COMMENSAL RODENT CONTROL: CHALLENGES FOR THE NEW MILLENNIUM

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Abstract - Predictions for world human population trends predict exponential growth. The close relationship between commensal rodents and human populations suggests that the commensal rodent population may also increase exponentially, perhaps most dramatically in those areas which are least able to cope. The paper identifies a number of challenges relating to both the need for further research and development of effective control techniques and the co-ordination and application of the results of this research on a world wide basis. The need for effective identification of the cost benefits of control is identified as a catalyst for the development of more effective rodent control strategies.
Key words - Commensal rodents

INTRODUCTION

Perhaps the two most significant advances in rodent control over the last century have been firstly the development of rodent control as a science with the work of Chitty and Southern at Oxford in the 1940s. Since then we have learnt a great deal about the behaviour and biology of the rodent species with which we come into conflict, we understand at least something of the way in which they behave and are able to target our control. The other great step forward was the development of the anticoagulant (chronic) rodenticides, which revolutionised the control of rodents.

The new millennium

With some 2,000 rodent species worldwide it is important to identify exactly what it is that we are talking about. The Oxford English Dictionary defines "commensalism" as an association between two organisms in which one benefits and the other derives no benefit or harm. The commensal rodents benefit from their association with man, but man will suffer significantly from this association. Possibly a redefinition of the term commensal rodent is called for. The term "cleptoparasitic", a parasitic thief, may better define the relationship.

The close association with man which gives those species which we term as commensals their ecological advantage. Some of those species which are broadly term as commensal include, *Rattus norvegius, R. rattus, R. exulans, Bandicota bengalensis*, *Mastomys natalensis,* and *Mus* spp. Some of these are distributed on a worldwide basis and others on a more localised basis. These species have benefited as human populations have increased and as transport systems have developed.

Commensalism in rodents is created by man and is seen at its most extreme in those situations where human habitation (urbanisation) is at its densest and where agricultural intensification is in progress. Commensal rodent populations do best where that urbanisation is least structured and where the facilities which support human populations, such a sewage and waste disposal and quality of housing, is least effective. Even relatively structured urbanisation supports commensal rodents, but here the levels of infestation, perhaps at around 10% of properties, is not as intense as those area where structure and support facilities are less and where levels of infestation can reach 90%. Any consideration of rodents and the new millenium, the status of the human populations will have to be considered, and here there is little doubt as to the potential challenges that will confront us.

World human populations are set to rise exponentially over the coming decades, from 5,716 million people in 1995, 6,158 million in 2000 and 8,294 million people in 2025! Whilst this world increase is impressive enough, what is of even more concern is that this increase is not spread evenly. Increases are

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set to be at their lowest in those areas where arguably the resources are most available and highest where these resources are presently least available.

The implications for the rodents, whose relationship with human populations is broadly if not specifically defined, is clear. We can expect corresponding exponential increases in the rodent populations, particularly in those areas where we are least able to control them and where the contact rates between humans and rodents is at its highest. The resulting impact on the infective status of the rodents is not clear, the potential for significant if not catastrophic impacts on the associated human populations cannot be ignored.

The new millenium will bring a greater need to develop effective rodent control systems. Are we likely to be able to meet this need and if we are to be prepared, what are the challenges relating to control that we will have to face?

The challenges

The reasons to control rodents are broadly summarised as: prevention of the spread of disease, reduction of damage to agriculture, reduction in losses to post harvest and processed food, reduction in structural damage. A problem arises when any effort is made to try to quantify the problem. Rarely is it possible to identify the actual levels of loss, damage or disease related to rodent infestations, and attempts to predict or calculate the cost benefits of control operations are difficult. Often resources are only available to those who can identify the cost benefit of any programme. The absence of good data on the levels of loss and damage from rodent infestation frequently prevents further progress.

There is ample evidence of the range of diseases potentially transmitted by rodents or for which rodents act as a significant vector (Gratz, 1988). In some areas there is localised knowledge of the impact of a particular disease transmitted by rodents on the human population. But seek this data on a wider basis, for a range of diseases, or for a whole city or even a small town and it is rarely available. The social and financial costs of such diseases, both on the human and livestock populations cannot therefore be determined. Until recently the confirmed relationship, between Norway rats and rodent borne diseases in the United Kingdom was limited, and specific infection levels were not available. In the early 1990s research at Oxford University has extended knowledge of the range of diseases carried by rats on English and Welsh farms. This research has confirmed some but also identified a range of additional diseases with which the rats were infected and which have been known to cause infections in humans.

