

Rodent infestations in domestic properties in England, 2001

A report arising from the 2001
English House Condition Survey

Prepared for European Wildlife Division, Defra
by Central Science Laboratory, York

July 2005

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Published by the Department for Environment, Food and Rural Affairs

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EXECUTIVE SUMMARY

RODENT INFESTATIONS IN DOMESTIC PREMISES IN ENGLAND

This report provides analyses of data on the infestation of dwellings by commensal rodents collected during the 2001 English House Condition Survey (EHCS). The rodents concerned were the house mouse and the Norway or brown rat. House mouse infestations inside properties and rat infestations both inside and outside have been considered.

The overall levels of infestation are 1.4% for mice inside dwellings, 0.3% for rats inside and 2.9% for rats outside. Infestation rates were generally higher in rural locations, as has been found in previous surveys.

FACTORS RELATED TO RODENT INFESTATION

Factors found to be related to infestation levels included dwellings where pets or livestock were kept in the garden; the degree of unfitness of the dwelling; the size of the plot and the level of problems in the area, such as dereliction, vacant properties and scruffy gardens.

COMPARISON WITH 1996 EHCS

Infestation rates were compared using both the longitudinal element of the survey, in which about 20% of dwellings were visited in both the 1996 and 2001 EHCS, and the full data from both surveys. The key points are:

- In 1996 the levels were reported to be 1.8% for mice inside, 0.4% for rats inside and 1.7% for rats outside. Thus the rates for both mice and rats inside are similar for 1996 and 2001 but the rate for rats outside is higher for 2001 than for 1996.
- The factors influencing rodent infestation in 2001 were similar to those for 1996 in terms of both location and property characteristics.
- The higher level of rat infestations outside dwellings in 2001 was general across the regions.
- This difference was evident in urban and rural locations but not in suburban ones. It was not evident at the highest housing density.

CONCLUSION

Overall the results confirm the 1996 survey in suggesting that commensal rodent infestation has two general forms. Firstly, there is infestation of older properties on large plots typically in rural areas. Secondly, there is infestation associated with properties that are unsatisfactory in terms of fitness and situated typically in urban areas with substantial problems. The keeping

of pets and livestock in gardens is also an important factor. The levels of mouse and rat infestations inside dwellings were similar in the 1996 and 2001 surveys but rat infestation outside dwellings was higher in 2001 than in 1996. It is not possible to eliminate entirely potential sources of bias that might lead to such a result, such as a greater likelihood of householders or surveyors detecting rodents. However, there are several reasons to suggest that the observed higher level of outdoor rat infestation in 2001 is a real effect. Firstly, any common source of detection or reporting bias would also be expected to be reflected in the reported levels for indoor mice and indoor rats and this was not the case. Secondly, that the difference was apparent in both urban and rural locations but not in suburban ones argues against a common source of systematic bias, as does the lack of increase at the highest housing density. It is possible that some common environmental factor, such as climate, to which rats are responding favourably, underpins the differences in both urban and rural settings. Alternatively, the increases in rural and urban settings may have different underlying causes. There is, however, always a danger in drawing strong inferences regarding trends based on only two data points. This will be addressed in due course. From 2002 onwards the EHCS has been carried out on a rolling annual basis. When these data become available more robust assessments will be made of temporal trends.

1: INTRODUCTION

This report provides information on the levels of rodent infestation found in and around domestic properties during the 2001 English House Condition Survey (EHCS) and compares these levels to those found during the 1996 EHCS. The report has five main sections - *Introduction, Levels of infestation, Factors related to infestation, Methods of control, and Comparison with the 1996 survey.*

COMMENSAL RODENTS

In England, the two main species of rodents that thrive in close proximity to human habitation are the house mouse, *Mus domesticus*, and the Norway or brown rat, *Rattus norvegicus*. These species represent potential threats to both human and animal health through transmission of a variety of diseases. It is thus important that commensal rodent populations are systematically monitored so that an objective measure of the risk can be gained. Furthermore, public concern is raised whenever changes occur that might lead to increases in rodent numbers. These changes can reflect rodent biology, such as the emergence of animals that are resistant to the effects of rodenticides, or socio-economic factors that impinge on rodent control practices and the quality of the habitats we create for commensal species. Hence, reliable data based on statistically valid surveys are required to place these concerns in a realistic and balanced context.

PREVIOUS SURVEYS

The English House Condition Survey (EHCS) is the only dwelling based survey undertaken in England. It provides a national and regional picture of the condition of the housing stock and how it changes over time. In 1996 commensal rodents were included in the physical survey undertaken as part of the overall survey programme, allowing analyses of the characteristics of dwellings that influence their susceptibility to rodent infestation. The results were reported in MAFF (1999) Rodent infestations in domestic properties in England: a report arising from the 1996 English House Condition Survey PB 4822. The inclusion of rodents in the 2001 survey has allowed a comparison of infestation levels to be made between these two snapshots in time.

SURVEY METHODS

The Physical Survey of EHCS 2001 was based on 26,300 properties, with adequate data obtained on approximately 17,500 of these. This gives a successful return of 67%, similar to

the 71% return for 1996. The numbers of properties for which data were available are shown in Table 1.1 tabulated by house type and by region.

Table 1.1. Number of properties surveyed tabulated by house type and region.

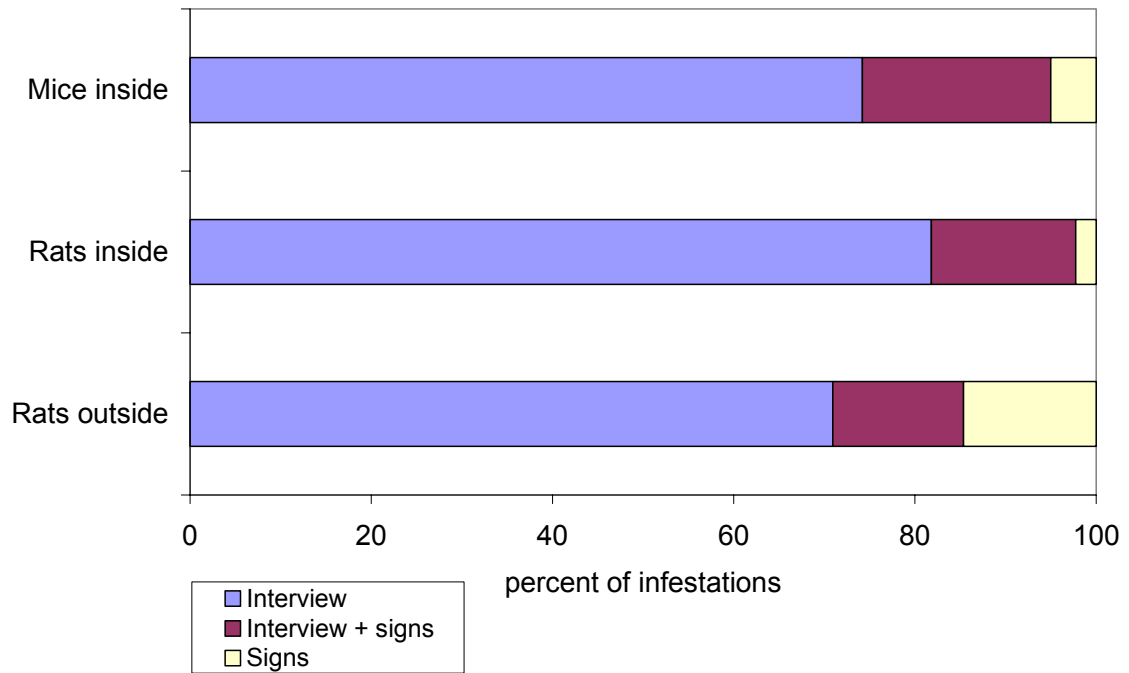
	End terrace	Mid terrace	Semi-detached	Detached	Purpose built flats	Converted flats	Others	Total
North East	238	505	799	155	332	40	0	2069
Yorks/Humber	217	424	669	220	336	34	1	1901
NW/Merseyside	272	568	670	174	327	44	0	2055
East Midlands	190	306	615	404	267	20	2	1804
West Midlands	207	334	549	233	335	28	2	1688
South West	208	327	510	410	275	56	5	1791
Eastern	181	297	502	358	291	23	4	1656
South East	199	285	505	368	366	49	6	1778
London	267	710	396	114	1045	258	0	2790
Total	1979	3756	5215	2436	3574	552	20	17532

During the Physical Survey, the occupier of the dwelling was asked a series of questions about pest problems they had suffered in the last twelve months. In addition, the surveyor looked for signs of rodent infestation, such as droppings, during the inspection. In the report on the 1996 EHCS, it was considered that since few householders keep exact details of infestations, data relating to the previous twelve months was not totally reliable. The authors therefore presented results that referred to infestations that were judged to be current at the time of the survey, either on the basis of information from the householder or on the evidence of signs. The present report follows this practice and refers only to infestations that were current at the time of the survey.

