RODENT RESEARCH

RODENT RESEARCH IS A BI-ANNUAL NEWSLETTER PRODUCED BY THE COMMUNITY ECOLOGY GROUP OF CSIRO SUSTAINABLE ECOSYSTEMS. THE COMMUNITY ECOLOGY GROUP AIMS TO FOSTER INTERNATIONAL LINKS BETWEEN SCIENTISTS, MANAGERS AND COMMUNICATORS INVOLVED IN PEST MANAGEMENT, RODENT CONSERVATION AND BASIC RESEARCH.

INTERNATIONAL REPORTS

Preparations for the 3rd ICRBM

At the XIXth International Congress of Zoology held in Beijing in August 2004 (see report later in newsletter) Zhibin Zhang (Institute of Zoology, China) hosted a lunch for some of the international scientists interested in rodent research. Those attending included: Valery Neronov (Russia), Nils Stenseth (Norway), Herwig Leirs (Belgium), Stephen Davis (Belgium), Grant Singleton (Australia), Lyn Hinds (Australia), Dale Nolte (USA) and Gary Witmer (USA). One of the topics of discussion was the next International Conference on Rodent Biology and Management (3rd ICRBM). All agreed it was time to begin serious planning of the next conference. All were keen on the suggestion to hold the conference in Hanoi, Vietnam, in September 2006. Grant Singleton and Peter Brown (Australia) met with Prof Nguyen Van Tuat (Director, National Institute for Plant Protection (NIPP)) and Dr Nguyen Phu Tuan (NIPP) in Hanoi in early September 2004. They enthusiastically confirmed that NIPP will host the conference and within 5 days had already drawn up a short list of possible venues.

Our next step is to finalise the organising committee for this conference. Current members are Grant Singleton, Lyn Hinds, Peter Brown, Herwig Leirs, Dale Nolte, Gary Witmer, Zhang Zhibin, Nguyen Van Tuat, Nguyen Phu Tuan and Steve Belmain (UK). Prof Neronov will nominate a colleague from Russia. We particularly welcome nominations from Africa, Asia, Central America (including Mexico) and South America. Please send nominations for the organising committee to Grant Singleton (Grant.Singleton@csiro.au). Prof Charles Krebs has agreed to continue in his role as Honorary Chairman.

Snow, voles and "Schrödinger's cat"

"Schrödinger's cat" is wrongfully thought of as an acronym for the problem of the observer influencing the measurements of the system being observed. I'll stick to the tradition. My "Schödinger's cat" problem is to find out how 8 months of 1-3 meters thick snow cover affects root vole (*Microtus oeconomus*) survival and space use during winter in Norway. Since the aim of the study is to find the effects of snow cover, we had to come up with a method that allowed us to register the voles and their whereabouts under two meters of snow without removing the snow. It is important not to walk on the snow since it will change the hardness of the snow pack and the conditions under it!

Tending PIT-tag traps on a good day (-10 degrees and 7m/s wind).

Voles and lemmings survive the long winter without entering torpor or hibernation, hence they must forage regularly. The layer between the snow and the ground will, under some circumstances, be changed into a layer of fragile pyramidal ice crystals creating a "subnivean space". In this layer voles and lemmings can dig and find food to sustain life throughout the winter. In some years food is plentiful and the voles and lemmings breed under the snow. To study survival and space use we increased the amount of subnivean space and connectivity using roof plates set in place just before the snow settled in the fall.

The Finse Research Centre (http://www.biologi.uio.no/fellesavdelinger/finse) lies at 1222 meters above sea level on the mountain divide between the west coast of Norway and the eastern interior. Being on the divide we get the bad weather from both sides and the weather is unpredictable with frequent and sudden winter storms. There is a lot of wind at Finse and snowdrift combined with cold temperatures makes travel dangerous and at times impossible. Therefore we could not rely on normal live trapping methods to get data since that could result in disaster if we could not attend to the traps due to bad weather. To make a weather independent, durable system to study the voles under the snow we equipped all voles with PIT-tags inserted under the skin on the neck and placed tubular antennas on the ground before the onset of winter. The antenna cable was attached to a stick extending above the expected snow. Trap checks were conducted by attaching PIT-tag readers to

The height of the modular chimney can be altered as snow level changes.

