

MARIN COUNTY PEST SPECIFIC IPM PLAN for RATS EXECUTIVE SUMMARY

OVERVIEW: A core IPM element is to have a “Pest Specific IPM Plan” that lists all of the management methods available and a “Site Specific IPM Plan” that lists those specific methods selected for a particular site. The Pest Specific IPM Plan provides information about Norway and roof rats for the IPM Decision-Making process and to aid in compliance with the county’s IPM Policy. This requires knowledge of the pest and its biology, monitoring to determine the extent of the problem, setting treatment (tolerance) thresholds, and selecting treatment methods that include a combination of cultural, biological, physical, mechanical, manual, and educational tactics and methods to mitigate the impact of these pests on people and County property. Least-toxic pesticides are a tool used, in combination with other methods, in a pest emergency, as a last resort, and/or a transition tool. Not all methods and tactics will work at every site. Monitoring is essential for regular evaluation of the IPM Plan and to provide feedback to determine the effectiveness of treatments selected.

Two points are important to keep in mind: (1) Rat control is about the local rat population not an individual rat, (2) habitat, food and water must be denied the rat population or it will rebound in a very short time. All efforts to control rats are temporary. Populations may be low for one to several years after conscientious IPM Plan implementation but, a new group of rats will eventually re-establish in the vacated biological niche if food, water, and habitat are available. A rat program that relies on trapping alone, without sanitation, exclusion, food storage measures, and habitat modification and elimination, is doomed to failure because of the high reproductive rate of rats. One female rat may produce as many as 80 or more offspring in a year.

IPM GOAL: The goal is to manage rats in such a way that the nuisance, destructive and disease hazards to the public, pets, structures, and staff is minimized to the greatest extent possible with the least negative impact to the environment.

DAMAGE & HEALTH HAZARDS: Rats can damage structures by gnawing on many materials, including pipes, wires (rat caused electrical fires), paper, fabric, wood, and burrowing under foundations, sidewalks, and asphalt. Rats foul an estimated ten times the food they eat with their urine, feces, hair, dander, and feet. Rats carry at least 10 diseases that can be passed by their fleas, mites, and fouling activities. Rats can be health hazards by spreading diseases, triggering allergic reactions, and contaminating food.

BIOLOGY: Rats live in single species groups. Norway rats (*Rattus norvegicus*) are the larger of the two rat species at about 11oz., its head/body is longer than its tail, a diagnostic feature. It lives mainly in burrows and sewers and is an excellent swimmer and occasional climber. Roof rats (*Rattus rattus*) are smaller than the Norway at about 7oz., its tail is longer than its head/body. It is an excellent climber and jumper and lives mainly in trees, homes and buildings. Sexual maturity for both species is about 3 months and they live 12 to 18 months, with their lifespan depending primarily on food supplies and harborage.



Roof rat traveling along electrical conduit. Rats use conduit, plumbing, and structural components for travel in structures.

MONITORING: Monitoring is done by looking for signs of infestation, actual sightings, non-toxic tracking powders, using non-toxic monitoring blocks and food baits. Monitoring records are used to determine whether or not management efforts are needed, where to concentrate control efforts, and to evaluate the success of management efforts employed at a site.

TREATMENT THRESHOLDS: Site thresholds are based on numbers of rats present, actual/potential damage, nest locations, health hazards and potential for interaction with the public, pets, and staff (e.g. No rats or signs of rats in food preparation areas.).

BIOLOGICAL CONTROLS: Birds of prey, especially barn owls, are natural predators of rats. It is estimated that rats

are from 1/3 to 1/2 of a barn owl's diet during the course of a year. Cats can help keep an area from becoming infested but will only attack small young rats and mice. American Rat Terriers are dogs bred specifically to kill rats and are the only breed that is consistently effective. Snakes are also rat predators, don't disturb non-venomous snakes. It is against State Law to relocate live "wild" animals.

PHYSICAL AND MECHANICAL: Exclusion is the primary tactic for reducing rat access to food and habitat. Sturdy screens, automatic doors, door sweeps, rat-proof containers, among other modifications, will send rats looking elsewhere for food sources and habitat. Roof rats can enter buildings on plumbing or wiring and by climbing rough surfaces (stucco, etc.) of exterior building walls. Use rat shields on wires and prune plants away from buildings that rats use as a bridge to enter structures. Norway rats may enter a building through the sewers. Rat-proofing and exclusion should be part of the planning process when building new structures or during renovation or other remedial work on existing structures.

TRAPPING (MECHANICAL): Trapping is the most effective tool for reducing rat populations. Inundative trapping, using many traps, may be required for large areas (e.g. Civic Center). Traps need to be maintained regularly and placed in trap boxes or in a way that children, pets, and non-target animals will not disturb them. Use only lethal traps, if live traps are used take the rats to a location where they can be euthanized. It is against State Law to relocate live rats and other "wild" animals.

CULTURAL CONTROLS: The critical and essential component of rat management is the storage of food and garbage indoors and outdoors. Store food in rat-proof containers and ensure that garbage is stored in cans and dumpsters with tight lids. Keep garbage areas and containers clean, including inside and under dumpsters. Fallen fruit should be picked up as soon as practical. Keep buildings in good repair, rats can enter through a hole the size of a quarter coin. Eliminate food and rats will relocate.

HORTICULTURAL METHODS: Prune shrubs, trees, and groundcovers away from buildings, about 3 to 6 feet is best. Create breaks in dense groundcovers to breakup long rat

runways (trails), rats don't like to travel in the open. Use gravel breaks, about 36" wide by 6" to 12" deep, along building foundations, sidewalks, groundcover breaks, etc. as rats cannot dig through the gravel. Remove ivy or other plants that are growing on building walls as these are a favored habitat for roof rats and allows them access to the upper levels of the structure. Roof rats are excellent climbers.

EDUCATIONAL METHODS:

- Train all DPW and Parks & Open Space District (POSD) field staff to identify rat signs and nests.
- Train selected DPW and POSD staff on monitoring and trapping methods.
- Train DPW and POSD staff on rat damage and health hazards.
- Train County employees on rat damage, health hazards, how to store and dispose of food and how to identify rat signs.
- Train IPM Commission on rat damage, health hazards, habitat modification, sanitation, food storage, and on methods that may be used to control the rat population.
- Provide outreach information for residents and employees on rat management. Include information on the hazards to people (especially children), pets, and wildlife inherent in the use of toxic baits and discourage the use of rodenticides.

LEAST-TOXIC CHEMICALS: There are no toxic rat baits (rodenticides) currently on the Allowed Pesticide List, any use of toxic bait requires an Exemption. Never use lethal baits inside a building or outside where raptor perches and owl boxes are present, the possibility of secondary poisoning to predators and scavengers is too great. Secondary poisoning occurs when a predator eats poisoned prey and the predator itself is made ill or dies from the poison still in the prey's body. Primary non-target poisoning occurs when toxic baits are eaten by people (usually children), pets, or wildlife directly. Toxic baits, if needed, require an exemption from the Marin County IPM Coordinator, who will consult with Marin County Public Health Officer before granting the exemption.

Marin County Pest Specific Integrated Pest Management Plan Norway Rats and Roof Rats Calendar Year 2010

Pest Species

Norway Rat (aka brown, wharf or sewer rat) - *Rattus norvegicus*

Roof Rat (aka black, ship, or house rat) - *Rattus rattus*

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How To Use This Document: This plan provides a wide range of information about IPM options for monitoring and managing rats. Each method is listed under a management category such as "monitoring" or "biological controls." The format is designed to assist county staff and contractors in the quick development of an IPM Plan for rat control at County of Marin IPM controlled locations. Non-chemical methods are emphasized.

- Select the individual methods you plan to integrate for rat monitoring and control.
- If a method you plan to use is not included in this plan, use the "other" category to describe it.
- Modify the IPM Plan as needed.

Submit updates and recommendations to the IPM Plan, as needed, to Ed Hulme, IPM Coordinator, Marin Parks & Landscape.

