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**INVESTIGATION OF BROWN RATS (*RATTUS NORVEGICUS*
NORVEGICUS BERKENHOUT 1769) LIVING IN THE TISZA DAMS,
WITH A VIEW TO FLOOD PREVENTION**

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The dams along the Tisza are strongly damaged by the gnawing of small mammals. My present investigations have been carried out on a dam sector close to Szeged, strongly damaged by the activity of these mammalia. In the course of my work, recommended by the town council of Szeged and directed by the National Office of Water Conservancy, I have obtained valuable assistance from the above mentioned organizations. I wish to express my thanks here to water specialists Mihály Bokor and Dr. István Vágás for their kind help afforded to me during my investigation.

Site, time, method of the investigation

The investigation was carried out on the dam between the segments 11+943—12+243, at the left bank of the Tisza. Apart from them, it comprised also the 20—20 m strips, on both sides along the dam, as well as the field at the inundation side of the dam till the line of a ditch running behind the old protective willow wood (*Salix*) and, on the protected side, the area of Works No. 2 of the Granaries of County Csongrád. My work was carried out from August 15 till October 15 1967. The small mammals living in the sector investigated were collected with traps. I have worked with 100 traps set in the form of a 1,5×1,5 m square net. 50 p.c. of the traps were baited with parsley roots, the other 50 p.c. with greasy meat a little stewed. In the mole-holes of the dams I have set five traps. The 100 traps mentioned were the common flat mousetraps, got in the trade, with the so-called beating system. From the great number of brown rats living in the dam I have collected some also by air-gun, watching the brown rat specimens living in the dam with field-glass and naked eyes, as well. For investigating the mammalian holes in the dam, I have opened 11 research ditches together, exploiting in each case 2—6 cubic metres of earth. (Tools used were: pick, spade, shovel and a bit brace.)

General characteristic of the area

In the time of the investigation the weather was rainless, dry. The material of dam is solid, yellow clay, picked with difficulty.

The vegetation of the dam sector consists of gramineae of law growth. On the two sides of the dam I have found mammalian populations differing from each other both in quantity and in quality. On its inundation side, the dominant ones are: *Microtus arvalis* Pall., *Crocidura leucodon* Herm. being subdominant; then *Mus musculus spicilegus* Petényi, *Rattus norvegicus norvegicus* Berkenhout. On the protected side, there occurred mainly specimens of *Rattus norvegicus norvegicus*-Berkenhout. According to my estimations, the specimen number of brown rats living here may surpass even 1000. On the protected side there are living two more species: *Citellus citellus* L., *Talpa europaea* L. but only in very low number. Apart from the dominant and subdominant species of the inundation side, I could ascertain the occurrence of six species more. These are as follows: *Sorex araneus* L., *Citellus citellus* L., *Erinaceus europaeus roumanicus* Bar-Ham., *Apodemus sylvaticus* L., *Apodemus flavicollis* Melch., *Talpa europaea* L.

As observed, problems of flood control are raised in the dam sectors where some mammalian species bred rapidly. This breeding causes the regression of other species. At present, on the protected side of dam, the problem of flood control was caused by the rapid breeding of brown rats. Their multiplication can be explained by the optimum of ecological factors. (Granaries at the foot of dam, a dam highly suitable for building holes, absence of natural enemies.)

Analysis of activity of the brown rats living in the dam

In this country — as I am informed — this was the first case that we could observe a major damaging activity of brown rats in the inundation dam of the Tisza at Szeged. In the future, we have to take

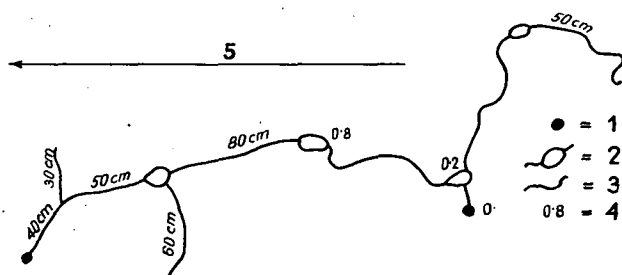


Fig. 1. Ground-plan of the burrows of brown rats in the inundation side of the dam.

5 Longitudinal axis of the dam

1 entrance opening

2 nest

3 hole

4 0,8 m depth points

this activity into account in an increased degree as this small mammalian species keeps spreading along the Tisza. This spread is in close connection with the great change that is at present carried out in the Tisza basin. (Barrages, campings, etc.)