Although the detection of rodent infestation by signs was important in some situations, particularly vacant properties, the large majority of the infestations were reported by the householder (Figure 1.1). Perhaps not surprisingly, this was most marked where rats occurred inside the dwelling, with very few householders unaware that they had an infestation.

This recording of infestation showed a somewhat different pattern to the 1996 EHCS in which a greater percentage of the infestations were detected only by signs - approximately 20% of the indoor rat infestations, 30% of the indoor mice infestations and 40% of the outdoor rat infestations.

Figure 1.1 Sources of information for infestations of mice and rats inside homes and rats in outdoor areas.



2: LEVELS OF RODENT INFESTATION

This section considers the levels of infestation for mice inside properties and for rats both inside and outside properties. Mice (including wood mice and yellow-necked wood mice, as well as house mice) are not considered to pose any major problem when they occur in gardens, and so no analyses are shown for mice outside properties.

Table 2.1 Percentages of properties with rodents present. Percentages are weighted in order to accurately represent the proportions of different classes of properties in the English housing stock.

	Infestations inside properties			Infestations outside	
	Properties	Mice	Rats	Properties	Rats
Occupied homes	16676	1.4%	0.3%	13783	2.8%
Vacant properties	765	2.0%	0.1%	503	2.7%
Properties on farms	49	12.1%	3.8%	45	38.3%
Properties with some commercial use	42	0.0%	2.6%	13	3.4%
Total	17532	1.4%	0.3%	14344	2.9%

Table 2.1 shows infestation levels for mice inside the properties and for rats both inside and outside. The sample size (number of properties) is smaller for outside infestations since many properties (especially flats) do not have gardens. Separate figures are shown for properties on farms, properties with some commercial use and for vacant properties since they tend to have different patterns of infestation compared to ordinary residential properties. Some caution is necessary when comparing figures for vacant properties with those for occupied ones. Since most infestations are identified by talking to the occupier, infestation levels may be underestimated in vacant properties, although this may be counteracted to some extent by the absence of regular cleaning, which will make it easier for the surveyor to find signs such as droppings.

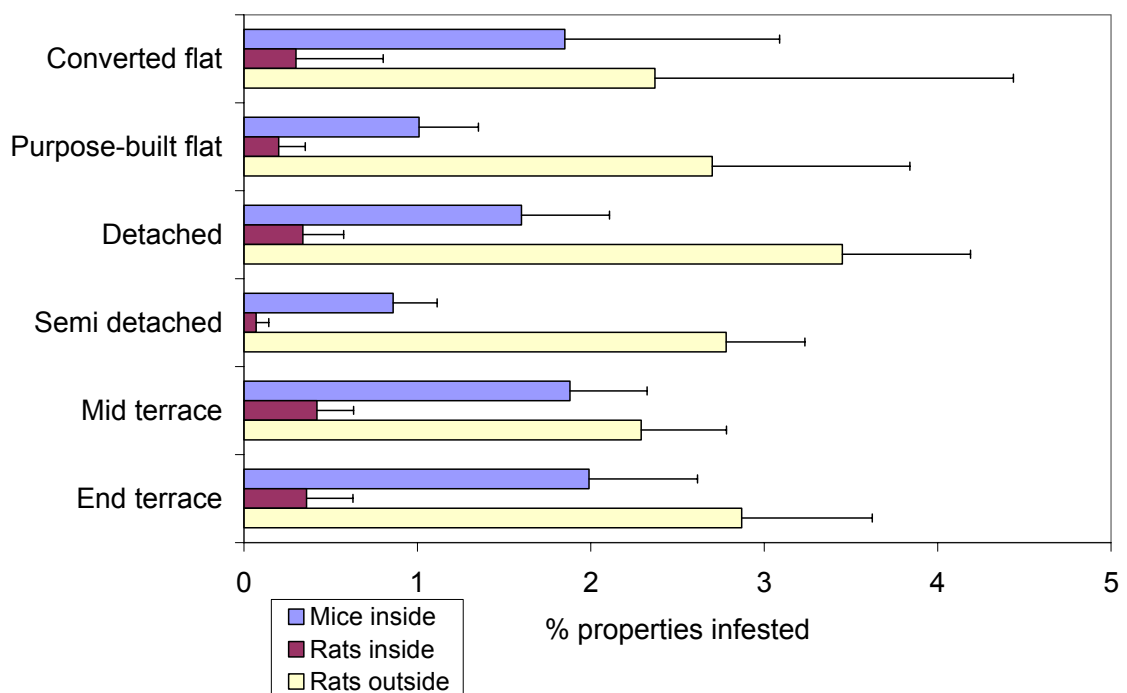
The overall levels of infestation are 1.4% for mice inside, 0.3% for rats inside and 2.9% for rats outside.

The remaining tables and figures in this report, except for Section 5, concentrate on domestic properties which are currently occupied and exclude the relatively small number of dwellings in the three other categories in Table 2.1 and also those whose type is classified as "Others" in Table 1.1, leaving a sample sizes of 16,659 for inside properties and 13,767 for outside.

TYPES OF DOMESTIC PROPERTIES

Purpose-built flats and semi-detached properties showed a lower level of mouse infestation inside (Figure 2.1) than the other types of property, which had similar levels of infestation. Semi-detached properties also had the lowest rate of rat infestations inside. Detached properties had the highest level of rat infestations outside but, generally, there were no marked differences in such infestations between the property types.

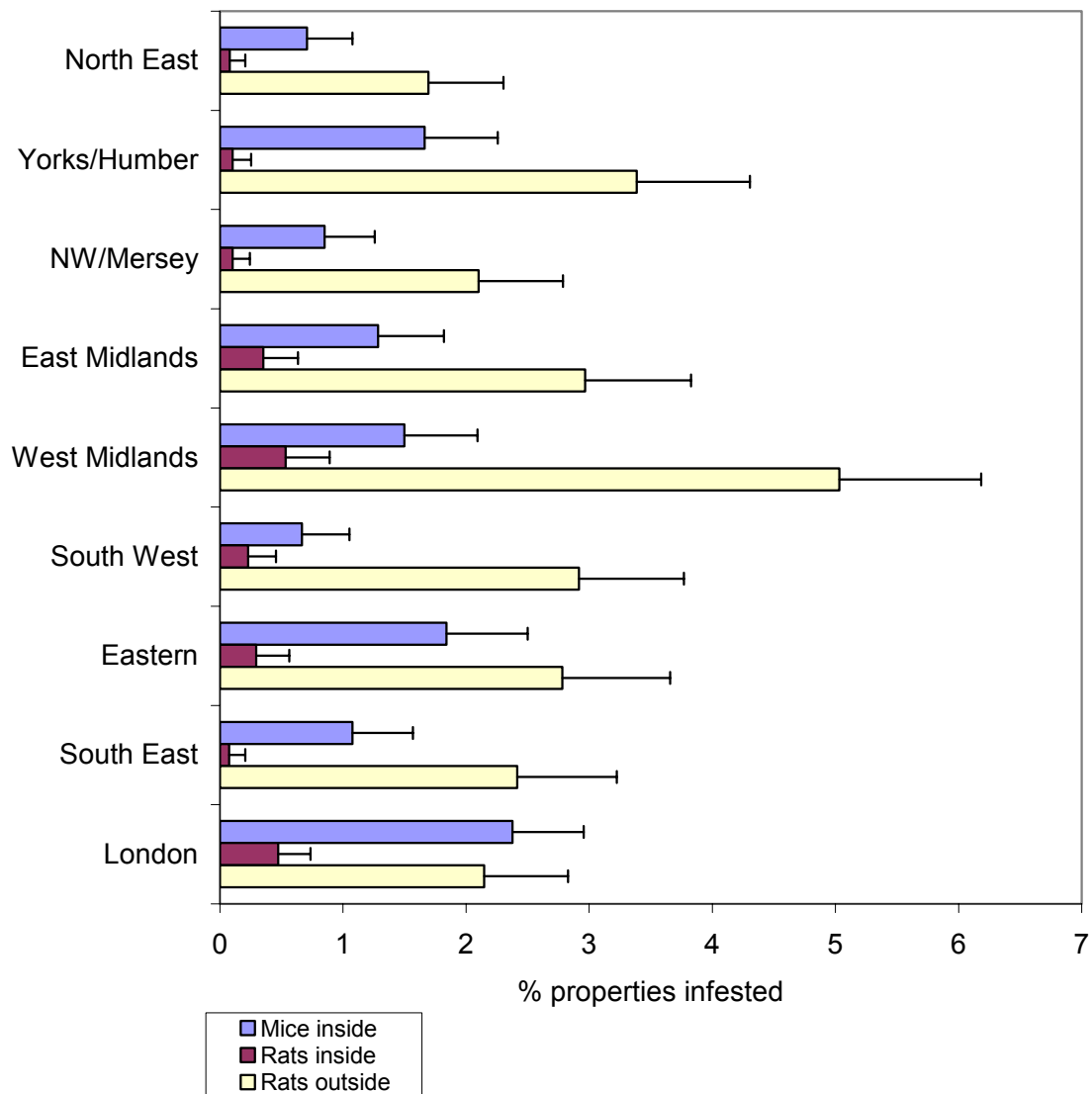
Figure 2.1 Infestation rates in different types of properties (bars are upper 95% confidence limits)



