studies, therefore, are needed to establish predicting methods for the occurrence of rodents in the fields.