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Note on Methods: The following are strict limitation on methods used for rat management.

- Rat sticky board traps are strictly prohibited on Marin County property.
- The use of toxic baits inside structures is forbidden.
- Trapping and exclusion are the only approved methods of control, any chemical treatment requires an exemption approved by the IPM Coordinator.
- Use of least-toxic baits, in bait stations, requires an Exemption from the IPM Coordinator which will include a consultation with the Marin County Public Health Officer.

1.0 General Management Objectives

General management and IPM objectives for reducing rat problems: The general management goal is to reduce or eliminate rat populations in food preparation, food storage, buildings, and landscape areas directly adjacent to buildings. It is useful to read this entire document before listing your site-specific management objectives. Solving rat problems requires a sustained commitment to reducing or removing the conditions that cause or encourage rat problems, in addition to removing the rats themselves. Familiarity with the available rat management methods listed below will help in defining realistic management objectives and selecting appropriate management components.

2.0 Pest Identification

The chart and illustration below will assist you in identifying which rat species you are trying to manage. For comparison purposes, a house mouse is compared to a young rat.

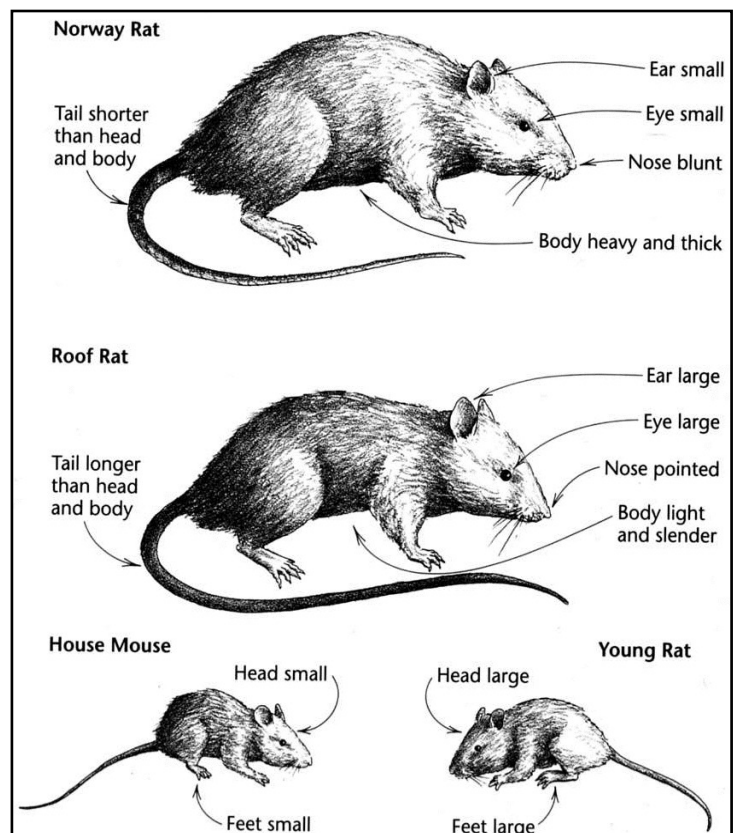
Table 1. Differences Between Norway Rats, Roof Rats, and the Common House Mouse			
Characteristic	Norway Rat	Roof Rat	House Mouse
Scientific name:	<i>Rattus norvegicus</i>	<i>Rattus rattus</i>	<i>Mus musculus</i>
Other common names:	Brown, wharf or sewer rat	Black, ship or house rat	None
Adult size:	12 ounces	7 ounces	1/2 ounce
Snout:	blunt	pointed	pointed
Ears:	small, short hairs	large, hairless	large, some hair
Tail Coloration:	dark above, pale underneath	all dark	all dark
Fur:	brown with black, shaggy	grey to black, smooth	light brown to grey
Droppings:	capsule-shaped (round ends)	spindle-shaped, pointed ends	rod-shaped
Food requirement:	1 ounce/day	1 ounce/ day	1/10 ounce/day
Water source:	free water	free water	water from food
Climbing ability:	can climb	active climber	good climber
Nest locations:	mainly in burrows	walls, attics, trees, ivy	near or in stored material
Swimming ability:	excellent	can swim	can swim
Litter size:	8 to 12	6 to 8	6 to 7
Litters per year:	7	6	8 to 10

Source: Olkowski, Daar, Olkowski (1991)

The Norway rat is larger and stockier than the roof rat. It weighs on average 12 ounces, but can reach over 20 ounces. It has small eyes, a blunt nose, and small ears with short hairs. Its shaggy fur is brown with some black and its scaly tail is darker above and pale underneath. It commonly grows to a length of 16 inches overall with a 7-1/2 inch-long tail. The tail is always shorter than its combined head and body length.

The smaller roof rat averages 7 ounces. Its overall length is 15 inches and its 8-1/2 inch-long tail is longer than its combined head and body length. Its nose is pointed, ears large and hairless, the smooth fur is grey to black, and its tail uniformly dark.

Which Rat? The easiest way to tell these rats apart is to examine the tail. If it is shorter than the head plus the body and is dark on top and light on the bottom, it is a **Norway rat**. If the tail is longer than the head plus the body, and dark on both sides, it is a **roof rat**.



3.0 Damage or Nuisance Activity

Rats do damage by gnawing, eating, urinating and defecating on food, and as vectors of human diseases. Rats damage structures by gnawing and are known to cause electrical fires by chewing on wiring causing a short circuit. Their abundant droppings destroy insulation materials and foul foods. Burrows of Norway rats often undermine concrete slabs, foundations, and asphalt paving. They eat human and animal food and contaminate foods with urine and droppings. Rats also eat the bark off of young trees and shrubs, especially new transplants. Rats shed hair, scales, dander, partially consumed food and pheromone-laden dust, all of which are allergenic. Although infection of humans in the U.S. is rare, rats are vectors (carriers) of human plague, infectious jaundice, salmonellosis, rat-bite fever, murine typhus, rickettsial pox, and other pathogens. Rats transmit diseases via bites, fleas, mites, as well as urine and feces contamination of water and food. Between 14,000 and 24,000 rat bites are reported each year in the United States. Some of these problems have been reported at Marin County properties and facilities.

4.0 Special Conditions

The Marin County IPM Ordinance and IPM Policy directly guides and impacts how rat management is carried out, please refer directly to those documents. One goal of the IPM Policy is to refrain from the use of toxic baits. This is due to the very real concerns of secondary poisoning of predators and scavengers and the possibility of accidental primary poisoning (e.g. a non-target animal eats toxic bait and is poisoned).

Exemption Requests and Exemptions for Least-Toxic Baits: The use of least-toxic baits is a tactic of last-resort. Exemption requests to use toxic baits will only be considered when other non-toxic measures have been instituted and shown to be ineffective. The use of any toxic baits for any reason under any circumstances requires an Exemption from the IPM Coordinator. Before the Exemption is granted the IPM Coordinator will consult with the Department of Public Health. How and where the baits are placed will be determined during the exemption process by the IPM Coordinator in consultation with the Structural PCO contractor and may include further discussion with the Department of Public Health. Disposal of rat carcasses is of the utmost importance to reduce risk to scavengers and predators. Provisions for post-treatment inspections and removal of dead rats will be detailed in the Exemption, if it is granted. Any area where toxic baits are placed will be monitored for efficacy and recorded in the site records. Baiting will cease immediately once monitoring demonstrates that the rat population has dropped below the treatment threshold for the site. The treatment threshold will be set as part of the exemption process. When the rat population has been lowered below the treatment threshold, all accessible baiting materials will be collected and disposed of safely in accordance with State and Federal Regulations.

Inter-departmental Collaboration on Rat Management: Four Marin County agencies and the county contractors have direct responsibilities for countywide rat abatement. The four prominent departments involved in these efforts are the Department of Public Health (DPH), the Department of Public Works (DPW), Marin Parks Department, and the Marin Department of Agriculture. These agencies, together with the county's IPM structural pest control contractor, work collaboratively to reduce rats and other rodents in and around county-owned structures. Any county facilities with rat problems should contact the facility manager, Rich Wallace at DPW, or Ed Hulme, IPM Coordinator, at Marin Parks.

