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Daniel Bajomi

Biologist and Head of Babolna Pest Control Centre, Budapest, Bathory u., Hungary

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DERATIZATION OF BUDAPEST AND FIVE YEARS OF FOLLOW-UP CONTROL MEASURES

DANIEL BAJOMI, Biologist and Head of Babolna Pest Control Centre, Budapest, Bathory u. 19, Hungary 1054

ABSTRACT: A brief review of deratization carried out in Budapest (.2 million inhabitants) is given. As a result of an extensive eradication project initial infestation level of premises amounting to 33% decreased below 0.5%. Materials and techniques employed for the preservation of a rat free state as well as the method how to determine the size of the remainder of the rat population are described. "Idealized premises" were introduced allowing comparison between rat infestations of various areas. Report on the relationship between rat population and temperature, on the areal dispersion of population and on how re-infestation occurs. Finally conclusions are drawn based on the favorable results achieved.

INTRODUCTION

According to a survey made in the sixties, there were about 2 million rats in Budapest and the losses caused by them were estimated at 300 to 400 million Forints a year. The Norway rat (Rattus norvegicus Berk.) predominated, while the roof rat or black rat (Rattus rattus L.) played a minor role.

Surveys carried out during the large eradication program in Budapest (Hungary) 1971 and 1972 indicated that 33% of the properties were infested by rats. In the inner town nearly 100% of the buildings were infested, while the infestation level of the outskirts ranged from 0 to 10%. Experience shows that when rat infestation of buildings in an inhabited area is as high as 10 to 15%, rat control or deratization is imperative.

DERATIZATION OF BUDAPEST

On the motion of the Public Health Epidemiological Station of Budapest (Budapesti KÖJAL) the Executive Committee of the Budapest Council decreed that Budapest, covering an area of 525 km² be deratized. This gigantic task was completed by the Babolna Pest Control Centre during 1971 and 1972. Effective rat control requires the application of new techniques based on theoretic and practical research work. The project's target was to reduce the infestation level below 1% and such an achievement would be considered unique even internationally.

The principles of deratization are as follows:

1. The rat eradication must take place in large and interconnected areas simultaneously.
2. Rat control must be done simultaneously in all surface premises and in the corresponding sewage system.
3. Use only highly efficient and environmentally acceptable anticoagulants in baits that are attractive to wild rats.
4. Employ proper techniques which are not detrimental to the environment.

The two year Budapest project was carried out in three phases, an average of 112 men and 20 cars took part. The project used 1,632 tons of bait containing 0.06% Coumatetralyl (Racumin '57) placed in 330,000 large self-feeding boxes (bait stations), 86,000 bait boxes placed in sewer manholes, 614,000 cardboard trays, and 40,000 feeding tubes. All the containers and their material were made by the Babolna Pest Control Centre.

FOLLOW-UP CONTROL MEASURES

Deratization carries enormous costs and is rewarding only if the rat-free state is preserved by the so called "work of maintenance". The Babolna Pest Control Centre was again commissioned to do this job with following objectives:

1. search and quickly destroy all rats which remained after deratization, by systematic surveys and poisoning,
2. prevent rats introduced by transportation from becoming established and reproducing, and
3. prevent invasion of rats from neighboring areas.

Methods And Materials Used

As a preventive measure surveys and poisoning are carried out monthly in 30 premises, the so called penetrating places (railway stations, quays, piggeries, slaughter houses, etc.). In addition 45 areas with permanent poison stations are built at the administrative boundaries - protection belt -and along river-banks where rat invasion is possible.

Surveys are carried out and, if necessary, baits are laid quarterly with 431 institutions, where risk of rat infestation is most likely. Special care is taken in baiting and inspecting sewers. In addition, attention is paid to all information collected from property owners.

Rat infestation reported by the public, institutions and the working teams is treated on the spot. Placing and number of poisoned bait stations depends on the character of the area to be disinfected, degree area is inhabited, function and technical condition of construction, and on the level of infection expected considering the biology, feeding behaviors and home range of rats.

