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POLYNESIAN RATS

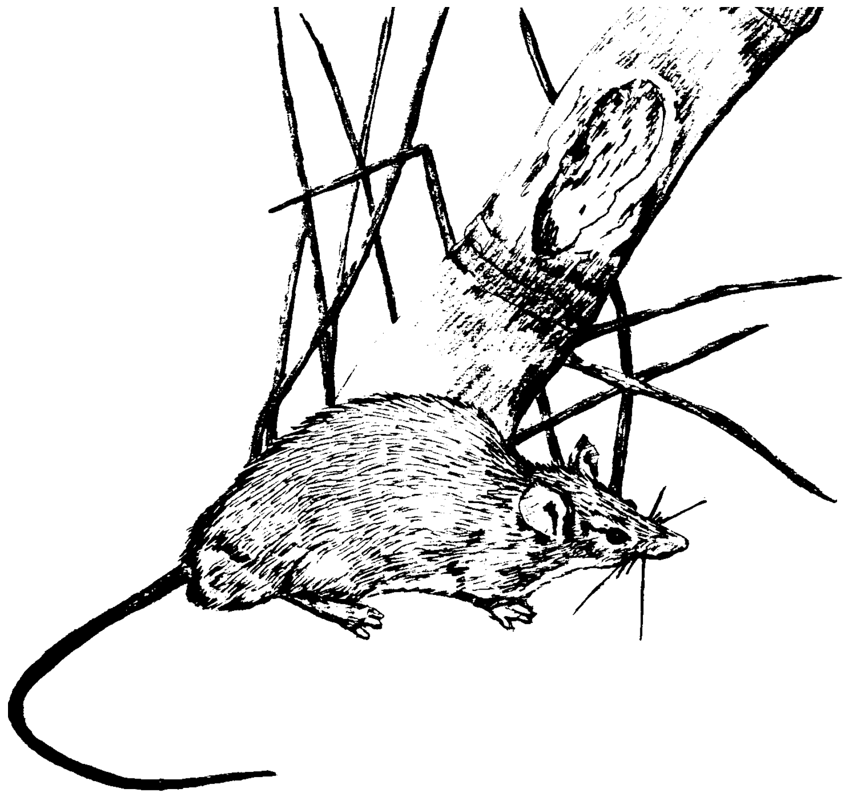

Fig. 1. Polynesian rat, *Rattus exulans*

Damage Prevention and Control Methods

Exclusion

Not practical for Hawaiian sugarcane fields.

Cultural Methods

Synchronize planting and harvesting of large blocks of fields.

Eliminate or modify noncrop vegetation adjacent to sugarcane fields.

Develop potential resistant sugarcane varieties.

Repellents

None are registered.

Toxicants

Zinc phosphide.

Fumigants

Not practical in and around sugarcane fields.

Trapping

Not practical in and around sugarcane fields.

Shooting

Not practical.

Biological Control

Not effective.

Identification

The Polynesian rat (*Rattus exulans*) is smaller than either the Norway rat (*R. norvegicus*) or the roof rat (*R. rattus*). Polynesian rats have slender bodies, pointed snouts, large ears, and relatively small, delicate feet. A ruddy brown back contrasts with a whitish belly. Mature individuals are 4.5 to 6 inches long (11.5 to 15.0 cm) from the tip of the nose to the base of the tail and weigh 1.5 to 3 ounces (40 to 80 g). The tail has prominent fine scaly rings and is about the same length as the head and body. Female Polynesian rats have 8 nipples, compared to 10 and 12 nipples normally found on roof rats and Norway rats, respectively.

PREVENTION AND CONTROL OF WILDLIFE DAMAGE — 1994

Cooperative Extension Division
Institute of Agriculture and Natural Resources
University of Nebraska - Lincoln

United States Department of Agriculture
Animal and Plant Health Inspection Service
Animal Damage Control

Great Plains Agricultural Council
Wildlife Committee

Range

Polynesian rats are native to Southeast Asia but have dispersed with humans across the central and western Pacific. Today, these rodents inhabit almost every Pacific island within 30° of the equator. They occur from the Asiatic mainland south to New Guinea and New Zealand, and east to the Hawaiian Islands and Easter Island. Polynesian rats accompanied early Polynesian immigrants to Hawaii and today occur on every major island of the archipelago. The Polynesian rat is not present in the mainland United States.

Habitat

In Hawaii, Polynesian rats are most common below 2,500 feet (750 m) elevation, although individuals have been captured at an elevation of 4,900 feet (1,500 m) on Mauna Loa on the island of Hawaii and 9,700 feet (2,950 m) on the rim of Haleakala Crater on Maui. Polynesian rats prefer areas with good ground cover on well-drained soil. Throughout much of their range, Polynesian rats live in close association with humans. In Hawaii, however, Polynesian rats are not a commensal pest, but rather favor wild lowland habitats such as wooded and grassy gulches, fields, and waste areas. They reach their highest densities on agricultural lands such as sugarcane fields and abandoned pineapple fields.

