

Rodent biology and management – who is outsmarting whom?

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Received 25 July 2011, accepted 12 September 2011, published online 30 November 2011

Developing a robust scientific understanding of rodents because they are agricultural pests, beneficial species within the landscape, harbourers of disease or undesirable inhabitants of built environments remains a challenge for scientists and managers. Despite much basic research over many decades our understanding of many areas of rodent biology – ecology and taxonomy, their interactions with other wildlife, livestock and people, their role in disease transmission and disease reservoirs – is far from complete. While there are many new research tools, these are not necessarily making it any easier to improve our management of the impacts of rodents on people's lives (e.g. food security) or the impacts of man on rodents (e.g. conservation). In agricultural landscapes there has been promising progress when community groups and biologists collaborate to address specific rodent problems. We will return to this central theme. In terms of agricultural impacts, farmers in many countries continue to state that rodents are one of their top three pests whose impacts they cannot manage. The knock-on effect on food security is high (Meerburg *et al.* 2009), but there are still too few efforts to prevent rodents taking the food from the table of the more than one billion people who are already undernourished.

In April 2010, some 140 scientists from around the world came together at the 4th International Conference on Rodent Biology and Management (4th ICRBM) in Bloemfontein, South Africa, to present and discuss research findings and developments across many disciplines from ecology, taxonomy, physiology, sociology, disease, behaviour, and population dynamics to conservation and management. The papers within this special volume comprise an eclectic representation of what was presented and discussed at the conference. Other papers contributed at the conference are being published in *Integrative Zoology*, *African Zoology* and *Navorsinge van die Nasionale Museum, Bloemfontein*.

What developments have occurred in rodent research since the 3rd ICRBM was held in Hanoi, Vietnam, in 2006? There continues to be exciting progress in taxonomy and phylogenetic analyses, with more scientists applying detailed molecular methods and new species continuing to be identified. One of the questions discussed was whether taxonomic species and ecological species are different. Conservation biologists are attempting to protect endangered species, but in doing so, are they conserving the appropriate level of genetic diversity?

At the 3rd ICRBM there was discussion regarding the expectation that a major 50-year bamboo flowering event would occur before the next conference – and it has done so. Between 2007 and 2010, major increases in rodent numbers occurred through the Chittagong Hill tract region of Bangladesh, in Chin State and Rakhine State in Myanmar, and in Mizoram, India. While the impacts of these rodent outbreaks could not be prevented, many researchers were able to gather significant new data relating to the species involved, the population dynamics of the outbreaks, and the social consequences of them. Indeed, the topic of these and other rodent outbreaks around the world was the subject of a special conference in October 2009 (Singleton *et al.* 2010a, 2010b). Several papers at the 4th ICRBM reported on the data collected and from these it was apparent that there needs to be careful analysis at a landscape scale of the phenomenon of rat 'floods' associated with bamboo flowering. However, these rodent outbreaks represent a special subset of a wide range of rodent outbreaks in different parts of the world. One common message is the need to be able to better understand the factors that lead to a population eruption. In this special issue there are two papers that took on this challenge by considering long-term datasets on the common vole, *Microtus arvalis*, in Germany. Blank *et al.* (2011) consider the habitat characteristics and Imholt *et al.* (2011) the weather parameters that may contribute to population outbreaks. Continuing on the theme of early intervention, Brown *et al.* (2011) adopted a refreshingly audacious modelling study by combining crop models on rice production with population models of the ricefield rat, *Rattus argentiventer*. They explore the likely benefits of early management strategies for reducing the impacts of chronically high rodent populations on irrigated rice cropping systems in the Mekong Delta of Vietnam.

A strengthening area for rodent research is the role played by sociologists and communication specialists in training people to cooperate and adopt management approaches, such as ecologically based rodent management (EBRM) to outsmart rats (Palis *et al.* 2011; Flor and Singleton 2011). Ecologically based rodent management was a dominant theme that emerged during the conference. Farmers in some countries appear to more readily adopt community management actions following training and extension (e.g. through farmer field schools) and one positive outcome has been a reduction in the use of

rodenticides; however, the social system and cultures of different countries means the approach is not yet universally adopted.

At the 4th ICRBM there were reports on research and implementation of EBRM in more than 20 countries around the world. One region where EBRM has recently made some headway is eastern and southern Africa. Makundi and Massawe (2011) review the progress and challenges of EBRM in this region. For EBRM to be successful we need to increase our knowledge and understanding of the behaviour, breeding performance and population dynamics of not only pest species but also those of conservation value. Three papers in this volume take on this challenge: one is a study of rhodamine as a marker to assist our ability to monitor the movement patterns of individual rodents (Weerakoon and Banks 2011); a second looks at the changes in movement patterns of rodents in and around crops and houses associated with maize-based cropping systems in southern Africa (Monadjem *et al.* 2011); and the third examines factors that influence the breeding performance of ricefield rats in the Mekong Delta of Vietnam (My Phung *et al.* 2011).

There continues to be great interest in the topic of wildlife diseases, transmission and zoonoses. A large number of papers were presented on rodent diseases at the conference, and they collectively revealed that, despite an increasing effort to understand diseases in wildlife and their impacts on human health, how these diseases affect wild species is minimally understood. Meerburg *et al.* (2009) reviewed zoonoses of rodents and this was the subject of a plenary presentation at the conference. In this volume, Meerburg and Reusken (2011) have provided some more detailed insights into the role of rodents in the spread and transmission of Q-fever; despite significant knowledge gathering, definitive roles for rodents are still unclear for this disease of livestock production and fever in humans. The same is true for many rodent-borne zoonoses, particularly those that are prevalent in developing countries.

With so many species and so many ecosystems and habitats there are always more ecological (e.g. Avenant 2011), behavioural and physiological studies (e.g. Mulungu *et al.* 2011) to do. Food security in developing and developed countries will remain a major challenge, and will become even more severe with increasing human populations, continued human modification to landscapes, and changes in climate patterns. We know that rodents will readily adapt to these changes and continue to thrive. Eruptions of rodent populations in agricultural landscapes may become more common, which highlights the imperative to anticipate these events and to interact closely with rural communities, using a mix of biological and sociological tools, so that rural households have a fighting chance to lessen the impacts of rodent pests.

Are humans winning the battle to outsmart rodents? If we were to rely purely on ecological research then humans would lose ground in the battle to outsmart rodents. The papers presented on rodents in this volume include aspects of social anthropology, breeding ecology, habitat use, dispersal patterns, modelling and rodent-disease interactions. They provide a timely reminder of the mix of knowledge required to effectively manage rodent populations. It will be the continued

integration of basic and applied wildlife research that will enable us to reduce rodent damage to crops and pastures, and to improve the livelihoods of farmers, both in developed and developing countries.

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