

# EFFICACY OF LARGE-SCALE RAT AND COCKROACH CONTROL ACTIONS IN BUDAPEST AS SHOWN BY EXPERIENCES OVER A 23-YEAR PERIOD

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**Abstract**—Pest control in urban environment can be carried out either sporadically or in a concentrated way, covering large areas. The efficacy of organized pest control programs comprising large parts of cities or even whole cities is far higher than the success of separate control works done by individual methods.

Having recognized this fact and taking into account the above modern aspects, the City Council of Budapest organized an overall deratization action covering the entire city of Budapest, capital of Hungary, as well as cockroach control actions comprising housing estates built by panel construction. As a result of a total deratization action carried out by Bábolna Bioenvironmental Centre in 1971–72, the initial 32.8 % rat infestation of properties has been decreased to below 0.5 %.

The success of this action allowed Budapest, a city with 2.2 million inhabitants to become rat-free in 1972. Due to the systematic maintenance works following deratization conducted since 1973, rats have not been neither a public health, economic or general feeling problem in Budapest for 23 years now.

As a result of the large-scale cockroach control action carried out in Budapest between 1978–1990, 144,800 flats, 2 million sq.m public area in dwelling houses, 1 million sq.m area in public establishments (schools, trade units, etc.) as well as 700,000 sq.m public health area (hospitals, social welfare homes, etc.) have become cockroach-free. This practically insect-free state could be saved on the long term due to the maintenance works carried out following the control itself.

During the years of proper control, the large-scale pest control programs carried out in Budapest over the past 23 years have implied higher costs than usual. These control actions have been, however, followed in each case by the continuous maintenance works carrying less costs. As a result of the complex pest control and maintenance programs in Budapest have not only been more successful than the average, but have proved to be more profitable economically as well.

## INTRODUCTION

Certain pests of public health importance (Norway rats, house mice, German and Oriental cockroaches) have a high degree of adaptability and find excellently their living conditions in urban environment. This is the reason why – taking advantage of the favourable ecological conditions – these pests settle down and proliferate rapidly in the cities (Bajomi, 1984). This was especially observed in several hundreds of thousands housing estate flats built from prefabricated elements by the Soviet technology in the 70's (Bajomi and Elek, 1979). The above mentioned pests proliferating in urban conditions may spread infectious diseases, cause considerable economical damages or – through the disgusting effect they provoke – may annoy the inhabitants; therefore, their control is a must (Burgess, 1981; Bajomi, 1983).

Budapest, the capital of Hungary lies on the river Danube. Covering an area of 525 sq.km, the city has 2.2 million inhabitants, living in 22 administrative districts and in approx. 220,000 properties and buildings. In spite of the sporadical control works carried out in Budapest in the late 60's, the health authorities estimated the number of rats as being 2 million and the annual damages caused by them at 300–400 million Forints which is equal to 10–12 million US Dollar at the rate of exchange at that time (Herczeg, 1969; Herczeg and Gács, 1975).

According to the surveys, on an average 32.8 % of the properties in Budapest were infested, mainly with the Norway rat (*Rattus norvegicus* Berk) (Bajomi, 1982; Burgert and Papócsi, 1972; Elek, 1974). The individual areas differed a lot in their level of infestation, the properties in the inner city being practically infested at 100 % (Gács *et al.*, 1977).

By the end of the 70's, cockroaches had become very numerous in commercial establishments, public health institutions and flats in housing estates of panel construction in Budapest (Göntér, Vámos and Gaál, 1981). Surveys using questionnaires showed that 11–30 % of the flats and nearly 100 % of the public institutions were cockroach-infested (Bajomi and Mayer, 1978; Göntér, Vámos and Gaál, 1981). In Hungary, the Oriental cockroach (*Blatta Orientalis*) was originally the most

common cockroach species. Subsequently, in housing estates of panel construction the German cockroach (*Blattella germanica*) have become the most prevalent (Bajomi and Elek, 1979).