Food Habits

Polynesian rats eat a wide variety of foods, including broadleaf plants, grasses, fruits, seeds, and animal matter. They prefer fleshy fruits such as melastoma (*Melastoma malabathricum*), passion fruit (*Passiflora* spp.), guava (*Psidium* spp.), thimbleberry (*Rubus rosaefolius*), and popolo (*Solanum nodiflorum*). In sugarcane fields, sugarcane comprises about 70% of their diet by volume, while in surrounding noncrop gulches, it comprises about 20% to 50%. Rats cannot subsist on sugarcane alone. They need additional protein, such as earthworms, spiders, amphipods, insects, and eggs and young of ground-nesting birds.

General Biology, Reproduction, and Behavior

Reproduction varies among geographic areas and is influenced by weather, availability of food, and other factors. Reproductive activity of Polynesian rats on Oahu reaches a peak in late summer and ceases in mid to late winter. Polynesian rats on Kure Atoll in northwestern Hawaii produce most litters from May through August. On the windward side of the island of Hawaii, Polynesian rats breed throughout the year, with peak reproduction occurring in the summer and early fall. Females have an average of 4 litters per year, with a range of 3 to 6 and an average of 4 young per litter. The minimum gestation period for captive rats is 23 days, with lactation prolonging gestation by 3 to 7 days. In captivity, newborns open their eyes about 2 weeks after birth and are weaned when about 3 weeks old. Captive-bred individuals reach reproductive maturity when they are 60 to 70 days old and weigh about 1.5 ounces (40 g). The life expectancy of wild rats is less than 1 year.

Hawaii is one of the few areas in the world where sugarcane is grown as a 2- to 3-year crop. Most rats living in cane fields either die or migrate to surrounding areas during harvest, and populations do not rebuild until the second half of the crop cycle. During much of the first year, the sugarcane stalks stand erect, the crop canopy is open, and most fields have little ground cover. Some rats from adjacent waste areas forage along the periphery of young sugarcane fields, but few venture into the interior until the sugarcane is 8 to 12 months of age. At this time the sugarcane stalks fall over and dead leaves accumulate. The resulting thatch layer is rich in invertebrate food and provides protective cover in fields where rats establish dens.

Movements and home ranges in sugarcane fields vary depending on population density, crop age, and other factors. Polynesian rats are nocturnal and are relatively sedentary. Males travel farther than females, but the home ranges of both sexes decrease as the sugarcane matures. Individuals typically stray less than 100 to 165 feet (30 to 50 m) from their burrows.

Population Changes

Roof rats, Norway rats, and Polynesian rats coexist throughout much of the Pacific basin. It is not known how much, if any, interspecific competition exists. After the arrival of Norway rats, roof rats, and house mice (*Mus musculus*) in New Zealand, populations of Polynesian rats declined. Today, they are very rare on the two main islands. It is not clear whether a similar decline occurred in Hawaii, but if so, Polynesian rats have adjusted. Today, they are the most abundant lowland rat in many parts of the state.

In Hawaii, roof rats, Norway rats, and Polynesian rats often occur in the same sugarcane fields. Only the latter two are major pests in sugarcane, with roof rats occurring mostly near field edges. Since the late 1960s Norway rats have increased their abundance relative to the other two species in Hawaiian sugarcane fields and are now the species of primary concern to the Hawaiian sugarcane industry. Polynesian rats, however, are still locally abundant in many fields.

Damage and Damage Identification

Polynesian rats are a major agricultural pest throughout Southeast Asia and the Pacific region. Crops damaged by this species include rice, maize, sugarcane, coconut, cacao, pineapple, and root crops. In the United States, sugarcane is the only crop of economic concern damaged by Polynesian rats. The most severe damage is to unirrigated sugarcane on the windward side of the islands of Hawaii and Kauai. Here, rats find excellent habitat in the lush vegetation of noncrop lands adjacent to sugarcane fields.

Rat damage to Hawaiian sugarcane is negligible until the crop is 14 to 15 months old, after which it increases substantially and progressively until harvest. Damage caused by roof rats, Norway rats, and Polynesian rats is very similar. All three species chew on the internodes of growing stalks. Injury ranges from barely perceptible nicks in the outer rind to neatly chiseled canoe-shaped cavities. Small chips usually are evident on the ground where rats have fed. Rat depredation can be distinguished easily from that of feral pigs (*Sus scrofa*). Pigs chew on the entire stalk, leaving it with a shredded appearance. Trampled vegetation is further evidence of pig activity.

Legal Status

Rats are an exotic species in Hawaii and are not protected by law. They may be controlled by any method consistent with state and federal laws and regulations.

Damage Prevention and Control Methods

Exclusion

Electric fences and physical barriers have been used to prevent rats from entering experimental farm plots. It is questionable, however, whether current fencing designs and exclusion techniques are practical for Hawaiian sugarcane fields.

