



Roof Rats: Identification, Ecology, and Signs

For Pest Management Professionals and Environmental Health Professionals

Paula Rivadeneira and Dawn H. Gouge

Introduction

The roof rat (*Rattus rattus*), also known as the black rat, ship rat, or house rat, is an Old World rodent species originating in southeast Asia. Although it is not native to North America, it is established in most coastal and southern states in the continental United States (U.S.), Hawaii, and small populations exist in Alaska. In fact, roof rats are now well-established pests in many parts of the world. In 2001, roof rats were documented in Phoenix, and likely introduced into the area through freight, or shipment of food, livestock feed, or equipment. They have now settled into ideal habitat among old growth citrus trees, palm trees, and other mature landscaping, and take advantage of abundant irrigation canals and food resources around homes. Reports of roof rats and the areas they occupy in Arizona are ever increasing, most recently in Yuma, indicating that the roof rat is now well established, even in our harsh desert environment. Here in southern Arizona, it is not uncommon to experience consistent summer temperatures above 110 degrees F.

Roof rats are destructive, consuming and contaminating stored food and feedstuffs, gnawing on wires posing a fire hazard, and tearing up insulation for nesting material. They pose a significant health and safety hazard as they are implicated in the transmission of several diseases to humans and domesticated animals, including murine typhus, leptospirosis, salmonellosis (food contamination), rat-bite fever, lymphocytic choriomeningitis, and even plague. Ectoparasites may be transferred from roof rats to domestic animals, such as the Oriental rat flea (*Xenopsylla cheopis*) that can transfer from roof rats onto pet rodents and rabbits. Ectoparasites that may transfer from roof rats and bite people in Arizona include the Oriental rat flea, the tropical rat mite (*Ornithonyssus bacoti*), spiny rat mites

(*Laelaps* spp.), and the spiny rat louse (*Polyplax spinulosa*). In most instances, people report skin irritation and itching because of ectoparasite bites, but some of the ectoparasites can have more serious effects, including vectoring disease-causing pathogens to people. For example, the Oriental rat flea can vector the pathogens that cause bubonic plague and murine typhus.

The roof rat is one of three commensal rodent species (those that live in close association with humans) that were brought to North America aboard ships in the 17th and 18th centuries (Figure 1). The Norway or sewer rat (*Rattus norvegicus*), although common in many North American cities, is not well established in Arizona. However, Norway



Figure 1. Roof rat.



Figure 2. White-throated pack rat – Richard N. Henderson, Our Lands and Their Creatures.



Figure 3. White-throated pack rat nest in truck Engine - John Cancalosi, Alamy Stock Photo.

rats are introduced regularly, and are confirmed in the Phoenix metropolitan area from time to time. House mice (*Mus musculus*) are found throughout the continental U.S. and throughout the world.

Native rats include several pack rat species (also called wood rats), including: the bushy-tailed (*Neotoma cinerea*), white-throated (*N. albigula*), desert (*Neotoma lepida*), Mexican (*Neotoma mexicana*), and Stephen's (*N. stephensi*) pack rat. The white-throated pack rat (Figure 2) is the most commonly encountered in urban areas. Pack rats can be a nuisance, largely due to their gnawing and nesting habits (Figure 3), but also because their middens (nests) are common breeding sites for kissing bugs, which can bite humans causing allergic reactions that can be life-threatening.

Contrary to media reports of pack rat/roof rat hybrids, these animals are from two different families, and therefore cannot hybridize.

Arizona is also home to several native cotton rat species including the Arizona cotton rat (*Sigmodon arizonae*), the yellow-nosed (*S. ochrognathus*), the Tawny-bellied (*S. fulvoiventer*), and hispid (*S. hispidus*) cotton rats. Cotton rats are agricultural pests, and rarely found in the built environment.