In order to assess cockroach infestation, the Public Health and Epidemiological Station of Budapest carried out several surveys. The wide-range questionnaire survey in 1973–74 – involving a total of 67,000 flats – indicated that 42 % of the blocks of flats were infested with one or more insect species. The flats in housing estates built by panel construction were mainly infested with German cockroach, while in the old flats built 60 years before the survey the Oriental cockroach was the dominant species. In 1974, surveys were made in 759 public institutions. Within the establishments surveyed, the food and catering units showed a 53 % infestation rate while in other establishments the level was 22 % (Göntér, Vámos and Gaál, 1981). A 1975–76 survey also showed that practically all hospitals were cockroach infested.

The City Council of Budapest together with the Public Health and Epidemiological Station of Budapest have recognized that the serious problems caused by the proliferated pests can only be suppressed by well-prepared control and follow-up maintenance programs covering large areas and using up-to-date technologies. The political situation allowed these enormous works to be carried out by a single entrepreneur, the utmost prepared Bábolna Bioenvironmental Centre.

For the successful conduction of the large-scale control actions, Bábolna Bio – in cooperation with the public health authorities – has worked out and developed new control and maintenance methods. Taking into account the experiences gained over the decades, these methods have been continuously updated. The control and maintenance programs carried out by a single entrepreneur permitted not only to get results over the international average, but – by means of the computerized data collection and processing – also allowed scientific research works to be done.

## METHODS AND MATERIALS

### Deratization

As the situation was urging, the City Council of Budapest decided to eliminate rats from the entire city. Based on a thorough investigation and in accordance with the minutely elaborated schedule, the deratization had to be carried out in three phases, in 21 months. The deratization work was ordered by the City Council and prepared through a wide mass media propaganda, and started in April 1971 (Papócsi, 1974).

The essence of the deratization was that in accordance with a so-called global control method, the poisoned bait containing 0.06 % coumatetralyl active ingredient should be placed by a single entrepreneur in all surface properties and in the sewage system simultaneously in a systematic way, following a schedule prepared in advance. The used bait was checked every 7–10 days (usually 3–4 times) until consumption completely stopped. A work sheet was made out of each treated property.

An average staff of 112 people took part in this work who had been trained within the frame of a special course in the Public Health and Epidemiological Station of Budapest. 20 cars were involved in the control. To promote successful work, a new capacity for the production of rodenticides and baiting stations (feeding box, sewer box, feeding prism) was installed within Bábolna Bioenvironmental Centre. Table 1 shows the quantities of materials used for the deratization action in 1971–72 (Csalava, 1974).

Table 1. Average annual rodenticide quantities and numbers of containers used in Budapest 1973–1995

|                              |           | During rat control<br>Programme<br>1971–1972 | During<br>Maintenance<br>1973–1995 |
|------------------------------|-----------|--|------------------------------------|
| Bait                         | kg        | 1,632,400                                    | 116,500                            |
| Paraffin Wax Blocks          | items pcs | —  | 37,200                             |
| Large Self-feeding Boxes     | items pcs | 300,000                                      | 9,600                              |
| Feed Prisms                  | items pcs | 40,000                                       | 4,100                              |
| Special Bait Boxes in Sewers | items pcs | 86,000                                       | 23,800                             |
| Cardboard Trays              | items pcs | 614,000                                      | 20,500                             |

All through the duration of the works, deratization has been supervised by the Public Health and Epidemiological Station of Budapest in both professional and efficacy respect. Efficacy and success of the control was determined by objective measuring methods (application of measuring wax cube, talc field). Altogether, control measurings were effected at 11,555 points in 7,468 properties specially chosen for this goal. Such properties were chosen where – according to the experiences – rats were most possible to be found. As shown by the measurings carried out, only 143 of the investigated measuring points remained rat-infested (Gaál, Herczeg and Vámos, 1974).

### **Maintenance of rat-free state**

As the deratization in Budapest implied enormous costs (182 millions Ft), it could only be considered economical if the achieved results can be maintained on the long run. Having recognized this fact, in 1973 the administration of Budapest published a tender for the maintenance of the rat-free state. Thanks to the results achieved during the control works, it was again Bábolna Bio who was favoured with a contract.

