23. Ecologically-based Rodent Management in Developing Countries: Where to Now?

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Abstract

This book has catalogued the impacts of rodents at an international scale and establishes that sustainable and ecologically-compatible management of rodent pests should be of equal importance to that of insect and weed pest management. Ecologically-based rodent management (EBRM) is a holistic approach to rodent management, but must be understood at all levels—by decision-makers, extension staff, scientists and the end-users. Inevitably more basic and strategic research will be required before appropriate strategies for EBRM are developed, and different constraints will apply in different situations when considering its implementation. Clearly EBRM must be finely targeted to specific agro-ecosystems and pest species. New technologies, conventional and biotechnological, will be developed over the next decades. Of critical importance will be full assessment of these before their adoption and widespread implementation. Training of the next generation of scientists and managers is also an essential element of EBRM because the solution to rodent management problems is complex and must be considered as a long term problem requiring continuing development and application.

Keywords

Ecologically-based rodent management, rodent pests, training, developing countries

Introduction

This book has achieved, for a subset of developing countries, an audit of the status of rodents as pests in the 1990s. In this chapter we consider the progress of 'ecologically-based rodent management' (EBRM) in developing countries through drawing on the contributions provided from Asia (eight chapters, six countries) and Africa (four chapters, three regions). We will focus primarily on management, training and research issues.

Establishing a Profile for Ecologically-based Rodent Management

The importance of the impact of rodents is a common theme which has emerged from the chapters contributed from developing countries. This recognition is felt commonly to be overdue. The breadth of information coalesced in this book is immense—for example, in Indonesia, the depredations of rodents are equivalent to the amount of rice required to provide 25 million people 65% of their annual dietary requirements, while the impacts of rodents are increasing in Lao People's Democratic Republic (agriculture), Madagascar (conservation), Tanzania (agriculture and health) and Vietnam (agriculture). We hope that this cataloguing of impacts at an international scale will assist in establishing that sustainable and ecologically compatible management of rodent pests requires equivalent stature to that of insect and weed pest management.

The inclusion of research on rodent pests in the current national 5-year plan in China (see Chapters 12 and 13) and the recent development of a national rodent pest laboratory in Indonesia (see Chapter 14), indicates that the impacts of rodent pests are beginning to gain appropriate status. In both these countries there is strong recognition for the need to develop and apply EBRM. These programs need to be progressed so that they become flagships for EBRM in developing countries.

A common message to emerge from those developing countries which have embraced EBRM, is that basic studies of the taxonomy, ecology and population dynamics of the target rodents are required before management strategies can be developed and implemented (see Chapters 15, 18, 21 and 22). The difficulty of convincing governments in developing countries of the need for basic research cannot be underestimated; these countries have major rodent problems today, whilst the food demands of society are intensifying, leading to increasing pressure on biologists to deliver immediate solutions.

Moving Beyond Mortality Control

Traditionally, rodent control has focused on numbers of rodents. An intuitive and simple response to high rodent numbers became generally accepted: if there are too many rats, then kill some. Methods for doing this killing have been developed over thousands of years and vary from simple hunting to use of sophisticated chemical compounds. This minimalist approach to rodent damage management is often successful, but it is not sustainable. Indeed, population size is the

result of several processes—not only mortality, but also natality, immigration and emigration. Focusing only on mortality neglects the other demographic processes and possible interactions. It is a strategy which concentrates on 'reparation' of the problem, rather than prevention. The holistic approach, which we have termed 'ecologically-based rodent management' (Chapter 1; see also Singleton and Brown 1999), at least provides for some optimism that more sustainable and persistent strategies can be developed and that rodent damage is not an insoluble problem.

The chapters on rodent pests in developing countries indicated a plethora of pre- and post-harvest problems in rural areas and storage and disease problems in both rural and urban areas. Several chapters also provided examples on how aspects of demography other than just mortality could become important elements in the management of rodent damage (e.g. Chapters 1, 10, 14 and 20). Another persuasive message to emerge from the contributions by authors from developing countries is that there is a strong will by their governments to adopt more ecologically-based rodent management. However, despite a wide interest in more integrated approaches of rodent control (see, for example, in Prakash 1988; Buckle and Smith 1994), the development and implementation of the principles of what we now call EBRM have been slow and difficult. The reasons and constraints for this are many, and may differ between situations. We discuss the most important of them here.

Constraints on Developing and Implementing EBRM

Basic biological knowledge

The complex biology and behaviour of rodents is probably the main reason why integrated pest management in rodent control has not evolved as fast as that for insect or weed control. For many rodent species, even for the common pest species, knowledge of their population ecology is far from adequate. In some instances even the taxonomy of the rodent pests is not well defined (see Chapters 15 and 18). Although a farmer may not care which species is destroying his crop, management strategies based on ecological characteristics require knowledge on which species are present, their habitat use, breeding patterns and population dynamics.