Identification

Roof rats may have black, gray, or brown fur, and a long naked tail that is long enough to be curled around to touch the end of the rat's nose. They have relatively slender bodies compared to Norway rats, and larger ears and eyes. The roof rat can appear similar to the Norway rat, native Arizona pack rat (*Neotoma* spp.), or cotton rat (*Sigmodon arizonae*). Table 1 provides a brief description of the physical similarities and differences among these rodents.





Ecology of roof rats and native rats

Behavior

While casual observations of roof rats or native rats can easily result in misidentification, the ecology and behavior of roof rats differs significantly from the others. These ecological and behavioral differences are important to consider when identifying a pest rodent and implementing appropriate control methods.

Roof rats are found in several low desert city areas in Arizona including the Phoenix Metro Valley, Yuma, and Tucson areas. They are active year-round in the low desert urban centers, although they are far more active during the cooler months of winter and spring (November through May). They are more commonly reported during the cooler months when back yard citrus trees are laden with fruit. Tangerines can be plentiful as early as September, while oranges can continue through the spring into the hottest

Table 1. Characteristics used to identify rat species

Adult rat	Roof rat <i>Rattus rattus</i>	Norway rat <i>Rattus norvegicus</i>	White-throated pack rat (woodrat) <i>Neotoma albigula</i>	Arizona cotton rat <i>Sigmodon arizonae</i>
			 Image by: Jim Rorabaugh	 Image by: Jim Rorabaugh
Adult head and body length in inches	7-8	8-10	6-8	5-7
Tail	Scaly, dark color. Nearly always longer than the body and head length.	Scaly, nearly hairless. Darker above, lighter underside. Shorter than head and body length.	Hairy. Bicolored, lighter ventrally, and as long as the head and body length.	Scaly, sparsely haired. Shorter than body and head length.
Color	Variable from grey to brown to black, but most commonly smooth black hair with a lighter ventral underbelly.	Brownish/grey above, grey underbelly.	Grey or brownish, with lighter feet and underbelly.	Grey/brown and black hair on backs, with a lighter underbelly.
Ears	Large ears, almost hairless.	Small, covered with short hairs.	Large, hairy	Almost hidden by hair in ears
Snout	Narrow and pointed.	Blunt and bulky.	Blunt	Blunt with high "Roman" nose.
Droppings	Pointed, banana-shaped, ¼ - ½ inch long, ⅜ inch diameter	Blunt ends, ¾ - 1 inch long, ¼ - ⅜ inch diameter	Blunt, ½ - ¾ inch long, ⅜ - ¼ inch diameter	Pale greenish or yellow, ⅜ inch long, ⅜ inch diameter
Pairs of mammary glands	5	6	2	2
Nesting	May nest in high places, such as trees and attics, but they also can burrow. Maintain about a 120 square yard territory or less.	Construct nests in below-ground burrows or sometimes at ground level. Often line nests with paper, fabric, or other material. Burrow along building foundations, beneath rubbish or in dense shrubbery.	Construct ground-level shelters, preferring rocky ground close to a water source. Build extensive piles of coarse woody debris against houses, in rock crevices, banks of washes, base of plants, or use burrows of other animals.	Live in shallow burrows or above ground in dense vegetation, fallen tree trunks or branches. They may utilize open cotton bolls as nesting material.
Medical importance	¹ Carriers of many pathogens that are transmitted through physical contact, bites, contamination, or ectoparasites.	² Reported to host many disease-causing pathogens. Many pathogens cause non-specific symptoms in humans, and infection in human populations may be largely underdiagnosed and undocumented.	³ Arenavirus carriers	⁴ Hanta virus carriers

¹ Pye, T., Swain, R., Seppelt, R.D., 1999. Distribution and habitat use of the feral black rat (*Rattus rattus*) on subantarctic Macquarie Island. *Journal of Zoology*, 247:429-438

² Webster, J.P., Macdonald, D.W., 1995. Parasites of wild brown rats (*Rattus norvegicus*) on UK farms. *Parasitology*. 111:247-55.