To maintain the rat-free state, a new special technology had to be worked out. As - according to this new technology – each work team is responsible for the maintenance of rat-free state in 3–4 administrative districts, a total of 7 teams work in Budapest. In thirty properties, the so-called “penetration gates” – where the massive transportation and handling of goods carries a potential risk of rodent introduction – rodenticides are placed every month as a preventive measure. According to the experiences gained over the last 23 years, the number of penetration gates has by now decreased to 9. As a result of the emergence of the biological gap, migration of rats from the infested settlements around Budapest was to be expected. To prevent this, a so-called protection ring has been set up along the administrative borders as well as along river and stream banks where placing and checking of rodenticide is also done monthly (Figure 1) (Bajomi, 1980).

In large industrial, commercial and food industry establishments checking takes place every six months together with the competent management staff at the given site. Investigation of the complaints from the tenants concerning infestation, as well as placing of the necessary rodenticide (earlier coumatetralyl, presently – since 1990 – bromadiolone) is carried out by the work teams within 24 hours, and checking is done every 7 days until complete elimination of the infestation. Maintenance of the rat-free state in the sewage system of Budapest – as a preventive measure – is ensured by systematic setting up and continuous checking of feeding sites.

### **Cockroach control**

According to the surveys carried out by the Public Health and Epidemiological Station of Budapest in 1973–74 and those effected by Bábolna Bioenvironmental Centre between 1976–1990, the cockroach infestation of flats in housing estates was intolerable (Table 2). That was the reason why the specialists responsible for the public health of Budapest started to search for alternative solutions. The goal was to carry out a well-organized large scale action which allows to decrease considerably the infestation in flats built by panel construction, in public areas in dwelling houses, in public establishments in housing estates (food shops, catering units, schools, nurseries, etc.) as well as in health institutions.

Bábolna Bio was commissioned to conduct the necessary large scale experiments and to put them into practice afterwards. On the basis of the contract concluded with the Municipality of Budapest an experimental cockroach control was carried out in 1978–79, comprising 15,000 flats as well as the public areas and public establishments in Újpalota housing estate. During the experiment, several technologies were tested. First the tenants were also involved in practical control by making them carry out the treatments themselves with the insecticides supplied. However, it turned out that one cannot rely on the effective and successful of the tenants, and only the treatments carried out by specialists can bring appropriate results (Bajomi and Guthy, 1981). Subsequently, on the basis of profound biological knowledge and of experiences gained under both laboratory conditions, but more specially in practical work, a new technology was elaborated which has been continuously updated further on.

