RODENT RESEARCH

RODENT RESEARCH (FORMERLY CALLED WAR AGAINST RATS) 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.

REPORTS FROM ABROAD

CSIRO Sustainable Ecosystems Rodent research in SE Asia has major social, economic and environmental impacts

The CSE Community Ecology Group recently completed 8 years of research in Indonesia and 7 years in Vietnam in lowland irrigated rice crops. When we began little was known about the biology of the main rodent pest species and there was virtually no professional skill base. We have made tremendous progress down an often challenging road and now we are at the stage of assessing the social, economic and environmental impacts of our journey.

The problem

In Asia, pre-harvest losses to rice alone are estimated to be between 5 and 10%. A 5% loss equates to approximately 30 million tonnes; enough rice to feed 180 million people for 12 months. Farmers often use inappropriate methods in their desperate attempts to reduce the impacts of rodents. This includes the use of broad-spectrum poisons such as endosulfans, organophosphates and carbamates. Occasionally these are mixed with used engine oil before applying to flooded rice crops - major environmental concern! Mains power is sometimes used to electrocute rats in flooded rice paddies. This has led to deaths of people in the Philippines and Vietnam and therefore has major social implications.

The solution

In Indonesia and Vietnam, we developed integrated ecologically-based rodent management

that was applied by farmers at a village level (70-100 ha) for 2.5 years. The integrated management methods included:

- synchrony of cropping (crops planted within 2 weeks of each other),
- the use of a community trap-barrier system (cTBS),
- short 2-week rat campaigns at key times (1 week prior to transplanting; or within 2 weeks of crop initiation) and in focal (source) habitats,
- reduce width of irrigation banks to less than 30 cm (prevents nesting by rats),
- increase general hygiene around villages and village gardens.

The impacts

In Indonesia, the benefit-to-cost ratio for all seasons and years averages 25-to-1, with an average mean increase in yield of 360 kg/ha per cropping season (two crops per year). In Vietnam, the economic benefit mainly accrued from reduction in costs of control: 18:1 benefit for treatment villages versus 3:1 for untreated villages.

The follow up social surveys highlighted a major decline in actions that are of concern socially and environmentally. In treatment villages in West Java, 49% fewer farmers used rodenticides. Also the use of endosulfan plus sump oil fell 28%. In the Red River delta, 66% fewer farmers used rodenticide. Also the use of plastic barriers fell by 65%. In treatment villages in the Mekong River delta, 24% fewer farmers used rodenticides during a period when 16% more farmers used them in the untreated villages. Electrocution was used in one province in the Mekong and it fell considerably in both treated and untreated villages probably because farmers at both sites were advised that it was an unsafe and illegal practice.

CSIRO Sustainable Ecosystems conducted this project in collaboration with the Research Institute for Rice in Indonesia, the National Institute for Plant Protection and the Plant Protection Department in Vietnam, IRRI and farmers in West Java and the Red River delta. The research was funded by the Australian Centre for International Agricultural Research (Indonesia and Red River delta) and AusAID (Mekong delta).

Further reading:

Singleton, G.R., Sudarmaji, Tuan, N.P., Sang, P.M., Huan, N.H., Brown, P.R., Jacob, J., Heong, K.L. and Escalada, M.M. (2003). Reduction in chemical use following integrated ecologically-based rodent management. *International Rice Research Notes* **28**, (In Press).

Singleton, G.R., Sudarmaji, Jacob, J. and Krebs, C.J. (200-) An analysis of the effectiveness of integrated management of rodents in reducing damage to lowland rice crops in Indonesia. *Agriculture, Ecosystems and Environment* (submitted)

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Update on Rodent Management from Bogor

In Indonesia there are at least nine species of rats and mice causing problems in agricultural areas and around human settlements: the rice field rat (*Rattus argentiventer*), wood rat (*R. tiomanicus*), house rat (*R. rattus diardii*), brown rat (*R. norvegicus*), Polynesian rat (*R. exulans*), bandicoot rat (*Bandicota indica*), lesser bandicoot rat (*B. bengalensis*), house mouse (*Mus musculus*), and field mouse (*M. caroli*).