Chimney viewed from the top.

A prototype of the homemade antenna.

the end of the antenna cable with the appropriate power source. Each PIT-tag reader is capable of storing 800 passages with tag ID and time. Each trapping grid consisted of 16 antennas. Using two car batteries as a power source, we were able to monitor a grid for more than a week continuously.

We have been running experiments on root voles for two winters and find the system extremely durable and useful. In stable periods with good weather we live trap to get information on body size and condition using Uglan live traps. The traps are placed on the ground inside chimneys installed before the onset of winter. The PIT-tag trapping record shows 100% trapability. In three instances we caught voles in the live traps that were not recorded in the tubular PIT-tag antenna traps for some time but these animals were live trapped after snowmelt and it is uncertain if they were on the trapping grids during the melting period when they were absent from the PIT-tag records. The method could easily be modified to accommodate many different situations where the animals should not be disturbed during trapping or in situations like ours where it is impossible to catch animals on a regular basis.

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NETHERLANDS

Report on "Food safety in organic livestock production" workshop – University of Wageningen, Netherlands

This workshop, held on 27-28 May 2004, addressed the question of whether there are rodent control strategies that fit better into organic livestock production than current heavy reliance on chemical rodenticides.

There are three main outputs expected from this workshop:

1. Publication of the presentations for the workshop in the Netherlands Journal of Agricultural Science (NJAS) (last issue of 2004)
2. Develop a consensus strategy for rodent management in intensive livestock production facilities and small-scale facilities that are registered organic farms. This approach will be published in the special edition of NJAS (Title of Paper: Seeking consensus: Rodent management strategies in organic pig and poultry production in Western Europe; Authors: B.G. Meerburg, M.K. Bonde, F.W.A. Brom, S. Endepols, A.N. Jensen, H. Leirs, J. Lodal, G.R. Singleton, H.J. Pelz, T.B. Rodenburg, A. Kijlstra)
3. Develop a field program to test this strategy.

The workshop was funded by an EU multi-country project on food safety in organic livestock production. This project began in 2004 and it was quickly recognised that rodents were an important health concern in these production systems but the project participants had no expertise on rodent pests and their management – hence this workshop. Only 11 people attended the workshop: 4 from the Netherlands (3 disease parasitologists; 1 human ethicist); 3 from Denmark (1 rodent biologist; 1 veterinary scientists; 1 bacteriologist); 1 from Belgium (rodent biologist); 2 from Germany (1 rodent biologist; 1 rodenticide specialist); 1 from Australia (rodent biologist).

The workshop considered free-range and organic production (see Table 1 for distinction) of pigs and poultry.

Interesting issues to emerge:

- In Netherlands there are approximately 50,000 free range pigs; 17 organic poultry farms (1% of market, stagnant growth); 91 organic egg farms (4% of market and growing). Denmark has higher organic production.
- Toxoplasmosis (*Toxoplasma gondii*; protozoan) has the cat as its reservoir species with rats and livestock acting as intermediate hosts. People can pick up oocytes from the environment or from eating poorly prepared meat (pork, poultry, sheep, goats (but not beef)). All edible parts of a pig can carry toxoplasmosis. The parasite can cause blindness in otherwise healthy adults. There is no effective therapy if it gets into the eye. In Holland there are 16 million people and 80,000 people are newly sero-positive each year with 40-240 having clinical eye problems each year.

Table 1. Distinction between regular, free range and organic farming of livestock

Features	Regular production	Free range	Organic
Use of preventative medicines (eg antibiotics)	✓	✓	×
Tails clipped	✓	×	×
Access to open areas	×	✓	✓
Organic food	×	×	✓
Straw bedding; straw for nest building	×	✓	✓
Weaning age	3-4 weeks	3-4 weeks	6-7 weeks
Stock density	High	Low	Low

NB: Free range and organic pigs have higher prevalence of toxoplasmosis than "regularly" housed pigs. Toxoplasmosis causes sub-clinical effects in pigs; there is no evidence that production is effected.