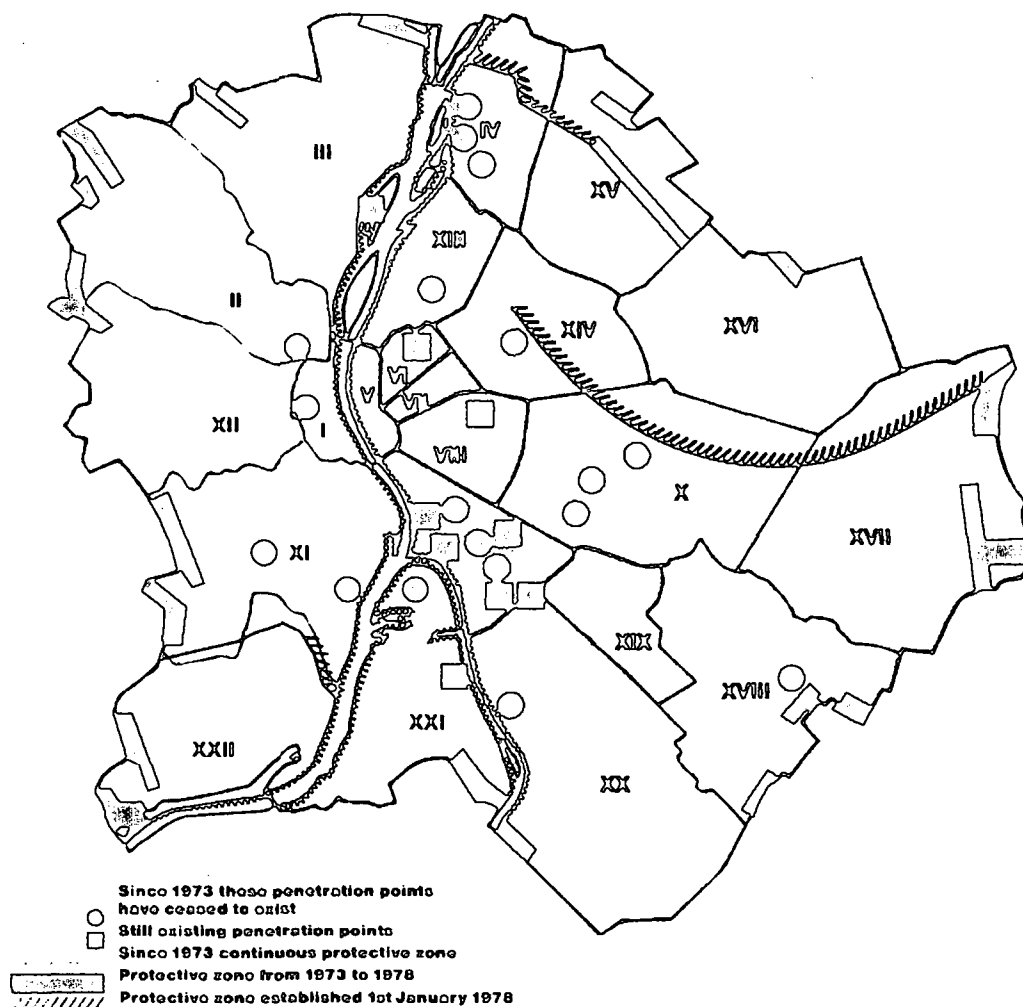


Figure 1. Protection zones and penetration points in Budapest.

Table 2. Ratio of cockroach infestation in housing estate apartments at the beginning of control as determined by questionnaire and by trapping

| Districts drawn into the survey | Years of survey | No. of apartments surveyed | No. of apartments evaluated | Ratio of cockroach infested apartments |          | Ratio of cockroach infested apartments per stair-case (extreme values in %) |
|---------------------------------|-----------------|----------------------------|-----------------------------|--|----------|---|
|                                 |                 |                            |                             | Questionnaire (values in%)             | Trapping |   |
| XI                              | 1976-1977       | 400                        | 400                         | 45.0                                   | -        | 25.0-65.0   |
| XIV                             | 1976-1977       | 513                        | 513                         | 46.2                                   | -        | 4.4-88.0  |
| XV                              | 1978-1979       | 15,402                     | 12,070                      | 31.2                                   | -        | 0.0-78.3  |
| XI                              | 1980-1981       | 13,553                     | 9,991                       | 34.7                                   | -        | 0.0-90.7  |
| XI, XXII                        | 1982            | 7,304                      | 4,513                       | 28.2                                   | 11.9     | 0.0-80.5  |
| III                             | 1983            | 8,477                      | 4,837                       | 22.6                                   | 10.8     | 0.0-79.3  |
| III                             | 1984            | 6,796                      | 4,345                       | 18.1                                   | 9.2      | 0.0-76.0  |
| III                             | 1985            | 13,524                     | 6,988                       | 16.0                                   | 8.6      | 0.0-75.0  |
| XIV                             | 1986            | 18,021                     | 8,634                       | 15.1                                   | 8.3      | 0.0-70.7  |
| IV                              | 1987            | 16,833                     | 8,422                       | 13.8                                   | 5.6      | 0.0-68.4  |
| X, XIII                         | 1988            | 18,165                     | 6,384                       | 22.5                                   | 12.2     | 0.0-75.0  |
| XI, XIII, XX                    | 1989            | 15,501                     | 3,516                       | 11.6                                   | 4.7      | 0.0-69.7  |
| XVIII, XIX                      | 1990            | 11,245                     | 1,905                       | 9.8                                    | 3.8      | 0.0-48.0  |
|                                 | 1976-1990       | 145,714                    | 71,408                      | -                                      | -        | -   |

In the beginning, questionnaires played quite an important role in preparing the treatments and in the methods serving for the assessment of efficacy. Later on it turned out that the data supplied by the tenants were rather unreliable, so use of the traps has gradually come to the front (Erdős and Koncz, 1981).