Cultural Methods

Advancing harvest from the usual 22- to 24-month schedule would reduce losses. Adoption of a shorter crop cycle, however, would increase planting and harvesting costs and probably would not be feasible considering current economic conditions. Synchronized planting and harvesting of adjacent fields might reduce movements of rats from recently harvested fields into younger fields. Modification or elimination of noncrop vegetation adjacent to sugarcane fields would help reduce invasion from surrounding areas. Cattle grazing or commercial production of trees for energy or timber might reduce the vegetative understory in such areas. Herbicide use probably is not economical or environmentally desirable.

Development of sugarcane varieties that are less susceptible to damage by rats is a promising avenue for research. Possible selection criteria include rind hardness, stalk diameter, degree and time of lodging, resistance to souring, and potential for compensatory growth.

Fig. 2. Rat-damaged sugarcane

Repellents

None are registered.

Toxicants

Zinc phosphide is the only toxicant registered in the United States for rat control in sugarcane. Baits are formulated either as pellets or on oats and usually are broadcast by fixed-wing aircraft at the rate of 5 pounds per acre (5.6 kg/ha). A maximum of four applications and 20 pounds per acre (22.4 kg/ha) may be applied per crop cycle.

Zinc phosphide baits in Hawaii are most effective against Polynesian rats and least effective against Norway rats. Because the relative abundances of the two species vary substantially from field to field and may shift as the crop matures, the efficacy of zinc phosphide baits also varies. Where Norway rat populations increase during the second year of the crop cycle, zinc phosphide baits become progressively less effective.

Fumigants

None are registered for the control of Polynesian rats in Hawaii.

Trapping

Polynesian rats can be captured easily with coconut bait and standard snap traps, modified wire-cage Japanese live traps, or other appropriate traps.

However, trapping in sugarcane fields is extremely labor intensive and is not practical for control purposes. Plantation personnel took an average of 141,000 rats annually from sugarcane fields on the island of Hawaii during the early 1900s, but with no apparent effect either on rat populations or on sugarcane damage (Pemberton 1925).

Shooting

This is not a practical form of population control.

Biological Control

In 1883, the Indian mongoose (*Herpestes auropunctatus*) was introduced into Hawaii from the West Indies to help control rats on sugarcane plantations, and today they are common on all the major islands except Kauai. Although mongooses are diurnal and rats are nocturnal, rodents comprise the major portion of the mongoose's diet in and around sugarcane fields. Pemberton (1925) found parts of rodents in 88% of 356 mongoose pellets collected in sugarcane fields, with 52% of all samples containing nothing but rodent parts. Kami (1964) reported that 72% of 393 mongoose scats collected along dirt roads adjacent to cane fields contained rodent pelage and bones. However, rats reproduce rapidly and continue to thrive and cause major economic damage in Hawaii. Not only has the introduction of the mongoose failed to control rat populations, but it has resulted in unforeseen ecological effects. Mongoose predation has been implicated in the decline of the Hawaiian goose (*Nesochen sandvicensis*), Newell's shearwater (*Puffinus newelli*), and other ground-nesting birds in Hawaii. If rabies ever becomes established in Hawaii, the mongoose is likely to become a public health concern.

Between 1958 and 1961, barn owls (*Tyto alba*) also were introduced into the state to help control rodent agricultural pests. This species and the native short-eared owl (*Asio flammeus*) subsist in Hawaii in large part on rodents. Although raptors sometimes are attracted to rats fleeing recently harvested sugarcane fields, heavy thatch prevents their foraging in maturing sugarcane fields.

Dogs have also been used to control rats in harvested sugarcane fields (Pemberton 1925, Doty 1945), but controls applied after harvest are likely to have little effect on damage or yields.

Economics of Damage and Control

In addition to direct losses, secondary infections of stalks by insects and pathogens result in additional losses of stalks and deterioration of cane juice. The economic impact of these losses fluctuates from year to year, largely dependent on the prevailing price of sugar. In 1980, when the average price of raw sugar was at a 50-year high, the Hawaiian sugarcane industry may have lost $20 million. Current losses are conservatively estimated to be greater than $6 million annually (A. Ota, Hawaiian Sugar Planters' Association, pers. commun.).

Aerially broadcasting 5 pounds of zinc phosphide-treated oats to 1 acre (5.6 kg/ha) of sugarcane costs approximately $4.99, including $3.50 for bait, $1.33 for the airplane, fuel, and pilot, and $0.16 for labor, transportation of materials, administrative overhead, and other expenses. The registration label calls for four applications during the crop cycle, which would cost about $20.00 per acre ($50.00/ha). Studies have indicated that applications of zinc phosphide reduce damage in Hawaiian sugarcane fields by as much as 30% to 45%. Thus, four applications of zinc phosphide would result in savings of $120 to $185 per acre ($296 to $475/ha), or a return of $6.00 to $9.00 for every $1.00 spent applying bait. This assumes a potential yield of 10 tons per acre (22.5 mt/ha) without applying controls, a farm price of $368 per ton ($409/mt), and a 10% decrease in yield due to rat damage. The benefits of using zinc phosphide are less in fields with lower damage.

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