- Campylobacter and Salmonella from poultry. The main risk factors are poor rodent control and poor hygiene. Campylobacter presents a higher risk on organic farms. However, there is very little known about the role of rodents as carriers of campylobactor. Perhaps rodents act as transmitters of the bacteria via carrying it on their feet (mechanical transfer).
- Campylobacter and Salmonella from pigs. A wildlife study in Denmark found campylobacter in rats and mice. Most were infected by *C. coli*; only a few had *C. jejuni*, which is the primary species that affects humans. Again there is evidence of higher bacterial infection in livestock in free-range production systems.
- Rodenticide strategies to eradicate rats from livestock farms: One rat per day produces 20ml urine and 30 droppings. If you have 100 rats on a farm then they would produce 700 litres of urine and 1,020,000 droppings per year. Stefan Endepols (Bayer) provided a strategy for managing serious rat infestations. For the first time in my professional career I heard a presentation by a representative of a multi-national chemical company that considered habitat use of rats at a farm scale rather than just around the farm buildings (foci of impact). This is encouraging – that the ecologically-based management concept is permeating into those who influence commercial pest control operators! However, little attention is paid to breeding sites or to re-infestation. Also their recent publication in Preventative Veterinary Medicine (58: 115-123, 2003) does not refer to any ecological studies.

  Piles of wood, etc and accumulation of old material away from buildings were foci for bait take and feeding activity of the Norway rat. A problem identified by Stefan is that the use of second generation rodenticides in these circumstances will increase risks of secondary and primary poisoning of non-target species.
- Jochiam Pelz (Biologische Bundesanstalt für Land and Forstwirtschaft, Germany) provided a nice overview of the geographic distribution and spread of rodenticide resistance in western Europe. His group recently identified a major gene involved in genetic resistance (published in Nature, 427: 537-541, 2004). He is now using rapid screening techniques (PCR, micro-array) to expand their geographic knowledge on the evolution of resistance to the anticoagulant rodenticides in Europe.
- A questionnaire of organic pig producers in Denmark revealed that foxes were their most important "perceived" problem (shooting is the current method). There are no good data on impact (loss of piglets) of foxes.

In Denmark there are nine species of rodents and two species of shrews that live in and around pig farms. Some of these species are protected and play an important ecological service. This highlights the need to develop control strategies that are specific for the few pest species.

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Tips for the identification of field rodent burrow entrances

The morphology of burrow entrances of rodent pests in the Cauvery delta, India, is species specific. A comprehensive knowledge of burrow morphology of rodents is useful for population estimation, placing poison baits and for physical control of specific target species. In the Cauvery delta the following rodent species are known to occur in the bunds surrounding agricultural crops (rice paddy, sugarcane, soybean, cotton fields): the lesser bandicoot rat or Indian mole rat, *Bandicota bengalensis*; the soft furred field rat or Metad, *Millardia meltada*; the Indian field mouse, *Mus booduga*. The Antelope rat or Indian gerbil, *Tatera indica* is found only in the barren lands. Each of these species are of economic importance to agriculture. The following tips for the identification of burrow entrances of these field rodent pests are described for the sake of rodent researchers, extension personnel of both state and central agriculture departments and the farming community.

The Tips

***B. bengalensis* and *M. booduga*:**

The burrow entrances of *B. bengalensis* have a large quantity of heaped soil with large sized pebbles (Fig.1) while the *M. booduga* burrow entrances have a small quantity of heaped soil with small sized pebbles (Fig.2). Both the rodents plug their burrow entrances after entering the burrow. Burrows of these species are located at the sides of the bunds. In order to confirm the presence of animals, the closed and open burrow entrances of *B. bengalensis* and *M. booduga* were excavated. For excavated *B. bengalensis* burrows, 112 of the 114 closed burrows were occupied. In contrast, none of the 52 open burrows were occupied. For excavated *M. booduga* burrows,

Fig 1. Burrow entrance of Bandicota bengalensis.

Fig 2. Burrow entrance of Mus booduga.

Fig 3. Burrow entrance of Millardia meltada.

Fig 4. Burrow entrance of Tatera indica.

47 of the 48 closed burrows were occupied while none of the 22 open burrows were occupied.