Survey of cockroach infestation by trapping introduced in 1984 represented an improvement of the control system. This enabled pest control operators to perform insecticidal treatment only in the infested flats, and to localise the focus of infestation in the neighbouring flats situated above and below the former. This control procedure is more economical and environment-friendly than the one used earlier, as in most cases it involves treatment of the infested flats only. However, to ensure satisfactory efficacy, in staircases where more than 40 % of the flats were infested, all flats were treated (Bajomi, Kis-Varga and Bánki, 1993).

Treatment consists of spot or zone spraying, aimed treatment of cracks and crevices, and then flush-out by cold fogging. It is advisable to apply several control procedures and rotation of insecticides depending on local conditions. Long-acting synthetic pyrethroids and microencapsulated organophosphates have the most favourable utilisation parameters. The applied method and formulations are shown in Figure 2.

### Maintenance of cockroach-free state

Initially it was thought that under appropriate guidance the tenants would be able to maintain the cockroach-free condition, by giving them appropriate information and by using the insecticides available in trade. However, the survey carried out 18 months after the control did not support this concept, therefore – similarly to the maintenance of rat-free state – an overall program was launched in order to maintain cockroach-free state.

To detect eventually re-infested flats, notices were placed in staircases. Questionnaires and postal cards serving for notice-giving were also supplied. Though this method gave some result, it became evident that the picture we had got on the site and level of re-infestation is not quite precise. That

