

## RAT CONTROL by LOCAL AUTHORITIES within the UNITED KINGDOM

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**Abstract** The control of rats in the United Kingdom falls to various public and private sector organisations. Local authority environmental health departments do have certain legal duties related to the public health risks posed by rodents, but the way in which they meet these duties varies. This paper reports the findings of a survey sent to all Local Authority Environmental Health Departments in England, Wales, and Northern Ireland. Sixty-two percent (n = 250) of the 402 Local Authorities returned completed questionnaires. External harbourages, defective drains/sewers, poor structural maintenance, and poor hygiene were identified as the most important causes of rat infestations. The most likely sources of infestation were external harbourages, sewers, and defective drains. A quarter of the respondents charged for treatments to control rats in domestic premises within their Authority boundaries. The most popular active ingredients used were second-generation anticoagulants presented as edible baits. Nineteen percent of respondents reported experiencing treatment failures. The most likely causes of treatment failures were re-invasion from untreated areas, non-co-operation from client/neighbouring buildings, and poor bait take. Only 65% of local authorities were able to confirm the arrangements within their boundaries for sewer treatments. The need for a fundamental review of the current arrangements is examined.

**Key Words** *Rattus norvegicus* infestation control strategies

### INTRODUCTION

Public health has been defined as the science and art of preventing disease, prolonging life, and promoting health through the organised efforts of society (Vickers, 1958). In the United Kingdom, Environmental Health Departments in Local Authorities play an important role in preserving, promoting, and protecting the public's health. Their officers are authorised to enforce statutory duties relating to health and safety at work, food safety, housing, and environmental protection. The last decade has seen a major overhaul of much of the legislation relating to these areas of work, driven in part by the European Commission, which is striving for harmonisation of the legal powers available to enforcing authorities within its member states. However, the public-health legislation relating to the control of pests has not received such attention. Within the United Kingdom, three main pieces of legislation are used in controlling pests, the Public Health Acts of 1936 and 1961, neither of which relate to rodent control, and the Prevention of Damage by Pests Act 1949, which outlines statutory duties placed on Local Authorities and also provides them with powers to control rats and mice. This Act was introduced after the second world war primarily to reduce damage to agricultural crops. Additional powers related to general statutory nuisance are specified under the Environmental Protection Act (1990) and can be used where rodent infestations are in evidence.

### Risks Posed by Rodents

The continued survival and proliferation of rodent populations in the urban environment owes much to their capacity to adapt to life in close association to man. Research into the patho-

gens that wild rats may carry is limited. Whilst their role in the transmission of diseases such as leptospirosis is well understood (Torten and Marshall, 1994; Vinetz et al., 1996), their role in the propagation of diseases such as Salmonellosis, Listeriosis, Toxoplasmosis, and Hantavirus is less clear (Healing, 1991; Konishi and Takahashi, 1987; LeDuc, 1987; Webster, 1996). Much of what has been reported relates to rural rat populations (Webster, 1996; Quy et al., 1999), and little research had been undertaken to address the issues of disease transmission to human populations in the urban environment.

Although it is now agreed that in the United Kingdom anticoagulant resistance is present within the agricultural setting (Quy et al., 1995), no work has been undertaken to assess whether this problem exists in the urban setting and, if it does, whether it poses a significant threat to the public's health. The worst-case scenario is of course that rodent populations are becoming resistant to anticoagulants and that their numbers will continue to rise as the proportions of those with heritable resistance continue to increase.

### **Rats and Sewer Systems**

In industrialised countries brown rats are often found in considerable numbers within the sewer systems of cities (Lund, 1994). This is often their main refuge in modern situations where slums are no longer present and where efficient refuse removal operations make it difficult to find edible food sources above ground. Decisions on the nature of rat control in sewers may lead to a very high density of rats within the sewer system and consequently a pressure on more subordinate animals to seek shelter elsewhere. It is generally agreed that rats in sewers are not a problem by themselves as rats do not damage properly installed, intact pipes (Lund, 1994). However, damaged sewers and drainage systems facilitate egress from the sewers to above-ground environments. *R. norvegicus* is the only urban species in Britain that harbours within the sewer systems, and this environment will, by its function, be heavily contaminated with pathogens. Bentley et al. (1955) have emphasised that sewer systems vary widely in their capacity to support rats. The most important factors that influence population sizes are probably the amount of food available, the size and structural condition of the sewer, and the nature of the flow. Furthermore, control of a given population by poison baiting at the manholes is obviously affected by the distance apart of the latter.

Following privatisation of the United Kingdom, water authorities' responsibility for the control of rats in the sewer system was unclear. Although a national protocol for co-operation on rodent control (LGA, 1999) was sent to all local authorities and water authorities, the level of co-operation remains vague.