Stakeholder Collaboration: Ideal habitats for rats exist at many Marin County parks and properties. The goal of this plan is to help identify these areas and provide the strategies and tactics needed to reduce the rat's impact on the public and on those properties. This requires that stakeholders (those that use and maintain Marin County properties and facilities) understand their part in the rat management process. This collaboration will be encouraged and benefit from a combination of

educational materials, training, and/or meetings that are appropriate to the size and uses of the property or facility.

Marin Department of Agriculture and Weights and Measures: The Marin Agricultural Commissioner's Office is an important pest management resource and partner in the oversight and enforcement of regulations involving pest management activities throughout Marin County, including the County's IPM Program.

5.0 Biology/Behavior of Rats

Rats are nocturnal, with their peak activity at dusk and before dawn. When the population is large and/or they are disturbed, sick, or hungry, they can be seen during the day. Rats have poor eyesight, but have keen senses of hearing, smell, and taste. They are wary of new things in their environment, which affects how trapping and other management activities are carried out. Both Norway and roof rats have similar reproduction cycles and share certain behaviors, but their food and harborage preferences can differ significantly within the same habitat, and this necessitates somewhat different strategies for managing these two species.

The Norway Rat

Harborage: Rats live in colonies, although they are territorial and have a pecking order. These factors lead rats to maintain some distance from one another within the same burrow system. The Norway rat generally prefers to live outdoors in underground burrows. Their outdoor nesting burrows are often located along the foundation of exterior walls, under wood piles or other debris, in vegetation near dumpsters, etc. Typically, outdoor burrows are about 3 feet long and about half as deep. Burrows have two or more entrances with openings 2 to 4 inches in diameter.

At least one opening is a well-hidden escape route. As their population increases, the network of underground tunnels becomes extensive. The Norway rat is also known to live inside buildings, commonly building surface nests on the ground floor or basement level. If the population becomes too large, they are capable of climbing interior or exterior walls and relocating to ceiling voids and attic areas, although this is not their preference.

Food and Water: Norway rats require about 1 ounce of food per day, preferring meat, fish, and cereal grains, with pet food a favorite choice. However these rats will eat most foods, including human garbage, when favorite foods are not available. When food is scarce, they may be attracted to unusual foods such as the fat in bars of soap. Norway rats also nest and forage in sewers. Norway rats will forage 100 to 150 feet from their nests in search of food. Outdoor-dwelling Norway rats will seek food outside, but will also enter a structure at night to forage for food and then return to their outdoor burrows. Indoor-dwelling rats that are able to obtain sufficient food and water inside the structure may not forage outdoors. The Norway rat is usually the primary species around dumpsters and garbage cans, fishing areas and shorelines, shopping malls, restaurants, and at ground or basement level in warehouses and residential buildings. This species is an excellent swimmer and can obtain water from toilets, sinks, rain puddles, ponds, or condensation from utility pipes. Its ability to travel sewers and drains and enter buildings through these passageways makes it a countywide problem.



Figure 2: Roof rat in vegetation. Ivy and dense shrubs are a favorite for roof rats nesting outdoors.

The Roof Rat

Harborage: Roof rats are active climbers and prefer elevated harborage in trees (especially date palms) and dense vine-covered fences and walls. In buildings, they harbor in the upper levels inside voids in walls, ceilings, attics, or along the roofline. When populations are very high, they are sometimes forced to burrow in dense groundcover (Algerian and English ivy are favorites), overgrown landscapes, and woodpiles. Roof rats will forage up to 300 feet from their burrows in a three-dimensional range.

Food and Water: The roof rat consumes about 1 ounce of food per day, preferring fruits, nuts, grains, and invertebrates (e.g., snails and insects). This species forages in family groups of up to 10 rats, but could expand to several hundred if food is abundant. The roof rat can swim when needed, and obtains drinking water from toilets, sinks, rain puddles, ponds, or condensation from utility pipes.

General Rat Behavior

Reproduction: Rats build their nests from soft material such as shredded paper, chewed grass, or other fibrous material. Mating is followed by a gestation period of about 21 to 23 days and produces litters of 8 to 12 offspring (Norway rats) and 6 to 8 (roof rats). Females can mate within 1 or 2 days following a litter. During a rat's average life expectancy of 1 year in the wild, a female can produce from 4 to 9 litters, with 8 to 12 pups per litter. Litter size is determined by environmental factors, especially food supply. Young rats develop quickly, eating solid food at 3 weeks of age and reaching sexual maturity in 2 to 5 months. Female rats may produce 80 or more live young per year.

Reproduction generally peaks in spring and fall, with lessened activity in summer and winter. Rat populations increase when food and shelter are abundant. If food and shelter are not reduced as part of the IPM strategy, rat numbers can rebound quickly following lethal control measures by increasing breeding frequency and producing larger litter sizes. Rats can rapidly develop very high populations; rats seen during daytime hours indicate a very high density.

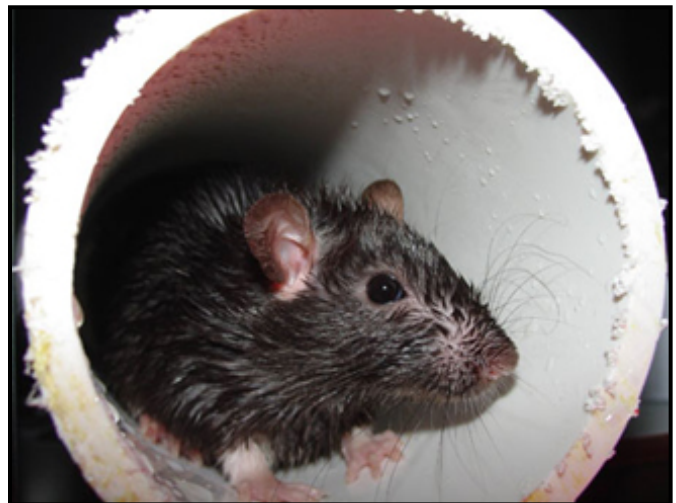


Figure 3: Norway rat crawling through PVC pipe. Norway rats prefer nesting at or below ground level.

Feeding behavior: Rats cache food in or near their harborage. Initial feeding and aversion preferences are learned from the mother. Rats develop individual feeding and aversion habits based on population density, ranking in the social hierarchy (pecking order), experience with traps, and food availability. Even though rats have food preferences, they tend to be omnivorous. They will travel 100 to 300 feet from their nests for food and water sources, using established runways. Rats are wary of new objects in their surroundings, so it is often prudent to pre-bait traps with non-toxic baits or foods in unset snap traps for 1 to 3 days prior to setting traps to determine food preference. If food is readily available, such as garbage or fallen fruit, pre-baiting may not be needed, just use the food they are used to.

Physical Abilities:

- Pass through openings as small as 1/2 inch square. Rule of thumb: adult rats can enter through an opening the size of a quarter coin

- Walk along horizontal wires and climb vertical wires (roof rats)
- Scale up and down the inside of vertical pipes from 1-1/2" to 4" in diameter
- Climb the outside of pipes up to 3" in diameter
- Climb pipes and conduits of any size if within 3" of a wall surface
- Crawl horizontally on any size pipe or conduit
- Climb walls with textured surfaces such as brick, stucco, and wood
- Jump vertically at least 3 feet from a flat surface
- Reach 13" above a flat surface
- Dive and swim underwater for up to 30 seconds
- Swim through drain traps such as toilets and floor drains
- Gnaw through or leave marks on nearly anything, including wood, particle board, lead and plastic pipes, cinder blocks, asbestos, aluminum, sheet metal, glass, and sun-dried adobe

Inspection, Monitoring, and Management Methods

The following sections contain a comprehensive menu of available IPM monitoring and management methods for solving rat problems in a wide variety of sites and conditions. The most effective management programs involve use of several methods within an integrated program of prevention and direct suppression of unwanted rats. **To permanently reduce rat presence and damage at a site, 80% to 95% of the rats and substantial sources of rat food and harborage must be removed in order to prevent recovery of the rat population within 1 year.** Recovery occurs from a combination of (1) larger litter sizes; (2) increased number of litters; (3) lower death rates due to reduced competition for resources; and (4) immigration of new rats. To achieve this high level of management requires use of a wide range of methods.