The diameter of the burrow entrances of these two rodent species is another criteria for identifying the occupant species. The burrow entrance diameter of *B. bengalensis* (overall range 46 - 71 mm) was larger than that of *M. booduga* (overall range 18 –26 mm).

M. meltada

The burrow entrances of *M. meltada* (79 observations) do not have the heap of soil and the burrows go vertically downwards and remained open even when occupied (Fig.3). The burrow entrance diameter of *M. meltada* ranged from 32 to 45 mm. Interestingly, in all the crop fields these three species of rodents had similar burrow morphology.

T. indica

The burrows of *T. indica* (75 observations) can be observed only in the barren lands and often they have more than one adjacent opening (Fig.4). The burrows are slanted (roughly 45°) and the entrances have a small heap of soil. The diameter of the burrow entrance (overall range: 64 - 100 mm) is significantly larger than other three species of rodents.

The population of *B. bengalensis* and *M. booduga* can be estimated directly by enumerating the plugged burrow entrances. For *M. meltada* populations, the best method for estimating the population is as follows: the burrow entrances of *M. meltada* should be plugged with sand in the evening hours of the day and then inspected the following morning; the unplugged burrows should be considered as live or active burrows.

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MYANMAR

Workshop on Developing Rodent Management Practices

A workshop was recently held in Myanmar for farmers, extension staff and scientists to review the current knowledge of rodents in the lowland rainfed cropping system and to develop control strategies for management. The workshop was held at the Central Agricultural Research and Training Centre (CARTC) at Hlegu, Myanmar in the first week of June 2004. There were 20 farmers, 7 research staff, 16 extension staff and 2 CSIRO scientists attending.

The first day of the workshop focussed on presentations of the results obtained thus far in the ACIAR funded project, "Ecologically-based management of rodents in lowland rainfed cropping systems in Myanmar". Presentations were made by the core staff of the rodent project and by PhD students from the University of Yangon. The second day of the workshop was spent visiting the field sites, seeing the farming system and speaking to farmers about what sort of rodent problems they have in their fields. The main aim was to get the farmers and extension staff thinking about how rodent management could be done in these farming systems and in village areas (around houses and grain stores). They also visited the Rice Research Centre where a demonstration trap barrier system (TBS) had been set up in the previous week. The TBS is a new technology for rodent management in Myanmar and it is currently being tested for effectiveness in the rainfed system.

On the third day of the workshop participants split into groups to discuss and develop a list of the rodent management strategies that they currently use as well as other management practices they have not used but might consider using. The participants discussed when these management practices should be conducted, whether it was feasible, economical, environmentally friendly, sustainable, the likely level of adoption of each action (farmer, village, district) and the priority for reducing damage (low, medium, high). A summary of one group discussion is provided in Table 1. Over the next 18 months of the ACIAR project, trial sites (at a whole of village scale) will be set up to conduct these management practices and to monitor changes in rodent abundance, damage to crops and yields of crops.

Visit to field site showing processing of rats (top left), discussion with farmers about farming system and rodent problems (top right), visit to village to see grain stores and to discuss rodent problems (bottom left) and a visit to the Myanmar Rice Research Centre to see a demonstration TBS (bottom right - the crop inside the fence was to be planted later that week, and the crop outside the fence was to be planted 3 weeks later).

Table 1. Decision analysis for Myuandaga and Nyaunggone in Hwambi township, Yangon Division (Y=yes, acceptable; N=no, not acceptable).

Actions for rodent management	Timing (when)	Feasible	Economic	Socially acceptable	Environ friendly	Sustainable	Scale of adoption (Township)
1. Sanitation	Land preparation	Y	Y	Y	Y	Y	Y
2. Bund size - <30 cm within	Land preparation	Y	Y	Y	Y	Y	Y
3. Synchronised sowing and planting	Seed bed, transpanting	N	maybe	N	N	N	Y
4. Trapping	All	Y	Y	Y	Y	Y	Y
5. TBS	Monsoon and summer rice	N	N	N	N	N	Y
6. Rat hunter	Booting stage monsoon to harvest summer rice	Y	Y	Y	Y	Y	Y
7. Keep water high in field	Monsoon and summer rice	Y	Y	Y	Y	Y	Y
(8. Rodenticides)		Y	N	N	N	N	Y

Note that this group of farmers did not wish to consider rodenticides as a management action because of concerns about social acceptance. They do not want to use rodenticides in their fields.