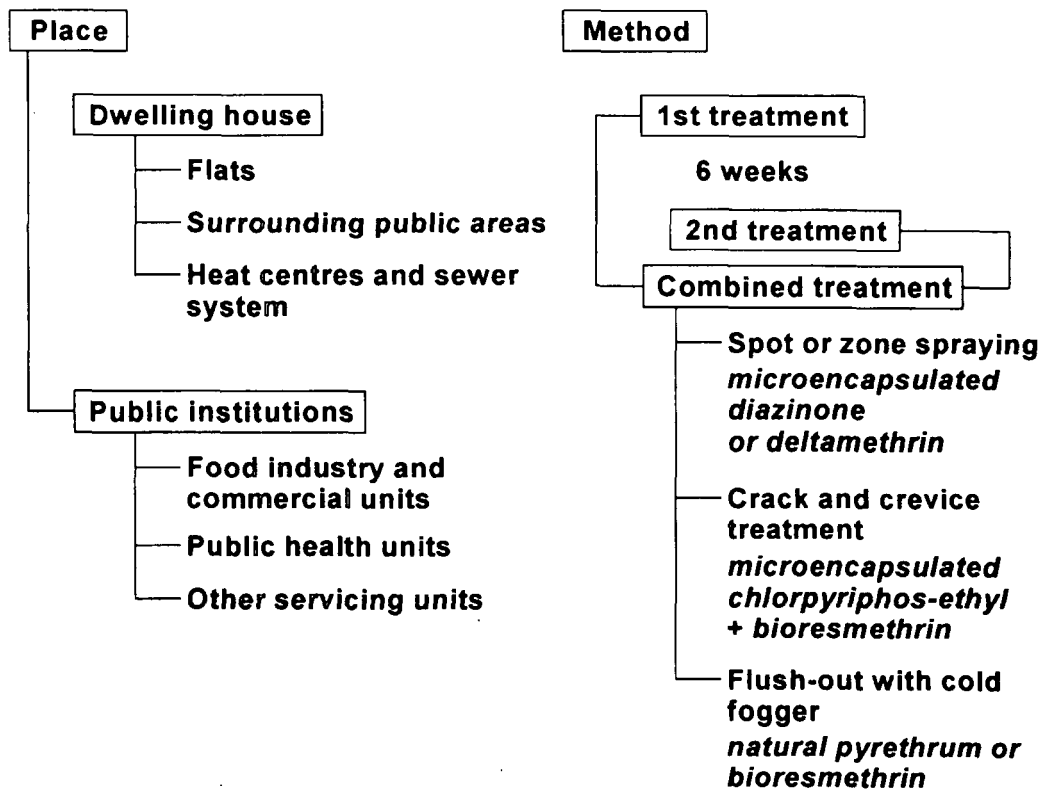


Figure 2. Treatment schedule of cockroach control method developed by Bábolna

| Mode of treatment   | 1979–<br>1980 | 1981 | 1982 | 1983 | 1984 | 1985–<br>1986 | 1987–<br>1990 |
|---|---------------|------|------|------|------|---------------|---------------|
| Treatment by tenants with insecticides available in shops                             | ○             |      |      |      |      |               |               |
| Questionnaire for tenants twice a year  |               | ○    |      |      |      |               |               |
| Determination of infestation by cold fogging in infested apartments                   |               | ○    |      |      |      |               |               |
| Assessment by trapping as reported by the public                                      |               |      | ○    | ○    | ○    | ○             | ○             |
| Treatment by experts in infested apartments   |               | ○    | ○    | ○    | ○    | ○             | ○             |
| Treatment of neighbouring apartments situated above and below the infested apartments |               |      |      | ○    | ○    | ○             | ○             |
| Search for focal points on the basis of infestation in the previous year              |               |      |      |      | ○    | ○             |               |
| Investigation: preventive assessment of staircases excluded from categories           |               |      |      |      |      | ○             | ○             |

Figure 3. Development of the technology for maintenance of cockroach-free conditions in housing estates

was the reason for the introduction of “search for infestation focus” in 1984 first, and of “checking program” afterwards, starting from 1985 (Figure 3) (Bajomi, Kis-Varga and Bánki, 1993).

Putting the assessment of infestation by trapping into general practice has permitted to carry out treatments – in most cases – only at the sites actually cockroach-infested. This has allowed to decrease both superabundant insecticide application and pollution of the environment, and to improve efficacy of work at the same time.

Naturally, maintenance also covers public areas within dwelling houses as well as public establishments situated in the area of the housing estate. Special emphasis is put on food producing, processing and distributing establishments. In case cockroach infestation was detected at such sites or in flats, reiterated treatments – similar to those performed during control – were carried out.

### Computer system

The expansion of cockroach control and rat and cockroach-free maintenance activities have called for a suitable computer back up. The system developed allows computerised administration of the work processes mentioned above and also schedules work processes to be carried out next and then checks their efficacy. The statistical programs developed permit comparison and perform analysis to be made (Bajomi, 1993).

The large number of data collected and processed regularly for years now are also suitable for drawing scientific conclusions as for the biology of the pests (Bajomi, 1986; Bajomi, 1983). Unfortunately, this presentation does not offer enough time and place to share these extremely interesting information.

## RESULTS

Thanks to the control action, the average 32.8 % rat-infestation of the properties in Budapest in 1970 has decreased to less than 0.5 %. As a result of the continuous maintenance activity carried