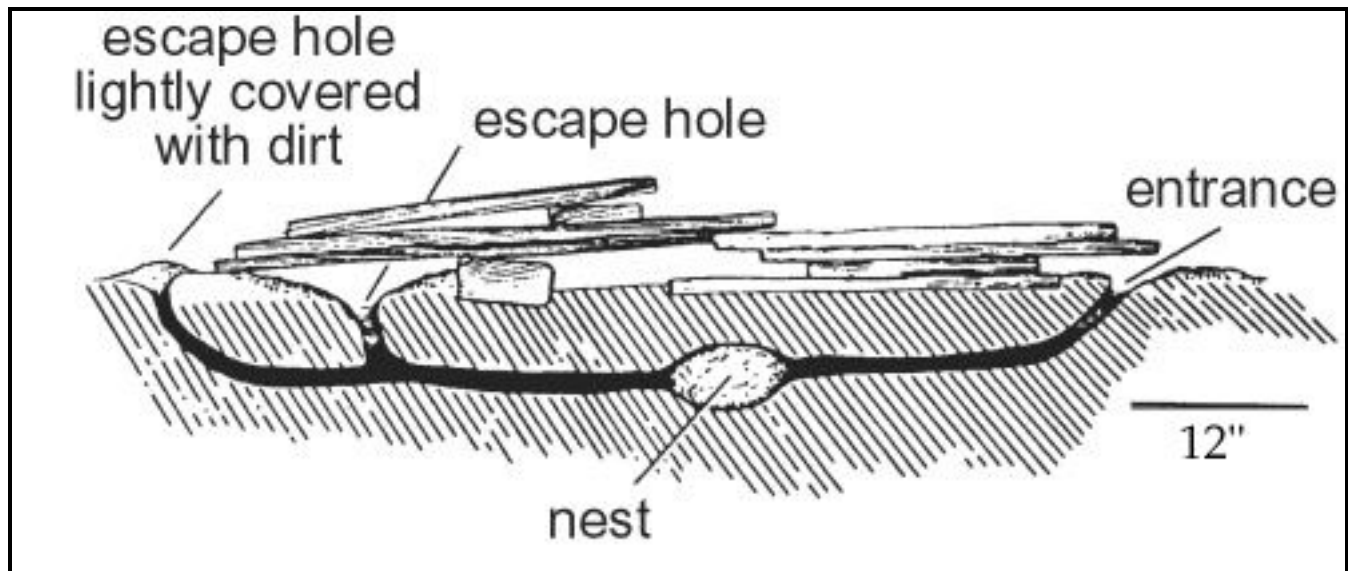


Figure 4: A generalized Norway Rat burrow. When burrow entrances are found, block the hole with soil, newspaper or similar materials. Return in a few days and recheck the holes. If the plug is removed then the burrow is active. Map and record actions.

6.0 Inspection, Monitoring, and Record-keeping

Inspecting and monitoring for rats is essential in urban areas, especially where food services of any kind are located. In the IPM process, an initial inspection is made in the area where rats are suspected or reported in order to gain background information on location and degree of rat activity, health concerns, damage, or nuisance occurring. Following the inspection, an IPM program is implemented and monitored in order to evaluate success and fine-tune the program elements as needed (see

Section 8.0). Monitoring for signs of rats can be performed at any time of the day or night. To see rats, it is best to monitor between sunset and sunrise, just after sunset is best. Monitoring activities are most effective when performed at suspected food sources and habitat sites.

Tools for monitoring include a strong flashlight, a portable ultra-violet light, various non-toxic monitoring blocks, non-toxic tracking powder (such as ground limestone), lockable bait stations, a drill with concrete bit to secure bait stations, snap traps, gloves, binoculars and night vision goggles (if affordable). Table 2 describes a method for using visual monitoring information to estimate the size of a rat population.

Table 2. Estimating the Size of a Rat Population Using Information From Visual Monitoring <i>[Source: Timm (1994)]</i>	
Population Size	Visual Observation
Rats not present, or in very low numbers; any infestation is probably recent	None of the signs listed below, have been observed
Medium Population	Old droppings present. Signs of gnawing seen. One or more rodents seen at night by flashlight. No rats seen during the day. Each rat seen at night usually represents 10 or more elsewhere.
High Population	Fresh droppings. Signs of recent gnawing. Tracks observed in dust. Three or more rats seen at night by flashlight or one or more seen in daylight.

Inspection is generally a one-time event. The primary purpose of inspections is to:

- identify the pest
- locate food, water, access points, and sources of harborage sustaining the pest
- identify factors conducive to the presence of rats and make recommendations for reducing or removing them
- identify human behaviors contributing to the presence of rats

Monitoring is an ongoing activity. The purpose of monitoring is to:

- track pest activity
- properly time pest management actions
- document methods and products used
- evaluate the effectiveness of pest management programs
- communicate with and educate those involved with solving the problem

The purpose of record-keeping is to:

- provide a paper trail of pest problem assessment, recommendations, actions taken, and results
- display monitoring information such as efficacy of non-chemical methods, exclusion measures, sanitation efforts, etc.
- provide evidence of compliance with laws and regulations
- develop a permanent institutional memory about the rat IPM program

Information gained from monitoring is used to fine-tune pest management methods and plan future actions. The monitoring methods described below are generally used when:

- rat presence or damage is likely to rise to levels of concern (reach the treatment threshold)

- damage or nuisance is occurring inside county structures where health concerns, safety issues and building damage can arise
- damage is occurring outdoors where rat burrowing can undermine structures and paving, damage vegetation, and cause nuisance issues.

Listed below are a variety of methods that can be used to identify and record the presence of rats and determine the scope of the problem. Not all methods will be needed on every site or every situation.

- **Reports of Sightings and Signs (Required):** Reports of rat sightings and/or rat signs from facility staff or users initiates management actions. Use the information from the person reporting the sighting to locate where rat activity is located and to initiate monitoring. Keep records of actions taken. These records are the start of the site-specific plan, which is developed as actions are taken.

- **Mapping Estimates (Required):** Obtain a copy of an existing map of the site or sketch one out on grid paper. Mark, count, map and loosely plug burrow entrances with soil or paper on a weekly basis. Burrows that are reopened the following week are active. This provides the relative abundance of burrows in a limited area, and can be adapted to quickly show where the priority areas are located, and to track decreases or increases of burrows over time.
- **Rat Activity Visual Inspection:** To look for rats in an area it is best to inspect the site after sunset when rat activity is relatively high. Use a strong flashlight for direct viewing, a portable ultra-violet light to illuminate urine stains (they fluoresce blue), binoculars for viewing at a distance, and night vision goggles (if available) to watch rat activity in dim or no light situations. If the timing is right you may be able to observe rats leaving their nesting areas and their preferred paths to food sources.
- **"Tracking Patch":** A non-toxic tracking patch can help determine the location and extent of rat activity. Place a light dusting of powdered limestone, unscented talc, or baby powder in suspected runways and near rat signs. Typical patch sizes range from 12"x4" to 18"x6". When active rats walk through the powder, they leave behind their characteristic 3/4 inch footprints with a "drag line" (from their tail) in the middle of their tracks. Examine the patch for tracks at regular intervals, this is best done the morning of the day following placement.
- **Tracking Block Estimates:** Estimates of the number rats present can also be made by placing cereal based pre-measured nontoxic monitoring blocks in various locations to determine how much is eaten each night. Double the amount each day until the amount taken in one night levels off. Divide the amount by 1/2 oz. This information will provide a very rough estimate of the minimum number of rats present and the relative severity of the problem.
- **Trapping or Non-toxic Food Baiting Counts:** An estimate of rat populations and areas of activity can be obtained by placing baited snap traps or bait boxes containing weighed non-toxic food baits in areas suspected of rat activity (e.g. around dumpsters or other food sources). A sample monitoring form for recording catch data is provided in Appendix A.