REGIONAL DIFFERENCES

There was variation apparent between regions (Figure 2.2), with mouse infestations most prevalent in London and rat infestations most prevalent in the West Midlands. However, some care is necessary in interpreting regional differences as all properties in a region will have been surveyed by a relatively small number of surveyors (typically 10-20). Regional figures are therefore more susceptible to errors caused by differences between surveyors than are the other tables in this report, and it is likely that this explains some, but not all, of the regional differences. In the absence of information on whether the same surveyors surveyed in the same regions in 1996 and 2001, it is unsafe to draw assumptions about apparent differences within regions between the two surveys.

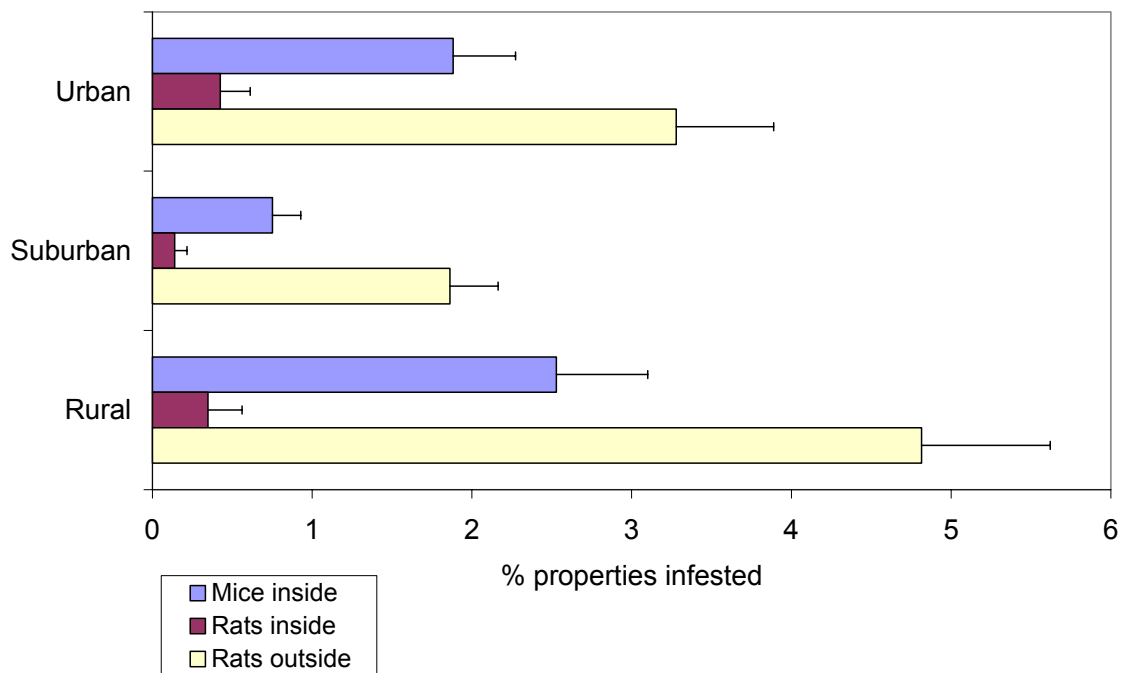
Figure 2.2 Infestation rates by region (bars are upper 95% confidence limits).



LOCATION

Properties were classified by the surveyor into a number of categories based on the nature of the surrounding area. In order to obtain adequate sample sizes these categories were amalgamated to form the groups 'urban' (the cores of towns and cities), 'suburban' (housing estates surrounding towns and cities) and 'rural' (isolated dwellings and houses in or around villages). Infestation rates were highest in rural locations and lowest in suburban ones (Figure 2.3). These differences were more marked than in the 1996 survey.

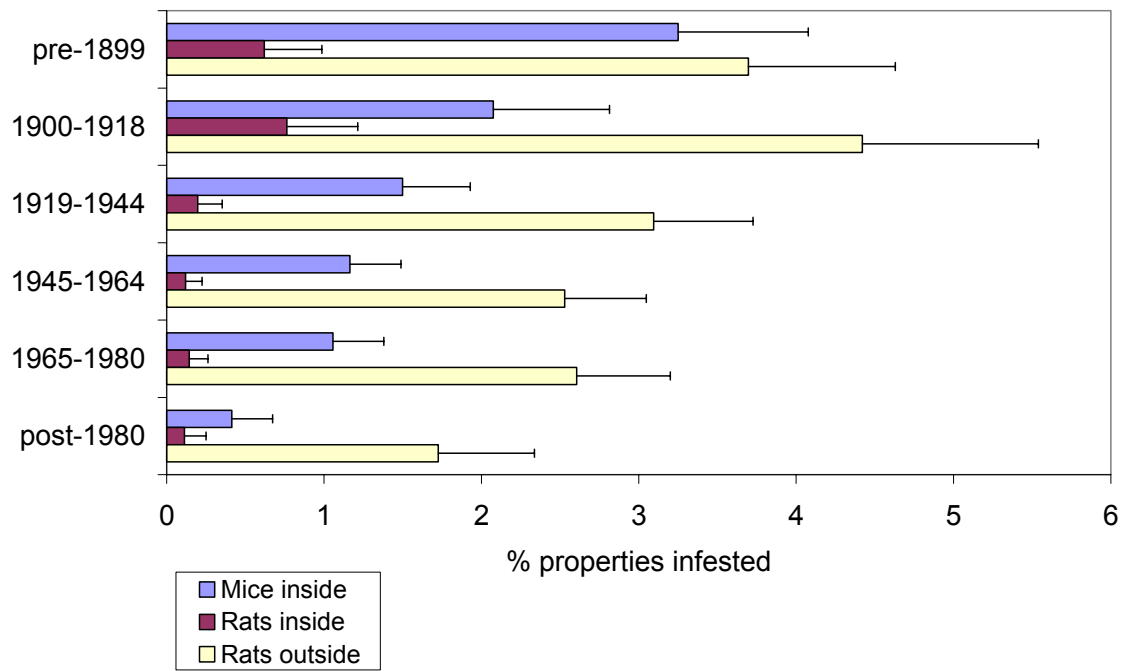
Figure 2.3 Infestation rates by location (bars are upper 95% confidence limits).



AGE OF PROPERTY

Infestation rates were higher in older properties for both mice and rats. Some, but not all, of this relationship can be explained by the tendency for many older properties to be in rural areas, and by the higher than average number of older properties that are in a poor state of repair.

Figure 2.4 Infestation rates by age of property (bars are upper 95% confidence limits).