The most important part of this research is that it points to the presence of diseases in rats which whilst causing significant concern when detected in human cases, have not previously been closely associated with Norway rat populations. Their presence on farms, where the human food chain starts and where rat populations may be most significant. The very high levels of infection of Cryptosporidiosis, Toxoplasmosis and Q Fever in these rat populations is of concern. The detection of the Hantaan virus (4%), Listeriosis (11%) and Pasteurellosis (6%) must be of concern. No rats were found on any of the farms from which isolates of *Salmonella* sp. were obtained, highlighting the difficulties of determining the epidemiology of zoonoses.

The financial impact of the other forms of rodent damage are rarely identified in any detail. The absence of any sound data on the social and cost implications of rodent damage mean that the potential cost benefits are unclear and thus all too frequently the financial support for rodent control is not made available. Here therefore must lie the first of the challenges for the new millennium. We must identify more clearly what the problem is, we must identify more clearly what the social and financial implications of infestation involve. We can then start to identify with more clarity the cost benefits of rodent control operations.

COMMENSAL RODENTS FIGHT BACK

Traps

It is becoming increasingly clear that the rodents are fighting back. Perhaps this is not surprising for a group of mammals which have perfected the art of survival over some 150 million years. If we look

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at the techniques we use to control rodents, not a great deal has changed in the last few hundred years. Great reliance is still placed upon the use of trapping techniques which either kill the animal outright or capture them live. The most common form of trap, the break back trap remains a relatively inefficient form of control. Break back traps are not only very labour intensive in their use, but they are good methods for inducing avoidance. Rodents which may be exposed to the dramatic and painful attentions of a break back trap, but still survive the experience, will learn from the experience and will be far less likely to expose itself to a similar risk again.

Exposure to forms of sticky or glue traps will induce avoidance in survivors, but remain relatively inefficient and labour intensive in use. Trapping techniques, including live capture, may have a roll to play in localised infestation control, but will have relatively little roll in any extensive control programme.

Neophobic behavior

The problems we face with overcoming the protective nature of the rodent natural, learned and adaptive behaviour also causes problems in other ways. However good a rodenticide we may have, it will remain ineffective if we cannot persuade the rodents to eat it! The naturally protective neophobic behaviour of some rodents and the equally protective unpredictable behaviour of others continues to lead to the failure of control programmes. Presenting edible rodenticides in a place where they are not only safe but also likely to be eaten by the rodents has been shown to be a continuing problem. The reluctance of Norway rats to enter bait containers (Quy *et al.*, 1996), particularly in stable and predictable environments results in control failure. The question that should be asked is whether the levels of behavioural intensity which we currently experience have always been with us? Have we, with our intensive application of almost identical control techniques over time, led to the selection of higher levels of neophobia or increased unpredictability?

It is clear that in the United Kingdom the long term application of similar bait bases for house mouse (*Mus musculus*) has led to difficulties with control. Failure to control many populations in central urban areas (London, Birmingham, Manchester) has been linked to a reluctance to feed on bait bases containing cereals (Humphries *et al.*, 1996). The reluctance has been associated with unusually low levels of a amylase, an enzyme associated with the digestion of these cereals. Failure to digest the cereals when eaten leads to discomfort which in turn leads to future learned avoidance of these cereals and hence failure to be exposed to the toxicants in cereal based baits. The implication is clear, continued long term application of the same control technique leads to the selection of avoidance mechanisms. All these points raise the central issue of the need for continuing research. We are far from understanding the true behavioural and adaptive versatility of the rodent species with which we deal.

A further challenge therefore presents itself, that those who both undertake and fund research understand the need for continuing work in this area. It is essential however that such research is targeted at both wild populations of commensal rodents and at the problems which are encountered in the field. A closer relationship between academic research and rodent practitioner is essential. In addition, since the very nature of the rodent problem is an international one, the research response is best co-ordinated on an international basis. It is not enough to simply share the results of isolated work at irregular conferences. The opportunities presented by the potential for co-operation within the European union and with North America must be taken.