### **Organisation of Rat Control**

In the United Kingdom the arrangement for the control of rats is a complex and often disjointed matter. Within the agricultural setting, control is overseen by DEFRA (Department of Environment, Food and Rural Affairs). In non-agricultural settings, control undertaken by local authorities is overseen by the LGA (Local Government Association). Water Authorities have responsibility for the control of rats within the public sewer system. Private pest control companies undertake treatment work in both agricultural and non-agricultural settings. Finally, the Health and Safety Executive (a statutory non-departmental public body) provide controls on the advertisement, sale, supply, storage, and use of pesticides.

## **MATERIALS and METHODS**

A questionnaire dealing with several aspects of rodent control was developed and piloted before being distributed to all local authorities in England, Wales, and Northern Ireland (n = 402) during 2001. Questionnaires were returned anonymously in addressed envelopes enclosed with

the questionnaire. A total of 267 completed questionnaires was returned. Seventeen questionnaires were returned uncompleted and were removed from the sample, leaving a total of 250, giving an overall response rate 66% and a valid response rate of 62%. Data were analysed using SPSS software. This paper will report on the findings associated with rat control.

## RESULTS

Whilst there is no statutory requirement for Local Authorities to provide in-house pest control services, the vast majority of respondents ( $n = 241$ ; 96%) reported that they did undertake treatments to control rats. Of those who did not ( $n = 9$ ), one had contracted out this service, three offered advice only, and the others did not specify the arrangements made.

### Main Causes of Rodent Infestations

Respondents were asked to indicate what they considered to be the main causes of rat infestations within three different settings (domestic, commercial (non-food), and commercial (food)) in their local authority and to rank the three they considered to be the most important causes. The results presented in Table 1 show the percentage of local authorities that indicated the cause specified and a weighted rank (calculated by giving a rank of 1 (i.e., most important cause) a score of three, a rank of 2 a score of 2, and a rank of 3 a score of 1 and summing the scores; the weighted ranks were then standardised to 100 to facilitate comparison).

The weighted rankings revealed different patterns for the three specified settings. For domestic rat infestations, the three most important causes (in order) were external harbourages (100), defective drains and sewers (85.6), and poor structural maintenance (71.8). For commercial (non-food) rat infestations, the three most important causes (in order) were poor structural maintenance (100), external harbourage (97.2), and defective drains/sewers (71.5). For commercial (food) rat infestations, the three most important causes (in order) were poor hygiene (100), poor structural maintenance (89.4), and external harbourage (78.3).

### Main Sources of Rat Infestations

Respondents were asked to indicate what they considered to be the main sources of rat infestations within their local authority; results showing the percentage and weighted rankings are presented in Table 2. The three most important sources identified by the respondents were external harbourages (100), sewers (75.8), and defective drains (71.3).

Table 1. Causes of rat infestations in three locations in the United Kingdom.

Cause	Domestic ( $n = 242$ )		Commercial Non-food ( $n = 195$ )		Commercial Food ( $n = 182$ )	
	%	Weighted rank	%	Weighted rank	%	Weighted rank
External harbourage	88.4	100	80.2	97.2	71.9	78.3
Defective drains/sewers	81	85.6	57.4	71.5	54.1	60.8
Poor structural maintenance	71.9	71.8	74.1	100	70.3	89.4
Poor hygiene	60.7	57.1	45.2	44.7	71.9	100
Other	23.1	27.4	9.1	12.2	7.6	8.3
Failure to report infestation	43	18.4	42.6	24.8	42.2	21.2
Poor refuse collection	23.6	14.4	35	37	45.9	53.5
Internal harbourage	36.8	11	43.1	25.2	43.8	21.2
Unknown	7.9	3.5	8.1	5.3	5.9	5.5

Table 2. Main source of rat infestations

Source	%	Weighted rank
External harbourages	85.1	100.
Sewers	75.5	75.8
Defective drains	78.8	71.3
Derelict areas	55.6	37.1
Other	31.1	33.4
Railway embankments	56	32.6
Internal harbourages	28.2	10.7
Rubbish tips	28.2	10.7

### Charging For Rat Infestation Treatments

The arrangements for charging for rodent control services within Local Authorities varied widely across the United Kingdom and often reflected local political sensitivities and historical (often erroneous) associations with disease. Previous cuts in Local Authority funding during the 1980s and 1990s forced Local Authorities to consider means by which they could generate income to offset the costs of their statutory functions. Decisions on charging policies for pest control services were driven by local political priorities and public opinion on the threats posed by rodents. Local Authorities were asked about their charging policies; results are presented in Table 3.