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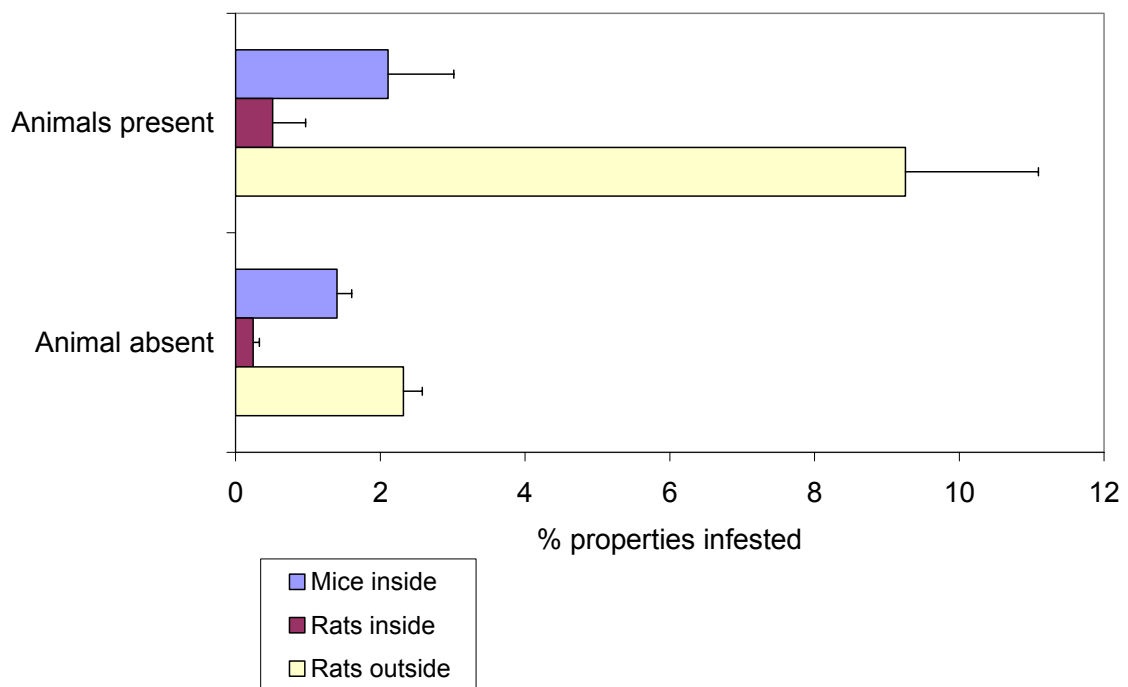
3: FACTORS RELATED TO RODENT INFESTATION

This section highlights some of the variables that showed strong correlations with the levels of rodent infestation.

PETS AND LIVESTOCK

Infestations of mice inside, rats inside and rats outside were all higher in those properties where pets or livestock were kept in the garden (Figure 3.1). This is partly, but not fully explained by the higher proportion of properties with animals in rural locations (see Figure 2.3). It is probable that the presence of pets and livestock makes infestation more likely by providing food and shelter for rodents outside the property.

Figure 3.1 Infestation rates according to whether pets or livestock were present in the garden (bars are upper 95% confidence limits).

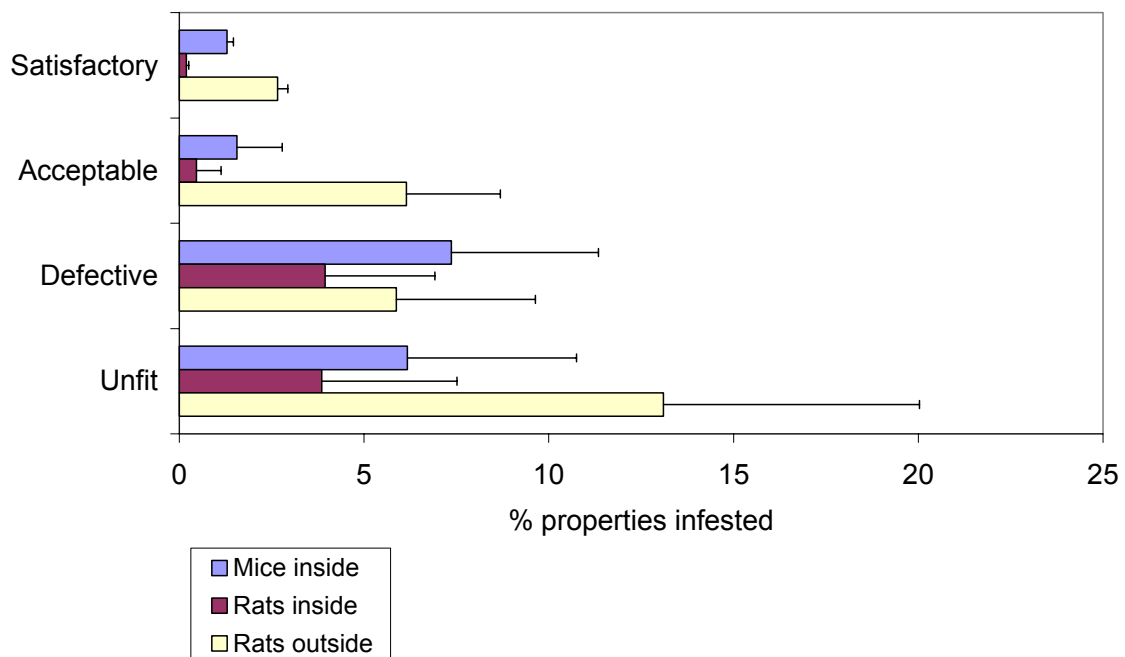


UNFITNESS

The EHCS records several hundred variables relating to the condition of the properties surveyed. Inevitably there are strong relationships between many of these variables since, for example, poor maintenance will manifest itself in many ways. The overall 'fitness assessment', which assesses whether dwellings fail to meet one or more of nine statutory requirements, was categorised into four levels in the 1996 EHCS. These were not available for the 2001 data. Therefore for this report four fitness levels were created based on ten different aspects of fitness which were classed as either fit or unfit in the survey. The four categories were zero, one, two and three or more aspects of fitness classed as being unfit. These are named 'satisfactory', 'acceptable', 'defective' and 'unfit' respectively.

Infestations were clearly higher in the unfit category than in the satisfactory one (Figure 3.2).

Figure 3.2 Infestation rates by an overall fitness assessment of the property (bars are the upper 95% confidence limits).

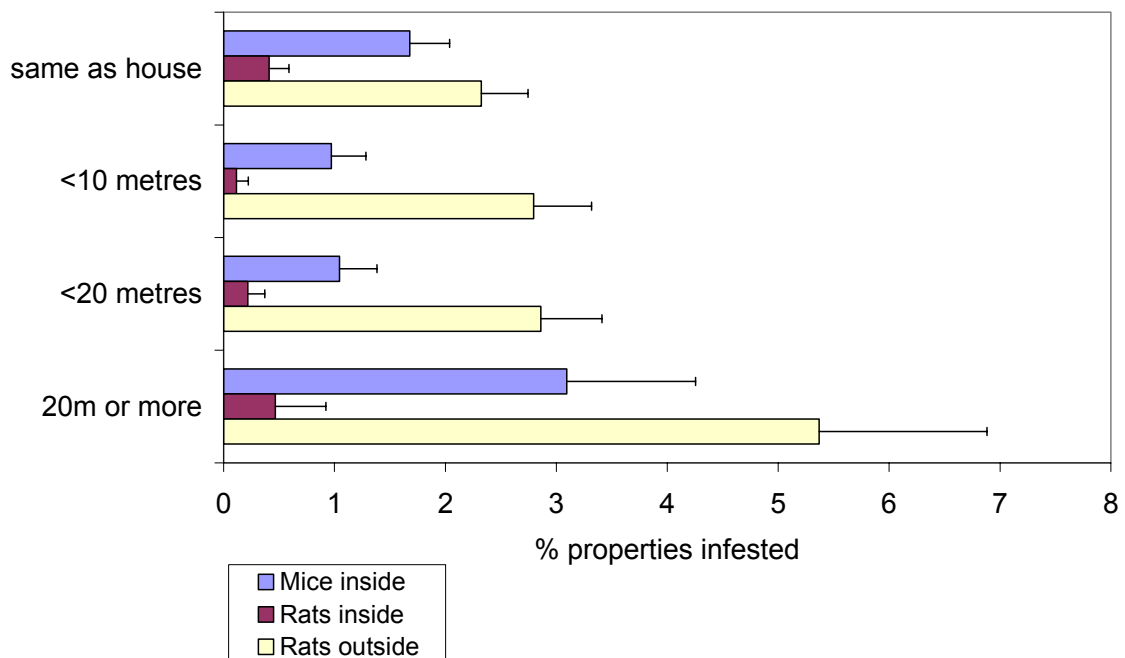


There was some evidence that defective drains were linked to outdoor rat infestation. This is of particular interest given the possible link between above ground rat problems and rats living in sewer systems. However, there is need for caution in inferring that the result stems directly from such a link. Firstly, the result was on the cusp of statistical significance. Secondly, the sample size was particularly small for properties with defective drains. Thirdly, a similar trend was apparent for indoor mouse infestation and mice are not considered to be common inhabitants of sewers.