It is of great importance that the poisoned baits are simultaneously laid within all surface premises and their adjacent area including neighboring buildings and the sewage system pertaining to them. In other words, beside the dwelling house reported, the two neighboring buildings are treated as well. If consumption is observed when checking the neighboring buildings then treatment with poisoned baits is extended to additional buildings.

In outdoor locations, the rodenticide is placed in closed wooden feeding boxes or in cardboard tubes covered with polyethylene, these containers are marked with "POISON". The poisoned bait is placed in cardboard trays which are also provided with warning signs. In the sewers special bait boxes on wooden legs are used which are placed in the manholes. Treatment in the storm water drains is done with paraffin discs containing anticoagulant active ingredient. The discs are lowered on wires attached to the grid. Impregnation of the baits with paraffin extends their efficiency for a long time. In case of need dusting powders are applied to treat borings and holes. The wettable formulation of coumatetralyl is used only in cases when bait acceptance may not be successful.

The poison baits are checked every 7 to 10 days with a view to measure consumption, to replenish the rodenticide supply and to establish new poison places if needed. After the first and second check a third inspection is carried out (after 21 to 30 days from placement of poison) and if no consumption can be observed work is finished. Following this the containers are removed and destroyed by burning. In our knowledge no problems have arisen by carcasses. In order to prevent accidents notices were put up near the bait stations informing the public on safety regulations.

Good organization and methodical work are essential to maintain a rat-free state. Thus the territory of Budapest was divided into 9 sections treated by one working team, with each section containing 2 to 4 administrative boroughs. One borough was divided into smaller "working districts" for a total of 551. The staff of the working teams is financially responsible for maintaining its section rat-free.

Each working team consisted of one chief technical assistant who had previous experiences during the eradication campaign, one driver and 2 manual workers. The "sanitary gas masters" and disinfecting workers were trained by the Budapesti KOJAL. Each working team used one small lorry to attend to its area. During the work of maintenance, 13 cars were in service. The work of teams was managed and controlled by a foreman.

Results

As one single contractor performed the maintenance of the rat-free state in Budapest, the minimum rat population can be observed in a reliable way. The techniques of the work of maintenance involving the search for foci, systematic assessments, detailed documentation and exact recording enable the analysis of the biotop of rats and the time of their occurrence.

1. Determination of the size of rat population

Rats live in hidden places and therefore it is often difficult to establish their number and in many cases their presence. In the history of deratization it was the first time that the reports on rat infestation received from the public and companies could be used for assessments. Thus the number of reports based on observations are compared to the number of properties found infested during checkings (Table 1).

Table 1. The number of reported infestations received from the public are given for each of five years and compared with the properties found infested upon investigation.

Year	Number of reports by the public and companies	Number of reports on properties found infested during checking	Percentage of mis-information
1973	928	504	45.7
1974	1,179	651	44.8
1975	989	589	40.4
1976	947	524	44.7
1977	877	426	51.5
	4,920	2,693	45.4

It appears from Table 1 that in an average 45.4% of the reports are erroneous. The reason for this is that people confuse the damages made by or the traces of cats, mice, hamsters, bats, etc. with those of the rat. Another reason for the report not reflecting the real degree of infestation is the negligence shown by the public.

In order to determine how information received from the public and companies reflect the infestation level of the whole area checked, we have to compare the number of reports to the number of rat occurrences verified (Table 2).

Table 2. The number of premises reported and found infested are given along with the number and percent found infested of all premises upon investigation over each of five years.

Year	Number of premises reported and found infested (100%)	Number and percents of all premises found infested %	
1973	504	825	163.7
1974	651	1,046	160.7
1975	589	892	151.4
1976	524	761	145.2
1977	425	657	154.6
	2,693	4,181	155.1

It can be established that the number of properties found really rat infested was about by 66% higher than the number of properties reported. The difference proceeds from the systematic search for infestation of preventive character performed by the Pest Control Centre (investigation, checking of controlled properties quarterly, checking of penetrating places, supervision by Budapesti KOJAL). This fact also shows that the system of maintenance based on prevention is necessary and effective.