Report on the XIXth International Congress of Zoology

The XIXth International Congress of Zoology was held in Beijing, China at the end of August 2004. There were 800 delegates with 350 from outside China. The Opening Ceremony emphasised many issues relating to the environment, conservation, animals welfare and collaborations with colleagues around the world. Over the four days of the conference 3 or 4 plenary lectures were presented each morning and there were 10 parallel symposia sessions each afternoon.

Grant Singleton (CSIRO, Australia), Prof Zhang Zhibin (Director of Institute of Zoology, Chinese Academy of Sciences), and Prof Nils Stenseth (Dept. of Zoology, University Oslo, Norway) co-chaired a symposium on Rodent Ecology on the afternoon of the first two days of the congress. The symposium was held with a great colleagiate spirit. There were 14 papers from 8 countries, spanning 5 continents. The standard of the papers was high and there were excellent exchanges of ideas. It was great to find out what other rodent research groups are currently doing around the globe.

General discussions were held at the end of each day and they focused mostly on ways to improve application of the findings of basic research in a management context. This was especially true for research based in Africa, where there has been little opportunity to deliver the scientific findings via extension activities in the area of ecologically-based rodent management. Some discussion about measuring the socioeconomic impacts of various strategies was held. Technical issues relating to capture-mark recapture studies were important for some of the scientists because without this information it is very difficult to obtain good data on age structure and survivorship, and thence modelling of population dynamics.

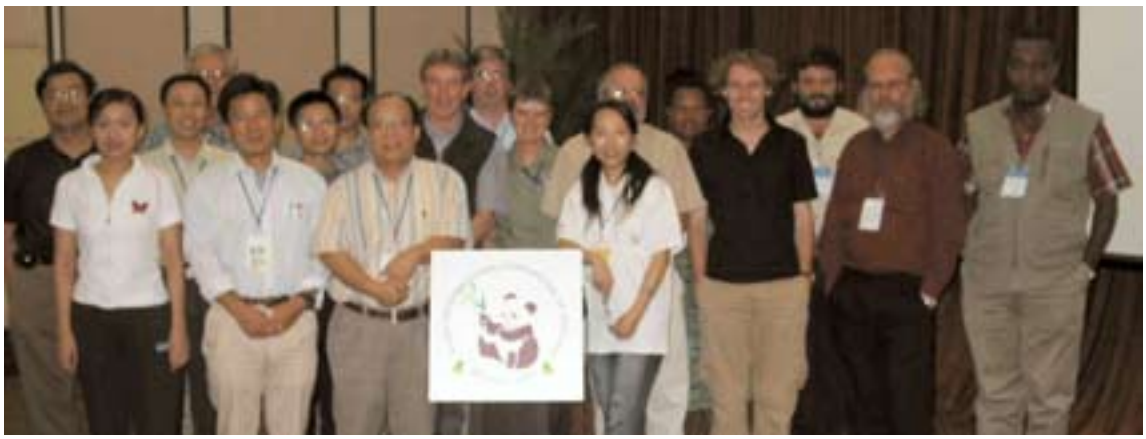
Staff from the Institute for Zoology, CAS, were excellent hosts and ensured the symposium progressed smoothly. We particularly thank Wenhua Xiong and Xiaohui Yu for their great

Stephen Davis presenting his talk on rodent borne diseases. He presented his entire talk in this Panda-like pose (note the hands).

Wenhua Xiong and Xiaohui Yu (PhD students from Insitute of Zoology, Beijing) – they ensured the symposium ran smoothly and led the social drinking at the end of the symposium.

Apia Massawe and Rhodes Makundi (Tanzania) – they provided a refreshing eastern African view on rodent biology and management.

Nils Stenseth is a "model" of concentration, but Herwig Leirs has his own response to the latest Stenseth theory.



Some of the participants at the symposium on Rodent Ecology, Beijing, China, August 2004

efforts in assisting the presenters – service with a smile!