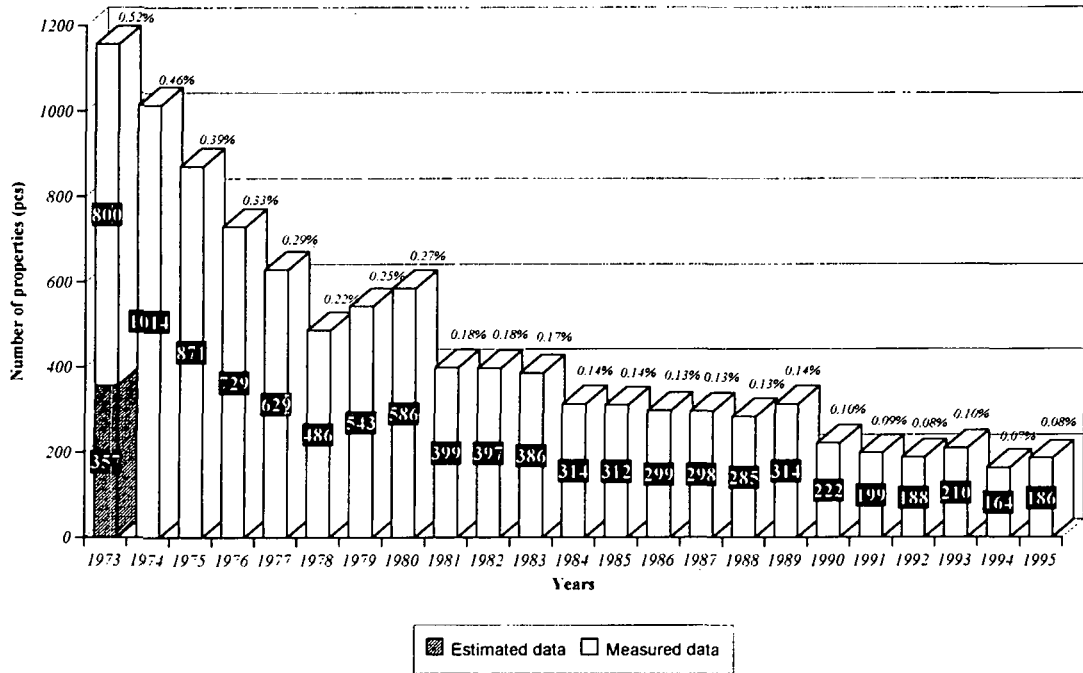


Figure 4. Size of remaining rat population in Budapest as compared to the number of properties

out since 1973, this level continued to decrease and reached only 0.08 % in 1995 (Figure 4). Taking into account the large area of Budapest (525 sq.km) and the rare rat occurrence as compared to this area, the city can be considered rat-free (Bajomi and Vámos, 1983; Vámos, Gaál and Salfay, 1974; Bajomi, 1993).

According to the questionnaire survey carried out in 71,408 flats in Budapest housing estates, the average level of cockroach-infestation of the flats prior to control was as high as 22.7 %. Within this average, in certain highly infested districts the level happened to be 32.0 %. As a result of the cockroach control action and the follow-up maintenance works, the remaining infestation has gradually decreased, and in 1990 reached only 0.7 % as compared to the number of flats (Bajomi, Kis-Varga and Bánki, 1993).

## DISCUSSION

The even internationally outstanding results of large scale rat and cockroach control works effected in Budapest in the last 23–24 years prove that the unified technologies using up-to-date control principles, the effective pesticides and the systematic work allow to carry out successful pest control actions even on contiguous large areas (housing estates, city districts, whole cities). It was also proved that if overall control operations comprising large areas are carried out instead of individual controls, and especially when they are performed by a single well-prepared specialized company according to a unified method, then the results achieved this way will be far beyond the efficacy of unconcerted control works.

It became also evident that due to the favourable ecological conditions further existing after the accomplishment of the control works, the re-settlement and re-proliferation of the pests is quite probable. Therefore, it is advisable from both professional and economical point of view that the large scale control actions should be followed by a maintenance activity in each case. The experiences gained in Budapest also proved that the systematic work applied during the maintenance will permit to preserve the pest-free state on the long run. This is especially confirmed by the fact that on the 525 sq.km area of Budapest rats have practically not caused neither public health, economic or general feeling problems for 23 years now.

During the maintenance of both rat and cockroach-free state it became evident that the so-called free state preservation requires considerably less labour expenditure and, consequently, less cost than the less effective and unconcerted control operations that – as a consequence – have to be carried out in a practically continuous way. A further important advantage of the systematic pest-free state maintenance works consists in putting into front mainly the preventive activity instead of the curative methods.

To sum up, it can be stated that during the past 25 years in Budapest we have managed to work out and put successfully into practice such control and maintenance methods that allow the elimination of pests on large contiguous areas on the long run, without endangering the environment by unwanted intoxications.

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