³ Calisher, C.H., Nabby, S., Root, J., Fulhorst, C.F., Beaty, B.J., 2001. Transmission of an Arenavirus in White-Throated Woodrats (*Neotoma albigula*), Southeastern Colorado, 1995-1999. *Emerging Infectious Diseases*, 7(3):397-402. <https://dx.doi.org/10.3201/eid0703.017305>

⁴ Ravkov, E.V., Rollin, P.E., Ksiazek, T.G., Peters, C.J., Nichol, S.T., 1995. Genetic and Serologic Analysis of Black Creek Canal Virus and Its Association with Human Disease and *Sigmodon hispidus* Infection. *Virology*, 210(2):482-489. <https://doi.org/10.1006/viro.1995.1366>



Figure 4. Roof rats hollow out citrus leaving much of the rind – Maricopa County Environmental Services.



Figure 5. Roof rats living in an abandoned building – Maricopa County Environmental Services.

months. The rats hollow out citrus on the ground and on trees, leaving the rind (Figure 4).

Like native rats, roof rats are nocturnal (active at night), and roof rats will begin to roam during twilight hours, which is when most people observe them traveling around their neighborhood.

Unlike our native rats, roof rats prefer to forage for food above ground in elevated areas, both indoors and outdoors. They are an arboreal species, and as such, they are agile climbers and easily travel through trees and along vines, utility wires, rafters, and rooftops. They often use trees and utility lines to reach food and to enter buildings, but they can also be found foraging in dense ground cover. Roof rats can swim and may use sewer systems or canals to disperse to new areas. Outdoors, they can travel several hundred feet in a single night to find resources.

Roof rats establish a home range around their nesting site that encompasses 0.5 to 5 acres in rural areas. However, their home range is usually much smaller in urban environments where resources are plentiful so they typically travel only up to 120 yards from their nest. Roof rats tend to travel within their home range unless displaced from their nest or if their resources become limited. Roof rats do not hibernate, but they do hoard food in caches throughout their territory. They invade undisturbed parts of homes and abandoned structures (Figure 5).

Arizona cotton rats are most common in central and southeastern Arizona and parts of Mexico. They inhabit only grassy areas where there is enough water to support grasses and ground cover. Therefore, they are common around ponds and in irrigated agricultural fields.

Cotton rats are, for the most part, nocturnal in wild habitats, but will venture out in the daytime and may become more diurnal (active during the day) in some situations. They are active year-round. Populations increase during the warmer months, particularly in irrigated areas or after rain. They are solitary, but multiple dens may be found in clusters.

Cotton rats are ground dwelling creatures that rarely invade buildings, although they can be found in storage sheds and barns, and may take refuge in winter homes and cabins that are undisturbed for some time. When seen around homes, they are generally associated with lawn areas and gardens. Their home range is small, generally 0.25 – 0.75 acres for females and 1 – 1.25 acres for males. Cotton rats do not store food or hibernate.

The white-throated pack rat can be found in most areas of Arizona as well as southern Nevada, Utah, Colorado, New Mexico, parts of Texas and Sonora Mexico. They favor wooded riparian wildland, but are increasingly common in suburban areas. The white-throated pack rat is the most



Figure 6. Pack rat midden – T. Beth Kinsey, Firefly Forest.

commonly found pack rat in the suburban areas of the Phoenix Metro area. They are active year-round, although most breeding occurs in spring and summer months.

White-throated pack rats are nocturnal, solitary rodents that are proficient diggers and climbers. They usually build extensive above ground dens (Figure 6), but will sometimes opportunistically move into the attics and walls of houses. Home ranges are small and may overlap extensively, encompassing less than 100 yards from the middens.

