

Commensal Rodent Pests

Michael W. Fall

National Wildlife Research Center, USDA/APHIS/Wildlife Services, Fort Collins, Colorado, U.S.A.

Abstract

Norway rats, roof rats, and house mice, collectively known as commensal rodents, cause a variety of kinds of economic damage and related problems worldwide. Damage and contamination of stored commodities, damage to crops, and predation on eggs and baby chickens are common problems. Damage to roads, bridges, railroad track beds, and hydraulic structures results from burrowing activities; structural damage to buildings results from gnawing and these species are sometimes implicated in fires resulting from damaged wires. In addition, they may prey on wild birds, nestlings, and eggs and have been recognized as a cause of rare bird extinctions. Commensal rodents are often associated with poor sanitation or accumulation of trash and food refuse in urban areas, although outdoor feeding of pets and wildlife supports suburban populations. Commensal rodents also serve as reservoirs of a number of diseases that may affect humans and domestic animals. In areas with high rat populations in close association with humans, rat bites, particularly to babies or young children, may be observed. Most commensal rodent problems can be successfully resolved by a combination of pest management approaches entailing initial rodent population reduction with traps or rodenticides, removal of food and harborage, sealing of access points, and continuous monitoring and maintenance.

INTRODUCTION

Rodents are an important group of mammals with more than 2000 species occurring worldwide.^[1] They are principally herbivores or omnivores and often construct elaborate burrow systems that serve to aerate soil. Those that store or consume seeds may play an important role in plant propagation. Most rodents live in areas where they have little contact with people or their activities. Less than 100 species are serious pests worldwide, damaging crops, stored commodities, structures, sometimes preying on desirable wildlife species, and spreading disease to humans and livestock. Three species that generally live in close association with people are commonly known as “commensal rodents”—the Norway rat or brown rat (*Rattus norvegicus*), the roof rat or black rat (*Rattus rattus*), and the house mouse (*Mus musculus*).

CHARACTERISTICS OF COMMENSAL RODENTS

The most prominent anatomical features of commensal rodents are their long, sparsely haired tails and their continuously growing incisors. These teeth are worn continuously by gnawing and are used for investigating food and other materials. Young are born fully dependent on the mother, but mature in about 3 weeks and can breed in another 3 weeks. Litter sizes for commensal rats and mice average about 4–8; breeding may occur throughout

the year. Rats and mice are excellent climbers. This coupled with their abilities to jump and to squeeze through small openings makes them difficult to exclude from structures. Their senses of hearing, smell, and taste are well developed, but like most other nocturnal mammals, their vision is poor. They have long, sensitive whiskers called vibrissae, used in navigating runways or burrow systems. They detect sounds at frequencies well above the range of human hearing. Scientists have studied these characteristics and have used many of them in developing rodent control methods.

COMMENSAL RODENT SPECIES

Norway rats, the largest of the three commensal species, weigh about 500 g as adults. Fur color is brown on the upper part of the body and light gray below. The tail is about the same length as the head and body and appears scaly. Norway rats are well established throughout the world in both rural and urban areas, including cold, northern areas and many oceanic islands. Roof rats are smaller in size, weighing 150–250 g as adults. Their fur color is black, brown, or reddish brown, with the underparts lighter or nearly white. The tail is noticeably longer than the head and body. Roof rats also occur worldwide, but large populations are more commonly restricted to coastal areas in the tropics and subtropics; transient populations may occur in other areas. Roof rats readily climb in vegetation and in

buildings, sometimes establishing nests in such areas rather than using burrows. Compared to rats, house mice are tiny, with an adult weight of about 15–20 g. Fur is grayish brown above, with the underparts varying from gray to buff to white. Mouse home ranges are typically very small and their activity is often suppressed in the presence of rats; rat control may lead to a surge in mouse activity.

TYPES OF DAMAGE

All three species cause a variety of kinds of economic damage and related problems. In farm settings, damage to stored food and grains, damage to garden crops, and predation on eggs and baby chickens—particularly by Norway rats—are common.¹²¹ Grain consumption and contamination with feces and urine are common rodent problems in commercial grain storage facilities.¹³¹ Damage to roads, bridges, railroad track beds, and hydraulic structures may result from Norway rat burrowing activities and the associated soil loosening or flooding. Structural damage in buildings results from gnawing and burrowing and may include damage to doors, woodwork, and walls, as well as to pipes and wiring; insulation may be damaged or removed in the course of nest building.¹⁴¹ Mice, in particular, are sometimes implicated in fires resulting from damaged wires.¹⁵¹ Roof rats readily adapt to field and forest habitats in tropical and semitropical areas causing damage to orchard, grain, and sugarcane crops.¹⁶¹ They occur in many situations where they prey on adult birds, nestlings,