The brown rat builds its hole scratching in the dam. The size, site and depth of these holes have a decisive influence on the resistance of dam during inundation. From the point of view of flood control it is therefore important to know the exact location and size facts of the holes scratched into the dam. On the surface of dam, the openings of holes can well be observed. On the inundation side, 91 percent of the entrance openings can be found in the upper one-third part of the dam. This is to be explained with the quick, immediate gushing out effect of the inundation waves. On this side I have noticed as many as 25 dwelling openings. On the opposite side, however, I could count 1800 rat's hole. From them about 1000 were in the 0—2 m strip of the foot (foundation) of dam, about 300 between 2—6 metres. In the strip close to the top of dam (6—8 m) there were about 500 openings.

The diameter of entrance holes is 7—9 cm. Their environment is covered with dredged earth and dirt. Among the holes run the much used small paths of rats. This path net converges into 1—1 major path, some of them leading partly to the inundation area, partly to the granaries.

The brown rats move in the daytime but in low number, in the twilight, however, they show themselves in masses. Then they go on the paths to the granaries for food. In the morning twilight I have also observed a movement of opposite direction of rats as they consume the sapful plants, the crop of blackberry in the holes of inundation area and at the riverside.

In the dam side at the inundation area I have opened three research ditches. Here opened the holes in three metres distance from the top of the dam, being only 0,8—1 m deep. One hole-dwelling divides into branches in an area of 2—3 sq.m, and two of them were not connected with each other. The direction of holes is parallel with the longitudinal

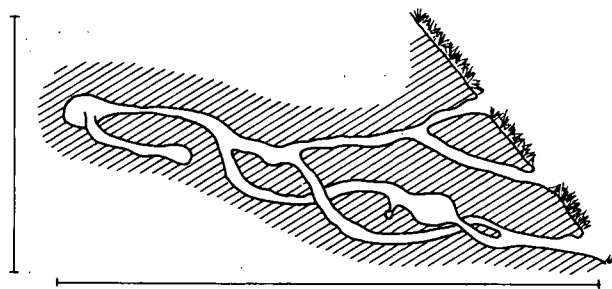


Fig. 2. Drawing of the burrows of brown rats in the foot zone of the protected side of the dam.
Surface of the slope
Nests full of crumbs

axis of the dam. The diametre of the net holes is 20—25 cm, they have a mildly flattened spherical form. They are lined with dry gramineae, in two of them I have also found corn-cobs.

The brown rat holes in the inundation side are not at all so dangerous from the point of view of flood prevention as those in the protected side, as they do not go deep. Their presence can, of course, not be tolerated here, either, because the wide holes can get eroded at inundations.

In the protected side of the dam I have opened a ditch system in eight places. Here did the brown rats damages first of all only at the foundation of dam (0—2 m) and at the edge of the top of dam (6—8 m), while in the middle zone (2—6 m) I have found but a low number of holes. The rats' holes here have one main entrance, and one side entrance or two, covered with clumps of grass.

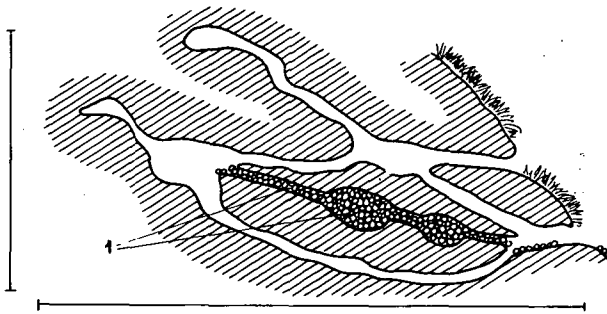


Fig. 3. Burrows of brown rats, the nests, holes filled up with crumled soil being indicated.

The holes in the zone of the dam foot (0—2 m) were all leading in a smaller or greater angle upwards in the body of dam. As explored, they were running 2—2,5 metres long into the body of dam (at right angles to the longitudinal axis), never going deeper than 1,2—1,4 m below the surface. Cp. Fig. 2.

I have explored here also two holes where beside the nests used there were some ancient nest holes, too, filled up with crumbled earth, dirt, etc. nearly fully. I have found also a hole system filled up. It seems so that the dredged earth material of great quantity of the new holes is scratched through into the old, deserted nests. From the point of view of the flood control this activity is very harmful. The number of holes filled up with crumbs is higher and higher in every year, and, besides the holes used, also these filled up holes contribute to the disintegration of the dam body, although it is apparently solid. From the surface conditions we cannot, and may not, ascertain, therefore, the degree of damage caused by the mammalian activity.

In the middle zone of the dam side (2—6 m) I could explore only short and not deep holes (0,8—1 m deep). Cp. Fig. 4. As I observed, these were holes of collective use, so-called escape paths. The brown

rats, if they meet quickly some danger far from their own holes, are fleeing here. I have observed baglike escape places of wide entrance (15 cm diameters) like these in the parts of the inundation area with clearings, along the rats' ways, as well.

