Rat floods and water floods: the ecological and sociological dynamics of rodent management in Bangladesh

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DOI: 10.5073/jka.2011.432.094

Abstract

Rodent pests in Bangladesh are ubiquitous and cause severe damage to agricultural production and human health. Pest problems are typically chronic in the lowland flood plains, with some minor seasonal variation in the types of problems occurring. In the upland areas, rodents are not normally a severe chronic problem because agriculture is less intense and highly seasonal. However, the uplands face serious acute problems with rodent outbreaks every 50 years. Until now, the dynamics of these outbreaks have been poorly documented and studied. Our research in Bangladesh has focused on studying this outbreak phenomena as well as mitigating the chronic problems of rodents by introducing agricultural communities to ecologically-based rodent management strategies.

Introduction

Bangladesh suffers from both acute and chronic rodent pest problems. Acute outbreaks of rodents are confined to the uplands of the Chittagong Hill Tracts and related to the 50-year flowering and seed masting cycle of the bamboo species, *Melocanna baccifera*. These acute outbreaks lead to regional famine over 2-5 consecutive years, with longer term problems affecting an entire generation of children caused by household indebtedness incurred during the famine years (Singleton et al., 2010). The most recent bamboo flowering cycle spread southwards from India into Bangladesh in 2007 and has continued each year since up to the present. This has provided the opportunity to collect basic scientific evidence that links gregarious bamboo flowering to rodent population outbreaks (Belmain et al., 2010).

Chronic rodent pest problems are found throughout the Brahmaputra-Ganges flood plain where rice production is nearly continuous with 2-3 crops per year and only disrupted during the monsoon floods when most agricultural land is put temporarily under water. Seasonal flood water limits rodent harborage and food resources but also drives rodents into villages where rodent damage to food storage and disease transmission to livestock and people are exacerbated. Despite these acute and chronic problems, farmers and householders in Bangladesh do relatively little to try to control their rodent pest problems. We argue that commonly held beliefs such as 'rodents are too clever to be controlled' can be overcome through scientifically-driven programs that provide farming communities with appropriate knowledge and tools. Research in Bangladesh has taken place in both upland and lowland agro-ecosystems with a view of helping communities and extension services to implement ecologically-based rodent management (EBRM) strategies.

Materials and methods

In the uplands, we started removal trapping of rodents in March 2009 in several habitats (bamboo forest, rice fields, villages and houses) in Ruma Upazilla, Bandarban District on a monthly basis using a combination of kill and live traps (Sherman single capture, multicapture cage, single capture cage). Breeding and taxonomic data were collected from all captured animals. At the same time and in the same forests where rodents were collected, data on bamboo phenology were collected regarding seed fall timing, abundance, germination, and seed damage by rodents using 30 plots (1 m^2), 10 m apart arranged in three separate transects. In the second season of data collection, bamboo phenology data were collected in forests that were cut, burned or left undisturbed to understand how such treatments potentially affect bamboo seed production rates.

To prevent rodent migration from bamboo forests to rice fields, experimental trials were established using trap-barrier system of fences (TBS), comparing indigenous bamboo constructed fences embedded with kill traps against the typical TBS design construction from plastic sheeting embedded with multicapture traps. Damage to growing rice was measured in unfenced rice fields and compared to the two types of fenced field by counting cut tillers in $1m^2$ plots, 6 plots per field, 3 replicates per fence treatment. In the lowlands, case-control studies were implemented to evaluate a program of EBRM which focused on community-based intensive trapping inside households. Household trapping was coupled with environmental management to reduce rodent harborage in the village area, particularly by rodent-proofing haystacks used to feed livestock and to reduce rodent access to stored food by rodent-proofing granaries situated within houses. The efforts of communities implementing EBRM were scientifically monitored and compared to non-intervention communities using footprint tracking tiles to understand the effect of this intervention on rodent numbers, and using controlled trials to monitor the levels of post-harvest damage to household rice stores. Community members collected monitoring data in personal diaries on a weekly basis across a range of rodent management and rodent damage factors.

Results

In the uplands, the dominant species of rodents in all habitats belonged to the *Rattus* species and *Mus* species complexes. Rodent captures were generally very high in village households and very low in outdoor environments, including bamboo forests. Breeding females in forest habitats were apparent throughout the bamboo masting period, appearing soon after bamboo seed initiation. Surveys of bamboo phenology showed that rodents partially damaged bamboo seeds from very early on when seeds were small and still developing, with damage continuing through seed development, after the seed has fallen to the ground and during early stages of germination.

The amount of bamboo seed produced was estimated at 30-80 tonnes per hectare of forest; lower yields were found from forests that had been cut or burned around the time of flower initiation. TBS fences were able to significantly reduce rodent damage to rice fields; however, the cost-benefits were unfavorable for widespread adoption. In the lowland plains of Bangladesh, research on the ecological dynamics of rodents showed that rodent impacts on rice and vegetable production, food storage loss and contamination, and physical damage to houses and personal possessions were severe, chronic and ubiquitous.

Rodent damage was exacerbated by continuous and asynchronous crop production, diverse and fragmented habitats, and poor environmental sanitation and food storage practices. Scientific and community monitoring activities showed that the case-control trials to implement EBRM in lowland agricultural communities reduced rodent populations and the damage caused to people's livelihoods by up to 80% compared to traditional rodent management practices (typically *ad hoc* poison use). Trapping at the village-wide scale, particularly during the monsoon season, reduced the potential for rodents to re-colonize rice fields after flood waters subsided. Efforts to scale up the extension of EBRM across Bangladesh are ongoing, and data will be presented that show sustainable EBRM implementation is possible at a sizeable scale without large government or donor support.

Discussion

Previously, the Western scientific community was skeptical about the scale and impact of rodent outbreaks in the bamboo forests of the Himalayan foothills across India, Bangladesh and Myanmar. This skepticism was fuelled by historical accounts and descriptions of rodent outbreaks that fell into the realm of the improbable if not the mythological. Our research in the Chittagong Hill Tracts has provided clear evidence that rodents do eat bamboo seeds and increase their breeding in response to this superabundant food resource.

We can also confirm that there is variability in the flowering, with some areas flowering all in one season, whilst others take 2-3 years, with the entire masting event possibly taking >5 years to complete in a given locality due to the patchy nature of bamboo stands. Our ongoing trapping in non-masting bamboo forests will help clarify and confirm this evidence of linkages between gregarious bamboo flowering, rodent outbreaks and regional famine.

Chronic rodent damage in the lowlands of Bangladesh is severe and routinely accepted by local communities due to poor awareness of appropriate methods and tools. EBRM can make significant reductions in rodent numbers and damage, particularly when communities are encouraged to work together to intensively trap rodents during the monsoon season. Communities that receive appropriate knowledge about EBRM and experience it first-hand do change their behavior and practice. Adoption of community-based trapping remains stable in the majority of communities two years after their initial experience.

References

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