PLOT WIDTH

Properties were categorised according to the width of the garden or plot surrounding the house. The infestation rate for rats outside was similar for the three smallest categories but then much higher for the widest plots (Figure 3.3). Mouse infestations inside were also most common in the widest plots, although they were also more common in the narrowest plots than in the two middle categories. Part of this can be explained by factors such as the presence of pets or livestock in larger gardens. Another reason, not discernable from the survey data, is likely to be a combination of mature vegetation and outhouses/sheds providing suitable rodent harbourages.

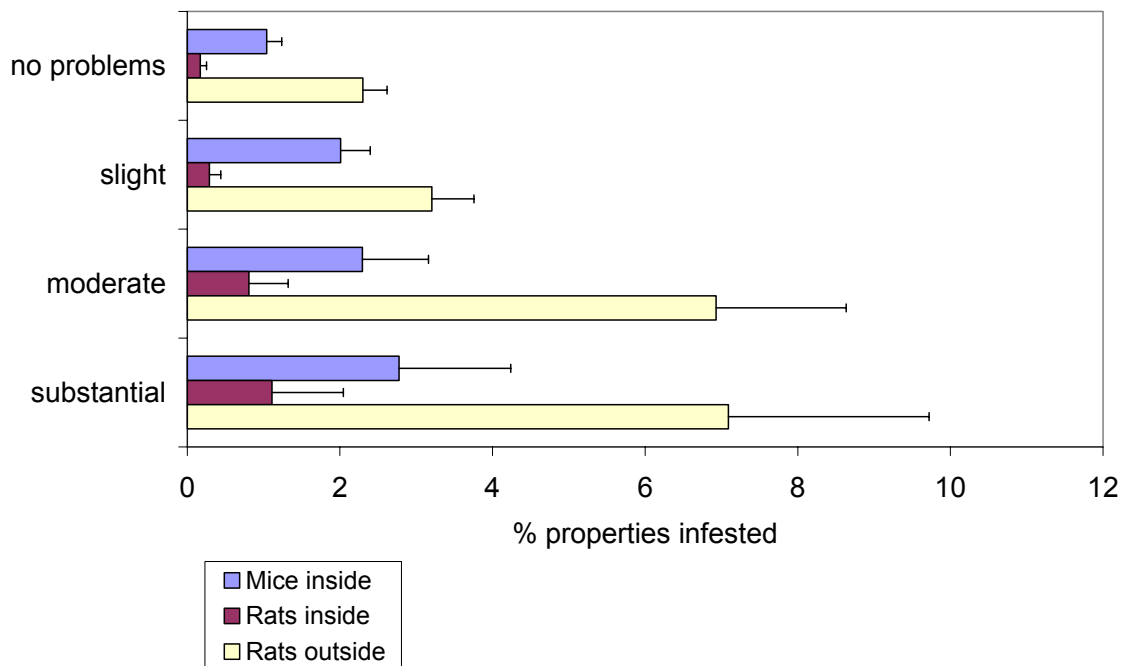
Figure 3.3 Infestation rates by plot width (bars are upper 95% confidence limits).



PROBLEMS IN THE AREA

Several types of problem in the area, such as litter, neglected buildings, scruffy gardens, vacant buildings and vandalism, were scored by the surveyors on a scale of 1 to 5. Six of these were combined to produce overall problem ratings. The infestation levels show an increase as the problem level increases (Figure 3.4).

Figure 3.4 Infestation rates by severity of problems in the area (bars are upper 95% confidence limits).



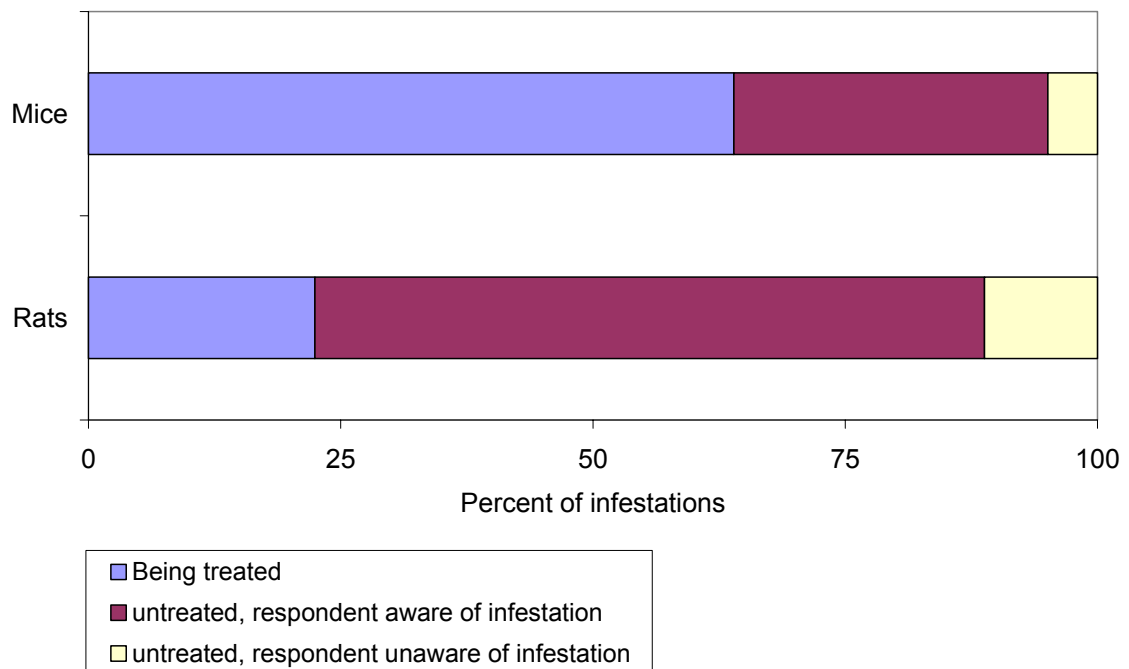
4: METHODS OF CONTROL

This section looks at whether current infestations were being treated, what methods of treatment were being used, and who was conducting the treatments.

TREATMENT OF INFESTATIONS

A higher percentage of mouse than rat infestations were being treated at the time of the survey (Figure 4.1). This may be because the mouse infestations were inside whereas most of the rat infestations were outside. The percentage of mouse infestations being treated was similar for each type of property listed in Figure 2.1.