In agricultural areas, *R. argentiventer* is the most serious pest. It has a wide range of distribution in Indonesia and produces the largest litter size of about 12 pups with the possibility of 2-3 litters during the rice growing season. They attack rice crops (the most valuable crop) as well as secondary crops (maize, soybean, peanut, cassave, sweet potato), estate crops (sugarcane and oil palm) and horticultural crops (shallot, chilli, potato, pineapple, zalacca, citrus). By comparison *R. tiomanicus* attacks only estate crops, *R. rattus* damage occurs mainly in human settlements and *R. exulans* causes damage mainly in rice fields on tidal and swamp areas in Sumatera and Kalimantan and is rarely found in Java. Papua is the only area in Indonesia where

there is no information about rodent species causing agricultural damage.

There are several methods of control used to combat rats and mice in order to reduce populations and damage to crops. However, there is no single control action that is satisfactory. Integrated rodent management combining all control methods - physical, agricultural, biological, and mechanical - is the best way.

In rice fields, the community trap barrier system (cTBS) combines mechanical control (traps and a barrier), agricultural control (rice planted earlier), and social factors (participation of several farmers) with good results in reducing damage. In estate crops (oil palm plantations), the use of barn owls (*Tyto alba*) as predators of rats, combined with reducing rodent numbers through the use of rodenticides, has shown satisfactory results.

Laboratory research at Bogor Agricultural University has identified several plant compounds that can be used for controlling rats. Rhizome powder of *Costus speciosus* mixed with livestock feed (pellets) has been shown to reduce the number of progeny and the weight of the uterus and ovary in laboratory mice, and to reduce the weight of the testes and seminal vesicles in males (Priyambodo, 1994). Using the same methods for rice field rats, the rhizome powder reduced the length and weight of uterus and ovary in females, and reduced the width and weight of testes and seminal vesicles in males. Diosgenin, an active ingredient in the rhizome powder of *C. speciosus,* acts as a sterilizing agent.

Other research on plant compounds that might be useful for rodent control has been conducted by Anwar (1998) using an extract of leaves of *Gliricidia sepium* as a possible anticoagulant. This extract fed to white rats in the laboratory reduced the ability of the blood to coagulate by lengthening the bleeding time and coagulating time, and reducing the number of thrombocytes and the amount of haemoglobin in the blood, as well as increasing the weight of the liver. Coumarin is the active ingredient contained in the leaves of *G. sepium*. Further research will have to be conducted to determine if these compounds can be used in agricultural fields or human settlements for rodent control.

Anwar, R. 1998. Effect of leaves extract of *Gliricidia sepium* (Jaqc.) Steud. on some haematologist values of white rats (*Rattus norvegicus* Str. Albinous). Thesis. Post-graduate Programme. Bogor Agricultural University, Bogor.

Priyambodo. S. 1994. Study on the rhizome powder of *Costus speciosus* (Koen.) Sm. as an antifertility agent against white mice (*Mus musculus* Str. Albinous) and rice field rats (*Rattus argentiventer* Rob. & Klo.). Thesis. Post-graduate Programme. Bogor Agricultural University, Bogor.

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INDIA

Rodent Pest Management Using Barn Owls in Cauvery Delta, India

Rodents are by and large the most destructive vertebrate pests on earth and they are also considered to be the principal foes of farmers since time immemorial. The Indian subcontinent harbors a remarkable diversity of rodent fauna represented by 101 species of which 14 have been reported to be of economic importance. In Cauvery Delta, "the granary of South India", four species of field rodent pests are found: (i) the lesser bandicoot rat (*Bandicota bengalensis*), (ii) the soft-furred field rat (*Millardia meltada*), (iii) the Indian field mouse (*Mus booduga*) known to inhabit crop fields and (iv) the Indian gerbil (*Tatera indica*) found in barren lands around the crop fields. Rice is the staple food crop of Cauvery Delta. Crops such as pulses, banana, soybeans, sugarcane, cotton, and sesame also are cultivated.