Three plenary presentations of interest at the Congress were:

1. Vole, Mice and Lemmings: a Homage to Charles Elton - a Zoologist. Prof Nils Chr Stenseth, Norway.
2. Role of Vertebrates in Forest Regeneration. Prof Zhibin Zhang, China.
3. Ecological aspects of invasive mammal species. Dr Grant Singleton, Australia.

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Conference Notice

Japan

IX International Mammalogical Congress July 31 - August 5, 2005 Sapporo, Japan

The IX International Mammalogical Congress (IMC 9), formerly International Theriological Congress (ITC), will be held in Sapporo, Japan in 2005. The congress will address aspects of research on mammalogy including conservation and management. The congress may also provide an appropriate opportunity for meeting of IUCN/SSC specialist groups. Please visit the congress website for more information (http://www.imc9.jp).

Recent Publications of the CSIRO Rodent Research Group

Arthur, A.D., Pech, R.P. and Dickman, C.R. 2004. Habitat structure mediates the non-lethal effects of predation on enclosed populations of house mice. *Journal of Animal Ecology* 73: 867-877.

Hinds, L. A. 2004. Viral-vectored immunocontraception for the wild house mouse, *Mus domesticus*, in Australia. In `*Managing African Elephant Populations : Act or Let Die*?. Proceedings of an Expert Consultation on the Control of Wild Elephant Populations.' p. 33-35. (Office of International Cooperation, Faculty of Veterinary Medicine, Utrecht University: Utrecht.)

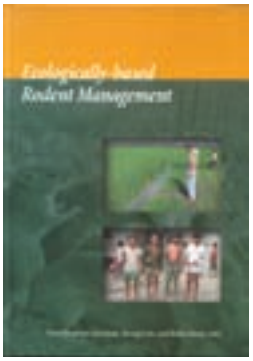
Jacob, J. 2003. Body weight dynamics of common voles in agro-ecosystems. *Mammalia* 67: 559-566.

Jacob, J. and Sutherland, D.R. 2004. Murine cytomegalovirus (MCMV) infections in house mice: a matter of age or sex? *Wildlife Research* 31: 369-373.

Joshi, R.C., Gergon, E.B., Aplin, K.P., Singleton, G.R., Martin, A.R., Cabigat, J.C., Desamero, N.V., and Sebastian, L.S. 2004. Rodents and other small mammals in Banaue and Hungduan rice terraces, Philippines. *International Rice Research Note* 29(1): 44-46.

Rodent Books & CDs available from ACIAR

To obtain copies of any of the following publications contact comms@aciar.gov.au (or phone +61 2 6217 0500). ACIAR's distribution policy is to provide complimentary copies of its publications to developing country libraries, institutions, researchers and administrators with an involvement in agriculture, and to any scientist involved in an ACIAR project.



Singleton, G.R., Hinds, L.A., Leirs, H. and Zhang, Z. (eds) 1999. Ecologically-based management of rodent pests. *ACIAR Monograph No.* 59. 494 pp.

This book consists primarily of a selection of papers presented at the 1st International Conference on Rodent Biology and Management held in Beijing in October 1998.

Singleton, G.R., Hinds, L.A., Krebs, C.J. and Spratt, D.M. (eds) 2002. Rats, mice and people: rodent biology and management. *ACIAR Monograph No.* 96. 564 pp.

This book consists of papers presented at the 2nd International Conference on Rodent Biology and Management held in Canberra in February 2003. Available as a book or on CD.

Aplin, K.P., Brown, P.R., Jacob, J., Krebs, C.J. and Singleton, G.R. 2004. Field methods for rodent studies in Asia and the Indo-Pacific. *ACIAR Monograph No.* 100. 223pp.

This field guide contains information on scientific methods directly relating to rodent research, descriptions, photos and distribution maps of all rodent pest species found in the Asia and Indo-Pacific region, and a dichotomous key for identifying rodent pest species in the region. Available as a book or on CD.

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CSIRO

This newsletter presents the personal views of the individual authors and not necessarily those of ACIAR, CSIRO, or collaborators in ACIAR projects on management of rodent pests in rice-based farming systems in Southeast Asia.