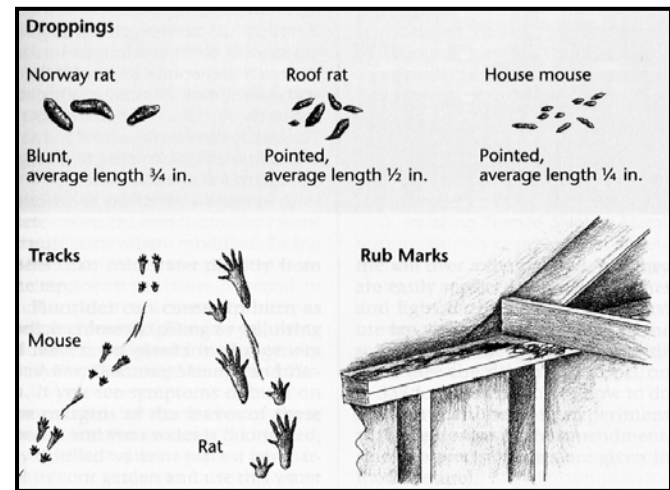


Figure 5: Identification of rat droppings can help determine which species is creating the problem. Tactics may vary depending on whether the target species is roof rat or Norway rat. Source: redrawn from Timm (1994)

- **Photo Points.** Standing in the same position each time, take pre-and post-treatment photos of priority rat-infested sites. Store them in a photo binder, or on a computer, along with a written log of the date, technician's name, site location(s) shown in the photos, IPM treatment methods used, results of the treatments, and any other relevant information. Update the photos and information periodically until the problem is solved.

7.0 Treatment Threshold (Tolerance Level)

The "treatment threshold" (also known as the "tolerance level") is the maximum number of rats that can be tolerated in an area without causing unacceptable health concerns, damage or nuisance. Once the number of rats approaches the threshold, treatments are applied to prevent an increase in rat numbers that will produce unacceptable damage. Treatment thresholds are site specific, and will likely differ from one site to the next.

Be aware that rats occur in locations throughout the county and that elimination of rats from all locations is not possible. A comprehensive IPM program focused on reducing or eliminating the conditions that rats need to survive (i.e. sources of food, water, harborage) combined with population reduction through carefully planned inundative trapping and sustained monitoring, can keep rat numbers at very low levels where they are rarely seen. Toxic baiting may be used only with an approved Exemption by the IPM Coordinator.

One rat in a cafeteria, kitchen, office, hospital, jail, etc. is the treatment threshold for these and similar sites. Sewer workers and buildings connected to the sewers are at risk from large sewer rat populations. Regular monitoring can help establish subterranean tolerances for rats. When rats are seen living in a date palm on a right-of-way they can be more easily tolerated, but the area should be monitored regularly for population density. Remember as you set your treatment threshold that it is not possible to eliminate all of the rats in Marin County. However, it is possible to manage them at acceptable population levels.



Figure 6: Using high numbers of traps (inundative trapping) for a few days of intensive trapping is more effective than using a few traps set out over a long period of time.

Treatment thresholds will be established for individual sites on either a priority or an as needed basis. Children's facilities, food preparation and storage, and other sensitive areas are high priority sites and will receive prompt action. Facilities and properties, not in the high priority group, will require action beginning with monitoring to determine the scope of the problem followed by treatment actions such as exclusion measures, site modification, sanitation, and trapping that are appropriate to the site.

8.0 Rat Inspection & Monitoring Guidelines

The following information describes general guidelines for establishing an IPM inspection and monitoring program for rats in indoor and outdoor areas on Marin County property.

1. Determine the location(s) or area(s) to be inspected. Base this on "trouble calls" regarding visual sighting of rats, signs of their presence (discussed below), or locations with conditions conducive to rats. Talk to building managers, custodians, and other workers in county buildings, county crews that work in the area, members of the public that use the facility, and others familiar with the area at the

beginning and during the inspection process. Ask if rats have been sighted recently, or if there has been a prior history of rat presence. People often do not notice rats or rat signs in a particular area until they are made aware of the problem. Once made aware that a problem exists, they are often able to provide important information during subsequent interviews.

If rats are reported present in the area, ask what **time of day or night** they have been observed. Use this information to help you decide where and when to focus your initial inspections.

2. Inspect areas suspected of harboring rats. Visit areas both in daylight and at night using a flashlight or spotlight with a red filter. Look for the following signs of rat presence:

- **Visual sightings.** Seeing rats in daylight usually indicates a high population and/or sick rats. Notice what type of food the rats are eating (e.g. fallen fruit, contents of garbage cans), and place the same type of food in bait boxes or traps used for monitoring.
- **Droppings.** A single rat can easily produce 50 or more droppings daily. They are usually found along rat runways, in feeding areas, and near rat holes and nests. Identify currently infested areas by sweeping up old droppings then re-inspect after one week. Fresh droppings have putty-like texture, old droppings crumble easily. See the illustration of rat droppings below to distinguish Norway rats from roof rats.
- **Urine stains.** These deposits occur along traveled pathways or in feeding areas. Both wet and dry rat urine glows blue-white under any ultraviolet light. Use portable UV flashlights made for rat inspections.
- **Burrows.** These occur next to walls, along fences, next to buildings, under shrubs or debris, and other secluded places.



Figure 7: Rat droppings and urine stains in a dumpster area. These fresh droppings had the characteristic soft texture.

Indoors, **Norway rat burrows** are primarily found on ground floors or basements, although they are capable of living higher up if populations are high. Any hole or out-of-the-way location is potential harborage. On upper levels **roof rat burrows** can be found in wall, ceiling, and roof voids, under enclosed bathtubs, and other protected areas. Roof rats also nest in trees, vines, dense plantings, and rarely in ground-level burrows.

- **Runways.** Rats establish well-defined runways between their burrows/nests and sources of food and water. Outdoor runways appear as narrow beaten paths on the ground, or worn-down paths in the grass. Rats memorize these pathways and habitually use the same routes. Indoors, runways are marked by droppings and grease marks on vertical or horizontal surfaces along walls, pipes, and wires.
- **Smudge marks or rub marks.** Marks are made when the oil and grease on rat fur rubs off and builds up on well-used runways. Check for these markings on walls, pipes, beams, and other fixtures in and around buildings and other structures.

- **Tracks, including footprints and tail marks.** An adult rat's footprint is about 3/4 inch long and leaves a drag-line from their tail in the middle of their tracks. These may be found in dusty or muddy surfaces. A light sprinkling of powdered limestone, unscented baby powder, or talc in suspect areas can reveal tracks and help determine the location and extent of rat activity.
- **Odors.** Heavy infestations have a distinctive odor. Experienced pest managers can smell the difference between a rat and a mouse infestation.
- **Sounds.** Scrambling in walls, squeaks, gnawing, and clawing sounds are all typical of rat presence.
- **Pet Excitement.** Cats and dogs often probe an area of floor or wall where rats are active, particularly if the rats have only recently invaded.
- **Gnawing marks.** Rats constantly gnaw on hard surfaces. Marks occur on door or window frames, ledges, moldings, in corners, etc., and on the trunks and branches of trees and shrubs. Rats feed on the bark of young trees and shrubs, especially new transplants. Fresh wood shavings, insulation, and other gnawed material indicate active infestations. Rats can also gnaw through rusty sheet metal.
- **Nests and Food Caches.** Found in large quantities in undisturbed areas such as dense shrubbery, trash piles, building foundations, attics, wall voids, etc.