Magnitude of Rodent depredation

The extent of crop-losses caused by different species of rodent pests in the Cauvery delta are 61% for paddy, 65% for black gram, 61% for green gram, 11% for sesame, 11% for oil palm, 44% for pine apple, 55% for cotton, 22% for ground nut and 35% for soybean. These vertebrate pests are a constant threat to food production and management is urgently needed.

The Common Barn owl – An Eco-friendly Bio-control agent

The common barn owl (*Tyto alba stertens*) is thought to be a good predator of rats. It has an acute sense of hearing and can locate prey even in absolute darkness.

In the Cauvery delta barn owls primarily inhabit man-made structures. They hunt in agricultural lands, human habitations and groves. Indirect signs such as regurgitated pellets, prey remains and milky white droppings on the floor and walls can indicate owl nest and roost sites. Food begging calls of the nestlings may be heard after sunset.

Nesting and roosting sites of Barn owls

Barn owls do not construct a nest, however, occasionally they use their own pellets as a cradle for egg laying and rearing nestling. Our observations in Nagappattinam district, Tamil Nadu, revealed that barn owl nesting and roosting sites can be found on the inner side of the temple towers, gaps in the statues around the temple towers, unused rooms and barns in the temples, dilapidated buildings, big tree holes and the branches and crowns of trees with dense foliage. Almost all the nests were found in dark places at a height of 9-12m. The results of the habitat evaluation indicated that rural areas had more nests (18) than urban areas (7).

Diet of Barn owl under wild conditions

The predatory pressure of barn owls on different prey species was studied indirectly by analysing regurgitated pellets. Analysis of 4574 pellets (yielding 6962 prey items) over a period of 31 months revealed that rodents accounted for 78% of the prey items (*Bandicota bengalensis* 32%, *Millardia meltada* 25%, *Mus spp.* 5%, *Tatera indica* 1%, *Rattus rattus* 5%, unidentified rodent species 10%). The remaining prey items were *Suncus murinus* (10%), amphibians 11%), birds and insects (<1%).

Most pellets had more than one prey item or species, ranging from one to a maximum of six, indicating that the barn owls consumed more than one rodent/day under wild conditions.

The total biomass (g) and proportions of small mammalian prey of barn owl were estimated from the mean body weight of the respective species. *B. bengalensis*, a predominant vertebrate pest, accounted for 45% of the total small mammal prey composition.

Food requirements of Captive Barn owls

The monthly prey requirements of barn owls was extrapolated from a study under captive conditions with one adult and one subadult owl. Owls require 47 prey items/month, or 577 prey items/year for adult owls and 569 prey items/year for subadults. These results vividly point out that the barn owl can be a good predator of rodents in nature.

Nesting and Productivity

Barn owls are well known for their great reproductive abilities. In our observation, the clutch size varied from 3 to 8 eggs and the brood size from 2 to 7 nestlings. Eggs were incubated for a period of 30 to 35 days. The nestlings were voracious eaters of rodent pests, grew very quickly, and fledged at 70 to 75 days. A barn owl family comprising parents and six young consumed 700 to 800 rodents in about three months. The overall nestling success was 50%.

Artificial Nest Boxes

Efforts were made to conserve and propagate the barn owls in a portion of Nagappattinam district, Tamil Nadu. Artificial nest boxes were designed measuring 36x18x21 inches. Forty nest boxes were installed 3 to 10 m above ground level in places of poor quality natural nesting sites. The adoption of nest boxes was high near human habitations (45%) followed by agricultural lands (42%) and groves (16%). The barn owls used the maximum number of boxes during peak breeding season (November to April). The overall mean nest box utilization by barn owl for

nesting and roosting was 41% over a period of 17 months.

