THE RICE-FIELD RAT, *Rattus argentiventer*, is the main rodent pest in rice fields in Indonesia, Malaysia, and Vietnam.

Of rice and rats

Story and photos by Grant Singleton

Rats and mice do untold damage to rice crops and stocks across the globe. Here,* Rice Today *presents the facts on the rodent scourge.

"Nature has sent the rats to our homesteads by thousands, and farmers are being eaten off the face of the earth by them."

This quote from H.C. Bartley (1911) appeared in his book *Studies in the art of rat catching*. After a career spent catching rats and rabbits in England for a living, he wrote this book as a reference for teaching his profession at schools. He dedicated his book to the headmasters of Eton, Harrow, Westminster, and Rugby. Alas, given the dearth of specialists in rodent management in Europe, it appears that the book did not become prescribed reading.

The human fascination with rats is highlighted by the recent re-publication of this book and a new best seller published in 2005 simply called *Rats*. The latter is the story of Robert Sullivan, a journalist who spent a year observing the secret lives of rats in Harlem in New York City. He punctuated his observations with historical accounts such as how rats catalyzed major changes in the living conditions of Harlem tenants after many other efforts, including tenant strikes, failed.

Rats and mice, animals that have played a central role in human life for thousands of years, are arguably the most important family of mammals. There are over 2,270 species of rodents (defined as animals that have continually growing incisor teeth and no canine teeth) and 42% of all mammal species are classified as rodents. They are the ultimate mammalian weed, living in almost every habitat on Earth, and adapting well to environments significantly altered by humans.

Rodents have two major impacts. The first is the substantial pre- and postharvest losses they cause to agriculture. The second is as carriers of debilitating human diseases.

Rodents have an enormous economic impact on stored grain in developing countries. Rats need to eat 10–15% of their body weight each day and they contaminate much more rice than that with their droppings. In one year, 25 adult rats would eat and damage about half a ton of grain and produce about 375,000 droppings! Good data on postharvest losses caused by rodents are sparse; however, reports of up to 20% postharvest losses of rice are not unusual. In 1991, a study in the central Punjab in Pakistan found that for every person living in a village there were 1.1 house rats. Extrapolating to the national level, it was estimated that 0.33 billion metric tons of cereal (rice, maize, and wheat) were consumed annually by house rats in Pakistani villages. This is a conservative figure because rodents damage more food than they consume and cause major damage to the structure of grain stores, which in turn leads to increased weather and insect damage.

Taking food from our table

Across Asia, preharvest losses of rice range from 5% in Malaysia to 17% in Indonesia. To put this into perspective, a loss of 6% in Asia amounts to enough rice to feed 225 million people—roughly the population of Indonesia—for 12 months. Rat damage is often patchy and family rice plots small, so it is not uncommon for farmers or villagers to lose half of their entire rice crop to rats. Some farmers

TRAP BARRIER systems, like this one in Banaue, Philippines, help farmers control rodents.

A WOMAN SELLS barbecued rat meat at a market in Pyay, Myanmar.

state that "for every eight rows of rice they sow for their families, they sow two rows for the rats."

In Southeast Asia, the ricefield rat (*Rattus argentiventer*) is the number-one preharvest pest in Indonesia and is one of the top three pests in Vietnam. In Laos, a member of the *Rattus rattus* complex of species causes episodic problems, and Lao upland farmers consider rats as the problem they have least control over. In the uplands of Laos, Vietnam, and parts of India, rat populations occasionally erupt and cause massive problems. Mizoram, in northeastern India, is currently experiencing such an outbreak (see *Preparing for the rat race* on pages 34-35). A previous massive plague in the 1950s led to famine conditions and triggered a change of government. The lowlands of India and Bangladesh have a number of rodent pest species, with the lesser bandicoot rat, *Bandicota bengalensis*, being a major pest.

In many areas, farmers actually abstain from planting a second or third rice crop because of the expectation of severe rodent damage. This "forgone" loss in productivity is rarely taken into account.

Searching for the ideal rat trap

Through understanding the population ecology of specific rodent species, effective rat-control methods that are simple to apply and environmentally friendly have proven effective in lowland irrigated rice crops (see *A simple solution*, right). Each rodent pest species has different behavioral characteristics, breeding dynamics, and habitat preferences. Some species are seasonal breeders, some breed throughout the year, and others breed at very specific times. The ricefield rat, for example, breeds only when rice is in the reproductive phase—if there is one rice crop per year, they have one breeding season, if there are two, they will have two, and, if three crops, they will have three breeding seasons.

Female rats are pregnant for 21 days and mate the day after they give birth. One female can give birth to three litters (12 young per litter) during a rice crop, resulting in a total of 36 rats. These young will not breed until the next crop *unless* neighboring farmers plant their crops more than 2 weeks apart. This will extend the breeding season, allowing the rats (six females) from the first litter to also breed (rats breed at 7 weeks of age). Therefore, the one adult female could potentially give rise to 120 rats in a single season.

Attempting to rid their crops of rats, rice farmers have developed a range of ingenious devices and strategies. Rat traps of all shapes and sizes have been used but mostly with little success in reducing damage to rice. This is mainly because they have been applied by individual farmers after rat numbers are already too high.

WILDLIFE BIOLOGIST Rachel Labador is surrounded by rat-damaged fields (see the bare, brownish patch) in Banaue, Philippines.

The good, the bad, and the not so ugly

The challenge for biologists has another important dimension: on a continental scale, usually less than 10% of rodent species cause substantial impacts. Indeed, many rodent species provide important "ecological services" (they assist cycling of nutrients, for example, and generally play an important role in nature's food web). Given that management programs rarely distinguish between rodent species, often the nonpest rodents are at grave risk. The negative ecological consequences of rodent control can therefore be better managed if the method is specifically tailored to the problem species.

H.C. Bartley's commentary that the art of rat catching should be taught in schools needs to be taken a step further in Asia. Rodents cause tremendous economic hardship to Asian smallholder farmers, yet solutions for management can be simple and effective. More young biologists need to be encouraged to enter the fascinating secret world of rats and work closely with farmers to assist them in their struggle against the hardships caused by rodents.

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A simple solution

Once the ecology of a major pest species is understood, scientists and extension specialists can work closely with farmers to develop ecologically sound, cost-effective management strategies that dovetail into normal farming practices, including traditional rat-catching methods. Village-level studies in Indonesia and Vietnam have clearly shown that rat populations can be successfully managed if farmers work together as a community and if they apply their control at the right time and in the right habitats. Such ecologically based actions have also led to a 50% reduction in the use of chemical rodenticides.

One simple technology added to the armory of rice farmers is a trap-and-fence system known as the trap barrier system (see *Building a better rat trap* on pages 34-35 of *Rice Today* Vol. 4, No. 2). Used across much of Southeast Asia, it comprises a plastic fence surrounding a small rice crop planted 2–3 weeks earlier than the surrounding crop, with traps set into the plastic. At night, rats follow the line of the plastic until they reach a hole, which they enter to reach the rice. They are subsequently caught and removed the next morning.

The trap barrier system is most effective when combined with the following community actions:

- keep irrigation banks less than 30 cm wide to make it difficult for rats to build nests;
- conduct community campaigns using local methods to control rats within 30 days of planting the crop (before rats breed); these community actions should focus on village gardens, main irrigation channels, and roadsides;
- clean up any grain spills at harvest; and
- synchronize planting so that crops are planted within 2 weeks of each other.