Figure 8: Rats and mice can make up to ½ of the diet of barn owls. Placing barn owl boxes encourages these predators to establish and hunt in the general area which can help reduce local rodent populations.

9.0 Biological Controls

Predators: Barn owls (*Tyto alba*), hawks, coyotes, feral cats (*Felis catus*), domestic dogs, foxes, and raccoons (*Procyon lotor*) are the primary predators of rats in urban, suburban and rural areas. All these species are present in Marin County. Predation is probably most successful during spring and fall when rat activity peaks. Mounting specially constructed barn owl nest boxes and/or hawk perches can attract these raptors to locations with large rat infestations where reducing food, shelter, and habitat for these pests is difficult or impossible (e.g. rats in date palms). Rats and mice comprise about 1/3 to 1/2 of the diet of barn owls, although there is no definitive efficacy data on barn owls significantly suppressing urban rat populations. Contact Ed Hulme, IPM Coordinator (415/499-6405) for information about any plans to erect raptor perches and nest boxes for barn owls in various park locations for supplemental suppression of pest rodents. Directions for building or purchasing barn owl nesting boxes can be obtained from the Marin Hungry Owl Project (415-454-4587) or visit their website at <http://hungryowl.org/index.html>, V.J. Ketner, 169 Via Baja, Ventura, California 93003 or from the Lindsay Museum, Walnut Creek, California (925-935-1978) Donation: \$10.00. Plans as well as pre-built owl houses are available from Rincon-Vitova Insectaries, (800-248-2847) and other sources.

American Rat Terriers are dogs bred specifically to kill rats. They have been bred for hundreds of years in the United States and England by farmers, these dogs may be available for specific sites

through Pestec. The dogs do not eat the rats. When the rats are flushed out of hiding the dogs chase it down and kill the rat by breaking its neck, death is nearly instantaneous.

Snakes feed on rats and other rodents. While they are not readily available for “structured work”, non-venomous snakes should be tolerated whenever possible as a serious predator of rats and other rodents. It is illegal to capture snakes or other animals and release them in new locations. Newly relocated animals usually die within days of release in new surrounding.

10.0 Cultural Controls

Cultural and horticultural controls for rats focus on reducing/removing, to the greatest extent possible, the sources of food, water, and habitat (harborage) that rats depend on for survival.

Improve Sanitation: Practices that reduce or eliminate rat access to food are essential to successful rat management programs. Unless sanitation measures are maintained over time, rats will return.

- **Proper garbage disposal:** This is a key issue in rodent control. Wherever there is edible garbage available there will be rats. Even the use of in-sink garbage disposals, which eliminate food waste storage problems, has the side effect of feeding rats in the sewers. When garbage is accessible to rats, it seriously hampers trapping and exclusion programs that cannot compete with the rats' regular food.
 - **Indoors:** Dispose of food wastes promptly into rat-proof containers such as plastic bag-lined metal garbage cans with tight-fitting lids. Make sure all indoor garbage is sealed in plastic bags and moved to outdoor storage each evening (no overnight garbage indoors).
 - **Outdoors:** Collect and/or store garbage in galvanized metal garbage cans with dome-top lids and one-way swing doors, in heavy-duty plastic wheeled cans with flip-top lids, or in dumpsters. Keep dumpster and garbage can storage areas clean and free of food debris, and ensure that lids on cans and dumpsters are kept tightly closed.
 - Be certain that all indoor and outdoor garbage containers are emptied frequently enough to prevent overflowing, and that containers are thoroughly washed with soap and water no less than once every 2 weeks.
 - Never leave pet food exposed (indoors or out) before or after pets eat. Store uneaten pet food in the refrigerator overnight.
 - Promptly clean up spilled birdseed around feeders.
 - Remove food residues from recyclables before storage, and remove them weekly for pickup.
- **Good housekeeping practices:** Keep areas clean, dry, and well maintained.
 - Clean all food service and dining areas as soon as possible following use. Food residues should also be removed from all preparation and cleaning equipment including pots and pans, sponges, mops, and brooms quickly after use. Wash and hang mops and brooms to dry. Rinse off rubber floor mats daily.



Figure 9: Rats have easy access to garbage in this open type garbage receptacle. Notice the rat gnaw marks on the upper right of the can.

- Remove rodent droppings and urine-contaminated dust and debris (including those in attics) with a HEPA-filtering vacuum cleaner. Wash hard surfaces that have been contaminated with rodent urine and/or droppings with soap and hot water.
- Reduce/remove clutter. Store essential non-food materials and goods neatly on racks or shelving. Keep floors clear of goods. Clutter provides harborage for rats and impedes inspection, monitoring, and management activities.
- **Proper food storage:** This denies rats access to food.
 - Inspect new deliveries of food and goods for signs of rats prior to moving containers into food storage areas.
 - Restrict food storage to food preparation areas. Storage in refrigerators or enclosed steel cabinets is preferred. Food kept in desks or lockers, on open shelves, in garages and basements is an invitation to rodents.
 - Store general food materials (snacks, groceries, etc.) in rodent proof (or rodent-resistant) containers such as glass jars with screw-on lids with rubber gaskets, or metal or hard plastic containers with tight-fitting lids.
 - Store very large containers of food on shelving beginning at least 18 inches above the floor and in narrow rows (6' wide or less). Shelving should be kept at least 18 inches from walls to permit access for monitoring and management of rats.
 - Store large containers of dry pet food in rodent-proof containers such as metal garbage cans with lids secured with bungee cords. This includes birdseed and similar food sources.
 - Warehouses and storage outbuildings are favorite spots for rodents, since they have little human activity per square foot (compared to say an office) and often no people are present for up to 16 hours per day and all weekend. Keep pallets and equipment stored 18 to 24 inches away from sidewalls to facilitate monitoring and trapping.
 - Store grass-seed (a rat favorite) and plant bulbs in steel containers such as garbage cans with lids held tight to the can with bungee cords.
 - Bulk foods should be stored on pallets (not on the floor) and regularly rotated "first in, first out."



Figure 10: This gap at the bottom of the door is large enough to allow rat and mouse access to the building. Installation of a door sweep would exclude rodents.

11.0 Non-Lethal Physical/Mechanical Controls

Physical/mechanical controls include designing, constructing, and retrofitting methods that deny rats access into buildings and other structures.

Exclusion/Pest-proofing: Exclusion and pest-proofing are generally used as inter-changeable terms referring to denying pest entry into an existing structure. (Some define "exclusion" as actions to deny pest re-entry into existing structures in contrast to "pest-proofing" which refers to design and construction details that prevent pest access into a new structure).

- **Build out pests:** When building renovation or new structures are in the design phase, it is important that pest-proofing be incorporated into the designs at an early stage in the process. Any opening roughly the size of a quarter coin can allow entry to a rat. A thorough inspection of existing structures is necessary to identify such openings so they can be permanently sealed. Construction documents for building renovations or new construction should contain detailed instructions regarding pest-proofing design details and finish work sealing requirements.