Once a nest box was used by barn owls, they continued to nest there in subsequent seasons showing considerable site fidelity. Thus, the provision of nest boxes for barn owls in man-made structures and trees near agricultural lands could be a feasible strategy for the conservation and propagation of barn owls and the effective management of rodent pests.

Artificial Perches

The common barn owl requires a perching place to sit and observe prey. The addition of perching poles may result in some reduction of vertebrate pest numbers. Perching poles of "T" shape (3 m in height with a 0.75 m cross-bar of 5 cm diameter) were placed 10m away from areas of high rodent activity with a minimum spacing of 10 to 15 m. 70% of the perching poles were utilized during the *Kuruvai* season (June-August) and 60% were utilized during the *Thaladi* season (October-January).

Diurnal insectivorous birds such as the black drongo (*Dicrurus adsimilis*), small green Bee-eater (*Merops orientalis*), white-breasted kingfisher (*Halcyon smyrnensis*) and blue jay or Indian roller (*Coracias benghalensis*) also used the perching poles. Of these, the black drongos used the poles more frequently than the other insectivorous birds. Thus, the plantation of 3m high perching poles in the rice fields could not only help the farmers to reduce rodent pests during night hours, but also insect pests during the daytime.

The density of rodent pests and their depredation to rice crops was found to be less in the experimental plots when compared with control plots in both seasons.

The Common Barn Owl – A Friend of Farmers

Rural people of our area believe that the barn owls screeching during night hours near to their dwellings portend a death in the house. They also consider the mere appearance of the barn owl around their houses as a sign of evil and misfortune. Because of these superstitious beliefs this timid nocturnal bird is either killed or chased away. Efforts were made by us to counter these beliefs through wall posters, leaflets, local newspapers, radio, television and farmers meetings. As a result farmers have started to accept the barn owl as their friend.

We conclude that barn owls can be included as one of the components of an *Integrated Rodent Pest Management (IRPM)* Programme for efficient and Eco-friendly control of rodent pests.

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RATZOOMAN - A new project aimed at understanding emerging/ re-emerging infectious diseases transmitted by rodents.

The European Commission has recently funded a research project titled: *The prevention of sanitary risks linked to rodents at the rural/periurban interface*, or RATZOOMAN for short. The project, which is led by the Natural Resources Institute in the UK, involves scientists from Belgium, Denmark, the Netherlands, South Africa, Tanzania, Mozambique and Zimbabwe with expertise in the biological, environmental and social sciences. The three-year project officially started on January 1st, 2003, and partners are now involved in collecting information on the epidemiology of plague, leptospirosis and toxoplasmosis, including socio-economic, anthropological and environmental factors that lead to the persistence and spread of zoonosis.

The general objective of the project is to provide new insights on the risks to public health caused by rodents living in close association with humans in rural and peri-urban areas of south-eastern Africa, and apply this information for the development of risk-management strategies. Because of changes in rural ecology, previously rare diseases could become more common. Because of increasing connectivity between rural

and urban areas, these diseases could reach cities. Because of deteriorating hygiene and increasing urban rodent pests, these diseases could easily spread and persist in cities. In order to confirm these hypotheses, these three diseases are being studied as model systems because of their different clinical manifestations and different transmission routes in relation to designing predictive models.

Within the proposed project, the disease prevalence and livelihood constraints will be measured for these diseases. Ecological and anthropogenic factors responsible for their spread and transmission will be identified and evaluated. Host ranges will be investigated, and the infection dynamics within the host populations and from the hosts to humans will be studied. Predictive tools and control strategies will be developed which can reduce the risks posed by rodent-borne diseases. The project aims to help Southern African countries develop strategies for the prevention of sanitary risks linked to the proximity of humans and animals by ensuring that policy makers and extensionists are provided with the appropriate tools and information to manage rodent disease risks using cost-effective, sustainable and ecologically-based strategies. Such predictive tools will help policy makers to support rural and peri-urban communities to handle their natural and social capital in a way that improves people's health as well as their land and water management.