Most Local Authorities classify rats as public health pests and undertake their control as part of their public health function. However, a quarter of Local Authorities did make a charge for undertaking domestic rat infestations. Whilst the debate continues regarding the actual disease threats posed by rats to the human population, the ability and/or willingness to pay for treatments may hamper the reporting of infestations and the co-ordination of control strategies.

### Rodenticide Usage

Local authorities were asked to indicate which products and formulations they used in the treatment of rats; results are presented in Tables 4 and 5. Not surprisingly, the results demonstrated a heavy reliance on second-generation anticoagulants due to the less intensive application requirements. Difenacoum was the most popular poison used in domestic, commercial (food and non-food) premises, and outdoors. For sewer control, brodifacoum was the most popular poison. Edible grain baits were the most popular formulations in domestic, commercial (non-food), outdoor, and sewer settings. In commercial food premises, edible blocks were the most popular formulation and probably reflected concerns about contamination of commodities during production.

Table 3. Percentage of Local Authorities (LA) that charge a fee for rat infestation control services

Location	% LA which charge for service
Domestic rat (n = 220)	24.1
Commercial rat (n = 190)	94.2
Agricultural rat (n = 159)	91.8
Sewer rat (n = 134)	79.9

Table 4. Active ingredients used by Local Authorities to control rats in five settings

	Domestic	Commercial non-food	Commercial food	Outdoors	Sewers
Diphacinone	4.5	5.1	4.6	4.8	–
Chlorophacinone	6.7	5.1	6.3	6.0	3.3
Coumatetralyl	10.1	7.6	7.8	9.6	–
Warfarin	20.2	22.8	18.8	21.7	18.0
Difenacoum	60.7	58.2	54.7	55.4	9.8
Brodifacoum	50.6	48.3	45.3	–	70.5
Bromadiolone	55.1	54.4	51.6	50.6	23.0
Flocoumafen	11.2	12.7	14.1	–	1.6
Difenacoum	6.7	5.1	6.3	3.6	–
Cholecalciferol					
Zinc Phosphide	1.1	2.5	–	2.4	–
Other	–	1.3	–	1.2	–

Table 5. Formulations of rodenticides used in five urban settings

	Domestic	Commercial non-food	Commercial food	Outdoors	Sewers
Edible Baits					
Blocks	73.3	81.9	100	77.3	54.5
Grain	100	100	89.0	100	100
Pellets	26.7	23.9	29.4	22.1	14.6
Throwpacks	19.3	13.8	14.7	19.3	30.1
Liquid baits	6.0	3.7	5.9	5.5	7.3
Contact dust	9.7	5.8	7.3	6.6	4.9
Concentrates	5.1	4.8	7.3	6.6	5.7
Gels	4.6	4.8	8.1	5.5	4.9
Gas generating compounds	4.6	4.2	5.9	7.2	4.9
Other	4.6	4.2	8.1	9.4	7.3

### Managing Treatment Failures

Nineteen percent ( $n = 74$ ) of respondents reported experiencing treatment failures. They were asked to identify the reasons why treatments had failed. The percentages and weighted rankings for each reason are presented in Table 6. For rat treatments, the three most important reasons for treatment failures were re-invasion from untreated areas (100), non-co-operation from client or neighbouring buildings (92.5), and poor bait take (64.5). Although 8 Local Authorities suspected anticoagulant resistance, none had undertaken anticoagulant resistance testing to confirm if this was indeed the case. Respondents were asked to indicate how they had attempted to manage the treatment failures. Percentages of those that adopted each strategy are presented in Table 7. The use of alternative rodenticides, improved hygiene and proofing, and the use of physical methods were the most frequently adopted strategies to manage treatment failures.

### Control of Rats in Sewers

The importance of co-ordinated sewer control has been acknowledged by several authors (Bentley et al. 1955; Bentley et al., 1959; Colvin et al., 1998). Colvin et al. (1998) reported that a

Table 6. Perceived causes of rat treatment failures

Cause	(n = 74)	
	Tick	Rank
Re-invasion from untreated areas	81.1	100
No cooperation from client/neighbouring buildings	75.7	92.5
Poor bait take	54.7	64.5
Insufficient baiting points	35.1	31.8
Other	13.5	27.1
Unusual behaviour patterns	24.3	20.6
Inappropriate application technique	16.2	17.6
Anticoagulant resistance	9.5	14.0
Removal of bait by non-target species	10.8	10.3

Table 7. Percentage of Local Authorities that adopted different strategies to manage rat treatment failures

Strategies	%
Use of alternative rodenticides	68.8
Improved hygiene and proofing	64.1
Use of physical methods (traps)	52.4
Not using bait boxes	35.9
Use of alternative bait bases	31.3
Other	10.9

random, haphazard approach or reactive sewer baiting did little to actually manage a rat population or to solve localised problems. Subsurface baiting requires a systematic approach with close review and adjustments of the baiting strategy based on the quantities and geographic patterns of bait consumption. Recovery of sewer populations was likely within six months (or less) if they were not effectively baited. Baiting programmes that used single bait placements (e.g., annual or twice annual), without follow up, simply cropped a portion of the population and enhanced the rate of population growth.