- **Quality Control:** Exclusion work must be competently executed so that it is both permanent and neat in appearance.
 - Use only durable materials that are properly suited to the location. Typical tools and supplies needed include: tape measure, tin snips, hammer, screwdrivers, drill, pliers, utility knife, scissors, small pry bar, assorted nails and screws, sheet metal, spackle, backer rod, several types of caulk, expanding foam, metal drywall corners, metal kick plates and door sweeps, raised metal thresholds, knitted copper wire mesh, 1/4 inch galvanized welded wire mesh (hardware cloth), mortar, and paint for touch-ups.
 - Use mortar, 1/4 inch galvanized welded wire mesh, expanding foam, or caulk to close voids, cracks, crevices, gaps around windows and roofing ledges, holes in foundations and concrete slabs, etc. Note: copper and wire mesh must be securely stapled or nailed to surfaces or covered with galvanized sheet metal to prevent rats from pushing them out. Spaces filled with expanding foam should also be covered with galvanized sheet metal if possible.
 - Use 1/4" galvanized welded wire mesh to enclose vents in crawl spaces, attics, fan outlets, stand pipes, exhaust vents, and necessary structural openings.
 - Seal gaps where pipes, wiring or other conduits pass through exterior walls and seal interior openings that limit rodent movement to particular rooms or areas.
 - Weather-strip doors and windows, and seal gaps between the bottom of doors and floor by installing brush or vinyl door sweeps, automatic drop sweeps, and/or raised metal thresholds.
 - Close holes in building foundations or entrances to rat burrows with a minimum of 2 inches of reinforced mortar mixed with iron filings (from machine shops) or broken glass pieces 1/8 to 1/4 inches long (place glass pieces in a thick paper bag, smash with a hammer, and shake out broken pieces of glass directly into the mortar as you mix it).
 - Repair or install window and door screens if needed.
 - Install a tight-fitting access door for the crawl space.
 - Install metal kick plates or flashing at the base of doors to prevent rat gnawing.
 - Insure that all HVAC units are well sealed from rodent access, especially those on the roof.
 - Repair underground and basement sewer pipes that are broken.
 - Install threaded caps on sewer pipe clean-outs.
 - Install grates with small 1/4 inch openings on open indoor and outdoor floor drains. Brass drains with hinges and latches work well and can be opened for drain cleaning.
 - Install plastic or metal barrier disks to prevent roof rats from using overhead wires and conduits to access structures.
 - Where rats are digging under foundations, excavate soil adjacent to building walls to a depth of 6 to 12 inches by 12 inches wide and install pea gravel, through which rats are unable to dig.
 - Repair all plumbing leaks and remove other sources of water available to rats, who require up to 1 oz of available water daily to survive.
- **Inspection strip:** Remove all plants from an area 36 inches wide between the exterior building walls and adjacent vegetation around the building perimeter. Install a 3 foot wide path of concrete, paving stones, or a 6 to 12 inch depth of pebbles or gravel on top of weed fabric, or the heavier construction felt, to discourage plant growth. This cleared area excludes habitat for rats to live in and serves as an inspection, monitoring, and management zone for rats and other pests. Rats will avoid these open areas because they are exposed to predators.

Horticultural Controls: These consist of corrective actions concerned with landscape design, re-design, and maintenance that remove or reduce conditions conducive to rats.

- **Vegetation management to remove harborage and food:**
 - Remove tree and shrub branches at least 6 feet away from buildings, trim overhanging branches to at least 6 feet above rooflines and prevent vines from growing on building walls. This is to prevent rats from gaining access to roofs or other elevated access points.

- Install 1/4 inch welded wire barriers around the base of trees to deter rats from feeding on the bark (citrus bark is especially attractive to rats). Tree protector sleeves should be about 18 inches high and buried a few inches into the ground. The barrier needs to be about 2 inches away from the tree trunk on all sides. Wire sleeves can also be made of lightweight galvanized steel or heavy gauge plastic.
- Regularly pick up fallen fruit, nuts, seeds, and similar foods from trees and shrubs and place in a hot compost, or place into and seal plastic bags before depositing bags in dumpsters. Crabapples, plums and cherries from flowering ornamentals (inedible to humans), figs, citrus, and palm fruit are especially attractive to roof rats. Netting of various types may be erected over fruiting ornamentals in landscapes to deter rats from accessing trees and shrubs.
- Thin out or replace dense trees, vines, and shrubs.
- Reduce or remove dense groundcover or replace with less dense varieties or alternative species.
- Break up dense plantings with pathways, stretches of lawn, or very low groundcover to discourage long rodent runs. It is recommended that pathways be made of 2 inch wide pebbled rock up to 6 inch wide cobble at least 6-inches deep and at least 36 inches wide.
- Regularly mow all lawns within 25 feet of structures.
- Trim shrubs up about 1 foot from the ground if they are within six feet of foundations to expose lower trunks and allow sunlight to penetrate to the ground, which reduces conditions favoring rat hiding places and runways.
- Steps will need to be taken to control weeds where plant pruning has exposed previously shaded soil to sunlight.



Figure 11: Rat gnawing damage to rock rose plant. Rats and mice feed on the bark of woody plants and are attracted to new transplants.

12.0 Lethal Controls

Lethal Trapping: When lethal controls are necessary, trapping is the method of choice. The best time to trap is at dusk or later in the night.

- **Precautions:** It is highly recommended that pest control professionals always use the following PPE (Personal Protective Equipment) when servicing traps or monitoring baits, especially when working in attics, crawl spaces, and other enclosed environments:
 - PPE includes rubber (vinyl, latex) or thick leather gloves; boots with disposable shoe covers; disposable Tyvec coveralls sealed with tape at the wrists and ankles to prevent access to the skin by fleas and mites carried on the rat; safety glasses (goggles); a dust mask or HEPA filter respirator to prevent breathing contaminated debris from rat droppings. Wash thoroughly after handling rats, traps, monitoring blocks, and stations.
 - Rat traps can be harmful to children, pets, and non-target species. In sensitive areas, place traps in protected locations, use constructed barriers, or use traps modified for use in an enclosed trap station to prevent unauthorized access. For example, J.T. Eaton & Co. makes a metal Snap Trap Station that can hold and protect 2 rat traps or 3 mouse traps.
 - Do not leave traps set in open areas unserviced for longer than 24 hours unless they are placed in locked areas or in tamper-proof trap stations. Unset and remove exposed traps placed in populated areas when PCO staff leave the site.

- **Food bait selection:** Choose food baits that the rats are already accustomed to, if that can be discerned. For example, fallen fruit from ornamentals, edible fruits, garbage, etc. Or try baits that could be highly competitive with the rats' standard diet, including the ones listed below. Once you have determined the bait preference, stick with that bait for as long as it is taken.
 - Baits for Norway rats include peanut butter, pieces of hot dog, singed bacon, nutmeats, fresh apple slices, and multi-grained bread.
 - Baits for roof rats include nuts, dried fruit, fresh apple or banana slices, candy, marshmallows, raisins, and peanut butter.
- **Pre-bait traps:** This refers to placing baits on unset traps and monitoring the traps daily to see if the bait is taken, then replacing missing bait. When the take is steady, usually about 2 to 4 days, add a very small amount of fresh bait onto the underside of the trigger and set the trap. Rats are likely to manipulate the trigger when looking for the bait that they were accustomed to finding and that they can now smell. Baits that don't stick to the trigger can be tied on with string, dental floss, or very thin wire. Once you have determined the bait preference, stick with that bait for as long as it is taken. Where food, especially food in the landscape, is abundant and rat populations are large, pre-baiting of traps may not be necessary as the rats are already accustomed to the available food and the abundance of food reduces their wariness in proximity to people. For example: rats at Pier 39 in San Francisco preferred sourdough French bread as this was a major component of garbage (e.g. stale loaves and discarded sandwiches) which was the primary food source for the rats. Pre-baiting to determine the rat's bait preference was accomplished in a couple of hours and trapping was successfully done on the same night.
- **Set traps:** Trapping is most effective when done at night (shortly after dusk is recommended). Spring-loaded snap traps (e.g. Victor Easy-Set rat traps) with expanded triggers set for a light touch are preferred for trapping rats.
 - Set traps out along rat runways or where evidence of rat activity is present. Using large numbers of traps, preferably in groups, produces greater success. Ten to 30 or more traps may be needed where populations are high.
 - Trapping intensely for a few days is generally more effective than distributing traps sparsely over a wide area with irregular trap checks. Experiment to learn what pattern of trap placement works best in each situation.
 - Set snap traps with the trigger end facing the wall and the edge of the trap flush with the wall. Two or three traps in a row will make it difficult for rodents to jump over them without being caught.
 - Snap traps can be nailed to trees, walls, rafters, vertical or horizontal boards and wired, strapped or "u-clamped" to pipes to catch rats (especially roof rats) moving along these passageways. Position traps with the trigger projecting into the runway.
 - Move objects around to funnel rats into traps. Objects can also be used to protect traps from non-target species, or place traps inside ready-made snap trap stations, or place traps in areas or rooms inaccessible to non-target species.
 - Remember that traps must be positioned so that rats easily encounter them in their normal activity areas. Place traps so they are difficult for the rats to avoid during normal activity.
 - Pre-bait unset traps for a few hours or a day to allow rats to become accustomed to the new object in its environment. Once baits are taken regularly, bait and set traps.
 - Rats will be less wary of a trap that has "rat odors" already on it, so if possible, recycle traps when continuous trapping is underway. Otherwise clean traps with a stiff brush and detergent then lightly oil the metal parts to protect them from rust.