Expected outcomes from the project:
• Increase understanding of zoonosis prevalence in rural and peri-urban African communities and of the impact of agro-ecological and anthropogenic factors on the disease transmission pathways of plague, leptospirosis and toxoplasmosis
• Establish the impact of rodent-borne diseases on sustainable livelihoods
• Raise the profile of the effects of rodents on people's health
• Inform and influence policy formulation at government, institution and community levels
• Provide potential risk reduction strategies that can be cost-effectively used to reduce the impact of zoonotic diseases on people's lives
• Create predictive and simulation modelling tools to measure the threats of zoonotic disease

For further details about the project, as well as links to relevant publications and other websites, please refer to the webpages of RATZOOMAN at: http://www.nri.org/ratzooman

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Edouard Saouma Award (United Nations)

The Sichuan Provincial Plant Protection Station, Chengdu, Sichuan Province, People's Republic of China has received the 2002-03 Edouard Saouma Award for its outstanding performance with the project *Rural Rodent Control in Sichuan Province.* The project has been praised for its local impact as well as its broader impact on rodent control in the wider region. FAO provided technical assistance through Dr. A.M.K.Mohan Rao, International Consultant (India) and Dr. Guo Cong, National Consultant (Sichuan University, Chengdu). The project was implimented by Dr. Tu Jianhua, National Project Director & Director of the Plant Protection Station, Sichuan Province, Chengdu, and his staff in Sichuan province.

The project was launched to reduce grain losses both in the fields and in post-harvest storage, as well as to establish an effective rodent monitoring system. A training curriculum was developed and 60 extension staff completed the first training course. They passed on their knowledge to 600

Dr. Guo Cong (left), Dr. A.M.K. Mohan Rao (centre), and Mr. Tu Jianhua (right).

farmer-trainers who subsequently disseminated the new management techniques in Farmers' Field Schools (FFS) to more than 36,000 farmers. Farmers quickly adopted the new techniques and reported a large decrease in rodent numbers, a reduced rate of rat-transmitted human diseases, and reduced hazards of accidental poisoning of non-target animals.

A random survey after the project was terminated indicated that damage to crops was seven times higher in non-FFS villages than in FFS villages. Storage damage was reduced to 5 kg per FFS family compared with 68 kg per non-FFS family, and the unit cost of rodent control in FFS villages was only one-third the cost in non-FFS villages.

In 2002 the number of counties involved were more than doubled, and a total of 63,000 farmers were trained. A manual on rural rodent control in Chinese has been published to boost further expansion beyond the province of Sichuan.

The achievements of this project in terms of impact on rodent management are largely due to the outstanding performance of the Sichuan Provincial Plant Protection Station. The new strategies for rodent management are not only being sustained locally but are also spreading rapidly to other counties in the province. The project demonstrated in an impressive manner the ability of the Sichuan Provincial Plant Protection Station to motivate its staff, the farmer-trainers and the farmers to achieve these important outcomes.

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PHILIPPINES

Master Class on Rodent Ecology and Management at IRRI

A 3-week Master Class on Rodent Ecology and Management took place in May/June (2003) at the International Rice Research Institute (IRRI) Training Centre, Philippines. Participants from 13 different countries were sponsored by the ATSE Crawford Fund, IRRI and the Australian Centre for International Agricultural Research (ACIAR). In the first week, participants were exposed to the theoretical aspects of rodent ecology, population dynamics and modeling, and ecological management of rodents. In the second week, they focused on taxonomy, breeding biology of rodents, how to construct a trap-barrier system, and damage assessment. Through hands-on use of freshly caught rats and mice, and preserved specimens from other Asian countries, participants learned how to identify rodents using dichotomous keys and a computer-based "Lucid Key." The course focused strongly on field ecology. Seventeen participants, not deterred by a typhoon, undertook four different field-based projects, which often involved long hours of work, from 6:00 a.m. to 10:00 p.m. The field-based projects were farmers' surveys, radio tracking, habitat distribution of rodents, and commensal rodents.