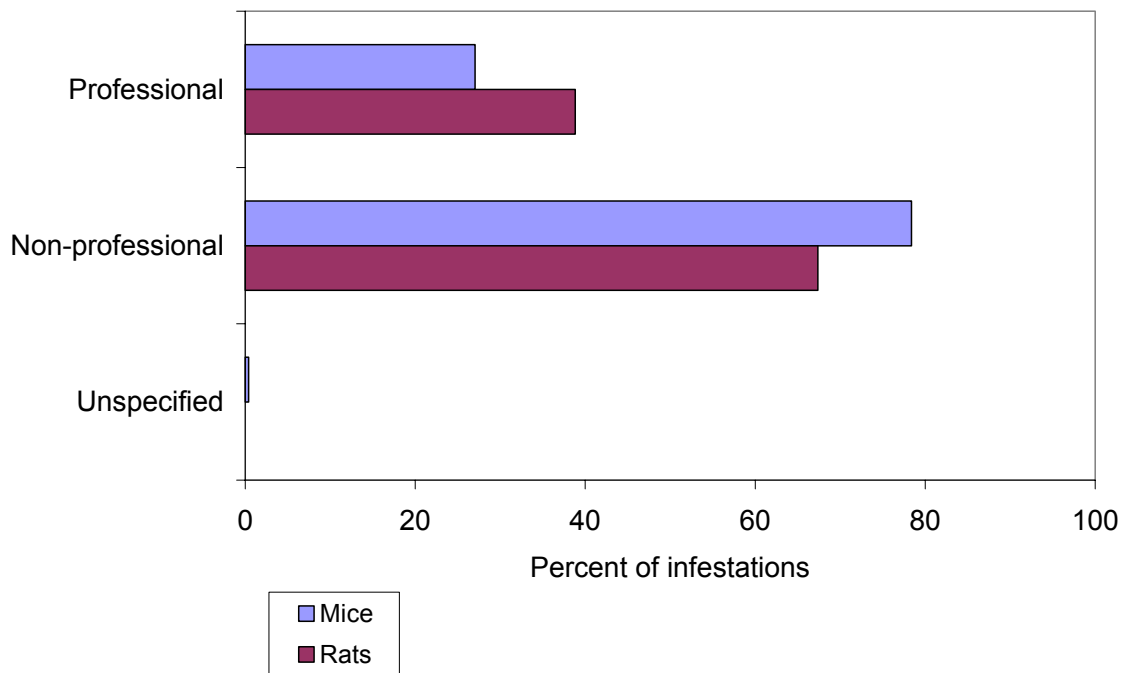
Figure 4.1 Percentage of rodent infestations that were being treated at the time of the survey. Those that were not being treated are subdivided according to whether the respondent was aware of the infestation.



PERSONS CARRYING OUT THE TREATMENT

For both mice and rats more infestations were treated by non-professionals, such as the occupier or landlord, than by professionals, such as the Council or pest control company (Figure 4.2). This was more pronounced with mouse infestations.

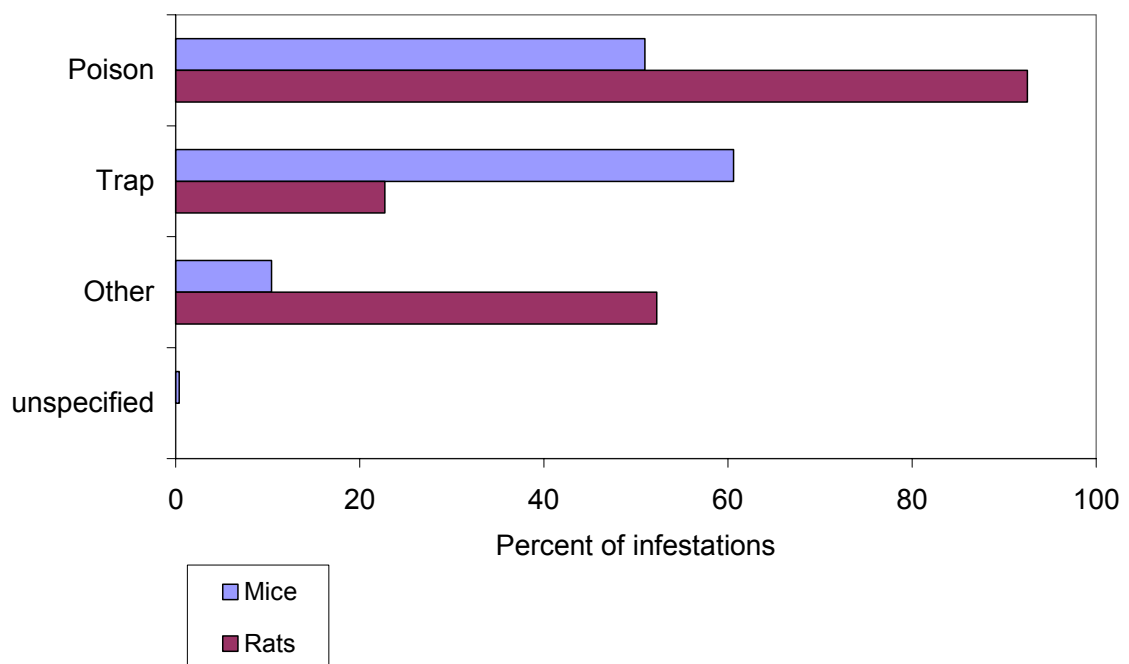
Figure 4.2 Whether control of infestations was carried out by a professional rodent control operative (local authority or commercial company). Numbers are expressed as a percentage of those infestations currently being treated. Percentages may sum to more than 100%.



METHOD OF TREATMENT

Poisons were more commonly applied against rats than against mice and traps were more commonly used to control mice than rats (Figure 4.3). Traps and poison accounted for almost all mouse treatments but other methods were commonly employed to control rats.

Figure 4.3 Methods of control as a percentage of current infestations being treated. Percentages may sum to more than 100% as poisons and traps can be used in combination.



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5: COMPARISON WITH 1996 INFESTATION LEVELS

OVERALL INFESTATION LEVELS

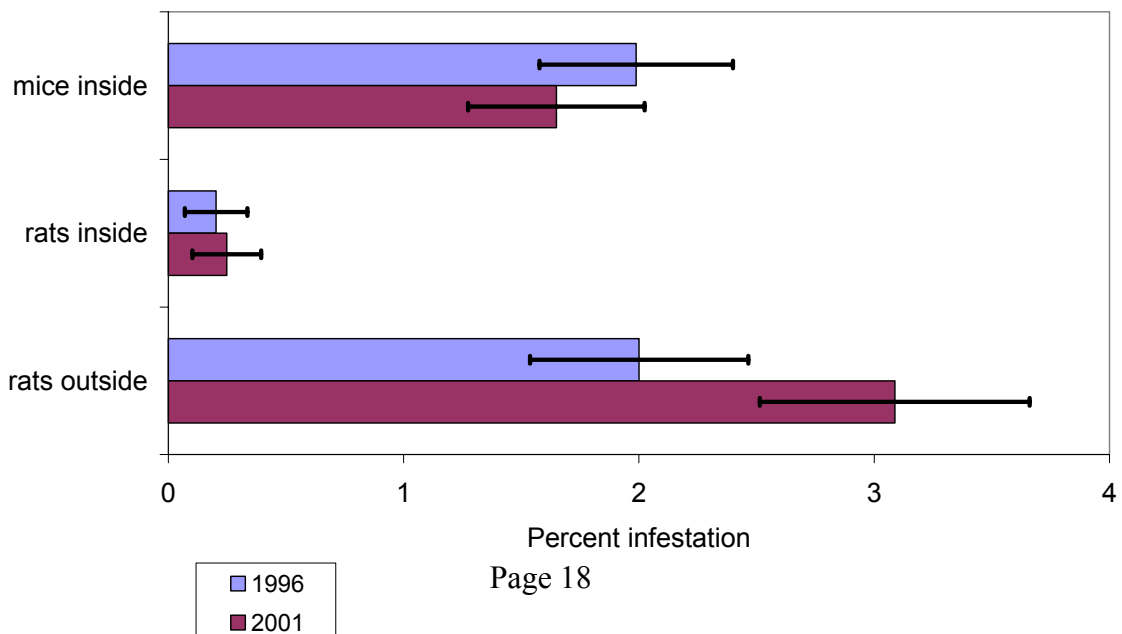
The overall levels of infestation found in 2001 were 1.4% for mice inside, 0.3% for rats inside and 2.9% for rats outside. In 1996 the levels were reported to be 1.8%, 0.4% and 1.7% respectively. Indoor levels of both species are thus similar between surveys, with overlapping confidence intervals, whilst outdoor rat infestation is higher for 2001. It should also be born in mind that the 1993 National Rodent Survey reported that 4.4% of properties had outdoor rats, although the methodology for this survey differed from the EHCS.

LONGITUDINAL COMPARISON

Approximately 20% of the properties in the 1996 EHCS were included in the 2001 survey as a longitudinal element to allow a direct comparison between the two years. The number of properties for which infestation information was collected in both years was 4,426. In the following, percentages are based on this total number of properties and are not weighted to allow for the different sampling intensities used for different types of properties.