Sometimes, taxonomic differences are of paramount importance to a rodent problem. For example, within the African genus *Mastomys*, there are two morphologically similar species that can be recognised only by the number of chromosomes. One of them, *Mastomys natalensis*, is resistant to, and a reservoir for, the plague (*Yersinia pestis*), while the other, *Mastomys coucha*, is very susceptible to the plague (Isaacson et al. 1981). Knowing which species are present in an urban or semi-urban environment has major implications for management strategies, especially when resources are limited, as is the case in most eastern African rural communities.

Krebs (Chapter 2) claims that it is now time to move on from descriptive studies of rodent pests to experimental work. This unfortunately is only true for a few pest species in African and Asian countries

where sufficient knowledge is available. The case studies presented in this book on the population ecology of rodent species from China, Indonesia, Malaysia, Mali, Tanzania and Thailand indicate examples of where an experimental approach would be timely. In most instances, however, more basic research is required. Information at community or landscape level is even more scarce, but vital for investigations on such issues as the potential for biological control using predators.

The development of specialised techniques like immunocontraception requires a detailed knowledge of the reproductive physiology of the target species and a thorough understanding of its population ecology (Chapter 10). In developing countries, such a broad knowledge base is available for just a few species of rodent pests.

This shortage of biological knowledge often reflects a limited understanding of its importance by funding organisations, the low number of interested and adequately trained scientists, and the poor economic situation of many of the countries that we discuss here. Added to this is the reality that most of the research underpinning EBRM in developing countries has to be done in situ, where scientists are often working in isolation from international colleagues because of language problems, poor communication infrastructure and/or international political issues.

Ownership of rodent problems

In many countries, national rodent control programs or services have been established, often for good reasons (e.g. Madagascar, see Chapter 21). Yet, however well meant or successful, some of these programs contribute to a perception that rodent control is not the farmers' responsibility but the government's and, at best, farmers should participate in control actions directed by government technicians. Moreover, rodent problems are often considered to be a fact of life and a common view held by farmers is that nothing can be done about them. As a result, there is often not a strong commitment by farmers and other end-users in applying strategies that may require a long-term involvement.

Few governments in developing or developed countries are involved in early tactical management of rodent pests. Instead, governments generally only become involved when problems suddenly reach a level at which emergency actions are required. After this 'crisis management', rodent pests generally again fall back to the bottom of the political agenda. If farmers take a lead from how governments handle rodent pests, then it makes it harder to convince farmers that they need to adopt early tactical control rather than crisis management. Unfortunately, this happens at all levels, be it local, regional, national or with regard to international funding agencies.

An ecologically-based approach also requires an acceptance that activities in one place may have a dampening effect on rodent populations in another place. For example, EBRM may recommend changes in land management or in irrigation schemes where the individual who applies the actions is not always the one (or the only one) who will benefit. Socioeconomic, cultural or political aspects may then dominate the development of EBRM

strategies (Singleton and Petch 1994; see Chapters 8 and 14).

Access to information

EBRM is, by necessity, targeted to specific agro-ecosystems and pest species. Solutions are rarely generic; they cannot simply be transplanted between places. Therefore, large information campaigns cannot be set up easily. On top of that, the rather complex message of EBRM has to compete with straightforward techniques of pesticide application. Promotion of the latter is nearly always driven by commercial objectives, and therefore often is better organised and has more financial support.

Where national authorities have a large influence on rodent control strategies, they will search for national solutions. These will not always take into account the specific local conditions that are important in EBRM.

Investment capital

Finally, it should be noted that most EBRM strategies are, by definition, aiming for long-term results. In countries such as Indonesia, Tanzania and Vietnam, most farmers are risk-aversive, low-capital entrepreneurs. Therefore, many will not invest in solutions which immediately are more expensive, even though they may pay off in the long run. Therefore, EBRM ideally should only be marginally more expensive to implement than existing practices, even if these practices are less effective and more expensive than EBRM in the long term.

Maintaining the Momentum for Ecologically-based Rodent Management

Training the next generation of scientists

Although we have discussed a number of factors which are likely to constrain the development and implementation of EBRM, the most basic and important of them is the lack of biological knowledge. Fortunately, there is a growing interest among zoologists and wildlife managers to spend the time and energy on understanding the population biology of rodent pests. Many authors of chapters in this book stand proof of that. In order to secure this development, particularly in developing countries, there is an urgent need for more ecologists. Young population ecologists and wildlife managers need to be educated at academic levels (M.Sc., Ph.D.) with a strong emphasis on pure science, but in the context of applied, strategic research. Far too often there has been a wide gap between basic and applied research, leading to technologists providing incremental improvements on methods that are part of a classical but unimaginative template, while pure scientists conduct their research and gather new insights outside agricultural systems. Today, we have a need for scientists and managers to be adept in both fields. The chapters in section 1 of this book are by scientists who have a major focus on basic research but are aware that their research in ethology (see Chapters 2 and 3), modelling (Chapter 4), ecosystem dynamics (Chapter 5) and epidemiology (Chapter 6) could make important contributions to the management of rodent pests. However, the findings of their

research need to be readily accessible to field practitioners. Often this is not the case and we are pleased that they were willing to use this book as one forum to bridge this communication gap.