Building a Trap Barrier System.

Although each group was responsible for one project, each participant worked one day on each of the other projects. Rodent specialists Dr. Grant Singleton, Mr. Peter Brown, and Dr. Ken Aplin supervised farmers' surveys, radio trapping, and Mt. Makiling trapping projects, respectively, while the ecologist, Professor Emeritus Charles Krebs,

supervised the commensal rodent project. The main objective of these projects was to expose the participants to different techniques essential for field research on rodents. Participants reported their project findings at the end of the course.

The course was a great success. We enjoyed excellent cooperation from the staff of the IRRI Training Center during a rather demanding course with field work involving early mornings and radio-tracking at night. They are to be commended on the work they did in ensuring everything ran smoothly. Special mention goes to the organisational efforts of Dr Zahirul Islam.

All the lectures presented during the course have been uploaded onto the IRRI Knowledge Bank in order of their presentation (http://www.irri.org).

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9th African Small Mammal Symposium, 14-18 July 2003, Mororgoro, Tanzania

The 9th International African Small Mammal Symposium was held in Morogoro, Tanzania, 14-18 July 2003. There were 129 participants from 30 countries at the conference presenting 84 oral presentations (each 20 minutes) and 49 posters.

There were a number of good talks including:

- "Survival and roost-site selection in the bat *Nycteris thebaica*" (Ara Monadjem, University of Swaziland) – the author developed a sampling method where he sent undergraduate students through the pipes with a shield to force all the bats out of the pipe and into a net;
- "Temporal variation in the population dynamics of *Mastomys huberti* in the Niger River inner delta, Mali" (Jean-Francois Cosson, Centre de Biologie et Gestion des Populations, Montferrier, France) – an excellent study incorporating population dynamics and genetics of rats with barn owls;
- "Effects of predation pressure on the population dynamics of a pest rodent species" (Solveig Vibe-Petersen, Danish Pest Infestation Laboratory) – maize yields were highest in fields where predators were attracted and indicated that factors other than direct rodent mortality affected damage to the crop.

Overall, it was a great conference. It was a very busy week with no break, but I met many people and renewed some old contacts. Two highlights were: (1) visiting the rodent groups facilities at the Sokoine University of Agriculture and seeing a multimammate rat (*Mastomys natalensis*), and (2) visiting the minefields at the University to observe African giant pouched rats (*Cricetomys gambianus*) training to locate land mines.

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The African giant pouched rat. Photo on right shows a rat working to locate land mines at the Sokoine University training field. The rat is on a leash that slides along a pole (top of photo) and allows the rat to move across the field.

Report on the 4th European Congress of Mammalogy Brno, Czech Republic, July 27 to Aug 1, 2003

The conference was held in the picturesque town of Brno where Gregor Mendel's monastery is located. The conference consisted of 12 specialist symposia and 4 general sessions with approximately 405 people attending from 38 countries.

The highlight for me was a two-day symposium on house mice and its sibling species. The symposium was dominated by molecular studies of the general biosystematics of the *Mus* complex of species, of reports on the hybrid zones between *Mus musculus* and *Mus domesticus*, and by papers on the chromosomal evolution (particularly Robertsonian chromosomal evolution) of *Mus domesticus*. Of note was that most speakers refer to *Mus domesticus* as a species distinct from *Mus musculus* rather than a subspecies.