In such a large area as Budapest (525 km²) the number of individuals of the rat cannot be established. Therefore the properties found infested must be examined in certain intervals (years, months) to assess the size of rat population. Considering that buildings or factories have various functions and are of different size, a comparison can be made only between areas of similar character. Thus the so called "idealized premises" served as a unit of measurement. The following areas correspond to one "idealized premises":

- one traditional building including the sewage system in the street in front of it,
- one family house with the land attached, including the sewage system in front of it,
- one building having up to 4 staircases including the sewage system located within 10 m from the wall,
- one public building (office block, school, theatre, etc.) irrespective of its size, including the sewage system in front of it which may extend to a number of bordering streets,
- one smaller industrial unit with a ground space of up to 2000 m² including the sewage system pertaining to it,
- each area of up to 50x40 m, inside of a large factory including the sewage system pertaining to it,
- each 1,000 m area of land without buildings (garbage, dumps, river sides, etc.).

If an area (e.g., a large factory) under examination is larger than the area of an idealized premises, then it will represent a premises as many times larger as the number of the selected unit of measurement is comprised.

2. Size of the remainder of rat population

Employing the calculation methods mentioned, it can be established (Table 3) that since 1974 the number of actually rat infested places (idealized premises) has steadily decreased. The decrease in the number of infested premises (since 1974 in the average about 14% yearly) has been due to the reduction of the remaining population size on the one hand and to a more effective work of maintenance promoted also by the public on the other (introduction of preventive search for foci). The smaller number of rat infested properties in 1973 was due to the faulty techniques being still immature initially, to the inadequacy of search for foci and inactivity of the public in reporting what derived from lack of information.

In the whole area of Budapest, the amount of the remaining rat population and the extent of re-infestation can be established in the way when the yearly number of actual rat occurrences is compared to the 220,017 total number of "idealized premises" (Table 3).

Table 3. The number of premises infested relative to the total number of premises in Budapest for the years 1973 through 1977.

Year	Number of premises infested	The yearly rat infestation in relation to the total number of premises in Budapest
1973	825	0.37%
1974	1,046	0.47%
1975	892	0.40%
1976	761	0.34%
1977	657	0.29%

The monthly level of rat infestation can be calculated from the percentage showing the yearly infestation level.

3. Relationship between size of rat population and temperature

The size of rat population is altering. The relationship between the size of rat population and temperature is shown in Fig. 1; according to which, the size of the Budapest rat population changes parallel with temperature except for the winter months. Between the temperature and the population size, there is a phase shift of 4 to 8 weeks. During the winter months, the decrease of temperature takes a smaller effect on the population due to the fact that the majority of rats live in biotops (sewers, cellars, stores, etc.) where the average temperature never falls below a certain level irrespective of the outer temperature.