and eggs under some circumstances and are recognized as a cause of rare bird extinctions on many islands.¹⁷¹ Rats are commonly associated with poor sanitation or accumulation of trash and food refuse in urban areas, although outdoor feeding of pets and wildlife often supports suburban populations as well.¹⁴¹ Commensal rodents are reservoirs of a number of diseases that may affect humans and domestic animals, most commonly salmonellosis, leptospirosis, and trichinosis.¹⁸¹ In areas with high rat populations in close association with humans, rat bites may occur, particularly to babies or young children.

ECONOMIC LOSSES

The dollar value of damage by rodents is very difficult to estimate because of the diversity of problems, the risks of potential problems, and the associated costs of prevention and control worldwide; it is generally agreed by experts to be overwhelmingly high. Pimentel¹⁹¹ estimated losses and damage caused by rats in the United States at \$19 billion. Conover¹¹⁰¹ summarized the annual cost of damage and prevention by all wildlife species in the United States as \$22 billion. Corrigan¹⁴¹ reported the approximate annual costs of rodent control programs in the United States as \$337 million in professional services and about \$23 million in retail rodent control products; he noted a 1982 report by the United Nations Food and Agriculture Organization that rats destroyed 42 million tons of food worldwide worth \$30 billion (\$67 billion in current dollars). Hopf, Morley, and

Table 1 Methods and techniques for rodent damage prevention and management that have been suggested, tested, or used for various problems.

Physical	Chemical	Biological	Other
Barriers: physical, electric	Attractants	Biosonics	Appeasement or offerings
Barrier/trap combinations	Aversive agents	Buffer crops	Bounties or incentives
Burrow destruction	Baits/baiting systems	Crop diversification	Compensation for damage
Clubbing	Fumigation	Crop timing	Harvest for fur or food
Drift fences	Glues	Cultural practices	Insurance for crops or property
Drives	Plant systemics	Diseases	
Flame throwers	Poison moats	Habitat modification	
Flooding burrows	Poison sprays	Harborage removal	
Frightening devices	Psychotropic drugs	Immunogens	
Habitat destruction	Repellents	Lethal genes	
Hunting	Sterilants	Parasites	
Rodent-proof construction	Tracking powders	Predators	
Trapping		Resistant plants	
		Synchronous planting	
		Ultrasonics	

Only few of these methods have been objectively evaluated and some may be ineffective. Some may be hazardous to the health and safety of humans or domestic animals or have unacceptable impacts on wildlife or the environment.

Source: Modified from Controlling rice losses to rodents in rural communities, in *Rodentus and Rice—Expert Panel Meeting on Rice Rodent Control*.¹¹³¹

Humphries^[11] using mail surveys and Jackson^[3] using published literature summarized extensive rodent damage to crops and stored products by country, but did not provide overall value estimates. House mouse populations periodically reach massive densities in the wheatlands of Australia, causing average annual losses of more than \$25 million.^[12]

METHODS OF PREVENTION AND CONTROL

The diversity of commensal rodent management problems generally requires a variety of approaches to resolve pest situations. Rodent pest management is the utilization of a variety of prevention and control methods, appropriate to specific situations, emphasizing both environmental controls on population growth and continuous evaluation to maintain tolerable levels of damage. In homes, this generally means managing the interface between people and rodents so that no rodents are detected and no damage is evidenced. Here, and in larger scale rodent infestations, particularly in buildings, warehouses, and livestock or poultry production facilities, professional services may be required and are readily available worldwide.^[4]

Many methods for preventing or controlling rodent damage have passed to us through folklore. Others have been tested and proven effective in particular situations. Still others are promoted or marketed as ultimate solutions to a gullible public, but are not effective. Some materials or methods, once widely used, are no longer available or are now recognized as unsafe or environmentally or socially unacceptable. Because of the continuing high costs of rodent damage and the pervasive nature of commensal rodent problems, research and development to find new rodent control methods continues to be an exciting area for scientists. Table 1^[13] summarizes the great variety of techniques suggested, used, or tested to manage various rodent problems: Most problems can be successfully resolved by a combination of approaches entailing initial rodent population reduction with traps or rodenticides, removal of food and harborage, sealing of access points, and continuous monitoring and maintenance.

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