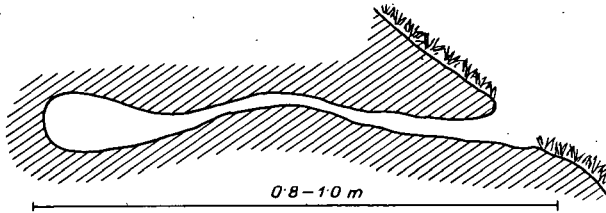


Fig. 4. Drawing of the so-called escaping places of collective use.

At the edge of the top of dam, the number of rat's holes is higher, again. They reach to 1 m depth in an area of 2 sq.m or so. Every hole consists of 2—3 nests and a path net connecting them.

The brown rats, collected in the time of investigation in the dam with traps and air-gun, were all male ones. Female ones were caught between the double plank walls of the granary, as many as three specimens. In spring an summer also the female rats must live in the holes in dam, as shown by the large nests with the remains of food rings. At the nests encircled with food like these I have observed pass-out labyrinths of very narrow diameter in two cases. These pathways must be the result of hole-making activity of cub-rats as in these narrow holes the old rats could not pass.

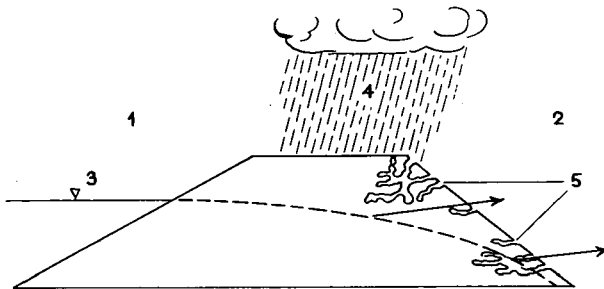


Fig. 5. The modifying effect of the burrows of brown rats upon the oozing curve.

- 1 Inundation side
- 2 Protected side
- 3 Flood level
- 4 Precipitation

The network of the holes of brown rats discussed above causes the destruction of dams in case of inundations. The shape of the oozing curve of the river water pressing the dam lastingly in case of an inundation wave is well known. Cp. Fig. 5.

This curve may not reach to the surface of dam anywhere because otherwise a bursting of the dam can occur. (Therefore the theoretical curve maximum is calculated with plus one metre safety height.) The holes of brown rats draw up this oozing curve, in case of inundation, prolongating it till the surface of the dam, particularly in the strip along the foot of the dam at the protected side, and then after oozing there may follow bursting or soil slip.

Another possibility, similarly dangerous from the point of view of flood control, may occur if an inundation wave is accompanied by a lasting raining. The holes, nests in the top of the dam and at its edge become drenched from rainwater. The oozing precipitation gets to the layer of the oozing curve and "drawing it upper" makes it straight, what again means "cutting it out". Cp Fig. 5.

The dwelling nests, holes and deserted cavities full of crumbs disrupt the resistance of dam. According to the law of communicating vessels, the water of large inundation waves endeavours to get a way upwards in the body of dam, too. An undamaged dam counterbalances this force of uprush well with its mass but it can do that only in a low degree if there are holes, loose parts inside the dam, as a result of causes mentioned above, there can be developed so-called internal springs in the dam body. In the history of flood prevention, the cause of several unexplicable dam burstings may have been the activity of small mammals that escaped notice.

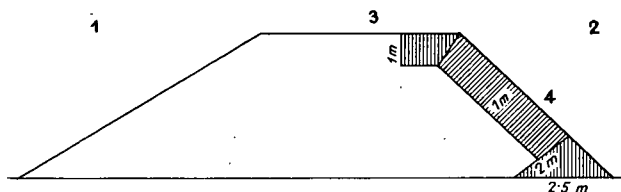


Fig. 6. Renovation of the damaged layer of dam.

- 1 Inundation side
- 2 Protected side
- 3 Top of the dam
- 4 "Infected" layer

Also the joint result of the activities of moles and brown rats can be dangerous. The moles escaping from the inundation area in time of floods make a great number of holes in the dam in a short time. (Mole progression!) One or more mole holes can reach to the parts of dams that are made loose by brown rats, in them oozing, water course can begin in case of high flood and, even if the dam did not get soaked through, a quick bursting can occur, widening in a few moments.

The part of dam where my present investigations were carried out (11+943—12+243) is demanding urgent renovation. On the protected side of the dam, the soil stratum "infected" by the holes of brown rats is to be removed and replaced with earth material compact enough. Cp. Fig. 6.

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