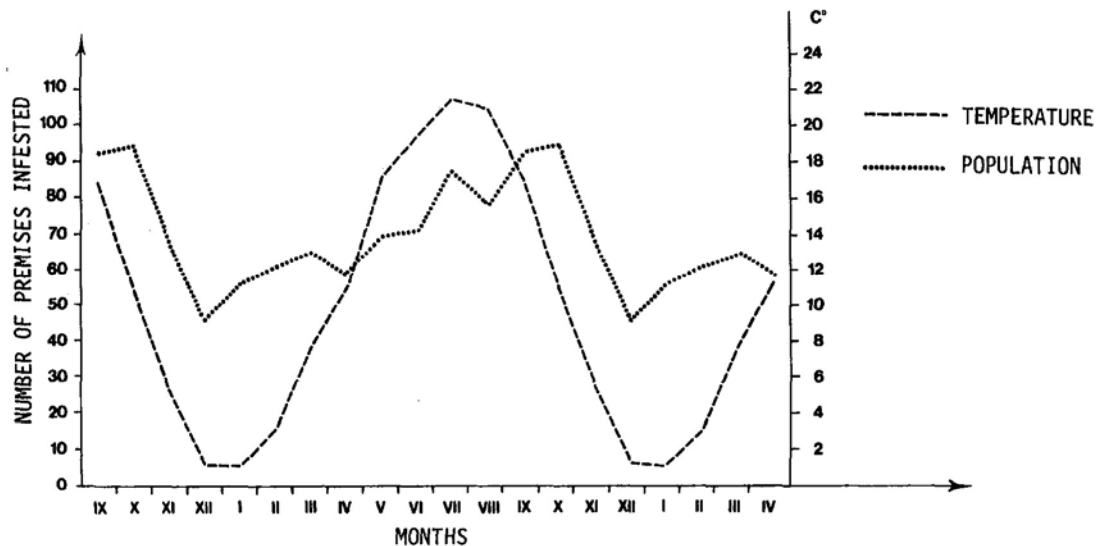


Fig. 1. Monthly change of the rat population size of Budapest in an average of 5 years (1973 to 1977).

Population begins to increase from January and will continually grow parallel with rising temperature from April. Rat population will reach its maximum size, however, not in July and August when temperature is highest, but 8 weeks later during September and October. Then population size will decrease abruptly such as temperature falls.

4. Regional distribution of rat population

Since 1975 it has been examined yearly how many rat infested premises were found in each smaller "working district" during the preceding year. To demonstrate this exceptionally increasing categories were set up. Sections showing 8 to 15 rat infested premises in a year fell in certain categories of priority signed with number 1, those with 4 to 7 rats were ranged among category two, those with 1 to 3 rats fell under category three, while category four showed "working districts" with no rat infestation at all. On the basis of this classification, the distribution of yearly rat infestation of Budapest can be plotted.

This is the principle of a target inspection system, because districts under category one are checked quarterly, those under category two twice a year with a view to search for foci and prevent

spread of infestation. Districts under category three are surveyed once a year. Besides premises requiring systematic checkings (penetrating places, properties checked quarterly) were inspected at stated intervals.

It appears from the data covering the period of four years (1974 to 1977) that although rat infestation known decreased by 14.4% yearly, 51.6% of the districts remained in the same category, while 42% of the districts got in a higher or a lower category. This means that the distribution of population has actually scarcely changed.

5. Active invasion and passive introduction of rats

At the initial stage of maintaining the rat-proof state, it looked as if filling in of the biological space created by rat control in Budapest would take place through invasion in an active way and through introduction in a passive way.

Within the protection belt created to prevent invasion, rats were detected only in two cases. On the Danube embankments declared as a protection belt and therefore checked monthly, invasion occurred in three cases at two different places. From this small number of rat occurrence, it may be concluded that active rat invasion is insignificant. That is why the size of areas creating a permanent poisonous zone, which acted as a protection belt over several years, could be diminished and translocated to other danger zones such as banks of brooks in the outskirts of Budapest.

Rat introduction in a passive way in premises mostly endangered, i.e., the penetrating places was continually checked. Initially, there were 30 such places in Budapest, but presently with infestation diminishing only at 18 penetrating places are treated monthly. The yearly level of rat infestation at these places amounts to 5.1 to 7.0% in relation to the overall infestation of Budapest. Thence it follows that the majority of rat introduction does not occur through these points. Considering the fact that apart from one or two cases in other areas of Budapest rat infestation did not develop in foci, introductions occur at most different places and times.

At the penetrating places, infestation was established in 254 cases during the period of five years. This means that rat introduction in these premises occurred at least in 254 cases. In the premises frequency of introduction varies: rats were found in three places within one premises covering 54.7% of all cases (slaughter house, piggery), while the other three places with rat infestation (Market-hall, port, co-operative piggery) represented 23.6% of all cases. Transportation through these penetrating places particularly exposed to infestation takes place by road and railway as well as by water. Transportation of cattle on foot and fodder from various places of the country to Budapest occurs irregularly thus increasing infestation. To prevent spread of infestation introduced by transportation, we must treat the penetrating places regularly.