The direct comparison between the same properties yields very similar results to comparisons between the overall surveys. The percentage of properties with mouse infestations inside was similar for the two years (Figure 5.1) and rat infestations inside were similar also. However, rat infestations outside were higher in 2001 than they were in 1996. That this difference was apparent only for outside rats suggests that this was not due to some general systematic bias between the surveys, such as an increased likelihood of householders or surveyors detecting rodent presence.

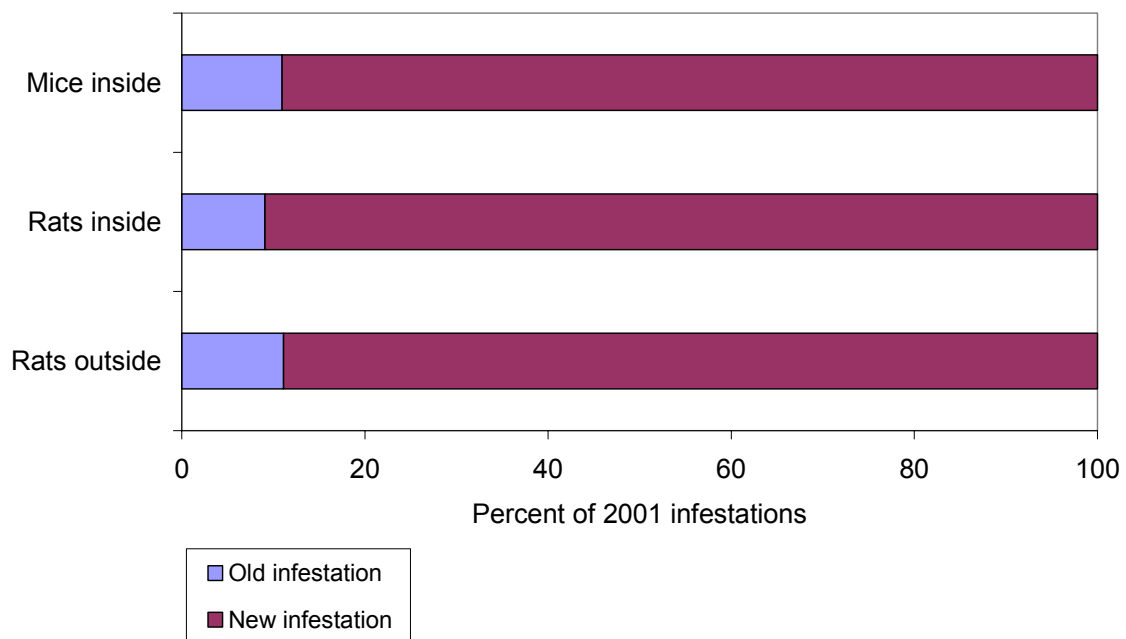
Figure 5.1 Percentage infestation in those properties which were visited in both 1996



and 2001 (bars are 95% confidence limits).

For each property with an infestation in 2001, the data were checked to see whether an infestation was present in 1996 also. Rats inside were included in these checks although the number of infested properties involved was extremely small. For each of the three types of infestation approximately 10% had been infested in 1996 while the remaining 90% were new infestations (Figure 5.2).

Figure 5.2 Percentage of rodent infestations detected in 2001 that were detected previously in 1996 (old infestations) or not detected in 1996 (new infestations).



The 2001 infestation levels in properties that were not infested in 1996 were approximately the same as the overall levels but the percentages for properties previously infested were considerably higher (Figure 5.3).

RATS OUTSIDE PROPERTIES

To ascertain whether the higher level of rat infestations outside was a general difference or limited to particular regions or density of housing, the full datasets (restricted to properties with gardens) for 1996 and 2001 were compared. The percentages given in the following are weighted to allow for the different sampling intensities used for different types of properties.

To simplify matters and produce larger sample sizes, the regions listed in Figure 2.2 were grouped into North, Midlands and South, with London kept separate. The resulting infestation levels for rats outside show similar patterns for the two years, with higher levels of infestation in 2001 across the regions (Figure 5.4).

Figure 5.3 Infestation levels in 2001 categorised by whether or not properties were infested in 1996.

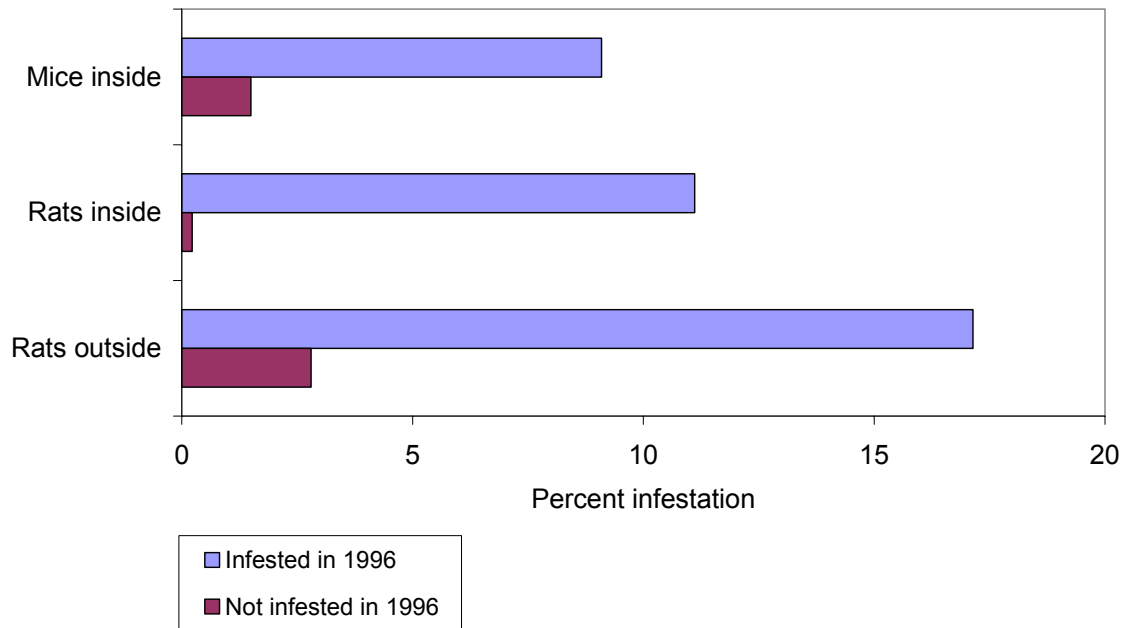
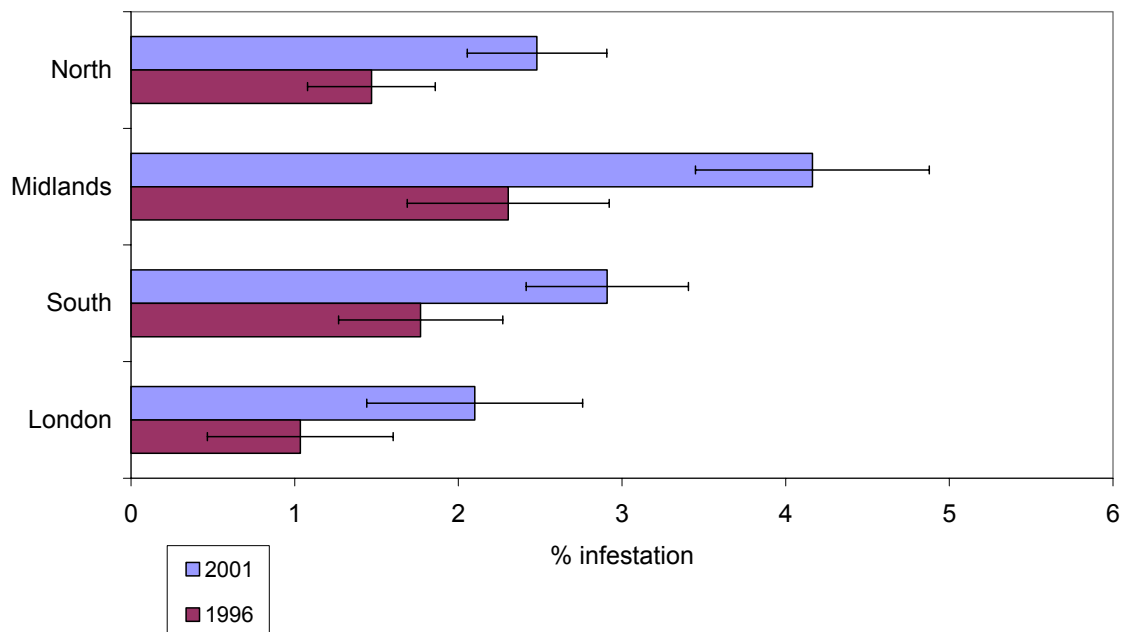


Figure 5.4 Infestation rates of rats outside properties for different regions of England in 1996 and 2001 (bars are lower and upper 95% confidence limits).