Resistance

The significance of the development of the anticoagulant rodenticides has been the most significant development in commensal rodent control this century. The benefits we derive from their availability may not last forever. It is clear that as with so many other pesticides used continuously over long periods of time, the target species are fighting back and are increasingly becoming resistant. The intensive use of anticoagulants over the last fifty years in the United Kingdom can act as a indicator for others in the future. As far as house mice are concerned, it is already accepted that the use of any first generation anticoagulants in the United Kingdom will largely be a waste of time. Resistance levels and

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the extent of the resistance result in such high rates of treatment failure that their use is no longer recommended. Resistance to at least some of the second generation anticoagulants is also present, although lack of monitoring and confusion with the behavioural resistance mentioned earlier confuses the true picture.

As far as Norway rats are concerned the picture is clearer. Whilst certainly not present over the entire United Kingdom, there is extensive resistance to both first and some of the second generation anticoagulants. In some rural areas in central southern England, it is now proving very difficult to control rats on some farms with the anticoagulant rodenticides which can legally be used out of doors. High levels of resistance to all the first generation anticoagulants and to both bromadiolone and difenacoum is widespread. The continuing use of anticoagulants as rodenticides of first choice is likely to lead to the extension of both the areas where resistance is to be found and the levels of resistance within populations. It is likely that the days of the anticoagulants is numbered in these high resistance areas. A further challenge must be to develop resistance management strategies in an attempt to minimise or delay the development of rodenticide resistance. In addition, new rodenticides with novel modes of action will be required. A challenge to both governments and industry.

It is essential that the trend towards increased restriction on the use of rodent control techniques is considered in the context of the need to control rodents. We have an ever increasing amount of data on the effects or potential effects of rodenticides for instance on the environment, their use may then be restricted or prohibited. We know much less about the effects of uncontrolled rodent populations on the environment! The balance needs perhaps to be redressed.

CONTROL STRATEGIES

Perhaps one of the most disappointing aspects of rodent control over the last thirty years is the failure of both local and central governments to address such a collective problem in a collective way. When dealing with pest species which are both mobile and utilise so many aspects of their habitat, the only cost effective method of controlling them is to adopt a proactive rather than a reactive approach to control. This requires a central support and organisation if it is to be effective.

The benefits of such centralised approaches have been demonstrated a number of times (Drummond *et al.*, 1977), but perhaps most dramatically and recently in Budapest (Bajomi, 1997). It should not be seen as a challenge to ask that such collective approaches become the rule rather than the exception, but it looks as if it has to be seen as one of the most significant challenges of all.

CONCLUSION

If there is a central theme to this paper it is that the commensal rodent problem is a common problem, even the species which cause the problem are largely the same. It is not only present on a world wide basis, but the problems that the rodents cause area also similar throughout the world. In addition the problems which are encountered with respect to the control of rodents are similar. They may differ in their extent and the degree to which they have developed, but they are essentially the same. Perhaps then greatest challenge is not simply to develop solutions to some of these problems, but to do this in a shared way. If we do not manage to do this, then it is likely that we may also have to share the direct and indirect consequences of our failure.

REFERENCES CITED

Bajomi, D., C. Guthy, and T. Markos. 1997. Efficacy of Large Scale rat and cockroach control actions in Budapest as shown by experiences over a 23 year period. In K.B. Wildey, ed., Proc. 2 Int Conf on Insect Pests of the Urban Environment, Edinburgh, Scotland.

Drummond, D. C., E. J. Taylor, and M. Bond. 1977. Urban Rat Control: further experimental studies at Folkestone. Environ Health 85 (12):265-267.

Proceedings of the 3rd International Conference on Urban Pests.
Wm H. Robinson, F. Rettich and G.W. Rambo (editors). 1999.

Gratz, N. G. 1988. Rodents and human disease: a global appreciation. In I. Prakash, ed. Rodent Pest Management. CRC Press, Boca Raton, pp. 101-169.

Humphries, R. E. 1996. The characteristics of “behavioural resistance” and bait avoidance in house mice in the UK. Brighton Crop Protection Conference - Pest and Diseases, pp157 - 164.

Quy, R. J., D. P. Cowan, C. Morgan, T. Swinney. 1996. Palatability of rodenticide baits in relation to their effectiveness against farm populations of the Norway Rat. Proc. 17th Vertebr. Pest. Conf. R.M.Timms and A.C. Crabb, eds. Pub Univ of Calif.,Davis.

Webster, J. P. 1996. Wild brown rats (*Rattus norvegicus*) as a zoonotic risk on farms in England and Wales. Communicable Diseases Report 1996; Vol 6 Review No 3: R46 - R49.