Although yearly rat infestation observed in the penetrating places amounts only to 5 to 7% when compared to the total infestation level of Budapest, this method of prevention proved to be effective because during the period of five years the control treatments completed in 1,260 cases showed an infestation level of 19.6%. This relatively high efficiency could be achieved by treating those properties only systematically where necessary i.e., the premises declared as penetrating places in 1973 had been selected.

6. Surveys of premises in danger of infestation

Another preventive method to maintain the rat-proof state is the quarterly survey and checking of 446 large premises representing industrial and food processing premises. During the first five years, surveys were made in 8,920 cases including nearly 500 premises. Infestation was found in 240 cases only. Only 121 out of 446 premises showed simple or several rat infestations. There was not even a single rat infestation in the other 325 premises during the five years. Frequency of infestation within the properties shows great deviations. At the Csepel Iron and Metal Works, infestation was detected in 15 cases and at the Duna Cooperative in 8 cases during the five years. During the same period, rat occurrence was found once in 66 premises and twice in 32 premises.

EXPERIENCES GAINED AND CONCLUSIONS

In Budapest the rat infestation is negligible at present and due to the quickly and effectively acting service of maintenance, no problems of public health and conditions or material losses arise. Considering the large area of Budapest (525 km²) and the rare occurrence of rats in relation to it, the town can be considered rat-free. The remainder of the rat infestations of Budapest has continually decreased since 1974 and this means that the excellent result achieved by the eradication operation can still be improved by adopting a good method for the work of maintenance. An average reduction in the amount of minimum rat infestation is due to the fact that the techniques of maintenance based on the general and continuous establishment of poison places, which method was in general use in Western-Europe, were replaced by the introduction of preventive techniques adopting target treatments accomplished in rotation. The main point of this method is that the places where rats had occurred were analyzed yearly and on the basis of rat infestation falling yearly on the individual working sections, the latter were classified and preventive surveys were carried out accordingly.

The Budapesti KÖJAL also supervised the rat infestation level continuously during the period of maintenance. For this purpose, more than 50,000 measuring points (paraffin feeding blocks for detecting rat occurrence in sewers, powdering with talcum, questioning, attended traces indicating rats) were established. During the period of maintenance (60 months), 152 positive measuring places were found and 85 reports received from the public making 237 positive places in total. This is equal to an infestation level of 0.056% when compared with all premises (417,500) supervised. The separate measurements by Budapesti KOJAL also showed the low level of rat infestation i.e., the effectiveness of the follow-up treatments.

The techniques applied are safe. Despite the fact that an average quantity of 210 tons of poisoned bait were laid, no accident had occurred. In order to be successful supervision and internal checking are of main importance, by the means of which it can be assured that techniques prescribed be observed what is the guarantee for an effective work.

Rat control and maintenance of a rat-free state can be effective only if the persons concerned (public, institutions) are ready to help. It is therefore important to develop a scheme of propaganda and a good information system. The public's readiness to help can be promoted by releasing it from bearing charges. With the passing of a certain time, the rat-free state becomes customary and will not be interesting any more. This attitude must be combated by permanent propaganda.

Re-infestation occurs in the main by introduction through goods transported by road. In the Budapest area, introduction takes place dispersedly and irregularly. The number of protection belts could considerably be decreased due to the negligible active re-invasion of rats. Also, the number of penetrating places could be decreased as the majority of introductions did not occur through these points.

In spite of the fact that deratization has been in progress for 7 years in our capital, the techniques previously elaborated had not to be changed considerably. So far no tolerance or resistance has been reported. The lack of resistance is due to the techniques based on exact checkings, application of a bait containing a larger amount of active ingredient, extensive treatments and placement of rodenticides in abundance to be safe.

Without organizing the work of maintenance, rat-proofing is of no use because infestation in the areas eradicated will soon reach the initial level or even exceed it. But operation of maintenance must not be ceased after a certain time because risk of re-infestation steadily exists.

The practical and theoretical experiences gained when organizing and completing rat eradication and maintenance of the rat-free state in Budapest according to the method of the Babolna Pest Control Centre which all goes to show that it has become possible to render large and contiguous areas rat-free with guarantee excluding any hazard.