Figure 12: Trap in a tamper-proof box keeps out pets and wildlife.

- Wooden snap traps are not expensive and can be disposed of after use if preferred. Use gloves when handling traps to prevent getting human odors on them that might cause the rats to avoid the trap. Gloves are also needed for personal protection to prevent contact with rat-vectoring human parasites.
- Set spring snap traps in twos or threes, with the traps side by side and the triggers facing the wall. If the rat jumps the first trap it may be captured by the second or third.
- Dispose of dead rats in closed plastic bags deposited into dumpsters.

Live Trapping in Cages

Live trapping is not recommended since removing and releasing the live rat in another area is illegal, and would just transfer the problem to another area. In cases where lethal trapping is an unacceptable method for use (e.g., during a rat emergency in a child care center), live trapping may be an acceptable method for capturing and removing the rats to a location where they can be euthanized.

Glue Boards

Glue boards are strictly prohibited. County policy does not permit use of glue boards to manage rats on county property.

13.0 Least-Toxic Chemical Controls (Requires Exemption)

IPM plans must comply with provisions of the county's IPM Policy, IPM Ordinance, and Allowed Pesticide List with regard to use of lethal controls such as least-toxic rodenticides. Any rodenticide use requires an approved exemption from the IPM Coordinator. When using rodenticides for spot-treatments, all effective non-chemical methods should be continued as scheduled. These IPM methods will continue to add their "control percentage" to the management equation.

• Compliance requirements relevant to rodenticides:

- Rodenticides require an approved exemption from the IPM Coordinator.
- Least-toxic rodenticides are to be considered only as a last resort.
- When use is necessary, least-toxic rodenticides must be incorporated within a comprehensive IPM program rather than used alone.
- Use of chemical controls must be considered only after non-chemical methods have been evaluated and integration of a rodenticide into the treatment program found necessary.
- Only least-toxic rodenticides listed on the county's Allowed List may be used, and only with an approved Exemption.
- Use restrictions specified in the county's IPM Policy and Allowed List must be followed, including **prohibition of rodenticide use indoors**, only trapping of rodents is permitted indoors.
- A written recommendation from a licensed pest control advisor (PCA) must be obtained in advance of any rodenticide application made *outdoors* on county property by county staff or contractors holding a Qualified Applicator's License (QAL) or under the direct supervision of a QAL.
- Structural pest control operators holding a Branch 2 license may, after receiving an exemption, apply rodenticides outdoors around the immediate perimeter of buildings on county property. These applications require compliance with the County's IPM Ordinance, IPM Policy and an approved exemption, but do not require a PCA recommendation.



Figure 13: Locked tamper-proof trap or bait station.

- A copy of the pesticide label and Material Safety Data Sheet (MSDS) must be available on-site during the rodenticide application and kept on file following the application.
- All rodenticide label directions must be read and followed, including the health and safety protocols. The PCA recommendation may stipulate greater restrictions than the label requires, these PCA restrictions must be followed.
- **Precautions:** Rodenticides are not only toxic to rats, but are also poisonous to many non-target species, including humans, domestic animals, and both avian and mammalian predators and scavengers. For this reason, rodenticide treatments are limited to affected areas (spot-treatments) and above-ground applications must be enclosed in tamper-proof bait stations to avoid killing or harming other organisms. Bait station placement and other safety measures must be described in the Exemption Request form when it is submitted, including collecting and disposing of rat carcasses as soon as possible.

Least-toxic rodenticide treatments should be planned to maximize the efficacy of the selected product, minimize environmental impact, and protect staff and the public from exposure to the rodenticide. It is important to monitor and evaluate the rodenticide treatment regularly to determine whether it has been effective. Re-treatment of an infested area should only be done if monitoring shows the rat population is remaining the same or is increasing.

Least-Toxic Rodenticides

An approved Exemption is required before any rodenticide is used on county property. Least-toxic baits should only be used under specific conditions defined in the exemption and by the IPM Coordinator. Only baits listed on the “Exemption” section of the Allowed List may be used unless an exemption is approved by the county’s IPM Coordinator. No toxic baiting is permitted inside structures. Above-ground baits used outdoors must be placed in a tamper-proof bait station. Monitoring with non-toxic bait blocks to determine presence of active rats should precede placement of toxic baits into bait stations. Once feeding signs are observed on the monitoring blocks, they should be substituted with the lethal bait named in the approved Exemption Request.

The use of least-toxic baits and bait stations in exceptional situations where trapping has been ineffective will be discussed and determined during the pesticide exemption process. The Exemption Process is done in consultation with the Marin County Public Health Officer, Marin DPW Engineers (for structural integrity issues) and IPM Coordinator. The Exemption Request must be attached to a current IPM Plan for the site that includes written records that demonstrate non-chemical methods that were attempted, without success, prior to the exemption request.

Rodenticides Require an Approved Exemption Permit

14.0 Education and Training Needs

Educational methods include staff and public training, reference materials, signage, public outreach, and similar efforts to increase awareness and knowledge about rats. A list of educational materials for facility users (e.g. ways to store food and garbage) and training of staff (e.g. trapping techniques, sanitation, etc.) is available on the Marin County IPM website.

15.0 Creating a Site-Specific IPM Plan

When possible, cost-effective, and prudent, a Site-Specific IPM Plan may be developed to address long term solutions for rat infestations at large or complex sites.

At some sites it may not be practical or cost-effective to create a new detailed IPM Plan for managing rats. At these sites the initial report of rats or rat signs will be the first entry of the IPM records for the

site. In these instances the initial report of rat activity, combined with additional IPM recordkeeping (inspection, etc.), can easily and effectively serve as a starting point for the Site-Specific IPM Plan. The Generalized Rat IPM Plan provides an outline to guide IPM activities that can be used for nearly any problem sites or structures. Use “cut and paste” editing methods to move information from the Generalized Rat IPM Plan, and/or the Pest-Specific Rat IPM Plan, to quickly and easily create a Site-Specific IPM Plan. Inspection, mapping, monitoring, exclusion, sanitation, site modification, and trapping results and activities must be recorded. IPM recordkeeping is critical and a valuable use of resources.

16.0 Labor and Equipment Needs

Special labor and equipment requirements and costs should be addressed and enumerated in the Site-Specific IPM Plan.

17.0 References and Bibliography

Integrated Pest Management is information intensive. Use the scientific names when doing research on rats or any pest you are trying to manage, the results are more likely to be scientifically oriented. When searching for products, use common names and terms to get the best results (e.g. “rat traps”).

In the process of putting together this IPM Plan we reviewed many sources of information. Some of these sources contain and/or recommend methods whose use or implementation is not allowed in Marin County under our IPM Ordinance and Policy. When you review any of these references we recommend that you disregard, as we did, any toxic methods recommended by the authors of the particular reference you are reviewing. Below is a list of the main sources used for this plan.

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Acknowledgments

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MARIN COUNTY IPM PROGRAM RAT TRAP/BAIT BOX MONITORING FORM

Technician	Phone/pager	Date
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Department

LOCATION	# TRAPS	# BAIT BOXES	TYPE & WEIGHT of BAIT USED	# RATS SEEN OR CAUGHT	TIME LIVE RATS SEEN	COMMENTS
				Seen _____ Caught _____		
				Seen _____ Caught _____		
				Seen _____ Caught _____		
				Seen _____ Caught _____		
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