Nesting habits

While Arizona cotton rats weave nests of grass either in shallow burrows or on the ground, roof rats prefer to nest in secluded areas above ground in such places as attics, soffits, overhead garage storage areas, in the vine cover of fences or buildings and in woodpiles or other stored materials where harborage can be found. They favor dense non-deciduous trees or trees with hollow cavities and the crowns of palm trees, especially when old fronds are not removed. Roof rats sometimes burrow in the ground, especially in hot, dry environments and in the absence of Norway rats. In these areas, they may use trees, materials stored on the ground, concrete slabs and sidewalks to support shallow burrows.

Pack rats build extensive dens made of dead plant material, including twigs, cactus joints, and other materials (Figure 6). They favor natural areas surrounded by cacti or the bases of trees that offer protection against predators. Nests may have multiple nesting chambers, food caches, and interesting piles of debris that can include leaves, plastic, paper, chewed up objects and all manner of bits and pieces.

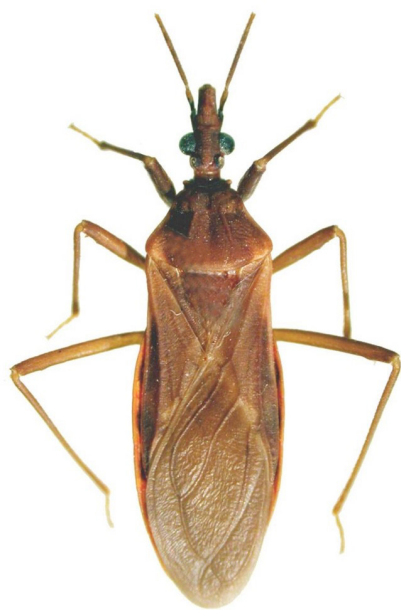


Figure 7. Kissing bugs in the genus *Triatoma* are also known as conenose bugs and measure 1/2 to 1 inch in length.

Pack rats will invade attics and dropped ceiling voids if given access. Kissing bugs, also known as conenose bugs, *Triatoma* species (Figure 7), are blood-feeding insects often associated with pack rats and other wildlife. After dark, they are attracted to homes by lighting and if they gain access, they will bite human and pet occupants. Although the bites are painless, and people often sleep through the process, many individuals awake in discomfort with intense itching at the bite site, which can become severely swollen. The insect bite triggers a high degree of sensitivity, and some people develop extreme allergic reactions that may become life-threatening over time with successive bites. Additional concerns have arisen because a high proportion of the insects carry the protozoan *Trypanosoma cruzi*, which causes Chagas disease in humans. However, there has historically been a low incidence of Chagas disease in humans in the U.S. due to the relatively poor parasite vectoring ability of the North American kissing bug species. However, Chagas disease is a serious concern for dog owners in some southern states. **Kissing bugs in the home should not be tolerated.**

Reproduction

Roof rats have high reproductive potential, breeding year-round in warmer areas in the low desert. Females produce 5 to 8 pups per litter and may have up to 5 litters per year. Young roof rats are able to reproduce at around 3 months of age. In residential areas where food resources and water are plentiful, a few rats can become a significant population very quickly.

Little is known about Arizona cotton rat reproduction, but if it is similar to the closely related *Sigmodon hispidus* rat, it could range widely from 1-15 pups. Females are sexually mature at around 40 days, and males at around 3 months of age.

White-throated pack rats have small litters, usually 2 pups every 6 to 8 weeks during spring and summer months, and may have between 2-5 litters per year. They become sexually mature at around 2 months of age.

Food resources

Roof rats are omnivores (plant- and animal-eating), but they are particularly fond of fruit. Roof rats feed on fruit-producing ornamentals, dates and most palm fruits, stored food, birdseed in feeders, eggs and nestling birds, insects, snails, as well as the fruit and vegetative portions of many landscape and garden plants, including bark, which may result in complete girdling of young trees. They also eat non-food items like garbage, bars of soap, and other animal droppings. Roof rats especially enjoy oranges, eating the pulp from hanging fruit, and leaving only the empty rind (Figure 8). With sour citrus, like Meyer's lemons, they eat the rind off of the fruit, leaving the peel-less fruit hanging on the tree. They also feed on stored food and livestock feed, and will contaminate much more than they actually eat by damaging it and leaving feces behind.