My paper on the ecology of house mice in Australia was one of two papers on field studies of house mice. Prof Sam Berry delivered the other paper on the population genetics of mice in the British Isles. I reviewed our work of the past 20 years on the ecology, modelling and epidemiology of house mice in Australia. We recently celebrated 100 years of mouse plagues in Australia hence the title of our paper "One hundred years of eruptions of house mice in Australia – a natural biological curio." The dearth of population papers reflects the fact that most members of the *Mus* complex of species in Europe live in close association with humans in dwellings, barns and hay/feed storages. However, studies of hybrid zones and populations with chromosomal mutations are often conducted in the absence of good ecological studies. Indeed for some students their only interaction with wild mice are tips of tails from which they extract DNA! Perhaps the editorial by Reed Noss in Conservation Biology (1996; 10, 1-3.) entitled "The naturalists are dying off" is too close to the bone for those working on species of the Mus complex.

A couple of papers provided interesting insights into the *Mus* species of Asia. Two new species have been discovered over the past year. Much of the biosystematics and phylogenetics of Asian mice relies on very few specimens.

The papers from the *Mus* symposium will be published in a special issue of the Biological journal of the Linnean Society in mid 2004.

A successful conference is one which is well organised, has a high quality scientific and social program, excellent plenary talks and leads to new contacts. The conference in Brno passed each of these criteria with flying colours. The Czech hospitality was of a high quality indeed.

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XIX International Congress of Zoology August 23-27, 2004 Beijing, China

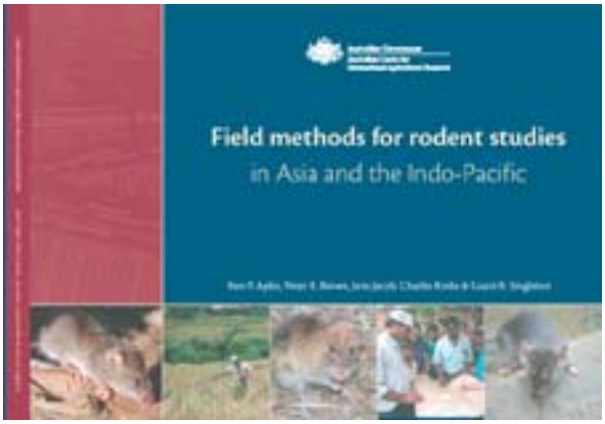
There will be a symposium devoted to RODENT ECOLOGY at the 19th International Congress of Zoology. The Rodent ecology symposium will be organised by Nils Chr Stenseth (Norway), Grant Singleton (Australia) and Zhi-Bin Zhang (China). Abstracts for papers must be in by 28 February 2004. Please visit the congress website for more information: http://www.icz.ioz.ac.cn.

Recent Publications of the CSIRO Rodent Research Group

Brown, P.R., Leung, L.K.P., Sudarmaji, Singleton, G.R. (2003) Movements of the ricefield rat, *Rattus argentiventer*, near a trap-barrier system in rice crops in West Java, Indonesia. *International Journal of Pest Management* 49(2): 123-129

Stenseth, N.C., Leirs, H., Skonhoft, A. Davis, S.A., Pech, R.P., Anderassen, H.P., Singleton, G.R., Lima, M., Machang'u, R.S., Makundi, R.H., Zhang, Z., Brown, P.R., Shi, D., and Wan. X. (2003) Mice, rats, and people: the bio-economics of agricultural rodent pests. *Frontiers in Ecology and the Environment* 1: 367–375.

Ylönen, H., Jacob, J., Runcie, M.J., Singleton, G.R. (2003) Is reproduction of the Australian house mouse (*Mus domesticus*) constrained by food? A large scale field experiment. *Oecologia* 135: 372-377.



A field manual for rodents has now been completed! The manual is published by ACIAR and will be available for distribution in December 2003. If you would like to obtain a copy of this manual contact comms@aciar.gov.au (or phone +61 2 6217 0500). Libraries, institutions, researchers and administrators with an involvement in agriculture from developing countries qualify for complimentary copies.

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 100, 223 pp.

The field guide contains

- information on scientific methods directly relating to rodent research,
- detailed descriptions (with photos) of all rodent pest species found in the Asia and Indo-Pacific region with distribution maps, and
- a dichotomous key for identifying rodent pest species in the region

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