Local authorities were therefore asked whether they knew what sewer control was being undertaken within their local authority boundaries. Only 65% (n = 158) were able to confirm details of sewer control. Results as to which organisations undertook sewer control are presented in Table 8.

Table 8. Percentage of organisations undertaking rat control within sewers

Local Authority (in house)	56.1
Private Company (contracted by LA)	4.9
Private Company (contracted by water authority)	25.0
Other	14.0

## DISCUSSION

The results from the Local Authority survey confirmed the wide array of niches that facilitate the continued persistence of rat infestations in the United Kingdom. Several authors have underlined the need for an integrated approach to controlling rodent pests (Lambropoulos et al., 1999; Kaukeinen, 1994). However, the current arrangements in the UK may hamper the development and implementation of a strategic integrated pest management system. Whilst the continued use of rodenticides will certainly kill some of the rats, without complementary strategic measures to address the environmental factors of concern — such as external harbourage, defective drains/sewers, poor structural maintenance, and poor hygiene — rat numbers will quickly recover to pre-treatment levels.

The main statutory duties placed on Local Authorities for rat control are detailed in the Prevention of Damage by Pests Act 1949 (PDPA) and require Local Authorities to take such steps as may be necessary to secure so far as practical that its district is kept free from rats and mice and, in particular, a) from time to time to carry out such inspections as may be necessary for this purpose; b) to destroy rats and mice on land of which it is the occupier and otherwise to keep such land so far as practicable free from rats and mice and to enforce the duties of owners and occupiers of land under the statutory provisions as to rats and mice and to carry out such operations as are authorised by those provisions.

Whilst these powers seem to provide a useful platform to facilitate rat control, in practice there are inherent weaknesses. The PDPA does not provide Local Authority enforcement staff with automatic powers of entry to premises and, whilst some Local Authorities have augmented the powers specified within the PDPA with local legislative arrangements to circumvent this loophole, this procedure is by no means widespread and thwarts action to prevent or control infestations. The second fundamental weakness is that an infestation must be proven before Local Authorities can require action on owners. This weakness reduces the opportunities for proactive measures to reduce the likelihood of infestations becoming established.

Local Authorities identified the impact of defective drains and sewers in facilitating the continued survival and proliferation of rat populations. Since privatisation of the water authorities in the United Kingdom in the late 1980s, the complexities around the responsibilities and organisation for rat control in the sewers has increased. Although there is an agreed protocol (Local Government Association, 1999) setting out a more structured and informative way of working for the various stakeholders, the fact that only 65% of Local Authorities knew what control measures were being undertaken in their sewer system is cause for concern. Whilst there is evidence that some Local Authorities and Water Authorities are co-ordinating efforts, such coordination is by no means universal. A review of sewer control techniques and practices and the development of standardised operational protocols would help to ensure that a consistent approach was adopted.

Not surprisingly, many local authorities relied heavily on second-generation anticoagulants when undertaking treatments to control rats. Private pest control companies will also undertake treatments within urban areas, and there is no legal requirement for these two groups to share information on product usage. Many Local Authorities provide commercial treatment services to offset the charges associated with their public health work, and commercial confidentiality is likely to stifle information-sharing between public- and private-sector organisations. Without information on the products being used within different settings, effective strategies to manage anticoagulant resistance are difficult. The fact that repeated anticoagulant resistance has been confirmed in agricultural areas within the United Kingdom adds more urgency to the need for anticoagulant resistance management systems. To date, no testing of urban populations has been undertaken to confirm resistance status. In addition, little research has been undertaken to examine the potential health threats posed by rodents in the urban environment. If their control be-

comes increasingly more difficult because of the development of anticoagulant resistance, then the opportunities for the transmission of rodent-borne infections could increase.

This research underlines the need for a fundamental review of the way in which rat control is organised and delivered in the United Kingdom. A clearer overview of the roles and responsibilities of the key stakeholders needs to be considered. Mechanisms to encourage more effective environmental management programmes are essential and may require a review of the current legal powers. Management of the risks posed by rodent-borne infections requires an effective rodent control strategy that is able to co-ordinate control measures and evaluate treatments so that the reasons for control failures can be evaluated and where necessary ameliorated.

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