Once young scientists have been trained formally, they require the opportunity to conduct strategic research. In an EBRM context this would consist of basic biological research under the field conditions where rodents cause problems. This kind of research will not quickly provide new techniques and solutions meaning that long term funding has to be secured.

Also, the results of strategic research need to be transferred to practitioners. This technical transfer should focus on new EBRM methods that have been tested under field conditions in replicated, experimental studies conducted on an appropriate scale. It is very important that at this stage, the science can be integrated with particular socioeconomic systems. Investigating socio-cultural aspects and consequences of EBRM strategies, as well as economic cost–benefit ratios, are essential.

Short-term thinking for long-term problems

EBRM requires a long-term approach, both in development and in application. Much effort will be needed to convince policy-makers of this. On the other hand, the impacts of rodent pests will not abate until we have developed appropriate EBRM-techniques. Therefore, there will be continued pressure for urgent, short-term solutions, particularly in developing countries. Consequently, EBRM proponents must be prepared to develop interim management practices, even though they are unlikely to be sustainable. An example of this is the work of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Rodent Research Group. The focus of this group is EBRM (Singleton 1997; Singleton and Brown 1999) and long term research (> 5 years) is progressing to develop strategies for EBRM. Mouse plagues have occurred in the past few years whilst this research has been in progress. To help combat these outbreaks, research effort has been deflected periodically to help develop broad-scale aerial application of rodenticides (Brown et al. 1997; Brown and Singleton 1998). This balance of research focus has meant that farmers see the research outputs of the group as relevant to their needs, and this has maintained their interest in the ongoing research on EBRM.

Maintaining credibility with farmers and other end-users

Ecologically-based rodent management will rarely provide spectacular quantities of dead rodents. Indeed, the concept of EBRM is to maintain rodent densities below levels that cause significant economic losses to agricultural produce or significant health problems. On the other hand, as discussed above, EBRM will require investments in material or labour. For these reasons, farmers may be sceptical about applying such methods. Therefore, a major challenge is to convince farmers of the benefits of EBRM.

An equally large challenge is to ensure that new methods are only promoted when they have proven their value. There is a risk that enthusiastic scientists, managers of scientists, impatient funding organisations

or politicians may promote strategies that are not yet well tested but that are popular, politically correct or attract research funds. If these strategies are less effective than announced, the loss of credibility would make it difficult to later convince end-users to adopt an improved version. A topical example in Southeast Asia is the trap–barrier system plus trap crop. This method has good potential to be the cornerstone for developing EBRM in rice ecosystems, but a number of possible weaknesses have been identified (see Chapter 8). This management system is being strongly promoted by some government agencies in the region, yet its performance has not been assessed at the village level, nor do we know whether any of the potential weaknesses are sufficiently major to require some modification of this simple technology (Singleton et al. 1998).

Incorporating and integrating different strategies

As a holistic approach, EBRM will rarely focus on one single element in the rodent's biology. Management strategies will therefore implicate different techniques and methods. Some may be slight modifications of existing technologies, others may be more innovative. The challenge will be to find a balance, ensuring that focusing too much on one technique does not compromise the benefits of an EBRM approach. For example, the argument that immunocontraception of house mice, *Mus domesticus*, if successful, needs to be integrated into an EBPM context (Chambers et al. 1997; Chapter 10) is a good example of the type of thinking that is required.

Concluding Comments

The re-emergence of the importance of population ecology and an emphasis on management directed at the agro-ecosystem level raises hopes that rodent pest management will begin to match the progress made by entomologists and botanists in controlling insect and weed pests. We are confident that the next decade will see rapid advances in ecologically-based rodent pest management. The development of this strategy will be driven not only by a new generation of wildlife managers who will have stronger training in the theory and practice of population ecology and ecosystem management, but also by the imperative to produce 'clean and green' produce for domestic and export markets. Therefore, by necessity, we will have to develop more environmentally benign and sustainable methods for rodent pest management, reducing our sole reliance on rodenticides as killing agents.

Ecologically-based rodent management provides the necessary platform for designing management strategies which are environmentally safe. The combined contributions to this book indicate strongly that reasonable progress towards the development of EBRM requires good cross fertilisation between basic and applied research on rodent pests, plus the ability to apply the fruits of this union in a meaningful socioeconomic context. In developing countries in particular, advances in EBRM could translate to significant improvement in the human condition. If this book can influence the basic and applied rodent biologists of today and tomorrow to contribute towards this outcome then we will be well satisfied.

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