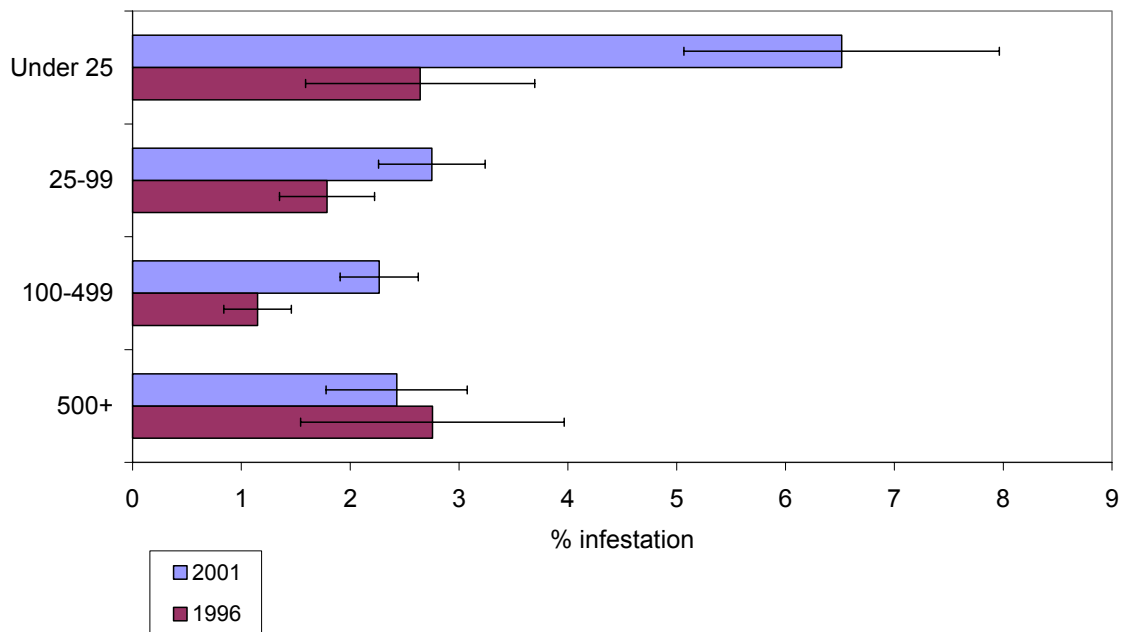
The number of dwellings in the immediate area of a property was used as a measure of housing density to see whether this was related to the higher level of rat infestation outside in

2001. At the highest density grouping (500+) there is no difference between the two years but at all the lower densities there is an increased level of infestation (Figure 5.5).

The relationship with the location of properties, categorized as urban, suburban or rural, was investigated also. In suburban properties the level of rat infestation outside does not differ between the two years (Figure 5.6). However, in both urban and rural properties the infestation rate for 2001 is substantially greater than that in 1996.

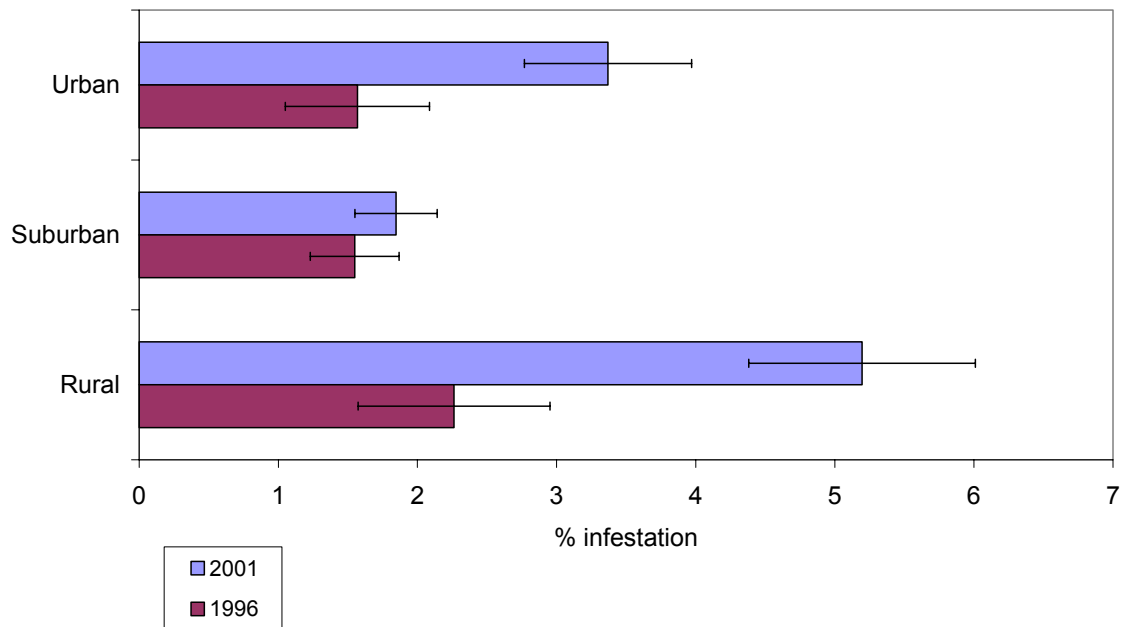
Thus the difference between surveys in rat infestation outside is general to all regions but mostly restricted to urban and rural locations. It seems unlikely that changes in sewer rat management or provision of hygiene services would have such similar consequences in both rural and urban settings. That the difference is apparent in both urban and rural settings suggests that there is some common environmental factor, such as climate, to which rats are responding to favourably. Alternatively, the increases in rural and urban settings may have different underlying causes. There is, however, always a danger in drawing strong inferences regarding trends based on only two data points. This will be addressed in due course. From 2002 onwards the EHCS has been carried out on a rolling annual basis. Analyses of these data will enable a more robust assessment of temporal trends in infestation.

Figure 5.5 Infestation rates of rats outside properties for different housing densities



(bars are lower and upper 95% confidence limits).

Figure 5.6 Infestation rates of rats outside properties categorised as Urban, Suburban or Rural (bars are lower and upper 95% confidence limits).



ANNEX: STATISTICAL METHODOLOGY

All infestation percentages for 2001 shown in this report are weighted to allow for the different sampling intensities used for different types of properties, either by design or due to non-response.

Bar-charts also display the upper 95% confidence limit. A lower limit can be imagined as an equivalent distance below the estimated percentage; the lower limit is not shown as this would clutter the chart. These limits are needed because of the uncertainty in selecting the sample; put crudely, there is no way of knowing whether the sample of properties surveyed were typical, or whether they contained an unusually large or small number of infestations. Thus the true percentage infested is unknown, but the size of the bar represents the best estimate, and there is a 95% probability that the true figure lies between the lower and upper confidence limits.

The method used for calculating the limits is based on estimating the variance of the estimate according to the formula:

$$\text{variance} = p \times (1-p)/n$$

where p is the proportion (%/100) and n is the unweighted sample size

The standard error of the percentage is the square root of the variance and the width of the 95% limits is 1.96 times (1.96 is the appropriate percentage point of the normal distribution) the standard error in each direction. This method is an approximation because it assumes that the percentages are normally distributed and because it ignores the effect of unequal weights. It is however the best method of giving a guide to the variability inherent in the results, without having to display both lower and upper limits.

In the comparisons of the 1996 and 2001 infestation levels, using the subset of properties which were visited in both surveys, the percentages are not weighted - they are the straightforward proportions of visited properties that were recorded as being infested. The confidence limits for these percentages were calculated as described above. In view of the high degree of churning in the infestations (the great majority of infestations detected in 2001 were in properties in which they were not detected in 1996) the results from the two surveys were treated as though they were independent samples and both Pearson chisquare tests and logistic regression were used to test whether the differences were greater than might be expected to occur by chance.