Figure 8. Orange peels hollowed out by roof rats

Roof rats generally begin searching for food shortly after sunset. They may cache or hoard considerable amounts of solid food, which they will eat later. These food caches may be located in attics, in dense vegetation such as hedges, or in a variety of other hiding places generally near their nests.

Roof rats obtain much of their daily water intake from their food, but unless their diet includes a sufficient amount of succulent plant material, they will access any source of available water, including landscape irrigation. They can even gnaw through lead or PVC drain pipes to access water.

Arizona cotton rats feed on grasses, herbaceous plants, grain, seeds, germinating seeds under bird feeders, and nuts, as well as some fruits, crops, insects, and carrion.

White-throated pack rats feed on cactus, especially prickly pear (*Opuntia*), cholla cactus pads, and cactus fruit. They consume seeds and fruits, and even bark off of mesquite, yucca, acacia, and juniper trees.

All the rodents themselves are preyed upon by raptors, snakes and carnivorous mammals.

Signs of roof rats

Sounds in the attic are often the first indication of the presence of roof rats in a residence. At night when the house is quiet, the rats may be heard scurrying about. If you look in the attic with a flashlight or in other locations where you suspect roof rat activity, you may find roof rat feces, also called droppings or scat. Roof rat droppings are black, banana-shaped, and $\frac{1}{4}$ to $\frac{1}{2}$ inch (6-12 mm) long. However, identifying rat species from droppings alone is not a reliable method, so it's best to look for more specific signs, such as smudge marks on surfaces from oil and dirt rubbing off their fur as they travel (Figure 9). Because of their propensity to climb, look for roof rat smudges up high on structures, such as between rafters, as opposed to marks along walls near the floor which are likely made by other rodent species. Because they often live overhead, between floors, or above false ceilings, you are less likely to see obvious signs of roof rat tracks, urine, and droppings. Residents in the Phoenix Metro area often see roof rats traversing overhead utility



Figure 9. Smudge marks on a dumpster indicating a roof rat travel path into and out of the dumpster.

lines at sundown. Schools have constant problems on campuses, and office buildings sustain considerable losses if the rats chew up computer wiring. This can be reduced by running cables through conduit or using wires with taste deterrent insulation.

Rodents are an important part of a healthy wildland ecosystem.

Roof rats, as well as rats that are native to Arizona, are an important part of a healthy wildland ecosystem. Among their most important roles, they are a critical part of the food chain, serving as a prey item for numerous desert-dwelling species, including canids (such as coyotes) and predatory birds. Issues with roof rats arise primarily when they invade buildings in urban settings, or damage citrus in agricultural areas. Roof rats are considered an invasive species, so it is important to implement control measures at any time of year to ensure that their populations do not increase in areas where they are present. However, rodenticides should be used thoughtfully because they are designed to kill mammals, and therefore may pose a significant risk to non-target mammals, including people. As a result, the indiscriminate use of rodenticides to manage rodents, particularly rodents that are of an unknown species, is not advisable. The vast majority of native rodents pose no risk of injury or harm to humans, and are an important component of the ecosystem. Information about integrated rodent management is available in a publication entitled *Roof Rats: Integrated Rodent Management* by the same authors.

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Cooperative Extension

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
TUCSON, ARIZONA 85721

PAULA RIVADENEIRA

*Assistant Specialist, Fresh Produce Safety, Yuma Agricultural Center,
Department of Soil Water, and Environmental Science*

DAWN H. GOUGE

*Specialist and Professor - Urban Entomology, Department of
Entomology*

CONTACT:

PAULA RIVADENEIRA
pkrivadeneira@email.arizona.edu

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